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PREFACE

The Agricultural Engineering Board of the Hungarian Academy of Sciences which supervises the development of this branch organises annually a conference at Gödöllő, which is the central place of the Hungarian agricultural scientific activity.

During the sessions, research scientist, developing engineers, experts of institutions engaged in agricultural engineering development strong in numbers the organizer, the hungarian universities and other higher grades of education, the research institutions: Hungarian Institute of Agricultural Engineering at Gödöllő, Faculty of Mechanical Engineering of the St. István University at Gödöllő and foreign guests give account of their results obtained in the research work and development of agricultural machinery.

This yearly English-Language publication the "Hungarian Agricultural Engineering", started at 1988, contains selected papers presented at the conference of 2000. We do hope that this publication will be found interesting to a big part of agricultural engineers.

Dr. János Beke
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PART I.

ABSTRACT OF SELECTED PAPERS

THERMODYNAMICS OF RHEOLOGICAL MODELS

L. Bense - Dr. P. Szendrő - Dr. Gy. Vincze
Szent István University, Gödöllő

Out of the thermodynamic process, the theory of non-equilibric thermodynamics render also the exact description of mechanical occurrence and interaction among forms of motion, so the knowledge of this process is essential for engineers dealing with transport processes. Each time, the thermodynamic method describes the form of mathematical relationships much shorter and more elegant for instance methods based on partial differential equations. It can be an additional advantage that it eliminates uncertainties came about unreliability assumptions concerning the structure of matter. In the last case the chopped green forage masses are a proper example.

RESULTS OF THE ENVIRONMENTALLY PROTECTIVE RECONSTRUCTION OF A PIG FARM

Dr. L. Fenyvesi - L. Mátyás
Hungarian Institute of Agricultural Engineering
Dr. I. Dombóvári - J. Deák
Cooperative of the Seregélyes pig Breeders

Large-scale pig farms of Hungary are more than 30 years old. Technical level of them is out of date. In accordance with the opinion of that age manure is removed from pig houses by adding water to it (hydraulic removal). For this reason slurry production is far too much as it would be required. Following the changes of the agricultural sector at the beginning of the 90's most of the pig farms have not sufficient arable land to dispose or utilize the large volume of slurry. There are only two ways for these pig farms. One is to develop their technical level and minimize the slurry production while the other one is to give up their activities.

The Cooperative of the Seregélyes Pig Breeders (Seregélyesi Sertéstenyésztők Szövetkezete) has been running an Agrokomplex type pig farm with 800 sows near the settlement of Seregélyes, along the national road of No. 62. The enterprise started to run in 1972. The last decades made the modernization of the technology not to be delayed.

The Application, titled "Sustainable agricultural production technology" that was submitted under Reg. No. of 5916 was considered as worthy of financial assistance by the National Committee for Technological Development (OMFB).

Opposite of the well-known difficulties, of the pig farming sector, modernization has spread over the whole housing technology e.g. automatized feeding-drinking system, ventilation-climatization, slurry handling by separation and composting of the solid phase etc.

Aims of the technological development were to minimize the slurry production and handling the slurry expediently to gain saleable by-product.

CONNECTIONS OF GRAIN DRYING PROCESSES

Prof. Dr. J. Csermely - Dr. M. Herdovics
Hungarian Institute of Agricultural Engineering

During operation tests heat and material transport processes were determined and fairly accurate mathematical relationships were elaborated to describe the drying characteristics of corn as well as the changes of seed temperature and density. Examinations comprised the determination of the measure of dust and gas fume in the case of different driers and drying technologies.

CONNECTIONS OF COMPACTNESS OF SILAGE BALES

Dr. L. Fenyvesi - Dr. Z. Bellus
Hungarian Institute of Agricultural Engineering

In the course of preservation of coarse fodder and other plants aim is to produce sufficient organic acid, mainly lactic one, by means of lactic acid producing bacteria that makes possible to adjust the pH value and the bacteriostatic function on the required level. Fermentative ability of fodders are basically determined by the fermentable carbohydrate and protein content as well as buffer capacity. Effectiveness of the preservation is influenced by the chemical compound, the technical-technological level of the process and the technological strictness.

The Hungarian Institute of Agricultural Engineering (FVMMI) has dealt with the preservation of alfalfa and grass with lower dry matter content as silage for years.

Harvesting technologies, harvesters, balers and wrapping units serving the minimization of losses caused by weather on land are also testing continuously. We have stated that harvesting and preservation of fodder can be solved by up-to-date machines mainly Western European of origin. These machines are balers with constant bale chamber, balers with slicer unit, wrapping machines, etc. On the other hand preservation problems of the hardly preservation problems of the hardly preservable alfalfa have reminded us the necessity of application of additives that help fermentation in order to gain a silage of stable and good quality. Taking into consideration the above mentioned facts we have elaborated such kind of harvesting and preservation process that was based on large-scale method to apply additives to assist and control the fermentation process, prevented the multiplication of harmful microorganisms in order to have silage of good quality that could be stored stably and for long time.

THE INTERACTION BETWEEN SOIL AND DIFFERENT RUNNING GEARS

J. I. Jóri - Gy. Kerényi - T. Illés
Budapest University of Technology and Economics
M. Szente
Hungarian Institute of Agricultural Engineering
G. Antos
IKR Crop Production System

The aim of the research made in 1998-1999 was to do a comparison between the soil compaction by rubber track and wheeled tractor (four wheel driven and mechanical front wheel driven). There was examined the traction capability too. For this reason we have done field tests with RABA-250 and 4WD, New Holland FIAT G-240 2MFWD and Claas Challenger-45 rubber track tractors. The test results with different running gears show the tractor with rubber track has higher traction capacity as compared to wheeled one(at the same weights). The experiences and the test results show there are no significant difference between the same powered wheeled tractors.

On the other hand the soil compaction and the environment impact of rubber track is better than the conventional running gears. The advantages of the rubber track system can be used in that case if we have well-matched implement line (tillage machines, fertilizer spreader, plant protection machines, drilling and seeding machines etc.) for the tractor and not only the tractor equipped rubber track but all heavy agricultural machines like tractors, forage and combine harvesters.

DETERMINING KERNEL HARDNESS THROUGH THE GRANULOMETRIC PARAMETERS OF GRINDING

A. Véha - E. Gyimes
University of Szeged College

The authors have been working for years on the developement of a method of determining the hardness of wheat kernel through measuring the so called 'grinding resistance'. By 'grinding resistance' they mean the specific surface grinding energy (kWh/cm^2) of milling with a hammermill at a constant e_d (kWh/t) specific grinding energy consumption. (Bölöni - Véha - Gyimes, 1997, Véha - Gyimes - Bölöni, 1998 and Véha - Gyimes, 1999).

FODDER PRESERVATION BY FERMENTATION IN PLASTIC BAGS

Dr. J. Csermely - Dr. Z. Bellus - Dr. M. Herdovics - Gy. Komka
Hungarian Institute of Agricultural Engineering
Dr. J. Schmidt - Dr. J. Sipőcz
University of Western Hungary

In the frame of the R & D project, subsidized by the MoARD, working examinations in three agricultural enterprises and working observations in nine ones were carried out in 1999. Working examinations were done by AG-BAG equipment and TAUROS machines. More than 40,000 tons of fodder was preserved by means of this technology on twelve farms. Selection of fodder was enlarged by production of cob corn crushings and corn-cob mixture. Examinations were included the determination of biological characteristics of fermentation as well as digestible characteristics of the nutritives.

RUNNING COST OF POWER MACHINE FLEETS ACCORDING TO DIFFERENT FARM SIZES

L. Magó Ph.D. student
Szent István University, Gödöllő

We have developed a measuring system to analyze the dynamic loads of machines connected to electric motors that can make possible to samples determined by different trigger signs as zero point of power voltage or power current or ordered to different phase situation during one rotation. In our measuring the getting of samples were synchronized by the current cross points. The generated data were set in a txt. file type to the data processing in a high level software (e.g. Excel).We have analyzed in our paper concretely the contact of a three-phase electric motor of P = 5.5 kW and a hammer mill grinding different materials, i.e. barley, maize, wheat and changing the screens of different size.We have measured the effects of sudden increasing in feeding (loading) upon the slip and $\cos\varphi$ and the electric current and calculated the momentary power and torque. (See in diagrams.). Besides one can get a quick balance about use of electric energy.

RELATION OF QUALITY REQUIREMENTS TO TECHNICAL DEVELOPMENT PROCESS IN THE AGRICULTURE

Prof. Dr. I. Husti
Szent István University, Gödöllő

The **technical development** – as a part of **innovation** – has been playing *determining role* in the agricultural development. This activity system is fundamentally predestined to harmonise, integrate and transform the essential elements of technical development to agricultural producers. Technical development is not independent from space and time. At all times, development is realised according to the existing demands and possibilities. Hereupon, in the course of setting the development targets, the actual challenges of agriculture have to be considered.

Among the challenges of the Hungarian agriculture, this paper will lay emphasis on the **quality requirements**.

In the interest of our agricultural future, it would be important that the requirements of quality production conduct the technical development activities of agricultural producers already in the planning phase of the developments. Furthermore, the demands of end-users ought to enjoy the priority in this process.

STUDY OF INTERMITTENT AND CONTINUOUS-MODE MICROWAVE DRYING

L. Ludányi - J. Beke
Szent István University, Gödöllő

For the automatization of the drying process the inner qualities of the material to be dried must be measured. The microwave dissipation field (i.e. the electromagnetic cavity) does not allow the application of traditional sensors.

In convective drying technologies the information bearing (i.e. the energy-transmitting) medium is the drying air. In the microwave drying chamber the main parameters of drying are ensured by the electrical parameters of the electromagnetic field, and not by the changes of state of the air.

The parameters of drying are not easy to measure due to the inhomogeneity of the microwave field, the geometry-depending resonance frequencies and the irregularity of energy distribution. This problem is specially important in the case of large-size, intermittent microwave chambers. Thus investigations have been made using continuous-type, smaller-size dissipation fields as well. An important point was to test the response of the humid material to.microwave radiation by measuring such an electric parameter that is of microwave character, can be measured easily and provides suitable data for analyses.

ANALYSIS OF THE TRAJECTORY OF THE KNIFE CONTROL MECHANISM IN THE CUTTERHEAD „VIBRO CUT"

Dr. P. Szendrő - Dr. J. Nagy - O. Dezső
Szent István University, Gödöllő
(Made in the framework of the project K+F no. FKFP 1171)

The edgewise displacement of the knives of the cutterhead has a favourable effect on the energy requirement of the cut. We have patented many different kinds of structural solutions, each being able to perform the edgewise displacement. As a result of our developing work in the near past (and with the support of the project mentioned above), a new cutterhead mechanism has been implemented. This vibration cutterhead, which has already been patented as well, performs the edge displacement with a control of forced trajectory. The motion came about this way, raises several technical questions. The solutions of these questions are decisive regarding the devices which run smoothly and properly, and which are easily carried out. This includes for eg. the increased noise load, the problems with mass balancing and the adequate endurance/machine life of the control disc and the percussive roll pairs- both being exposed to high accelerations, thus to mass forces. This is why the topic of our study – the dynamic analysis of the trajectory of the control mechanism – is of great significance.

EFFECTS OF ADDITIVES ON THE QUALITY OF SILAGE BALES

Dr. Z. Bellus
Hungarian Institute of Agricultural Engineering
F. Iván
ALLTECH HUNGARY Kft.

In the frame of the project entitled "Effects of additives on the quality of silage bales" we have made roll bales of sliced and traditional length of coarse by means of two technologies at Erdőhát and Lászlópusztai of the MARTONSEED Rt. Latest bales were handled by additive. Bales, made by NEW HOLLAND 544 CROPCUTTER and by PÖTTINGER ROLLPROFI 3500 type balers, were wrapped by an universal, automotive bale wrapper machine that was suitable to use on middle and large-scale farms. Using up of the examination results of the SZIE-MKK Takarmányozási Tanszék and the OMMI we have stated the followings. Owing to the required compound of the volatile fatty acid and the general composition as well as the favourable microbiological state, feeding value can be preserved still in case of longer storage.

PREVENTION OF THE DAMAGES IN SOIL TILLAGE BY THE QUALITY ASSURANCE METHODS

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Szent István University, Gödöllő
L. Csík
MEZŐGÉP Ltd., Szolnok

The importance of soil and environment conservation and their maintenance will be required improving the quality assurance and spreading the view of quality management connected with soil and environment conservation policy in EC. Soil conservation and energy save tillage are the most important factors of the tillage systems in a sustainable agriculture. The quality assurance gives for both factors an appropriate background, qualifying and controlling aspects and make possibilities surveying the probable risks, preventing tillage damages, recognizing the faults in time and decreasing the costs of the faults.

Quality management in soil tillage can be become a continuous activity, aiming a higher process effectiveness and efficiency. The quality assurance system of soil tillage can be divided into 8 stages, such as: 1. Principles and strategy. 2. Technology variants listing. 3. Decision in suitability of technologies. 4. Specification and quality planning. 5. Quality control of processes. 6. Fault diagnosis and corrections. 7. Evaluation of results and quality costs. 8. Documentation and perfection.

This study presents results of research programs supported by FKFP-B-2020/97, OTKA 25.315 and INCO COPERNICUS CA ERB IC15.

EVALUATION OF FRUIT FIRMNESS

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The objective of the paper reported herein was to determine correlation of the relationship found between the coefficient of elasticity and the rupture stress and between the acoustic stiffness coefficient and the rupture stress for apples, pears, peaches and apricots of different ripeness. Furthermore the purpose was to develop a system for fruit firmness evaluation from firmness characteristics measured by nondestructive methods.

Relationship was determined between the coefficient of elasticity and the rupture stress and a system was developed for the evaluation of the firmness. This system provides with the ranges of the rupture stress and the coefficient of elasticity for two different ripeness ranges of the tested fruits.

The firmness ranges were determined for the ripeness "suitable for picking/harvesting" and for the ripeness "suitable for eating" for different cultivars of apples, pears, peaches and apricots. The firmness was expressed by the rupture stress and by the coefficient of elasticity.

The system can be used for the practical evaluation of fruits and the system can be developed for further fruits and vegetables as well.

SOME QUESTIONS OF VIBRATIONAL TRANSPORT AND SEED CLEANING

I. Bíró - L. Deák
Tessedik Sámuel College, Agricultural Faculty, Mezőtúr
A. Hegedűs - L. Brindeu - I. Orgovici
Technical University of Timisoara

The most important part of the vibrational machines which are used for transport, ordering and cleaning of granular materials is a flat riddle plate or a feeder trough. This flat surface swings, hereby the grains move too on the surface. In this paper we have studied the motion of an only single grain. We determined the conditions of formation of the different motiontypes in function of the motion influencing parameters. We studied the motion of the grain particularly when it doesn't leave the swinging surface and it slides only in the direction of the transport.

FLOW PATTERN CALCULATION IN AN AXIAL FLOW FAN CASCADE

F. Szlivka
Szent István University, Gödöllő
M. Lohász
Budapest University of Technology and Economics

We were dealing with the calculation of the flow pattern in an axial flow fan. A 2D mathematical model, $\Psi\omega$ method, was used. The blade passage and the tip clearance secondary flow were calculated. The effect on the secondary flow was investigated by the clearance dimension between the running blade and the standing casing. The effect of the viscosity was also carried out.

NEW METHODS IN TOWER DESIGN

G. Horvath - G. Tóth - Dr. L. Tóth
Szent István University, Gödöllő

The main consideration in this wind turbine analysis was the possibility of FEM and CFD modelling. Flow around the tower was modelled with Computational Fluid Dynamics. An on site wind measurement data have been used as inlet boundary condition for a dynamic system analysis. There was an effort to find the most suitable height and cross section for tower design considering the possible vibrations and torque. The results were verified with wind tunnel and vibration measurements.

The first wind turbine installation was planned on the hilly region on the bank of Danube near Dunaujvaros. The wind speed measurements were carried out from the beginning of 1999. Topographical and wind speed measurement data was collected in the first step. These were the input for the pre-feasibility study.

DETERMINING FLOW PARAMETERS OF GRAIN MATERIALS

Prof. Dr. P. Soós - Prof. Dr. Zs. Szüle - Dr. K. Petróczki - Dr. I. Fülöp - Dr. K. Hentz
Szent István University, Gödöllő

The cast distance in air can only be determined by experiments as no exact formulae like that for cast in vacuum are available. The experimental determination of the parameters is rather costly because large laboratory, experimental spreader and collecting appliances are needed. The formulae of cast in vacuum are not valid for throwing in air. The difference is especially significant above 20-25 m/s air velocities and in the case of low density extraordinarily shaped seeds.
The experiments are necessary because in the education and in the research for developing artificial fertilizer spreading equipments a need for the cast distance computation of fertilizer grain and wheat seed arose several times.
In chapter *Motion of mass point under gravity and air resistance* of the book Kármán Tódor -Maurice A. Biot: Methods of mathematics (1967) the development of the equations of horizontal cast can be found in detail. There is no neglection there. The reader is correctly guided in the development of expressions but the final equations (for path, velocity, time of flying) contain complicated integrals and the book gives no exact solution. As we made several unsuccessful attempts to solve the integrals it seemed reasonable to use numerical method. We think that our experiments and the elaboration of relating theoretical relationships could serve the design of spinning disc spreaders.

ENERGETICAL EXAMINATION OF VIBRATIONAL RIDDLES EXCITED NEAR SELF-FREQUENCY

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A. Hegedűs - L. Brindeu - I. Orgovici
Technical University of Timisoara

Seed cleaning is a very important operation of harvesting in the agriculture. The basic machines of the cleaning are the riddles with different construction and drive. The condition of the unbroken riddling is the relative motion of the seed mass on the screen surface. As the cleaning of a very big mass happens in every year, therefore the energetical examination of the riddling is very important.
In this paper we have studied the possibilities of the reduction of the energy-requirements of the seed cleaning, especially in the event of the energetical examination of vibrational riddles excited near self-frequency.

APPLICATIONS OF ARTIFICAL NEURAL NETWORK IN THE RESEARCH OF VISUAL PARAMETERS OF FRUITS AND VEGETABLES

Anett Szepes Ph.D. student
UHFI, Budapest

The visual quality parameters of fruits and vegetables are very important in trade, because these features can be influenced by the quality of fruits and vegetables. The visual quality parameters like shape and color features must to determined by an objective and non-destructive method. Therefore these features were investigated using image processing. Image processing by computer vision was chosen, because this method is rapid, non-destructive and the results of this method give objective parameters. These features were analysed in order to apply these parameters in the classification of varieties.

DEVELOPMENT RESEARCH OF AC HYDRAULIC ENERGY TRANSFER

I. Czupy - Dr. B. Horváth
University of West Hungary, Sopron
Dr. J. Lukács
Miskolc University, Miskolc-Egyetemváros

Application of the method of AC hydraulic energy transfer results in several advantages. The objective of our research is to provide an ongoing operational experimental model of this transfer. In the course of the procedure an acceptable clarification of constructional and theoretical questions is to be also provided. Idle running tests and loading tests are to be designed to describe the basic static and dynamic transfer properties. We would like to create- as a result of some constructional variant s - a very efficient energy transfer, which can be widely applied, and its operation is economical. Vibration stump lifting seems to be a perfect forest application. In case the stump is vibrated it accelerates and lightens the procedure of stump lifting. It also decreases the power and moment- stress needs. The significant task is to optimise the parameters of the vibration (frequency, amplitude). A diphasic AC system is suiatable for stump lifting, where the motion of the hydraulic generator is rotary and the motion of the hydraulic engine is linear. The amplitude and the frequency of the vibration can be adjusted and controlled by the alteration of the liquid stream.

APPLICTAION OF COMPUTER AIDED MODELLING IN DEVELOPMENT RESEARCH OF FOREST MECHANIZATION

Dr. B. Horváth - T. Major
University of West Hungary, Sopron

Theoretical operational basis of the agricultural machinery has already been described. But on the other hand a similar description of the forest machinery does not exist. At the same time agricultural machines can not be adopted in forest utilisation since forest conditions are sometimes totally different from the agricultural ones.
Formerly certain mathematical calculations required plenty of time and energy since computer background was missing. Nowadays computer programmes – based on the finite-element method – are designed for this job. The advantages of the finite-element method- aided planning are as follows:

- fast and cost-effective, since being familiar with the modell the most suitable machine is to be created without manufacturing several experimantal machines for testing,
- operational testing under all conditions is not necessary,
- there is a very good possibility for strength and functional analysis of the projected machine.

Naturally the computer aided modelling is not enough. A running in test of the prototype is also necessary. This sort of testing is designed to satisfy the following needs: on one hand it should detect the possible unreliability of the modelling procedure, and to prove the theoretical calculations with the hands on experience on the other.

FOREST STEAM SEDIMENT TRANSPORT IN SOPRON MOUNTAIN

Z. Gribovszki
University of West Hungary, Sopron

Small catchments research is the best way of studying erosion processes and sediment transport in the upper, forest covered watersheds. This study runoff caused erosion and sedimentation processes have been analyzed under conditions of forest exploitation in two neighbouring catchments, between the years 1996-99 (Farkas-valley (FÁ) and Vadkan-valley (VÁ). Two sediment forms have been examined, bed load and suspended sediment. Not only the sediment yield, but also quality parameters of sediment have been analyzed and evaluated. Correlation system between sediment quantity, quality parameters and environmentally variables were determined, too.

DETERMINING THE TENSILE STRENGTH OF GLASS METALS USING A THEORETICAL METHOD

Ibolya Zsoldos - I. Pálinkás - L. Pellényi
Szent István University, Gödöllő

A computer algorithm based on a topological model has been created to determined the tensile strength of glass metals in a theoretical way.

EXAMINATION OF PARAMETERS GENERATING LIGHT REDUCTION IN GREENHOUSES

Dr. Márta Szabó
Szent István University, Gödöllő

Light is one of the factors of efficiency in greenhouse production. Solar radiation coming through the cladding material is of prior importance in greenhouses partly in terms of growing (photosynthesis) partly in terms of energy using. The measure of incoming radiation into the greenhouse is influenced significantly by construction and cladding materials besides other effects. One of these effects is condensation. The research was focused on how greenhouse covering materials used in Hungary and condensation formed on them influence the intensity of light coming into the greenhouse. Light reducing effect of intentionally generated condensation was tested instrumentally time depending during laboratory examinations. It can be stated as a result of examinations that the measure of light intensity reduction can reach 7-21,9 % (depending on the type of covering materials) due to condensation in our climate that can not be left out of consideration in greenhouse production. This research was made with the support of OTKA F 032582.

FINDING THE POSSIBLE MEANS OF THE FINANCIAL REGULATORY SYSTEM FOR THE AGRARIAN BRANCH OF HUNGARIAN ECONOMY WITH RESPECT TO ACCESS TO THE EUROPEAN UNION

M. Kopasz
EAKI, Budapest

The future of the Agrarian branch of our economy could be more easily surveyed and predicted by the 1990-ies than earlier. Its financial regulatory system had become more simplified and the purpose of the measures taken with a view to its future functional vigour was to give reliable subsistence for the people engaged in agriculture for at least 4-5 years ahead and to increase the financial aid offered to the domestic producers.

Our Parliament showed a serious commitment to this issue when passed the decree contained in the 8 § of the law. "The farmers drawing on the financial aid provided from the state budget are obliged to supply data specified by the statutory rules." This decree reflects the endeavour to ensure that the state and the different state authorities should pay special attention to the fact that the budgetary subvention reach only the targeted sphere of people to the greatest possible extent. The *structural build-up of the present subvention system of agriculture*, its priorities and its main supportive arrangements will promote the following intentions included in the law on the development of the agrarian branch of economy as *passed by the Parliament, and comprised in the government programme.*

PART II.

SELECTED SCIENTIFIC PAPERS

THERMODYNAMICS OF RHEOLOGICAL MODELS

L. Bense - Dr. P. Szendrő - Dr. Gy. Vincze
Szent István University, Gödöllő

Introduction

The processed plant structures (for example the mass of chopped green forages) behave as viscoelastic materials, have some important physical parameters from the aspects of fodder quality and utilisation, which make the mechanical strain, movement relation and compactness determination more difficult with method of traditional rheology. These masses are random mixture of morphologically different vegetable parts so the biological diversity and the inhomogenity render the modelling more difficult.
The continuum mechanics build up the continuous body from structureless pieces, so-called mass elements. If we would like to model a real substance, for example a chopped forage mass, as continuum, than we have to consider the mass element as the smallest part of mass in which anisotropy balanced. Inside such a particle the inner structure is neglected and the particle considered homogenous and isotrope. Although we cannot neglect that the mass because of its viscoelasticity has certain memory, which means that the inner energy of mass depends not only on the temporary value of state characteristics, but on total state history. For this reason to a thermodynamical description of viscoelastic body it is practical to adopt the so-called functional formalism. If we have not got exact knowledge about the physical structure of the substance's non-linear behaviour, we can also draw conclusions from its macroscopic manifestation with formally introducing inner variables. This does not mean that we give up the determination of physical meanings of inner values. It is better to say that the temporary uncertainty of physical meanings of inner values does not obsolete the mathematical determination of deformation and strain status.
In this article we demonstrate for a simple viscoelastic body, that from practical aspects the two formalism (functional-, and inner values) is equal. Furthermore we demonstrate that the so-called inner energy is an essential concept, which can be initiated in a simple way. We completed the examination in the case of finite small deformations.
Afterwards we present an experimental method to determine the functions of substance. The essence of method is that instead of tenzor-tenzor function scalar-scalar functions can be determined that is why the method does not claim similarity of the measure equipment and processing technology.

Thermodynamics of viscoelastic body

Look at the viscoelastic body according to the Figure 1a, which relative extension is formed jump-function (Figure 1b). Write the first major premise on the system, when time is t>0:

$$\dot{U}=\dot{Q}^{(b)}+\dot{P}^{(b)}=\dot{Q}^{(k)}+\dot{P}^{(k)}=0\,. \tag{1}$$

Here we took advantage of the fact that the system is adiabatically isolated and the external energy is zero.
If the inner energy was only the state function of the observable ε and T parameters than according to $U(\varepsilon,T)=\text{constant}$ and ε = constant condition we found that in case of t > 0

$$T=\text{constant} \tag{2}$$

But it is a contradiction because the $W=\int_{t=-0}^{t=+0}\sigma\frac{d\varepsilon}{dt}dt=\sigma(t=0)\varepsilon^{0}$ energy has stored in the springs and the viscous body connected with the second spring consumes a certain part of this energy. From the aspects of the system the dissipated energy is a heat-effect whereby the system temperature is rising.

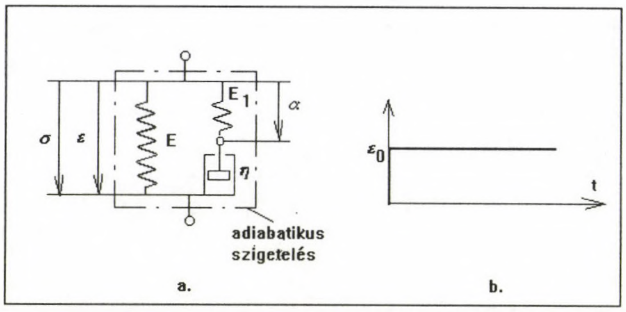

Fig. 1 Poynting-Tomson model of the viscoelastic body

Energetically the process can be defined from the first major premise characterised with inner energetic variables. Looking at Figure 1 it is obvious that the inner energy is not zero (because the extension of the spring connected with the St. Venant's body is decreasing) therefore the inner performance is not zero, (or negative) either. In this way the inner heat-performance is positive, which increases the temperature.
The contradiction comes from the inadequate determination of the inner energy's dependency. There are two equivalent possibilities to the right state characterisation. The first is an enlargement with inner variables, in this case: $U=U(\varepsilon,T,\alpha)$.
According to the second method the inner energy is the function of observable state-parameters. This means that the inner energy is not depending on the momentary value of state-characteristic but on total state history. In the first case (based on the Figure 1) we can define

$$U=U(\varepsilon,T,\alpha)=cT+\frac{1}{2}E\varepsilon^{2}+\frac{1}{2}E_{1}\alpha^{2}+\text{constant} \tag{3}$$

It follows that in the case of t > 0: $T(t)=\text{constant}-\frac{E_{1}}{2c}\alpha^{2}$. As α is decreasing, the temperature is increasing, corresponding with our physical concept.
Let us see now the functional formalism. We can prescribe the following mechanical functions based on the Figure:

$$\sigma=E\varepsilon+E_{1}\alpha,\quad E_{1}\alpha=\eta\frac{d(\varepsilon-\alpha)}{dt} \tag{4}$$

The solution on the α :

$$\alpha=\int_{0}^{t}e^{-\frac{t-\vartheta}{\tau}}\frac{d\varepsilon(\vartheta)}{dt}d\vartheta \tag{5}$$

where we lead the $\tau=\frac{\eta}{E_{1}}$ time-constant. It follows that the strain is the function of the extension.

$$\sigma=E\varepsilon+E_{1}\int_{0}^{t}e^{-\frac{t-\vartheta}{\tau}}\frac{d\varepsilon(\vartheta)}{dt}d\vartheta=\sum_{s=-\infty}^{s=t}\left[\varepsilon(t-s)\right] \tag{6}$$

It is also true for the inner energy

$$U=cT+\frac{1}{2}E\varepsilon^{2}+\frac{1}{2}E_{1}\alpha^{2}+\text{áll.}=$$
$$=cT+\frac{1}{2}E\varepsilon^{2}+\frac{1}{2}E_{1}[\int_{0}^{t}e^{-\frac{t-\vartheta}{\tau}}\frac{d\varepsilon(\vartheta)}{dt}d\vartheta]^{2}+\text{áll.}=\underset{s=-\infty}{\overset{s=t}{U}}[\varepsilon(t-s),T] \tag{7}$$

The above verifies the statement that strain and inner energy is the state-function of the deformation history and that the two procedures are equals.

Experimental specification of the functions of substances

If we subject the sample mass to deformation characterised with jump-function it is known that after a while it gets new state of equilibrium. In this new status the inner variables have zero value so the functions of substances, which determined the behaviour in time, keep to the zero value in relaxation experiments.

$$\lim_{t\to\infty} \lambda(t) = 0, \qquad \lim_{t\to\infty} \mu(t) = 0 \tag{8}$$

So in the state of equilibrum:

$$\frac{1}{\rho_0}\overline{\overline{T}}_p = \frac{\partial F}{\partial \overline{\overline{C}}}, \tag{9}$$

When: $\overline{\overline{T}}_p$ - Piola - Kirchoff strain tensor, $\overline{\overline{C}}$ - Cauchy-Green's tensor, F - function of free energy, which is (because of anisotropy) also isotrope scalar function of deformation. From mathematical point of view this means that the free energy also depends on the scalar invariants of Cauchy - Green's tensor.

$$F = F(I_1, I_2, I_3) \tag{10}$$

Based on this function the measurable strain tensor of the state of equilibrium is the following:

$$\frac{1}{\rho_0}\overline{\overline{T}}_p = \frac{\partial F}{\partial \overline{\overline{C}}} = \frac{\partial F}{\partial I_1}\frac{\partial I_1}{\partial \overline{\overline{C}}} + \frac{\partial F}{\partial I_2}\frac{\partial I_2}{\partial \overline{\overline{C}}} + \frac{\partial F}{\partial I_3}\frac{\partial I_3}{\partial \overline{\overline{C}}} \tag{11}$$

$$\overline{\overline{T}} = \rho \overline{\overline{F}} \frac{\partial F}{\partial \overline{\overline{C}}} \overline{\overline{F}}' = \rho[(I_3 \frac{\partial F}{\partial I_3})\overline{\overline{\mathbf{I}}} + (\frac{\partial F}{\partial I_1} + I_1 \frac{\partial F}{\partial I_2})\overline{\overline{\mathrm{B}}} - \frac{\partial F}{\partial I_2}\overline{\overline{\mathrm{B}}}^2] \tag{12}$$

Taking the advantage of the measuring procedure we will reduce the general functions worked out so far. The research apparatus can be seen in Figure 2.

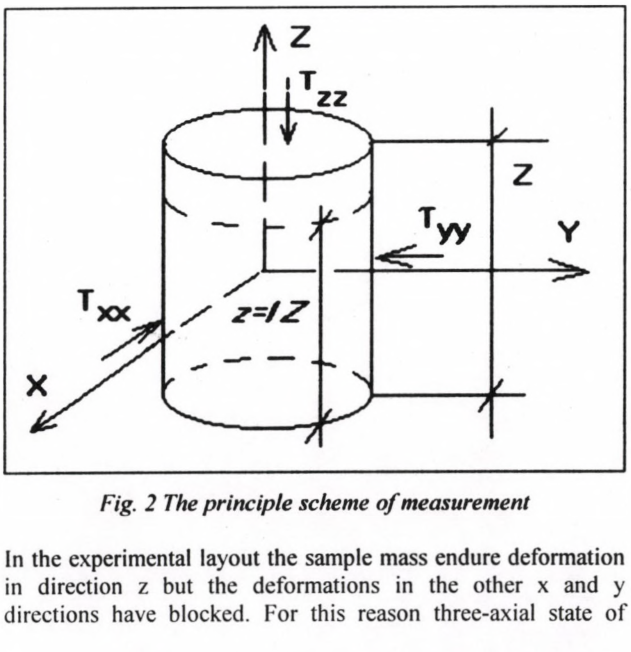

Fig. 2 The principle scheme of measurement

In the experimental layout the sample mass endure deformation in direction z but the deformations in the other x and y directions have blocked. For this reason three-axial state of strain occurs and because of symmetry and isotropy the strains of x and y directions are equal. The Cauchy - Green's tensor of deformation is formed (based on Figure 2.):

$$[\overline{\overline{\mathrm{B}}}] = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & l^2 \end{bmatrix} \tag{13}$$

The strain co-ordinates are:

$$T_{xx} = T_{yy} = \rho[\frac{\partial F}{\partial I_1} + (l^2+1)\frac{\partial F}{\partial I_2} + l^2\frac{\partial F}{\partial I_3}],$$
$$T_{zz} = \rho l^2[\frac{\partial F}{\partial I_1} + 2\frac{\partial F}{\partial I_2} + \frac{\partial F}{\partial I_3}]. \tag{14}$$

Let us see the creation of free-energy function. Study the following free energy function:

$$F = a(I_1-3)^2 + b(I_2-3)^2 + c(I_3-1)^2, \tag{15}$$

where we normalised the expression to be zero deformation-less state. In this way we get from two equations:

$$T_{xx} = T_{yy} = \rho[2a(l^2-1) + 2b(l^2+1)(l^2-1) + 2cl^2(l^2-1)] \tag{16}$$
$$T_{zz} = \rho l^2[2a(l^2-1) + 4b(l^2-1) + 2c(l^2-1)$$

Let us examine two cases. The first is when $a = -b$. In this case:

$$\frac{T_{xx} = T_{yy}}{\rho(l^2-1)l^2} = 2a + 2c$$
$$\frac{T_{zz}}{\rho l^2(l^2-1)} = 2c - 2a \tag{17}$$

It is obvious that $T_{xx} = T_{yy} = \frac{a+c}{c-a}T_{zz}$

In the other case $c = -b$, then:

$$\frac{T_{xx} = T_{yy}}{\rho(l^2-1)} = 2a + 2c$$
$$\frac{T_{zz}}{\rho l^2(l^2-1)} = 4b = -4c \tag{18}$$

In this case the proportion is clearly in existence:

$$T_{xx} = T_{yy} = -\frac{a+c}{4c}T_{zz}$$

In the foregoing examinations we studied the determination of equilibric strains, which writes down the non-linear elastic feature of matter. In the following we will determine the viscous strain, which consists of two parts: a volumetric and a shear viscous strain.

$$\frac{1}{\rho_0}\overline{\overline{T}}_p - \frac{\partial F}{\partial \overline{\overline{C}}} = \lambda(t)\overline{\overline{\delta}} tr 2\overline{\overline{C}}_0 + 2\mu(t)2\overline{\overline{C}}_0 \tag{19}$$

where $\overline{\overline{C}}_0$ the final value of deformation. The matrix of deformation is:

$$[\overline{\overline{\mathrm{C}}}] = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & l_0^2 \end{bmatrix} \tag{20}$$

Let us dissolve the equation (19) to coordinates:

$$\frac{1}{\rho_0}T_{pxx} - \left(\frac{\partial F}{\partial \bar{\bar{C}}}\right)_{xx} = \frac{1}{\rho_0}T_{pyy} - \left(\frac{\partial F}{\partial \bar{\bar{C}}}\right)_{yy} = 2\lambda(t)l_0^2 \qquad (21)$$

$$\frac{1}{\rho_0}T_{pzz} - \left(\frac{\partial F}{\partial \bar{\bar{C}}}\right)_{zz} = 2[\lambda(t) + 2\mu(t)]l_0^2$$

It can be seen that the substance-function is typical for volumetric viscosity:

$$\lambda(t) = \frac{1}{2l_0^2}\left[\frac{1}{\rho_0}T_{pxx} - \left(\frac{\partial F}{\partial \bar{\bar{C}}}\right)_{xx}\right] \qquad (22)$$

and the shear viscous strain can be determined in the following way:

$$2\mu(t) = \frac{1}{2l_0^2}\left\{\frac{1}{\rho_0}T_{pzz} - \left(\frac{\partial F}{\partial \bar{\bar{C}}}\right)_{zz} - \left[\frac{1}{\rho_0}T_{pxx} - \left(\frac{\partial F}{\partial \bar{\bar{C}}}\right)_{xx}\right]\right\} \qquad (23)$$

Summary

Out of the thermodynamic process, the theory of non-equilibric thermodynamics render also the exact description of mechanical occurrence and interaction among forms of motion, so the knowledge of this process is essential for engineers dealing with transport processes. Each time, the thermodynamic method describes the form of mathematical relationships much shorter and more elegant for instance methods based on partial differential equations. It can be an additional advantage that it eliminates uncertainties came about unreliability assumptions concerning the structure of matter. In the last case the chopped green forage masses are a proper example.

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RESULTS OF THE ENVIRONMENTALLY PROTECTIVE RECONSTRUCTION OF A PIG FARM

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Introduction

Large-scale pig farms of Hungary are more than 30 years old. Technical level of them is out of date. In accordance with the opinion of that age manure is removed from pig houses by adding water to it (hydraulic removal). For this reason slurry production is far too much as it would be required. Following the changes of the agricultural sector at the beginning of the 90's most of the pig farms have not sufficient arable land to dispose or utilize the large volume of slurry. There are only two ways for these pig farms. One is to develop their technical level and minimize the slurry production while the other one is to give up their activities.

The Cooperative of the Seregélyes Pig Breeders (Seregélyesi Sertéstenyésztők Szövetkezete) has been running an Agrokomplex type pig farm with 800 sows near the settlement of Seregélyes, along the national road of No. 62. The enterprise started to run in 1972. The last decades made the modernization of the technology not to be delayed.

The Application, titled "Sustainable agricultural production technology" that was submitted under Reg. No. of 5916 was considered as worthy of financial assistance by the National Committee for Technological Development (OMFB).

Opposite of the well-known difficulties of the pig farming sector, modernization has spread over the whole housing technology e.g. automatized feeding-drinking system, ventilation-climatization, slurry handling by separation and composting of the solid phase etc.

Aims of the technological development were to minimize the slurry production and handling the slurry expediently to gain saleable by-product.

Material and method

In the frame of the technological development the Hungarian Institute of the Agricultural Engineering, the Cooperative and the Gyulai Kft. have elaborated a slurry handling system that was based on separation, composting of the separated solids and recycling one part of the liquid phase to remove the manure from the gutters of the pig hauses.

Following number of consultations the FAN PSS-P1 type separater was choosen and the process of the technology was developed. Volume of slurry to be separated was measured by IDA-22 type induction flow meter. During the test of the system slurry as well as the separated solid and liquid were analysed at the Laboratory of the University of Agricultural Sciences at Gödöllő. (At present the name of the university is Szent István University). Flow diagram of slurry handling is shown on Fig. 1.

Results

Capacity of the FAN PSS-P1 slurry separator is shown in Table 1. while the main characteristics of the slurry processing can be seen on Fig. 2.

Table 1 Capacity characteristics of the FAN PSS-P1 slurry separator

Operating time (h)	Charged slurry (m^3)	Capacity (m^3/h)
7	90	12,86
5	130	26,00
9	109	12,11
8	81	10,13
9	122	13,56
9	160	17,78
Total: 47	**692**	**Mean value: 14,72**

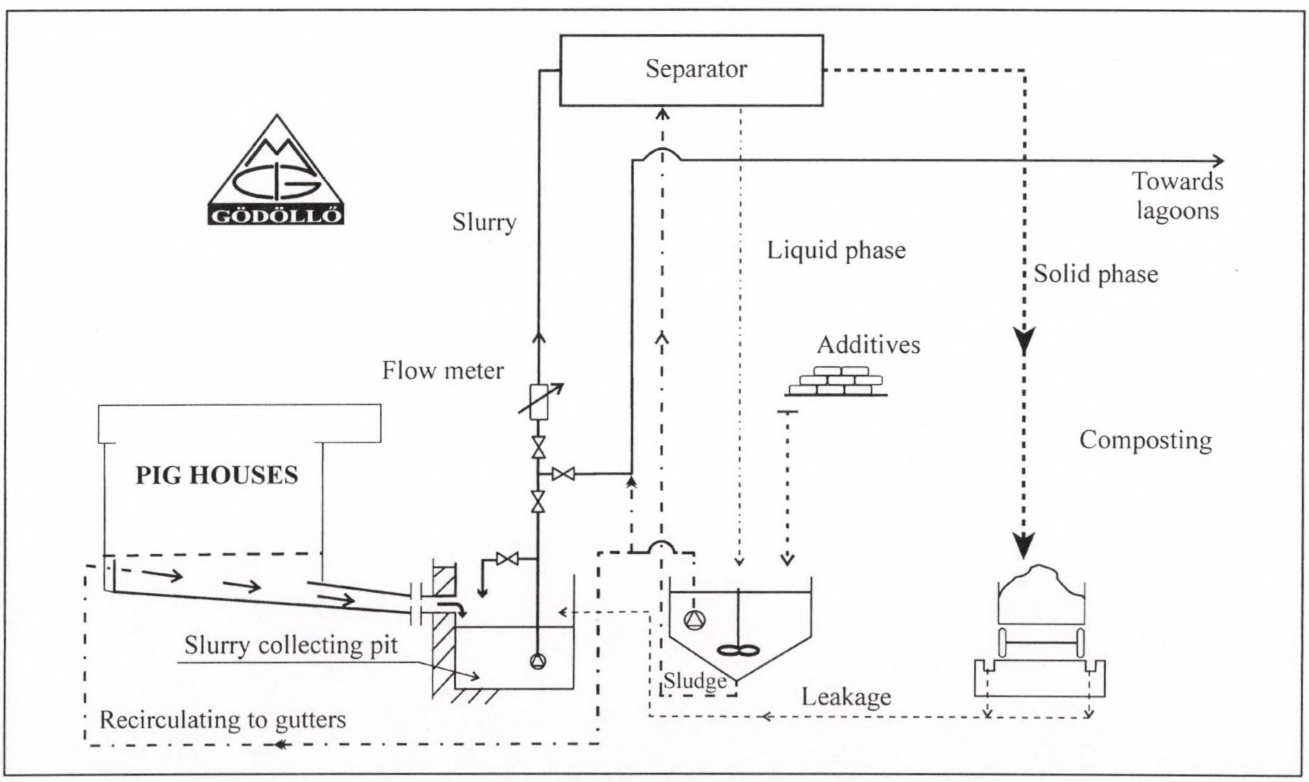

Fig. 1 Flow diagramm of slurry handling

Conclusions

Aims of the technological development were realistics. The typical dilution rate system of a pig farm with hydraulic (damming) removal is 3-4 times of the manure (faeces & urine). As a result of the modernization of the feeding and drinking system fattenings reach the end-weight by 14 day earlier than previously; feed consumption for 1 kg of live-weight production decreased by 0.5 kg of fodder. Volume of the daily slurry production decreased by 40-50 %. Dry matter content increased from 2 % to 4 %. Problems of slurry application and utilization were decreased considerably just as the environmental loading and danger of environmental pollution.

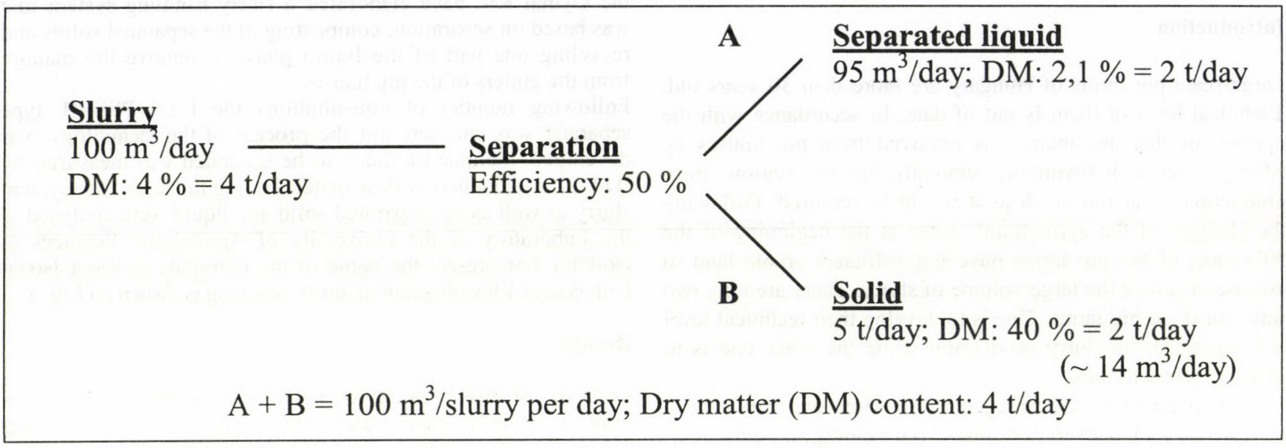

Fig. 2 Material balance of 100 m^3 processed slurry per day

CONNECTIONS OF GRAIN DRYING PROCESSES

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Summary

During operation tests heat and material transport processes were determined and fairly accurate mathematical relationships were elaborated to describe the drying characteristics of corn as well as the changes of seed temperature and density. Examinations comprised the determination of the measure of dust and gas fume in the case of different driers and drying technologies.

Aims of the research

Aims of the research comprised the determination of the processes of heat and material transport of the widely used grain drying systems as well as the elaboration of measuring methods and determination of the measure of emission of dust of diffuse character and gas fume.

