PART I.

ABSTRACT OF SELECTED PAPERS

TAJECTORY OF PARTICLES SUBJECTED TO GRAVITATIONAL FORCE AND AIR RESISTANCE

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The incentive of carrying out the experiments was given by the need of the education where several times occurred the motion of fertiliser particle, wheat grain, spray droplet. One was not capable to calculate the cast distance, the instant velocity and the time of falling. The reason was that the literature gives the air resistance and drag coefficients in a wide range. Some textbooks gives 0.4-0.5 range of the air resistance (shape) coefficients for spherical body while some others give 0.7. It causes large uncertainty in calculations. The question has arisen which value should be used for example with peas without coating and what is the air resistance coefficient of non-spherical seeds like maize, sunflower, etc.

The relationships calculated with evacuated space for velocities and cast distances can be informative, however, they are far from the reality. The difference is especially large in the case of air velocities above 20-25 m/s.

In some textbooks the cast distance of the particle shot horizontally only the horizontal directional air resistance is considered. The vertical motion of particle is considered as if it would fall in evacuated space. This solution was certainly chosen by the authors, because the differential equation of motion was much simpler and the problem could be solved in an exact way.

DESCRIBING AUGER OPERATION BY MEANS OF DIMENSION ANALYSIS

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Design and research of auger conveyors by dimensional analysis has a lot of advantage. This powerful tool provides an orderly method for combining the many variables influence on auger conveyor performance which avoid the purely theoretical approaches. According to the principle auger conveyors can be considered similar that characterised by same independent similarity (dimensionless) variables. The performance (capacity, energy requirement etc.) of similar augers can be satisfactory predicted before they leave the drawing boards if the variables groups are known. Other advantage of dimensional analysis are that the number of variables decrease due to they are grouped therefore the results of tests or investigations become clearly arranged.

RADIATION OF SOWING-SEEDS IN ELECTROMAGNETIC DISCHARGE SPACE

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The study deals with those effects of physics, what influence the individual grains of material bulk of sowing-seeds in a zero mean value asymmetric electromagnetic space excited by high voltage series of impulses. The experimental model pilot apparatus is being outlined also. One effect discovered by the authors is that if a negative corona discharge is superposed on the above characterised electromagnetic space then the individual grains in the aggregation will be filled up according to their permettivity, so that they are effected by different magnitude and direction electromagnetic force. Based on the effect the grain bulk can be separated to its components. A utilisation of the effect is the sowing-seed cleaning. Further application possibilities are separation according to thousand grain mass and germination ability. The effect of surface discharge occurring to the individual grains is well utilisable. The treatment can significantly improve the germination ability and vigour of the low germination ability seeds.

This research was made with the support of OTKA 1522 and OMFB

DEVELOPMENT OF A NEW SYSTEM MILK VOLUME METER

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During the last 30 years, improvements of many variations of milk quantity recorders have been completed by the specialists of the R + D teams in research institutes and the factories. Because the milk is quite a heterogeneous material with respect to its flowing during the milking, the measuring devices got complicate equipment. The biggest problem of their use is the cross section area increased in comparison with the milk tubes or pipes and because of that, the flow intensity of the cleaning liquid decreases and it can be compensated only with use of extra energy (heat and detergent). A combined sensing process depending on the filling ratio was chosen which was suitable to perceive the changing in conductivity and permettivity (dielectric constant) of the liquid and this made unnecessary to alter the cross section area of tube even in the lowest measure. Conclusively, the milk quantity flowing through is measured by quasi external sensors assembled into (onto) the long milk tube section and its displaying, summarising and registrating is solved with the help of the connected PC. During the research. the basic parameters of a construction were determined which can be manufactured in the industrial practice.

DESIGN AND CONTROL QUESTIONS OF ROTARY DISC FERTILISER SPREADER MACHINES

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The fundamental question of the design and operation of rotary disc fertiliser spreader machines is the optimum working quality of the machines. Determination of the factors influencing the cross directional distribution of fertiliser is the most important to ensure this. Especially those affecting the motion of the fertiliser grains on the disc and those determining the discharge point, discharge velocity and discharge direction are the most important. The spreader should be designed to meet different fertiliser types with optimum working quality. This can be achieved only by using an appropriate theoretical knowledge and experimental background.

