Part II.

SELECTED SCIENCIFIC PAPERS

Plastic formation, a method for component repair

Dr. I. PÁLINKÁS, University of Agriculture, Gödöllő,
Dr. F. LEIDECKER, IH, Berlin–Wartenberg

The position of component parts renewal in the GDR deviates significantly from the Hungarian conditions. In the recent dekades various renewal technologies have been extremely rigorously developed and the collecting-repairing-trading network assuring acceptable series scales have been organised in the same way because of the very modest stock. As a result of this in the period between 1983-87 the quantity of renewed component parts calculating at the price of new component parts increased from 108 million M to 1612 million M. The proportion of the renewed component parts in spare parts supply of agricultural machines has already reached 42 %. A multi-level repairing-renewing network has been established within the scope of which even component parts by small number of pieces demanding simple technology /e.g. welding renewal of axle-like component parts by topping up/ and complicated component parts by large number of pieces demanding hightec. level and expensive equipments /e.g. renewal of synchronous gear by plastic deformation and electron-beam welding/ can be renewed. In the recent year there have been even demands on renewing such complicated component parts which have been qualified as unrenewable up to the present. Such methods of procedure--applied only in manufacturing processes until now--have been developed for renewing these component parts like the above mentioned plastic deformation, superficial alloy building etc.

The applicability of plastic deformation in renewal of component parts

Significant advantages can be obtained by plastic deformation fitted into the manufacturing process of a new component part.

Simultaneously with formation of the prescribed geometrical sizes the structure of the material and its mechanical properties are shaping favourably. The loss of material of this technological procedure is low as opposed the loss of material of cutting where it makes approximately 50-60 %. The plastic deformation assures the above mentioned advantages in renewal as well and its application conditions are very multiple. Conditions depending on material, shape and state of the component part

- the material of the component part should be plasticly deformated,
- the component part should have enough reserves for replacing the shortage of material arising from abrasion,
- the shape and complexity should not hinder plastic deformation,
- cracked or broken component parts can't be repaired by means of this method,
- abrasion should be equable as much as possible on the surface to be renewed.

Economic conditions:

- because of rather high costs of fittings a sufficiently great number of pieces should be available
- the renewing process should be possible automatized.

The determination of geometrical and substantial properties of the renewalable component parts by plastic deformation was carried out on the basis of scientific experiments in the GDR. Nowadays there are-of course - also practical experiences at our disposal in connection with it.

In fig.1 those characteristic geometrical elements can be seen which are able to be renewed with the help of plastic deformation. Fig.2. shows the flow-curves of a material capable of being tempered in a case recorded in various state of the material where the deformation velocity is $\varphi = 17s^{-1}$.

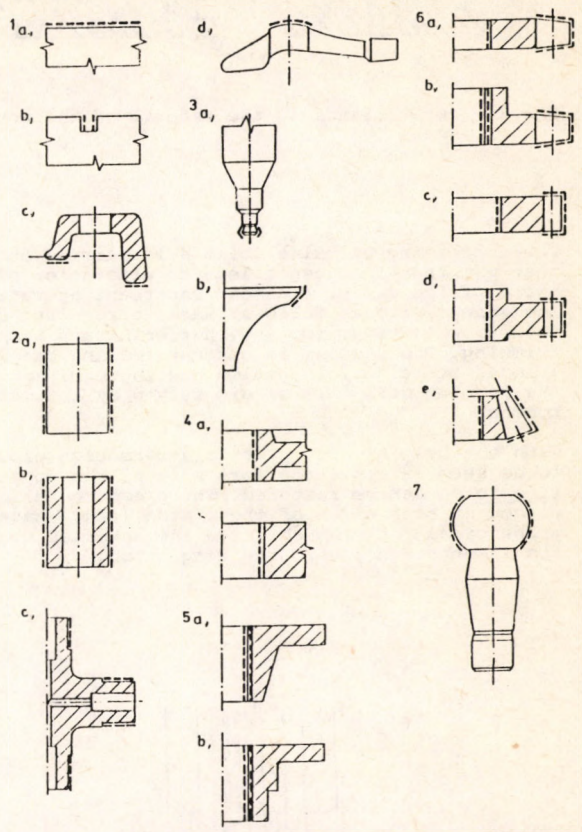

Fig.1.: Geometrical formations and their combinations which are renewalable by means of technologies of plastic deformation

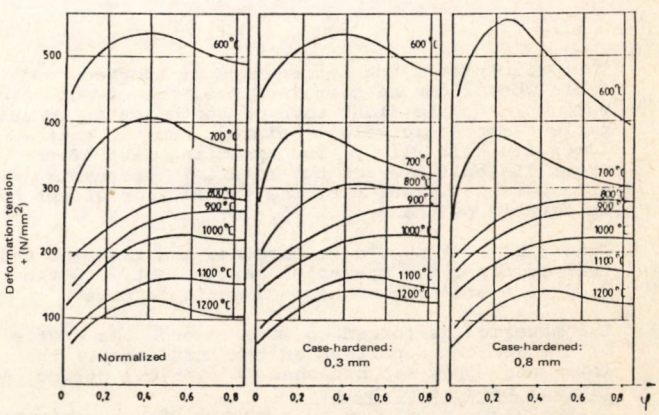

Fig.2.: Flow-curves of the basic material of 16 Mn Cr 5 in a normalized and case-tempered state

Some characteristic application examples

In case of renewal of inlet- and exhaust valves of internal combustion engines the cone-shaped packing surface should be restored first of all /Fig.3./.

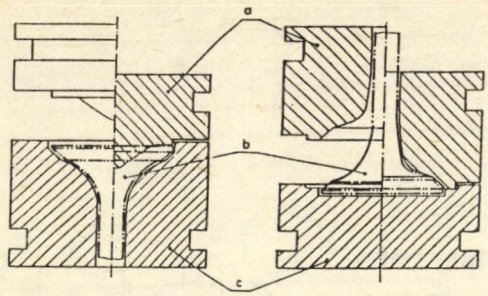

Fig.3.: Two variants of the renewal of the worn valve

The increasing of valve collars is carried out in that way that it doesn't lead to alteration of other parts of the valve. The most important operation of the renewal are as follows: wash, error-recording, induction heating, forging, hardening and tempering, trimming. The process is automatized and the work /piece/ container, induction heating equipment and the forging work /place/ are served by industrial robots.

With the help of cold plastic deformation process to be seen in Fig.4 the worn size of the upper piston ring notch can be restored. The pressure pulleys placed on both sides of the piston /4/d./ have got trapezoidal rings which force the material during the indentation toward the ring notch.

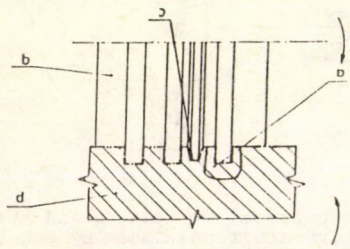

Fig.4.: The renewal of the piston ring notch

The principle of hot deformation of toothed- and chain wheels can be seen in Fig.5. The component part worn on the flank side of tooth heated to suitable temperature will be placed into the toothed lower die half /5/b./. The upsetting part of the upper die half presses the material towards the worn part i.e. rack bar. The wanted size of the hole is assured by the broach /5/e./.

Pieces of work should be hardened and tempered and refined after the operation carried out with the help of a stamping machine of sutiable power.

The material is forced to move towards the centre of the component part under the infulence of the lower and upper set broaches /6/f, 6/b./ during the renewal process of holes.
So the diameter of the worn hole will be diminished in the whole of the hole. Afterwards by means of cutting the original nominal size and tolerance range can be shaped out and the renewed component part remains inter changeable.

Economic questions of renewal by means of plastic deformation

The technological possibilities of a modern component parts renewal with regard to high expenses of set of tools and equipments are only practicable in case of a large number of pieces of component parts to be renewed. It is in general use to evaluate the economic questions of the renewal of component parts in comparison with manufacturing parameters of the new work-piece.

The calculations refer to such different component parts which are renewed by means of plastic deformation, electron-beam welding and with technological combination of these, respectively, in a minimal number of pieces of 150 000.

The relation of renewal and manufacturing to each other in %:

use of materials:	25-30 %
energy-intensity:	70-75 %
work time-intensity:	85-95 %
technological expenses:	45-50 %

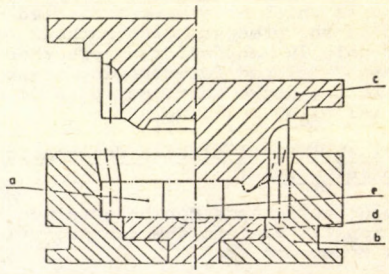

Fig.5.: The principle of renewal of tooth- and chain wheels

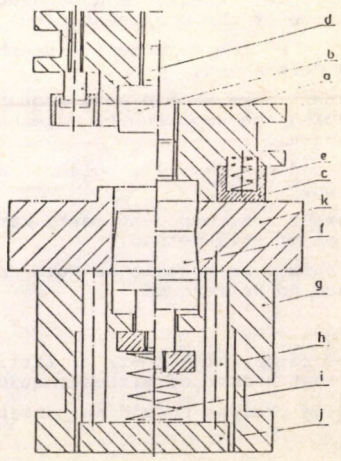

Fig.6.: The tool of the plastic hole-renewal

Automatic quality control of hydraulic pump gears

Dr. G. BEER–Dr. O. SZIJJÁRTÓ, University of Agriculture, Gödöllő

Rotary gear pumps originating a good deal of super-pressure have been used in aeroplanes and in modern agricultural machines and engines of high-output for several years. The modern rotary gear pumps originating pressure over 400 bar differ from their ancestors of the same size originating pressure of nearly 100 bar in the first place in their accuracy to gauge. The tolerance of the most accurate gauges of the latter is of one-hundredth millimetre scale. The tolerance of several gauges of gears working in pumps of high pressure is only 2-3 micrometers. In the years past licence buying and orders from capitalist markets have rendered possible to start with producing modern high-pressured rotary gear pumps in a scale of several ten thousand even in Hungary yearly. A consequence of this is that in case of producing e.g. 50.000 pumps-, which means 100000 pinions and driven gears respectively - many millions of gauging will become necessary. Pressure, delivery power and quiet operation required at receipt can only be achieved with a really very high quality product of high realiability level and this demands the each piece control of components being important from reliability point of view. Figure 1. demonstrates gauges displayed in manufacture drawing and supplied with accurate tolerance to be checked during final control. The following should be noticed with a view to information:

The surfaces of trunnions marked with A and C are the measuring bases during the drop test of the tip circle rack bar and side-surfaces. The reason for this is that not the peak-holes figuring as manufacturing bases are determining from accuracy point of view required to smooth operation but the trunnion surfaces fitting in the house. Therefore the wheel tangs should be rotated in lathe ways during shock-measuring.

- The wheels during their turning-over should be measured in several positions, too. These measurements, however, can only i.e. have to be carried out tooth by tooth, because the tip circle diameter only on the individual tooth-tips and the shock of the rack bar only in the tooth-groove can be checked. So even taking the tooth number into consideration it can be realised that only shock test on 100.000 gears makes more than one-million measurements necessary.

- The geometry of gears of the pump generation - apart from the shape of shaft-ends-differs only in size b determining the devlivered quantity. The equipment made at the Department of Repairing Agricultural Machines of the University of Agricultural Sciences and operating at the pump manufacturer's renders adjusting every b size between 5-50 mm possible in that way that it classifies wheels of all kinds of width size into 2 micrometer tolerance ranges attaching themselves to each other. The chart shown in Fig. 2 gives full information about /the/ differences between permissible size of measurements to be controlled.

Supposing the normal distribution of measuring scattering, the values of permissible measuring uncertainties are summarized on the basis of tolerance calculations also in this chart. The described task can be economically and reliably solved only by means of measuring automatic machines.

Metrological characteristics

By choosing the appropiate measuring technique - besides metrological points of view however, the mass character of this test had to be taken into consideration and the possibility of electronic processing all measuring results because of classification task.

Taking measuring theoretical and technical points of view into consideration the measuring feeler Type GT-22 of the Swiss firm TESA was applied as measuring sensor. The measuring range and error curve of this are shown in Fig. 3. and its metrological data can be seen in Fig. 4.

The 0,00001 /one-hundred thousandth/ mm measuring uncertainity and reversing error are accentuated.

The nine kinds of measuring tasks shown in Fig.1. were solved by means of six pieces of pick-up boxes. The placing of pick-up boxes can be seen in Fig.4.

The measuring signals are received by a 16-channel--programmeable measuring converter operating in multiplexer mode. This equipment supplies the pick--up boxes with appropriate voltage and this one forms the necessary logical levels needed for further computer data processing for the outputs.

The processing of measuring data, preparing of measuring documentation and controlling of movements needed to measuring is solved by means of a measuring tasks orientated special computer.

Operation of the measuring automatic machine

All the measuring instruments are organised like one place of work in that way that one person can operate them in sitting-mode.

It is characteristic of the function of this measuring automatic machine that it repeats the readings of a single gauge ten times and it stores the average of this.

The time of a measuring cycle by a gear - altogether 280 measurements is 30 seconds. It is followed by the change of a new gear which takes up not more than 15 seconds. The equipment qualifies the product - according to the registerable tolerance range - as good or as inferior; and it orders the product on the basis of width size into 5 classes.

The position of measuring feelers is marked in Fig.4. and the surfaces serving as measuring base as well. The measuring feels marked by 1,2 and 3 measure not only the diamters but they test the shock, too. The feeler Nr.5 and 6. operated together measure the width of teeth and give signals to classification. The same feelers separately control the end-stocks.

The rotary mechanism is of pneumatic operating and of electro-pneumatic controlling. The rotary mechanism during the measuring moves off the gear, the position of which is set in and fixed up by the mechanism operating the feeler Nr.4.