Material and method

Examinations were carried out under operative conditions. Moisture content of corn varied between 21.3-29.5 %. Types of driers were MECMAR 34/90 and STELAMUF 70/2 of intermittent running thick layer and material circulating systems. Type of measuring instrument was ALMEMO-5590 heat and airtechnical measuring and data logging system.
Emission tests of other type of driers e.g. B1-15; CIMBRIA AE-9 and AEA-12 also were carried out. Emission of dust of diffuse character was done with a measuring system of individually developed. Emission of gas fume was determined by TESTO-350 type measuring instrument.

Results

Test results and measuring connections of corn drying at different type of driers are shown on Fig. 1. Changes of seed temperature and density can be followed on Fig. 2.
Test results concerning emissions of dust and gas fume of driers and drying technologies can be seen in Table 1. and Table 2.

Evaluation of results and conclusions

During the tests of heat and material transport of grain drying it has been found as follows.

• Drying process of corn in the range of the examined moisture content (29.5 → 12.0 %) can be described by exponential functions (see on Fig.1.) fairly accuratelly.

• Velocity of drying was 3.00-3.10 moisture %/h in the case of thin layer continuous running and cross-flow system and 2.10-2.20 moisture %/h in the case of thick layer intermittent running and recirculating type of driers at 110 ^{R}C pre-setted material temperature.

• Raising of seed temperature of corn can be described well by a quadratic polynome and in the test conditions did not reach the 50 ^{R}C that meant a quality drying.

• Owing to the contraction of corn and the abstraction of moisture content density of corn increased by 10.5-12.5 % during the drying process. Quadratic equation that described the process had a maximum value around 720 kg/m of density, close to the equilibrium moisture content of 14.0-15.5 %. In the case of over-drying, between 12.0-13.8 % water content, density decreased to about 710 kg/m .

For verifying this theory examinations were carried out with different kind of hybrids in exsiccator. Corn seed with original moisture content of 12-14 % and density of 700-740 kg/m were dried under the constant moisture content to 0.04-3.60 % value. In this case density decreased to 669-696 kg/m while the inner structure of corn was lost.
Main test results in terms of dust and gas fume emissions of driers and the applied technologies are as follows.

• The developed sampling method and measuring system for testing dust emission are suitable. Error limit is under 5 %.

• Measured value of dust emission under the height of 10 m is 1.2-7.1 kg/h that is higher with orders than the premissible limit value. Even if a drier e.g. CIMBRIA-AEA 12 type is equipped with the most up-to-date and very expensive dust and light-waste precipitator, the measured value will remain under the limit one if the height of source is above 20 m.

• Adequate measuring of gas fume emission is only possible if the examined drier is equipped such kind of heat exchanger that ensures the right possibility of test.

• In the case of gas burning the floor-type burner has the most advantageous NO_x and CO emission. At block-burners of fuel oil we found smaller CO and higher NO_x emission values.

• Global decreasing of gas fume emission can be reached only by spreading of the use of natural gas, by decreasing the sulfur content of fuel oils by moderation of energy consumption and by the systematic control or regulation of burning systems.

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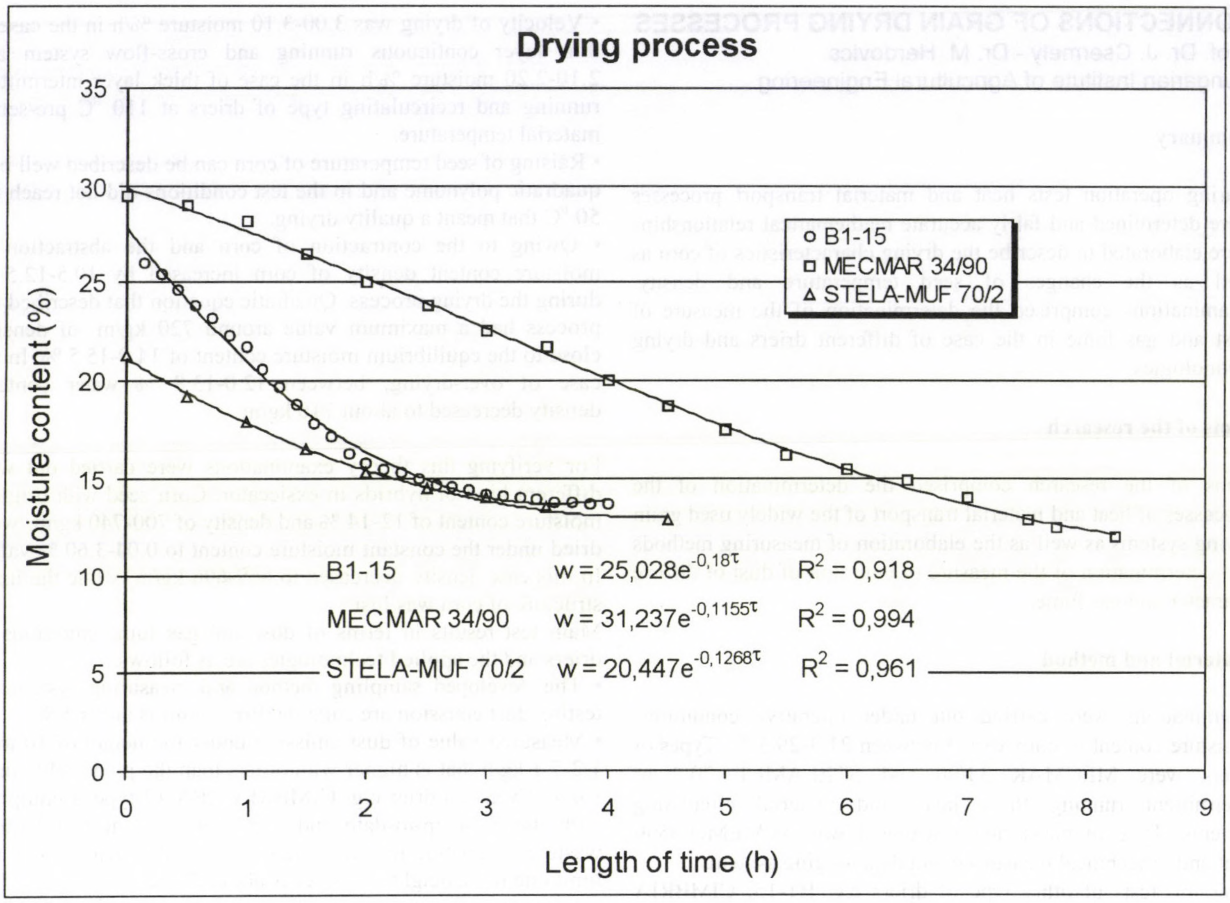
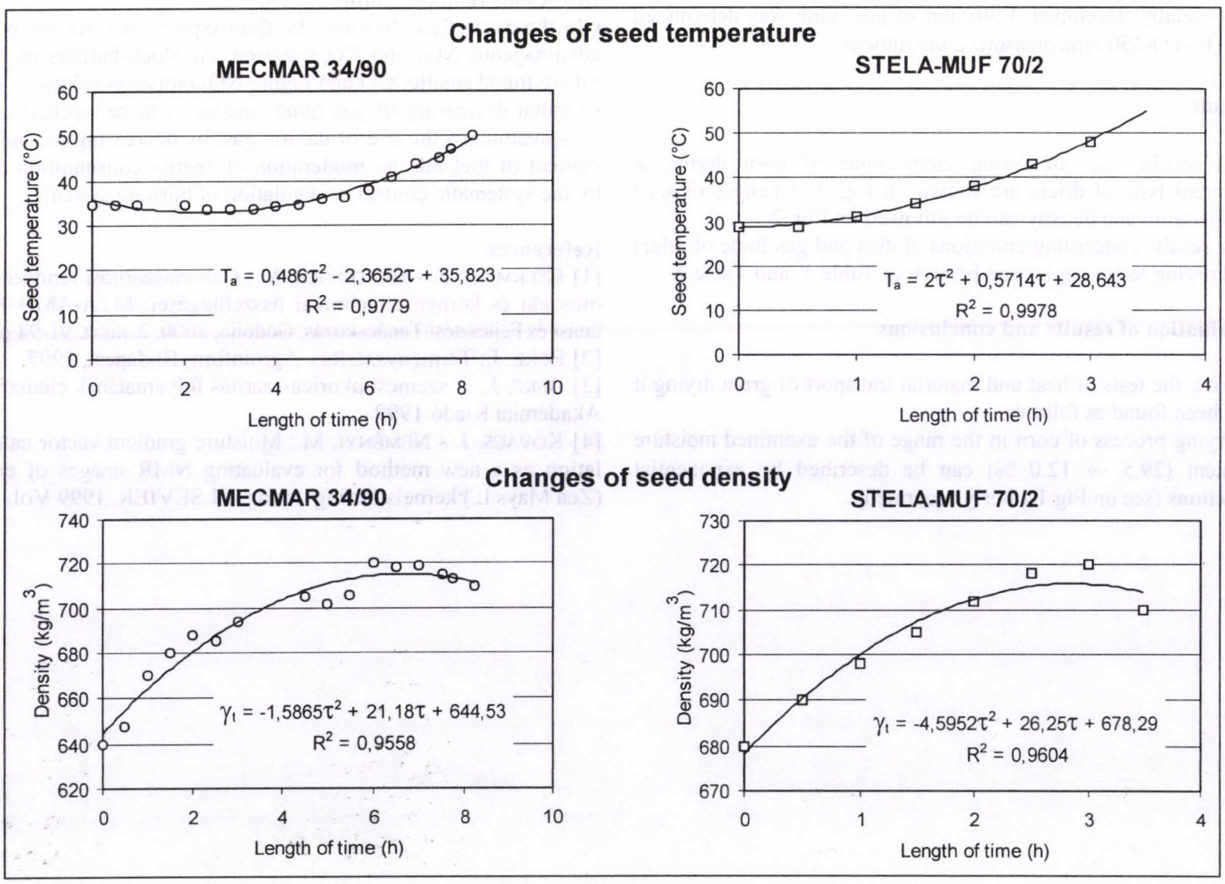


Drying process
Moisture content (%)
Length of time (h)
B1-15
MECMAR 34/90
STELA-MUF 70/2
B1-15 w = 25,028e^-0,18τ R² = 0,918
MECMAR 34/90 w = 31,237e^-0,1155τ R² = 0,994
STELA-MUF 70/2 w = 20,447e^-0,1268τ R² = 0,961

Fig. 1



Changes of seed temperature
MECMAR 34/90
STELA-MUF 70/2
Seed temperature (°C)
Length of time (h)
Ta = 0,486τ² - 2,3652τ + 35,823
R² = 0,9779
Ta = 2τ² + 0,5714τ + 28,643
R² = 0,9978
Changes of seed density
Density (kg/m³)
γt = -1,5865τ² + 21,18τ + 644,53
R² = 0,9558
γt = -4,5952τ² + 26,25τ + 678,29
R² = 0,9604

Fig. 2

Table 1 Dust emission (Permissible and measured values)

Denomination	Permissible limit value (Point-like source of emission) (kg/h)			Measured value (kg/h)				
	Specially protected	**Protected I.**	**Protected II.**	**B1-15**	**CIMBRIA AEA-12 recirculating type H>20**	**MECMAR 13/90**	**STELA MUF 70/2**	**CIMBRI A AE-9**
Height of emission H (m)								
$0 < H \leq 10$	0,048	0,12	0,32	7,1	-	6,0	4,3	1,2
$10 < H \leq 20$	0,144	0,36	0,96	3,0	-	-	-	-
$20 < H \leq 35$	2,16	5,4	14,4	-	0,4	-	-	-

Table 2 Gas fume emission (Permissible and measured values)

Denomination	Permissible limit value (Point-like source of emission) (kg/h)			Measured (kg/h)			Block burner
	Specially protected	**Protected I.**	**Protected II.**	**B1-15 heat exchanger**		**Floor burner (gas)***	**B1-15 gas**
				Fuel oil (block burner)	**Fuel oil residue**	**CIMBRIA AE-12**	
Height of CO emission H (m)							
$0 < H \leq 10$	2	7	18				
$10 < H \leq 20$	6	21	54				no data
$20 < H \leq 35$	190	315	810	0,06	0,063	3,95	
Height of NO_x emission H(m)							
$0 < H \leq 10$	0,07	0,119	0,27				
$10 < H \leq 20$	0,21	0,357	0,81				0,7
$20 < H \leq 35$	3,15	5,355	12,15	1,15	1,118	0,532	
Height of SO_2 emission H (m)							
$0 < H < 10$	0,1	0,17	0,9				
$10 < H < 20$	0,3	0,51	2,7				0
$20 < H < 35$	4,5	7,65	40,5	0,01	6,33	0	-
Burning efficiency (%)				91,0	94,7	90,4	-

Notice: ***** : Calculated on the basis of measuring data of floor burner

CONNECTIONS OF COMPACTNESS OF SILAGE BALES

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Introduction

In the course of preservation of coarse fodder and other plants aim is to produce sufficient organic acid, mainly lactic one, by means of lactic acid producing bacteria that makes possible to adjust the pH value and the bacteriostatic function on the required level. Fermentative ability of fodders are basically determined by the fermentable carbohydrate and protein content as well as buffer capacity. Effectiveness of the preservation is influenced by the chemical compound, the technical-technological level of the process and the technological strictness.
The Hungarian Institute of Agricultural Engineering (FVMMI) has dealt with the preservation of alfalfa and grass with lower dry matter content as silage for years.
Harvesting technologies, harvesters, balers and wrapping units serving the minimization of losses caused by weather on land are also testing continuously. We have stated that harvesting and preservation of fodder can be solved by up-to-date machines mainly Western European of origin. These machines are balers with constant bale chamber, balers with slicer unit, wrapping machines, etc. On the other hand preservation problems of the hardly preservation problems of the hardly preservable alfalfa have reminded us the necessity of application of additives that help fermentation in order to gain a silage of stable and good quality. Taking into consideration the above mentioned facts we have elaborated such kind of harvesting and preservation process that was based on large-scale method to apply additives to assist and control the fermentation process, prevented the multiplication of harmful microorganisms in order to have silage of good quality that could be stored stably and for long time.

Material and method

Researches and developments of alfalfa silage making were carried out on two sites (Petőfi Cooiperative at Kocsér and MEDICAGO Farm Ltd, at Decs) by same type of machines (PÖTTINGER ROLLPROFI 3200 L SC baler and PÖTTINGER ROLLPROFI G 90 S bale wrapper) with and without additives.
In one case alfalfa was natural length in other one it was sliced. Size of wrapped bales wer Ø 1,200 × W 1,200 mm.
At the **first process** 18 bales were made. Alfalfa was Tápiószele of kind with on average length of 542.1 mm. Length of sliced plant was 80 mm.
Average moisture content of alfalfa was 57.1-64.6 % and 56.8-64.5 % respectively. Technical and technological characteristics of the balers was continuously measured together the size and mass of the bales.
Values of volume mass were calculated on the basis of the measured parameters.
At the **second process** kind of the alfalfa plant was Synalfa of second cutting with an average length of 576.1 mm and 55.8-64.3 % of moisture content. Length of slicing was 80 mm. Moisture content of the sliced alfalfa was 57.4-63.9 %. In this method one part of the cuttings was handled with additive other one was baled without additive.
The SIL-ALL marked additive was dealt by ALLTECH Hungary Ltd. The additive contained three kind of bacteria eg. Streptococcus Faecium; Pediococcus Acidilactici and Lactobacillus Plantarum and three of enzymes eg. Amilase, Xylanase and Cellulase.
Type of additive feeder was SPRAY-FOIN sprayer 10 g/t of dosage through three of TEE-JET nozzles. (Fig. 1. and 2.)

Fig. 1 Dispensing of additive and baling

Fig. 2 Bale wrapping of individual system

The SZIE MKK Takarmányozástani Tanszék and laboratory was charged with carrying out the examinations of utilization of nutritive and digestibility.

Results

To determine the capacity and energetic characteristics of baling as a first step, the $\rho = f(DM)$ connection of function was set up (volumetric mass depends on dry matter content).
According to the investigations the average volumetric mass without additive at sliced fodder was 408.6 kg m^{-3} at the dry matter range of 354.4 g kg^{-1} - 432.5 g kg^{-1}. At the original or natural length of plant volumetric mass was 395.2 kg m^{-3} (Fig. 3.). The above mentioned values in the case of using additive were as followed.
Dry matter range: 356.7 g kg^{-1} - 442.3 g kg^{-1}, and volumetric mass: 445.3 kg m^{-3} - 409.5 kg m^{-3} (Fig. 4.).
With knowledge of the above mentioned values connections between baling capacity and dry matter content $[Q = f(DM)]$ as well as specific energy consumption and dry matter content $[e = f(DM)]$ are shown on Fig 5. and 6. Baling capacity at 1.41-2.08 m s^{-1} range of working velocity, at natural length of the alfalfa and at the average 602.2 kg of mass of bales was 17.0 t h^{-1}. In the case of sliced plant and at 640.6 kg mass of bales capacity was 18.3 t h^{-1}. Specific energy consumptions were 16.8 MJ t^{-1} and 18.7 MJ t^{-1} respectively.

Capacity and energetical characteristics of bale wrapping were also tested at bales of different baling methods. As we stated there were only negligible differences among baling methods, as for wrapping capacity and energetical characteristics. Measured characteristics were influenced mainly by the so called lapping index that basically depended on the winding number. For example at 24 of winding revolutions and at an average 564.5 kg mass of bales baling capacity was 26.7 t h^{-1} while the specific energy consumption was 9.8 MJ t^{-1}. In the case of 36 of winding revolutions and at a 625.1 kg bale mass these values were 18.9 t h^{-1} and 16.1 MJ t^{-1}. Wrapping foil consumption from the original, non pre-stretched material was 73.3 m in the first case while 109.2 m in the second one.

On the basis of laboratory analysis of the individually wrapped alfalfa bales, we have pointed out that by the effect of the SIL-ALL additive content of the raw protein, real and metabolisable protein were increased alike. Possible reason of this increasing was the more intensive microbial protein synthesis. Increasing of the two latest kind of protein is definitely important because these proteins contribute effectively to the protein supply by means of absorption from small intestines. Slicing increased the intensity of the additive because bacteria on larger surface can reach more easily to the nutritives that are required to their vital functions.

Enzymes decreased the content of the raw fibre and cellulose of the sliced alfalfa while increased the content of the hemicellulose. In the case when natural length of alfalfa was baled and the free surface was smaller fibres can hardly be decompostable and the effect of additive on the elements of the fibre was minimum (Fig 7. and 8.).

Amount of the total acids in the silage with additive increased by the effect of the lactic acid producing bacteria.

In the sliced alfalfa increasing was higher. Within the total acids increasing of the lactic acid content was meaningful while acetic acid and butyric one decreased. Owing to the suitable rate of lactic-acetic and butyric acid (83 % - 8 % - < 0.2 %) and the sufficient energy content stability of the fodder was good and the nutritive value could be saved. (Fig 9.)

Test of utilization of nutritives showed that additive had a good effect on the digestibility of the nutritives by means of decreasing of the fibre elements and increasing of the protein content. Owing to that the microorganisms and digestive enzymes of the rumen in the case of sliced alfalfa can reach more easily to the nutritives of the silage we can calculate better digestibility than in the case of coarse alfalfa. Beside the above mentioned it is very important that in the case of sliced fodder there is a less requirement of chewing that means the energy surplus is higher to remain the utilization of nutritives (Fig 10.)

Due to the basically steril raw material, the well realized baling and handling technology, the wrapping that ensures perfect anaerob conditions both the value of total number of germ (<104 db g^{-1}) and the number of mould (<102 db g^{-1}) were on low level.

Conclusions

• We can produce alfalfa silage of good quality and with minimum loss by means of cutting on windrow with stalk shattering, by intensive pre-withering and by special baling and wrapping completed with additive using.

• Bale making by slicing and using baler of constant bale chamber results increasing of capacity and energy consumption and at the same time a higher density.

• Due to the using of additive increasing of density of bales caused by slicing can be improved.

• Due to using additive, mainly in the case of slicing both the metabolisable and the total protein content was increased with special regard to the lactic acid content. At the same time amount of acetic and butyric acid decreased rapidly.

• As a result of the additives content of raw fibre and cellulose decreased, while amount of hemicellulose increased. These tendencies was more intensive by the effect of slicing.

• As the result of the additive both the decreasing of the true and metabolisable protein content had favourable effect on the digestibility of nutritives.

• Effectiveness of additives is basically influenced by their concentrations and the system of dispensing.

• Bale wrapping that ensures anaerob conditions minimizes the loss of preservation and storage.

• Increasing of the lapping index of wrapping result longer and more safety storage period.

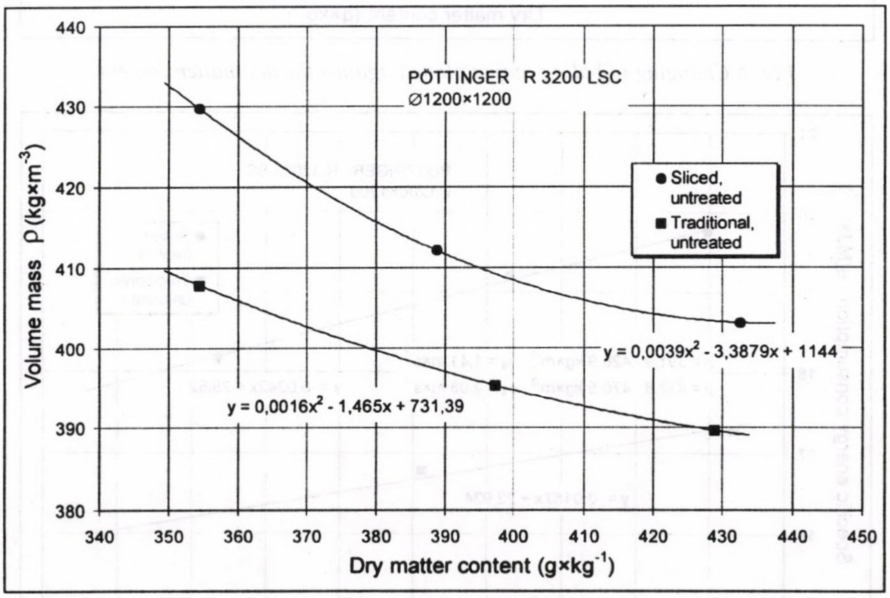

Fig. 3 Changing of volume mass plotted against the dry matter content

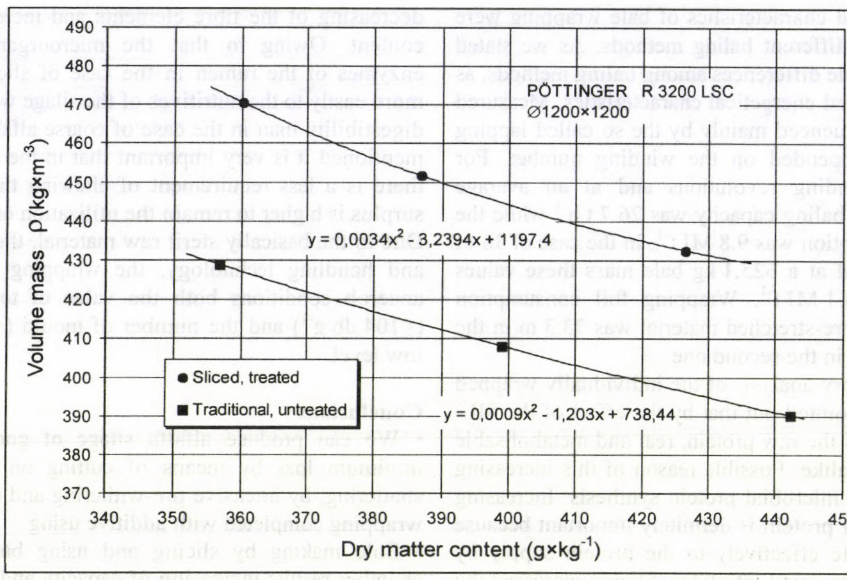

Fig. 4 Changing of volume mass plotted against the dry matter content

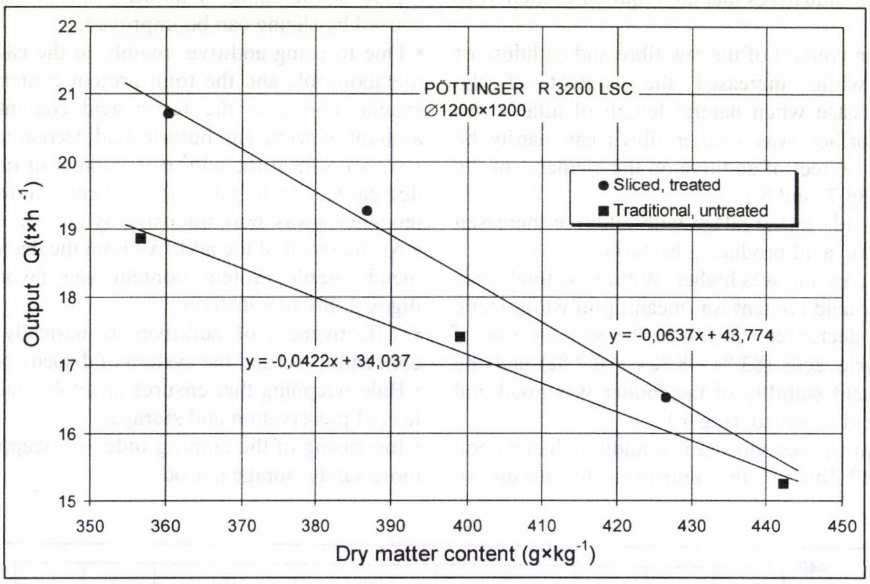

Fig. 5 Changing of baling output plotted against the dry matter content

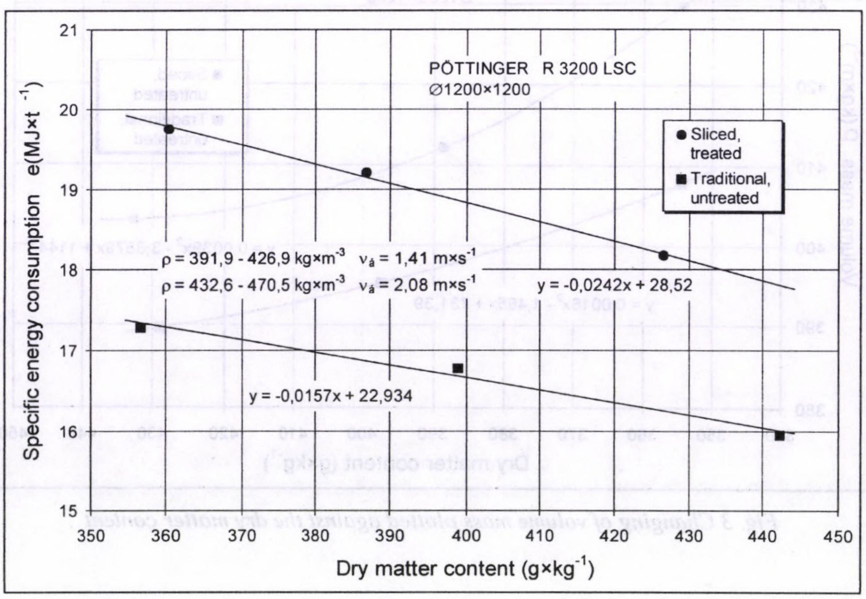

Fig. 6 Changing of specific energy consumption of baling plotted against the dry matter content

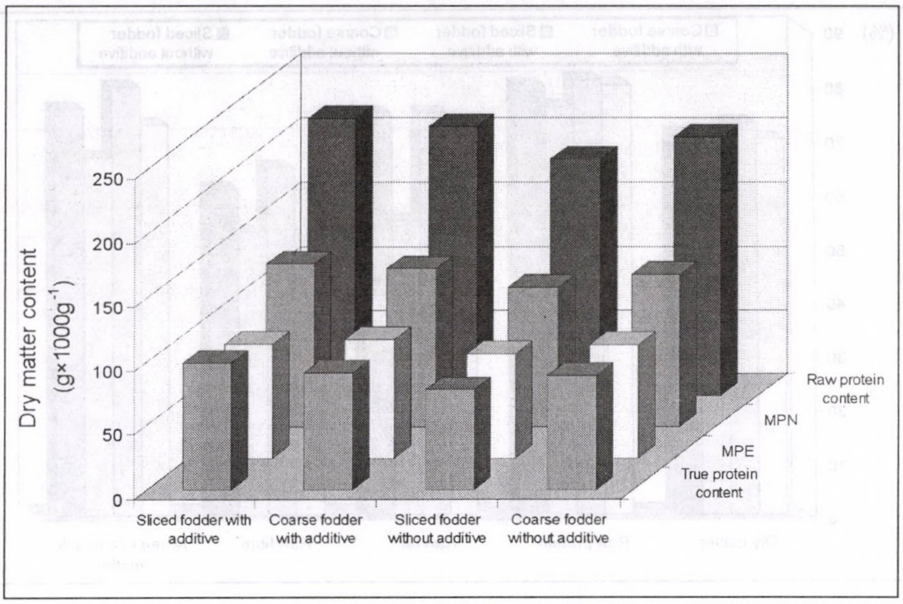

Fig. 7 Protein content of the samples of alfalfa silage

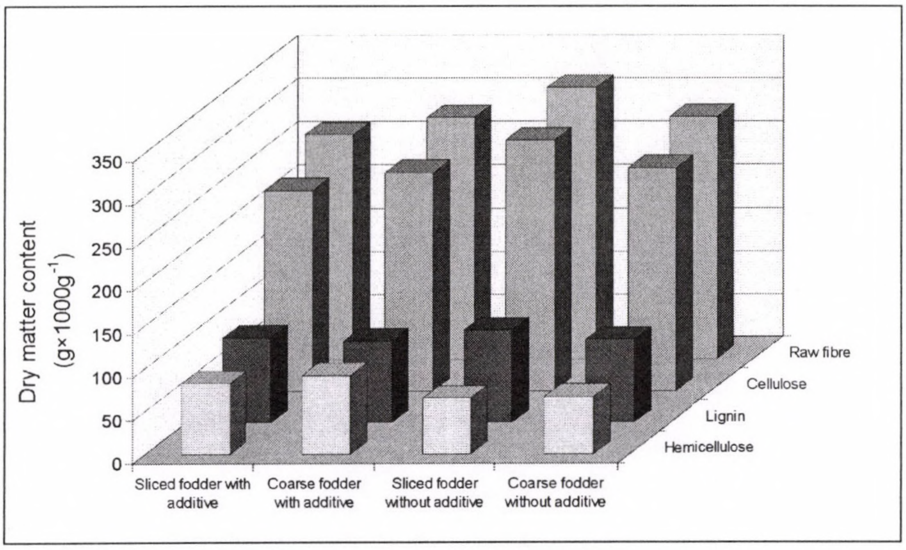

Fig. 8 Fibre content of the samples of alfalfa silage

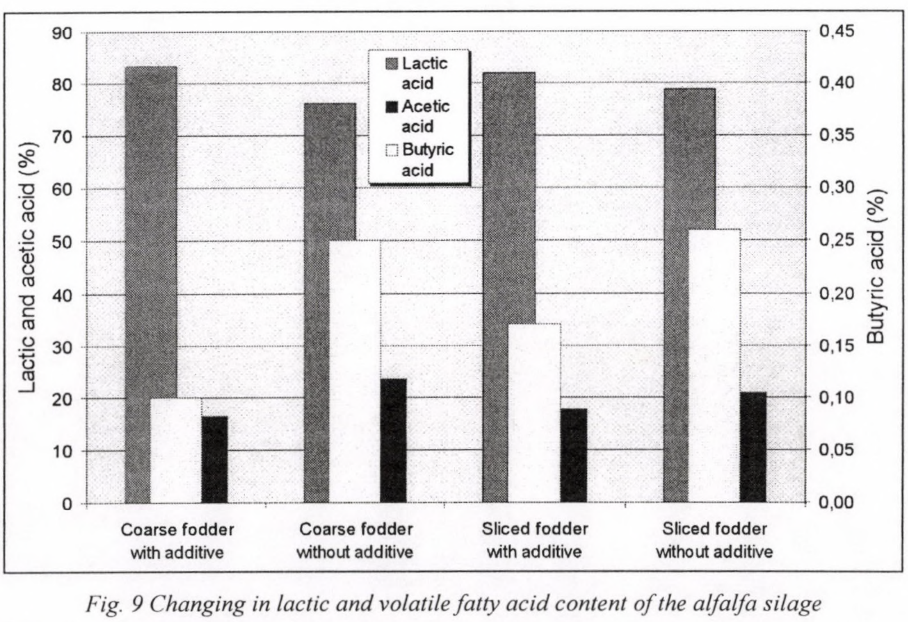

Fig. 9 Changing in lactic and volatile fatty acid content of the alfalfa silage

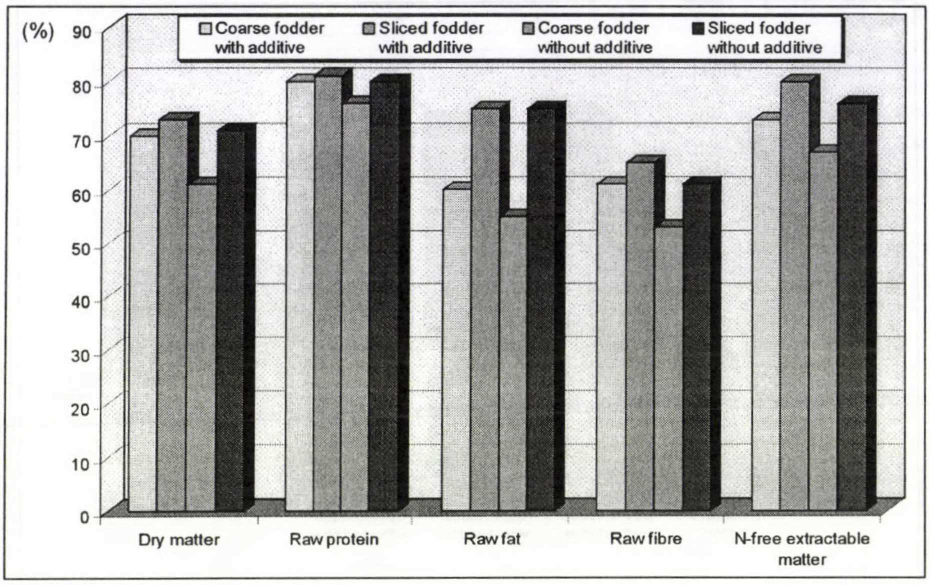

Fig. 10 Digestibility of the nutritives

THE INTERACTION BETWEEN SOIL AND DIFFERENT RUNNING GEARS

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Introduction

The track-type tractors first appearance in the agricultural was at the very beginning of 20th century. The track-type system give a chance to till new area like mud and slope, because its higher tractive efficiency, greater pull/mass ratio, lower ground contact pressure, and better stability. Tracked vehicles have been and continue to be used by these advantages but their importance are decreasing with the fast and successful development of heavy four wheel tractors. During the late 1960s, the pneumatic track, i. e. a cross between the pneumatic tire and the steel track was developed in Italy. The development of rubber belt track was reported first time in 1986. This new type of running gears has removed many of disadvantages of steel tracks relative to rubber tire and has led to renewed research and development on tracked vehicles for crop production.

To study the newly developed rubber track type tractors a couple of research was organized in Hungary also. In 1990-91 a team of Hungarian Institute of Agricultural Engineering (FVM-MI) made the first field test to investigate the tractive efficiency and soil compaction of steel track, rubber track and four wheel drive tractor. In the last 20 years the Caterpillar Company has spent a lot of time and money to modernized his Challenger tractor line. To study the up to date results of developments a research team was organized from the representatives of FVM-MI and Integrated Crop Production System (IKR, Bábolna). This team made a comparative test with Claas-Challenger 45 rubber belt and 2MFWD and 4WD wheel type tractors.

Review of literature

Erbach (1994) have evaluated the track drive system used in crop production. During the early 1950s the average mass of a wheeled vehicle was around 3 Mg, but by the 1980s the mass of 4 wheel drive tractors ranged from 10-20 Mg. Since the 1960s, mass and power of tractors have increased by 60-80%, while the area of the footprint of the running gear has increased by only 20%. Studies indicate that the heavier the load of the soil, the more detrimental the effect of traffic on crop yields.

During the past 70 years, there have been considerable changes in the proportion of tracked tractors in the U.S.A., but the sales were normally between 6 and 10% of all tractors produced. In the U.K. the use of track-type tractors is even lower, account for only approximately 1% of agricultural tractors sold. In some other countries, particularly in southern and eastern Europe, the proportion of track-type tractors in use has been much greater. In the 1960, in Italy and the former U.S.S.R., 24 and 43%, respectively, of the agricultural tractors were equipped with track. Although the number of tracked tractors is generally declining, the numbers in use in eastern Europe remain higher than in western Europe. In Hungary, about 7% of all tractors are 52kW tracked vehicles, while in Germany, France, Spain, The U.K. and Italy the overall proportion of tracked vehicles in total tractors sales amount to about 4%. While the world-wide use of tracked tractors in crop production is likely to remain of limited importance, there is continued interest in their potential benefits. Current use of tracked tractors is generally confined to certain areas and special purposes, for instance, in sugar cane production, rice harvesting or seedbed preparation. Tracked vehicles have obvious disadvantages, but they also have many advantages. Traditionally, tracked equipment has used steel tracks. Based upon equipment designed primarily for industrial work at low speeds, agricultural steel tracked tractors is characterized by low speed, but also by high drawbar pull. Operating speed of steel-tracked vehicles is limited by power loss, noise, vibration, and wear.

Many studies indicate that tracked vehicles compact soil less than wheeled vehicles (Reaves and Cooper, 1960; Soane, 1973; Taylor and Burt, 1975; Janzen et al., 1985; Bashford et al., 1988; Rusanov, 1991). However, other studies report little difference between tracked and wheeled vehicles with respect to their compaction effects (Dilts and Clark, 1975; Brixius and Zoz, 1976; Burger at al., 1985).

Because of certain limitations, tracked vehicles virtually disappeared from use in U.S.A. agriculture between 1960 and 1990. The two major limiting factors were maintenance costs and restricted movement on hard-surfaced roads.

Slow speed and rough ride limit the agricultural use of tracked tractors. Traditionally, tracked tractors are noisy and less comfortable to drive than wheeled tractors and therefore operator fatigue is greater. This results in reduced field efficiency and lowered productivity. Steel-tracked tractors are not adopted for, and often are not allowed to travel on hard surface roads. Slower moving tracked tractors may require more time to turn than do wheeled tractors and therefore field efficiency is reduced. When tracked vehicles are turned in a short radius on soft soil they cause berming, or mounding, of the soil. Some factors limit the suitability of tracked tractors for row-crop use. In particular, damage caused to crops when turning track-type tractors at the end of field may be excessive. But tractors with tracks have most commonly been used under conditions requiring high drawbar pull over extended periods of time (Brixius and Zoz, 1976).

Advantages of tracks include: (1) higher tractive coefficient, which requires lower vehicle mass; (2) higher tractive efficiency, which requires smaller engines and drivelines; (3) a long, narrow track contact patch of a larger area, which results in lower ground contact pressure (Janzen et al., 1985).

During the late 1960s, the pneumatic track, i.e., a cross between the pneumatic tire and the steal track, was developed in Italy. Taylor and Burt (1975) compared performances of a steel track, a pneumatic track and a pneumatic tire under controlled conditions, and concluded that steel and pneumatic tracks exceeded the tire in traction performance as measured by the pull/mass ratio. They observed that the long, narrow footprint of a track (compared to the large, oval footprint of a tire) disturbs and compacts a smaller proportion of the soil surface. Soil bulk density after passage of the tractive devices was greater for the tire than for either a steel or a pneumatic track.

The development of a rubber belt track was reported by Evans and Gove (1986). The belt is made of wire-reinforced rubber, which is constructed much like a tire. The roadwheels for the rubber-belt track may be solid or pneumatic. This track allows on-road mobility similar to that of rubber tires. However, bituminous road surfaces may be damaged when a rubber-belt tracked machine is steered.

Culshaw and Dawson (1987) reported that the rolling resistance of rubber track was greater than that for a tire, for all but very soft surfaces. They also found that on hard surfaces the contact pressure under the track had a very uneven distribution. They evaluated traffic effects for four soil conditions and they reported that soil bulk densities before and after passage of a rubber track and a radial tire were not significantly different. For machines of similar mass, Culshaw (1988) found that vehicle with rubber tracks produced twice the pull of a wheeled tractor. Tractive efficiencies of the two machines were similar, but, the tracked vehicle caused less rutting of a soft soil. Bulk density of soil trafficked with a rubber-belt track tractor was less than when trafficked with a rubber tire of a four-wheel drive tractor (Bashford et al., 1988).

Evans and Gove(1986) reported that the tractive efficiency of rubber belt track type and wheel type tractors were 86%/82% on firm soil and 82%/60% on tilled soil respectively and finally concluded that a rubber-belt track can reduced soil compaction because less machine weight is required for a given drawbar pull, less area is disturbed because of the long, narrow contact patch, and lower vertical pressures are possible because of the large ground contact area.
Evaluating the different reports the conclusions can be drawn: pneumatic rubber tracks were developed to overcome problems with steel tracks. These tracks give on-road mobility while exceeding the rubber tire in tractive performance. The development of rubber tracks, along with improvements in operator comfort, has removed many of the disadvantages of steel tracks relative to rubber tires and has led to renewed research and development on tracked vehicles for crop production.
As yet, there is an incomplete understanding of the effects of track-type equipment on soil compaction and of the responses of crops to soil compactions. However, there is much research in progress and, because of the concern about the use of large equipment in crop production, their is considerable innovative work underway on the development of equipment for rubber tracked tractors. This exciting research and development will lead to options and recommendations that farmers can use to be more productive while improving and sustaining their soil resource.

Methods and materials

The test was made on the field of Cosinus Gamma Agricultural Farm Limited in August 1998. Three different type tractors took part in the test: Claas Challenger 45 rubber track type, New Holland Fiat G240 MFWD type and Rába Steiger 4WD type.
The PTO power of tractors was measured before the drawbar test by AW-400 mobile engine break bench using a Flowtronic type fuel-gauge to measure the fuel consumption.
The drawbar test was done on the clayey loam soil wheat stubble (water content 16,0-18,5 w/w%) using a special "breaking car" which was developed by Hungarian Institute of Agricultural Engineering.
The axle and wheel (track) load was measured by TELUB D-1203 scales. The soil compaction under the wheels and track was evaluated by soil samples taken from different places and depth range.

Test results

Evaluating the tractive features of the tractors with different running gear system was found that the tractive capacity of rubber track is bigger than the wheel type with the same tractor weight. The maximum tractive efficiency of rubber track was 56% bigger than the 4WD and 66,7% than the 2MFWD tractor at 15% slip(the soil condition and the tractor weight was the same.)

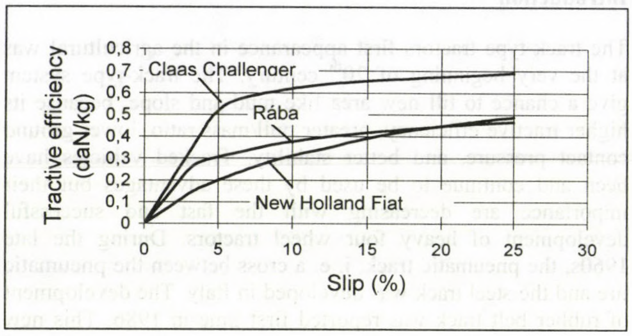

Fig. 1 Tractive efficiency vs. slip

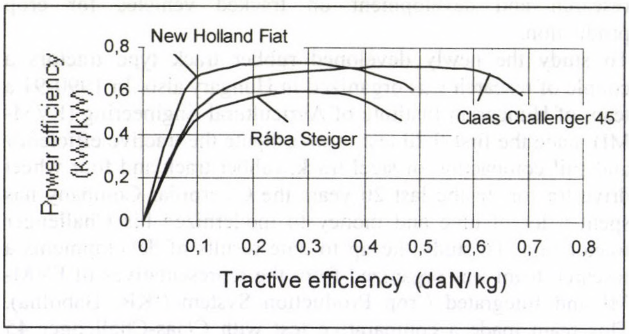

Fig. 2 Power efficiency vs. tractive efficiency

The maximum power efficiency of 2MFWD tractor was better than the rubber track type, because of the bigger rolling (moving) resistance (bigger power losses of self driving) of rubber track type tractor. The maximum power efficiency was getting at approximately the same slip value with 4WD and rubber track tractor but at higher value with 2MFWD. It means, using the 2MFWD tractor with maximum power efficiency, the

Table 1 Specification of tractors

	Units	Type		
		Claas Challenger 45	New Holland Fiat G240	Rába Steiger
Running gears		rubber-belt	tire 2MFWD	tire 4WD
Tire size				
- front			600/65 R28	30,5-32
- rear	-		710/70 R38	30,5-32
Rubber belt				
- width	mm	650	-	-
- length	mm	2250	-	-
Inflation pressure				
- front	bar		1,4	1,6
- rear	bar	-	1,6	1,6
Weights				
- on front axle	kg	-	6300	7200
- on rear axle	kg	-	6500	4960
- Total	kg	11800	12800	12160
Height of dynamometer	mm	520	520	520

change of soil structure, losses and wearing of running gear will be the biggest.

The tractive coefficient at maximum power efficiency was the best with rubber track, smaller with 4WD and the lowest with 2MFWD. It means that a tractor with rubber tack are able to pull wider implement (greater performance) with same power and specific fuel consumption (kg/ha).

The static ground load test (weight/wheel) gave load ranges as follows: 2430-3680 kg of Rába Steiger, 3100-3340 kg of NH Fiat G240 and 0-2220 kg of Claas Challenger 45 (measured all drive, idler and midwheels separately). No big differences were found between the ground load of wheel type tractors' wheels, but weight balance was different. The axle load was near the same at front and rear on NH Fiat G240, but it was different on Rába Steiger where the front axle load was 2290 kg bigger than rear one. The axle (wheel) loads of rubber track type tractors were significantly smaller than the wheel type tractor's.

The surface deformation caused by different running gear was examined with profile-meter on tilled soil. The depth range of ruts was smallest (10-15mm) after Claas Challenger 45 and the biggest (55-60mm) after Rába Steiger.