DETERMINATION OF ENERGY BALANCE ON THE BASIS OF RHEOLOGICAL PARAMETERS

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The time depending stress and deformation states are described by the discipline of rheology.

The linear models of rheology describe those states and can be successfully used for characterising stress and strain changes in agricultural materials. The introduction of stress rate and strain rate to the material equations makes possible to take the time factor into account. The general form of linear homogenous material model is

$\Phi(\sigma, \varepsilon, \dot{\sigma}, \dot{\varepsilon}) = 0,$

which already accounts for time depending creep and relaxation phenomena, too.

A possible form of this equation for uniaxial stress state is as follows

$$\sigma = a\varepsilon + b\dot{\varepsilon} + c\dot{\sigma},$$

where the notations are

σ the stress,

ε specific strain,

$\dot{\sigma}$ stress rate,

$\dot{\varepsilon}$ rate of specific strain and

a, b, c are material constants.

Provided that the materials in question follow the above relationship, the formula can be utilised in the determination of material characteristics. The complex viscoelastic material model corresponding to the equation may be built up from parallel and serial connections of the basic elements representing the elastic, viscous and plastic properties.

One of the basic elements is perfectly elastic, the force is proportional to the strain rate. The other basic element is for viscous liquid property producing a damping force proportional to the velocity. The plastic element restricts the stress level to plastic limit.

The solutions of the material equations describing the phenomena produce the characteristic constants of the material with the relevant boundary conditions.

The application of these equations reflects rather diverse approaches, moreover the selection of the models is not clear being random or uncompelled many times.

CHANGING OF THE MOISTURE TRANSMITTING SURFACE OF ALFALFA STEMS DURING DRYING

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From 1994 thin layer scale-model experiments are conducted in order to study the drying properties of alfalfa in the Department of Mechanization and Environmental Technology of the Mosonmagyaróvár Faculty of Agriculture, Pannon University of Agricultural Sciences. The goal of the work was to discover the effect of the chaff length and other basic parameters on the modelling of heat and mass transfer processes.

In the 1996 year experiments the size and surface changes during drying were measured. Therefore the specific the variation of the moisture transmitting surface and of the mass flow intensity values as functions of moisture content. In addition to the mechanical measuring tools the method of „artificial vision" was also used.

EXAMINATIONS RELATED TO SOME IMPORTANT MECHANICAL CHARACTERISTICS OF THE FODDER PELLETS

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In the course of our research work in 1996 experiments were carried out to determine the crumbling force and the shredding tendency using different composition of feed produced at a given expanding pressure and at the same composition of feed at different expanding pressures.

On the basis of the research followings can be stated:

- increasing in expanding pressure decreases the rate of chippings, increases the average grain size, gives favourable shredding index and higher crumbling force,
- increasing of crumbling force directly proportional to the schedding index,
- connection between the crumbling force and the shredding index in relation to the expanding pressure is more moderate than in terms of composition of the feed.

DIGITAL IMAGE PROCESSING FOR QUALIFYING CHOPPED PLANT BULKS

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On the basis of experimental investigations it can be stated that the digital image processing is applicable to evaluate image information and it can supply reasonable results in agricultural circumstances, too.

The data obtained by computer and manual processing can be compared and the distribution functions are very similar. It proves that the method is really applicable to qualify the bulk of plant eliminating the tiring work of manual selection and measurement. Moreover the evaluation is considerably sped up.

Although the tools improving the quality of processing significantly are rather expensive, the application shape and colour recognition – in general artificial vision – research in the agriculture is not questionable.

DEVELOPMENT AND INVESTIGATION OF VIBRATION CHAFFING DRUM

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The production of the silage material requires significant amount of fuel oil consumption which is almost half of the fuel need of the self-propelled agricultural machine therefore it is an important factor of the agricultural energy management and economy. Based on the energetic investigation results of the self-propelled chaffing machines it has been found that the highest energy consumer is the chaffing apparatus. The experiments proved that the chaffing drum uses 60 % of the total power need in idle operation and 86 % of the power in working operation.

Theoretical research on the theory of self-propelled chaffing machines with special attention to the energetic conditions has been being conducted for several decades in the Institute of Machine Theory of Gödöllő University. The current experimental and product developing work is based on this.

In the framework of the development the performance of the chaffing drum is intended to be reduced by using a new drum of vibration principle which applies sliding cut. During the chaffing process the blade moving along the edge penetrates easier into the green material which saves not only energy but the lifetime of the blade will also increase due to the reduced edge load.