At the end of the measuring cycle the equipment displays an inscription inferior ones attention will be drawn by flashing, too.

The adjusting of measuring automatic machine is carried into effect by means of master gears. The most important is the shape-correctness of master gears and accuracy of absolute dimensions is not an essential requirement because the equipment takes the known size deviation from the middle of tolerance range into account.

A further advantage of applying a computer is that the accurate adjusting of prick up boxes could be supported by a programm.

This means, however, that an absolute O-value shouldn't be adjusted as the programm reads /out/ the basic values of the pick-up boxes before starting measuring and it calculates the measured values in proportion to them. The application of this method made the applying of the line code to adjusting of

the middle of measuring range possible. On adjusting--every pick up box - without any further control - should be fixed up in such position that only one line-code could be seen.

In the End the equipment makes also a measuring documentation at demand. It has got especially then importance if on the display the inscription INFERIOR Could be seen. This time the inscription in italies emphasizes the size causing inferior goods.

The equipment by means of employment of master gears can be authenticated also during the measuring series.

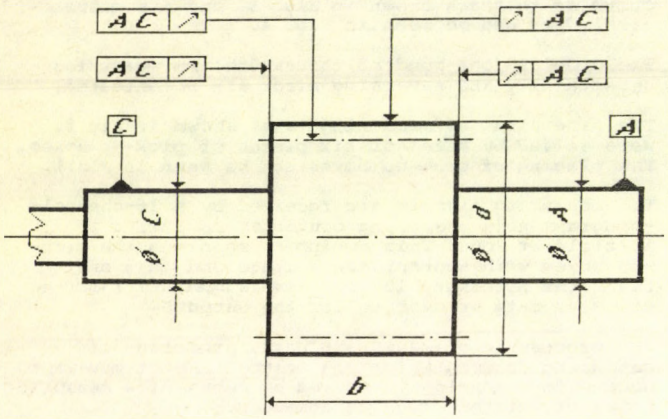

Fig.1.: Sizes measured on driving and driven wheels of a rotary gear pump

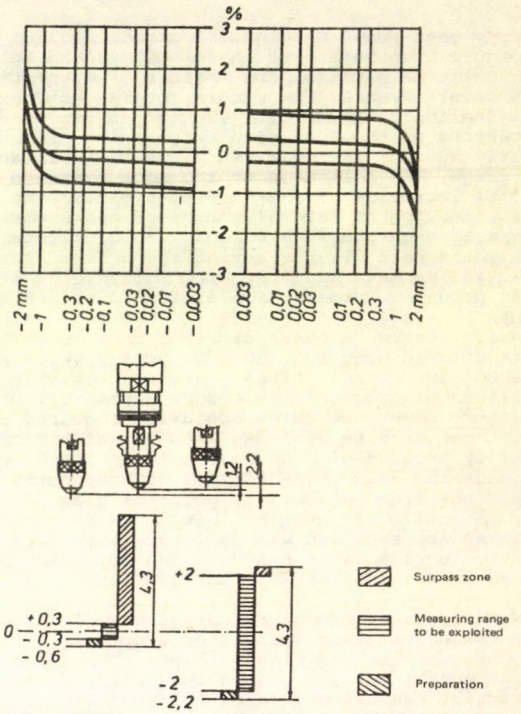

Fig.3.: Mesuring range and error curve of measuring feelers GT-22

GAUGE SIGNAL		TOLERANCE (mm)	MEASURING UNCERTAINTY /µm/
A		-0,040 -0,050	± 1,0
C		-0,040 -0,050	± 1,0
d		-0,100 -0,120	± 1,5
b		+0,004 -0,008	± 1,5
SHOCK	SIDE	0,002	± 0,2
	TIP CIRCLE	0,002	± 0,2
	TOOTH/GEAR	0,010	± 1,0

Fig.2.: Differences between permissible sizes to be checked and the allowed measuring uncertainity /± 3s/

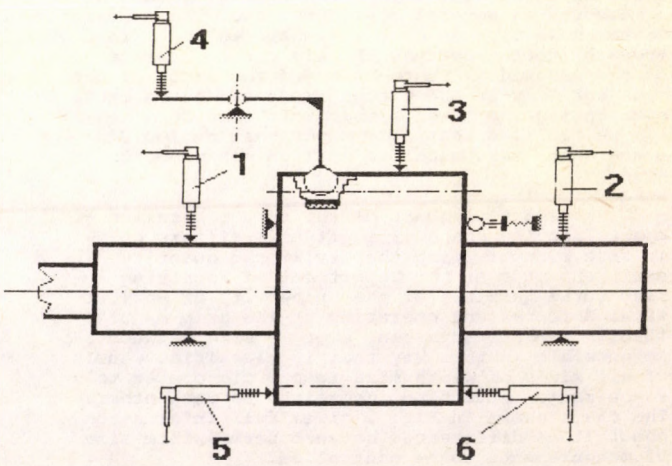

Fig.4.: The placement of measuring feelers and equipments

Development of tobacco dryng by air preheated by solar collectors

P. PECZNIK, Hungarian Institute of Agricultural Engineering, Gödöllő
P. POLENSZKY, University of Agriculture, Gödöllő

Efforts have been made to reduce the energy consumption of tobacco drying and to find other energy sources instead of hydrocarbons. One of the simplest and cheapest methods is the use of solar energy for preheating the air used for drying tobacco.

In Hungary one could take into account a medium strong solar radiation because of the geographical and meteorological possibilities: the yearly amount is 4,2 to 4,7 GJ/m^2. The difference between the different parts of the country is about 5% /Fig.1/. The tobacco should be dried since July to October. This is good for the utilization of the solar energy. According to average data the predicted value for the mentioned period is 1,8 GJ /m^2 /Fig. 2./.

The drying of tobacco needs a specific technology, that is a process of 120 to 140 hours long. The ambient air is pumped into the drying chamber during about 68% of the drying period. About 776 x 10^3 kg air is needed when supposing 50 % of relative humidity and 15 °C ambient air temperature by 5 °C, that results 3 881 MJ energy, that is equal to about 93 . kg oil equivalent.
Usually the drying chambers are in the open air, so it is reasonable to mount the solar collectors on the top of the drying chamber.

The construction of the solar collector is as follows: the roof of the drying chamber is painted black and a wooden frame is mounted on the roof, to give 2x3 air channels. The air intake takes place above the doors, through the fron side of the chamber. The air moves three times along the chamber and then it is blown into the air collector and further into the thermo-generator.

The air while flowing from the air collector into the thermogenerator will be preheated by the solar radiation through the foliage and by leaving the drying chamber through the roof /Fig.3/.

Two advantages were achieved by the described construction of the system: the heat of solar radiation is utilized and the dissipation of heat of the drying chamber is utilized as well. The measurements show that the heat production of the solar collectors is 4 kW in average and the energy increase is about 8% relative to the conventional driers.

After the promising results the development was carried on in two fields, as follows:

- the increase of the surface of the solar collectors to improve the energy utilization;
- the modification of the solar collector construction to increase the efficiency and to improve the air flow through the channels.

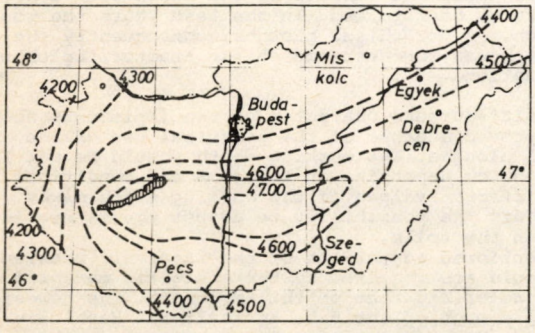

Fig.1.: The energy of solar radiation over the horizontal surace of Hungary /MJ/m^2/

The increase of the collector surface: The southern side of the drying chamber was used as an absorber surface. Four air channels were constructed on the southern side wall, so it gave 21 m^2 absorber surface. The total absorber surface became approximately 70 m^2. The roof of the drying chamber was modified to have three channels instead of the earlier six ones. The absorber surface was the black painted side wall and the roof of the chamber.

Modification of the collector construction: When the drying chambers are too close to each other, i.e. the distance is 1 m, the side wall cannot be used as an absorber surface. Three air channels were constructed on the roof and the absorber surface was the black aluminium plate that covered the air channel. This was covered by foil at a height of 100 mm /Fig. 4/.

In both cases the collector frame was simplified, the number of the channels were decreased to 3 ones /instead of 6/, and the average height was increased to 330 mm in the first case and to 220 mm in the second case. This modification improved the air flow and decreased the flow resistance. The stability of the collector frame was increased by the means of grated frame.

At the air intake an air chamber was built in the system for mixing the preheated air and the fresh air according to the need. A computer programme was developed to control the operation of the drying chambers and the collectors. The programme can be used to evaluate such solar collector systems.

The results of the tests and the computations are summarized as follows:
The average output of the increased collector is 22,5 kW. The maximum output is 39,2 kW, when the intensity of the solar radiation is 730 W/m^2, the inner temperature of the dryer is 41 °C and the maximum temperature of the collector is 58 °C.

The heat recovery because of the collectors is 16 kW during the night operation.

The output of the collector of two layers is 13 kW. The maximum output is 33,2 kW, when 730 W/m^2 is the solar radiation, 78 °C is the maximum collector temperature and 41 °C is the inner temperature in the drying chamber.

The heating oil saving for three drying cycles was 208 kg oil, 24,7 % for the collector of increased surface and 121 kg oil, 14,7 % for the collector of two layers. The saving for five years period is minimum 20 000 Forints /Hungarian/ with the collector of two layers. The reduction in the fuel oil results a reduction in the exhaust smoke, consequently the use of solar collector is beneficial for the environment control.

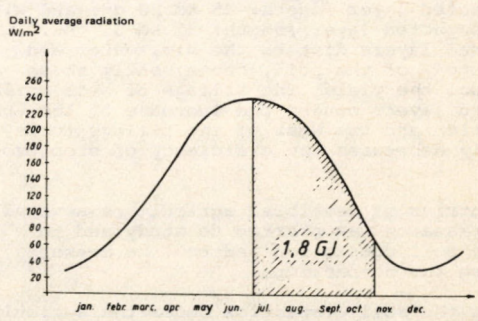

Fig.2.: The daily available solar radiation energy for the period of tobacco drying

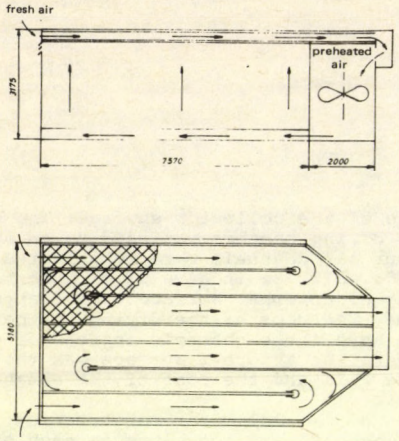

Fig.3.: Experimental solar collector for air preheating/first modification/

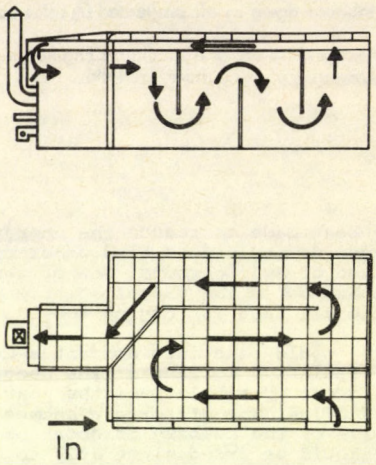

Fig.4.: Developed solar collector /second modification/

Means and methods to reduce soil compaction

Dr. I. J. JÓRI–Dr. S. SOÓS, Hungarian Institute of Agricultural Engineering, Gödöllő

The fertility of the soil should be maintained and soil protection should be developed to maintain and to improve the high yields achieved during the last decades.

One of the most important problem of the mentioned topic is the analysis of the soil compaction generated by the running gears of the agricultural vehicles /tractors, harvesting machines, transport vehicles, implements/. The meintoned vehicles have a bad effect on the soil structure, especially on the upper soil layer, however the compaction can be experienced in the deeper layer, where its effect could accumulate during the years. The significance of the problem is emphasized by the tendency that the performance and the mass of the vehicles increases now as well. So the force transmitted to the soil increases further.

Another reason of the soil compaction is the tillage, especially the too frequent use of disc harriws and the repeated ploughing at the same depth can cause compaction as well. On this basis we deal with an upper compacted layer /depth: 15 to 20 cm/ and with a deeper compacted layer /depth; 30 to 35 cm/. The mentioned layers disturb the air, water and nutrient supply of the soil, consequently these layers reduce the yield. The tillage of such soils of compacted layers causes the increase of the energy consumption and the wear of the tillage tools, consequently decreases the efficiency of crop production.

In the countries of developed agriculture several years ago research was started to study and to measure the soil compaction and to take measures for reducing the compaction.

In reducing the soil compaction uncer the agricultural machines the first job was the determination of the conditions /site, time, manner/ for compaction. For the mentioned purpose the density of the soil should be measured and evaluated during the different operations /fertilizing, tillage, seedbed preparation, crop protection, drilling, harvesting, transport/.

The soil density can be characterized by the strain/pressure curves. The pressure/strain curve can be called penetrogramme because of the used penetrometer. The pressure and strain values of the penetrogramme are similar to the bulk density values versus depth. Both vaues are characteristics of the soil density. The bulk density is a characteristic of the geometric distribution of the soil grains, however the penetrogramme is the dynamic result of the geometric distribution.

To eliminate the compacted layers one should know the development procedure of such layers. Principal tillage is the best operation to eliminate compacted layers, this operation can be done by turning, without turning /chisel ploughing/ and by a combined method.