The influence of rubber track on soil bulk density was investigated by soil samples. It was found that compaction effects of different track rollers (idle, driving) are superposed in the upper 10 cm lay (from 0,99 to 1,67 g/cm3). The significant increasing of soil bulk density was found only in the 20-25cm depth range.

Summarizing the results of different testing aspects could be said:

- No significant differences between the 2MFWD and 4WD tractors if the power and weight range is similar.
- The soil compaction and environment effects of rubber track is better than the conventional running gear.

The advantages of the rubber track system can be used in that case if we have well-matched implement line (tillage machines, fertilizer spreader, plant protection machines, drilling and seeding machines etc.) for the tractor and not only the tractor equipped rubber track but all heavy agricultural machines like tractors, forage and combine harvesters.

Acknowledgements

The authors wish to acknowledge the financial grant from Ministry of Agriculture (FVM) and the Hungarian Scientific Research Fund (OTKA).

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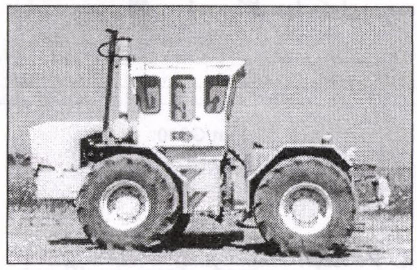
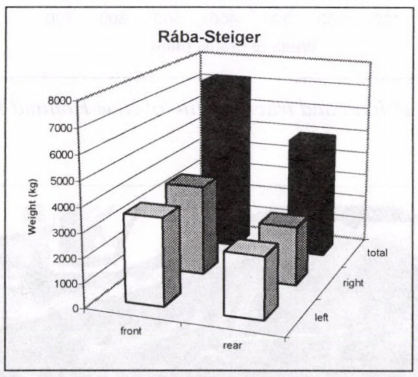


	Left	Right	Total
Front (kg)	3550	3680	7230
Rear (kg)	2510	2430	4940



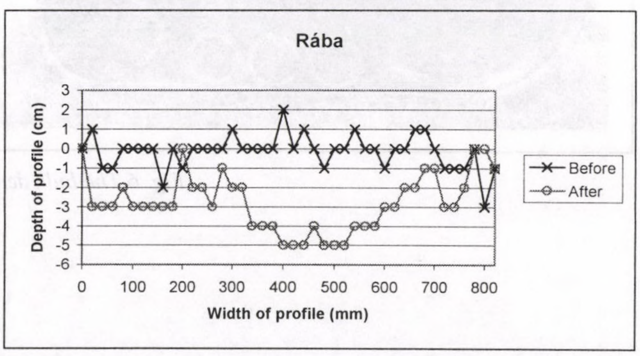
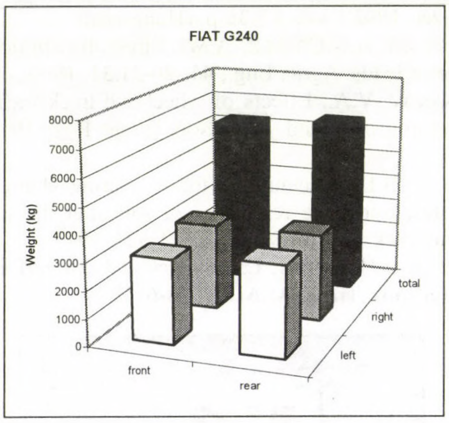
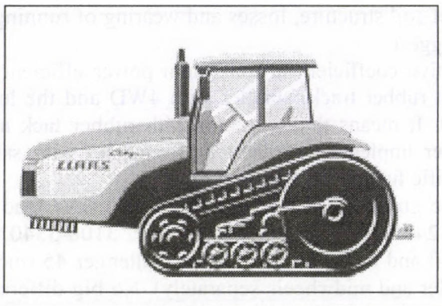


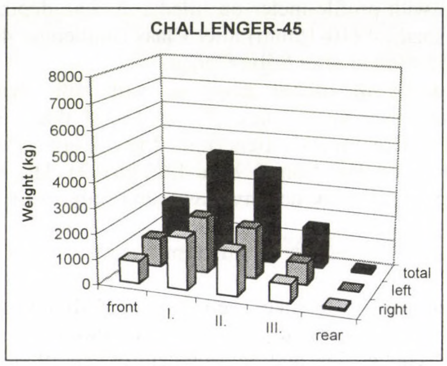
Fig. 3 Wheel load and track profile of Rába -Steiger

	Left	Right	Total
Front (kg)	3070	3207	6277
Rear (kg)	3313	3227	6540





	Left	Right	Total
Guide wheel (kg)	880	1150	2030
Front roller (kg)	2040	2220	4260
Middle roller (kg)	1740	2020	3760
Rear roller (kg)	740	870	1610
Drive wheel (kg)	90	0	90



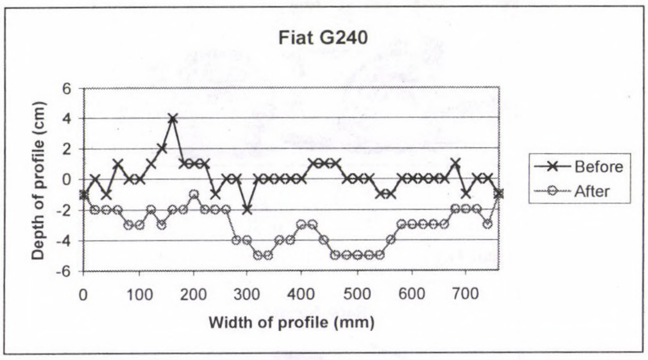


Fig. 4 Wheel load and track profile of New Holland Fiat G 240

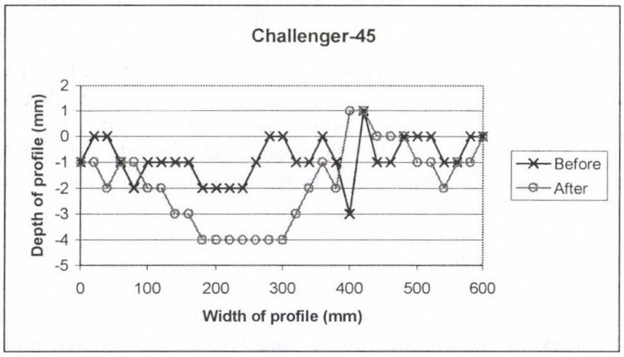
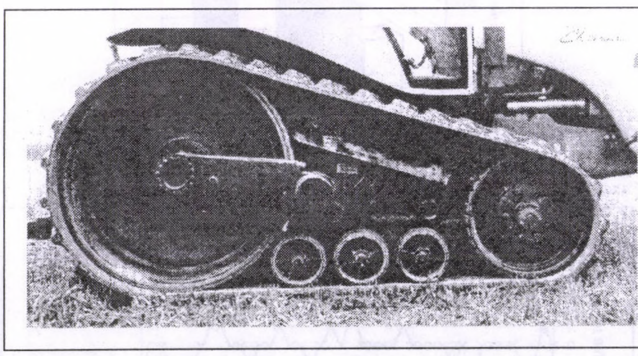


Fig. 5 Wheel/roller load and track profile of Class Challenger 45



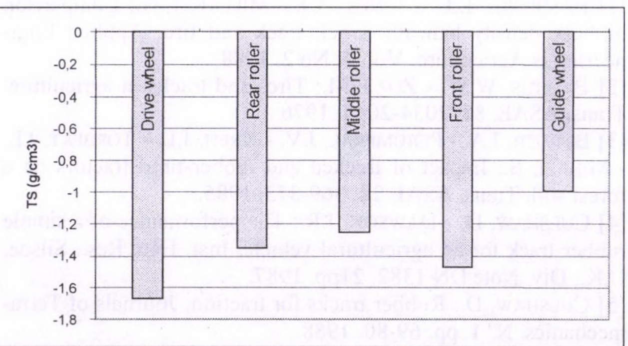


Fig. 6 The bulk density under the rollers

DETERMINING KERNEL HARDNESS THROUGH THE GRANULOMETRIC PARAMETERS OF GRINDING

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Introduction

The authors have been working for years on the developement of a method of determining the hardness of wheat kernel through measuring the so called 'grinding resistance'. By 'grinding resistance' they mean the specific surface grinding energy (kWh/cm^2) of milling with a hammermill at a constant e_d (kWh/t) specific grinding energy consumption. (Bölöni - Véha - Gyimes, 1997, Véha - Gyimes - Bölöni, 1998 and Véha - Gyimes, 1999).

Objectives

To stabilize mass flow, in 1999 we decided to develop a measuring method, where we used a self-made rotary cellular induced dosier and a KD-161S type hammermill, which had been enabled to control grits fineness continuously.
During our investigations we measured the physical parameters (the mass of 1000 grains, density, average grain size) of 21 autumn breadmaking wheat varieties (Triticum aestivum) and of 1 macarony-making wheat variety (Triticum durum) and we determined the structural characteristics of the grains (hardness index (H_i), grinding resistance (e_f), through different methods of determining kernel hardness.
By examining correlations we both wanted to determine how the results of different hardness-measuring methods related and wether there was a correlation between the physical parameters of the varieties tested by us and their individual hardness values.

Means of Investigation, Equipment

Measuring was carried out by means of a KD-161S type hammermill with an engine power of 1.5 KW and a variation-drive cellular induced dosier machine.
Electric energy consumption was determined by a Conrad Electronics EKM-265 integrated circuit watthourmeter. Grits fineness or specific surface (and its increase during grinding), average grain size and the average size of whole grains and also their original specific surfaces were determined by means of a series of sieve analysis. Their numerical data were calculated based on the rules of mathematical statistics.
The density of different wheat varieties was measured with a volumetric displacement pycnometer. For data processing the Statgraphics and Excel programmes were used.

Test Method and Material

The method is based on the application of Bölöni's (1996) new energetic equation of two variables:

$$\mathbf{e_d}\ (\text{kWh/t}) = 10^6\ (\text{g/t}).\ \mathbf{e_f}\ (\text{kWh/cm}^2)\ .\ \mathbf{a_d}\ (\text{cm}^2/\text{g})$$

If we wish to compare the e_f(kWh/cm^2) grinding resistance values of different wheat varieties, it seems practical to keep the specific grinding energy consumption constant so that we can collate the previous e_f values under the same conditions. In this case the grinding resistance (e_f) and the specific surface increase of grits ($\Delta\ a_d$) change according to a hyperbolic linear function [equation (1)]. We already proved this in our above mentioned publication (Véha - Gyimes - Bölöni, 1998).
We determined vitreousity with a diaphonoscope (transillumi-national method), in accordance with the Hungarian standards MSZ 6367-5:1988.In this kind of investigation the vitreousity of an average of 100 grains is expressed in percentage. To determine Perten's kernel hardness index (H_i:%) we used a SKCS 4100 type device, which did not only give mean hardness index, but mean grain size, grain mass and moisture content as well.
Furthermore, e_d (kWh/t) specific grinding energy consumption can only be set constant if we can control the fineness of identical Q_d (kg/h) = constant grits mass flow continuously and if we are able to adjust P_d (kW) available grinding capacity demand (havind determined in accordance with Q_d mass flow), so that $P_d\ /Q_d = e_d$ (kWh/t) $\cong$ be constant. Based on the experience from our previous investigations in our present test we wanted to reach constant value $e_d \cong 2.0$ kWh/t, which we managed to apply for each variety by using a hammermill.
We tested the following Hungarian wheat varieties (year given in parenthesis):
GK Duna (1996, 1998), GK Csűrös (1997, 1998), Jubilejnaja-50 (1996), GK Öthalom (1995, 1997, 1998), GK Kata (1995, 1997, 1998), MV-15 (1994), MV-16 (1994), MV-17 (1995), MV-21 (1995), MV-22 (1997), MV-23 (1997), MV Fatima (1998), MV Magvas (1998), MV Summa (1998), MV Pálma (1998) and GK Durum (Bétadur) (1998).
In our investigations we took 135 measuring points.

Results, Conclusion

We examined 12 Szeged (marked GK) and 10 Martonvásár (MV) wheat varieties, which meant picking up 6-7 measuring points (135 points altogether), and this allows us to come to some statistical and methodological conclusions.
Table 1 shows the most important parameters of grinding, which we got through measurements and calculations. The last column contains the hardness index peculiar to the given variety (grinding resistance: e_f kWh/cm^2).
Based on the main averages we can say that grits mass flow came to about 160 kg/h, driving capacity to about1.12 kW and and specific grinding energy consumption to 2.0 kWh/t as predicted. The variation cellular dosier machine we installed last year proved really useful here. The average grits size we got turned out to be a bit coarse, about 1700 μm, which resulted in a grits surface increase of about 45 cm^2/g.
After analysing the statistical figures we came to the conclusion that we can ensure a constant 2.0 kWh/t specific grinding energy demand and a decrease in grits fineness by reducing Q_d, i.e. the extent of grits mass flow (to about 120-130 kg/h) while reducing the size of the sieve holes down to a range of $x_d \approx 800$-1000 μm; (in this way Δa_d is expected to increase to 80-100 cm^2/g). The relative standard deviation (c.v.) we are going to get as a result, is going to be a lot better , which means that the present distortions will not disturb the statistical evaluation of the method so much.
Table 1 shows the change of grinding resistance (e_f), i.e. the hardness index characteristic to various wheat varieties.
It can be seen that the e_f values of the different varieties at $\varepsilon = 0.05$ probabitity level show significant differences. Our previous publications also indicate that the hardness limit is between 0-30 for soft, floury wheat varieties, and 30-120 [x 10^{-7} kWh/cm^2] for vitreous wheat varieties with a hard endospermic structure.
Two exceptionally hard varieties emerged: MV Pálma, GK Durum (Bétadur) with hardness values 80-100. GK Kata proved definitely soft (25-30), its kernel stucture was soft in each year.
Besides testing hardness we also examined the physical properties of grains.These examinations were mainly focused on the shape of grains.
Instead of a detailed description of indices, we will only show how different parameters are related.

Table 1 Some of main physical and grinding-energetic parameters of tested wheat varieties

Varieties / year	Moisture content (%)	1000 kernel weight (g)	True density (g/cm^3)	Average size (mm)	Perten hardness Hi (%)	Grinding resistance e_f (mWh/cm^2)
MV Pálma 1998	12.3	38.00	1.40	3.36	72.11	98.70
GK-Durum 1998	n.a	34.35	1.33	2.80	99.75	80.08
MV-15 1994	11.7	37.60	1.37	3.16	75.99	76.00
MV Fatima 1998	11.9	45.00	1.31	3.52	65.68	74.20
MV-21 1995	12.1	37.90	1.30	3.25	76.11	63.70
MV-16 1994	12.3	39.40	1.36	3.18	75.01	62.70
GK-Öthalom 1998	11.9	40.20	1.31	3.21	58.20	61.90
GK-Duna 1998	11.7	35.10	1.31	2.95	62.50	60.20
MV Summa 1998	12.3	37.00	1.43	3.35	19.72	57.10
MV-22 1997	12.2	32.70	1.36	3.11	48.93	52.20
MV Magvas 1998	11.8	40.00	1.33	3.30	73.69	50.50
MV-17 1995	12.9	41.80	1.35	3.55	34.47	46.20
GK-Duna 1996	8.6	40.20	1.37	3.37	71.20	44.90
GK-Csűrös 1998	11.7	41.90	1.36	3.33	35.90	44.10
MV-23 1997	12.1	40.00	1.34	3.44	14.87	41.70
GK-Csűrös 1997	11.7	47.20	1.31	3.38	53.50	41.10
Jubilejnaja-50 1996	11.5	48.70	1.34	3.40	52.12	37.30
GK-Kata 1998	11.9	35.80	1.30	3.22	14.65	34.20
GK-Öthalom 1995	11.4	44.60	1.35	3.38	64.66	30.00
GK-Öthalom 1997	11.3	43.90	1.27	3.37	49.34	28.70
GK-Kata 1995	11.4	44.60	1.31	3.40	9.92	26.50
GK-Kata 1997	10.5	41.00	1.27	3.39	6.49	24.30
Average	**11.68**	**40.32**	**1.34**	**3.29**	**51.58**	**51.65**
SD	**0.86**	**4.18**	**0.04**	**0.18**	**25.77**	**19.31**
c.v (%)	**7.33**	**10.36**	**2.92**	**5.33**	**49.96**	**37.38**
No. of samples	**21**	**22**	**22**	**22**	**22**	**22**

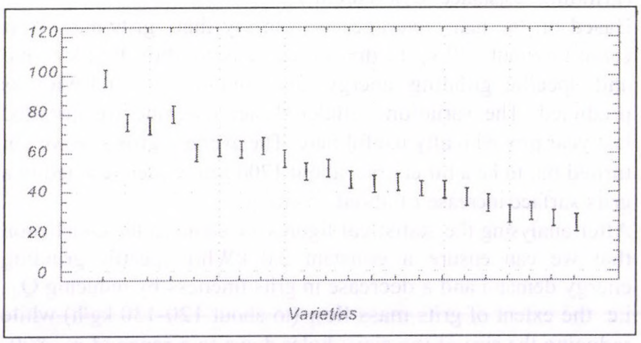

Fig. 1 The confidence intervals (at $\varepsilon = 0.05$ probability level) of average kernel hardness values (e_f) for 22 tested wheat varieties.

In table 2 we can see the correlate matrix of 22 wheat verieties, which we obtained by testing the correlations of different parameters.

We are going to evaluate the correlated coefficients rather than analyze wheat varieties according to the order of their measured properties. The strong correlation (r=0.70) between the average kernel size and the mass value of 1000 grains is remarkable. There is a medium strong correlation (r=0.53) between kernel hardness (H_i) as measured in the American way and hectolitre mass, while there is a medium strong negative correlation (r= -0.48) between H_i and the average grain size. This suggests the smaller the average grain size (bellied wheat), the harder kernel can be expected.

Similar correlations can be seen in the case of gringing resistances (e_f) : r= -0.46 and r= -0.40, which shows a medium correlation between grain size and 1000 kernel-mass value. This is completed by the correlation value of grinding resistance and density, r=0.42, i.e. the smaller and denser the grain, the bigger the grinding resistance value.

Finally we would like to mention the medium strong correlation r=0.6 between the American H_i value and the values we got from the Hungarian grinding resistance (e_f) method (see Figure 2). Both methods follow the principle of grinding, however the character of the Hungarian grinding process is different.

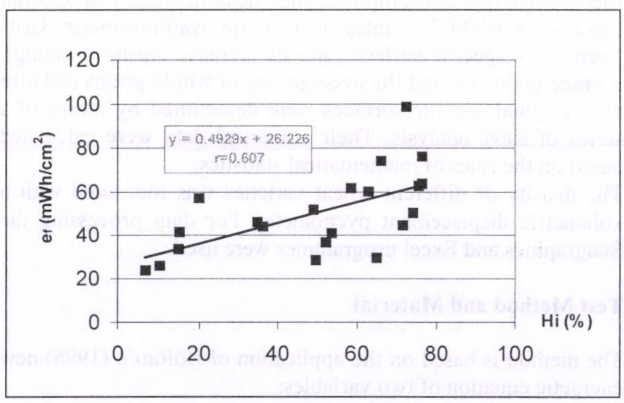

Fig. 2 The correlation of kernel hardness methods (H_i-e_f) of 22 tested Hungarian wheat varieties

The basic difference is that the Hungarian method takes the change in surface after grinding into account, in this way the hardness of the kernel structure represents the grinding energy needed to produce 1 cm^2 of new grits surface.

By comparing the different tested values we can see that essentially both methods are suitable for investigating the kernel structure (hardness, grinding resistance) of wheats and other grains with a few exceptions (MV-23, MV Summa). All this suggets that both the method of investigation and the work of variety classification are worth being developed in future.

Acknowledgement

We would like to thank the Wheat Management of Cereal Research Non-Profit Company, Szeged and the Martonvásár Agricultural Research Institute of MTA for providing true to variety wheat samples. We are also grateful to consultant Dr István Bölöni, for his help and support.
Our work was financed by research programmes **MKM K+F 70-081 502-033/98 FKFP 1032/1997** and **OTKA T 030009** and **F 029631.**

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FODDER PRESERVATION BY FERMENTATION IN PLASTIC BAGS

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University of Western Hungary

Summary

In the frame of the R & D project, subsidized by the MoARD, working examinations in three agricultural enterprises and working observations in nine ones were carried out in 1999. Working examinations were done by AG-BAG equipment and TAUROS machines. More than 40,000 tons of fodder was preserved by means of this technology on twelve farms. Selection of fodder was enlarged by production of cob corn crushings and corn-cob mixture. Examinations were included the determination of biological characteristics of fermentation as well as digestible characteristics of the nutritives.

Aim of the research

Aim of the research was to develop an up-to-date preserving and storing technology that would ensure more suitable quality and stable feed with minimum loss compared to the traditional above ground bunker silo. Further aims were to establish the home adaptation of the modern technology based on fermentation in plastic bag, finding out the technical, technological and feeding connections and elaboration of the running costs. During the examinations in 1999 determination of technical and technologic parameters as well as the fermentation biological and digestible characteristics of nutritives were carried on.

Collaborators

- University of Western Hungary, Department of Feeding Science, Mosonmagyaróvár
- AG-BAG Hungária Ltd, Mosonmagyaróvár
- Dalmand Agricultural Inc., Középhídvég
- Pankota Agricultural Inc., Szentes
- BOS-FRUCHT Agricultural Cooperative, Kazsok

Material and method

In 1999 41,695 t of fodder was preserved in 182 plastic bags in 12 agricultural enterprises by TAUROS filling machines. Kind of fodders were as follows.

- alfalfa silage with additive: 11,380 t
- mixture of corn-cob crushings (LKS): 1,850 t
- corn-cob mixture (CCM): 690 t
- wet corn grits: 10,380 t
- sugar beet slices: 17,395 t

Experiments were carried out under operative conditions during harvesting and storing.

Results

Average technical and technologic characteristics based on experiments and observations under operative conditions are summarized in Table 1.

Fermentation characteristics of the alfalfa silage and the wet grids are shown on Fig. 1 and 2. Digestibility of the nutritives can be seen on Fig. 3. Influences of the dry matter content (DM) and the additives on the quality of silage can be followed on Fig. 4 and 5.

Summarising and conclusions

- Fermentation is more immediate and faultless and owing to the higher density (520-630 kg/m^3) damages are less in plastic bag compared to other preservation technologies.
- In plastic bags anaerobic conditions can be ensured easily and for long time.
- Owing to the better synchronism of harvesting and storing losses of land and storage decrease and quality of fodder improves.
- Flexibility and universality of the technology ensure considerable management advantages and the risks of weather can be eliminated.
- Every kind of additives improve the fodder quality and stability during silage making. Without additives a medium quality of fodder can be made. Best result was given by applying of lactose and Silaferm combination of additives.
- Filling capacity is basically determined by timing of service in the case of same filling machine. Kind of fodder and material characteristics are of miner importance. Measured average capacity of 14-15 t/h can be increased up to 20-30 t/h by means of more synchronized service and by increasing the capacity of transport. In this way storing of one plastic bag can be finished during an 8 hours shift.
- At making of wet corn grits capacity of harvesting can be increased, duration of it can be decreased and in this way considerable amount of energy and drying cost can be saved. Drying cost of the moisture content of 22-30 % of wet corn suggested to fermentation is 2,00-3,00 HUF/t. This amount is corresponds to the price of a pressing machine in the case of preservation of 4,00-5,000 t of wet corn.
- According to the running experiences 35-45 % of dry fodder consumption in pig fattening and in the case of dairies can replace by fermented fodder and in this way earning capacity of animal husbandry can be improved.

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Table 1 Average technical and technologic characteristics

Kind of fodders	Range of DM content (%)	Measure of chaff/grid (mm)	Density (kg/m^3)	Filling capacity (t/h)	Specific energy consumption of filling (kWh/t)
Alfalfa silage + additive	30-40	35	580	13,5	2,6
Mixture of whole corn crushings	35-40	25	630	14	2,3
Mixture of corn-cob crushings (LKS)	60-65	6-7	650	14	2,3
Corn-cob mixture (CCM)	65-70	3	740	15	5,0
Wet corn grits	70-75	1,2	800	14	6-10
Sugar beet slices	20-22	-	870	40	1,0

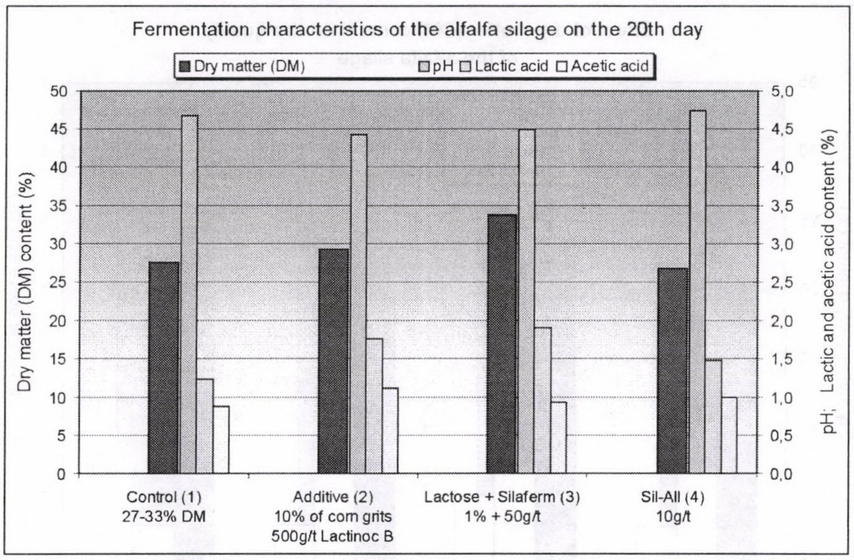

Fig. 1

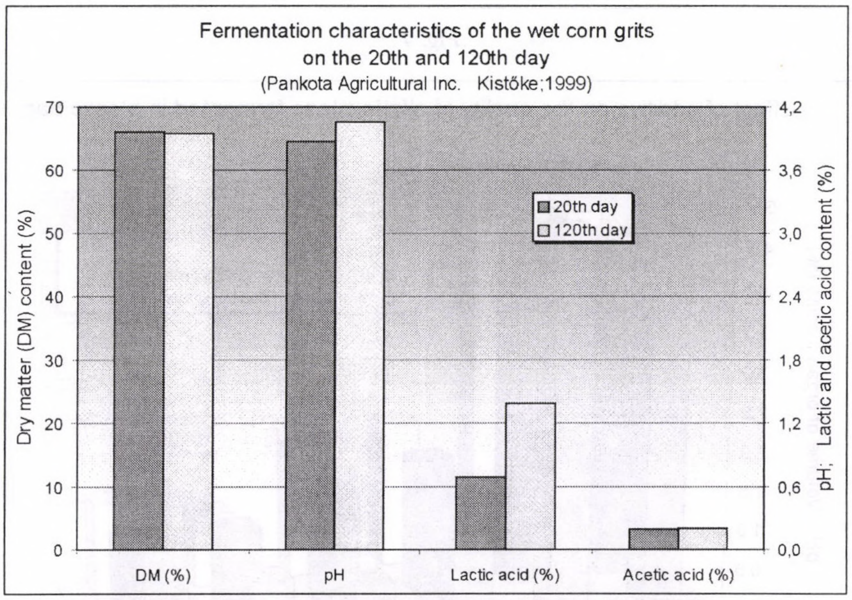

Fig. 2

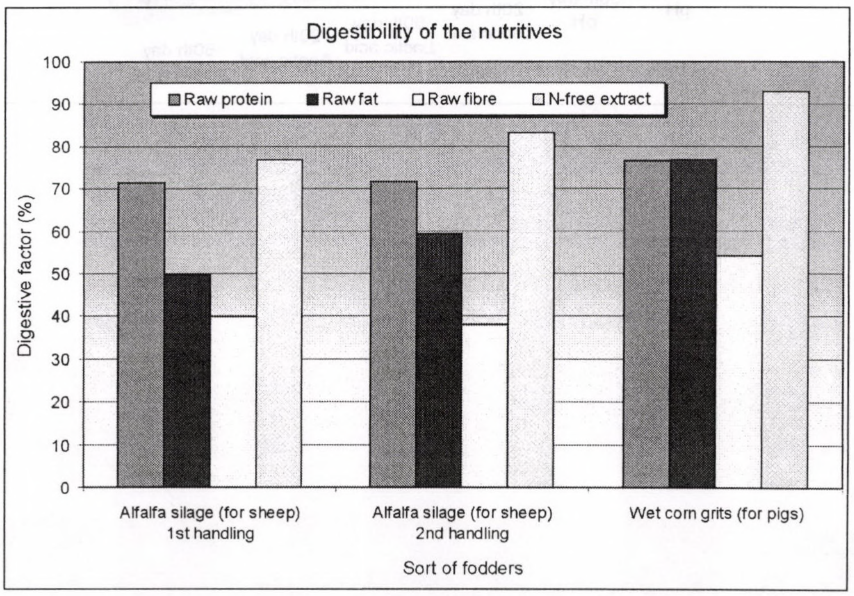

Fig. 3

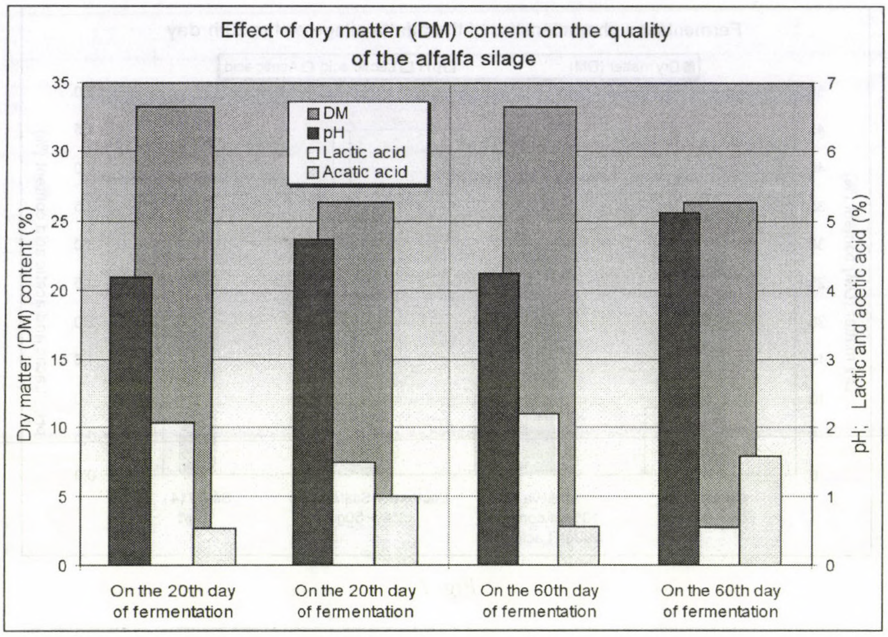
Effect of dry matter (DM) content on the quality
of the alfalfa silage
DM
pH
Lactic acid
Acatic acid
Dry matter (DM) content (%)
pH; Lactic and acetic acid (%)
On the 20th day
of fermentation
On the 20th day
of fermentation
On the 60th day
of fermentation
On the 60th day
of fermentation

Fig. 4

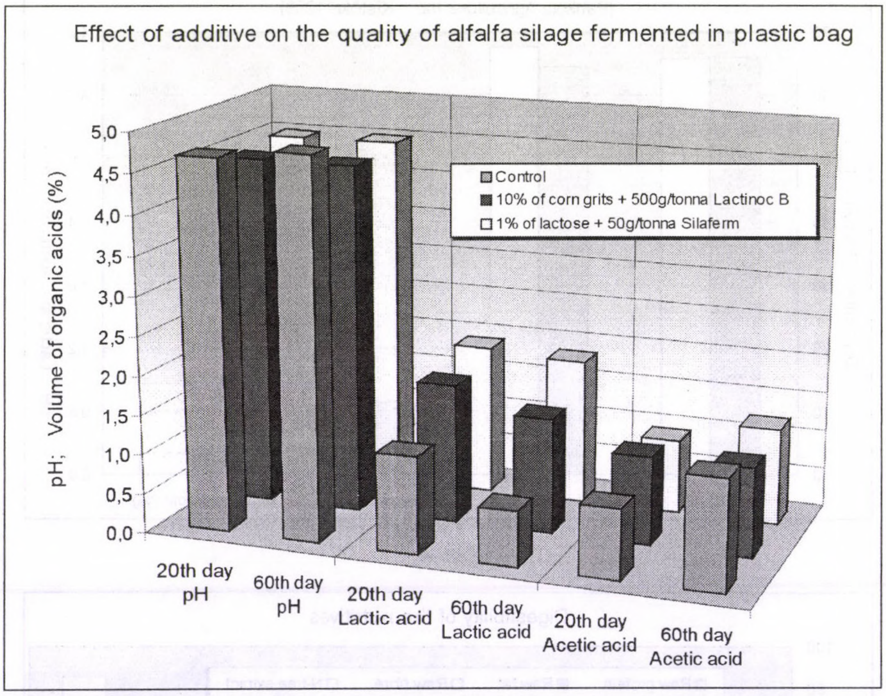
Effect of additive on the quality of alfalfa silage fermented in plastic bag
Control
10% of corn grits + 500g/tonna Lactinoc B
1% of lactose + 50g/tonna Silaferm
pH; Volume of organic acids (%)
20th day
pH
60th day
pH
20th day
Lactic acid
60th day
Lactic acid
20th day
Acetic acid
60th day
Acetic acid

Fig. 5

RUNNING COST OF POWER MACHINE FLEETS ACCORDING TO DIFFERENT FARM SIZES

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Summary

One can find small a few hectars fertile area and large several thousand hectars territory farm in the current Hungarian agriculture. Those different size plants have very different conditions for mechanization and machine utilization. In this paper the optimal power machine composition based on the usage cost and the characteristic usage economy parameters are shown for the different area companies.

The examinations cover the plant sizes from 50 hectars to 10 000 hectars. The analysis uses a computer assisted machine aggregat system planning procedure. In my computation optimal machine systems were compiled for five power machine families. In the optimal systems the tractors are groupped according to the power and the hervester machines according to their function. Based on the results conclusions are made for the power machine system of different size agricultural companies. At the same time the lower and upper limits of the power machine utilization cost of the plants were determined. The specific usage expense and the performable operation hours were also estimated.

Preliminaries

The most important aim for an agricultural company to perform the plant growing operations in the optimal time with a well aggregated machine system while the effectivity and the quality of work is as high as possible.

The optimal machine aggregate forming for agricultural plants were established in the seventies. The research was based on the method of linear programming. Several foreign researcher reached outstanding results in this field (Butani K., Kubas P., Malinnikov A. E., Sagonovic A.). We can mention Hungarian researchers: Acsay F., Csáki Cs., Husti I., Tóth J., Varga Gy.

The researche promoted the large scale farm mechanization to form complex machine aggregates. These days the optimal machine system forming should meet the new challenges of the considerably changed economy conditions. In this era the computerized background should serve a reliable and fast decision support for the farmers even taking into account the different company sizes the extended power machine and implement choice as well as the conyinuously changing machine purchasing prices and machine utilization costs.

Method

The method of optimal equipment park is quite different as the widely spreaded necessary machine replacement based equipment park development, When optimization is made the effect of numerous factors are taken into account. The diverse set of the interelationships could be handled hardly and inaccurately in the traditional "hand-controlled" way. This accounts for the application of up to date machine configuration methods.

The used planning method first determines the plant size, sowing plan, the utilization and investment cost of the power machines and equipments, their rate and daily operation hours then selects the power and implement machine aggregates which are most favourable for operations of the company. Based on the selected machine aggregates the periodical need for the power machine categories are determined. Finally the total number of the necessary power machines and equipments are determined for the complete production period of the plant. The method is based on the linear programming procedure which gives an economically **optimal solution** taking into account both the goals and the conditions.

The selection of the machine aggregates applicable for specific operations is made under the given technical environment by comparing the performance and the operational cost. This can carried out such way that the lowest operation cost machine aggregate is chosen for the given operation.

In order to reduce the specific usage cost rate per operation hour or unit area one should strive for the highest operation hour performance while the limits of the machine maintenance and machine utilisation are taken into consideration. All of this can be met if it is garanteed during the optimization that the higher utilization rate power machine which has lower specific operation hour cost is favoured to the less utilisation rate machines. Such way the given operation is performed by a higher utilization rate machine which increases the number of its operation hours and decreases the specific usage cost. Due to this the power machine of the mentioned aggregate can be used for more operations as its cost rate is lower. As a result of the optimization the operetions are performed by the most favourable area-operation cost rate power machine and implement aggregates [5].

The performed optimization excludes that low operation hour, high specific utilization cost power machines would be qualified in the optimal machine aggregate of a company. The performed operation hours of the machine categories forming the optimal machine system is the possible highest one so that they results in maximum utilization and minimum machine utilization cost.

Basic data and conditions of the computer optimization

In the following the basic data of optimization, the plant structure of model companies, the applicable power machine types and the conditions of the planning are presented.

The initial data are the figures of the plant structure for the given area size. The seeding area rates of each plants are showen in Table 1. The rates are slightly modified with the magnitude of the area. In addition no sile maize is considered in small companies.

During the procedure five different quality consequently different cost rate machines were examined, such as, MTZ based, Zetor based, Massey Ferguson, New Holland, John Deere [5]. In the case of each power machine families near homogeneous nmachines from the same manufacturer were consideredfor the optimum machine system of different company sizes. Such way the differences of purchase prices, brands, quality, environment load, etc. will not influence the distribution of the machine park according to the performance categories.

As for power machine families the tractors were classified according to power, the transport and the harvest machines according to the function. In the power machine categories of the families not all product class were available from a given manufacturer. In such cases an independent manufacturer's machine of the same quality, technical economy characteristic machines were selected.

Examining the machine families from the MTZ based machines to the John Deere family almost the entire Hungarian power machine market is characterized and global results are collected for the different performance tractors and different function harvester machines while the optimum machinae aggregate parameter determination for given company size.

Results

It can be stated in general that a 50 hectar needs optimally one tractor of category 1 (60 kW), while one tractor ofcategory 2 (80 kW) is enough to perform the necessary operations. One tractor of category 2 (80 kW) and one tractor of category 3 (120 kW) and an additional combined harvester is needed by a 300 hectar farm. For those area sizes the conditions of optimized machine aggregate of the different power levels and functions should be built up making use of those performing the operations with the possible lowest cost. At small and medium farm sizes the farmer concentrates on the investment cost reduction and the specific machine operation costs are reduced by the lower permanent cost and higher utilization machine system. In the mentioned size plants an optimal operation performance plan can be formed by computer planning procedure, however, due to the low number operation hours per machine it is reasonable to rearrange the the operations for higher usage rate power machine in order to reduce the machine operation costs.

In the case of 500 and 1000 hectar farm sizes the active rate category numbers increases further as in this case already the categories 1 (60 kW), 4 (180 kW) and 5 (transport machine) contribute the formulation of optimal power machine park. Then the different power machine categories can be chosen free for the given operation and operation rearranging is not necessary either.

The complete range of the power machines is needed only by companies over 3000 hectars area. In this case it is possible to keep the operation hours performance of the all harvester machines within economical limits and one can observe the quantity rates of the machines demanded from the different power machine categories.

Among the tractors the machine of the category 2 has the highest number in the optimal machine park and the next one is that of category 3 and finally the categories 1 and 4. From that one can conclude that the most versatile and utilized tractors belong to the 80 kW power category while the low power tractors are much less utilized and the high power tractors are mainly used in the tillage tasks.

Paying attention to the all power machine categories one can see the high number of transport vehicles. It can be explained with the specific nature of the transport tasks. The demand for selfpropelled harvester machines is low and the combined harvesters of category 8 are demanded in high number.

In the followings the specific power machine utilization costs of optimal power machine park are demonstrated for different farm area sizes.

The utilization cost increases progressively in all the five families at smaller sizes. In the higher sizes the increase is linear in all the families. The specific machine utilization cost per hectars has a hyperbolic decrease (Table 2). In small and medium size companies the utilization of their own machines is low while the specific operation cost is high. Above one thousand hectars a satisfactory yearly utilization rate can be reached for each category. In this sense the yearly machine utilization cost per area is high as the amortization, maintenance and other expenses belongs to this small areas. The case is opposite for higher area sizes as the operation hours of the individual machines are high so that the permanent costs per operation hours or cultivated area are moderate.

Above 500 hectars the operation rearrangement cost sacrifice may arise which comes from the fact that some operations are not made with the lowest operation cost power machines and equipment. This value can be 0.1-6 % of the total machine utilization cost. If a machine park misses a power machine of a category the one is forced to make some operations with machine as that belonging to the optimum power category. This results in higher machine utilisation and lower investment cost. In the globally decreasing trend of machine utilization costs one can observe a local increase around 300, 500 hectars ferm area sizes. It can be explained mainly by the low utilization of the category 8 harvester machines.

The machine utilization costs per shifts of power machines belonging to the categories is decreasing with the increasing farm sizes. Figure 1 demonstrates the specific operation cost of tractors, transport and harvester machines in the John Deere family. The figures of the expenses ease in the function of the farm size since the better utilization power machines has favourable operation cost and it ensures an optimal operation plan through the power machine composition assigned to the large scale company sizes. In the case of individual tractors and harvester machines even 20-30% and 40-60% cost reduction can be reached, respectively. All of this proves that the operation tasks are performed in different cost levels by the same machine in the case of different company sizes.

Considering the optimal machine composition one can see that it is not monolithic in the function of farm size. In small companies the tasks can be performed by one or two power machine or sometimes by a harvester machine. Those power machines do not have the suitable load by operation hours and their operation cost per unit area is higher than the acceptable one by the efficient production.

In the case of large company sizes the optimum machine system composition which account for the production structure according to the different power categories and harvest functions. The condition for the operation of own machines arise only above the appropriate area size. Consequently the individual power machine categories become a part of the optimum machine park at different company sizes. This contains all the power machine categories above 3000 thousand hectars.

The cost and investment data of the examined power machine families carry important information. They reflect the quality assurance investment cost sacrifice for different farm area sizes and the cost limits of operations in the case of given area size.

The higher machine utilization cost of the small and medium farm sizes can be well observed through the figures of the specific machine operation costs. The difference is 10-20 % depending on the power machine families and this is a great disadvantage for the agricultural companies.

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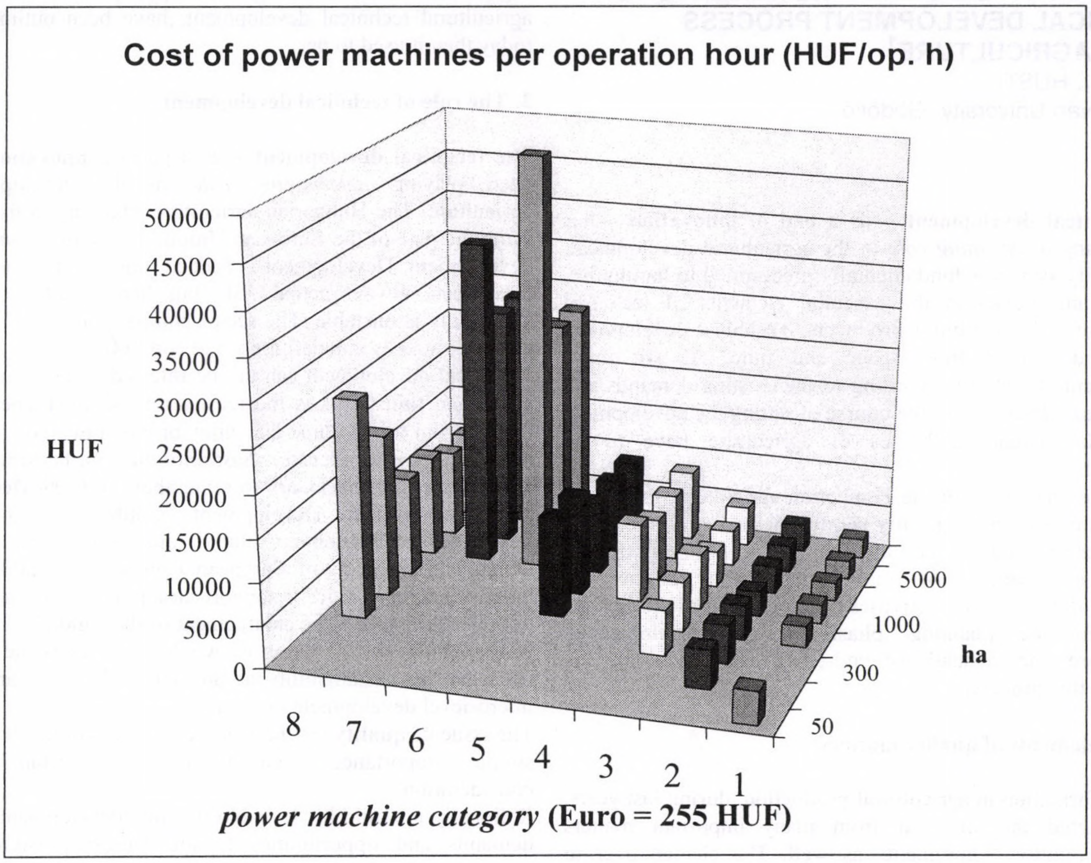

Fig. 1

Table 1 Plant species structure rates (%)

autumn barley	spring barley	autumn wheat	sunflower	maize	silo maize	sugarbeet	oilrape	alfalfa
5	5	20	10	25	10	10	10	5

Table 2 Utilization costs of optimal power machine park in terms of farm area sizes (HUF/ha) (1 Euro=255 Ft)

Farm size / Power machine family	50 ha	100 ha	300 ha	500 ha	1000 ha	3000 ha	5000 ha	10000 ha
MTZ based	36,65	29,92	37,07	37,77	35,32	36,37	34,42	35,04
Zetor based	43,06	38,07	50,18	49,25	41,47	42,01	39,01	39,90
Massey Ferguson	49,53	42,07	52,09	51,94	44,28	44,13	40,85	42,05
New Holland	55,73	39,13	51,03	51,86	44,27	43,45	40,57	41,73
John Deere	60,25	43,08	54,84	55,96	48,76	46,73	44,05	45,38

RELATION OF QUALITY REQUIREMENTS TO TECHNICAL DEVELOPMENT PROCESS IN THE AGRICULTURE[1]

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Abstract

The **technical development** – as a part of **innovation** – has been playing *determining role* in the agricultural development. This activity system is fundamentally predestined to harmonise, integrate and transform the essential elements of technical development to agricultural producers. Technical development is not independent from space and time. At all times, development is realised according to the existing demands and possibilities. Hereupon, in the course of setting the development targets, the actual challenges of agriculture have to be considered.
Among the challenges of the Hungarian agriculture, this paper will lay emphasis on the **quality requirements**.
In the interest of our agricultural future, it would be important that the requirements of quality production conduct the technical development activities of agricultural producers already in the planning phase of the developments. Furthermore, the demands of end-users ought to enjoy the priority in this process.