In the development process the new principle experimental equipment was made. The drum dimensions of the most widely used chaffing machines even then. In the first stage of the development (1995) still the control of blade-holder elements was investigated. After the encouraging results in the second phase (1995) the new chaffing drum with blades was adapted to a widely used self-propelled chaffing machine (Claas Jaguar). The extensive laboratory examination is bieng made with this machine. This paper reports the results of the laboratory investigations achieved so far.

Szolnok Mezõgép Rt. the joint developer would like to supply the most significant self-propelled chaffing machine manufacturers with the product resulted by the development work.

DYNAMICS MODEL OF CARDAN SHAFT TRANSMISSION

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The driving of a machine operating very often in a long distance from the driving gear can be carried out by cardan-shafts bedded properly having only zigzag line series-connection because of spatial position and other construction of the machine.

The deviation of cardan drive during operation or generated effects because of load cause resonance if the forced frequencies and one of the natural frequencies of the system coincide.

In the case of resonance the amplitudes of vibration increase until one element of the cardan drive breaks. With the description of the dynamic model of cardan drive during designing the forced frequencies can already be determined, which can be off-tuned by choosing the stiffness of bedding and geometrical dimensions properly.

Due using the model the cardan drive dimensioning ensures significant savings both by shortening the expensive test-bench experiments and by producing construction to be fitted for manufacturing.

EVALUATION OF THE NUTRIENT UPTAKE OF VEGETABLES BY BIOELECTRIC METHOD

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These tests were suspended by Hungarian Scientific Research Fund. The method elaborated during the previous years is based on a passive bioelectric measuring technique. The plants were tested in their lifetime by impedance measuring using auxiliary power source. Knowing the impedance and the phase angle we calculate the electric capacitance. The capacitance describes the transport which occured by the hydroponic solution. So we evaluated the nutrient uptake but are did not test the infiltration of the nutrient and the effects of biochemical reactions. We are searching for the answer, using this technique, if the uptake and metabolism is perceptible or not.

MEASURING OF RHEOLOGICAL PROPERTIES OF SILAGE

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The size distribution of the cut up living material is essential in successful silage process, although the mechanical behaviour of the viscoelastic bulk is important as well. Difference between mechanical parameters of silage and metals of machines' mechanical parts are definitive and there is no data for silage which could be the starting point in construction its machines of transportation, further process and storage. Namely the data gathered under different circumstances by instruments working in different ways, to say nothing about the changeable nature of the biological material. Our task is now to standardise the rheological analysis conditions for silage masses, further to develop a measure instrument and method to standardise. We also want to set up a table on different plant materials (corn, alfalfa, sunflower, sorghum, miscantus and mixed green forages) including their silage masses' rheological properties processed by different methods such as exact chopping, using recutter or corn-cracker.

MATERIAL TRANSPORT OF THE SEED CORN DURING DRYING PROCESS

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- Heat-and material transport of the **lower** layer in the CAMPBELL system chamber driers can be considered as a single process.
- In the 1st stage of the **upper** layer increasing of the heat content, while in the 2nd stage the material transport are the determining factors.
- Equation of the **material transport**:
- $W_a = W_v+(W_k-W_v)\ \exp[-a(T_a-T_k)^n]$ At the end-stage of drying **back-moistening** of the cob can be pointed out. Dewatering of corn takes place conductively in 90 % and convectively in 10 % extent.
- Average value of the **germinating power** in the lower and upper layers is 97,7 % and the deviation is not more than 1 %.
- **Lenght** of **time** of the **drying** process can be decreased by 4-5 hours, so the energy consumption can be reduced.

RELATIONSHIPS BETWEEN INDIVIDUAL AND AGGREGATION CHARACTERISTICS OF SOME AGRICULTURAL MATERIALS

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Most of the agricultural materials are found as aggregations in different technologies and processes. These bulk materials are usually loaded on the whole (e.g. transport, storage etc.) and then loads are transformed in different ways. Loads on the individual parts are developed as a result of these processes and cause lasting deformations (e.g. fracture, damage etc.). While the load is mostly a form of stress on the aggregation (e.g. repeated load, flow etc.) damage is basically determined mainly by the individual features too. In the first part of our OTKA supported research program methods of the examinations are elaborated.