In this paper the results of the tests with loosening are to be reported. In the last years the tools were chosen for chisel ploughs, consequently the research was concentrated on the tractor/implement combination.

The multi-purpose character of the implements should be improved because of the practical use of the chisel ploughs. The working depth should be set from 30 to 50 cm depending on the jobs and conditions. The different values of the working depth makes necessary the possibility to adjust the intervals between the tolls.
The mentioned adjustment of the intervals between the tools are required by the energetic matching of the tractor and that of the implement. The newest chisel plough of the Rába Agricultural Machinery Factory, Mosonmagyaróvár, is of variable working width, this chisel plough was constructed to meet the mentioned requrements.

The "V" shape two frames of the new implement can be varied by a screw drive, consequently the intervals between the tools can be stepplessly adjusted in a given range. The tools can be adjusted to be in a parallel plane in the direction of the movement, because the tools have independent mounting. The good characteristics of the new chisel plough was approved by field tests. The corn stubble was horisontal and of compacted heavy clay soil /Fig.1/. The measurements were carried out with three different tool intervals /minimum, medium,maximum/ and tests were performed with the medium tool interval at different working depths.

The variation in the tool intervals are acharacterized by the whole transversal profile /Fig 2 and 3/. The working quality of the chisel plough was found to be good in spite of the dense soil, the standard deviation of the working depth was favourable /5,33-6,41 < 10/. The profiles show that a 600 mm tool interval is the best for a working depth of 40 cm. With 425 mm tool interval the working quality was not good enough, the energy consumption was relatively high, the loosening effect is not good and the soil breaks into 400x425 mm size columns. With the 700 mm tool interval the transversal loosening is not complete, therefore the agricultural requirements are not met.

The working quality of the chisel ploughs of different setting did not show a significant difference. The loosening effect that was calculated from the average surface rise shows that the increase of the tool interval improves the loosening effect.

Table 1 shows the energetic effect of the variation in the tool interval. The specific drawbar pull requirement /pull/width/ and the specific power requirement /power/width/ show that the increase of the width reduces the energy consumption. Consequently the largest working width should be chosen in the range of the suitable loosening. This possibility is a result of the implement construction.

Also the transverse profiles are used to illustrate the effect of the variation in the working width /Fig. 4-5/. According to the results the increase of the working depth has a favourable effect on the variations in the depth, since the coefficient of variation on the depth are as follows: 7,16 %, 4,98 % and 3,48 %. One should take into account that the coefficient of variation for the shallowest working depth is lower than the accepted value. From the transverse profiles a close relationship between the working depth and the tool interval can be concluded. The 600 mm tool interval is too large for the 30 cm working depth and the wanted loosening effect is not achieved.

However with 50 cm working depth the tool interval is too small, the interval can be increased, because the soil is overloosened. It is not so easy to evaluate the influence of the different configurations on the soil surface. When taking into account the deviation of the surface line after the tillage, it is proportional to the working depth. However the loosening effect, that takes into account both the surface rise and the working depth, does not show a definite tendency.

Table 2 shows the effect of the variation in the working depth on the energy consumption. The increse of the working depth increases the energy consumption, both the absolute value and the specific value /calculated for the working width/. Consequently the working depth of the loosening should not be deeper than the depth determined by the agrotechnical requirements. The wanted depth can be set by the appropriate controls of the implement. The working quality and the energy consumption was evaluated on the basis of field tests, the evaluation shows that the chisel plough can be set for a working width of 425 to 700 mm and for a working depth of 30 to 50 cm. The increase of the tool interval shows that as a result of this intervention decreases the energy consumption and the tranverse loosening effect will be reduced as well. However the increase of the working depth increases both the loosening and the energy consumption. The best results were achieved with 600 mm tool interval and with 40 cm working depth on silage corn stubble of medium heavy soil.

The advantages of the new chisel plough are as follows: the working width is variable, and it can be carried out easily and quickly, it can be used with tractors of articulated steering, because of its width the implement can be transported along the roads, and the construction of the implement ensures the reduction in the possible clogging of the machine.

The mounting of the tools ensures a swing of $\pm$ 15° that results a minimum transverse stress because of the effect of the articulated steering of the tractor and minimum clogging of the implement meets the requirements of the traffic regulations /maximum 2,5 m/, this is due to the screw adjustment and the hinged frame. Our research work of the past years dealt with the measurement of the soil conditions, with the effect of the tool angle and that of the working width, and with the working quality and energetic characteristics. Consequently chisel ploughs of energy saving and that of good loosening effect can be manufactured. The analysis of the test results and experiences contributed to the development of frame and tool mounting that has the advantage of the mounted implement and can be beneficially used for articulated tractors. The new construction of the chisel plough improves its capabilities to match the tractor performance, the wanted working depth and the type and conditions of the soil by the means of the steppless variability of the tool interval.

Energetic characteristics with different tool intervals

Table

Tool interval, mm	425	600	700
Working speed, km/h	5,0	5,0	4,9
Working depth, cm	40,8	39,5	40,1
Working width, m	2,13	3,00	3,50
Drawbar pull:			
average; kN	31,45	35,12	36,57
specific, kN/m	14,80	11,71	10,45
Drawbar performance:			
average, kW	44,15	48,85	49,43
specific, kW/m	20,78	16,28	14,12

Energetic characteristics with different working depths

Table 2

Set working depth, cm	30	40	50
Working speed, km/h	5,2	5,0	4,4
Actual working depth, cm	32,1	40,5	51,9
Working width, m	3,0	3,0	3,0
Drawbar pull:			
average, kN	23,0	39,21	65,19
specific, kN/cm	0,72	0,97	1,26
Drawbar performance:			
average, kW	33,22	54,60	80,47
specific, kW/cm	1,03	1,35	1,55

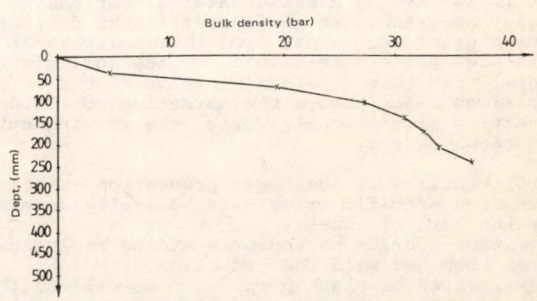

Fig. 1.: Soil bulk density of the test field versus depth

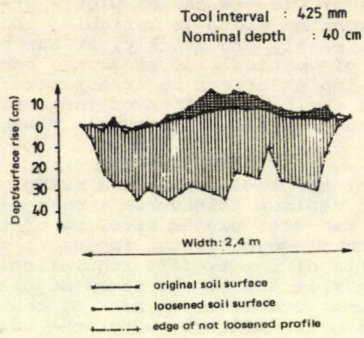

Fig. 2.: Transverse profile of the soil with minimum tool intervals

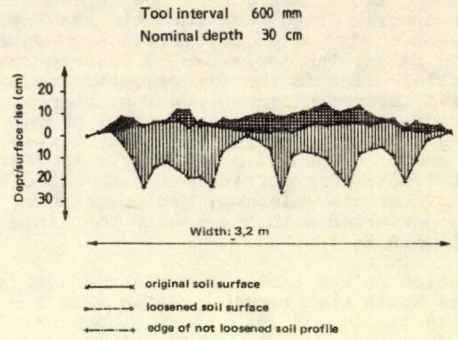

Fig. 4.: Transverse profile of the soil with maximum working depth

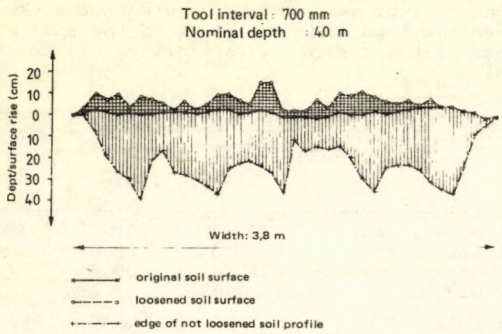

Fig. 3.: Transverse profile of the soil with maximum tool intervals

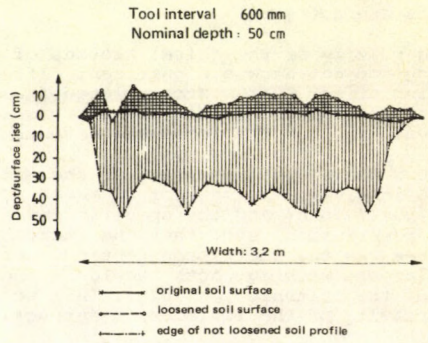

Fig. 5.: Transverse profile of the soil with maximum working depth

Reduction of the loss of sunflower harvesting

Dr. P. SZENDRŐ–I. SZABÓ, University of Agriculture, Gödöllő

From the oil plants cultivated in our country the sunflower is of the greatest importance. Fructification of the cultivated, up-to-date hybrids is 45-50 per cent which is suitable for human consumption and regarding its physiological effect contains excellent edible oil. Due to its favourable biological effect it is used as a basic material for making of different cosmetics, at the same time the dehydrated sunflower grits mean about 2500 thousand tons of concentrated protein feedstuff for the agriculture. Probably, with this outstanding value of use if can be explained that, though the marketing conditions were getting significantly worse, the growing spirit is unvariably great.

The profitability of sunflower production - regarding its high specific value - is basically determined by the rate of losses.
The dominant hybrids having outstanding biological features together with the reduction of height - unequlization of plant population as well as the harvest or the right time selection of artifical desiccation which is hard to eliminate under the climatic conditions of the country - contributed significantly to the moderation of crop left behind.

Over and above these technological consideration in the reduction of losses a significant role can be played by modified adaptation of the most suitable machine system of maize production used in the harvest.

The traditional combine harvester - regarding its net mass-output in the sunflower harvest - is practically unutulized, which is unutilization loss on the one hand, at the same time, going with the low loading level of cleaning device, the good cleaning work and a minimum /below 1 per cent/ fructification loss.

The increase of travelling speed and utilization of adapters is limited by losses which are increasing progressively with the speed of travel and the rate of loss depends on the type of adapter.

On the base of our early tests it can be stated that the row-type machines fitted with so-called active draw - in mechanism /e.g. SNA family/ out of the special sunflower adapters marketed in our country have acceptable paramters. However, the one purpose feature of the machine hinders its wide sreading,

the majority of farms being in difficult situation regarding their investment possibilities uses home-modified FKA adapters for maize harvesting. Our measurements have justified the grounds of maize adapters for sunflower harvest /low investment, adeptable 4-6 per cent loses left behind etc./, at the same time have shown deficiencies:

- in the case of traditionally modified FKA adapter within the losses the fructification shatter which is caused by the dynamic effect of cutting caused by the welded blades and this problem increases at higher speed;
- in the absence of reel the getting of cut stems to the auger, even at higher stem moisture content can be critical;
- it is very difficult to adapt such a harvest into a predise and modern technology which is typical for the sunflower production where the rate of loss influencing the profitability depends on a non-unified, often defective homemade modification.

For the elimination of deficiencies mentioned we began a series of test at the National Institute of Agricultural Engineering with new FKA adapters and own conceptions. The essence of these modifications is that two revolving disc pair remove the head of sunflower instead of standing-moving blade pair. The forming state of cutting is more considerate, the device eliminates the knocking effect. The first measurings taken in 1988 were continued with a modified construction in 1989. The essence of modification is to approach the revolving disc pair to the auger obtaining an optimum detaching place. Moreover, other supplementary modifications were also made. During the tests this equipment was compared with a traditional adapter.

The results can be summarized as follows:

- with reduction of the fructification, the loss parameters of machine, which approach the work quality of row-adapters in the most frequent range of combine speed;
- the experimental adapter was operating acceptable in the range of higher, extreme speed /3-4 m/s/, the loss was 6-8 per cent, comparing with the traditionally modified version it can be stated, that in case of use of the new construction, the loss increase moderately with the increase of area covered;
- the new conception does not require higher investment, the modification was carried out with the use of own components of the adapter, there is no need for additional operation, the modification can professionally be solved;
- succes of the modification would significantly be influenced if the maker would attach the machine parts needed, in a form of unit package together with the directions for mounting or similarly to the former's ones, the maker would packet these in the form of spare parts;
- the time required for the modification if the components needed are available is not more that in case of traditional version, the carrying out of minimum modifications backing the adaptation /e.g. halving of chain fasteners, making of mounting holes etc./ would mean facility therefore this would be taken into consideration by the maker;
- in case of high speed of travel the minimum increase of the auger revolution /e.g. with factory change of sprockets or supplying of suitable sprockets/ would improve the safe passing of material;

Taking also the farming conceptions into consideration it can be stated that with cooperation of the maker regarding the possibilities of utilization a multi-purpose, investment tolerant adapter with low cost of operation will be available for the farms and its parameters will approach the row-adapters.