1. A few elements of quality matters

The transformation in agricultural production, during last years, had detracted the attention from many important matters including quality requirements as well. The change over to market economy, the keen international and home competition, the joining process to the European Union are all urging us **to re-evaluate** our *approach and engagement in quality issues.*
The basis of quality matters is the **quality**, which is:
– in general: "*the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs*" (ISO 8420);
– in substance: "*meeting the requirements*" (Philip Crosby);
– in market context.
- *the basis of the customer's value judgement,*
- *the expression of customer's satisfaction and*
- *important, strategic means of market competition.*

In the industry and the service sector the significance and the tasks of quality issues had been recognised earlier than in the agriculture.
In 1996 the Hungarian Academy of Sciences took on to elaborate answer-versions to the strategic questions standing before the nation and the society. Strategic research programmes had been set up in this framework. Two sub-programmes have to be mentioned here, the "Agricultural Production at the Turn of the Millennium in Hungary" and "Agro-qualitas 21". During the last three years significant work was going on in the programme "Agro-qualitas 21".
Let we show some data to characterise the research work. Twelve professional conferences were organised. More than 100 lectures were held at these occasions. Selected expert wrote altogether 142 papers. The slogan of the research programme was: *"Everywhere, at any time, in everything: quality in all quantity".*
One of the most important results of the programme, that ended last year, was that it had drawn the attention of experts in wide-range to the growing significance of quality matters. Research workshops responded to the challenge, noteworthy new professional alliances, creative communities were organised. As a result, general quality issues, related to agricultural technical development, have been outlined better today than it used to be.

2. The role of technical development

The **technical development** – as a part of **innovation** – have been playing *determining role* in the development of agriculture. The Hungarian agriculture, standing in front of the symbolic gate of the European Union, has *no other choice* than development. Development is needed, not only because it is an ever-green, always actual task, but first of all because our agriculture is unstable. The sector compared to its possible and desirable state is in a definitely bad condition.
Technical development can not be referred without considering space and time. This is the reason for the emergence of new factors from time to time that enjoy or ought to enjoy priority in the development processes. *Sustainability* can be mentioned as an example. It is necessary to remember the **Cork Declaration** (European Rural Development Conference, in 1996): "Sustainable development should stand on the very first place among the problems of European Union and it should be the basic principle in order to support rural policy of any kind in the near future and after the enlargement of the Union".
In the light of the quotation we would make a mistake if we did not consider sustainability as an actual challenge among the micro-level development criteria.
The issue of **quality** can be regarded as an another challenge of similar importance even if it comes from different consideration.
Rationally it would be desirable if actual developments met the demands and opportunities to the largest possible extent. However, experiences prove that it can be only rarely achieved. In reality developments are realised as a result of *compromises.*
The problem of **demand** is a much-debated question. It seems to be right to accept that agricultural technical development is for the favour of improving production effectiveness. We are on the right way as well if inside widened borders we wish to determine the aim of innovation that is the characteristics of technical development.
Where is the contradiction? The potential source of contradictions is that what good is for the agricultural producer is not certain to be good for the foodstuff manufacturer and the customer. From an another point of view: demands and requirements on the foodstuff market do not coincide by all means with the criteria of efficient agricultural technical development and the possibilities of producing organisations. In professional circles in Hungary this is not a new problem. The issue of the borderlines among the participants of foodstuff economy has been much-debated for a long time. The issue is particularly sharp today because, due to the privatisation, the classic foodstuff industry is standing more far away from the agricultural producers than at any time in the last decades.
As to the **possibilities** are concerned, the situation is similarly interesting.
The development possibilities of the producers are unfavourable. Development from own resources is fairly limited under the present circumstances. The distribution of central development funds is going on several occasions with peculiar preferences. Getting other outer resources is restricted again.
The picture at the *organisations of foodstuff industry* is somehow different. Progressive trends and spectacular cutbacks are present at the same time due to the selective market and development policy.
By the analogy of quality matters: The *real market demands* are integrated after all on the consumer market by the end-users. Their circumstances and possibilities in satisfying the demands might restrict the participants of the previous phases. Agricultural producers, aspiring to market success, have to keep

[1] The paper is connected to the OTKA research number T-30745

in mind this proposition particularly when drafting their development plans.

At this point it is worth referring to a specific inherence of the quality matters. According to the modern approach it is too bad if we can get a picture from the quality of a product or service only after it is ready-made. The revolutionary observation of *W. E. Deming and J. M. Juran*, two classics of quality matters, was that **quality planning is to be done in the early stage of development** rather than to test an assumed-quality at the end of the production.

It is decisive to reveal the consumer demands, to determine the parameters of the expected quality and to plan the quality of the product. After this phase the 'only' thing we have to take care of is to comply with the planned instructions. It is obvious that *product development should be subject to the criteria of quality development.*

3. The relation between mechanisation and quality

According to the classic interpretation the *backbone of technical development is mechanisation.* It is worth looking over shortly what the relation is between quality issues and mechanisation, machine operation on enterprise level. This chain of thought could lead to reveal the links of other elements (**Figure 1**.) integrated in technical development with the quality.

We can analyse the issue of quality, in the respect of **agricultural mechanisation**, at least **in three relations**.

- *quality of the machine, device, equipment;*
- *quality of the work and process made with machine;*
- *quality of the manufactured product.*

(The three relations can not be divided rigidly. It is obvious that the machine quality is of primary importance as you can not make "good" work with "bad" machine. On the other hand we must know that a 'good' machine only in itself is not enough guarantee for the success that is for quality work and quality production.)

3.1. The **machine quality** is expressed in the value judgement of the users as well. It is a basic interest of all customer-oriented machine manufacturers to enter into the market with quality, reliable, reasonably-priced machine that can meet the demand of the user. Otherwise demand for the machine declines and later it will come to an end and the manufacturer-distributor company will be in crisis. This is the reason that most agricultural machine producers have got independent quality system to assure the expected quality of their products.

The quality requirements of agricultural machines, regarding them as product, can be divided into *four phases*:

- planning,
- production,
- distribution,
- operation.

The *phase of operation* emerges from the other ones, as the results of previous phases are qualified here.

It goes without emphasising that **end-user's judgement is strongly influenced** by **economic considerations** of the machine, such as price, operational costs and quality. These elements are of primary importance at development considerations, at the bidding phase.

3.2. The achievable advantages of mechanisation mainly depend on what kind of work is done by the equipment. It is necessary to emphasise that the quality of agricultural machine work depends on a range of factors and is influenced by the changes of the elements of the 'human-machine-material-surroundings effects'.

The **question is** more **complicated** because human being can not or only hardly can influence the natural, biological effects that form a part of the production processes. It is difficult to monitor quality matters because there are a lot of technological operations where the **time gap** between finishing the work and accounting its result is significant. (Let us think to sowing. It is conceivable that the thanes of sowing can be well qualified only after braid. The time gap between the two moments is often too long to correct the sowing errors. Similar problems can occur at a range of other operations.)

In agriculture the quality issues, in connection with losses, are visible and gaugeable. We may say with some simplification that, *the less the visible loss, the better the quality of the machine work is.*

It is reasonable to deal here shortly with the **loss-causing effects of the machines**. *The production losses* can be divided into *quantitative and qualitative losses*.

In connection with mechanisation we might count for two loss-making possibilities.:

a/ Mechanical *losses*, **independent of the date** of the machine work. They originate from the single fact that the "living" agricultural produces meet "lifeless" machines at work. If the meeting is not corresponding the machine causes injuries, losses on "the object" (soil, plant, animal) of the working process.

According to theoretical consideration agricultural machines can not be manufactured free from loss-making effects. However, with the progress of technical development the loss-making effect can well approach the theoretical minimum level. Mechanical losses, which are independent of the date of the machine work, can have quantitative and qualitative characteristics.

b/ Biological *losses* due to **incorrect work-timing**. They originate from the attribute that each work process has a "biologically-technically optimal" interval when the conditions of the work process are the most favourable. If work-timing is not optimal, the economic target is rarely achievable. In cultivation of plants quite a range of examples can illustrate these findings. The better timing of machine use is very important.

According to general experiences biological losses can originated from **three causes** *plotted against time:*

1. Losses are only *hardly dependent of time*, the biologically optimal period is relatively long (soil cultivation);
2. *Late work* causes the biological losses (late harvest of grapes, fruits for example).There is no sense in harvest before the optimal period - think harvest of unripe grapes as an example.
3. The loss is in *strong correlation with time*. It is proved that work done in optimal time causes the less loss. The length of optimal interval for a work is different for each produce. The loss formation in this interval can be symmetrical or asymmetrical and the latter is the more typical. This loss-time correlation can be well observed at the work processes of plant protection, plant attention and harvest.

Naturally biological losses do not depend only on the timing of work processes, but a range of other factors (meteorological, geographical and so on) as well. A further fact is that the quality of agricultural produces is not influenced only by losses, but it is also effected by other factors.

4. Closing remarks

By analogy of innovation, the quality issues of agriculture are also linked to produces and processes with some important additions of "agricultural characteristics".

Such as:

– in agricultural production we work with *living materials* requiring and tolerating human and machine intervention only in particular phases of their development;
– agricultural production is not a closed *technological chain*, the production is going on with breaks in time, divided in space

and monitoring the quality matters is disturbed by time differences;

- the role of *natural effects*, which can not be at all or can be only partly influenced by men, is relatively high;
- there is a stronger opposition against the *increasing administration* accompanied by quality matters than in other economic sectors – although it is nowhere a pleasure in Hungary;
- generally it goes with more problems in agriculture than in other sectors to define qualitative criteria, to plan the quality, although there would be *heavy need for modern quality planning* in the agriculture as well.

In agriculture, despite the serious problems arisen, it is not just a question of decision to be successful with quality matters. I am convinced that quality matters are perhaps the most significant challenge today in front of the agriculture. I believe this is particularly true in the light of future market chances. A breakthrough in the different areas of agricultural quality matters including complex technical development as well, can be achieved by developing the education, the advising service, the demonstration programmes and by strengthening the co-ordinating activity of the sector-management at the same time.

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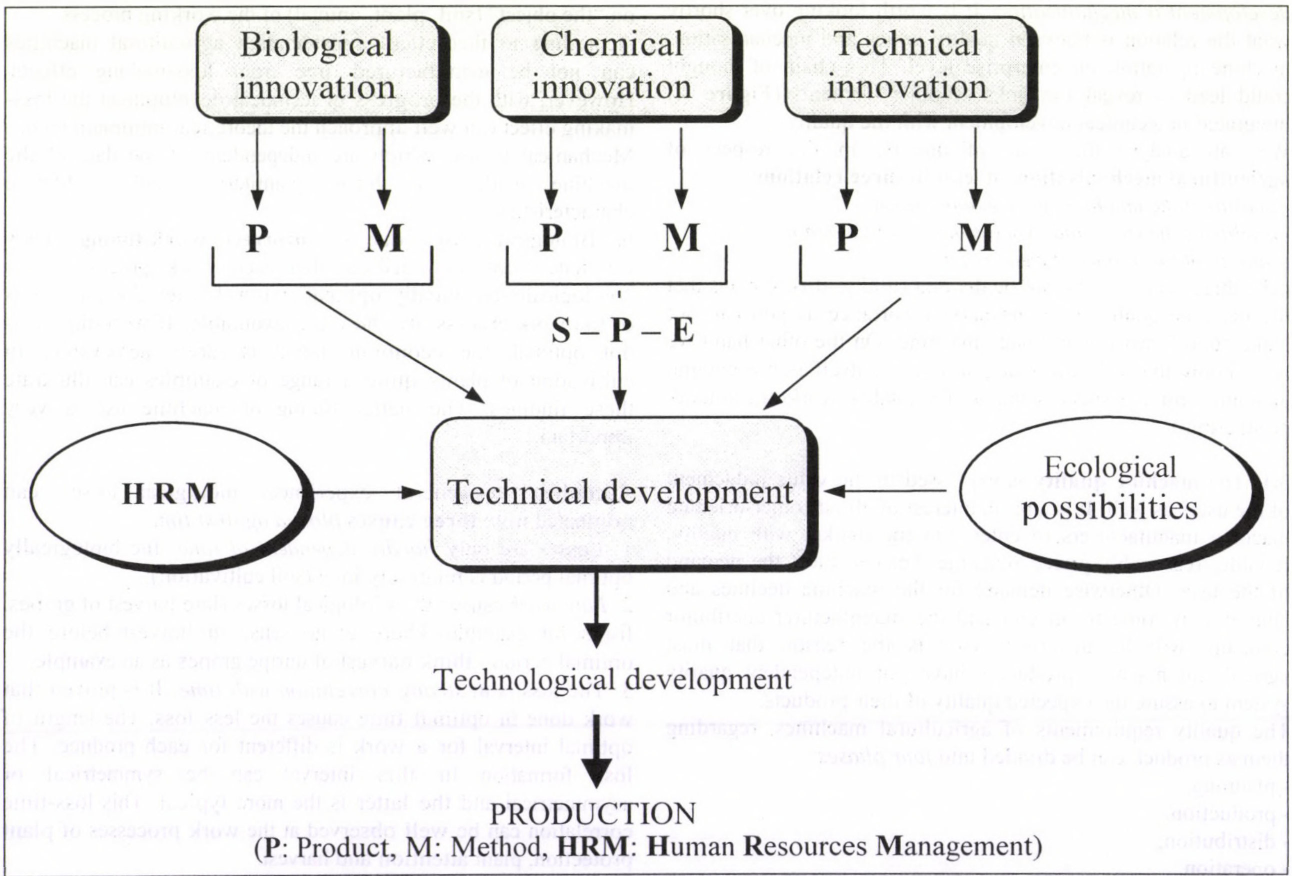

Fig. 1 The main elements of agricultural technical development in social-political-economic surroundings

STUDY OF INTERMITTENT AND CONTINUOUS-MODE MICROWAVE DRYING

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Theoretical background and present objectives

For the automatization of the drying process the inner qualities of the material to be dried must be measured. The microwave dissipation field (i.e. the electromagnetic cavity) does not allow the application of traditional sensors.

In convective drying technologies the information bearing (i.e. the energy-transmitting) medium is the drying air. In the microwave drying chamber the main parameters of drying are ensured by the electrical parameters of the electromagnetic field, and not by the changes of state of the air.

The parameters of drying are not easy to measure due to the inhomogeneity of the microwave field, the geometry-depending resonance frequencies and the irregularity of energy distribution. This problem is specially important in the case of large-size, intermittent microwave chambers. Thus investigations have been made using continuous-type, smaller-size dissipation fields as well. An important point was to test the response of the humid material to.microwave radiation by measuring such an electric parameter that is of microwave character, can be measured easily and provides suitable data for analyses.

Instruments and methods

Investigations have been made concerning drying in intermittent dryers equipped with a stationary conveyor belt and in continuos dryers equipped with a running conveyor belt. Further measurements have been taken concerning the drying of dry material as well as that of material with high input moisture content in an intermittent dryer and in a continuous dryer with running the conveyor belt in different directions and at different rates.

The moisture loss was the same in both types of dryers. In the case of continious drying methode – with the same moisture-eliminating - lower output temperature could be observed, caused by the radiation pressure of the microwaves.

In order to prove the above and to determine the radiation pressure a mathematical model was set up and the material to be dried was radiated at the resulting Brewster-angle.

With continuous running microwave drying the parameters of drying can be measured easily. Since investigations have proved that above a certain value the output temperature is independent of the speed of the conveyor belt and can be taken constant, thus in order to automatize the drying process it is enough to measure only the parameters of the input and output moisture contents.

Results and conclusions

In the course of building up an intermittent-running microwave dryer several problems had to be solved. At the beginning the problems were connected with the structure of the microwave field and the measurability of the parameters of drying.

The multimode feature of the microwave field has been defined and proved by means of measurements.

The electromagnetic fieldsis not homogeneous as energy distribution is concerned. Geometry-dependent energy maxima and minima develop in it. To prove this a measuring device has been made and used.

A mathematical model has been developed for the two-dimensional and three-dimensional visualization of the electromagnetic field. The model has been proved to be similar to the measurement results. The model is the following:

$$W(x,y,z)=\sum_{j=1}^{m}\sum_{i=1}^{n}P_i\exp\left[-\alpha_{ix}(x-x_i)^2-\alpha_{iy}(y-y_i)^2-\alpha_{jz}(z-z_j)^2\right]$$

where P_i is the normalized power determined using colour scale, α is the deviation coefficient, n is the sum of all stains on several sections of the indicating desk, m is the number of axis z measurements, and x_i, y_i and z_j are the coordinates of power maxima.

Using the above model a computer programme has been made to visualize the electromagnetic field. (Fig. 1).

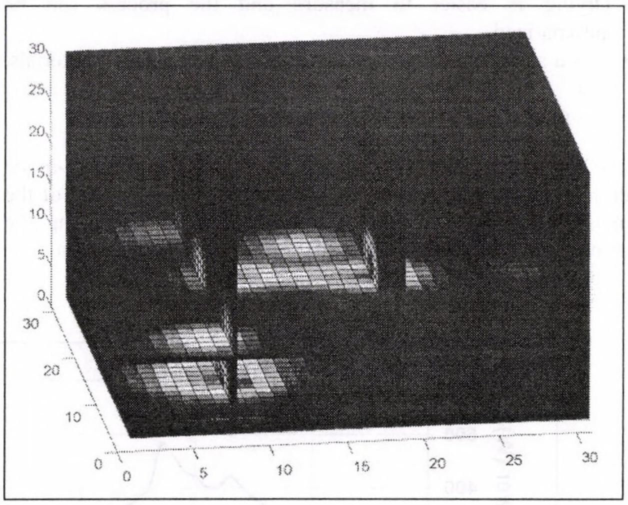

Fig. 1 The 3D Visualization of the Electromagnetic Field Simultaneous Computer Graphics of Two Measurements

It has been concluded that the parameters of drying cannot be measured in the microwave field with traditional sensors. The correct determination of the ε' (q, T) and ε"(q, T) values characteristic of the material to be dried is possible only in a dissipation field with a base-mode geometry.

The investigations have been extended concerning continuous running microwave dryers, as well. For this purpose a new-type microwave dryer has been developed using a conveyor belt with variable rotational velocity and variable direction of rotation. It has been concluded that the drying process can be measured and evaluated by means of one microwave parameter, the measured P_r reflected power. It has also been concluded and proved with the help of measurements that in stationary-belt mode the condition of the material to be dried is characterized by the $P_r(t)$ time scale.

In the case of stationary materials the oscillation of $P_r(t)$ is of high period time, and this feature is due to discrete changes in the moisture content and the temperature. (Fig. 2)

In the case of running-belt mode the oscillations feature of the measured $P_r(t)$ times scale is independent of the mechanical vibration of the material to be dried. It is influenced by the mass power of the moving dielectric material. The loss in moisture content is the same as in the case og drying with a stationary belt, but it occurs at a much lower output temperature. (Fig. 3)

The microwave field shows not only a thermic effect but a non-thermic effect (i.e. radiation pressure), as well. In the case of running material the moisture loss is the same as in the case of stationary-belt drying, due to the increasing radiation pressure. (Fig. 4)

In the case of vertical polarization applied in the present dryer the radiation pressure depends on the Θ_B Brewster-angle, ρ-density and ε dielectric coefficient.

For the determination of p_s-radiation pressure at vertical polarization the following equation has been set up:

$$p_s=E_i\cos^2\Theta_i(1+\Gamma)-E_i\cos\Theta_i\sqrt{\varepsilon_r-\sin^2\Theta_i}(1-\Gamma)$$

if $\Theta_i=\Theta_B$ then $\Gamma=0$

where $\Theta_B = ar \text{ ctg} \sqrt{\frac{\rho_t^2 - \varepsilon_t \rho_t^2}{\rho_t^2(\varepsilon_t - 1)}}$ -Brewster-angle, ρ_t is the density of the material to be dried, ε_t is the dielectric constant of the material, Γ is the eflexion coefficient, and E_i is the electric force of the input wave.

The material has been irradiated at the Brewster-angle determined using the above equation.

The advantages of drying with running mode have been established as follows:

- Drying is easier to measure and the process can be automatized,
- It is a suitable technology for drying heat-sensitive materials, and
- It is energy-saving. (Fig. 5)

The output temperature is practically constant in running-mode drying, and it is enough to measure only the parameters of the moisture content in order to regulate drying. Concering the above different practicable regulation principles are known.

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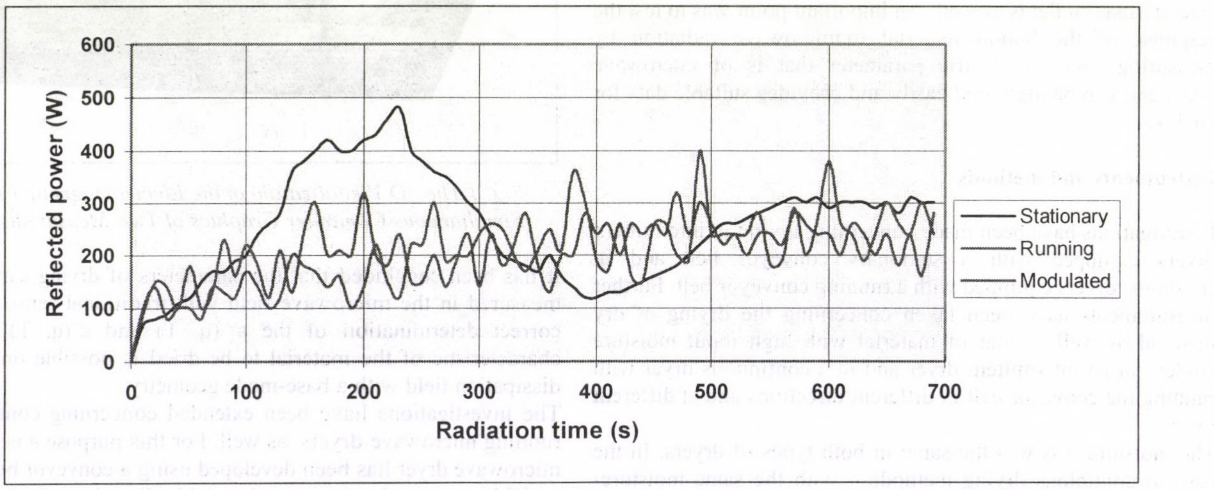

Fig. 2 Radiation of stationary and running belts

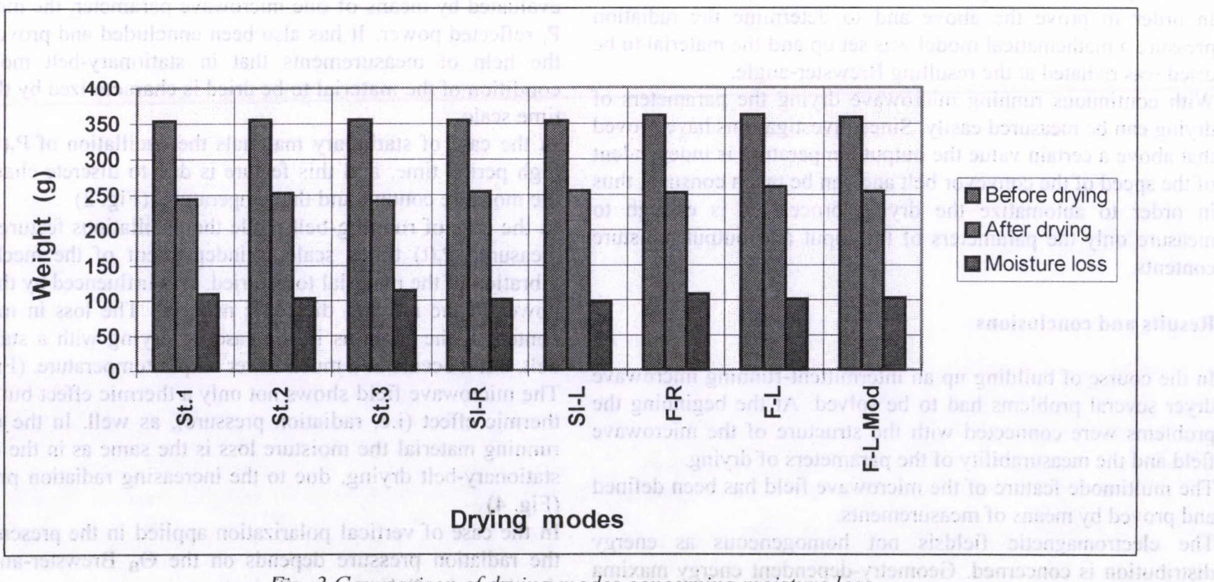

Fig. 3 Camparison of drying modes concerning moisture loss

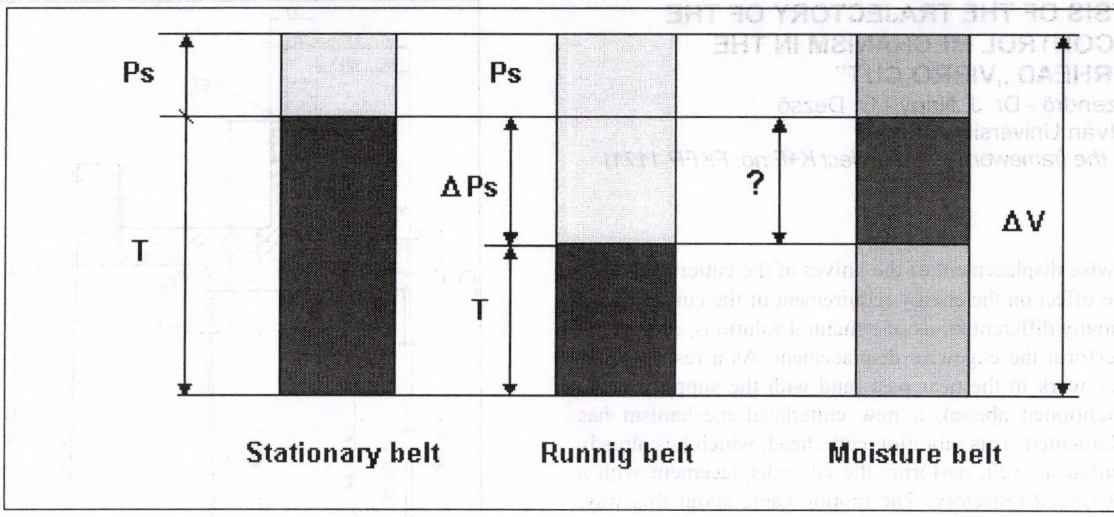

Fig. 4 Graphic analysis of the existance radiation pressure

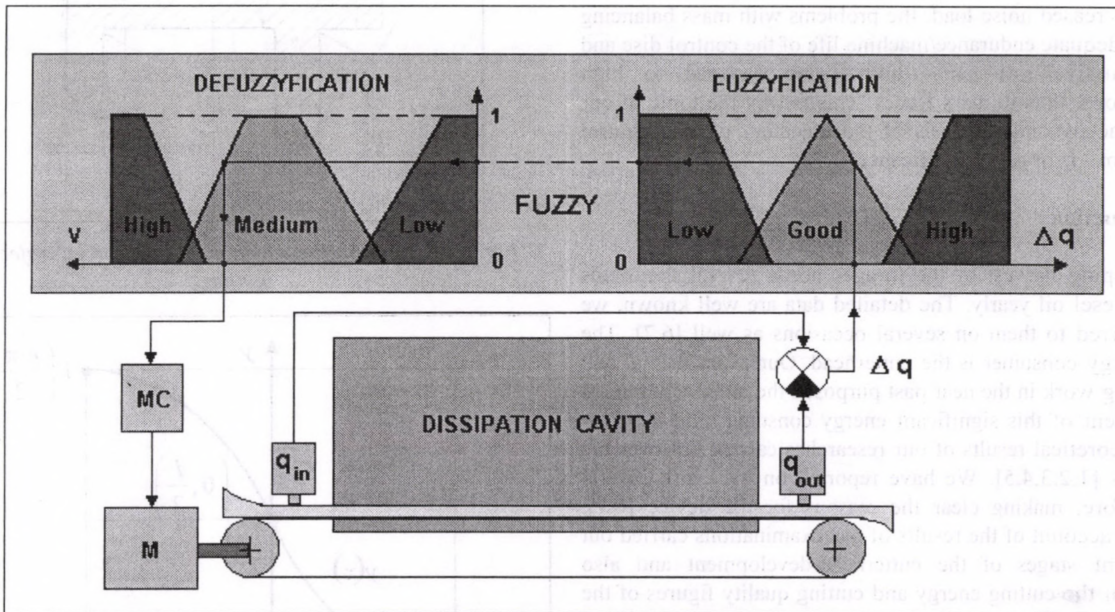

Fig. 5 Regulation of belt speed with Fuzzy control

ANALYSIS OF THE TRAJECTORY OF THE KNIFE CONTROL MECHANISM IN THE CUTTERHEAD „VIBRO CUT"

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(Made in the framework of the project K+F no. FKFP 1171)

Abstract

The edgewise displacement of the knives of the cutterhead has a favourable effect on the energy requirement of the cut. We have patented many different kinds of structural solutions, each being able to perform the edgewise displacement. As a result of our developing work in the near past (and with the support of the project mentioned above), a new cutterhead mechanism has been implemented. This vibration cutterhead, which has already been patented as well, performs the edge displacement with a control of forced trajectory. The motion came about this way, raises several technical questions. The solutions of these questions are decisive regarding the devices which run smoothly and properly, and which are easily carried out. This includes for eg. the increased noise load, the problems with mass balancing and the adequate endurance/machine life of the control disc and the percussive roll pairs- both being exposed to high accelerations, thus to mass forces. This is why the topic of our study - the dynamic analysis of the trajectory of the control mechanism - is of great significance.

1. Intruduction

The chopping harvest of the forages needs several thousands tons of diesel oil yearly. The detailed data are well known, we have referred to them on several occasions as well [6,7]. The main energy consumer is the cutterhead. Our experimental and developing work in the near past purposed the more economical development of this significant energy consumer and it builds on the theoretical results of our researches carried out over the past years [1,2,3,4,5]. We have reported on our work several times before, making clear the reasons for the device [6,7], giving an account of the results of our examinations carried out at different stages of the cutterhead-development and also relating on the cutting energy and cutting quality figures of the new unit used in the maize silage production [7].

In this particular work we would like to go into the issue of the control mechanism of the novel type vibration cutterhead called ***„VIBRO CUT"***. We will introduce the control disc (Fig 1.), which is the „key component" of the control mechanism and is fitted on to the plate of the chopping unit's house. The disk-like part of this device ensures the trajectory while leaving the plane. The rolls which move the knife run along this curve. As our main task we have pointed out the dynamic test of the trajectory.

With regard to the trajectory inducing a significant quantity of oscillating motion, the forced trajectory capable of moving the chopping knife edgewise was designed in a way that the values should remain on an acceptable level even at the places of the directional changes- where the accelerations are the highest. Consequently, our aim is the determination of such a trajectory function which satisfies this condition and can be assembled with the manufacturer tools at our disposal.

2. Determination of the dynamic condition

The problem drawn up the aim describes a forced movement. Using the symbols of Fig 2: we direct the axis x in the direction of the peripheral velocity, while the axis y is pointing to the direction of the controlled displacement.

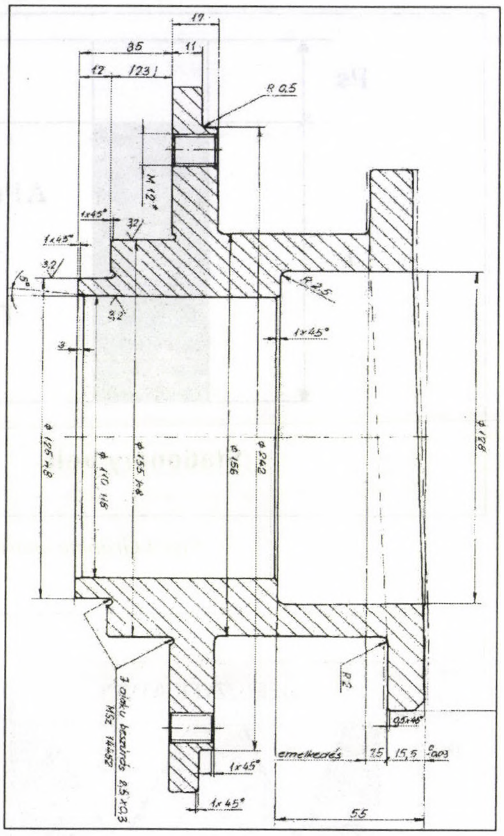

Fig. 1 The control disc which makes the forced-trajectory motion

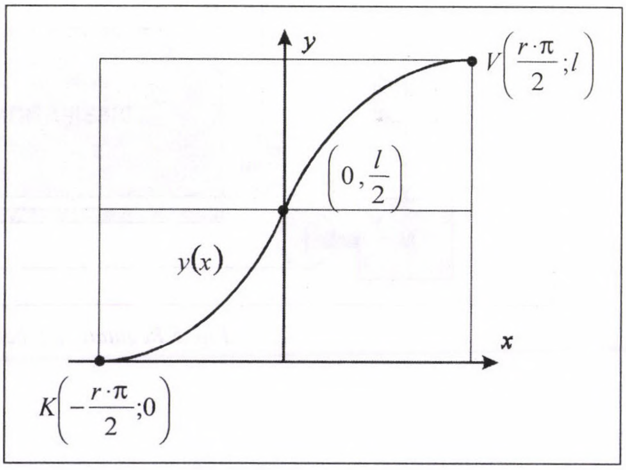

Fig. 2 The trajectory of the body making the forced motion

In this system of co ordinates the body to be moved travels along a prescribed y(x) curve while the velocity v_x is constant (which is the peripheral speed) whereas the motion in the y direction is as „smooth" as possible in terms of dynamics. This means that the acceleration values at the directional changes should stay on the lowest level.

The body moves from the starting point $K\left(-\frac{r\cdot\pi}{2},0\right)$ to the end point $V\left(\frac{r\cdot\pi}{2},l\right)$ (here we have supposed that the displacement in the y direction is covered in a rotation of 180^0, thus the time of this motion is $\frac{T}{2}$).

The motion in the x direction is:

$$x(t)=v_x\cdot t,$$

since $v_x(t) = r \cdot \omega = \frac{dx}{dt} = \acute{a}ll.$, and

$$\frac{dv_x}{dt} = \frac{d^2 x}{dt^2} = 0 \cdot$$

From now on the time domain is as follows: we assume that at the moment of $t = -\frac{T}{4}$ the body should be in point K and at the moment of $t = -\frac{T}{4} + \frac{T}{2} = \frac{T}{4}$ it is in point V. Therefore, it is valid that $-\frac{T}{4} \le t \le \frac{T}{4} \cdot$

For the motion in the y direction we obtain:

$$\dot{y}(t) = \frac{dy}{dt} = \frac{dy(x)}{dx} \cdot \frac{dx}{dt} = y'(x) \cdot v_x, \text{ and}$$

$$\ddot{y}(t) = \frac{d^2 y}{dt^2} = \frac{d[y'(x) \cdot v_x]}{dt} = \frac{dy'(x)}{dx} \cdot \frac{dx}{dt} \cdot v_x + y'(x) \cdot \frac{dv_x}{dt} = y''(x) \cdot v_x^2 \cdot$$

It is apparent that the characteristic parameters for the motion in the y direction depend only on the derivatives of the y(x) trajectory, since v_x is remains constant. The fundamental question is what we mean by „smooth" motion in terms of dynamics.

We can formulate it hypothetically: we have to achieve that the masses moved controlled should mean a minimum load for the joint pieces when changing directions. This can be accomplished if we shift the acceleration maximums from the places of the directional changes.

Furthermore, we assure that the body should not receive any impulse while being in motion, in other words, no discontinuity (jump) may appear along the $\ddot{y}(t)$ graph of acceleration versus time.

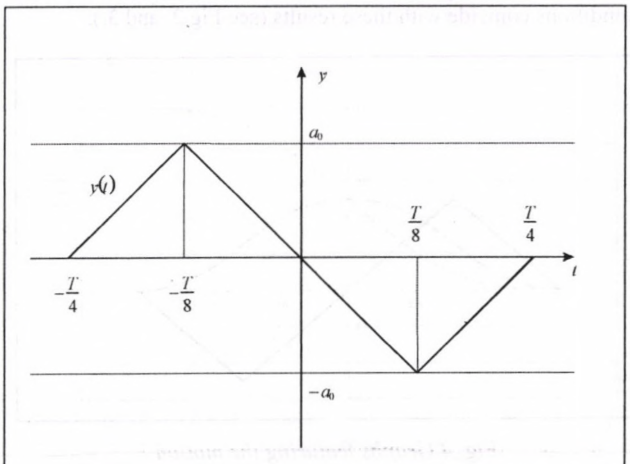

Fig. 3 The graph of acceleration versus time

Using this assumption:

$$\ddot{y}(t) = \begin{cases} \ddot{y}_1(t) = \frac{8 \cdot a_0}{T} \cdot t + 2 \cdot a_0 \text{ ,if} & -\frac{T}{4} \le t \le -\frac{T}{8} \\ \ddot{y}_2(t) = -\frac{8 \cdot a_0}{T} \cdot t \text{ ,if} & -\frac{T}{8} \le t \le \frac{T}{8} \\ \ddot{y}_3(t) = \frac{8 \cdot a_0}{T} \cdot t - 2 \cdot \text{ ,if} & \frac{T}{8} \le t \le \frac{T}{4} \end{cases}$$

From these initial and final conditions and from the continuity requirements of $\dot{y}(t)$ and y(t) the unknown y(t) and y(x) curves can be determined.

3. Calculation of the trajectory's equation

$$\dot{y}_1(t) = \int \ddot{y}_1(t) dt = \frac{4 \cdot a_0}{T} t^2 + 2 \cdot a_0 \cdot t + A_1 \cdot$$

The value A_1 can be determined from the initial condition of $\dot{y}_1\left(t = -\frac{T}{4}\right) = 0$ (at the moment of the directional change the velocity in the y direction is zero):

$$A_1 = \frac{a_0 \cdot T}{4} \cdot$$

Thus:

$$\dot{y}_1(t) = \frac{4 \cdot a_0}{T} t^2 + 2 \cdot a_0 \cdot t + \frac{a_0 \cdot T}{4},$$

$$y_1(t) = \int \dot{y}_1(t) dt = \frac{4 \cdot a_0}{3 \cdot T} \cdot t^3 + a_0 \cdot t^2 + \frac{a_0 \cdot T}{4} \cdot t + B_1 \cdot$$

We obtain the value B_1 from the initial condition of $y_1\left(t = -\frac{T}{4}\right) = 0$ (at the place of the directional change the deviation is zero).

$$B_1 = \frac{a_0 \cdot T^2}{48} \cdot$$

Therefore:

$$y_1(t) = \frac{4 \cdot a_0}{3 \cdot T} \cdot t^3 + a_0 \cdot t^2 + \frac{a_0 \cdot T}{4} \cdot t + \frac{a_0 \cdot T^2}{48} \cdot \qquad (*)$$

Furthermore,

$$\dot{y}_2(t) = \int \ddot{y}_2(t) dt = -\frac{4 \cdot a_0}{T} t^2 + A_2 \cdot$$

We will obtain the value of A_2 from the continuity assumption

$$\dot{y}_1\left(t = -\frac{T}{8}\right) = \dot{y}_2\left(t = -\frac{T}{8}\right).$$

$$A_2 = \frac{a_0 \cdot T}{8} \cdot$$

Thus:

$$\dot{y}_2(t) = -\frac{4 \cdot a_0}{T} t^2 + \frac{a_0 \cdot T}{8},$$

substituting this:

$$y_2(t) = \int \dot{y}_2(t) dt = -\frac{4 \cdot a_0}{3 \cdot T} \cdot t^3 + \frac{a_0 \cdot T}{8} \cdot t + B_2 \cdot$$

The value of B_2 can be obtained from the continuity assumption

$$y_1\left(t = -\frac{T}{8}\right) = y_2\left(t = -\frac{T}{8}\right).$$

$$B_2 = \frac{a_0 \cdot T^2}{64}$$

In this way:

$$y_2(t) = -\frac{4 \cdot a_0}{3 \cdot T} \cdot t^3 + \frac{a_0 \cdot T}{8} \cdot t + \frac{a_0 \cdot T^2}{64}$$

(**)

Similarly:

$$\dot{y}_3(t) = \int \ddot{y}_3(t) dt = \frac{4 \cdot a_0}{T} t^2 - 2 \cdot a_0 \cdot t + A_3$$

Value A_3 from the continuity assumption

$\dot{y}_2\left(t = \frac{T}{8}\right) = \dot{y}_3\left(t = \frac{T}{8}\right)$ is as follows:

$$A_3 = \frac{a_0 \cdot T}{4}.$$

Thus:

$$\dot{y}_3(t) = \frac{4 \cdot a_0}{T} t^2 - 2 \cdot a_0 \cdot t + \frac{a_0 \cdot T}{4},$$

On the other hand:

$$y_3(t) = \int \dot{y}_3(t) dt = \frac{4 \cdot a_0}{3 \cdot T} \cdot t^3 - a_0 \cdot t^2 + \frac{a_0 \cdot T}{4} \cdot t + B_3$$

We can obtain value B_3 from the continuity assumption

$$y_2\left(t = \frac{T}{8}\right) = y_3\left(t = \frac{T}{8}\right).$$

$$B_3 = \frac{a_0 \cdot T^2}{96}.$$

Thereby:

$$y_3(t) = \frac{4 \cdot a_0}{3 \cdot T} \cdot t^3 - a_0 \cdot t^2 + \frac{a_0 \cdot T}{4} \cdot t + \frac{a_0 \cdot T^2}{96}. \qquad (***)$$

We also have to calculate the parameter a_0 which can be determined either from the assumption $y_3\left(t = \frac{T}{4}\right) = l$ or from the assumption $y_2(t = 0) = \frac{l}{2}$ and as a result we obtain that:

$a_0 = \frac{32 \cdot l}{T^2}$, where l is the maximum displacement of the chopping knife in the y direction (Fig 2.)

The curve obtained this way according to (*), (**) and (***) is the following:

$$y(t) = \begin{cases} y_1(t) = \frac{128 \cdot l}{3 \cdot T^3} \cdot t^3 + \frac{32 \cdot l}{T^2} \cdot t^2 + \frac{8 \cdot l}{T} \cdot t + \frac{2 \cdot l}{3} & ,ha \quad -\frac{T}{4} \le t \le -\frac{T}{8} \\ y_2(t) = -\frac{128 \cdot l}{3 \cdot T^3} \cdot t^3 + \frac{4 \cdot l}{T} \cdot t + \frac{l}{2} & ,ha \quad -\frac{T}{8} \le t \le \frac{T}{8} \\ y_3(t) = \frac{128 \cdot l}{3 \cdot T^3} \cdot t^3 - \frac{32 \cdot l}{T^2} \cdot t^2 + \frac{8 \cdot l}{T} \cdot t - \frac{l}{3} & ,ha \quad \frac{T}{8} \le t \le \frac{T}{4} \end{cases}$$

We can get the equation of curve $y(x)$ by using:

$$x(t) = v_x \cdot t = r \cdot \omega \cdot t$$

and writing back

$t = \frac{x}{r \cdot \omega} = \frac{x \cdot T}{2 \cdot \pi \cdot r}$ to $y(t)$.

The equations of the acceleration curve after substituting the above value of a_0 are as follows:

$$\ddot{y}(t) = \begin{cases} \ddot{y}_1(t) = \frac{256 \cdot l}{T^3} \cdot t + \frac{64 \cdot l}{T^2} \\ \ddot{y}_2(t) = -\frac{256 \cdot l}{T^3} \cdot t \\ \ddot{y}_3(t) = \frac{256 \cdot l}{T^3} \cdot t - \frac{64 \cdot l}{T^2} \end{cases}$$

The equations of the velocity curve are:

$$\dot{y}(t) = \begin{cases} \dot{y}_1(t) = \frac{128 \cdot l}{T^3} \cdot t^2 + \frac{64 \cdot l}{T^2} \cdot t + \frac{8 \cdot l}{T} \\ \dot{y}_2(t) = -\frac{128 \cdot l}{T^3} \cdot t^2 + \frac{4 \cdot l}{T} \\ \dot{y}_3(t) = \frac{128 \cdot l}{T^3} \cdot t^2 - \frac{64 \cdot l}{T^2} \cdot t + \frac{8 \cdot l}{T} \end{cases}$$

On Fig 4. we represent the halves of the curves (the other halves can be obtained by reflection). It can be seen that the initial conditions coincide with these results (see Fig 2. and 3.).

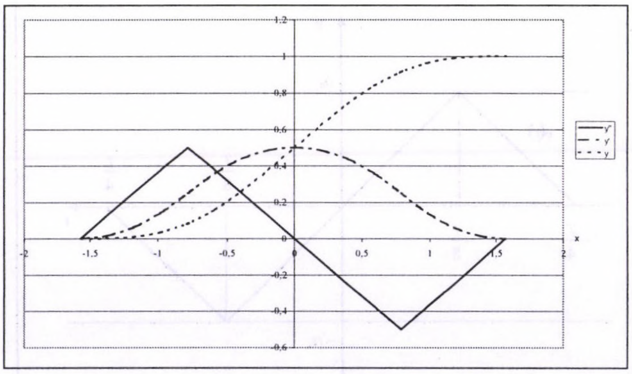

Fig. 4 Graphs featuring the motion

Consequently, in the case if we shape the trajectory bringing about the edgewise motion of the knife according to the relationships determined above, we can expect the realisation of a dynamically „smooth" control of the cutter head -appropriate to our aims.

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EFFECTS OF ADDITIVES ON THE QUALITY OF SILAGE BALES

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Summary

In the frame of the project entitled **"Effects of additives on the quality of silage bales"** we have made roll bales of sliced and traditional length of coarse by means of two technologies at Erdőhát and Lászlópusztai of the MARTONSEED Rt. Latest bales were handled by additive. Bales, made by NEW HOLLAND 544 CROPCUTTER and by PÖTTINGER ROLLPROFI 3500 type balers, were wrapped by an universal, automotive bale wrapper machine that was suitable to use on middle and large-scale farms. Using up of the examination results of the SZIE-MKK Takarmányozási Tanszék and the OMMI we have stated the followings. Owing to the required compound of the volatile fatty acid and the general composition as well as the favourable microbiological state, feeding value can be preserved still in case of longer storage.