QUALITY, RELIABILITY, EFFICIENCY AND COMPROMISES IN THE PLANNING OF MILKING SYSTEMS

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Dr. J. Bak
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There are two different trends at the design and the construction of milking equipment:

- In order to ensure the quality – because of the higher operational reliability –, the investment costs are extremely high and, this way, the energy and auxiliary consumptions will be increased as well.
- In order to avoid the oversizing the constructions, it is reasonable to make an effort to minimise the investment as low as possible which can result a save in energy and auxiliary requirement but at the same time the level of the

necessary service will be higher and the immediate intervention will be needed if the parameters are not suitable to the quality standards.

Both solutions can be advantageous if they are synchronised with the real conditions correctly. In the case of a good infrastructure and service network, the rapid service can be available and its extra costs covered by the saving of the energy and auxiliary expenditures. Under more difficult conditions of infrastructure services, the oversizing is evidently advantageous which can provide a higher reliability. The subject and aim of the present paper is to analyse and evaluate these trends which can be recognised in Europe as well.

TRANSMISSION OF RADIATION ON THE COVERING SURFACES OF GREENHOUSES

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Possibilities and importance of modelling of climate conditions in greenhouses were presented in my earlier publications. I pointed out the importance of examination of solar radiation which is the most important element of climate conditions in greenhouses.

Solar radiation respectively light are the fundamental factor of plant life conditions among the 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.

INVESTIGATION OF SIMULTANEOUS HEAT AND MASS TRANSFER WITHIN THE INDIVIDUAL MAIZE KERNELS DURING DRYING TIME

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Experiments have been in progress since 1981 at PANNON Agricultural University, Faculty of Agricultural Sciences, Department of Agricultural and Environmental Engineering in Mosonmagyaróvár to get information of heat physical properties and drying characteristics of different maize hybrids. These information provide very good bases for modeling simultaneous heat and mass transfer processes inside an individual maize kernel.

The main aim of this article is to give a mathematical model with numerical solution to follow the heat and moisture distributions inside a cross sectional area of an individual maize kernel as a function of drying time with respect to the effects of the coupled heat and mass transfer processes to be beyond the existing models and solutions published by literature sources.

FINITE ELEMENT PREDICTION OF SOIL LOOSENING AND FORCES ACTING ON A MEDIUM-DEEP SUBSOILER

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The finite element method was used to study tillage of a sandy soil being externally loaded with medium-deep subsoiler. The numerical analysis was performed with three-dimensional models and COSMOS/M 1.71 software. The soil was considered as elastic-perfectly plastic material of nonlinear behavior. On the basis of the elastic-perfectly plastic material assumption, the Drucker-Prager material model was adopted. Soil loosening was estimated as soil volume change. The chisel and shank particular forces as well as the subsoiler total forces were calculated from the finite element model at the interface elements.

THEORETICAL AND EMPIRICAL APPROACHES TO THE USE OF PID CONTROL FOR CLIMATE ENVIRONMENT

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This work shows a study to build up a temperature control for a laboratory scale greenhouse which can be, anyhow, used also for a general case in connection with climate environmental problems. A preliminary study was carried out first along with the physical properties of materials applied in the system and also the governing differential equations. The parameters of the system were identified on the basis of measurements inputting with standard signals. The identification shows that heat capacity dependence on ventilation can not be ignored. The constants of PID controller were determined taking into consideration the calculated and the measured parameters. A trial was made to use an empirical approach to the determination of PID controller, as well.

SIMULATION OF FERTILIZER DISCHARGE CHARACTERISTICS AS EFFECTED BY DISC AND VANE DESIGN PARAMETERS AND THE PARTICLE MOTION ON THE DISC

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The spinning disc fertilizer spreader is the most widely used tool of spreading fertilizer to the ground. A well designed machine should produce the uniform distribution as well as the desired working width. Our research focused on the comparison of different feeding radii, vane shapes and orientation. Computer simulation was applied in order to qualify and optimize vane designs with flat disc. The discharge direction, the absolute discharge velocity and the time of the duration on the disk were the output parameters. The approximate equation of vane shape, the equation of forces acting on the particle and the numerical integration formulae are considered as governing relationships. For straight radial vanes the effect of (1*) feeding and discharge radius on the target values were calculated and plotted. In the other groups of simulation experiments the mutual effect of (2*) pitch angle and friction coefficient, (3*) the feed and discharge angles as well as (4*) pitch angle and curve height of near circular shaped vane. In some cases mathematical optimum was found, but in all cases the results can be used for design and adjustment purposes.