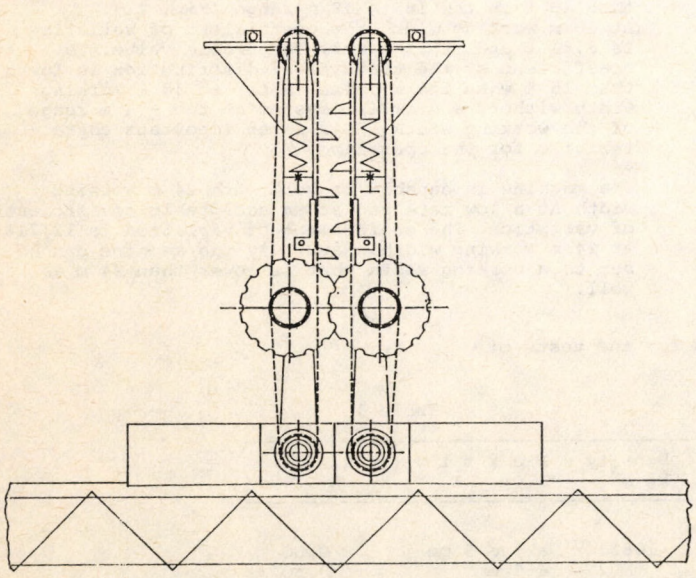

Fig. 1. Operational principle of the modified FKA adapter

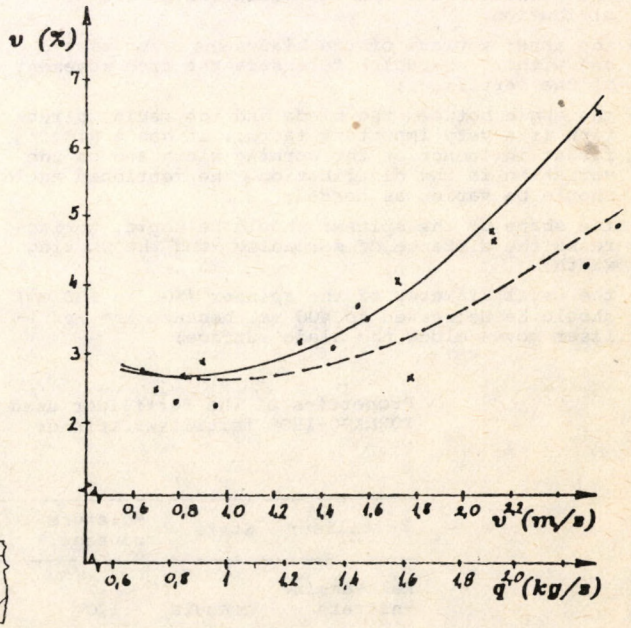

Fig. 2.: Loss parameters of the traditional and modified versions
——— traditional FKA adaptation
------ modified FKA adaptation

The development of fertiliser spinner for low rate fertilising

Dr. Z. Csizmazia, Agricultural University, Debrecen

The efficiency of nutrient distribution should be improved, because the importance of cost and energy saving and the environment control measures increases and one should take into account the high yields and the needed high quality produce. The purpose is to spread the required quantity to the appropriate place with a low coefficient of variation and with a large working width.

The majority of the nutrients are spreading solid state worldwide. Probably this tendency will continue in the future as well. Consequently a development is performed to improve coefficient of variation of the fertiliser distribution and to increse the working width of the machines.

A test track was built to improve the testing conditions of the fertiliser machines, especially the test of the transversal and longitudinal distribution of the chemicals. A computerized system is used to evaluate the results of the tests, consequently fast and efficient work can be performed.

In Hungary 18 and 24 m wide tramline systems are used and because of the divided method of fertilising, it is necessary to develop a fertiliser spinner mechanism for low rate fertilising.
Our Department together with the Hungarian Institute of Agricultural Engineering /MÉMMI/ developed a spinner mechanism for mounted fertiliser according to the contract signed by TORNADO Vehicle and Machine Manufacturer Ltd.

The principles of the development were as follows:

- the number of blades should ensure the continuous movement of the fertiliser along the surface of the blades in a single layer. A multilayer movement reduces the working width;
- the increase of the number of the blades increases the angle of spreading and increases the variation of the distribution;
- the use of blades of different length increases the working width and the variation of the distribution;
- the inner surface of the blades should be smooth and without obstacles to ensure the free movement of the fertiliser;
- the angle between the blade and the radial direction is a very important factor, it has a significant influence on the working width and on the variation in the distribution, the mentioned angle should be varied as needed;
- the shape of the spinner should be conic, to increase the distance of spreading and the working width;
- the usual diameter of the spinner /500 to 600 mm/ should be decreased to 400 mm, because the fertiliser moves along the blade surface;
- on the basis of publications and experiences the peripheral speed of the spinner should be higher than 25 m/s, to achieve the wanted 24 m working width. When taking into account the length and shape of the blades, the speed of the spinner should be higher than 750 rpm;
- the working width can be varied by the variation of the height of the spinners from the soil surface and by the angle between the spinners and the horisontal plane;
- the fertiliser rate should be remote controlled.

On the basis of the mentioned principles a spinner device was constructed. It is a twin spinner device, where the diamter of the spinners is 400 mm, the conic angle of the spinners is 9°, the speed of the spinners is 756 rpm. There are two 220 mm long and two 300 mm long blades on a spinner. The blades can be fixed in three different positions. The inner surface of the blade is smooth and its shape is an "U" profile. The peripheral speed at the end of the longer blade is 26 m/s. There are six positions for the deflector cone that transports the fertiliser onto the spinners. Consequently the optimum contact point of the fertiliser and the spinner surface can be varied as needed according to the physical properties of the fertiliser. The rate can be adjusted in 40 steps by a screw mechanism. The height of the spinners and the angle of the spinners can be adjusted by the three point linkage of the tractor.

The above described spinner mechanism was manufactured and mounted into the TORNADÓ-1300 mounted fertiliser spinner /Fig. 1/.

The machine was tested with different fertilisers used in the practice. The properties of kalk-ammine-nitrate are shown in Table 1. Characteristic testing of the machine was carried out when spreading the mentioned fertiliser.

The machine was tested for 18 and 24 m tramline systems.

In case of 18 m working width the coefficient of variation of the traneversal distribution was lower than 15 % in the 16 to 19 m range /Fig. 2./.
At 18 m working width the coefficient of variation is 8,61 % and it is a very favourable value. The coefficient of the transversal distribution is lower than 15 % when the machine is set to 18 m working width without a tramline system at the ± 1 m range of the working width. This is an important characteristic for the operation.

The machine is capable to work with 24 m working width at a low rate and at an acceptable coefficient of variation. The coefficient of variation is 12,71% at 24 m working width. Naturally the machine can be set to a working width that is lower than 24 m as well.

Properties of the fertiliser used for the tests of TORNADÓ-1300 fertiliser spinner

Table 1

Fertiliser	State	Moisture content,%	Density kg/m³	Particles %	
Kalk-ammine -nitrate	granule	1,0	1063	above 5 mm	0,00
				4-5 mm	0,50
				2 to 4 mm	63,15
				1 to 2 mm	34,30
				0,5 to 1 mm	1,65
				below 0,5 mm	0,40

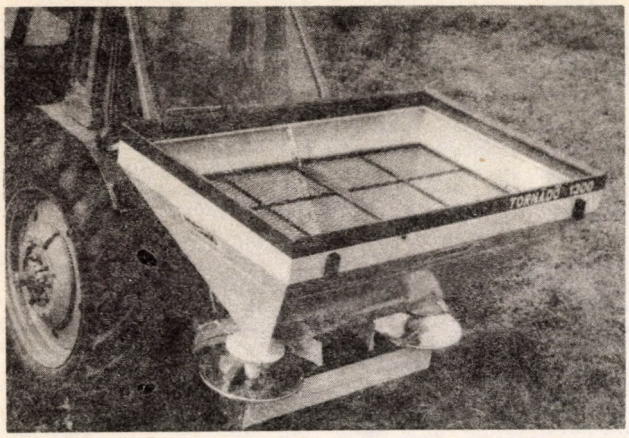

Fig. 1.: TORNÁDÓ-1300 mounted fertiliser spreader

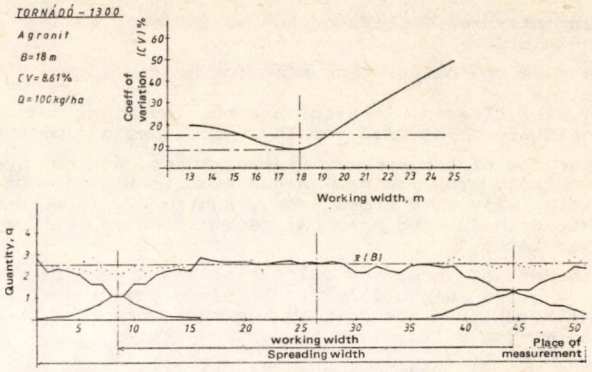

Fig. 2.: Transversal spreading pattern, overlapping and the coeffieient of variation of TORNADÓ-1300 machine when set to 18 m working width

The test results show that the new spinner mechanism meets the agrotechnical requirements and the machine can be used to spread fertiliser at a low rate and with a favourable coefficient of variation.

The TORNADÓ-1300 fertiliser spinner was shown at different exhibitions and it was found to be a successful machine. This machine is a good means of fertilising with respect to the cost saving and to the environment control. Serial production of the machine starts in 1990.

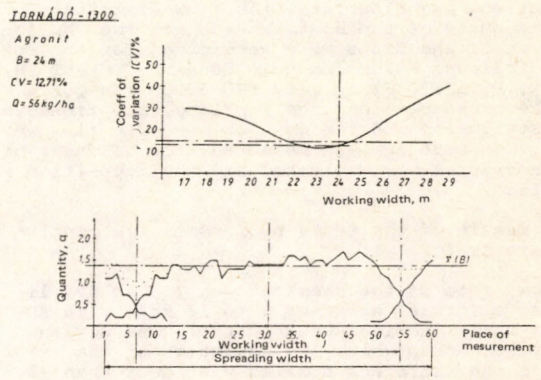

Fig. 3.: Transversal spreading pattern, overlapping and the coefficient of variation of TORNADÓ-1300 machine when set to 24 m working width.

High clearence sprayer for field crops

Dr. G. DEMES–Dr. G. DIMITRIEVICS–J. HUSZÁR–L. PURAK,
Hungarian Institute of Agricultural Engineering, Gödöllő

The efficiency of the field crop production is determined by operations as chemical weed control, the use of insecticides and desiccants and additional fertilising. The mentioned operations can be performed by the means of conventional terrain machines up to a definite crop height. However the serial distribution of chemicals has several drawbacks. The cost is higher and the working quality is poorer with airplanes, than with terrain machines. A considerable drift of the drops and the pollution of the environment occurs when airplanes are used for spraying. Not only a high chemical content, but actual damage can occur, especially with weed control and desiccation.

The HP-01 high clearance tractor was developed on the basis of the MTZ-80 and MTZ-82 tractors /made in the USSR/. The implements for the high clearance tractor are as follows:

- a frame of 18 m width for spraying/spreading /including the lift meachanism, the tube suspension, the pump, the spray pipe, and other parts/;
- a row sprayer that can be mounted on the frame /Fig. 1/;

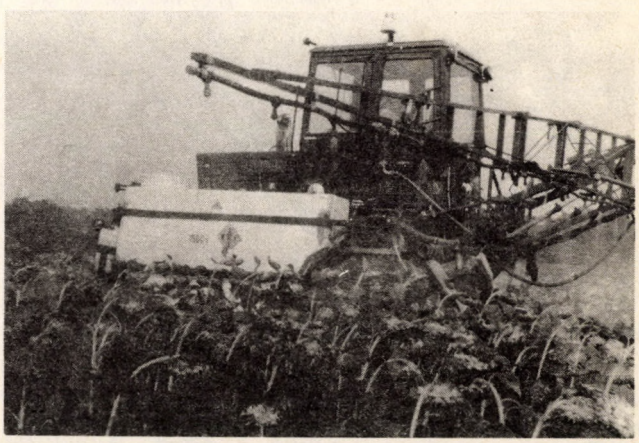

Fig. 1.: Sunflower spraying by a sprayer mounted on the HP-01 high clearence tractor

- an inter-row cultivator and an injector for N-solution;
- a male row cutter mechanism for hybrid corn.

The high clearance tractor and the implement combinations can be used for the operations as follows:

- the use of the sprayer framework for chemical weed control, crop protection and leaf fertilising of relatively high crops /corn, sunflower, rape, etc./ and cereals, and chemical desiccation of sunflower and rape;
- the use of inter-row cultivator and injectors for row crops /especially for corn/ to inject liquid nitrogen into the soil in the same operation when inter-row cultivation is carried out;
- the use of inter-row sprayer for high crops to perform inter-row crop protection and liquid nitrogen fertliser distribution onto the soil surface;
- the use of row cutter mechanism for cutting out of the male row hybrid corn.

The working quality was tested by the use of different nozzles to determine the best operational conditions for the high clearance tractor and sprayer combination. The flow rate, the flow distribution the cone angle of the distribution and the characteristics of the drops were determined for the nozzles as follows: KORUM /made in Hungary, TEEJET XR, TWINJET, FULLJET, Flood Jet, PVC 22000 and Quick Jet. The pressure along the pipeline, the transeversal distribution and the maximum specific flow were tested. The coverage was measured, the goodness of the penetration was evaluated and the deposition was determined.

As the result of the tests performed, the conclusions are as follows:

The flow rate of the chemical was 132 to 577 liter/h at a forward speed of 6 to 12 km/h with KORUM nozzles while chemical weed control. The working quality was acceptable, the deviation of the flow rate for the different nozzles was lower than ±7,5% relative to the avarage flow rate. The transeversal distribution was better than the allowed coefficient of variation of 15%. The workrate for the whole working period is predicted to be 6 to 7 hectars/h. Acceptable drops were produced by the nozzles /Fig. 2/.

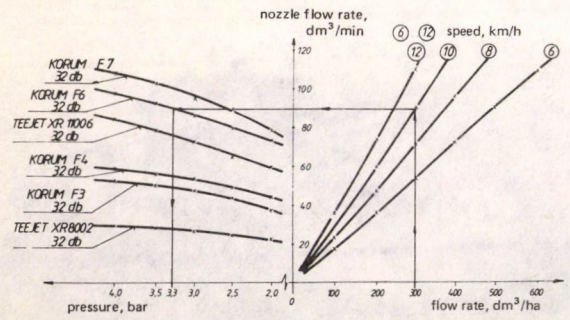

Fig. 2.: Drop size distribution of KORUM F6 nozzle

The leaf foliage can be sprayed from the two sides by the interrow sprayer, consequently the penetration and the coverage were found to be favourable. The flow rate was 134 to 622 liter/hectar by the means of TEEJET and XR TEEJET nozzles. The improvement of the coverage was 50 to 100 % higher than with sirplane spraying.