Introduction

The Hungarian Institute of Agricultural Engineering (FVMMI) has dealt with the preservation as silage of alfalfa and grass with lower dry matter content for years.
Harvesting technologies, harvesters, balers and wrapping units serving the minimization of losses caused by weather on land are also testing continuously. We have stated that harvesting and preservation of fodder can be solved by up-to-date machines mainly Western European of origin. These machines are balers with constant bale chamber, balers with slicer unit, wrapping machines, etc. On the other hand preservation problems of the hardly preservable alfalfa have reminded us the necessity of application of additives that help fermentation in order to gain a silage of stable and good quality. Taking into consideration the above mentioned facts we have elaborated such kind of harvesting and preservation process that was based on large-scale method to apply additives to assist and control the fermentation process, prevented the multiplication of harmful microorganisms in order to have silage of good quality that could be stored stably and for long time.
Our further aim was to select and use such type of bale wrapper that has a key role in the preservation and storage and that satisfies the requirement both the middle-scale and large agricultural enterprises as for capacity, work quality and economic aspects.

Material and method

Bales made with and without additive from second cuttings, pre-withered to 42-46 % and 38-39 % DM content alfalfa were wrapped. One part of the alfalfa had the length of natural while other part of the plant was sliced. Applied types of balers were NEW HOLLAND 544 CROPCUTTER and PÖTTINGER ROLLPROFI 3500. The KOMBI PACK bale wrapper was manufactured by the Dutch POMI Aps.
The SIL-ALL marked additive of the ALLTECH HUNGARY Ltd was dispensed by the JOHN DEERE 6110 type tractor mounted SPRAY-FOIN sprayer in 0.2 % concentration. Bales were wrapped in by a special wrapper machine with three of foil rolls. Size of foil was 750 mm of width and 0.03 mm of thickness. The self-propelled wrapper was operated by a loader of ZETTELMEYER ZL-802 type. The NEW HOLLAND 544 type baler made ∅ 1,500 x W 1,200 size of bales. In one part of bales were made from original length of plant while other part of them from sliced by 15 knives. Some bales were handled with additive others were not.
Winding number of wrapping was 10 and 12.
From the ready bales so called bale sausages were made. The first bale sausage contained 10 pcs of sliced and 10 pcs of unsliced bales of fodder without additive. Type of baler was NEW HOLLAND in this case.
The second bale sausage contained 2 x 5 bales from original length of plant. Five of them were handled with additive. Type of the baler was PÖTTINGER.
Test of the technology of bale wrapping was based on FVMMI Institute Standard No MÉMMISZ 00-00-03-87.
In the frame of the Standard work and time elements and capacity and time utilization factors were determined. Detailed parameters related to the different bale results of examinations capacity and energetic characteristics of the work elements were measured. Following these specific characteristics were also calculated. For laboratory analysis samples from the pre-withered windrows and from bale sausages during storage had been taken. Laboratory examinations as for changes of internal content and microbiological state were carried out by GATE Központi Laboratórium and the OMMI Központi Laboratórium.

Results

Testing the **wrapping capacity** we have stated that the measured characteristics were considerable less when we wrapped original length and sliced of alfalfa at 10 and 12 winding number and at ∅ 1,200 x W 1,200 mm bale measure and 322.3 kg m^{-3} volumetric mass than in the case of ∅ 1,500 x W 1,200 mm bale measure where bales consisted of original length of coarse, with and without additive and 441.6 kg m^{-3} volumetric mass.
Applying the NEW HOLLAND technology we wrapped bales of original length of coarse at 12 winding number with 19 t h^{-1} capacity.
Capacity of the PÖTTINGER technology at 10 and 12 winding number as for original length of plant, with and without additive was 46.1 and 33.5 t h^{-1}.
Energetic characteristics of bale wrapping were basically determined by duration and revolution of winding and the mass of the bales.
Owing to the 1-2 % differences as for the mass of bales there was not meaningful deviation in the capacities neither at original length nor sliced alfalfa. The NEW HOLLAND technology was characterizable with a fuel consumption of 0.08-0.1 kg t^{-1} and with 3.3-4.4 MJ t^{-1} specific energy demand at 10 and 12 winding revolutions. Against it in the case of PÖTTINGER technology where the volumetric mass of bales was higher by about 37 % than in the first technology characteristics were favourable. Fuel consumption was 0.05-0.07 kg t^{-1} while the specific energy demand was 2.1-3.0 MJ t^{-1}. Owing to it specific characteristics concerning the unit of mass showed more favourable parameters of 30-35 % when bales of higher volumetric mass were wrapped.
Running or operating characteristics of bale wrapping were influenced by the basic and additional duration of time. Productive capacity of 11.2-11.5 th^{-1} at the NEW HOLLAND bales with 10 and 12 revolutions dropped back by 45-60 % as for the characteristics concerning the basic time. This tendency was higher in the case of the PÖTTINGER technology where at 10 revolution decreasing of the capacity was more than 60 %. According to our calculations better results could be reached at NEW HOLLAND bales at 12 revolution [$K_{01}(12) = 0.6$ and $K_{01}(10) = 0.46$].
As for foil consumption it was stated that owing to the larger size of bales higher volumetric values were given at the PÖTTINGER bales [$L_{(10)}$ = 145.1 m and $L_{(12)}$ = 174.1 m]. Naturally these results could be reached by using less than 60 %

of original length of foil due to pre-stretching. Against it concerning the specific characteristics per mass unit we could observed more favourable values [$L_{(10)} = 0.09$ mkg^{-1} and $L_{(12)} = 0.11$ mkg^{-1}] at PÖTTINGER bales.

Examining changes of temperature there were not harmful warming up neither during fermentation nor following it. Temperature of alfalfa silage bales did not overrun the ambient temperature by +10 °C in the case of extreme weather conditions yet. On the basis of the examination results of internal content and microbiological state it could be stated that there was required to use additive in order to get a stable silage though the technology and its machines were suitable. Reasons of it were the changing dry matter content, low level of fermentable carbohydrate content, risks of weather etc.

Higher density could be reached at original length of coarse or fodder too if fermentation process was controlled by additive (pH = 4.36). In this case the most important characteristics of internal content such as raw protein, fibre, fat and carotine would not decrease by more than 10-15 %. Owing to the suitable rate of lactic-acetic and butyric acid (85 % - 15 % - < 0.3 %) and the sufficient energy content (NEm = NEg > 0.5 MJ g^{-1} and NE_l >3.0 MJ kg^{-1}) stability of the fodder was good and the nutritive value could be saved. Results of the microbiological examinations also backed it up because harmful conditions could not be observed. Due to the basically steril raw material, the well realized baling and handling technology, the wrapping that ensures perfect anaerob conditions both the value of total number of germ (<10^4 dbg^{-1}) and the number of mould (<10^2 dbg^{-1}) were on low level.

Evaluation of the results

In the frame of the project entitled **"Effects of additive on the quality of silage bales"** we have produced bales by two kind of technologies in different size and construction. Some of bales were handled by additive.

Bales were made from second cuttings, pre-withered to 42-46 % and 38-3% DM content of alfalfa. One part of the alfalfa had the length of natural while other part of the plant was sliced. Applied types of balers were NEW HOLLAND 544 CROPCUTTER and PÖTTINGER ROLLPROFI 3500. The KOMBI PACK bale wrapper was manufactured by the DUTCH POMI Aps. Measures of the NEW HOLLAND bales were Ø 1,200 x W 1,200 mm while of the PÖTTINGER ones Ø 1,500 x W 1,200 mm.

On the ocassion of examination of the wrapping capacity we have stated that at 10 and 12 value of revolution we could calculate smaller value (19.0 and 24.6 th^{-1}) concerning one bale and basic time, at the bale volumetric mass of 322.2 kgm^{-3}. Higher capacity values were resulted in the case of PÖTTINGER bales. At 441.6 kgm^{-3} volumetric mass the baling capacity varied between 33.5–46.1 th^{-1}. Higher mass of bales made better energy consumption too. For example energy consumption of NEW HOLLAND balers was 3.3-4.4 MJ t^{-1} while of the PÖTTINGER balers was 2.1-3.0 MJ t^{-1}.

The SIL-ALL marked additive of the ALLTECH HUNGARY Ltd was dispensed by the JOHN DEERE 6110 type tractor mounted SPRAY-FOIN sprayer in 0.2 % and 10 gt^{-1} concentration.

Analysis of the running parameters showed clearly that the balers were made for middle and large-scale farms. Their operations are on optimal level only if the service is suitable, bales are large sized round and angled one etc. This conclusion is supported by the productive time utilization factors that are under 0.6 in any case and the productive capacities among which no one reached the 20 t h^{-1} value. Due to the foil width of 750 mm and thickness of 30 µm as well as three-step windings even the higher lapping indices resulted a more favourable specific wrapping material consumption [$Lp_{(10)} = 0.09$ m kg^{-1} and $Lp_{(12)} = 0.11$ m kg$_{-1}$]. These values, due to the pre-stretching can be improved by 60 %.

Examinations of the internal contents showed clearly that in the case of non suitable chemical parameters of the raw material as well as the unfavourable weather conditions and the changing dry matter content, efficiency of silage making was negatively influenced against the suitable technology and machines. In the case if starting of fermentation and controlling of the process is ensured by additive value of the perfectly fermented fodder can be saved for a long time.

Preserving of the nutrient content as well as the steril microbiological state can be ensured by wrapping.

PREVENTION OF THE DAMAGES IN SOIL TILLAGE BY THE QUALITY ASSURANCE METHODS

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Abstract

The importance of soil and environment conservation and their maintenance will be required improving the quality assurance and spreading the view of quality management connected with soil and environment conservation policy in EC. Soil conservation and energy save tillage are the most important factors of the tillage systems in a sustainable agriculture. The quality assurance gives for both factors an appropriate background, qualifying and controlling aspects and make possibilities surveying the probable risks, preventing tillage damages, recognizing the faults in time and decreasing the costs of the faults.

Quality management in soil tillage can be become a continuous activity, aiming higher process effectiveness and efficiency. The quality assurance system of soil tillage can be divided into 8 stages, such as: 1. Principles and strategy. 2. Technology variants listing. 3. Decision in suitability of technologies. 4. Specification and quality planning. 5. Quality control of processes. 6. Fault diagnosis and corrections. 7. Evaluation of results and quality costs. 8. Documentation and perfection.

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Introduction

The technical studies of the quality requirements in soil tillage have been numerous, since the beginning, but at the same time there are not concrete experiences in the quality assurance use [1]. The importance of soil and environment conservation and their maintenance will be required improving the quality assurance and spreading the view of quality management connected with soil and environment conservation policy in EC [2]. Soil conservation and energy save tillage are the most important factors of the tillage systems in a sustainable agriculture. The quality assurance gives for both factors an appropriate background, qualifying and controlling aspects and make possibilities surveying the probable risks, preventing tillage damages, recognizing the faults in time and decreasing the costs of the faults [3].

Quality assurance can be harmonised with ambitions of sustainable management, which are induced land owners and farmers using environment conservation methods preventing the tillage damages, improving the unfavourable soil state and maintaining the soil culture condition [2,3,4,5].

Tasks

The objective of this paper is to briefly outline the important methods and steps of the quality assurance and to illustrate the adoption in the improvement of soil tillage processes and systems. The use of the quality assurance methods offering the prevention possibilities of the soil tillage damages, which can be endangered the quality of soils and the environment.

Fundamental definitions

The *quality* can be defined as the executing performs the planning. The *quality assurance* corresponds to the planned and the documented actions in quality management system focusing attention on satisfying the needs of customers, demonstrating that the organization performs the quality requirement. The *process* as a set of interrelated resources and regulated activities, which transforms inputs into outputs. Soil tillage in the quality assurance respect can be seen as a process, and is to evaluated by the view of the process-centering.

Results

The quality assurance system, from the planning to the documentation, is divided into eight main stages (Figure 1).

The theoretical and the practical steps of quality assurance in soil tillage are as follows.

1. Determining plans and objectives: Harmonization of the soil conservation with the demands of the crop to be grown. Plans contain the arable site factors and the environment conservation directives of EC, which are to adapt on national, regional and local situations (Fig.2).

2. Soil tillage variants planning regarding to the crop demand and different soil conditions. The quality-history documents of the site are to use for planning. Plans contain the possible tillage variants according to production technology and economical conditions.

3. Decision in tillage variants and selection the most suitable to the given soil and economical conditions. Risk assessment and analysis. Risk as a frequency occurrence of the fault. There are risk assessment methods such as team-activity, 5M, and FMEA analysis to evaluate the possible risks impacts. The most important risk factors in soil tillage are as follows: moisture content (very high or low), soil compaction (Fig. 3), stubble residues (mass, length, shattering), and suitability of tractors and tools.

4. Determination of the quality specifications on soil tillage processes. Planning of the quality control in tillage processes. Basic data and measuring results are to use to the planning of the quality. Determining the critical specifications regarding the actual demand of the crops (e.g. tillage depth, seed-bed quality, stubble residues on the surface).

5. Determination of the quality capability of the tillage processes. Decisions for the quality improvement. An evaluation of the quality capability of the tillage process (e.g. ploughing, loosening, disking) on given soil condition (e.g. dry, humid, wet, compacted, loosened) helps to determine which process fulfils the specifications. Tillage processes can be controlled by measuring in number and by this means can be ordered.

6. Analysis of soil damages caused by tillage processes. Fault corrections. Damage in soil tillage is a factor vitiating the quality capability of the process. Damages have unfavourable impact on the next process quality, on the crop production efficiency and on the soil condition. In the quality assurance system there are 7 traditional and 7 modern methods, which can be applied in soil tillage for the fault analysis and corrections as well.

7. Evaluation of direct and indirect results of the applied tillage system. Analysis of the quality costs. Evaluations are resulted the decrease in tillage damages and fault correction costs. The quality costs are contained the prevention costs, fault diagnosis and fault damage costs.

8. Documentation of the tillage experiences, promoting the next planning. The evaluation results of soil tillage impact on crop production and on the environment protection are needed documentation and announcement (Fig. 4). **Estimation of the satisfaction of the customers** is needed. **Steps to the tillage perfection are also necessary.**

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Principles of the quality assurance ↓		**Stages of the quality assurance in soil tillage** ↓
1. **Preliminary** determination of **principles and strategy** ↓	→ ←	1. **Determining plans and objectives**: Harmonization of the soil conservation with the demands of the crop to be grown ↓
2. Technology variants **planning** on different conditions ↓	→ ←	2. **Soil tillage variants planning** regarding to the crop demand and different soil conditions ↓
3. **Decisions** in technology variants and processes. **Risks assessment** ↓	→ ←	3. **Decision** in tillage variants and **selection** the most suitable to the given soil and economical conditions. **Risk assessment** and analysis ↓
4. **Specification**. Planning the quality and the quality control ↓	→ ←	4. **Determination of the quality specifications** on soil tillage processes. Planning of the quality control in tillage processes ↓
5. Determination of the **quality control** of the processes ↓	→ ←	5. **Determination of the quality capability of the tillage processes**. Decisions for the quality improvement ↓
6. **Fault diagnosis** and corrections ↓	→ ←	6. Analysis of soil damages caused by tillage processes. **Fault corrections** ↓
7. **Evaluation** of the results and the quality costs ↓	→ ←	7. **Evaluation of direct and indirect results** of the applied tillage system. Analysis of the quality costs ↓
8. **Documentation**, announcement, estimation of the customer's satisfaction, and **perfection steps**	→ ←	8. **Documentation** and announcement of the tillage experiences, promoting the next planning. **Evaluation** of soil tillage impact on crop production and on environment protection. Steps to the **tillage perfection**

Fig. 1 Scheme of the quality assurance improving the soil tillage quality

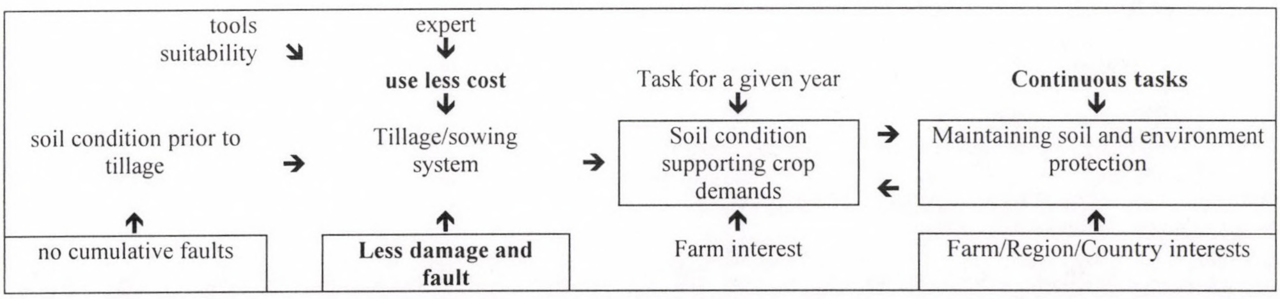

Fig. 2 Objectives of soil tillage for a long term

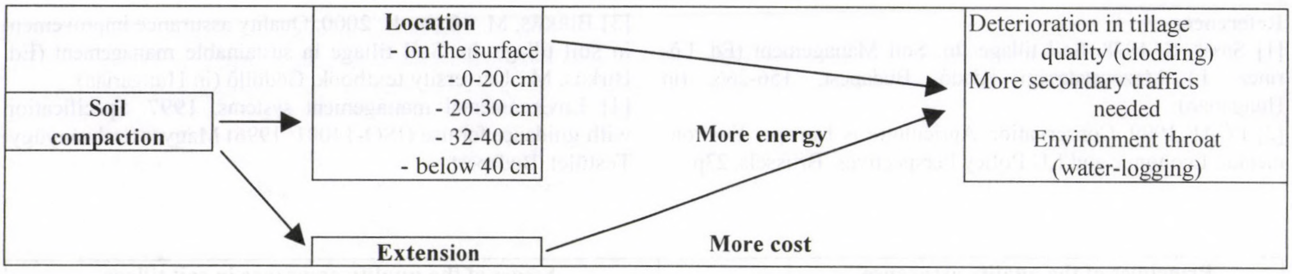

Fig. 3 Reviewing the soil compaction risk

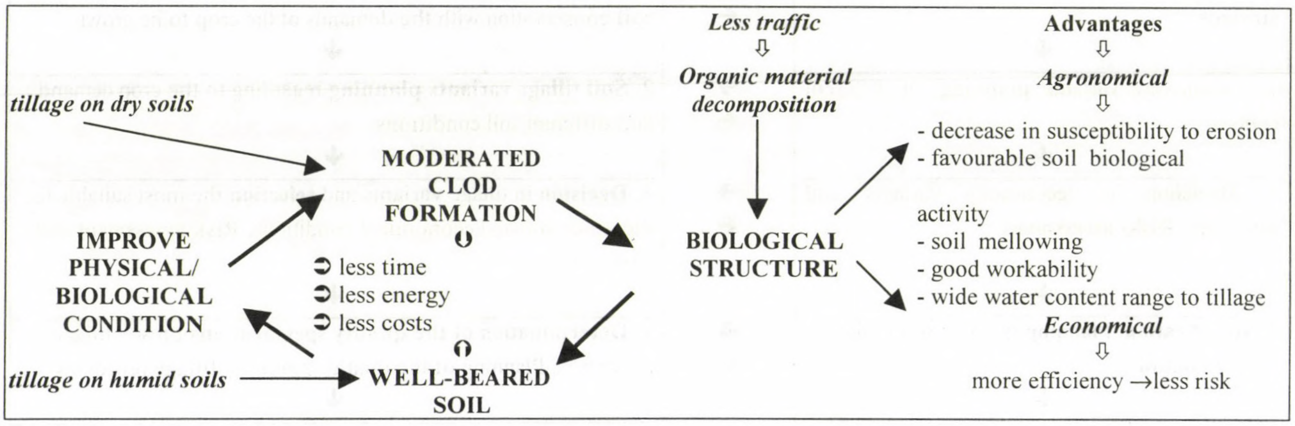

Fig. 4 Results of the tillage perfection

EVALUATION OF FRUIT FIRMNESS

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The objective of the paper reported herein was to determine correlation of the relationship found between the coefficient of elasticity and the rupture stress and between the acoustic stiffness coefficient and the rupture stress for apples, pears, peaches and apricots of different ripeness. Furthermore the purpose was to develop a system for fruit firmness evaluation from firmness characteristics measured by nondestructive methods.

Relationship was determined between the coefficient of elasticity and the rupture stress and a system was developed for the evaluation of the firmness. This system provides with the ranges of the rupture stress and the coefficient of elasticity for two different ripeness ranges of the tested fruits.

The firmness ranges were determined for the ripeness "suitable for picking/harvesting" and for the ripeness "suitable for eating" for different cultivars of apples, pears, peaches and apricots. The firmness was expressed by the rupture stress and by the coefficient of elasticity.

The system can be used for the practical evaluation of fruits and the system can be developed for further fruits and vegetables as well.

1. Introduction

There is an increasing need for produces of a definite quality depending on the conditions. Therefore research has been focused on the development of rapid and nondestructive test methods. There are different up-to-date methods suitable for big and small fruits, hard and soft ones and so on. However there is not a generally accepted nondestructive method, or parameter to describe the firmness. Therefore the researchers have no choice, the only method and firmness parameter accepted is the Magness-Taylor test method and the Magness-Taylor firmness. This is the reason why the firmness parameters measured by the means of up-to-date methods are compared to the Magness-Taylor firmness, or rather the rupture stress of the fruit.

Firmness is of considerable importance for the consumer and for consumers' preferences. Therefore firmness has a considerable importance for determining the optimum harvest date, the evaluation of the maturity, the postharvest treatments, shelf life and so on.

Generally firmness is used for the evaluation of mechanical tests. It is the resistance of a material, when a probe penetrates into the specimen made of the material mentioned. Usually the firmness is characterised by the force and the deformation (or the stress and the strain). The conventional firmness test method is the compression test, with which the force-deformation relationship is measured by precision testing machine. Both the force and the deformation are measured with high precision. The force-deformation relationship provides with the rupture stress and strain, the yield stress and strain, the modulus of elasticity and with other characteristics. The result of the compression test can be shown by the compressive stress versus the deformation.

Lately efforts were focused on the development of new, simple and rapid compression methods, with special respect to nondestructive character. The majority of the simple and rapid methods use only a special part of the force-deformation curve determined by the precision compression method.

A definite advantage of the rapid tests is that such tests can be performed with portable and handheld penetrometers. Rapid and destructive method is the puncture test, where a hand held penetrometer is used to force a probe into the fruit and the maximum force, or rather the rupture force is measured during the penetration to characterise the fruit firmness. This rapid and simple compression method, the Magness-Taylor method (1925), is widely used for fruit firmness testing.

Rapid and nondestructive method and electronic penetrometer have been developed (Fekete, 1993) for the measurement of the compression force/stress with a preset and very small penetration depth. From the results of the test performed by this penetrometer the coefficient of elasticity can be calculated as the ratio of the compression stress to the penetration depth.

Systematic efforts have been made on the development of different vibration test methods. Such methods can be used to measure the textural quality of fruits. By the means of such a test the resonance is measured within the fruit in a definite range of the frequency. Abbott et al. (1968 and 1995), Finney (1971), Yamamoto et al. (1980), De Baerdemaeker (1988) and others developed such methods and instruments. The objective of the different resonance tests is to determine a characteristic that is called the stiffness factor, the stiffness coefficient, or firmness index. This characteristic is a function of the resonant frequency and the mass of the produce. This stiffness factor has been used to characterise the firmness of apples, watermelons, peaches, etc.

There are two relatively simple methods available for nondestructive firmness testing, as follows:

- nondestructive compression test, that is to determine the coefficient of elasticity, a characteristic of the firmness near to the surface of the produce
- and acoustic resonance test, that is to determine the stiffness coefficient, a characteristic of the inside texture of the fruit.

The above mentioned characteristics are to be compared to the Magness-Taylor firmness, the result of the destructive Magness-Taylor compression test, that measures the rupture stress, including the firmness from the surface towards the centre of the produce

Therefore there is a need for relationships between the nondestructive and destructive firmness characteristics, for the firmness, or rather the ripeness and/or immaturity of a definite fruit population.

2. Objective

The objective of the paper reported herein was to determine correlation of the relationship found between the coefficient of elasticity and the rupture stress and between the acoustic stiffness coefficient and the rupture stress for apples, pears, peaches and apricots of different ripeness. Furthermore the purpose was to determine correlation between the firmness characteristics measured by nondestructive and destructive methods.

3. Method and materials

The rupture stress was determined from the destructive Magness-Taylor tests. These ones were performed by a precision penetrometer. The probe used was the same as with the conventional Magness-Taylor tests, the diameter of the probe: 8 mm and the deformation was enough for determining the maximum stress. The compression stress was recorded during the penetration and the maximum value of the stress, that is the rupture stress was determined.

The destructive tests were performed by the means of a conventional precision compression tester (type SMS). This tester is able to ensure constant and preset penetration speed of the probe, since it is computer controlled. The compression stress was recorded as the function of the deformation. The firmness can be determined as the maximum value of the stress, that is the Magness-Taylor rupture stress.

Rapid and nondestructive firmness test method was used to measure the compressive force at a preset penetration depth, or deformation and to calculate the coefficient of elasticity that was introduced for this purpose. This coefficient is the ratio of the compressive stress to the penetration depth.
With the nondestructive compression test the coefficient of elasticity - kPa/mm - is calculated for a very small value of the deformation and it is expressed, as follows:

$$c_e = \sigma/z \qquad (1)$$

where: σ - compressive stress, kPa
z - penetration depth, or deformation of the produce, mm

The equipment used for the nondestructive tests to determine the coefficient of elasticity was an electronic penetrometer type MGA-1091 fitted with a microcomputer. The tests were performed as follows: the flat surface of the probe was slowly pressed the surface of the fruit and then into the fruit. The deformation is equal to the penetration depth of the probe that was set generally to 0,15 mm for the tests. The actual force is measured by the electronic system and the microcomputer calculates and displays the coefficient of elasticity. The tester was fitted with a probe of 6 mm diameter.
Another nondestructive firmness test method was used for the evaluation of the firmness, that is the acoustic resonance method. This was used to determine the acoustic stiffness coefficient of the produce. With the acoustic resonance test the produce to be tested was mounted on a support that was covered by ring shaped elastic material to damp the impact (Fekete and Felföldi, 1996). The impact was performed with a ball shaped wood head of a hammer. A microphone was placed under the produce to detect the hitting sound. The output signal of the microphone was amplified and transmitted to the PC to record and process the measured data. The frequency spectrum was calculated by fast Fourier transformation and the second resonance frequency was taken into account for the determination of the acoustic stiffness coefficient, that is as follows:

$$s = f^2 \cdot m \qquad (2)$$

where: f - frequency, s^{-1}
m - mass of the produce, kg

Tested fruits

Tests were performed with apples, pears, peaches and apricots of two different ripeness groups. The fruits taken from the immature group can be defined as "suitable for harvesting/picking" and ripe fruits are to be defined as "suitable for consumers".

4. Results and discussion

Efforts were made to determine the coefficient of elasticity and the acoustic stiffness factor in the function of the rupture stress because the latter one is an accepted firmness characteristic that is generally used. Furthermore the relationship between the coefficient and the acoustic stiffness factor were determined as well.
The results of the tests performed with apples show an acceptable close correlation between the coefficient of elasticity and the rupture stress (Fig. 1) and between the acoustic stiffness factor and the rupture stress (Fig. 2). The correlation between the coefficient of elasticity and the rupture stress was found to be poorer than between the acoustic stiffness coefficient and the rupture stress.

The results of the tests performed with pears show an acceptable close correlation between the coefficient of elasticity and the rupture stress (Fig. 3). However the correlation between the acoustic stiffness coefficient was found to be very poor. Therefore the coefficient of elasticity is suitable firmness characteristic of pears.

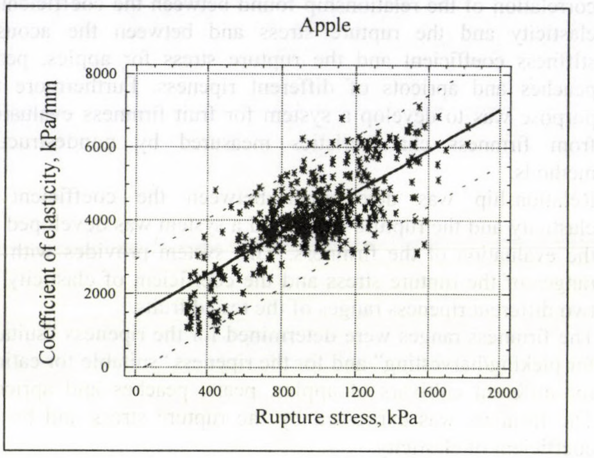

Fig. 1 Coefficient of elasticity versus the rupture stress for apples

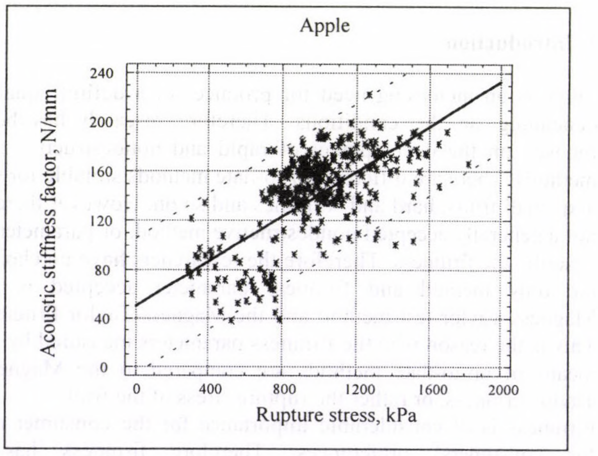

Fig. 2 Acoustic stiffness factor versus the rupture stress for apples

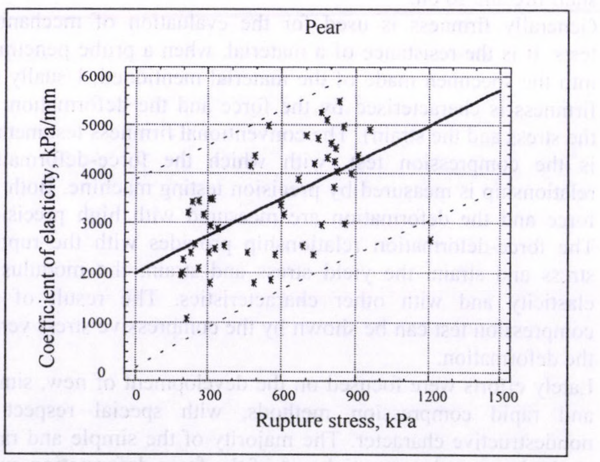

Fig. 3 Coefficient of elasticity versus the rupture stress for pears

The results of the tests performed with peaches show an acceptable close correlation between the coefficient of elasticity and the rupture stress (Fig. 4). However the correlation between the acoustic stiffness factor and the rupture stress and between the coefficient of elasticity and the acoustic stiffness factor was found to be very poor. Therefore the coefficient of elasticity was found to be an appropriate characteristic for the firmness evaluation of peaches.

The results of the tests performed with apricots show an acceptable close correlation between the coefficient of elasticity and the rupture stress (Fig. 5). However the correlation between the acoustic stiffness factor and the rupture stress was found to be very poor. Therefore the coefficient of elasticity was found to be suitable for the firmness evaluation of apricots.

Fig. 6 and 7 show the scatter plot for the coefficient of elasticity ant the acoustic stiffness factor, respectively, with immature and ripe pears of Peckham's Triumph cultivar. Fig. 8 and 9 show the means and the 95% LSD intervals for the coefficient of elasticity and the acoustic stiffness coefficient, respectively with immature and ripe pears of Peckham's Triumph cultivar.

The results show that a considerable reduction was found in the tested characteristics, the ratio in the reduction in the firmness/stiffness between the immature and ripe state was between 4 to 1 and 2 to 1. Therefore the methods used and the characteristics determined – such as the coefficient of elasticity and the acoustic stiffness coefficient – were suitable for the description of the ripening process.

5. Conclusions

Two nondestructive firmness characteristics were compared to the rupture stress. The rupture stress is a good characteristic for the description of the firmness of the texture of the fruit from the surface up towards an approximately 10 mm depth, including the influence of the peel, if the fruit was not peeled before testing.

The coefficient of elasticity is a good characteristic of the average fruit texture firmness near to the surface in a depth of several mm-s. This test can be performed at several spots along the fruit surface. Consequently the coefficient of elasticity is suitable for the assessment of the quality of apples, pears, peaches and apricots.

The acoustic stiffness coefficient is a good characteristic of the firmness of the whole texture of the fruit and there is no definite influence of the texture near to the fruit surface on this stiffness coefficient. Consequently the stiffness coefficient is a suitable characteristic for the assessment of the quality of apples, however this coefficient is not sensitive enough to the variations in the firmness near to the surface of definite fruits, such as pears, peaches and apricots.

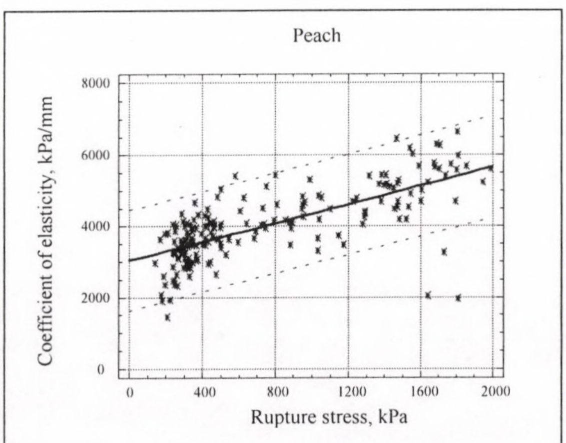

Fig. 4 Coefficient of elasticity versus the rupture stress for peaches

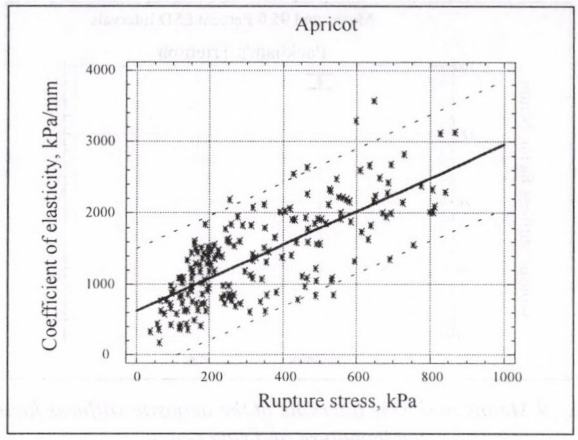

Fig. 5 Coefficient of elasticity versus the rupture stress for apricots

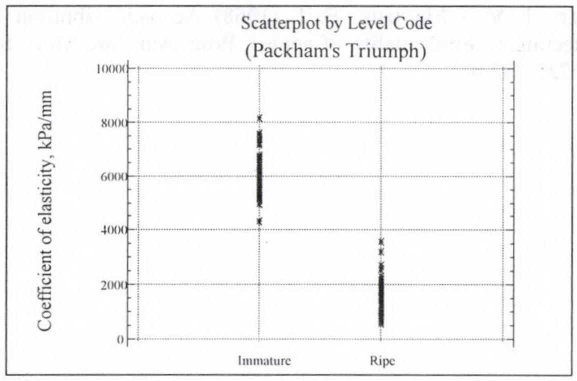

Fig. 6 Scatter plot of the coefficient of elasticity for immature and ripe pears

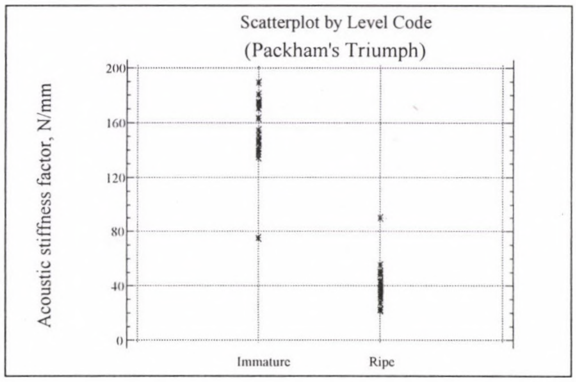

Fig. 7 Scatterplot of the acoustic stiffness factor for immature and ripe pears

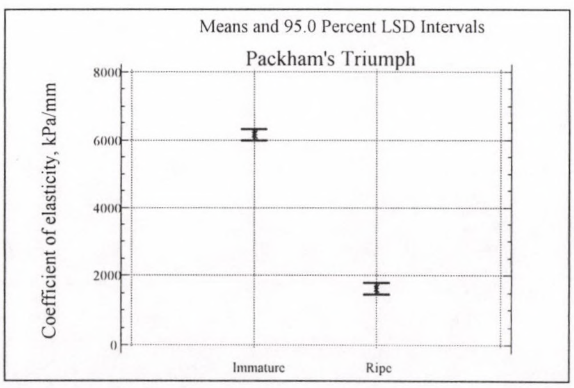

Fig. 8 Means and 95% intervals of the coefficient of elasticity for immature and ripe pears

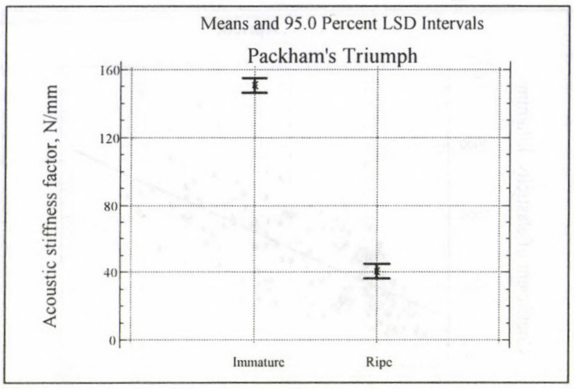

Fig. 9 Means and 95% intervals of the acoustic stiffness factor for immature and ripe pears

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SOME QUESTIONS OF VIBRATIONAL TRANSPORT AND SEED CLEANING

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The most important part of the vibrational machines which are used for transport, ordering and cleaning of granular materials is a flat riddle plate or a feeder trough. This flat surface swings, hereby the grains move too on the surface. In this paper we have studied the motion of an only single grain. We determined the conditions of formation of the different motiontypes in function of the motion influencing parameters. We studied the motion of the grain particularly when it doesn't leave the swinging surface and it slides only in the direction of the transport.

1. Introduction

Vibrational machines to transport and sort of granular material are often used in the industry and agriculture [1]-[3]. It is not a simple task to study these machines and the theorie of the motion of the transportable material. We wanted to deal with this theme because in this field a lot of problems have not been cleared up. In the paper we have established a part of our results.

2. Clearing of the motions of the surface and the grain

We suppose that the shaking surface can move according to $r\sin\omega t$ law. Angle α is named the angle of gradient of the shaking surface and the angle between the direction of the shaking and the surface is named β (Fig. 1). In Fig. 1 we can see the forces which are necessary to be taken into consideration during the studying of the relative motion of the grain on the moving surface. Owing to the transporting motion there is no Coriolis force. The differential-equations of the relative motion on the shaking surface with a fixed system of axes xy are

$$m\ddot{x} = mr\omega^2 \cos\beta \sin\omega t - mg\sin\alpha - \mu N\,, \qquad [1]$$

$$m\ddot{y} = N - mg\cos\alpha + mr\omega^2 \sin\beta \sin\omega t\,, \qquad [2]$$

where $\mu = \mathrm{tg}\,\varphi$ is the sliding friction coefficient.

If the grain stays on the moving surface $y = \dot{y} = \ddot{y} = 0$ and from equation [2]

$$N = mg\cos\alpha - mr\omega^2 \sin\beta \sin\omega t\,. \qquad [3]$$

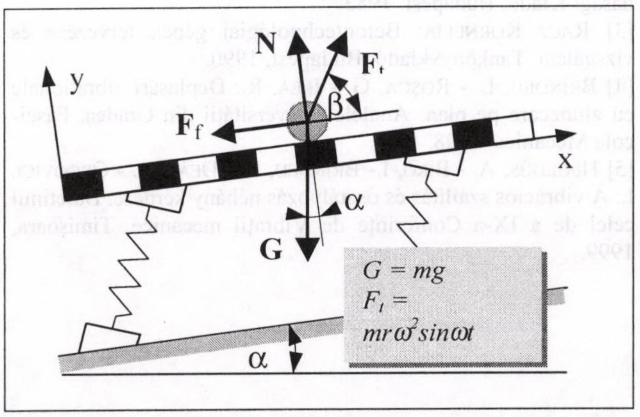

Fig. 1 The acting forces on the grain

In order that the grain may really stay on the surface it is necessary for the N>0 relation to be realized in every moment of the motion. This condition is realized if

$$\frac{r\omega^2}{g} < \frac{\cos\alpha}{\sin\beta}\,. \qquad [4]$$

The motion of the grain on the shaking surface can happen as follows: the grain slides only forwards namely in direction of transport (low-speed running) or it slides in both directions (quick-speed running). The relative motion can either be unbroken or interrupted, i.e. the grain can stay relatively in static condition in certain time interval of every period. From the relative rest position the grain will start on the shaking surface upwards [3, 5], if

$$\frac{r\omega^2}{g} > \frac{\sin\alpha + \mu_o \cos\alpha}{\cos\beta + \mu_o \sin\beta} \qquad [5]$$

and it will not start downwards if

$$\frac{r\omega^2}{g} < \frac{\mu_o \cos\alpha - \sin\alpha}{\cos\beta - \mu_o \sin\beta}\,. \qquad [6]$$

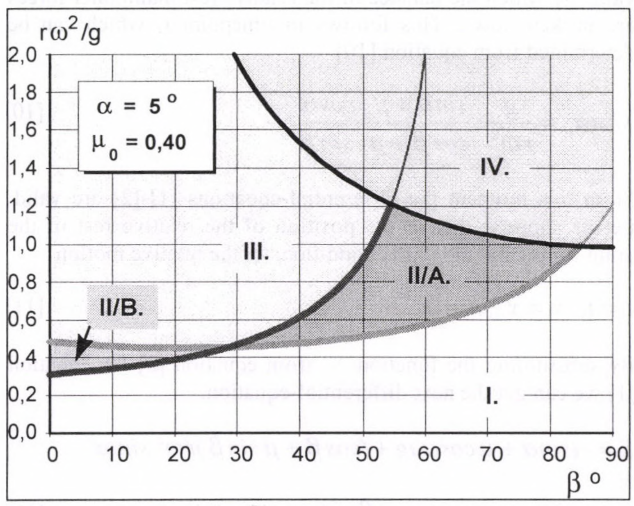

Fig. 2 The possible motions of the grain

In the both last mentioned relations $\mu_o = tg\,\varphi_o$ is the friction koefficient. On the basis of [4] and [6] relations the kinematical conditions can be cleared, which are drawn in Fig. 2 in the plain of parameters β and $r\omega^2/g$, if $\alpha = 5°$ and $\mu_o = 0{,}40$. In the lower part (zone I.) the grain moves without any relative displacement together with the shaking surface.

In the zone marked by dark shading the grain can slide in only one direction (low-speed running), namely in zone II/A in the direction of transport and in zone II/B in the opposite direction. In zone III, the grain can slide in both directions (quick-speed running), and in zone IV it leaves the shaking surface from time to time, after that it is free to move while it reaches the surface again (micro-throwing transport). The different motion types can be studied with different methods. Further-more we have dealt only with such a case when the grain stays on the shaking surface and slides only in the direction of the transport.

3. Investigation of the motion of the grain on the shaking surface

The staying of the grain on the shaking surface and only in the direction of the transport can be realized if on the basis of [4], [5] and [6],

$$\frac{\sin\alpha+\mu_o\cos\alpha}{\cos\beta+\mu_o\sin\beta}<\frac{r\omega^2}{g}<\frac{\mu_o\cos\alpha-\sin\alpha}{\cos\beta-\mu_o\sin\beta} \quad [7]$$

It is good of relation [7] if the fractional value on the right side is bigger than the fractional value on the left side. This condition is realized if

$$tg\,\beta>\frac{1}{\mu_o^2}tg\,\alpha \quad [8]$$

Besides this, the fractional value on the left side of relation [7] has to be smaller than the value on the right side of relation [4] and this can be realized if

$$\beta<90^o-\alpha \quad [9]$$

Relations [8]) and [9] determine possible values of α and β. From these among other things it follows that the investigated motion can be only realized if $\alpha<\varphi_o$ and the value of angle β can be between certain bounds.

Let us suppose that the grain moves together with the shaking surface in timepoint $t=0$. In this phase the grain stays on the shaking surface till the value of the transport force exceeds the value by which the balance of the relative rest maintainer forces are broken down. This follows in timepoint t_1 which can be determined from equation [10]

$$\sin\omega t_1=\frac{g}{r\omega^2}\cdot\frac{\sin\alpha+\mu_o\cos\alpha}{\cos\beta+\mu_o\sin\beta} \quad [10]$$

From this moment the differential-equations [1]-[2] are valid. Let us suppose that in the position of the relative rest of the grain $x = x_o$ and the initial conditions of the relative motion

$$t=t_1,\ x=x_o,\ \dot{x}=0. \quad [11]$$

By substituting the function N from equation [3] for equation [1] we can get the next differential-equation:

$$\ddot{x}=-(\sin\alpha+\mu\cos\alpha)g+(\cos\beta+\mu\sin\beta)r\omega^2\sin\omega t,$$

or

$$\ddot{x}=-\frac{\sin(\alpha+\varphi)}{\cos\varphi}g+\frac{\cos(\beta-\varphi)}{\cos\varphi}r\omega^2\sin\omega t \quad [12]$$

After the integration of equation [12] the velocity of the relative motion can be obtained:

$$v_r=\dot{x}=-\frac{\sin(\alpha+\varphi)}{\cos\varphi}g(t-t_1)+\frac{\cos(\beta-\varphi)}{\cos\varphi}r\omega(\cos\omega t_1-\cos\omega t) \quad [13]$$

The relative motion forwards will be finished at moment t_2 when the difference of velocities of the grain and shaking surface becomes zero. The value of timepoint t_2 can be determined by the aid of the next equations:

$$\cos\omega t_1-\cos\omega t_2=\frac{g}{r\omega}(t_2-t_1)\frac{\sin\alpha+\mu\cos\alpha}{\cos\beta+\mu\sin\beta} \quad [14]$$

The relative position-time function between t_1 and t_2 timepoints can be obtained after repeated integration of equation [13]:

$$x=x_o-\frac{\sin(\alpha+\varphi)}{\cos\varphi}g\frac{(t-t_1)^2}{2}+\frac{\cos(\beta-\varphi)}{\cos\varphi}r[\omega(t-t_1)\cos\omega t_1+\sin\omega t_1-\sin\omega t] \quad [15]$$

According to equation [15] the travelled distance between t_1 and t_2 timepoints on the moving surface is:

$$\Delta x=x(t_2)-x(t_1)=-\frac{\sin(\alpha+\varphi)}{\cos\varphi}\frac{g\Delta t^2}{2}+\frac{\cos(\beta-\varphi)}{\cos\varphi}r(\omega\Delta t\cos\omega t_1+\sin\omega t_1-\sin\omega t_2), \quad [16]$$

where $\Delta t=t_2-t_1$.