TECHNOLOGY OF TOMATO PRODUCTION ON SUPPORT SYSTEM

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The vegetable cultivation method on support system causes crop quality improvement of freshly consumed vegetables and increasing of yield quantity per area unit. The arrangement of this intensive cultivation method is made possible partly by technical development (spreading of production and application of drip irrigation systems, water soluble multicomponent fertilisers, soil cover materials) and partly by increased labour employment.

At the Horticultural Department of University of Agricultural Sciences in Gödöllő were investigated in 1995-1996 the agrotechnical elements of this cultivation method and the varieties, being able to produce using this system. Our results and experiences are summarised as follows.

DISC-RIPPER, THE NEW PRIMARY TILLAGE EQUIPMENT

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The old convenitonal clean tillage system is the most popular one in our region. But the inovative farmers are thinking about tillage in different ways.

They want to combine primary tillage operations, reducing time-, labour needs, soil erosion and correcting soil compaction. To substitute the "good old" moldboard plough the first step was a combination of subsoiler and disc harrow (KAPOSGÉP, AGRIKON). But the idea which put the subsoiler legs at the front of the machine was wrong. So our R + D concept should be corrected. Finally, for the conservation tillage practice, our proposal has two different models: the disc harrow + ripper combinaton for fall primary tillage and the disc harrow + ripper/ chisel + disc harrow combination for summer primary tillage.

MATHEMATICAL MODELLING OF THE RELATION OF SPECIFIC SUPERFICIAL GRINDING ENERGY REQUIREMENT VS. GRIT FINENESS

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The goal of modeling was to develop the theoretical relationships between specific grinding energy requirements vs. grit fineness on the basis of the so called superficial grinding theory that was originated by Rittinger 130 years ago.

Since the specific grinding energy consumption can be related to mass- (kWh/t), to volume- (kWh/cm^3) and to surface unit (kWh/cm^2) and to the particle mean size (kWh/cm) and also there are three characteristics for the grit fineness (i.e. particle mean size, grit specific surface and specific surface increase during size reduction) 4.3 = 12 different specific grinding energy equations were deduced. This is the mathematical model that was searched for.

UP-TO-DATE HIGH-STRENGTH PLASTICS IN THE MACHINE SERVICING

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In addition to the traditional constructional materials more and more new up-to-date materials are used. One type of them is technical plastics. The plastics have several properties which are only offered by them and those properties will determine their application aims.

Several types of them own excellent strength and tribology behaviour so that they can be well applied in manufacturing a variety of machine parts, e.g. bearings. Their chemical resistance makes possible an extended application. They are usually good insulators, dampers and visco-elastic parts. However, one ought to take the higher relaxation and creep values as well as the ageing property into account.

The paper presents a few application fields of the ERTA technical plastics covering the main material properties, too.

OPTIMISATION OF THE ENVIRONMENT OF INDOOR POTATO STORES

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The environment of indoor potato store is complex. It is governed by the heat and moisture transfer processes between the potato and the indoor environment. Maintaining the potato under strict temperature and humidity conditions is important for the safe upkeep of potato.

The long term objective of this study is to develop mathematical methods for optimising the environment of potato stores. The work will focus on bulk storage of potatoes in piles. In this type of storage, there is a need to ventilate the store in order to remove heat due to respiration and to decrease the temperature of the tubers. On one hand excessive ventilation rates are detrimental because they remove water and thus dry out the potato and cause weight and quality losses. On the other hand, low ventilation rates would rise the temperature of the tuber and could cause inadequate mixing of the air and thus including significant spatial gradients in temperature and moisture content within the potato pile. There is therefore a need to optimise environmental conditions within the store. This could be achieved eighter by optimising the design of the store (e.g. ducts, inlet points and fan positions), ventilation equipment (e.g. fan capacity) or air speed rate at inlet points.

The first step towards achieving this long term objective is to develop a mathematical model to describe the environment of indoor potato stores. The purpose of this initial study is to formulate the set of equations which describe the heat and mass transfer processes in a potato store which is exposed to forced ventilation.