The root fertilising of corn of 12 rows can be carried out by the means of the inter-cultivator and the injectors when the crop has maximum 4 to 6 leaves. The flow rate of the liquid was 123 to 465 liter/h at 6 to 12 km/h forward speed. The tractor and implement combination should not be used for corn that was planted by a six row planter, because the crop can be damaged where the rows join up and because of the soil compaction on the surface where the tractor and implement combination turns.

The sprayer framework can be used to spread the liquid nitrogen onto the whole surface. The tractor and implement combination can be used for cereals along the tramlines. Low pressure nozzles are needed for the mentioned purpose, to develop relatively big drops. TEEJET XR and TEEJET nozzles of three holes can be used for the mentioned operation. The flow rate can be 35,5 to 219,6 liter/hectar with XR TEEJET nozzles and 22,2 to 120,9 liter/hectar with the nozzles of three holes at 6 to 12 km/h. Consequently relatively big drops can be sprayed and the damage of the crop is eliminated. The predicted workrate is 4 to 7 hectar/h for the whole working period.

Inter-row spraying devices can be mounted on the framework to perform the inter-row fertilising. The inter-row spraying is especially important the second, or third fertilising of corn. The liquid nitrogen can be sprayed by the TEEJET nozzle of three holes in relatively big drops onto the soil surface. The flow rate is 52 to 352 liter/hectar. The transversal distribution meets the agrotechnical requirements, the coefficient of variation is lower than 7,7 to 11,1 %. The distribution of the sprayed liquid is the best with the nozzle of three holes. The coverage of the crop is 0 to 8,8 % in the middle of the working width and it is 7,0 to 17,5 % at the end of the framework.

Proposals were made for the appropriate operation of the HP-01 high clearance tractor and implement combination. Nomograms were drawn to ease the appropriate setting of the machine for the technology chosen /Fig. 3/.

The use of the machine is beneficial from the environmental point of view and because of the working quality as well. On the basis of the measurements and operational tests and operational experience the conclusions are as follows:

- the working quality with terrain sprayers is better than that with airplanes, the utilization of the chemicals will be improved and the crop protection will be more efficient /the transversal distribution is characterized by the coefficient of variation, this coefficient is 10 % with terrain sprayers and 25 % with airplanes/;
- inter-row spraying of high row crops /corn, sunflower, etc./ is more efficient, the penetration and the coverage are better than with airplane spraying;
- high row crops can be provided by nutrients independently on the crop height by inter-row fertilising, continuously according to the requirements;
- the problem of the terrain obstacles is not so serious as with airplane spraying and the influence of the weather /e.g. wind/ is not so essential;
- the drift of the expensive and dangerous chemicals is moderate relative to airplane spraying;
- the marking out of the spraying is better than with airplance spraying, consequently the pollution of the environment is lower;
- 2 to 3 % increase of the yield can be estimated as a reasult of the better utilisation of the chemicals and as a result of the more efficient crop protection;
- plots and fields can be protected, where airplane spraying is not possible /e.g. next to a wood strip, etc./.

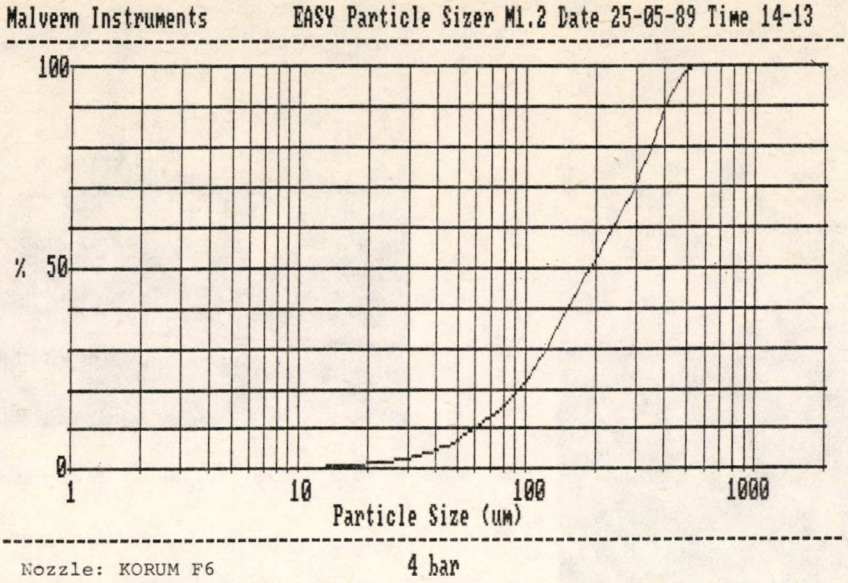

Fig. 3.: Nomogran of the sprayer mounted on the HP-01 high clearance tractor

Multi–Purpose irrigation with „hidrokonzol"

Dr. J. LELKES, Irrigation Research Institute, Szarvas

The "HIDROKONZOL" is a multi-purpose machine for the irrigation of horticultural crops and for intensive field crops. It is beneficial that the machine fits to smaller dimensions as well. The machine can be used for different conditions, such as for the shooting period of the crop, for conditioning and for water supply. Surface irrigation, sprinkling /raining/ and combined irrigation can be performed by the machine. The distribution of liquid chemicals and slurry can be carried out as well, when using different attachments to the machine.

The "HIDROKONZOL" is a self-propelled machine that moves continuously while irrigating. The irrigation is carried out along strips of the field. The frame can be moved by winch type irrigation machines as well. In this case the console should be mounted on the place of the sprinkler nozzle and after irrigating the given strip, the irrigation will be stopped automatically. From a hydraulic point of view and for beneficial management the system should consist of a diesel engine and pump combination, two winch type machines, two frames and 1000 to 1200 m long pipeline.

The "HIDROKONZOL" rolls on three wheels fitted to the chassis that has a frame consisting of two wings. The front wheel is steered and the two rear wheels can be turned at 90° angle for transport. The track of the rear wheel is adjustable. The machine is driven by the water that is supplied through the pipeline that can be wound. The flow rate of the water can be adjusted on the winch type machine by the variation in the winding speed. The water distribution device is mounted to the water supply pipe of the frame.

The appropriate operation of the system can be monitored by the measurement of the water pressure and that of the flow rate. The water pressure should be within a given range to ensure appropriate irrigation. The monitor counts the working hours when the system is operated in the wanted pressure range. When the pressure is lower than the wanted minimum value, it is indicated either by light, or by sound. When the water supply is stopped, or the pipe is plugged, the built in flow sensor indicates the problem. There is the possibility to adjust different flow rates along the length of the strip. The flow rate can be set without steps.

The "HIDROKONZOL" can be a system of any make where the manufacturer took into account the the specifications and the instructions of the HIDROEXPORT, Budapest and those of the Irrigation Research Institute /ÖKI/, Szarvas. The specifications and the instructions are important for mounting to the system the set of sprinklers and water supply elements, the different sensors, the recorder and the monitor. The "HIDROKONZOL" is a system that can be adapted to meet the requirements of the user concerning the best technological combination /Fig. 3/.

Specification of "HIDROKONZOL":

Pressure requirment:	2,5 to 3,5 bar
Flow rate:	25 to 50 m^3/h
Overall width:	min. 50 m
Clearance:	1500 mm
Forward speed:	max. 70 m/h
Mass:	max. 1200 kg

The "HIDROKONZOL" can be set to the requirements of the crop. The buffer plate type nozzles /Fig. 1/

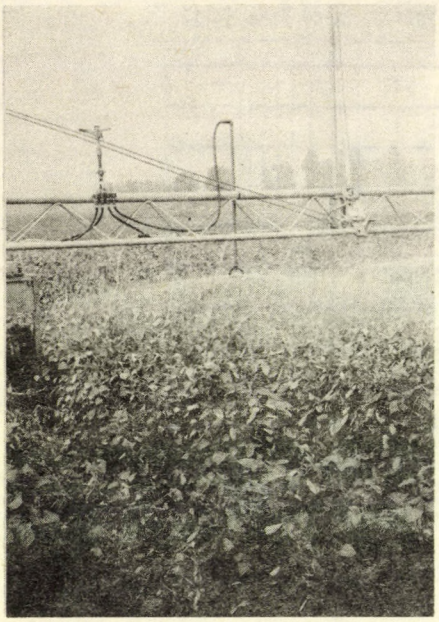

Fig. 1.: The position of the sprinklers

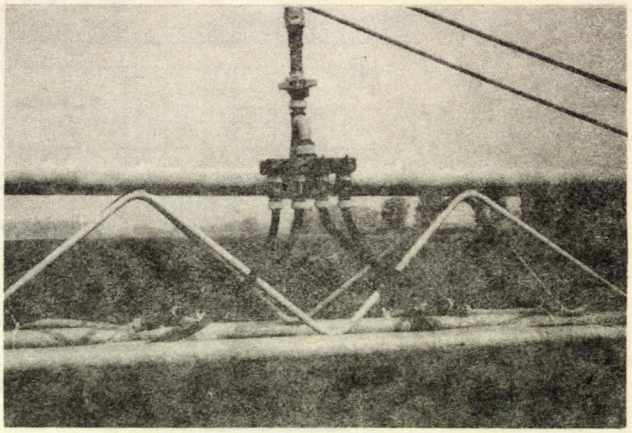

Fig. 3.: Water flow rate control

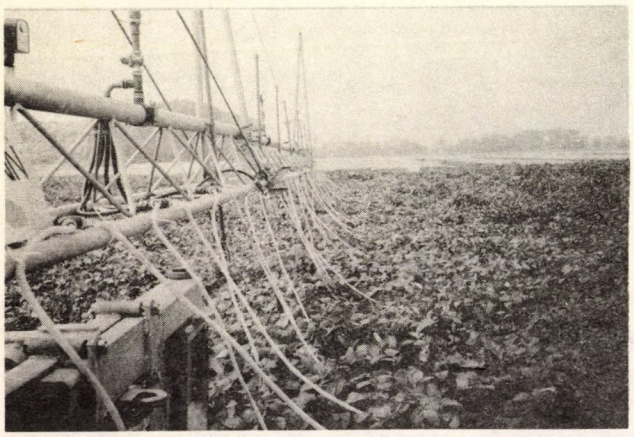

Fig. 2.: The flexible tubes for surface irrigation

Fig. 4.: Soil surface irrigation

irrigate the whole surface. If it is needed these nozzles can be positioned in the inter-row, near to the soil surface. The system can be used for soil surface irrigation when the water is conducted through flexible tubes to the surface /Fig. 2/. The temperature conditions of the crop can be controlled by the water flow rate, consequently the intensity of the assimilation is controlled as well. Under sandy soil conditions the water should be distributed along the soil surface, because the direct contact of the water to the crop causes crop damage. The probability of the fungoid infection can be reduced by decreasing the leaf moistering effect. In case of moderate quality requirements the productivity of the irrigation can be increased by about 30 % when using nozzles of medium action radius. Consequently the vegetables, the low and high field crops, vineyards and orchards of berries can be irrigated at a quality level that meets the agricultural requirements.

The "HIDROKONZOL" is outstanding because of its energy saving and water saving properties among the different irrigation systems.

The low energy consumption is due to the low pressure of water distribution /maximum 3,5 bar/. The water saving property is the result of the distribution of the water, that is performed by pipeline along the irrigated strip instead of sprinkling water through the air. The loss because of evaporation of maximum 5 to 10 % /Fig. 4/. Otherwise the evaporation could be 30 to 70 %. Consequently the productivity of the system will be by minimum 1/3 higher when used for surface irrigation and when it is equipped with the special devices for surface irrigation.

Engine load monitor for tractors

Dr. A. FEKETE–Dr. I. FÖLDESI, Hungarian Institute of Agricultural Engineering, Gödöllő

Since the early seventies more and more different monitors and control systems have been used on the tractors.The working quality can be improved and the productivity can be increased by the means of the mentioned systems.

The appropriate sonsor is the most important point for the monitoring and controlling the engine load. The used engine load sensort can be characterized as follows:

- engine speed sensors
- engine exhaust gas temperature sensors
- engine exhaust gas temperature and engine speed sensors
- fuel flow sonsors.

The engine speedometer is not a load sensor, however the speed indicates the load as well, the accuracy of the load sensing by the engine speed is very bad in the governed range of the engine, but it is acceptable in the non-governed range.

The engine load can be determined from the exhaust temperature as well. In this case the accuracy is not favourable, because it depends on the engine speed, on the cooling of the exhaust manifold, on the temperature of the intake air and on the technical conditions /compression ratio, injection pressure, etc./ of the engine.The accuracy of the load mesurement is improved when both the exhaust gas temperature and the engine speed are used to determine the load.

The technical conditions of the engine have an unfavourable effect on the accuracy when the position of the rack, or that of the fly weights are sensed. The measurement of the fuel flow rate, especially with diesel engines, is not an easy job at all.

All of the mentioned methods and systems need an individual setting with respect to the technical conditions and to the performance of the engine. This has a bad influence on the accurcy of the measurement.

When measuring the temperature of the exhaust gas, minimum 30 s time constant should be taken into account. Consequently the monitor, or the control system cannot react fastly on the variation in the engine load. This is a drawback especially when the engine is overloaded, it can result engine stalling when the shifting of a lower gear is delayed.