If $t=t_2$, the grain will stay temporarily in relative rest on the surface again, some time later namely in $t=t_1+T$ $(T=2\pi/\omega)$ timepoint it will start forward again, and the whole period will be repeated cyclicly. In this case the grain travels in equation [16] calculated distance during a period of the exciting, so the average speed of the grain is

$$v_{r\acute{a}tl.}=\frac{\Delta x}{T}=\frac{2\pi\Delta x}{\omega}. \quad [17]$$

4. Results, conclusions

In this paper we have cleared the possible motion of the single grain in function of the motion influencing parameters putting it on the shaking surface. We have determined analitical way of the kinematical functions of the relative motion and the average speed of the transport in the case when the grain stays on the shaking surface and slides only in the direction of transport. It can be seen that the studying of the simplest motion is a lenghty operation in which several conditions should be taken into consideration, and transcendent equations solved. In this way it is very difficult to investigate the influence of the changes of some parameters, for example, on the average speed of transport.

In order to surmount the above mentioned difficulties, we have established a computer program to investigate the possible motions. By the aid of this program we can determine the optimum parameters of vibrational transport. The so obtained results will be published in another paper.

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FLOW PATTERN CALCULATION IN AN AXIAL FLOW FAN CASCADE

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Summary

We were dealing with the calculation of the flow pattern in an axial flow fan. A 2D mathematical model, Ψ-ω method, was used. The blade passage and the tip clearance secondary flow were calculated. The effect on the secondary flow was investigated by the clearance dimension between the running blade and the standing casing. The effect of the viscosity was also carried out.

1. Introduction

An apparatus has been built at the Department of Fluid Flow, Budapest Technical University which is applicable to measure the flow characteristics of axial flow fans. The measurement completed on the apparatus was reported in a few papers BENCZE-FÜREDI-SZLIVKA [1], [2], [3]. Model fan characteristic graphs were measured through several years. The results were reported in articles BENCZE-KESZTHELYI-FÜREDI-SZLIVKA [4] and [5]. In order to improve the power and efficiency of the fans the investigation of flow microstructure has also arisen as a new direction of the development. The measurement of the velocity field in the neighbourhood of the blade wheel is made by laser Doppler-anemometer. The research so far targeted the fine structure of the flow velocity pattern next to the blade wheel. A data aquisition system was developed which could map the velocity field in front of and behind the selected blade wheel. The valocity map was successfully produced in the highest efficiency point in other working points. VAD [6] reported his results in his Ph.D thesis. The further direction of the research is the computer modeling of flow phenomena partly or entirely in the blade wheel. The results achieved so far are shown in this paper

2. Model formulation

The first version model of the axial fan is a two dimensional one. The flow in the fan was only computed in a plane which is perpendicular to its axis accounting first of all for the secondary flows. The blades were cocidered stright. Such way the computation domain shape were significantly simplified. The domain of numerical computation (see figure 1) was produced in polar system of coordinates. It can be assumed that the flow pattern is same and approximately stationary.

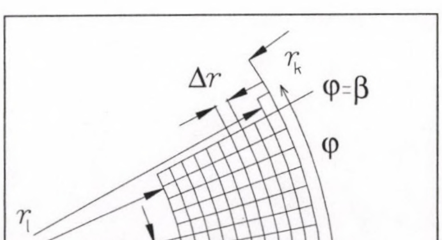

Fig. 1 Region of calculation

The equations what should be solved are the Navier Stokes and the continuity ones (2D, constant density, rotation-free. The unknowns are the velocity components and the pressure values. In the case of 2D flow computation it is favourable to consider the velocities as the rotation of a vector field i.e. they are determined from vector potential as the continuity equation with the substitution of vector potential becomes an identity if the vectorpotential has the required continuity (Young's rule). The velocities are expressed with the Ψ flow function as follows

$$v_r = \frac{1}{r} \cdot \frac{\partial \psi}{\partial \varphi} \qquad v_\varphi = -\frac{\partial \psi}{\partial r}$$

After writing it in the N-S equation system after simplification a partial differential equation system of two parts is obtained

$$\Omega = -\frac{\partial^2 \psi}{\partial r^2} - \frac{1}{r} \cdot \frac{\partial \psi}{\partial r} - \frac{1}{r^2} \cdot \frac{\partial^2 \psi}{\partial \varphi^2}$$ (turbulence definition equation)

$$\frac{1}{r} \cdot \left[\frac{\partial \psi}{\partial \varphi} \cdot \frac{\partial \Omega}{\partial r} - \frac{\partial \psi}{\partial r} \cdot \frac{\partial \Omega}{\partial \varphi} \right] = \nu \cdot \left[\frac{\partial^2 \Omega}{\partial r^2} + \frac{1}{r} \cdot \frac{\partial \Omega}{\partial r} + \frac{1}{r^2} \cdot \frac{\partial^2 \Omega}{\partial \varphi^2} \right]$$

(curl transport equation)
The boundary conditions are easily defined for velocities (e.g. adhesion condition)

3. Numerical solution

The equation system was solved by numerical method of finite differences for the geometry outlined at the model formulation. The main steps are as follows

1. Ψ adjusting the boundary conditions (one time only task as they are constant during the computation)
2. Ψ preliminary iteration which is a stream function computed by the Laplace's equation ($\Delta\Psi$). This speeds up the computation as good approximate starting values are supplied for the iteration procedure.
3. Alternate solution of Ψ and Ω equations. Iteration of Ψ Ω previous value is taken as the inhomogeneous part of the equation and then the adjustment of boundary values of Ω from the last values of Ψ. Then the curl transport equation is iterated taken Ψ as known from the previus computation.

4. Results

The calculations used a geometry which corresponds to the axial fan measuring apparatus at the Department of Fluid Flow, Budapest Technical University. (Only the blade thickness was higher for more computation poits could be placed between the blade and tube wall.) The figures are as follows:

hub radius r_b =0,213 m, tube radius r_k =0,315 m, number of blades N=12. The angular velocity was chosen as $\omega = 110 \frac{1}{s}$, and computed in counterclockwise rotating system relative to the blades. In the computation the effect of blade length and the viscosity were examined in the range

$$0{,}309\ \text{m} \le r_l \le 0{,}314\ \text{m}, \quad 10^{-5}\ \frac{m^2}{s} \le \nu \le 10^{-2}\ \frac{m^2}{s}.$$

The effect of blade length and the gap width

In the case of large gap (shorter blade) curl is formed between the two blades. While the gap is reduced the curl tapers away to the hub and its size decreases.

Further reduction of the gap causes the appearance another curl and the other curl is pushed to the compression side end of the blade. (see figure 2).

When the **effect of the viscosity** is examined similar significant results are obtained. For high viscosity value $\nu = 10^{-2}\,\frac{m^2}{s}$ a high intensity curl is formed in the blade chanel. As the viscosity value is reduced $\nu = 10^{-3}\,\frac{m^2}{s}$ one large and several small curls are formed (see figure 3) In the range of the laminar viscosity one relatively low intensity is formed in the blade channel.

As the viscosity increases the material velocity between the blades increases and the material flow quantity is also influenced by its viscosity.

5. Development possibilites

A measuring tools (LDA) is being made at Department of Fluid Flow, Budapest Technical University which is applicable to determine the velocity field between the blades. The current computation can be compared to this measurement. In the improvement of the computation method the 2 dimensional model will be replaced by a three dimensional one which makes the blade geometry more accurate.

Acknowledgement
The research is promoted by OTKA (T 026516).

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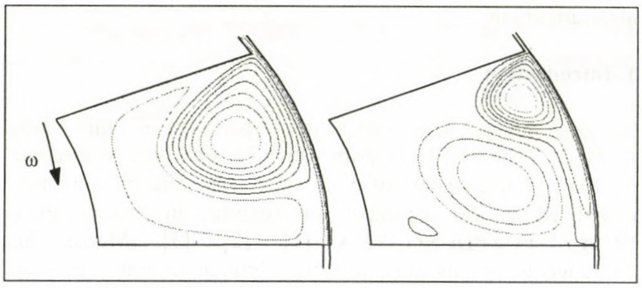
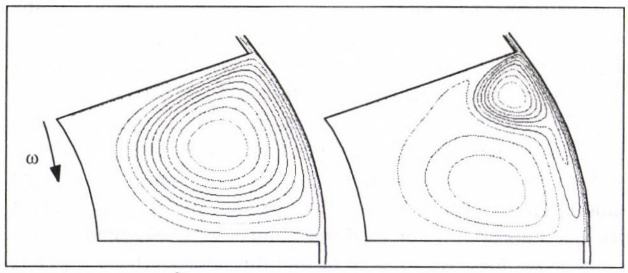


4 mm **1 mm**

Fig. 2 Effect of the tip clearance dimension on the flow pattern



$\nu = 10^{-2}\,\frac{m^2}{s}$ **3 mm** $\nu = 10^{-3}\,\frac{m^2}{s}$

Fig. 3 Effect of viscosity on the flow pattern

NEW METHODS IN TOWER DESIGN

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1. Introduction

The continental wind conditions differ from the coastal area in the manner of higher towers. The coastal towers are 30-60 m high while the towers installed at continental area are usually 60-100 m high, nowadays. The Hungarian installation is expected in the near future. The technical and mechanical questions should be answered in the case of Hungarian tower production.

In common with random loading problems in many other fields of engineering, the analysis of wind turbine fatigue loads may, in principle, be carried out using either frequency or time domain techniques. The frequency domain approach to the calculation of structural response to random loading has firm foundations in both wind engineering and the analysis of wave loading of offshore structures. The method becomes complicated for a wind turbine because of the need to deal with the rotation of the rotor blades slicing through the turbulent structure of the incident wind field. The response and loading output of the calculation is obtained finally in spectral form through inverse Fourier transforms of the correlation functions. Although the frequency domain approach has the advantage that it provides for a very rapid analysis of wind turbine loading, it suffers from the disadvantage that it cannot take account of system non-linearities associated, for example, with the rotor aerodynamics, structural dynamics and/or control system dynamics. For this reason in particular, the frequency domain approach is not currently used as the basis of final, detailed wind turbine design calculations. The method is, nevertheless, of some value in the very early stages of wind turbine design for optimization studies. The time domain approach to calculating the response of a system subject to some disturbance is termed simulation. Simulation is a widely used method and the techniques involved are well understood. Simulation forms the basis of all current, state-of the-art wind turbine design calculations.

2. Method

The problems arising with tower design:

- Optimising the geometry and wall thickness
- The possible strengthening joints inside the tower
- The vortices and pressure distribution between the blade and tower
- The vortex shedding behind the nacelle

There are two ways to optimise the tower for equal stresses to obtain the best diameter:

- using a different wall thickness
- changing coefficients in tower wall equation (influencing the diameter)

The possible results:

- the first solution would lead us to equipotential console (see Fig.11)
- the next possible option would yield a result with increasing wall thickness with height (see Fig.12)
- the third way showed us the possibility getting the smoothest curve of stress changes in the tower (see Fig. 7). It was done by optimising coefficients in tower wall equation in order of decreasing the stresses.

2. 1. Wind tunnel tests

Vibration and wind pressure measurements were carried out in wind tunnel in order to represent the difference between the calculated, measured, FEM and CFD result. The results indicate that we can use computational methods to describe the physical reactions in ambient conditions.

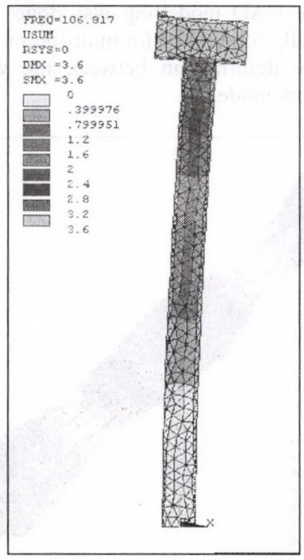

Fig. 1 The tower model for wind tunnel tests

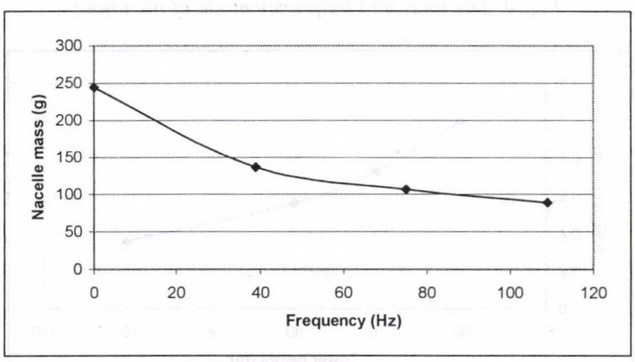

Fig. 2 The change of natural frequencies in the function of implemented nacelle mass

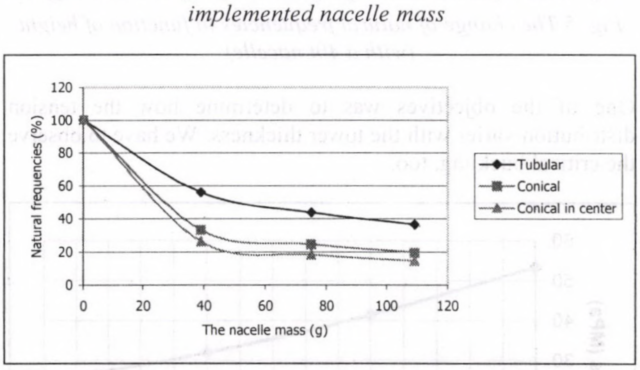

Fig. 3 The influence of different masses on the natural frequencies of towers in percentage

2. 2. The finite element modelling of the tower

The load frequency is always changing in the natural circumstances. We have to consider the natural frequencies of the structure and vortex shedding frequency Fig. 7, too. The distribution of load amplitudes can be a basis for fatigue life estimation. The overall result reflects the wind condition at a given site. It is applicable to any site for which it might be intended. The following task would be the comparison between the classical frequency superposition and blade-tower deflection influencing each other. With this method more frequencies can be added to each other at the same time. The service lifetimes could be predicted more accurately this way.

The natural frequencies were calculated by using finite element analysis. For tower modelling a 49 m high tower was taken as an example. The CAD modelling was done in Pro/Engineer, which was specially formulated for multi-point design.

There is a large deformation between the welded joints in torsional frequency mode.

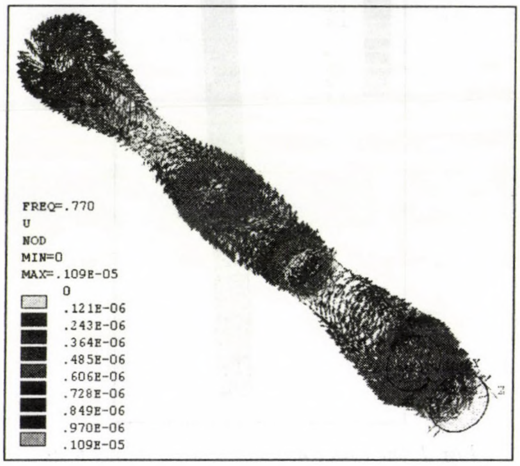

Fig. 4 The torsional frequency mode of the tower

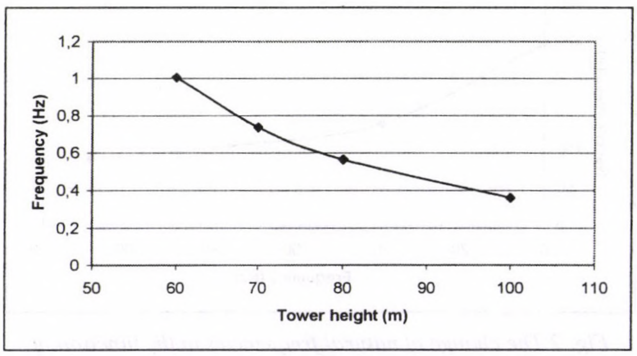

Fig. 5 The change of natural frequencies in function of height (with a 40t nacelle)

One of the objectives was to determine how the tension distribution varies with the tower thickness. We have to observe the critical buckling, too.

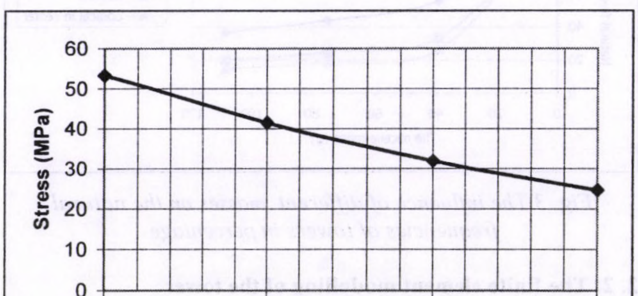

Fig. 6 The change of stress in function of wall thickness

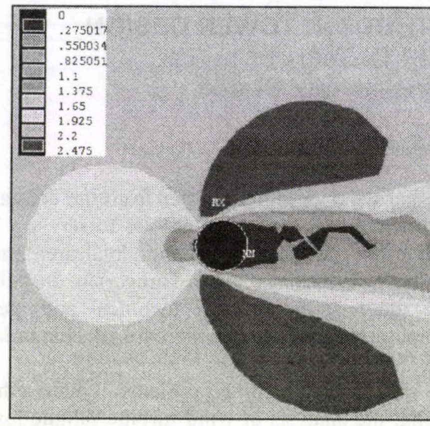

Fig. 7 Vortex shedding behind the tower

The vortex-induced vibrations were modelled with tower airflow interaction.

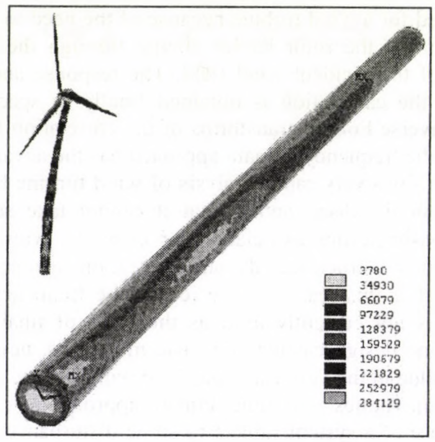

Fig. 8 Coupled-field analysis

The boundary condition for structural finite element analysis was the pressure distribution from the CFD analysis. We can see in Fig. 8 the Von Mises stress distribution.

2. 3. The influence of geometry

A classical formula of a hiperboloid:

$$\frac{x^2}{a^2}+\frac{y^2}{b^2}-\frac{z^2}{c^2}=-1$$

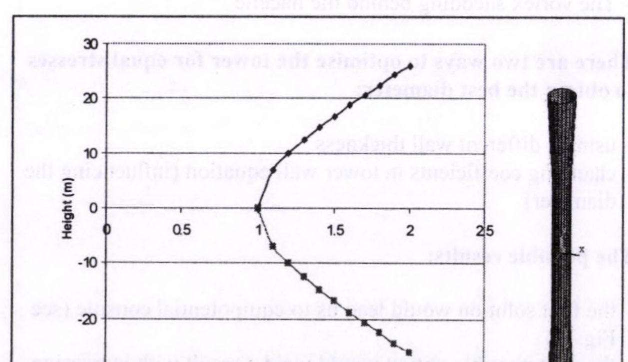

Fig. 9 Implementing a classical formula as a shape of a turbine tower - a) the curve b) the CAD modell

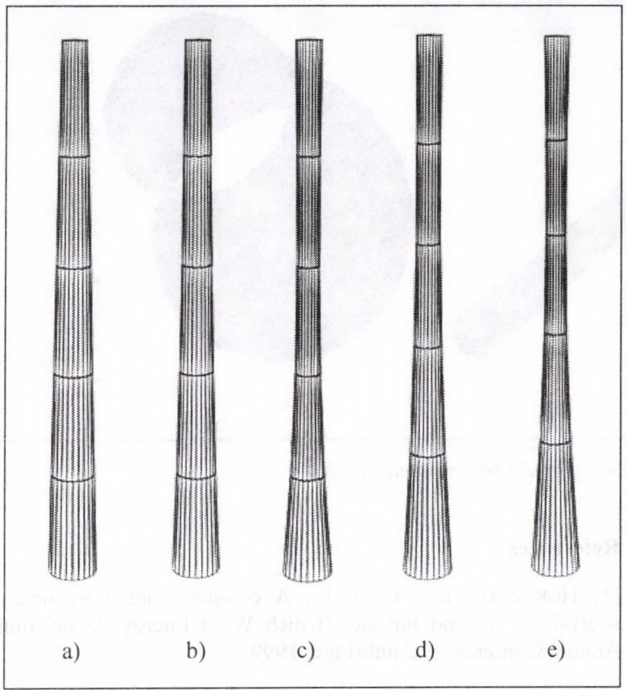

Fig. 10 Different tower shapes increasing the taper (a, b and c) Increasing the height of the smallest diameter (d and e)

Tower cross sectional drawing is represented in Fig 11. The tower diameter is decreasing in function of tower height. The base is the largest diameter of the tower on ground.

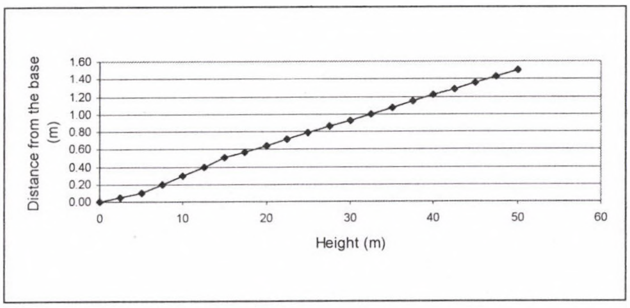

Fig. 11 A 50m high tower wall curve

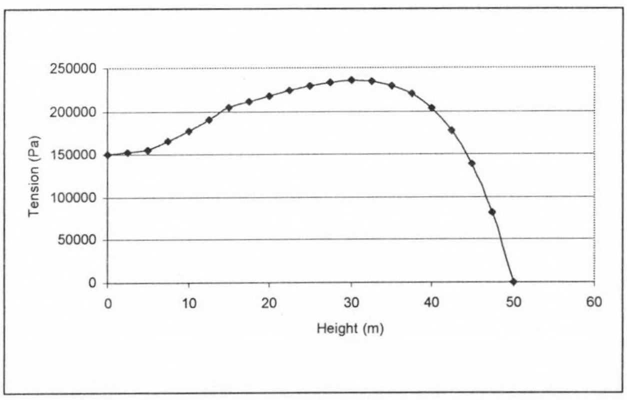

Fig. 12 The stress distribution along the tower

In order to represent the curve of tower wall cross section, the following equation was used:

$$y = \frac{x}{a + bx + c\sqrt{x}}$$

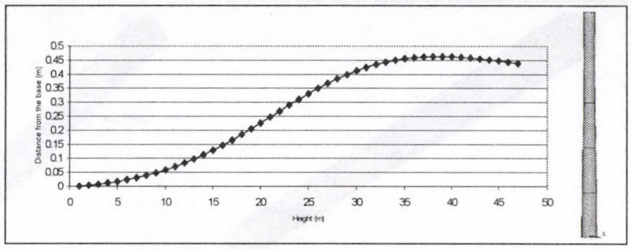

Fig. 13 The used tower curve with CAD model

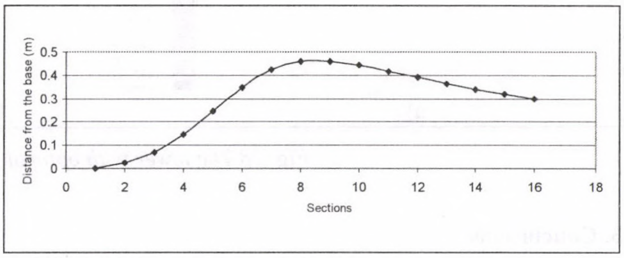

Fig. 14 The used curve up to 75 m

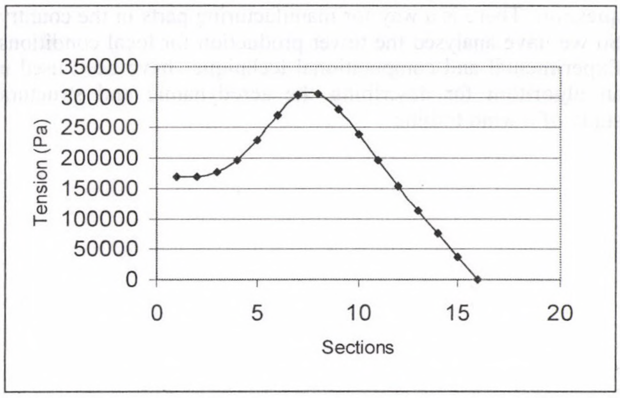

Fig. 15 The stress distribution

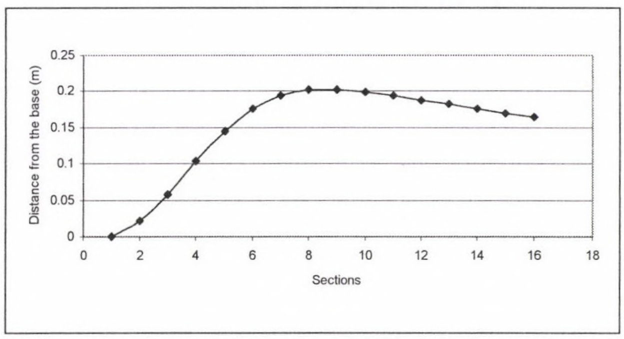

Fig. 16 The optimised curve (with new a, b and c variables)

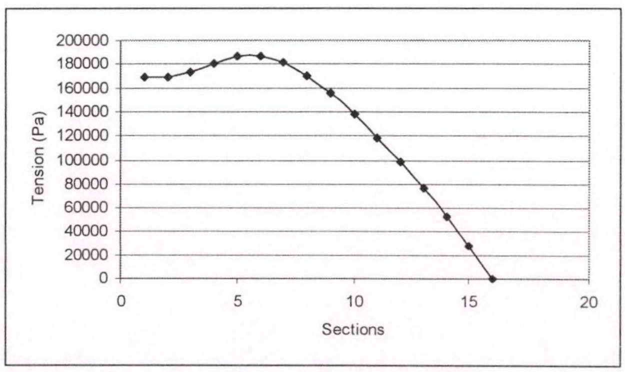

Fig. 17 The new stress distribution

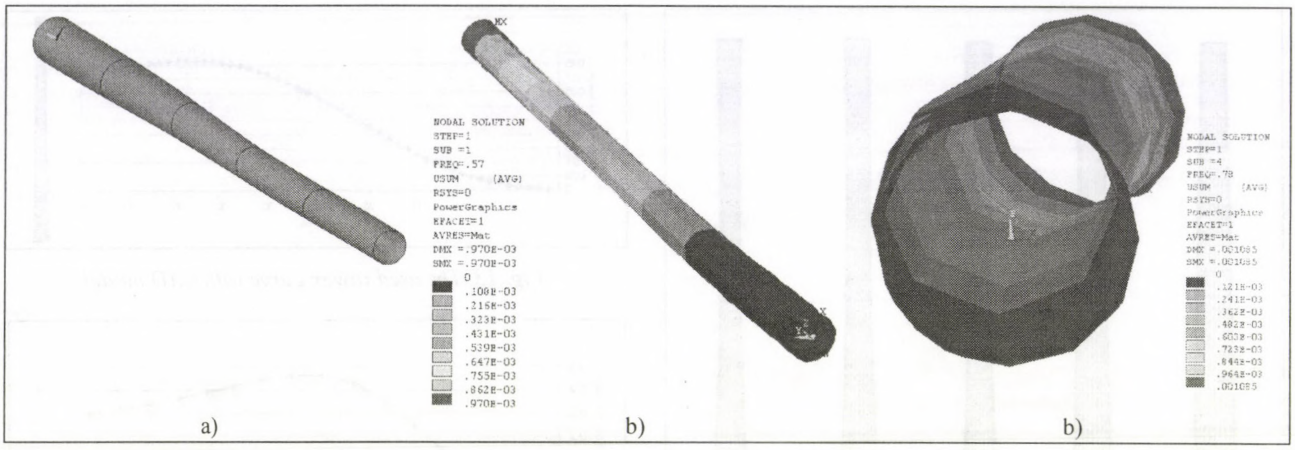

Fig. 18 The tower with optimal geometry could be analysed by FEM

3. Conclusions

Special attention should be paid to the wind turbine tower design. The theory of wind measurement is related to this question. There is a way for manufacturing parts in the country. So we have analysed the tower production for local conditions. Experimental and computational techniques have been used in an algorithm for describing the aerodynamic and structural study of a wind turbine.

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DETERMINING FLOW PARAMETERS OF GRAIN MATERIALS

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Introduction

The cast distance in air can only be determined by experiments as no exact formulae like that for cast in vacuum are available. The experimental determination of the parameters is rather costly because large laboratory, experimental spreader and collecting appliances are needed. The formulae of cast in vacuum are not valid for throwing in air. The difference is especially significant above 20-25 m/s air velocities and in the case of low density extraordinarily shaped seeds.

The experiments are necessary because in the education and in the research for developing artificial fertilizer spreading equipments a need for the cast distance computation of fertilizer grain and wheat seed arose several times.

In chapter *Motion of mass point under gravity and air resistance* of the book Kármán Tódor -Maurice A. Biot: Methods of mathematics (1967) the development of the equations of horizontal cast can be found in detail. There is no neglection there. The reader is correctly guided in the development of expressions but the final equations (for path, velocity, time of flying) contain complicated integrals and the book gives no exact solution. As we made several unsuccessful attempts to solve the integrals it seemed reasonable to use numerical method. We think that our experiments and the elaboration of relating theoretical relationships could serve the design of spinning disc spreaders.

Material and method

Eighteen different type seeds and grains were included in the experiments. For the measurement a disc type grain-shooting apparatus were fabricated. The computations needed the following data: air density, the grain main dimensions, its density and critical floating velocity, the shoot direction and initial speed. Substituting them made possible to calculate the cast distance for the given height of start, which was compared to the measured cast distance. This showed the accuracy of computation. The computation was made with our computer program.

The work relating to the topic has the following details:

- finding and analyzing the professional literature
- elaborating the theoretical relationships
- writing computer programs
- performing the laboratory measurements
- evaluation and demonstration of computed data
- evaluation summary and suggestions.

Results

One can consider the method elaborated for the solution of differential equation of ballastic curve as a basic research result, which is at the same time, improves the subject materials for engineering students. The numeric method can be used for the following expressions

$$v_x = v_0 f(\vartheta)$$

$$v_y = v_0 f(\vartheta).\mathrm{tg}\vartheta$$

where

$$f(\vartheta) = \frac{1}{\sqrt{1 + \frac{k v_0^2}{mg}\left(\ln\frac{1+\sin\vartheta}{\cos\vartheta} + \frac{\sin\vartheta}{\cos^2\vartheta}\right)}}$$

The velocity components are expressed in terms of the ϑ angle made by the horizontal +x direction and the tangent of the path curve.

$$v_x = v_0 f(\vartheta) = v_0 \frac{1}{\sqrt{1 + \frac{k v_0^2}{mg}\left(\ln\frac{1+\sin\vartheta}{\cos\vartheta} + \frac{\sin\vartheta}{\cos^2\vartheta}\right)}}$$

It should be noted here that if $k = 0$ is substituted for $f(\vartheta)$ it makes $f(\vartheta) = 1$ so that expressions of v_x, v_y, x, y and t change to the forms valid in vacuum.

Integrating the expressions of v_x, and v_y produces the path coordinates x and y as functions of ϑ tangent angle as follows:

$$x = \int_0^t v_x dt = \frac{v_0^2}{g}\int_0^{\vartheta} \frac{[f(\vartheta)]^2}{\cos^2\vartheta} \vartheta$$

$$y = \int_0^t v_y dt = \frac{v_0^2}{g}\int_0^{\vartheta} \frac{[f(\vartheta)]^2 \sin(\vartheta)}{\cos^3\vartheta} d\vartheta$$

The equation development supplied the expression of time, too:

$$t = \frac{v_0}{g}\int_0^{\vartheta} \frac{f(\vartheta)\,d\vartheta}{\cos^2\vartheta}$$

The *air resistance coefficients* (κ) of grains were determined by measuring the *critical (floating) air velocity* (v_{kr})

The measured and computed values are collected in the following tables. The path curves are shown in diagrams.

The intersection points of velocity hodographs are at the initial velocity. All the curves intersect y - axis at the critical air velocity.

Evaluation of results

1 - the numerical computer program written for computing the path points of the ballastic path curves can be considered as a basic research result, which – at the same time – serves the training material improvement, too. Due to the large size and characteristics of the computer program it can not be published here but the results are included in tables and the relationships are demonstrated in diagrams.

2 - table 1 demonstrates that the *measured* and the *computed* values are acceptably close to each other. It concludes that there is no need to build a costly laboratory and to perform many cast experiments as the measurements can be substituted by the computations. Only the physical parameters of the grains and their critical floating velocities (**v_{kr}**) should be measured in advance.

3 - table 2 contains the aerodynamically characteristics (**v_{kr}, k_v**, κ) of the examined grains the determination of which was the main aim of the experiments.

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Table 1 Cast distances for horizontal throwing as functions of the critical (floating) air velocity v_{kr} (m/s) with y = 0.56 m falling depth

EQUSAMPL	GRAIN TYPE	v_{kr} (m/s)	$x3_{meas.}$ (m)	$X3_{calc.}$ (m)	$x2_{meas.}$ (m)	$x2_{calc.}$ (m)	$x1_{meas.}$ (m)	$x1_{calc.}$ (m)
1	DAPPLE BEAN	14,44	7,92	7,5	5,41	5,79	3,09	3,2
2	WHITE BEAN	14,55	7,60	7,51	5,60	5,79	3,21	3,21
3	RED BEAN	14,77	7,85	7,54	5,57	5,81	3,08	3,21
4	WHITE LET.BEAN	15	7,60	7,57	6,05	5,83	3,30	3,22
5	DWARF BEANS	13	6,9	7,3	5,39	5,67	3,06	3,17
6	MAIZE	13	7,81	7,3	5,50	5,67	3,07	3,17
7	SWEET MAIZE	11,66	7,05	7,06	5,30	5,52	3,03	3,12
8	PEAS	9,5	6,48	6,51	5,2	5,18	3,08	3,01
9	FODDER BEET	6,44	5,13	5,16	4,28	4,27	2,61	2,67
10	LENTIL	10,5	6,91	6,79	5,31	5,36	3,01	3,07
11	SORGHUM	8,33	6,02	6,1	4,76	4,91	2,92	2,91
12	WHEAT	9,3	6,43	6,45	5,24	5,14	2,93	2,99
13	LARGE BEAD	11,88	7,14	7,1	5,58	5,55	3,17	3,13
14	FERTILIZER	11,4	7,00	7,00	5,46	5,49	3,11	3,11
15	SUGARBEET SEED	8,33	6,08	6,12	4,91	4,91	2,84	2,91
16	SMALL BEAD	9,5	6,49	6,51	5,16	5,18	2,94	3,01
17	AIR RIFLE SLUG	28	8,24	8,24	6,12	6,22	3,30	3,34
18	SCATTER	37,45	8,20	8,33	6,24	6,27	3,33	3,35

Table 2 Most important properties of the examined seeds and grains

EQUSAMPL	GRAIN TYPE	a (mm)	b (mm)	c (mm)	d (mm)	v_{kr} (m/s)	k_v (1/m)	κ	ρ_a (g/cm^3)
1	DAPPLE BEAN	9,11	5,65	13,2		14,44	0,047	0,442	1,249
2	WHITE BEAN	8,71	5,18	14,58		14,55	0,046	0,397	1,331
3	RED BEAN	11,74	7,9	20,06		14,77	0,049	0,528	1,144
4	WHITE ET.BEAN	13,18	8,93	19,73		15	0,0436	0,53	1,192
5	DWARF BEANS	6,10	5,10	11,91		13	0,058	0,443	1,421
6	MAIZE	9,54	5,13	13,56		13	0,058	0,55	1,218
7	SWEET MAIZE	8,40	4,05	10,54		11,66	0,0721	0,57	1,223
8	PEAS				**6,8**	9,5	0,1086	0,9	1,295
9	FODDER BEET				**4,15**	6,44	0,2365	0,62	0,71
10	LENTIL	4,74*	4,74*	2,52		10,5	0,0884	0,36	1,28
11	SORGHUM	2,47*	2,47*	4,9		8,33	0,1413	0,52	1,2
12	WHEAT	3,39*	3,39*	7,07		9,3	0,1134	0,55	1,2
13	LARGE BEAD				**7,89**	11,88	0,0695	0,63	1,064
14	FERTILIZER				**3,73**	11,4	0,0754	0,503	1,458
15	SUGARB. SEED				**3,70**	8,33	0,1413	0,53	0,836
16	SMALL BEAD				**3,91**	9,5	0,1086	0,52	1,0645
17	AIR RIFLE SLUG	4,49*	4,49*	5,78		28	0,0125	0,428	11,50
18	SCATTER				**4,44**	37,45	0,0069	0,374	11,75

Note: Values marked with '*' belong to circle or near circular cross sections.

***a* (mm)** - width of grain, ***b* (mm)** - thickness of grain, ***c* (mm)** - length of grain, ***d* (mm)** - diameter of grain, **v_{kr} (m/s)** - critical (floating) air velocity, **k_v (1/m)** - sailing effect coefficient, **κ** - air resistance coefficient, **ρ_a (g/cm^3)** - density of grain.

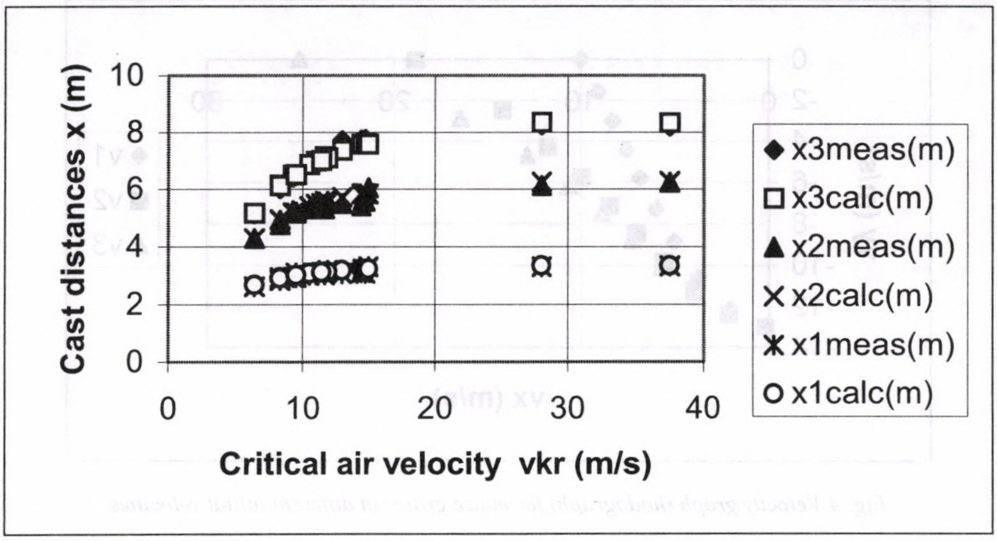

Fig. 1 The trend of cast distances versus critical air velocities

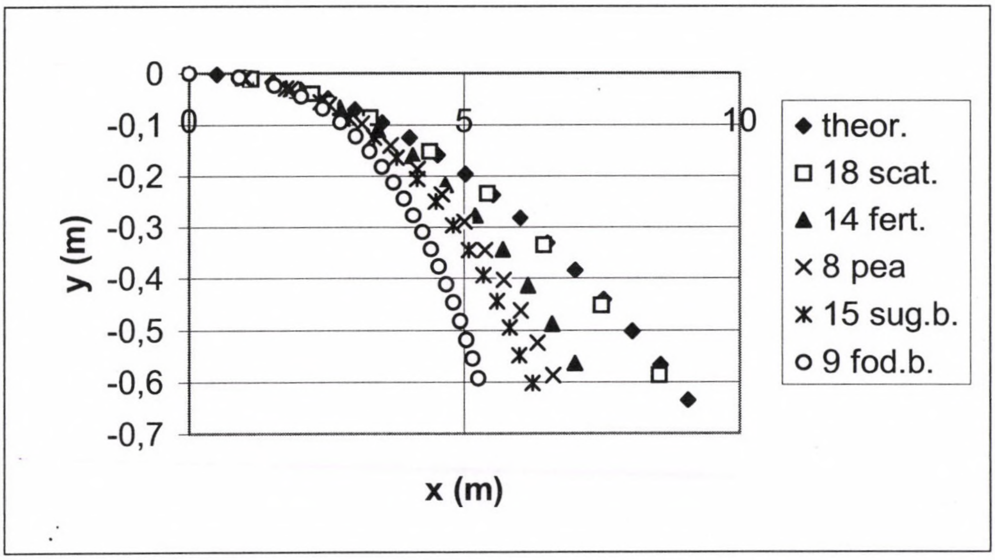

Fig. 2 Paths of grains compared to each other for an initial cast velocity $v_0 = 25,13$ m/s. (The theoretical path in vacuum is also included)

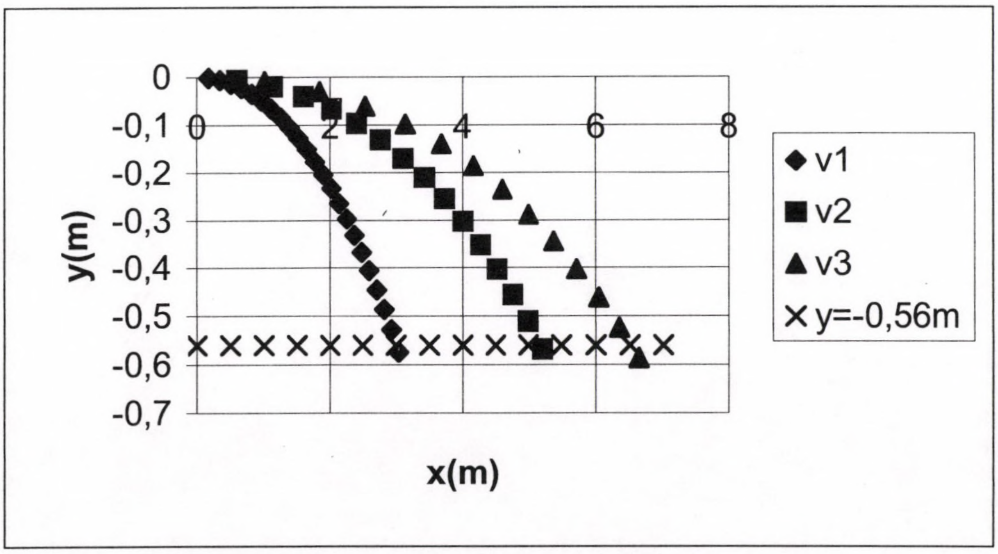

Fig. 3 Cast paths of peas grains for horizontal cast
Cast distances are $x_1 = 3,01$ m, $x_2 = 5,18$ m, $x_3 = 6,51$ m, for initial velocities
$v_1 = 10$ m/s, $v_2 = 18,83$ m/s,. $v_3 = 25,13$ m/s and $y = 0,56$ m vertical falling depth (see table 1 row 8).

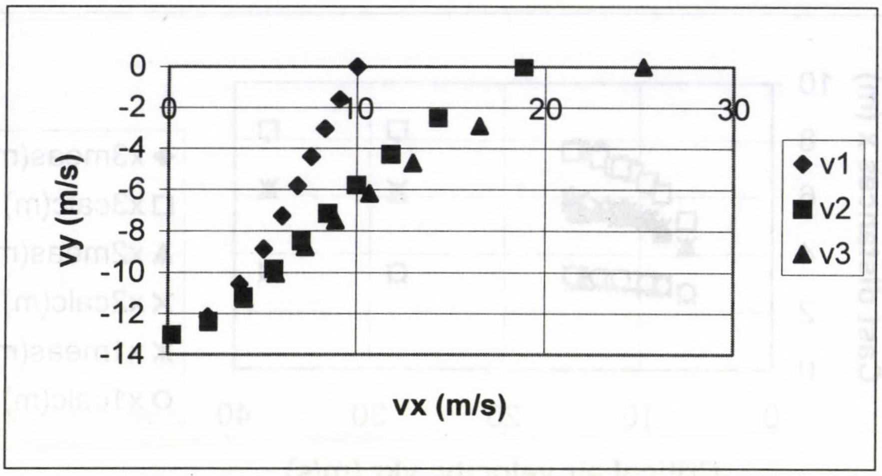

Fig. 4 Velocity graph (hodograph) for maize grains at different initial velocities

ENERGETICAL EXAMINATION OF VIBRATIONAL RIDDLES EXCITED NEAR SELF-FREQUENCY

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Seed cleaning is a very important operation of harvesting in the agriculture. The basic machines of the cleaning are the riddles with different construction and drive. The condition of the unbroken riddling is the relative motion of the seed mass on the screen surface. As the cleaning of a very big mass happens in every year, therefore the energetical examination of the riddling is very important.
In this paper we have studied the possibilities of the reduction of the energy-requirements of the seed cleaning, especially in the event of the energetical examination of vibrational riddles excited near self-frequency.