The "eco-control" monitor of the Renault measures the exhaust gas temperature and the engine speed and indicates the load. The Renault's "ACET", the Steyr's "INFOMAT" and the Massey Ferguson's "DATATRONIC" indicate the load and provide with on-board computer functions as well.

Experiments are carried out with different engine load control systems, but such systems are not manufactured yet. With the closed loop control system the time constant of sensing and the control of the transmission /gear shifting/ are the most important factors.

In Hungary there is no available system to control the load of the engine and that of the tractor. The operator of the tractor has no information on

- the wanted gear shifting and/or
- the wanted throttle setting.

The operator and/or the contractor needs other information, such as the area covered, the hours worked, the energy used /i.e. kWh/, etc. The measurement, indication and storage of the different operational data can improve the productivity, the control of the work done and can improve the administering of the payment.

Method and system were developed for tractors operated with different throttle setting

- to measure and indicate the engine load
- to measure the work performed in kWh and
- to measure, to store and to indicate other operational data.

An indirect method was used to determine the work and performance of the engine by the means of the measurement of the engine speed and the throttle setting. The performance/speed characteristics of the engine are stored in the memory of the control system and the momentary performance of the engine is calculated from the stored characteristics and from the measures data. Consequently the momentary value of the engine work is expressed in kWh. The principle of the system is as follows /Fig. 1./:

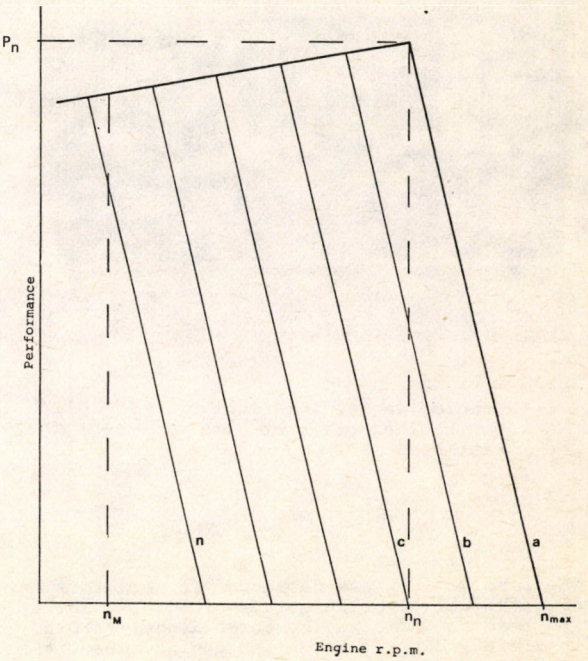

Fig. 1.: Simplified performance/speed characteristics of the engine.

- if the engine is operated with maximum throttle setting, the performance is indicated according to the curve "a";
- if the engine is operated with a given throttle setting /other than the maximum setting/, the performance of the engine is calculated from the signal of the engine speed sensor and from that of the throttle setting sensor and from the curves "b", "c" ... "n".

Since the maximum idling speed of the engine differs a little bit from the theretical value, the actual maximum idling speed of the given engine is an input data for the engine that should be stored in the memory of the system when mounting the system to the engine.

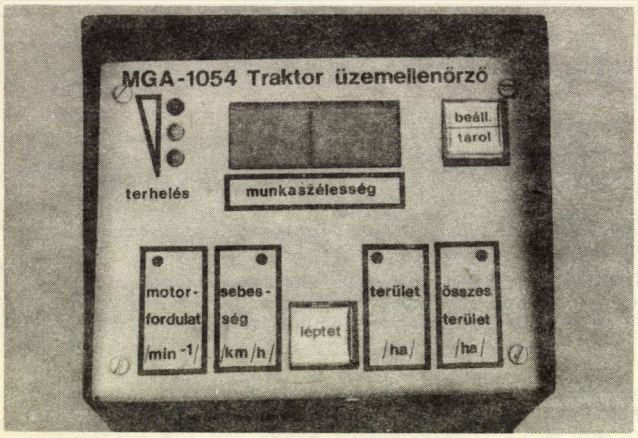

Fig. 2.: Tractor engine load monitor /MGA-1054/ for engines operaed with full throttle setting

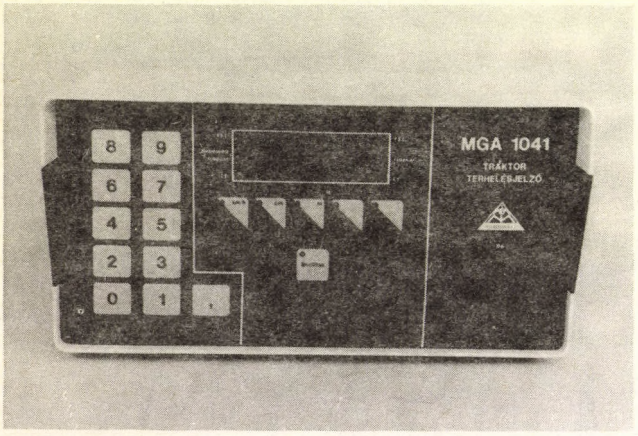

Fig. 3.: Tractor engine load monitor /MGA-1041/ for engines operated with different throttle settings

Engine load monitor was developed for tractors operated with full throttle setting /Fig. 2/. The engine load is indicated by three lights /LED-s/, and a digital display shows the engine speed, the forward speed, the hours worked, the area covered and the workrate. This monitor has only an engine speed sensor.

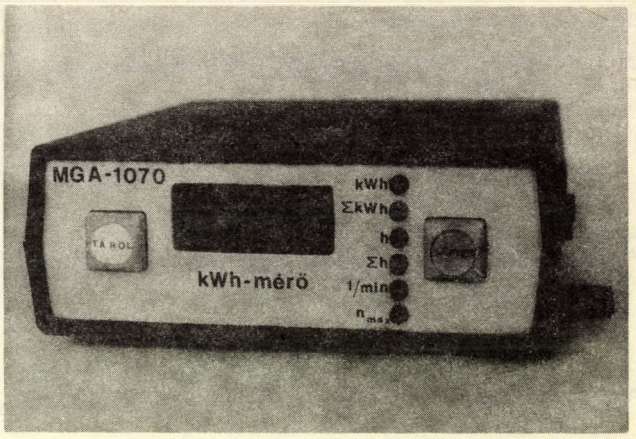

Fig. 4.: kWh-meter /MGA-1071/ for tractors

Engine load monitor was developed for tractors operated with different throttle settings and the monitor has an engine speed sensor and a throttle setting sensor /Fig. 3/. The digital display shows the engine load, the forward speed, the engine speed, the hours worked, the area covered, the workrate and the wanted gear shifting and throttle setting.

kWh-meter was developed for tractors that has an engine speed sensor and a throttle setting sensor /Fig. 4/. The monitor displays digitally the daily and total kWh and hour worked, and the momentary engine speed and engine performance.

The monitors developed were tested under laboratory conditions for the stability at different temperatures and for functioning at low supply voltage. The instrument were found to be appropriate for the use on tractors.

The engine load monitors were tested on a 185 kW four wheel drive tractor of articulated steering /Rába-250/. The tractor and implement combinations were operated in the conventional mode of operation and according to the load indication ot the monitor. The test results show that the operation according to the monitor indication increased the workrate by 8 to 12% and the specific fuel consumption decreased by 6 to 12 % relative to the conventional mode of operation when different tillage implements were pulled by the tractor.

Tets were performed with the kWh-meter that was mounted on a 185 kW four wheel drive tractor /Rába-250/. The results show that the error of the kWh measurement in lower than $\pm$ 5,4 % in the load range up to 75 % of the nomial engine torque. The results of the field tests show that the data displayed by the meter provide the operator, the farmer, or the contractor with useful information. The counted kWh can be a good basis to evaluate the work performed by the tractor and implement combination and to calculate the wanted payment for the work done.

Test results of case IH—7130 magnum tractor

G. RADVÁNYI—Dr. M. SZENTE, Hungarian Institute of Agricultural Engineering, Gödöllő

The case IH-7130 Magnum is a four wheel drive tractor with a water cooled, four stroke, turbo charged Diesel engine of direct injection. The performance of the engine is 136 kW at 2200 rpm.

The multi disc clutch is hydraulically operated. The transmission is of planetary type with 24 forward and 3 rearward gears. The gears can be shifted on-the-go. Speeds: 0,9 to 31,5 km/h forward and 1,2 to 4,9 km/h rearward.

The PTO is according to the standards with 2C splines, 45 mm diameter and it can transmit the whole engine torque. The PTO drive is independent on the transmission, its speed is proportional to the engine speed.

The front wheels of the tractor are steered by a hydrostatic system. The braking is performed through hydraulicaully operated differential sun gear brake. The "PARK" position of the transmission is used as hand brake. The lock of the rear differential is of automatic operation. The test tractor was equipped with 18,4 R 42" rear and 18,4-26" front tyres, however it can be fitted with 20,8 R 38" and 18,4 R 28" rear tyres as well.

The track of the tractor can be adjusted between 1577 and 2356 mm in eight steps at the front and between 1524 and 2565 mm without steps at the rear.

The cab is noise isolated, air conditioned safety cab with big windows.

Electro-hydraulic draft, position and combined control system belongs to the three point linkage. The closed center hydraulic system is operated by a variable axial piston pump. Three remote hydraulic rams can be operated by the system by the means of hydraulic couplers.

A radar speed sensor, temperature sensors, rotation sensors and an engine hour counter is connected to the on-board computer of the tractor. The memory of the computer stores the operational data of the tractor.

During the tests the engine characteristics, the tractive characteristics on two surfaces, the lifting characteristics of the hydraulic system and the main dimensions of the tractor were determined and energetic tests and operational tests were carried out with the tractor and different implement combimations.

The performance of the engine was measured through the PTO at 2200 engine rpm, it was found to be 136 kW. The maximum performance of the engine is 141,7 kW at 1900 engine rpm. The maximum torque is 791 Nm at 1465 engine rpm.

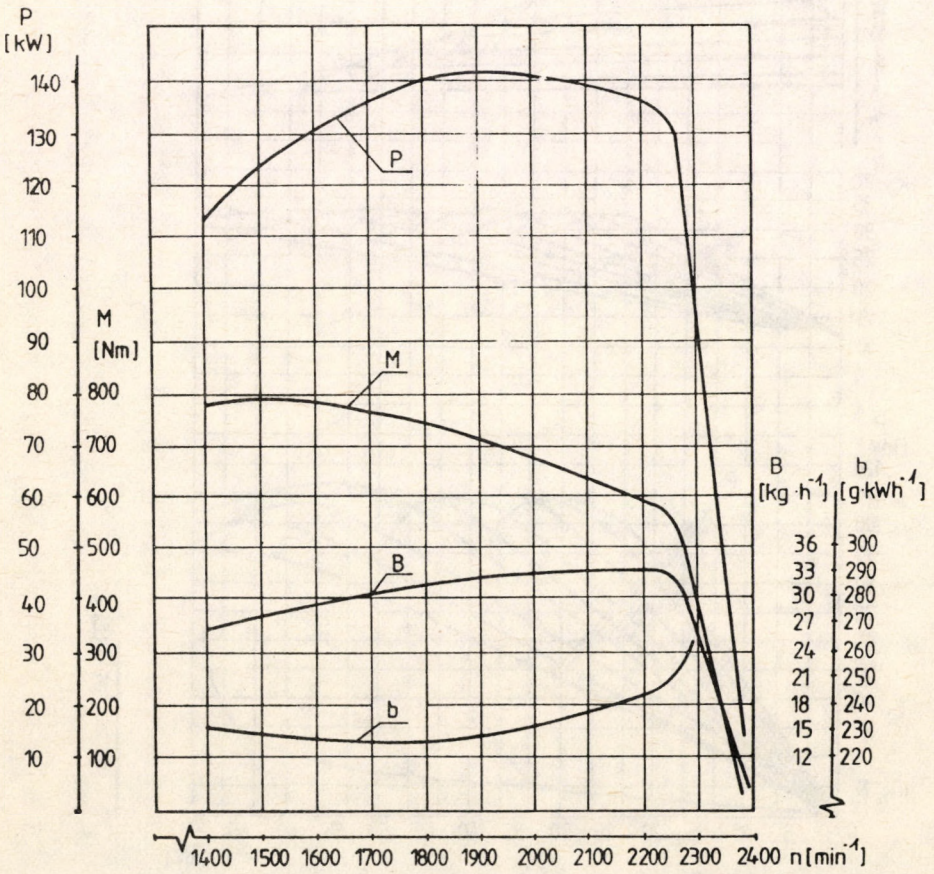

Fig. 1.: The characteristics of the 6T-830 engine

The 34 % torque increase of the engine is favourable. The specific fuel consumption is 224 g/kWh at the nominal engine performance, the minimum of the specific fuel consumption is 226 g/kWh.

The tractor was tested on ploughed soil: with two wheel drive the maximum tractive performance was 78,2 kW at 12,8 km/h speed, 22 kN pull and 11 % slip, however, with four wheel drive the maximum tractive performance was 86,5 kW at 9,8 km/h speed, 31,7 kN pull, and 10,8 % slip.

On asphalt road with two wheel drive the maximum tractive performance was 109,5 kW at 11 km/h speed, 36 kN pull and 5,2 % slip, however with four wheel drive the maximum tractive performance was 113 kW at 7,64 km/h, 53,3 kN pull and 5,3 % slip.

The flow rate of the hydraulic pump was found to be 102 dm^3/min at the nominal engine speed. The maximum power requirement of the pump is 22 kW. The maximum hydraulic performance was measured at 130 bar pressure and the maximum pressure was 180 bar. The maximum lift force of the three point linkage was found to be 55,7 kN at the pin centre of the lower arms of the linkage.

The connecting dimensions of the tractor; the size, the speed and the position of the PTO and the hydraulic couplers, the hydraulic pressure and the flow rate of the pump are suitable for the different implements. There is a good energetic relationship between the tractor and the implements. Consequently the tractor and implement combinations can be operated at a speed range that meets the agrotechnical requirements.

The measured values of the workrate were favourable in ploughing /RÁBA-CASE-IH-10-720 5/6 plough/, in cultivation /RAU Multitiller II heavy cultivator/ and in seedbed preparation /RAU-Kombimat 6,6/: 2,16 hectars/h, 3,4 hectars/h and 4,3 hectars/h, respectively.

The tractor can be used for row crop cultivation because of appropriate front and rear tyre width /18,4"/, the track variations and the good steering ability /front wheel steering/.

The reliability of the tractor was found to be very good /the coefficient of the reliability 0,99/. However a 1212 hours long reliability test is not enough to evaluate the durability of the tractor when taking into account the high technical level of the tractor.

One can conclude that the tractor can be beneficially used in the large-scale farms in Hungary, especially for soil tillage and for row crop cultivation. The existing implements of the big farms can be used with the tractor.

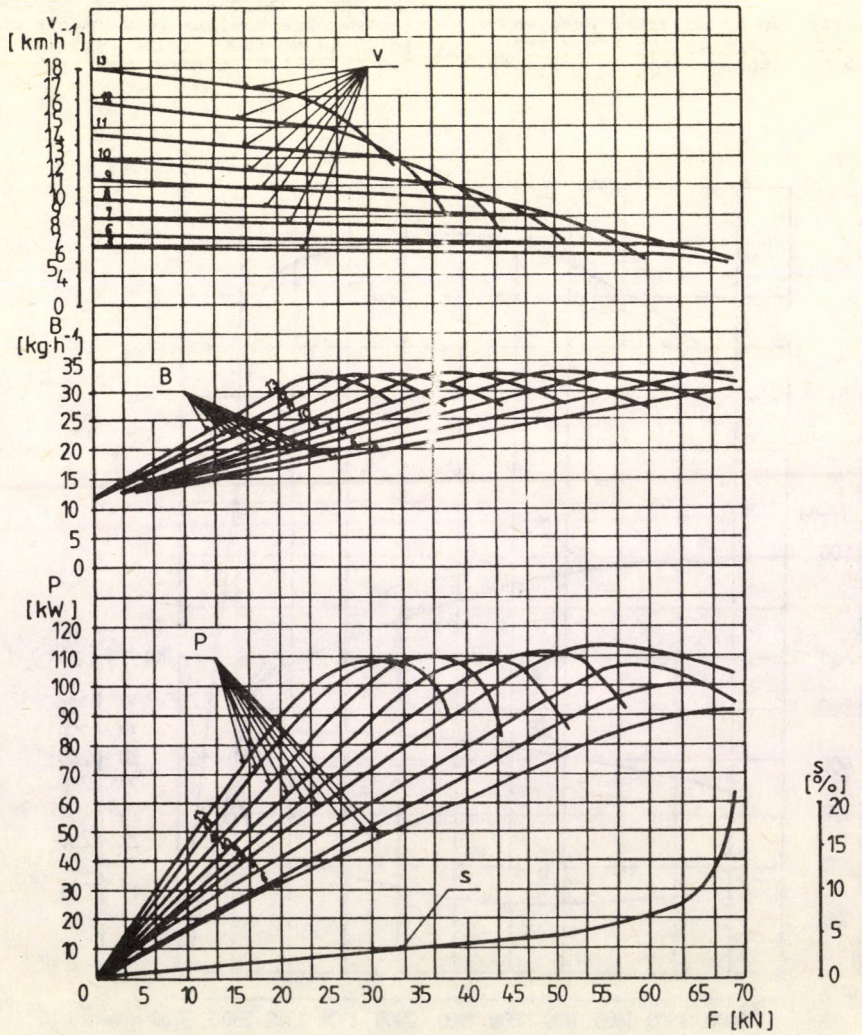

Fig. 2.: Tractive characteristics with four wheel drive on asphalt surface

Development of Self–emptying containers

Dr. L. FEKETE–Dr. I. SZÁSZ, University of Agriculture, Gödöllő

By request of the Grain and Milling Industry Co. in summer of 1989 we carried out the testing of fodder transporting roller type container. The container was made by the Flexum Co, Mosonmagyaróvár.

Function of the container: joining the material handling system of bran and other grits, the aim is to substitute the present, hand-bagging transport method which can already be regarded as a smal-scale procedure - with an entirely mechanized, modern method.

In our present study we raise some technical-technological problems of emptying device of the container.

The producing company has made W-shaped bottom part of the container and placed 1-1 emptyíng auger in the troughs. The augers are operated from mains with the help of an electric motor combined with drive--gears. In such a way it became possible that according to the previous requirements the emptying mechanism can be operated in a set-down position while the transport vehicle is far away.

The following problems appeared at the emptyino mechanism. We measured vary high starting moment at the start of the augers. The starting current impetus - at a motor selected for normal operation - was 2...4 times depending on physical parameters of the grain. The reason is: the auger started with full load /filled with material along its total length/ and not without material. The start was hindered by the lO...15 km long transport just before the emptying because the vibration during transport greatly compacted the bran.
The formation of drive-moment requirement is shown in Fig. 1. To reduce the load on the auger or the starting moment requirement we made a sectional sheet cover. The idea was useful but it can be used such materials which are not willing to bridge.Final solution can be a push-type sheet cover or a sectional auger drive. For testing we propose the last one. We paid special attention to the material flow in the container during emptying.

The material reduction begins on the counter side of the emtying auger's opening and will continue in the direction of transport. In the material layer above the augers there is neither vertical or axial material movement, only a small crater forms at the outlet noting the free cutflow of the material.

Explanation of the phenomenon: the bran - similarly to the flours and other ground materials - has a great inclination to bridge and due to this behavior a standing bridge forms above the material coloumn moving among the auger's blades. From the standing bridging the material can get among the twisted blades of the auger only there where the auger is running without material namely always on starting side of the auger. The consequence of this is, that the container is not emptying evenly, but is emptying from behind towards front /Fig. 2/.

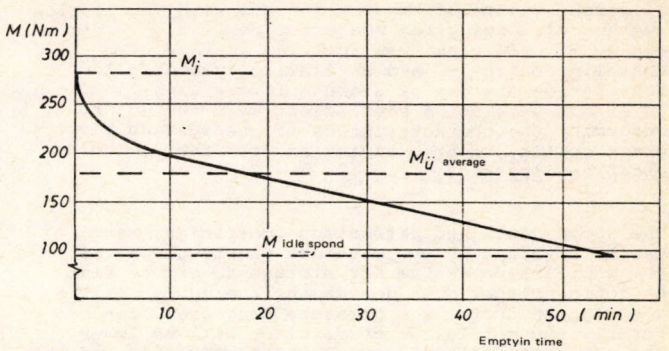

Fig. 1.: Formation of driving moment requirement of the emptying auger during emptying

This phenomenon cannot be objected in functional point of view, but on the energy side this means a problem because the friction between the stationary and moving material parts increawe the driving moment as well as the performance requirement.

Solution can be an other type of emptyino mechanism - or insisting on the auger idea - conical or using an auger with varying pitch.

In case of conical and varying pitched augers used in the grain and milling industry the material's taking up is even alongside the augers and this fact would result an even fodder-sinking in the container. However the starting problems under load at this type of augers would exist though slightly. Since the literature known by us does not deal with the development and specifications of augers having a long filling section or varying pitch, therefore an acceptable answer can be get after the making and testing of the improved prototype augers.

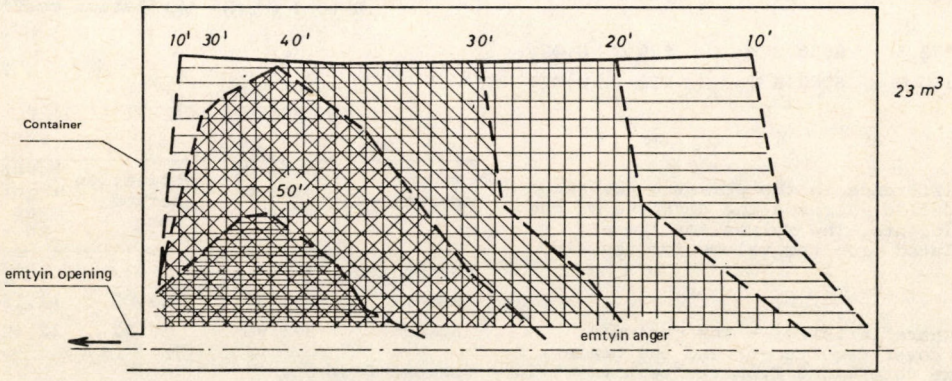

Fig. 2.: Formation of bran heap surface in function of the emptying time

Grain storage with ventilation of exhaust and forcing fan

G. KOMKA–Dr. Z. BELLUS, Hungarian Institute of Agricultural Engineering, Gödöllő

In 1989 comparative tests were carried out with ventilation systems of exhaust fan and with ventilation systems of forcing fan where the perflation - air change - coefficient was low. The systems were manually controlled and automatically controlled. Ventilation systems of storage towers with 10 to 15 $m^3/h,t$ perflation coefficient were tested to determine the characteristics of the systems for grain quality, energy saving and for the technological development.

The above mentioned perflation coefficient range can be obtained by the standard construction of the ventilation system for storage towers of flat or conic bottom. When decreasing the number of the ventilation ducts, the pressure increases, consequently the perflation coefficient will be lower and the ventilating channels can be modified and the air delivery can be reduced. The purpose of the work reported herein is to test the technical, the technological and the energetic characteristics of the systems with modified ventilating channels when operating in manual, or in automatic mode.

The tests were carried out with BSM-11 and KS-09 conventional storage towers of 13 to 15 $m^3/h,t$ perflation coefficient with two fans /Fig. 1/ and with modified storage towers of low - 6 to 8 $m^3/h,t$ - perflation coefficient with 1 fan /Fig. 2/, when the ventilation was of exhaust fan, or of forcing fan. The ventilation systems were operated in manual mode and in automatic mode. The air delivery, the pressure characteristics, the perflation coefficients and the air speed values were determined for the MS centrifugal fans in both modes of operation. The results are shown in Table 1.

Table 1

Ventilating characteristics

Mode of operation	Fan		Grains	
	Pressure	Air delivery	Perflation	Air speed
	Pa	m^3/h	$m^3/h,t$	m/s
Forcing fan:				
BSM-11	1705,0	8274,5	8,4	0,024
KS-09	915,0	6795,9	6,8	0,029
Exhaust fan:				
BSM-11	1872,5	6958,2	6,8	0,020
KS-09	1150,0	6289,6	6,2	0,027

Because of the difference in the pressure the reduction in the air delivery caused the decrease of the perflation coefficients. The values for the air speed were calculated from the values for the air delivery.

The operational characteristics - the period of ventilation, the power requirement and the grain temperature - were determined from the test result. The test period for the BSM-11 storage tower was 61 and 62 days and 48 days for the KS-09 storage tower. Table 2 shows the tets results.

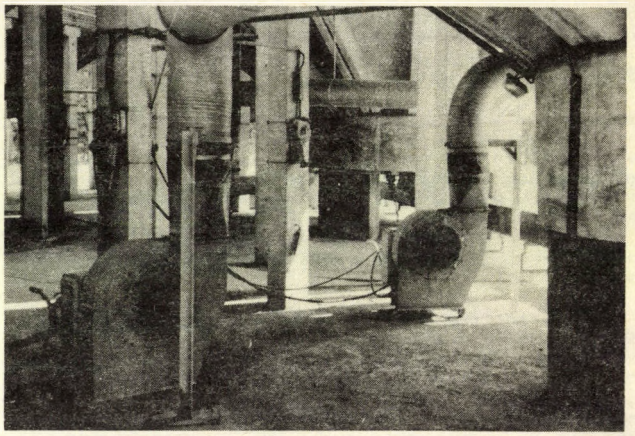

Fig. 1.: Conventional ventilation system with a perflation coefficient of 13 to 15 $m^3/h,t$

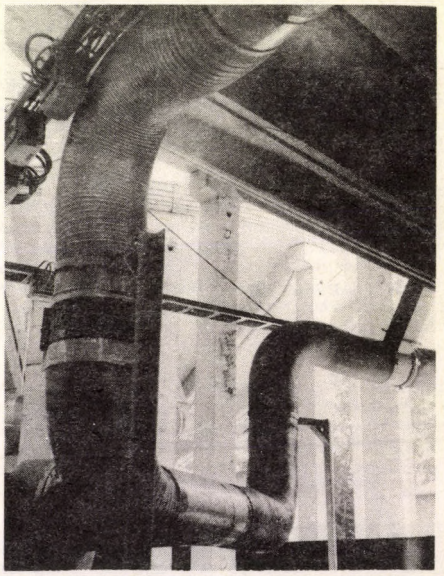

Fig. 2.: Modified ventilation system with a low 6 to 8 $m^3/h,t$ perflation coefficient

Table 2

Operational characteristics

Mode of operation	Mass of stored grain t	Ventilation period hour	Power requirement kW	Temperature reduction °C
Forced fan:				
BSM-11	984,77	59,00	11,16	3,1
KS-09	991,90	89,72	12,40	8,4
Exhaust fan:				
BSM-11	1023,42	60,05	12,64	4,6
KS-09	1016,50	68,32	11,60	7,3

The temperature of the stored grain decreased from 30,1 °C to 25,5 °C with exhaust fan and from 23,9 °C to 20,8 °C with forced fan, when the fans were controlled manually. The temperature of the stored grain decreased from 17,9 °C to 10,6 °C with exhaust fan and from 17,6 °C to 9,2 °C with forced fan, when the fans were operated by the automatic control system. A so called "temperature transfer" was caused by the ventilation and the reduction in the grain temperature was determined proncipally by the charcteristics of the surrounding air.