1. Introduction

At first let us investigate the conditions of continual relative motion of single grain. As it can be seen in Fig 1, the body marked by 1 can move according to

$$x_1 = r\sin(\omega t + \alpha) \qquad [1]$$

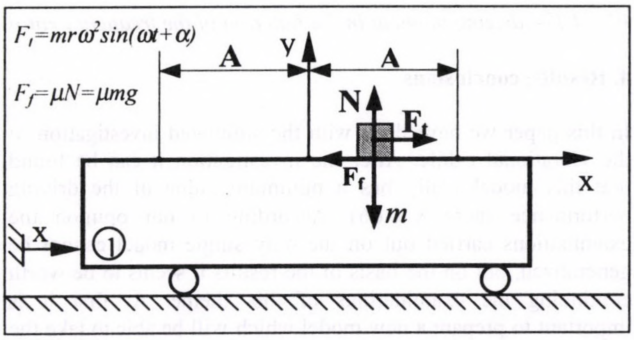

Fig. 1 Simplified dynamical model of the riddle

function. A masspoint (grain) marked by m can be situated on its surface. We study the relative motion of the masspoint respectively to the body. The differential-equation of the relative motion is

$$\ddot{x} = r\omega^2 \sin(\omega t + \alpha) - \mu g\,sign\dot{x}. \qquad [2]$$

After the solution of this differential-equation relation the

$$r > \sqrt{1+\left(\frac{\pi}{2}\right)^2}\,\frac{\mu g}{\omega^2} \qquad [3]$$

can be obtained, which is the condition of the continual relative motion of the grain. The maximal amplitude of the relative motion can be determined by the aid of the next function:

$$A = r\sqrt{1-\left(\frac{\pi}{2}\frac{\mu g}{r\omega^2}\right)^2} \qquad [4]$$

2. The model of the investigated vobrational riddle

After the investigation of some models we have chosen the Binder type vibrational riddle which is a typical resonance riddle. Despite their name, the resonance riddles operate not in the resonance point (λ=1) but only in its environs. The influence of the extent of the difference from the resonance point is important to the parameters of the vibration, the stability of the motion and - as we are going to see -, the power demand of the screening.
In Fig. 2 the excited, simplified model which has two degrees of freedom can be seen according to the displacement. We suppose that the damping of the springs applied in this model includes the damper effect of the plastic links of the drive, the exciting and supporting springs and finally the grain mass on the screen. Supposing that the damping factors of the springs k_g=k_t=k and their rigidities s_g=s_t=s, moreover φ=ωt, i.e. it is considered temporarily as one degree of the riddle, the mass of which is marked by m is described by

$$m\ddot{y} + 2k\dot{y} + 2sy = sr\sin\omega t + kr\omega\cos\omega t \qquad [5]$$

differential-equation. It is only true if $y=0$ and $\varphi=0$ i.e. the determined position and the deformation of the springs equals zero in the riddle.

3. The investigation of the model

If the particular solution of the second-order differential-equation is searched in

$$y = K\sin(\omega t - \varphi) \qquad [6]$$

form, where φ is the phase angle and K is the amplitude,

$$2kK\omega = sr\sin\varphi + kr\omega\cos\varphi \qquad [7]$$

$$-mK\omega^2 + 2sK = sr\cos\varphi - kr\omega\sin\varphi \qquad [8]$$

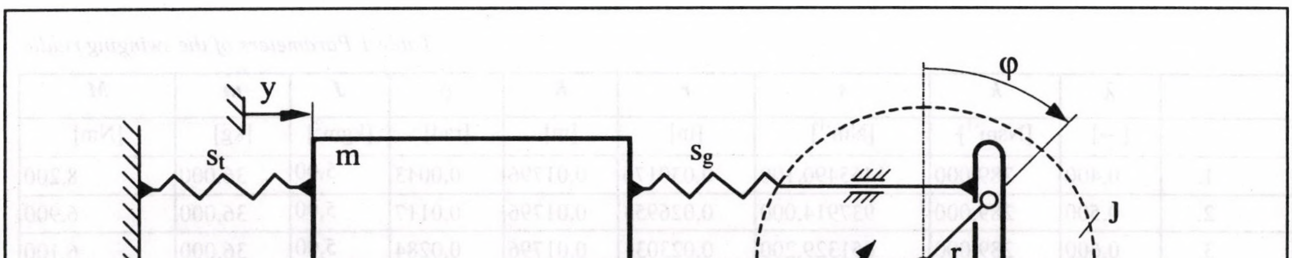

Fig. 2 The model of the riddle as swinging system

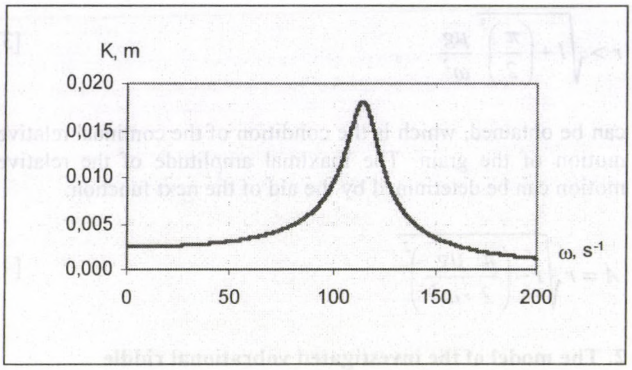

Fig. 3. Connection between the frequency of the excitation and the amplitude of the riddle equation-system can be obtained, from which

$$K=\frac{r\sqrt{s^2+(k\omega)^2}}{\sqrt{(2s-m\omega^2)^2+(2k\omega)^2}} \qquad [9]$$

In Fig. 3 the connection between the frequency of the excitation and the amplitude of the riddle can be seen, if r is stationary ($s=236870{,}5\ Nm^{-1}$, $k=289\ Nsm^{-1}$, $m=36\ kg$, $r=0{,}00497\ m$). The maximum value of the amplitude $K=0{,}01796\ m$.
It is commonly known that in case of stationary r the performance of the driving is maximum near the resonance (1).
Further-more we have studied how to change value r with the aim of keeping on stationary value of the amplitude of the excited vibration in case of different λ frequency ratio and stationary ω exciting frequency and how to modify in these cases the power demand of the screen. To fill this in table I, it is necessary to determine the different values of the exciting by the aid of (7) and (8) on the basis of

$$r=\frac{2kK\omega}{s\sin\varphi+k\omega\cos\varphi} \qquad [10]$$

equation. If $\varphi \neq \omega t$ then it can be stated that

$$m\ddot{y}+2k\dot{y}+2sy=sr\sin\varphi+kr\dot{\varphi}\cos\varphi \qquad [11]$$

$$J\ddot{\varphi}+sr(r\sin\varphi-y)\cos\varphi+kr(r\dot{\varphi}\cos\varphi-\dot{y})\cos\varphi=M\,, \qquad [12]$$

the differential-equation system of the two degrees of freedom.
As its solution (Matlab Simulink model) we have searched for the supposed M stationary driving moment which results in the case of different λ frequency ratios and r values, and in every case, the equivalent initial conditions ($y_o=0,\ \dot{y}_o=0,\ \varphi_o=0,\ \dot{\varphi}_o=\ =36\pi\ s^{-1}$) after the initial oscillation for the flywheel with the initial condition corresponding with the angular velocity, and the riddle in relation to the previously determined maximum value of the amplitude.
The most important curve of this paper can be seen in Fig. 4 made on the basis of Table I. The curve has minimum value between $\lambda=0{,}6$ and $\lambda=0{,}7$, therefore, in this range the driving moment and – because of the same angular velocity – this indirect proportion performance is at a minimum value.

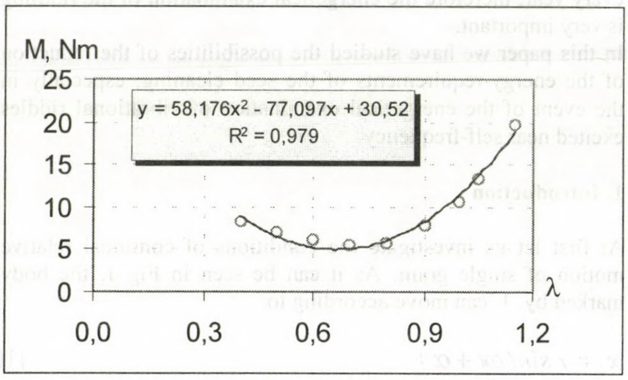

Fig. 4 The driving moment in the function of the frequency ratio

4. Results, conclusions

In this paper we have dealt with the simulated investigation of the vibrational riddle. After the investigation it can be found that this model really has a minimum value of the driving performance (here λ=0,66). According to our opinion the examinations carried out on the only single model cannot be generalized, but on the basis of the results it seems to be worth continuing the examinations of this theme. At first it is important to prepare a new model which will be able to take the characteristics of the grain mass and its effects on the riddle into consideration.

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Table 1 Parameters of the swinging riddle

	λ	k	s	r	K	φ	J	m	M
	[--]	[Nsm⁻¹]	[Nm⁻¹]	[m]	[m]	[rad]	[kgm²]	[kg]	[Nm]
1.	0,400	289,000	1465490,100	0,030176	0,01796	0,0043	5,00	36,000	8,200
2.	0,500	289,000	937914,000	0,026953	0,01796	0,0117	5,00	36,000	6,900
3.	0,600	289,000	651329,200	0,023031	0,01796	0,0284	5,00	36,000	6,100
4.	0,700	289,000	478527,600	0,018442	0,01796	0,0655	5,00	36,000	5,500
5.	0,800	289,000	366372,700	0,013276	0,01796	0,1553	5,00	36,000	5,800
6.	0,900	289,000	289476,600	0,007907	0,01796	0,4268	5,00	36,000	7,900
7.	1,000	289,000	236870,500	0,004967	0,01796	1,3600	5,00	36,000	10,600
8.	1,050	289,000	212678,900	0,006599	0,01796	2,0009	5,00	36,000	13,300
9.	1,150	289,000	177299,400	0,013148	0,01796	2,4344	5,00	36,000	19,700

APPLICATIONS OF ARTIFICAL NEURAL NETWORK IN THE RESEARCH OF VISUAL PARAMETERS OF FRUITS AND VEGETABLES

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Introduction

The visual quality parameters of fruits and vegetables are very important in trade, because these features can be influenced by the quality of fruits and vegetables. The visual quality parameters like shape and color features must to determined by an objective and non-destructive method. Therefore these features were investigated using image processing. Image processing by computer vision was chosen, because this method is rapid, non-destructive and the results of this method give objective parameters. These features were analysed in order to apply these parameters in the classification of varieties.

Objective

Our objective was to developed a method for qualitative color and shape characterisation of the tested fruit and vegetable varieties.

Materials and methots

Materials

The produces tested were as follows:
Five pear varieties were : „Beurre Durandeau" – 14 pieces, „Vilmos" – 14 pieces, „Hoshui" – 16 pieces, „Peckham Triumph" – 12 pieces- and „Clapp kedveltje" – 16 pieces.
Three cereal varieties: wheat, lightseed and hemp - 50-50 seeds.
One tomato variety: „Heinz" – 145 pieces.

Measuring system

A lighting system, a video camera, a frame grabber and a PC were in a measure system developed earlier (FELFÖLDI J., FIRTHA F., GYŐRI E. /1994/). The Fig. 1 shows the structure of measuring system.

To take the photographs four ordinary lamps were used. Diffuse light was used to prevent reflection from the surface of pear. The vegetables were lighted by four lamps too. The surface of vegetables was chosen according to the average color . In the case of cereals, the photo was taken from the shade of seed. That is to say the seed was between the camera and the white paper sheet, which was lighted by lamp.
The used video camera was a Hitachi HV-C20, and the camera included 3 CCD chips. The high color-true pictures were made by this camera.

Shape and color characterisation

Fast Fourier transformation and PQS (Polar Qualification System) method (MARTINOVICH L., FELFÖLDI J., 1996) were used to characterise the shape features of pears and cereals. The results of FFT were the first four Fourier coefficients (SZÉKELY, 1994), characterising the elliptic, triangular, quadratic symmetry of the shape. The PQS method is based on determining of centre of examined object. The color features were examined by a computer software, which can give the average value of the R, G, B parameters of the tested surface (FELFÖLDI J., FIRTHA F., GYŐRI E., 1994). In the case of tomato variety the value of R, G, B parameters were transformed to L, a* and b* parameters in CIELab color system.

Statistical methods

Two methods were used to evaluate the results of image processing.

Discriminant analysis:
The first step was to create 2 parts from the sample. The first part is the training sample. This sample has to be classified by experts before analysing with discriminant analysis. Some classifying functions were created which based on training sample. The other part of the sample, which is the test sample, was classified on the basis of classifying functions.
Artificial neural network:
Actually this method isn't a multivariate statistical method, but it was used as classifying method. The artificial neural network is similar to human neural network and its elements resemble

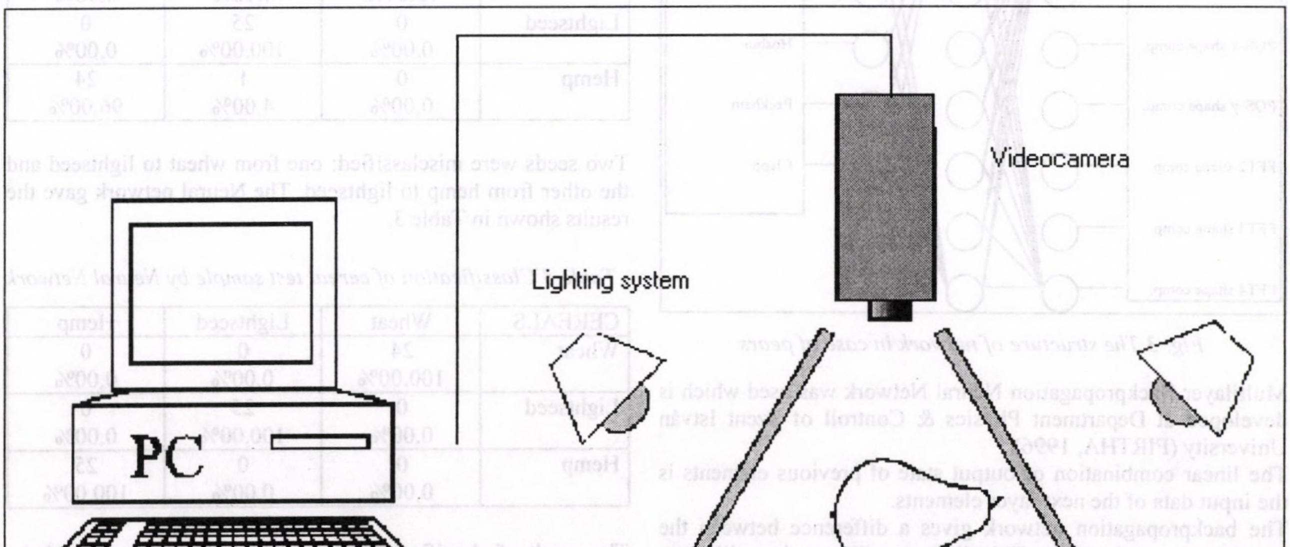
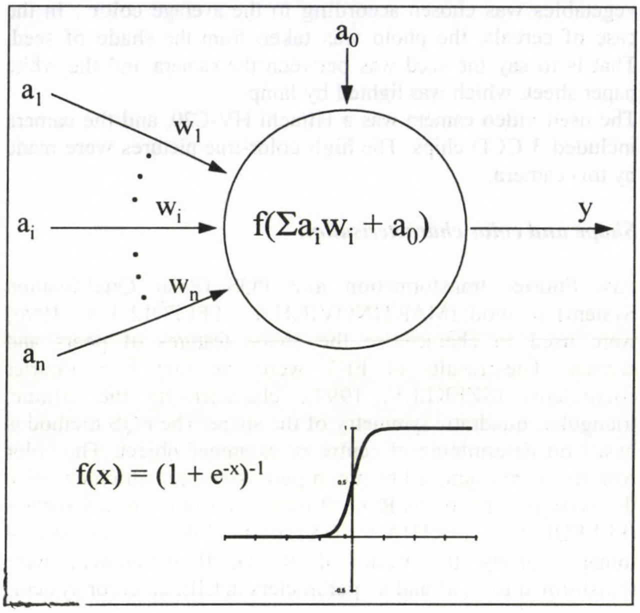


Fig. 1 The measuring system

the neurone. This simple model works with a threshold function based on weighted average of input data.(SIMPSON, 1990) The Figure 2 shows the work of the network's element.



.g. 2 The work of element of the Neural Network

The elements of a network are in one field. That field receives the input data called input layer, that field gives the result called output layer and that field which is between the input and output layer is called hidden layer.

Figure 3 shows the structure of a three layers Neural Network. The input data were the examined parameters and the output data were the classes of fruit and vegetable.

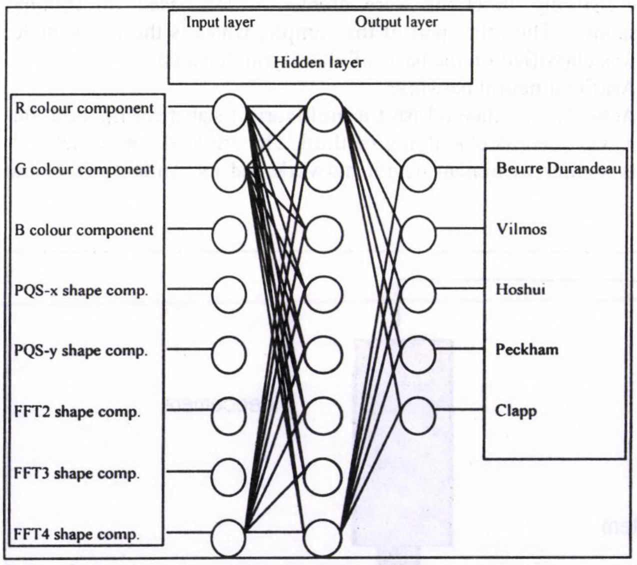


Fig. 3 The structure of network in case of pears

Multilayer Backpropagation Neural Network was used which is developed at Department Physics & Controll of Szent István University (FIRTHA, 1996).

The linear combination of output state of previous elements is the input data of the next layer elements.

The backpropagation network gives a difference between the output data and the target. This difference like a value will be an input data too. The output data is between 0 and 1 according to threshold functions. (If other kind of threshold functions are used, the output value can be between –1 and 1.) The best fit of calculated value to the target group means the 1 value.

At the application of neural network we must use 2 sample parts. One of them is the learning sample. The neural network is created during the learning. This process is based on iterations. One iteration means the combination of the input data. The running time is approximately 32s/5000 iterations with pear cultivars. The other part is the test sample which is unknown for the ready network. The goodness of network classification was measured in application of test sample.

Results

The shape parameters were analysed with the pear and cereal cultivars. The shape parameters were the PQS-x, -y components and the FFT2, FFT3 and FFT4 components.

The classification of the learning sample by the Discriminant Analysis and Neural network were good, but in the case of test sample it was not sufficient. Table 1 shows the result of classification of pear test sample by Neural Network.

Table 1 Classifying of test sample of pear by Neural Network

PEAR VARIETIES	Beurre Durandeau	Vil-mos	Hoshui	Peckham	Clapp kedveltje
Beurre Durandeau	5	0	0	1	1
Vilmos	0	4	0	0	3
Hoshui	0	0	8	0	0
Peckham	2	1	0	1	2
Clapp kedveltje	1	0	0	2	4

The rows are the target groups, the columns show the results of classifying. The results of the classifying of Discriminant Analysis was similar to the result of Neural network. Only the Hoshui cultivar classifying rate was 100%. But in this case this cultivar's shape can be make difference from other four cultivars without any difficulties.

The results obtained with cereals by Discriminant Analysis are shown in Table 2.

Table 2 Classifying of test sample of cereals by Discriminant Analysis

CEREALS	Wheat	Lightseed	Hemp
Wheat	23 95,84%	1 4,16%	0 0,00%
Lightseed	0 0,00%	25 100,00%	0 0,00%
Hemp	0 0,00%	1 4,00%	24 96,00%

Two seeds were misclassified: one from wheat to lightseed and the other from hemp to lightseed. The Neural network gave the results shown in Table 3.

Table 3 Classification of cereal test sample by Neural Network

CEREALS	Wheat	Lightseed	Hemp
Wheat	24 100,00%	0 0,00%	0 0,00%
Lightseed	0 0,00%	25 100,00%	0 0,00%
Hemp	0 0,00%	0 0,00%	25 100,00%

The result of classification was 100%. But in this method the selection of learning sample is very important. Because a not traditional seed-shape from the same cultivar can give an other kind of structure of Neural network, therefor the classification of test sample could give worse result.

In the case of pear samples the classification of shape parameters was only poor. Therefor the color parameters were added to the shape parameters. The result of classification are shown in Table 4.

Table 4 Classification of test pear samples by Discriminant Analysis based on color and shape parameters

PEAR VARIETIES	Beurre Durandeau	Vil-mos	Hoshui	Peckham	Clapp kedveltje
Beurre Durandeau	7	0	0	0	0
Vilmos	0	7	0	0	0
Hoshui	0	0	8	0	0
Peckham	0	1	0	5	0
Clapp kedveltje	0	0	0	0	8

One pear was misclassified from cultivar Peckham to cultivar Vilmos. The method of Neural network the classification was worse than in the method Discriminant Analysis. The number of misclassified pears is shown in Table 5.

Table 5 Classifying of pear test samples of pear by Neural Network

PEAR VARIETIES	Beurre Durandeau	Vil-mos	Hoshui	Peckha m	Clapp kedveltje
Beurre Durandeau	5	0	0	0	2
Vilmos	0	7	0	0	0
Hoshui	0	0	8	0	0
Peckham	0	1	0	5	0
Clapp kedveltje	0	0	0	0	8

With Neural Network two more pears were misclassified. The same Peckham pears were misclassified too. This special pear's shape and color resemble better to an ordinary Vilmos pear than to an ordinary Peckham Triumph pear. Because this pear's shape is more prolate than cultivar Peckham, its color is more yellow than an ordinary Peckham Triumph which is green.
In the case of Heinz tomato the classification by Neural Network was more successful than the classification by Discriminant Analysis.

In the tomato sample 3 different colors were taken into account: green, pink and red. These different color were in different groups.
The results of classification of tomato test samples by Discriminant Analysis are shown in Table 6.

Table 6 Classification of tomato test samples by Discriminant Analysis

TOMATOES	Green	Pink	Red
Green	13 92,86%	1 7,14%	0 0,00%
Pink	0 0,00%	14 100,00%	0 0,00%
Red	0 0,00%	2 4,76%	40 95,24%

With this method three tomatoes were misclassified, but in the case of classification by Neural Network, the classification gave a better result. None of tomatoes were misclassified That is shown in Table 7.

Table 7 Classifying of test sample of tomato in Neural Network

TOMATOES	Green	Pink	Red
Green	14 100,00%	0 0,00%	0 0,00%
Pink	0 0,00%	14 100,00%	0 0,00%
Red	0 0,00%	0 0,00%	42 100,00%

The results of analysis was confirmed by the sensory analysis.

Conclusions

The results show that the computer vision system is suitable for detecting color and shape parameters of pear, tomato cultivars and cereals and can give objective indices for classification parameters. The Neural Network gives acceptable classification results, but a systematic preliminary work is needed for the appropriate selection of training sample. The selection of right shape and color parameters is also very important. In the case of tomato cultivars homogeneity analysis is also possible with Neural Network.

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DEVELOPMENT RESEARCH OF AC HYDRAULIC ENERGY TRANSFER

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Summary

Application of the method of AC hydraulic energy transfer results in several advantages. The objective of our research is to provide an ongoing operational experimental model of this transfer. In the course of the procedure an acceptable clarification of constructional and theoretical questions is to be also provided. Idle running tests and loading tests are to be designed to describe the basic static and dynamic transfer properties. We would like to create- as a result of some constructional variant s - a very efficient energy transfer, which can be widely applied, and its operation is economical. Vibration stump lifting seems to be a perfect forest application. In case the stump is vibrated it accelerates and lightens the procedure of stump lifting. It also decreases the power and moment- stress needs. The significant task is to optimise the parameters of the vibration (frequency, amplitude). A diphasic AC system is suiatable for stump lifting, where the motion of the hydraulic generator is rotary and the motion of the hydraulic engine is linear. The amplitude and the frequency of the vibration can be adjusted and controlled by the alteration of the liquid stream.

1. Introduction

There are two groups of hydraulic transmissions:
– hydrostatic transmission,
– hydrodynamic transmission.

The group of hydrostatic transmission can be separated into the following sub-structures:
– DC hydraulic transmission,
– AC hydraulic transmission.

The application of the AC hydraulic transmission system results in several advantages. It is applicable in all the cases when at low revolution per minute a heavy efficiency is expected. When the user realises that the above outlined parameters should be taken into consideration the application of this system is beneficial since it can be directly applied. The base machine makes building in the switch-lever unnecessary. The principle has been successfully applied (base machine of flood plain winch, hauliers).

2. Forest application

An ideal application of AC hydraulic transmission is the vibration stump lifting method. If forest regeneration is carried out by the method of full soil preparation and stumps are to be extracted, collected and transported. The procedure of stump removal can be carried out several ways. Nowadays stump-lifting technology seems to be the most efficient way. This procedure requires tremendous power (several thousand Newton) and it also requires heavy efficiency (tremendous moment) at a low revolution per minute. The quantity of the required power and moment depends on the following factors: heavy soil conditions, tree species, diameter of the stump to be extracted. In case the stump is vibrated it accelerates and lightens the procedure of stump lifting and it also decreases the power and moment-stress needs. The significant task is to optimise the parameters of the vibration. The optimum level is expected to be on the resonance frequency. So the log's own frequency is to be determined, and vibration must be performed at this level. A very specific spring – mass mechanical composition model must be drafted, which is able to describe the behaviour of the stump left in earth when it is vibrated. When this mechanical model is done we are able to determine the own frequency of the earth – root – stump system, and we can also outline the expected amplitude. Our objective is to provide an experimental ongoing operational model, and clarification of certain constructional and theoretical questions. Idle running tests and loading tests are to be designed to prove the basic properties of static and dynamic transmission. As a result of several constructional experimental variants we would like to create a transmission model, which can be widely use and economical.

3. Establishment of vibration

Vibration can be established several ways with the application of AC hydraulic transmission. The Fig. 1 demonstrates a theoretical draft of a base machine, where vibration is provided by an excenter. The amplitude and the frequency of the vibration is adjusted and controlled by the liquid stream.

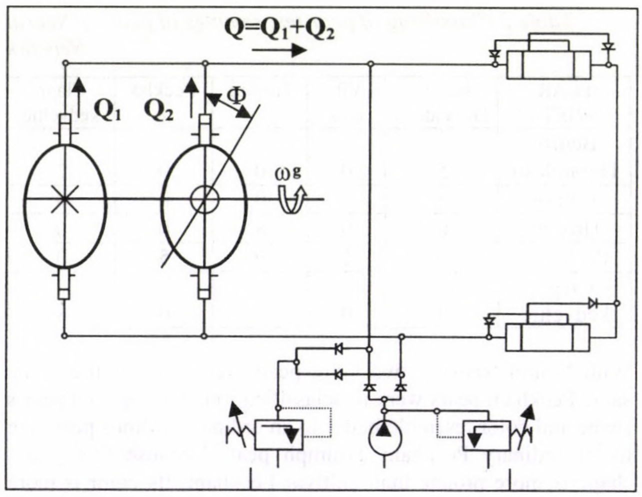

Fig. 1 Theoretical Draft of the AC Base Machine

Based on the 1. Figure we can verify that

$Q = Q_1 + Q_2$

Furthermore we can verify that

$Q_1 = Q_0 \sin \omega_g t$
$Q_2 = Q_0 \sin (\omega_g t + \Phi)$.

The resultant is as follows:

$Q_e = Q_{0e} \sin (\omega_g t + \Psi)$

Where Ψ is the angle of phase displacement and it can be determined the following way:

$$Q_0 \sin \omega_g t + Q_0 \sin (\omega_g t + \Phi) = Q_{0e} \sin (\omega_g t + \Psi)$$
$$Q_0 \sin \omega_g t + Q_0 (\sin \omega_g t \cos \Phi + \cos \omega_g t \sin \Phi) =$$
$$= Q_{0e} (\sin \omega_g t \cos \Psi + \cos \omega_g t \sin \Psi)$$
$$\sin \omega_g t (Q_0 + Q_0 \cos \Phi) + \cos \omega_g t (Q_0 \sin \Phi) =$$
$$= \sin \omega_g t (Q_{0e} \cos \Psi) + \cos \omega_g t (Q_{0e} \sin \Psi)$$
$$Q_0 + Q_0 \cos \Phi = Q_{0e} \cos \Psi$$
$$Q_0 + Q_0 \sin \Phi = Q_{0e} \sin \Psi$$

$$\text{tg}\, \Psi = \frac{Q_0 (1 + \sin \Phi)}{Q_0 (1 + \cos \Phi)}$$

Maximum level of liquid stream is expected when $\Psi = 0$, namely there is no phase displacement. In case we do not want liquid-supply ($Qe = 0$), $\Phi = 180°$ must be adjusted. Largeness of the liquid stream can be adjusted between the maximum and minimum value without staging. The amplitude of the vibration depends on the quantity of the liquid stream. The frequency of the vibration depends on the value of ω_g. The establishment of vibration should be carried out by the most suitable, most adequate way.

4. Extension

The Forest and Wood Limited Company, Kiskunság has bought a CASE POCLAIN 1188 CK machine for stump extraction. It is hydraulically operated and it is equipped with a special grabber. This machine can be applied in economic way in the following conditions: medium stump diameter, medium heavy soil. There is a development research duty: how to create the experimental AC base machines that way to be adopted for this machine. It would result in a more advanced application of the machine.

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APPLICTAION OF COMPUTER AIDED MODELLING IN DEVELOPMENT RESEARCH OF FOREST MECHANIZATION

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Summary

Theoretical operational basis of the agricultural machinery has already been described. But on the other hand a similar description of the forest machinery does not exist. At the same time agricultural machines can not be adopted in forest utilisation since forest conditions are sometimes totally different from the agricultural ones.
Formerly certain mathematical calculations required plenty of time and energy since computer background was missing. Nowadays computer programmes - based on the finite-element method – are designed for this job. The advantages of the finite-element method- aided planning are as follows:

– fast and cost-effective, since being familiar with the modell the most suitable machine is to be created without manufacturing several experimantal machines for testing,
– operational testing under all conditions is not necessary,
– there is a very good possibility for strength and functional analysis of the projected machine.

Naturally the computer aided modelling is not enough. A running in test of the prototype is also necessary. This sort of testing is designed to satisfy the following needs: on one hand it should detect the possible unreliability of the modelling procedure, and to prove the theoretical calculations with the hands on experience on the other.

Introduction

An environmental friendly forest management requires new technologies and techniques. This new attitude has resulted in giving up stump- lifting technologies in certain areas. These forest areas demands new technological and technical application, which must be less harmful for the environment, and are suitable for operations in stumped lands.
To meet the high demands of the above outlined need a very efficient analysis and a sophisticated description of the theoretical procedure and the equipment is indispensable.
A reasonable quantity of the necessary information is needed for the development research and the operational experts to achieve a professional, cost effective and economical operation of the machinery. Modification of the designed and manufactured machinery and its adoption to be relevant for the conditions and circumstances can be carried out only on the very basis of theoretical knowledge. A professional level of maintenance also can not be performed without a fair knowledge of the power and efficiency parameters.
The objective is to operate the machine with a high output, optimum quality parameters and the possibly lowest energy consumption. The satisfactory theoretical knowledge of the following factors is required to define the properties of the machine to meet the demands: size of the machine, size of its tools, arrangement of the tools, revolution per minute, hauling power, driving power, efficiency indices and other technical parameters.
Other analysis of soil cultivators in stumped lands should be designed in order to provide a full description of its operation. Theoretical description of such tools has not been provided for the time being. (Neither tools in use.)
Replacement of this description is absolutely necessary.

Development possibilities of soil-preparation machinery

Development research of agricultural machinery regards machine testing as a very efficient element of the development procedure. Results of the testing procedure displays the possibilities of its application, the quality of the work (under certain conditions), the possible operational faults, structural shortcomings.
Modells may have efficient adoption in two possible ways: Providing suitable basis for the design of similar device, and providing efficient basis for further development.
Theoretical operational description of the agricultural machines has already been done. But machinery applied in forestry has not been outlined this way yet. At the same time agricultural machinery can not be adopted in forestry since the conditions and circumstances are totally different.
The analysis and theoretical description of the agricultural machinery used in soil preparation is very significant since the different works of soil preparation (stump-lifting, brush – cutting, clearing of cutting area, soil cultivation) are really expensive. (50 – 60 % of the cost of forestation in national average)
The correct clarification of the correspondence was almost impossible without the computer aided background since tremendous and endless calculation was required. Nowadays the efficient computer aided method- based on the finite-element method- is applicable to meet the demands. There are several softwares: COSMOS, ANSYS, NASTRAN. These are finite – element analytical programmes. Application of these softwares has already been launched in forestry research.

Modelling soil-machine correlation

Establishment of the computer soil - model that is really difficult in modelling soil – machine correlation.
Modelling the machinery is relatively simple knowing the structural parameters and the material characteristics.
The description of the mechanical properties of the soil and the description of its regularity is really a difficult job since its complicated structural construction and its inhomogenity. The descriptions of soil characteristics applied nowadays have not properly described the mechanical behaviour of the soil under all conditions.
The results and correlation's of the experimental works can not be generalised without limitations.
Once fertile soil is regarded to be a non-linear, elastic material. According to others soil is an elastic, non-linear material, while other say it is an elastic, plastic non-linear system. Viscoelastic properties of soil should also be taken into consideration.
In **SITKEI'S** (1986) opinion the most significant characteristics of soil are as follows:

– load - bearing capacity, its modification depending on depth
– bulk density or (ratio of pore)
– moisture content
– cohesion
– internal friction coefficient
– shear deformation coefficient
– stress consolidation
– viscoelastic properties
– thixtoropic properties

Since mechanical properties of soil depend on its moisture content general weather conditions are in a close correlation with the possible distribution of the soil properties. An additional difficulty may occur in our forests as far as stumped and rooted lands are concerned.
The most significant parts of root-system is situated mainly close to the soil surface. 65–85 % of the length of the roots are available in the top 10 cm of the soil. The bigger the tree is the bigger diameter of its roots is about to be developed. (more than 20 mm) They go farther from the trunk. The fine, lateral roots are available in the top soil layer in huge quantities.
In the top soil layer 60-120 root / square meter is available. Their maximum length is about 200-500 meter. Less than 7 % is

thicker than 10 cm. The lateral root – system of an older tree – in case of lean soil-interweaves the soil in a 5-7 radial circle.
The occurrence of roots may increase the solidification of the soil. (The increment even can be 50-70 %)
On the other hand the quality of the root-system may influence the natural consolidation of the soil. (Over 1,25 g/cm3 the development of fine root-system is limited, only the saline root area is interwoven, over 1,35 g/cm3 the development of fine root-system is practically ceased, this kind of soil can not be regarded as a substrate to be interwoven.)
Numerical definition of the influence the root-system can be carried out with the addition of the total root- cross-section of the surfaces.
Further difficulties may occur as far as methodological and metrology-technical questions are concerned. It means that several surveying, measuring field experiments must be carried out. Since – for example – moisture content is about to modify the basic properties of soil, field experiments must be taken on the same premises for a long time.
Testing extensiveness of root-system is a very difficult procedure from the point of view of methodology. Application of rhizoscope can be beneficial.

Definition of necessary parameters

At the current stage of our investigation we are about to define the necessary parameters. We have been trying to find correlation between the genetic soil types and the consolidation of soil. Meanwhile soil cultivation is in process – under different moisture content- soil loosening is measured, and the need of hauwling power is tested. Testing hawling power is a sophisticated device to supervise the model to be created.
Physical and mechanical properties of the soil, its consolidation, its moisture content is measured by „3T System". It is an electronic layer indicator. This equipment has been designed to measure the consolidation and moisture content of the soil in 1 cm soil layers. The moisture content of the soil is defined in proportional percentage of arable land water capacity (pF 2,5) The soil penetration is registrated in kPa as a value of penetration resistance of the cone (60 0, 12,5 mm).

The measuring procedure enables us to define the most significant soil types and to define all the necessary parameters to create the model, and we can also come across some very useful pieces of information about the correlation between the moisture content and optimal soil cultivation, and last but not least: what the moisture conditional limits of the efficient cultivation are.
Meanwhile modelling the following forest machinery has been applied:
- EFE 1 Type strip plough
- TPF-2 driven hard pulley
- BPG 600 rotating strip machine
- ROTOR type, soil-cutter
- Forest soil looseners
- Forest interrow disc cultivator

Preferences

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FOREST STEAM SEDIMENT TRANSPORT IN SOPRON MOUNTAIN

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Abstract

Small catchments research is the best way of studying erosion processes and sediment transport in the upper, forest covered watersheds. This study runoff caused erosion and sedimentation processes have been analyzed under conditions of forest exploitation in two neighbouring catchments, between the years 1996-99 (Farkas-valley (FÁ) and Vadkan-valley (VÁ), **Figure 1**.). Two sediment forms have been examined, bed load and suspended sediment. Not only the sediment yield, but also quality parameters of sediment have been analyzed and evaluated. Correlation system between sediment quantity, quality parameters and environmentally variables were determined, too.

1. Introduction

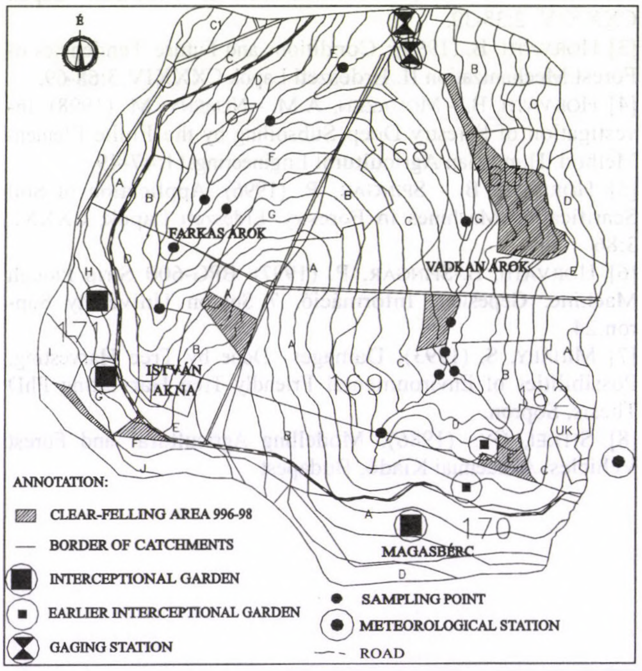


Fig. 1 Experimental catchments

Sediment loss data of forest covered area is fairly few. In Hungary Forest Research Institute measured firstly forest covered area erosion and sediment transportation processes in Mátra-mountain (Bánky, 1959; Újvári, 1981). In Sopron-mountain sedimentation research of Mihály Kucsara and József Rácz could be mentioned in this subject (Kucsara-Rácz, 1991).

Abroad forest stream sediment transport is examined in detail by Lisle, 1979, Parker and Klingemann, 1982, Jackson and Beschta, 1982; Milne, 1982; Andrews, 1983; Sidle and Campbell, 1985; Chikita, 1996.

Geological basis of the research area is alluvial deposit, which is strongly unclassified. 70-80 cm deep in soil has a loamy layer and because of water retaining effect this layer prone to erosion. Lot of earthfall can be found on steep slope beside stream system especially in FÁ.

For the last few years fairly lot clearfalling area took place, caused by woodborer disease, in this territory. In VÁ the clear-felling area was bigger and closer to the stream system (**Figure 1**.) therefore exploitations had stronger effect to the stream sediment transport.

2. Material and method

2.1. Measure of environmental parameters

Environmental parameters connected with sediment movement are measured inside experimental cathcments. Climate (e.g. precipitation and temperature) data comes from the central meteorological station and automatic climatic station, which can be found in interceptional gardens (uphill). Water discharge has been measured at the outflow point of catchments by automatic gaging stations (**Figure. 1**.).

2.2. Sediment measuring

Bed load sediment volume has been measured at gaging station water box by cubing. This type of sediment unlike big rivers mineral bed load sediment, because of high organic compound rate.

Suspended sediment has another sampling method. Suspended sediment concentration was measured by water filtering.

Sampling period weekly or casually depending on precipitation events.

2.3. Data analysis

Firstly data were analyzed by simple statistical methods (mean and extreme values, standard deviation analysis, time series analysis). Later relationships have been discovered between environmental parameters and sediment parameters with correlation and principal component analysis. Some processes have been characterized numerically with regression analysis.

3. Results

3.1. Bed load sediment

3.1.1. Time series of the bed load sediment discharge

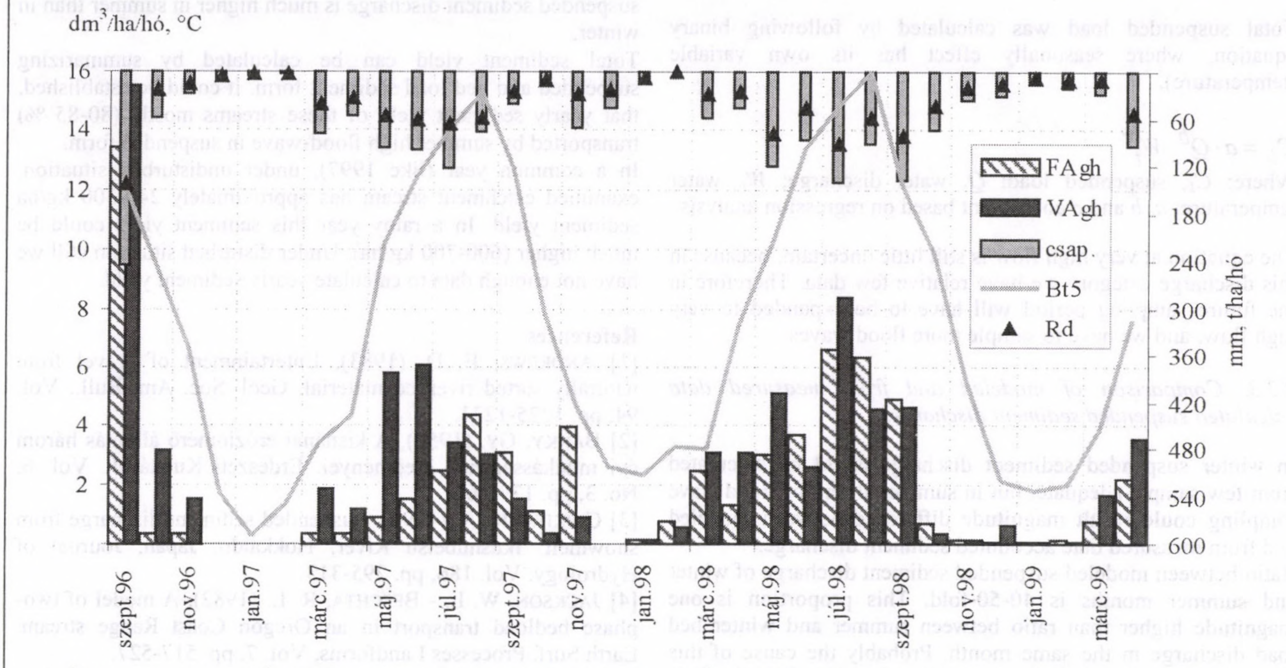
Minimum monthly values of bed load sediment are generally in the coldest winter months. The least value was in 1999 January (FÁ-VÁ, 0,05-0,09 dm^3/ha/hó), because this was one of the coldest month of sampling period. Maximum monthly value (FÁ-VÁ, 13-16 dm^3/ha/hó) was in September 1996, when a far-out precipitation took place. Common years the biggest bed load sediment movement occurs in July, August and September, when intensive rainfall events fall onto the soil surface. (**Figure. 2**.)

Average bed load discharge difference between summer and winter month is 20-30-fold. This difference is bigger when winter is cold and summer is rainy and smaller when winter is warm and summer is dry.

In Vadkan-valley some months after the stream adjacent to clear-felling (1996. summer; 1997. late summer) bed load discharge increasing (2-6-fold) and formation of sediment reservoirs could be detected. Opposite to this in Farkas-valley little earthfalls along the stream raise sediment discharge (twofold). In this catchment clear-felling so far from the stream that they have no impact on the stream sediment tarnsport at all. In both catchments existing sediment reservoirs cause high fluctuation of bed load discharge.

3.1.2. Bed load sediment yield at basic flow, high flow and at different precipitation categories (0-5, 5-10, 10-20, 20 mm<)

At basic flow period temperature effect is determinant onto bed load transport. Summer and winter sediment yield ratio is 4-20-fold in FÁ and 5-10-fold in VÁ. The basis of this difference is the time of clear-felling and the earlier snow melting in VÁ.



VÁ, Vadkan-valley; FÁ, Farkas- valley; gh, bed load discharge (dm³/ha/hó); csap, precipitation (mm), Bt5, soil temperature in 5 cm deep(°C), Rd, erosivity factor (t/ha/hó)

Fig. 2 Monthly bed load sediment discharge

At high flow bed load sediment yield has the strongest correlation with precipitation and erosion index (Wischmeier-Schmith, 1960), but the impact of temperature is not negligible. Summer and winter sediment yield ratio at high flow period is 15-50-fold in FÁ and 20-30-fold in VÁ. These ratio are higher than at basic flow, but causes are similar.

Bed load yield at high flow in comparison with total bed load yield is similar in case of two catchments, on average 88-90 %. During summer and early fall rainy period this ratio is higher (90-95%), but mild, arid fall-winter period remarkably small (30-50 %).

Daily sediment yield at big rainfall (20 mm<) is 40-fold higher than value of the lowest precipitation category (0-5 mm).

The biggest difference between daily sediment yield of valleys is in the 5-10 mm categories. The cause of difference is higher opening (from climatic point of view) and smaller forest covering (especially in expanded zone of runoff) of VÁ. These features of VÁ cause higher flow and sediment yield at little rainfall categories.

The biggest difference of daily sediment yield is between 10-20 mm and 20 mm< precipitation categories in rainy period (e.g. in 1996-97: 10-20-fold). Extreme rainfall cause large bed load discharge at undisturbed catchment, too. After this period smaller rains could not move considerable sediment amount especially in case of undisturbed catchment, where sediment reservoirs are totally depleted by previous extreme rainfall and no more sediment supply from clear-felling area.

3.1.3. Bed load sediment quality parameters

Beside bed load sediment magnitude, quality parameters (medium grain size, uniformity coefficient, organic compounds, density) have been analyzed, too. In connection with this parameters results are the following.

Sediment transport connected with clear-felling and earthfall diminish medium grain size 20-30 %, because of fine particles appearance. Sediment reservoir formed by clear-felling hold back coarser sediment and therefore sediment discharge becomes finer.

In connection with clear-felling and earthfall uniformity coefficient (U) arise and grain size distribution curve overlap wider particle range. As rainfall becomes higher, bed load sediment becomes more uniform and U decrease. But in case of extreme rainfall U increase, because of the sediment reservoirs are set free and bed armour broken up.

Sediment organic content increase 2-3-fold because of the clear-felling, but after earthfall organic content could be extremely high (27-28 %), too. Arid period organic content of bed load sediment is generally 10-15 %, in high flow period only 1-5 %.

In winter bed load sediment density is 40-50 % lower, than in summer. Bed load sediment density decrease after clear-felling and earthfall, because organic compounds diminish density.

3.1.4. Principal component analysis

Correlation system of bed load sediment discharge parameters and environmental factors had been analyzed with principal component analysis.

Basis of the correlation could be pointed out, that difference between catchments sediment characteristics appear strongest in maximum daily sediment discharge, organic content and density of bed load sediment. Therefore these parameters are the best for marking disturbance.

3.2. Suspended sediment

3.2.1. Suspended load and suspended sediment discharge characteristics at basic flow

Basic flow suspended loads are generally 5-10-fold higher in summer (110-220 mg/l) than in winter (20-50 mg/l). During an extremely cold winter period, when stream-water is over cooled, suspended load is very minimal (2-4 mg/l).

Both clear-felling and earthfall increase suspended load, but while clear-felling has delayed impact, earthfall (beside the stream) raises instantly suspended load.

Suspended sediment discharge in summer 3-8-fold higher, than in winter. The cause of the decreasing ratio compared to suspended load is higher winter basic flow.

3.2.2. Suspended load model

Total suspended load was calculated by following binary equation, where seasonally effect has its own variable (temperature).

$$C_k = a \cdot Q^b \cdot W_t^c$$

Where: C_k, suspended load; Q, water discharge; W_t, water temperature; a, b and c coefficient based on regression analysis.

The equation at very high flow is still little uncertain, because in this discharge category we have relative few data. Therefore in the future sampling period will have to be expanded to very high flow, and we have to sample more flood waves.

3.2.3. Comparison of modeled and from measured data calculated suspended sediment discharges

In winter suspended sediment discharge could be calculated from few sample adequate, but in summer absent of flood wave sampling could result magnitude difference between modeled and from measured date accounted sediment discharge.
Ratio between modeled suspended sediment discharge of winter and summer months is 40-50-fold. This proportion is one magnitude higher than ratio between summer and winter bed load discharge in the same month. Probably the cause of this difference could be that temperature has stronger effect for finer particle than coarser grain size.

3.2.4. Monthly sampling of stream system

Catchments were walked and streams were sampled monthly. These examination results are the following:
Suspended load difference is higher (20-30%) beside disturbed place (clear-felling, earthfall, stream-bed erosion) still at basic flow.
In high flow period 2-3 times higher suspended load has been detected at disturbed sampling point, especially next to clear-felling place.

3.3. Comparison of sediment forms

Suspended and bed load sediment ratio of forest stream is 30-40-fold in summer and a magnitude lower (2-3-fold) in winter. The difference between ratio comes from the fact that suspended sediment discharge is much higher in summer than in winter.
Total sediment yield can be calculated by summarizing suspended and bed load sediment form. It could be established, that yearly sediment yield of these streams mostly (80-85 %) transported by summer high flood-wave in suspended form.
In a common year (like 1997), under undisturbed situation, examined catchment stream has approximately 240-300 kg/ha sediment yield. In a rainy year this sediment yield could be much higher (600-700 kg/ha). Under disturbed situation still we have not enough data to calculate yearly sediment yield.

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Table 1 Suspended loads and discharges in Farkas valley

Farkas -valley	Summer (97. Július)				Winter (98. Február)			
	model conc.	model yield	total mass	sampled yield	model conc.	yield	total mass	sampled yield
	mg/l	*kg/ha*	*%*	*kg/ha*	*mg/l*	*kg/ha*	*%*	*kg/ha*
Basic flow	353,7	16,1	11,5		24,5	0,9	33,6	
High flow	1044,7	123,0	88,5		63,7	1,8	66,4	
Peak flow	3636,0	105,1	75,6					
Sum.	621,2	139,2	100	32,09	37,09	2,7	100	2,2

DETERMINING THE TENSILE STRENGTH OF GLASS METALS USING A THEORETICAL METHOD

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Abstract

A computer algorithm based on a topological model has been created to determined the tensile strength of glass metals in a theoretical way.

1. Introduction

The algorithm is based on two theoretical considerations, the interactions between atoms and the theoretical model of the atomic structure of glass metals.

Interaction between atoms:

It is known from solid state physics that the interaction (force) between pairs of atoms can be derived from the gradient of the energetic potential function. Figure 1 shows the well-known Lennard-Jones and Morse potential functions and their gradients (the distance between the atoms /r/ was not considered as a vector for simplicity).

Lennard-Jones potential:

$$U(r) = \varepsilon\left[\left(\frac{\sigma}{r}\right)^{-12} - 2\left(\frac{\sigma}{r}\right)^{-6}\right],$$

where 'r' is the distance between the atoms,
'σ' is the optimal distance of the atoms,
'ε' is a constant depending on the material.

Morse potential:

$$U(r) = \varepsilon\left\{\exp\left[2\alpha\left(\frac{\sigma}{r}-1\right)\right] - 2\exp\left[\alpha\left(\frac{\sigma}{r}-1\right)\right]\right\} f$$

$$\text{where } f(y) = \begin{cases} 1 & y \le 1 \\ 3z^4 - 8z^3 + 6z^2 & 1 < y < 1{,}4 \\ 0 & 1{,}4 < y \end{cases}$$

$$\text{and where } z = \frac{1 - r/\sigma}{1 - r_c/\sigma}$$

$y = r/\sigma$, $\alpha = 3{,}76$

$r_c/\sigma = 1{,}4$

According to the diagrams:

- If the distance of the atoms equals the optimal distance (r=σ), the two atoms are in mechanical equilibrium, the force is zero (see below) and the binding energy is at its minimum (see above).
- If r>σ, then an attracting interaction is in effect between the two atoms. The range of the attraction force is R=2σ in case of the Lennard-Jones potential, and R=1,4σ in case of the Morse potential. Thus, if the distance of the atoms is r>R, the attraction force can be considered zero.
- In the case of both energetic potentials the attraction force has its maximum in the interval of σ<r<R. If the two atoms are to be separated, detached from each other, a certain maximal force has to be overcame.

The theoretical tensile strength of crystalline metals was calculated by Orowan and Polanyi by determining the maximal

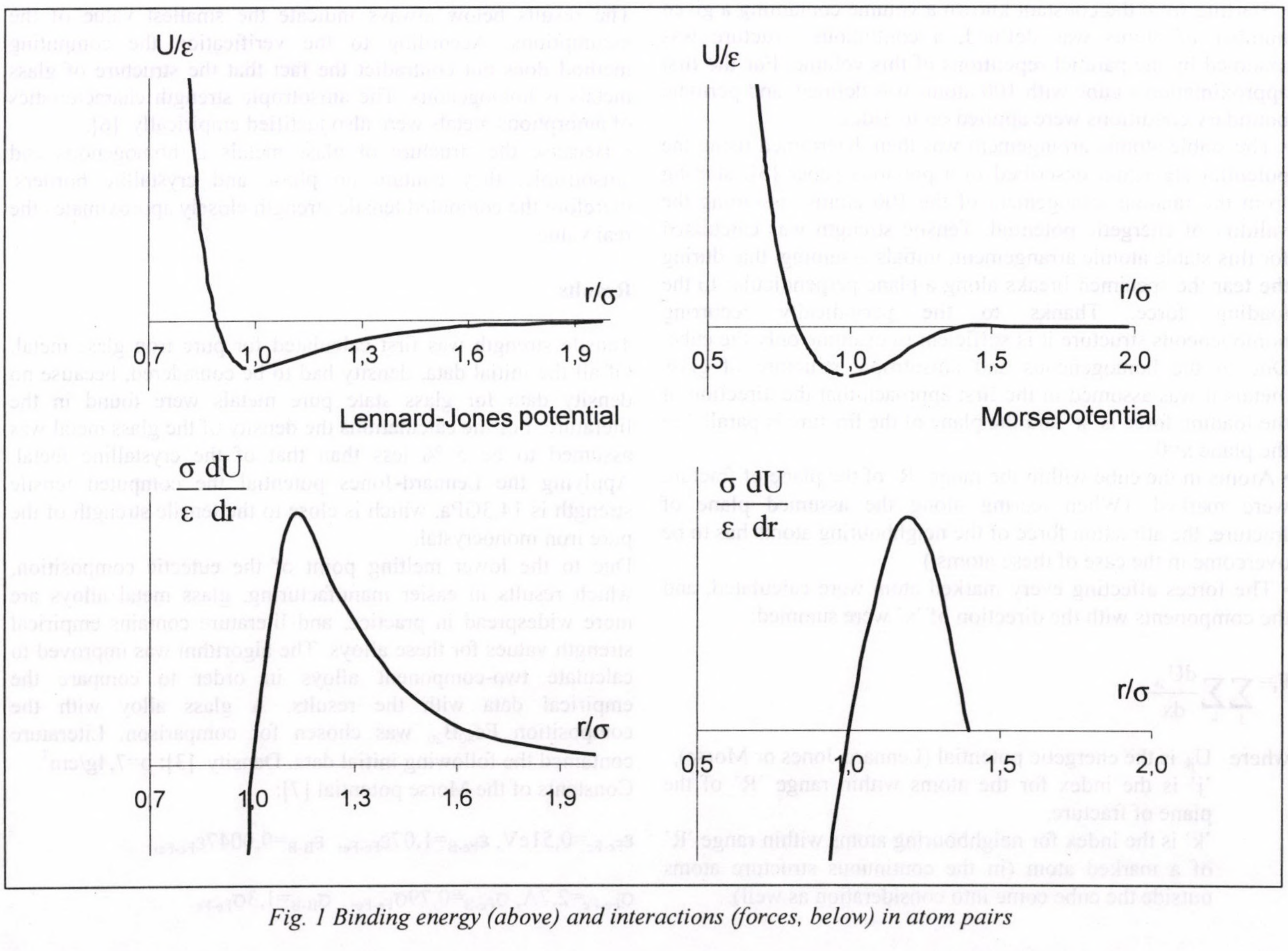

Fig. 1 Binding energy (above) and interactions (forces, below) in atom pairs

attraction force mentioned above [1]. Their results equaled the actual tensile strength of flawless monocrystals produced later, and this value is larger by a grade than tensile strength of polycrystals.

The structure of glass metals:

The structure of glass metals is identical to crystalline metals insofar as they are both atomic structures with metallic bonds. In the case of glass metals, however, the metal atoms are not arranged regularly and periodically. This inordinate atomic structure is homogeneous, anisotropic, it contains no phase or crystallite borders. This characteristic is transmitted from the liquid state thanks to the very sudden cooling during the production.
The interactions determined with the energetic potential are valid among the atoms of glass metals as well. Molecular dynamic models utilising the validity of the energetic potentials refer to glass metals in many cases.

2. Step of the Tensile Strength Calculating Algorithm

The atomic structure of glass metals was modelled with an inordinate but equilibratory, homogeneous and anisotropic structure. Tensile strength was calculated from this model by seeking the maximal force necessary for tearing, considering the atomic interactions.
The steps of the algorithm (Fig.2.):

- In order to begin the density and atomic weight of the glass metal and the constants of the material for the energetic potential are needed. Atomic weight and the material`s constant can be found in the appropriate tables. The density of glass metals has been measured for many alloys [2],[3]. If the results are unknown, it can be assumed that the density of the glass metal is by 2-5% less than the density of crystalline metals and alloys with identical composition [4].
- Starting from the constant known a volume containing a given number of atoms was defined; a continuous structure was assumed by the parallel repetitions of this volume. For the first approximation a cube with 100 atoms was defined, and periodic boundary conditions were applied on its sides.
- The stable atomic arrangement was then determined using the potential algorithm described in a previous paper [5], starting from the random arrangement of the 100 atoms, assuming the validity of energetic potential. Tensile strength was calculated for this stable atomic arrangement, initials assuming, that during the tear the specimen breaks along a plane perpendicular to the loading force. Thanks to the periodically recurring homogeneous structure it is sufficient to examine only the cube. Due to the homogeneous and anisotropic structure of glass metals it was assumed in the first approach that the direction of the loading force is `x` and the plane of the fracture is parallel to the plane x=0.
- Atoms in the cube within the range `R` of the plane of fracture were marked. (When tearing along the assumed plane of fracture, the attraction force of the neighbouring atoms has to be overcome in the case of these atoms.)
- The forces affecting every marked atom were calculated, and the components with the direction of 'x' were summed:

$$F_i = \sum_j \sum_k \frac{dU_{jk}}{dx},$$

where U_{jk} is the energetic potential (Lennard-Jones or Morse),
'j' is the index for the atoms within range 'R' of the plane of fracture,
'k' is the index for neighbouring atoms within range 'R' of a marked atom (in the continuous structure atoms outside the cube come into consideration as well).

- One of the sides of the structure was shifted along the assumed plane of fracture by dx. (calculations were made with the accuracy of $dx = \frac{R}{100}$.)
- The last two steps were repeated until the length of the total shifting reached 'R' (with the value $dx = \frac{R}{100}$ this meant 100 repetitions, $0 \le i \le 100$).
- The maximal force needed for the tearing was calculated: $F_{max} = \max(F_i)$, tensile strength was then determined as: $R_m = \frac{F_{max}}{A}$,

where 'A' is the area of the side of the cube containing the 100 atoms.

The created method of determining tensile strength is crude, because it is a very strong assumption that the fracture is a plane. It was expected, however, that the results will closely approximate the real tensile strength of glass metals for the following considerations:

- Orowan`s calculations started assuming fracturing along a flat surface, too, and their results matched the measured tensile strength of monocrystals well. In the case of amorphous atomic structures, however, the assumption of the flat fracture needs further verification in another respect. Namely, we cannot tell along which plane will the fracture occur, we do not know if such a plane exists that can be shifted with a force lesser then the force needed for shifting the above assumed plane x=0. The latter uncertainty of the method was tested as follows: the maximal attraction force was calculated for the same stable amorphous structure assuming different planes of fracture, and the smallest value was selected. Calculations were done for 10-10 assumed planes (30 altogether) parallel with the planes x=0, y=0, z=0. The differences of the resulting maximal forces were not significant; the difference between the greatest and the smallest value was always less than 8% of the smallest value. The results below always indicate the smallest value of the assumptions. According to the verification the computing method does not contradict the fact that the structure of glass metals is homogenous. The anisotropic strength characteristics of amorphous metals were also justified empirically [6].
- Because the structure of glass metals is homogenous and anisotropic, they contain no phase and crystallite borders, therefore the computed tensile strength closely approximates the real value.

Results

Tensile strength was first calculated for pure iron glass metal. Of all the initial data, density had to be considered, because no density data for glass state pure metals were found in the literature. For the calculations the density of the glass metal was assumed to be 5 % less than that of the crystalline metal. Applying the Lennard-Jones potential the computed tensile strength is 14,3GPa, which is close to the tensile strength of the pure iron monocrystal.
Due to the lower melting point of the eutectic composition, which results in easier manufacturing, glass metal alloys are more widespread in practice, and literature contains empirical strength values for these alloys. The algorithm was improved to calculate two-component alloys in order to compare the empirical data with the results. A glass alloy with the composition $Fe_{80}B_{20}$ was chosen for comparison. Literature contained the following initial data. Density [3]: ρ=7,4g/cm^3.
Constants of the Morse potential [7]:

$\varepsilon_{Fe\text{-}Fe}$=0,51eV, $\varepsilon_{Fe\text{-}B}=1{,}07\varepsilon_{Fe\text{-}Fe}$, $\varepsilon_{B\text{-}B}=0{,}0047\varepsilon_{Fe\text{-}Fe}$,

$\sigma_{Fe\text{-}Fe}$=2,7A, $\sigma_{Fe\text{-}B}=0{,}79\sigma_{Fe\text{-}Fe}$, $\sigma_{B\text{-}B}=1{,}3\sigma_{Fe\text{-}Fe}$.

An approximate initial distribution has to be specified in addition to the constants. The following starting distribution was assumed for the iteration: Fe atoms were placed at the vertices and the centres of the sides of a cube, while B atoms were positioned in the body-centre. Initial density was selected 5% less (heating), and the iteration was then done using the value given in the literature. The approximation was crude, but the result of the iteration was a stable glass structure with realistic density. The tensile strength computed with the algorithm is 3.2Gpa. This value can be compared with the empirical results. The measured tensile strength of the $Fe_{80}B_{20}$ alloy is 3.7Gpa, [3]. Some typical tensile strength values are summarised in Table 1. The values of some high-strength steel alloys are shown for information.

According to the Table 1, the values calculated with the algorithm closely match the empirical data in the literature.

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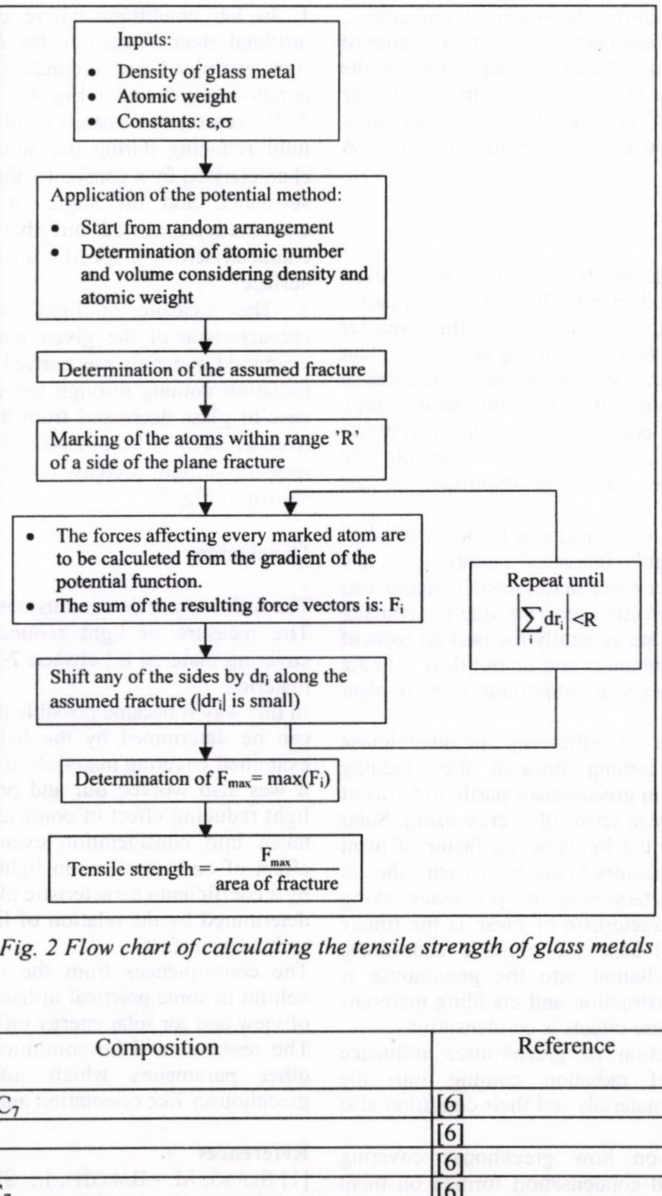

Fig. 2 Flow chart of calculating the tensile strength of glass metals

Table 1

Composition	Reference	Tensile strength GPa	
$Fe_{60}Ni_{20}P_{13}C_7$	[6]	(empirical)	2.45
$Fe_{80}P_{13}C_7$	[6]	(empirical)	3.04
$Fe_{78}B_{12}Si_{10}$	[6]	(empirical)	3.30
$Fe_{72}Cr_8P_{13}C_7$	[6]	(empirical)	3.78
$Fe_{80}B_{20}$	[3]	(empirical)	3.70
$Fe_{80}B_{20}$	Calculated in this work	(theoretical)	3.20
Pure iron		(theoretical)	14.30
Pure iron monocrystal	[1]	(empirical and theoretical)	13.50
52 CMoV 4 spring steel, tempered, up to Ø10mm	MSZ 2666	(empirical)	1.45
NCMo 6 tempered, up to Ø16mm	MSZ 61	(empirical)	1.42
BNCMo 2	MSZ 31	(empirical)	1.50

EXAMINATION OF PARAMETERS GENERATING LIGHT REDUCTION IN GREENHOUSES

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Abstract

Light is one of the factors of efficiency in greenhouse production. Solar radiation coming through the cladding material is of prior importance in greenhouses partly in terms of growing (photosynthesis) partly in terms of energy using. The measure of incoming radiation into the greenhouse is influenced significantly by construction and cladding materials besides other effects. One of these effects is condensation. The research was focused on how greenhouse covering materials used in Hungary and condensation formed on them influence the intensity of light coming into the greenhouse. Light reducing effect of intentionally generated condensation was tested instrumentally time depending during laboratory examinations. It can be stated as a result of examinations that the measure of light intensity reduction can reach 7-21,9 % (depending on the type of covering materials) due to condensation in our climate that can not be left out of consideration in greenhouse production. This research was made with the support of OTKA F 032582.

Introduction

The importance of greenhouse production is growing even today due to increase of market demand. The aim of greenhouse production is to develop an optimal - of the weather independent - surrounding of plants, providing beneficial plant protection and effective growing. Formation and maintenance these circumstances can be ensured only with great energy input. Due to increasing of energy prizes also in greenhouse growing the rentability of the energy using came into the foreground and became more and more important in last decades.

However the costs of artificial circumstances to be established in greenhouses has been recently increased according to the increase of energy prices and a more determined demand was arisen for assuring the more effective growing due to reducing costs. The earlier examinations are generally focused on costs of energy used for heating of greenhouses and do not deal with the examination of light which plays an important role in plant growing.

Light is one of the factors of efficiency in greenhouse production. Solar radiation coming through the cladding material is of prior importance in greenhouses partly in terms of growing (photosynthesis) partly in terms of energy using. Solar radiation respectively light are the fundamental factor of plant life conditions among several factors being with each other in close connection which are determining the processes taking place in greenhouses. The characteristic of these is the timely determination by geographical base and climatic conditions. The measure of incoming radiation into the greenhouse is influenced significantly by construction and cladding materials besides other effects. One of these effects is condensation.

The construction and orientation of greenhouses influence considerably the forming of radiation coming into the greenhouse however covering materials and their condition also have an important role.

The research was focused on how greenhouse covering materials used in Hungary and condensation formed on them influence the intensity of light coming into the greenhouse.

Method

The method of the research work was classical: hypotheses, modelling, measurements then evaluation of the results. The research covered the following tasks below: examination of physical characteristics in connection with condensation (what character and measure the condensation had on different greenhouse cladding material used in Hungary), examination of light reduce due to condensation and research of factors influencing all these.

The examinations were carried out on three materials used generally in Hungary: glass (thickness of 3 mm), lightstable polyethylene film (Pe_{fs}) and luminescent polyethylene film (Pe_{lum}) (thickness of 0,15 mm).

Light reducing effect of intentionally generated condensation was tested instrumentally time depending during laboratory examinations. Whereas a detailed physical analysis of the process of condensation was not direct aim of our research however there were examinations in this field. In the course of them the measure of light decrease can be exactly determined.

Results

The most important results in connection with condensation are summarised here by disregarding the details of our research:

1. In lab conditions where condensation was generated by artificial steam ingestion, the development of light conditions were examined due to condensation. The development of light conditions is shown in Fig. 1.
2. By reason of research results it can be determined that the light reducing during the so-called full condensation can be characterised by a constant value at a cladding material of given substance and tilt angle. It was stated on the basis of examinations carried out that the full condensation can be characterised by a specific quantity of condensate (M_K) on the surface.
3. The measure of light reduce due to condensation is characteristic of the given material. The size of this on the examined materials was carried out as a result so the measure of radiation coming through the material due to condensation in case of glass decreased from 86 % to 80 %, in case of PE_{LUM} from 87 % to 71 %, in case of PE_{FS} from 86,2 % to 67,3 %. The measure of light decrease on different covering materials in % is shown in Fig. 2.

Conclusions

The following main conclusions can be summarised:

The measure of light reduce due to condensation on the covering material is between 7-21 % depending on the cladding material.

In this way it became possible that the measure of light decrease can be determined by the help of the model in case of the examined covering materials at any period. In the research work it was also worked out and proved by measurements that the light reducing effect of condensation in radiation model can be taken into consideration even at mathematical models. The effect of condensation on light transparency can be expressed by a coefficient characteristic of the given material which can be determined by the relation of light transmitted through the wet and clean surface.

The consequences from the results of examinations can be helpful in some practical utilisation e.g. from architectural point of view and for solar energy utilisation equipment.

The research will be continued by examinations regarding to other parameters which influence the light inside the greenhouses like orientation and structure of greenhouses.

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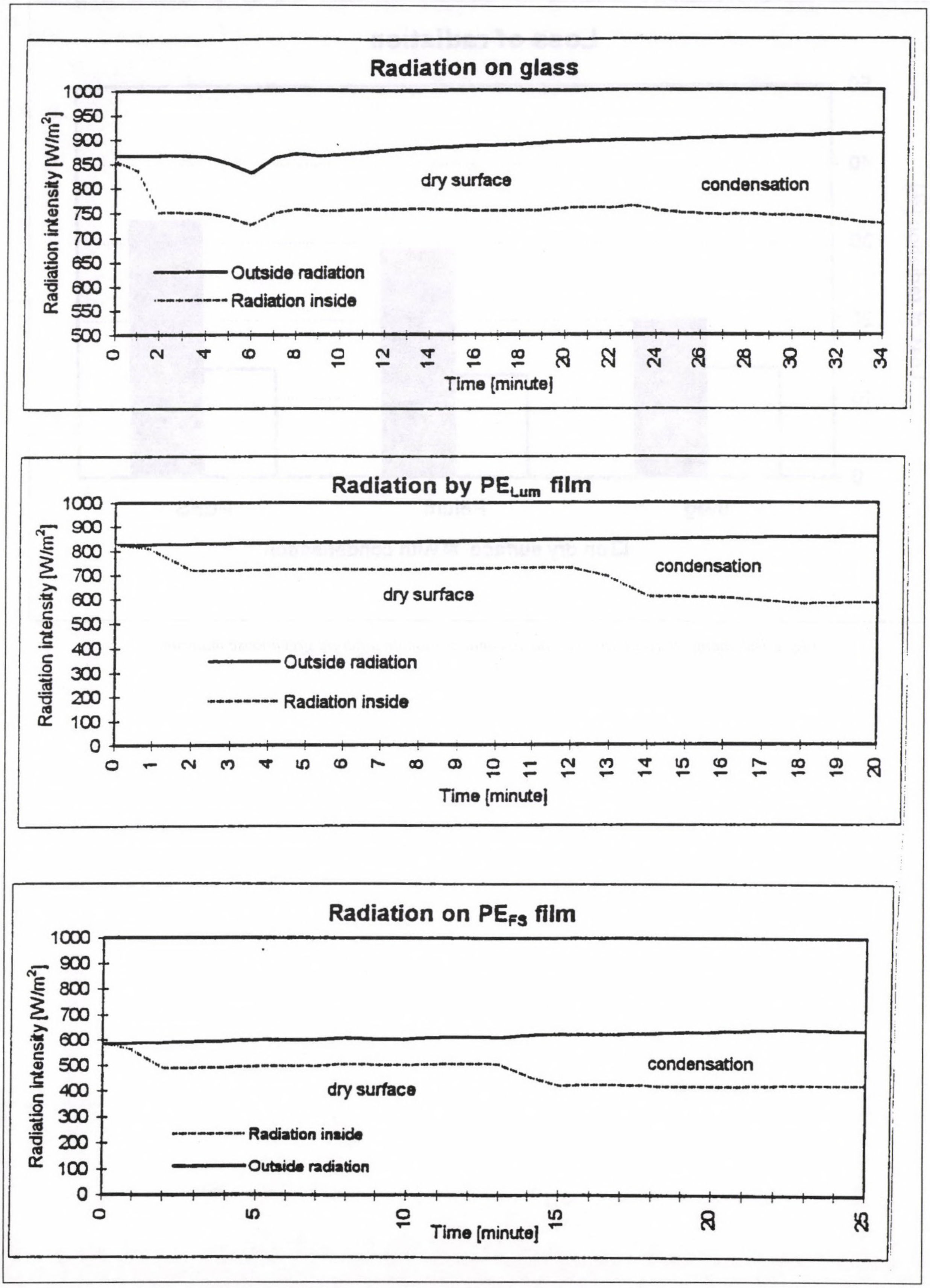

Fig. 1 Radiation conditions by condensation a) on glass, b) on PE_{Lum} film, c) on PE_{FS} film

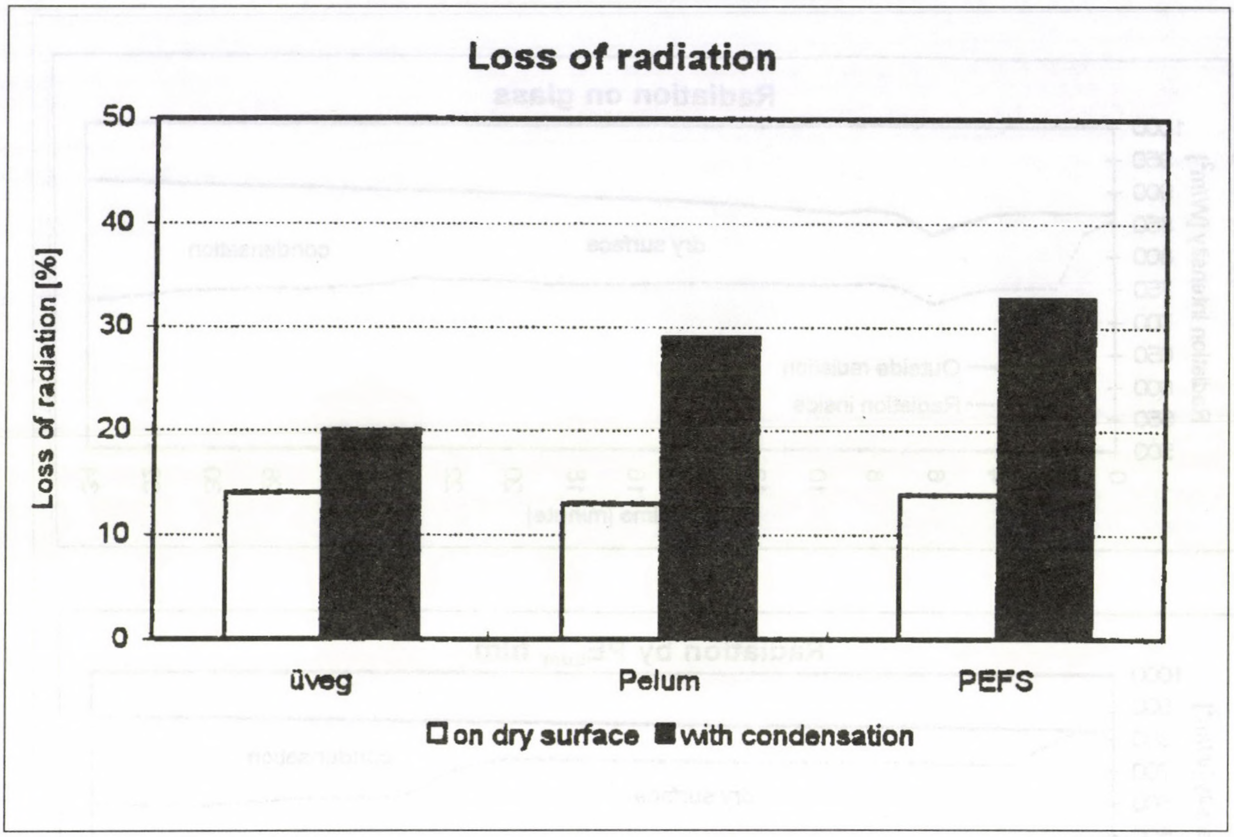

Fig. 2 The change of radiation loss due to condensation on different greenhouse materials

FINDING THE POSSIBLE MEANS OF THE FINANCIAL REGULATORY SYSTEM FOR THE AGRARIAN BRANCH OF HUNGARIAN ECONOMY WITH RESPECT TO ACCESS TO THE EUROPEAN UNION

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THE SYSTEM OF BUDGETARY SUBVENTION FOR THE AGRARIAN BRANCH AT THE TURN OF THE SECOND MILLENNIUM

The future of the Agrarian branch of our economy could be more easily surveyed and predicted by the 1990-ies than earlier. Its financial regulatory system had become more simplified and the purpose of the measures taken with a view to its future functional vigour was to give reliable subsistence for the people engaged in agriculture for at least 4-5 years ahead and to increase the financial aid offered to the domestic producers.
Our Parliament showed a serious commitment to this issue when passed the decree contained in the 8 § of the law. "The farmers drawing on the financial aid provided from the state budget are obliged to supply data specified by the statutory rules." This decree reflects the endeavour to ensure that the state and the different state authorities should pay special attention to the fact that the budgetary subvention reach only the targeted sphere of people to the greatest possible extent. The *structural build-up of the present subvention system of agriculture,* its priorities and its main supportive arrangements will promote the following intentions included in the law on the development of the agrarian branch of economy as *passed by the Parliament, and comprised in the government programme.* Accordingly, the main aspect to follow are:

- the financial aid should assist the agricultural policy of the Government in a more intensive measure;
- the subvention system should be more simple, more surveyable, predictable and reliable in a longer term;
- the actual sector-impartiality of the subvention system should be fortified, but it should promote and enable – much more than so far – that the small producers and private family farms should receive financial aid more easily;
- the aid should reach directly the producers to a greater extent than so far;
- this amendment at the same time should imply the approach to the principles applied in the EU.

The pre-condition of registration was to establish the so called registration system for the right claim of agricultural subvention. Accordingly only those are titled to claim the state subvention whose name is entered in the registration list of farmers. The farmer will fill in a so called primary identification form which contains the last year's (or envisaged) annual price income, the dimensions of the arable land area, the number of the livestock, and the number of the employee. The adoption and the conditions of *farmers' registration* are to be prescribe *in a governmental decree* with regard to the aspects of data protection. It is thing of great importance that – for the sake of simplifying the process of subsidisation – the aid of normative character should be paid *through an automatic system.* It means that the registered farmers will calculate the relevant financial aid themselves with the help of claim-forms elaborated and issued in advance by the FVM, then will have them countersigned by the farmers' notary who will pass a copy of the claim to the relevant office of the FVM. The automatic payment will involve a more frequent and tighter subsequent control activity than so far. Due to the change in the division of labour within the governmental administration, the area- or regional development has been transferred to the FVM, and as a consequence, it verifies the modification in the administration of the handicapped agricultural regions, too. Therefore in this situation it is justified to subsidise the insufficient price support needed badly in the region, the development of employment, the increase of income (e.g. land tourism) from the resources segregated for this purpose within the framework of regional development. In the future, *it should be avoided* that a part of the agricultural subvention be spent for the financing of official tasks.

MAIN ELEMENTS OF THE SUBVENTION SYSTEM

Subsidisation of Production

As a new element, the normative subsidisation is recommended, which can be drawn by the subsidised farmers entered in the registration lists in a specific measure calculated annually according to their field under cultivation and plough-land, as well as the livestock raised by them paid in terms of Ft/ha or Ft/piece, respectively.

• *financial aid for land cultivation*
This form of aid can be claimed by the farmers who undertake to growth the specified land culture. The measure of financial aid will vary with the size difference of the farmland involved:

under 50 ha of the arable land	12 000 Ft(ha)
above 50 ha of arable land	8 000 Ft(ha)

• *financial aid for breeding sucklers*
It can be claimed by the farmers who are breeding the female specimen of the most important species of domestic animals (cattle, swine, sheep, horses etc.), or else pursue the bee-keeping:

– for stock of milking-cows under 20 pieces 25 000 Ft/piece, while above it 15 000 Ft/piece
– for breeding of ewes under a stock of 1000 pieces: 4 000 Ft/p., while above it: 2 000 Ft/piece

• *subsidy for interest received*
The measure of the interest subsidy for the case of production credit is determined as 40% of the refinancing base rate, while in the case of recapitalization credits it will be 50%. The loans of credits taken by the small producers whose yearly income will not come up to 4 million Fts ill be subsidised by an additional 20% interest subsidy.

• *financial aid for supporting the upkeep and improvements of biological primes*
The sum of the financial aid should be decided on according to the aim of breeding, which can take place in the framework of normatives (e.g. in the case of preservation of gene pool) or else to the proportion of expenses.

• *financial aid for expertise*
This activity should be based upon the model plants specified for each regional districts, as well as upon the educational and research institutes (institutes of higher education, research institutes etc.)

• *financial aid for raising the economic potential of young agrarian entrepreneurs*
The form of financial aid can be *a non-refundable sum of money or else the interest subsidy.* In the case of acquisition of real property or reconstruction, financial aid can be claimed to the extent of 30% of the price of acquisition or the investment costs, while in the case of an investment credit contract for a period over a year, the measure of the interest subsidy can be increased up to 80%.

• *financial, aid for the establishment of co-operatives dealing with procurement of products, their sale, and providing services.*
The aid is provided as a contribution to the operational cost in the first year, as well as for covering the indispensable working assets.

• *Financial aid for the access to the market*
The export of agricultural produce is justified to promote, first of all, by export-subsidising constructions via tenderisation as developed with the closer knowledge of the commodity standard and market conditions, as well as by marketing activity. With respect to the most important agricultural products or agricultural branches, respectively, the arrangement of administered prices and the constructions associated with it should be applied. The present requirement system of the guaranteed prices should be eliminated. Appropriate financial funds should be segregated for the possible interventions in case of unexpected market failure.

Subvention of developments

• Investments for building is recommended to subsidise only with interest subsidy.
Procurement of machinery should be subsidised automatically by 25% interest subsidy (in the case of purchase without a loan of credit: by 30%), while in the case of a credit contract an additional 40% interest subsidy is recommended. The subsidisation of machine leasing is considered necessary on our part. High priority subsidisation (40%) should be given to the purchase of technological equipment.
The investment constructions of the agricultural subsidisation listed above supplement the funds to be used for regional development, which can be utilised as additional subsidy in the disadvantageous, handicapped areas the arable lands whose cadastral net income is at the maximum 17 gold crown/ha.
• One of the most important goals of our development policy is to replace the old machinery by new, up-to-date prime movers and heavy-duty machines, and to adopt new high-tec methods in the field of production.
• *Other forms of subvention*
In the field of subvention granted for forestry, e.g. the resources allotted to the operation of the narrow-gauge forestal railroads, and to the maintenance of the welfare and recreation parks developed for tourism purposes. That kind of subvention will be financed from state budgetary resources, and it can be claimed and awarded only via tenderisation.

The agrarian elements of the taxation system

In the present system of personal income taxation, the agricultural producers and within this sphere, especially the agricultural small producers are ranked in a distinguished place. According to the rules valid in 1998 they have the following advantages:
• under a yearly income of 250 thousand Forints, they have no tax return liability.
• the agricultural small producers -under a price income of 4 million Forints- enjoy exemption from taxation, or else a very considerable tax allowance (100 thousand Forints), as well as a possibility of 40% depreciation on cost if they are liable to draw up a statement of their expenses.
The tax basis of the small producers paying a lump sum of tax should be established proportionately to the rate of the gross yearly income earned by their activity (stock breeding: 6%, others: 15%).
• other primary producers (above a price income of 4 million Forints) will also be given subvention.
• the sale of wine made by the primary producers from grape of their own vintage will similarly be given preference in taxation.

Corporation profit tax

In the Act on the corporation tax and the distribution of dividend, actually no tax allowances for the branch of agriculture are are included. The possibility of establishing the system of account and taxation by financial years is emerging now and again, however it is excluded by the accountancy and taxation rules currently in force.

Value added tax (VAT)

At present, the agricultural produce, the agricultural services, as well as the basic foodstuff are subject to a tax rate of 12% VAT, which is justified in the future, too. There is a special agricultural regulation, the so called compensation premium, which can be claimed by the agricultural producers who will not charge VAT for their products when sold. The aim of this preference is to recompense the agricultural producers for the sum of VAT included in the price of goods, instruments bought for their production activity. The compensation premium will be payed by the storers who will reclaim it from budgetary sources as VAT compensation.

Local taxes

The self-governments are authorised to impose business taxes under the relevant law of taxation which covers the agriculture activity, too (on the basis of its price income not including the goods procurement). It is recommended that the business tax should not affect the sphere of agricultural activity whose rentability is substantially lower than the agricultural average.

Tax refund of the gas oil consumption tax

The sum to be reclaimed presently is 44,30 Ft/litre, which in the case of arable land and forest-land can be 90 litres/ha at the most, in the case of plantation it can be 200 litres/ha, in the case of grass-land – 12 litres/ha, for the milk-cow stock – 85 litres/piece, while after the area of fishpond its measure is 55 litres/ha.

The differences between the two subvention systems

The basic differences between the production conditions of the EU and Hungary have justified the differences between the two subvention systems even up to now, and they will continue to justify those to a certain extent in the period ahead up to the access to the EU, too. The characteristic deviations and major contradictions in the mentality of the agrarian policies of the Community and Hungary can be shortly sum up as follows: the CAP is based on a product-specific regulation model, while at the same time the Hungarian subvention system is of a skeleton (or block) character and subsidisation on the product level can be realised mostly in the case of certain branch development or else with the aim of promoting the access to the market.
Differences between the agricultural subvention systems of the EU and Hungary:
• The CAP determines the ways and alternatives of intervention according to a pre-fixed set of rules, while at the same time the Hungarian practice of market regulation is focused on the handling the troubles of the market.
• The Hungarian agricultural subvention system lays great emphasis on the issue of penetration into the foreign markets, so the 40-50% of the current budgetary estimate is channelled for this purpose. At the same time, the Community concentrates on the alleviation of the regional under-development and the maintenance of earnings on a safe level.
• With a view to the alleviation of the pressure on the market and the minimisation of the expenses for market intervention,

the EU will enforce contraction in production. Hungary would not apply quota regulations, or if so, only within a limited scope, and would not impose a limit to the means of production by direct measures.

• It is an important feature that the CAP will not dominate over the whole national-membership agrarian production but will give way to he activity of governments. In addition, due to the co-financing technique, the measure of participation in the structural funds is conditioned by the measure of national and self-governmental contribution. In contrast, the Hungarian subvention system has a block (skeleton) character in this respect, too. The Hungarian peasant proprietor can obtain subvention in any field of agricultural production.

• A special feature of the Hungarian agrarian production is the low-level dealing with small production, the poor forcing effect of registration. In contrary to this, the agrarian regulation of the Community is based on a full-scale of registration of the full-job agricultural producers. The subject of the subvention is the land-user and not the land-owner.

• In the EU, the family farms are the primary beneficiary of the subventions, but in our country the vantage-ground can be observed with the partnership ventures and the agricultural co-operatives.

• As far as export in concerned, in the EU the subvention is received for the raw material content contained in the processed goods, while in our country so far an inflexible system was in operation dependent on the market position of the product or rather on the bargaining position of the lobbies and unable to answer the changes of the market.

• The characteristic differences in the subvention system are projected to the institutional system, too. Consequently, the Hungarian agrarian subvention system in not supported on an institutional system or organisation of concentrated authority, which – similarly to that in the EU – would control the distribution, tenderisation and check of the funds resources and would manage the stockpiling of the surplus products.

• Contrary to the agrarian regulation of the Community, the Hungarian entirely lacks the section associated with the obligation of warranty, and the system of income-warranty as separated from the producer price is also to be drawn up.

• In our country, the additional forms of subvention which provide subsidies rounding-out the income can be detected only in a narrow scope apart from the price system. It can be considered as a special phenomenon characterising generally the period of our days that the income resulting from the agricultural producer prices can not provide coverage for the justified developments. Due to these circumstances, the situation is that – contrary to the EU norms – the domestic subvention systems do not exhibit an orientation or income equalization function but rather a supplemental one. The present agricultural subvention system in Hungary is a sector-oriented one, which is similar to the conditions of subvention prevailing in the EU in the period between 196-70.

• In our country the horizontal regulation is in force, which means that it applies uniformly to all regions. With respect to the conceptions of the EU Brussels Committee concerning the subvention granted to the countries applying to EU membership to be given prior to their access to the Community, and published in the document "Agenda 2000", it seems to be indispensable for us to increase the agrarian subvention associated with regional development, the delimitation of the regions, as well as the elaboration of the subvention systems tailored to the distinguished regions.

• According to the operation of the EU Structural Funds, the distribution of subventions is decided on four important basic principles (programmability, concentration, partnership, additionality). The programmability of resources and goals for a determined period (3-6 years) in our country is brought into question due to the annual change of financial resources and the lack of the medium-term stability. The principle of concentration is also injured at several points, there is no guarantee for the geographical concentration of subventions. The principle of partnership and additionality should be realised on the level of the state and the farmers. In the practice of Hungarian subvention system, the principle of subsidisation – consistently with reason – covers, first of all, the scope of tenderisation and control. The principle of partnership is a basic requirement associated with the transaction of affairs within the EU, and a concept covering the quality of co-operation between the organisations of the Community, the authorities of the member countries and the regional bodies.

• The institutional background of the Hungarian agrarian subvention system, which is in charge of legitimation, control, evaluation, identification and payment functions is centralised to a lesser extent than in the EU or the EU member countries.

• There are some fields of subsidisation which are left out of the Hungarian agrarian subvention system, or else are not duly emphasized and which are included in the Community regulation. For example, there is no compensation payment, crop rotation programme, the involved income supplemental subsidisation is missing, or the forms of subsidisation of the extensive agriculture as well as those which are connected with the reduction of environmental load

Summary

Hungary should develop such an agrarian policy which is compatible with the regulations used in the EU. There is a serious task ahead of the Hungarian farmers, they should be persuaded that they also have to accommodate themselves to the EU-conform prescriptions. Since without doing this, they can not maintain any more their lands consisting of a couple of acres in such a way that they be able to produce and grow competitive agricultural products. In conclusion it can be stated that agrarian policy has remained an open question further on, too. The preliminary negotiations associated with Hungary's admission to the EU have been carried on for two years, therefore the solution to the problems should be given as quickly as possible. The Hungarian committees should sit at the table being furnished with appropriate strategy, knowledge and skills. The whole of Hungarian society is expected to accept our intention to gain access to the EU. However, this does not mean that the existing social and political tension would be relieved.

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