The values of the specific energy requirement were determined for the specific period of storage, for the mass of the stored grain and for the temperature reduction. The results are shown in Table 3.

Table 3

Specific energy requirement

Mode of operation	Energy consumption kWh	Specific energy requirement kWh/t	kWh/°C	Wh/t,°C day
Forced fan:				
BSM-11	694,71	0,70	224,1	3,73
KS-09	1112,53	1,12	132,4	2,78
Exhaust fan:				
BSM-11	759,03	0,74	165,0	2,60
KS-09	792,51	0,77	108,6	2,25

The results of the tests show that the specific energy requirement with ventilation of exhaust fans decreases the consumption of energy by 30 % relative to ventilation of forced fans. The automatic control of the ventilation reduces the energy consumption by 20 % relative to manual control, because the subjectivity of the operator can be eliminated. The benefit of the system of exhaust fans is caused by the compression heat of the ventilation of forced fans.

The monitoring the quality of the grain discharged from the storage towers shows that the physical, microbiological and toxicological characteristics and the nutrient content of the grains can be evaluated as "non defective".

The ventilation system of exhaust fan and the system of forced fan were found to be appropriate for ventilated grain storage. The automatic control of the ventilation eliminates the operators' subjectivity. Contrary to the earlier procedures the perflation coefficient can be decreased to 6 to 8 $m^3/h,t$ and consequently one fan is enough for the ventilation of a storage tower. The mentioned modification of the construction of the ventilation system results in the 40% decrease of the energy consumption of the ventilation. The energy saving is improved by the use of automatic control of the ventilation by 20 %, in addition to the above mentioned 40%.

When comparing the ventilation system of forced fan and that of exhaust fan one should take into account the technical and technological conditions and the market as well.

Principal relationships for grinding and compacting of wet grain corn

Dr. J. CSERMELY–Dr. Z. BELLUS–Dr. S. ENDRŐDI,
Hungarian Institute of Agricultural Engineering, Gödöllő

The purpose of the work reported herein was to imrove the quality of wet grain corn during grinding and compaction and for storage.

The grinding was carried out by the means of a hammer mill /BM-4-750 of 37 kW/ with four different size sieves in the 22,8 to 44,1 % moisture content range under practical operational conditions.

The compaction was performed with different pressure values when the moisture content and the grain size varied between given limits. The compaction tests were carried out under laboratory conditions.

The test results of grinding showed that the throughput consiferably decreases as a function of the moisture content. Because of the reduction in the throughput, the specific energy consumption will increase. When analyzing this result one can conclude that the grain size decreases and increases the specific surface-increase as a function of the moisture content /Fig. 1/.

When analyzing the effect of the throughput one can determine the decrease of the specific surface-increase - that follows exponential function - as a function of the throughput. This phenomena shows the influence of the bigger granule size. The granule size can be controlled by the throughput/Fig.2/.

The relationship between the specific energy consumption and the specific surface-increase is one of the most important relationships for wet grain corn grinding /Fig. 3/. Both variables are good characteristics of grinding. The test results show that the specific energy consumption can be considered as constant and it is independent on the moisture content for a given sieve size.

8 test series were carried out to determine the density under laboratory conditions for compaction. The purpose of the test was to determine the influence of the pressure and that of the number of loading on the 30 cm deep upper layer of the compacted silage. The results show that the density, the pressure and the number of loading play a significant role /Fig. 4./. Consequently one should propose the users to perform the compaction procedure with n = 6 number of loading. Accordingly the tractor used for distribution of the material should follow the same track once and the tractor used for compaction should follow the same track twice.

In the case when n = 6 the average increase of the density is 50 to 60%. However, if it is needed the average increase of the density can be 60 to 80 % when increasing the number of loading and the pressure. The latter method increases energy consumption and decreases the productivity of silo loading, especially for horizontal silo.

The effect of the moisture content and that of the granule size was analyzed as well. Fig. 5 shows the influence of the moisture content and the indirect influence of the granule size. The density was found to increase according to exponential relationship as a function of the moisture content when

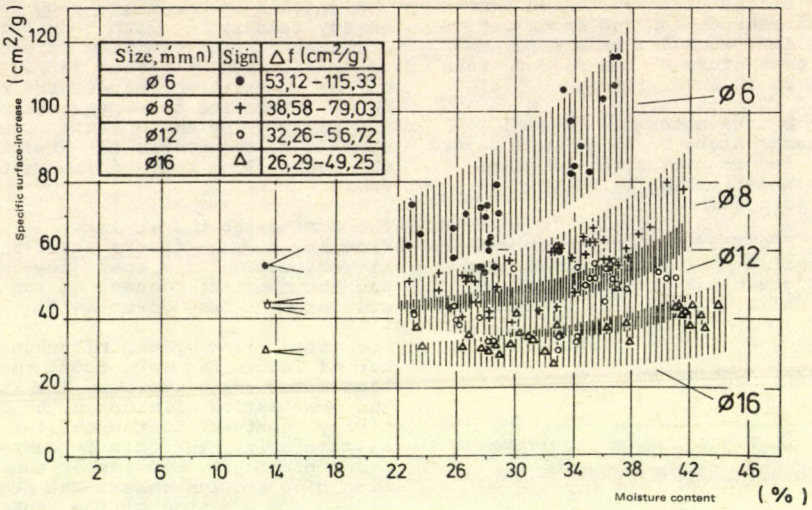

Fig. 1.: The specific surface-increase versus corn moisture content

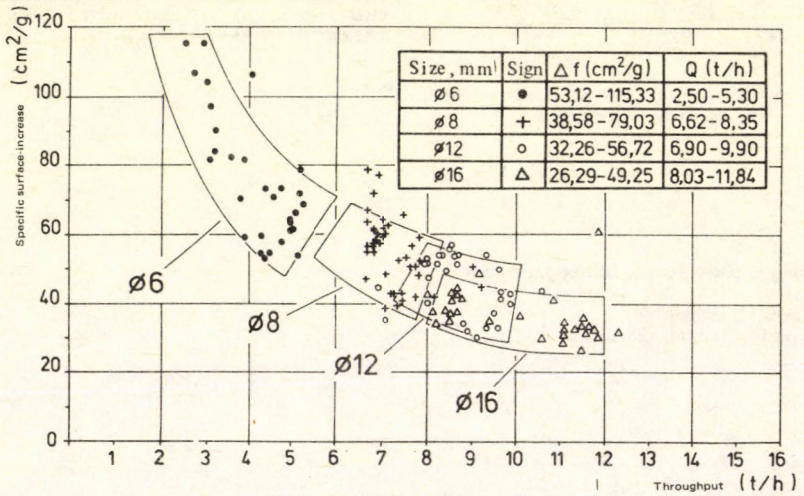

Fig. 2.: The specific surface-increase versus throughput

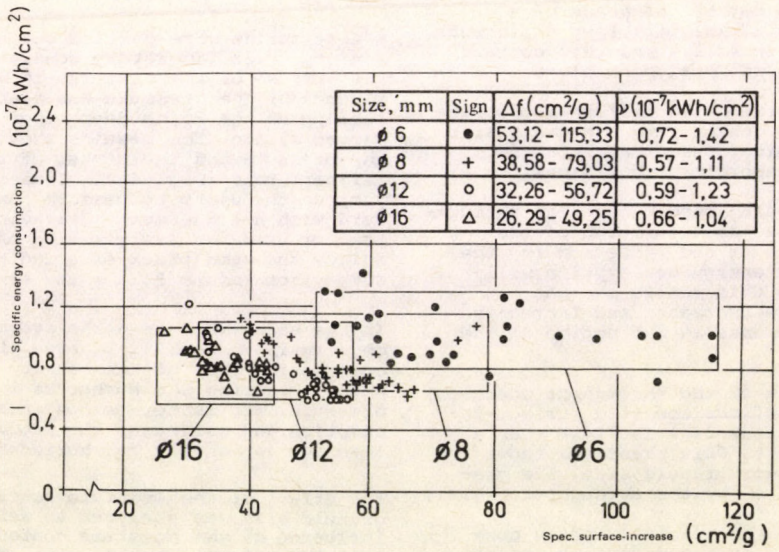

Fig. 3.: The specific energy consumption versus the specific surface-increase

the grinding and compaction characteristics are constant.

The results show that the specific surface-increase increases according to an exponential relationship as a function of the moisture content of the grain corn when grinding. Consequently the granule size decreases. The increase of the hammer mill throughput has a moderate influence on the specific surface-increase. With a given sieve size the specific energy consumption of grindig can be considered as constant and independent on the moisture content when grinding wet grain corn.

The extent of the compaction of grain corn meal is higher with higher moisture content. The density can be decreased with the increase of the granule size at a given value of the corn moisture content.

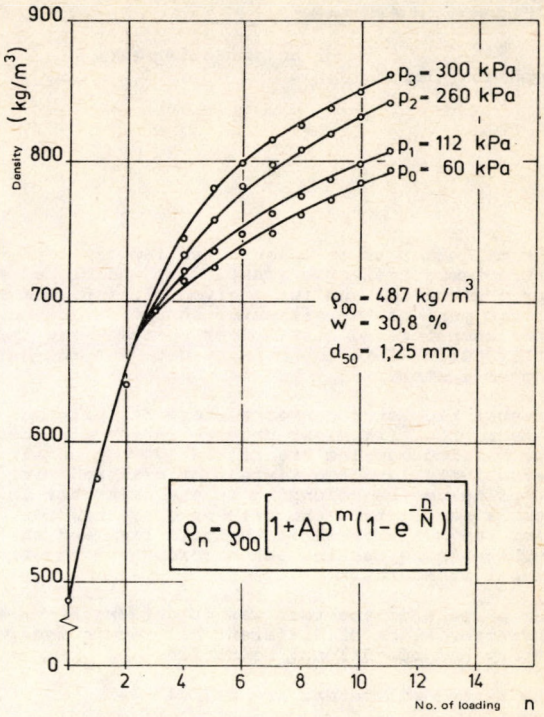

Fig. 4.: The density versus the number of loading

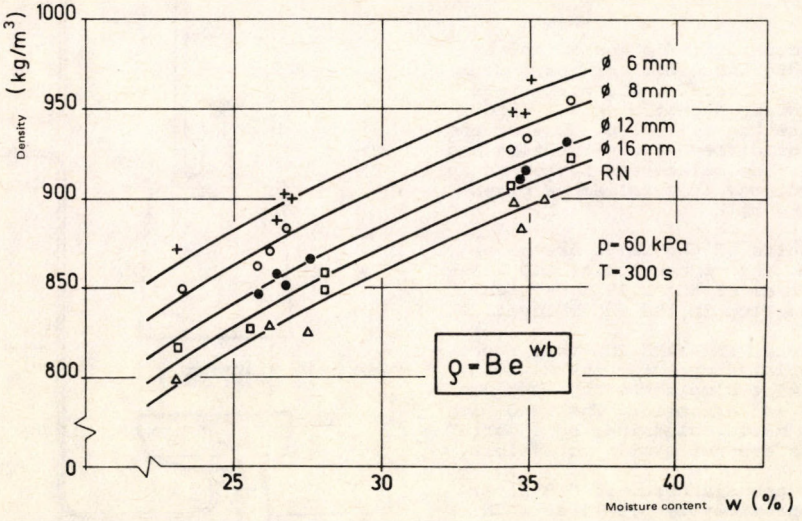

Fig. 5.: The density versus corn moisture content

Comparative test of milkmeters

Dr. J. BAK–T. LIPTAI, Hungarian Institute of Agricultural Engineering, Gödöllő

The milkmeter is to measure, to indicate and to store temporarily the quantity of the milked milk for a given cow and for a given milking. The electronic part of the milkmeter should be connected to a computerized data logger system where the milkmeter output data is an input data for the data logger system.

A usual flowmeter cannot be used for milking to measure the milk flow, because in the piplines of the milking machine are filled by milk, or air alternatively, and the mixture of milk and air. The sampling device belonging to the milkmeter is to take a sample from the milk or every cow for analysis. The measurement of the milk flow and the sampling should be carried out according to the international standards.

The purpose of the test was to determine the main characteristics of different milkmeters under laboratory and operational conditions.

The tested milkmeters are as follows:

- JAME 2000, made by JAHODA, Austria;
- AFIMILK MM 85, made by AFIKIM, Israel;
- TM-01, made by MÉMMI, Gödöllő, Hungary;
- MR 2000, made by Gascoigne-Melotte, the Netherlands.

The main technical data of the tested milkmeters are shown in Table 1.

Each tested milkmeter consists of a mechanical and an electronic part, where the electronic part measures and transfers data /Fig. 1/. The milkmeters utilize low voltage, vacum, magnetic valves and level sensors to measure the milk flow. However the tested milkmeters are of different construction and of different materials. The milkmeters tested measure the milk flow by the volume, they collect a given volume and discharge the milk.

The most important results of the tests are shown in Table 2 and Table 3. The connection of the milkmeters to the vacum system of the milking system caused about 2 kPa reduction in the vacum level.

Concerning the dimensions, the JAME 2000 was found to be the most favourable. Except for the MR 2000, all of the milkmeters were simple enough, they can be fastly disassembled and assembled. The TM-01 is the best milkmeter for manual cleaning, some parts of the other milkmeters are not easily accessible.

The average volume per one discharge is 0,5 liter for the MR-2000 and approximately 0,2 liter with the other milkmeters, these values characterize the accuracy. The error of repeatebility is the best /1,3%/ with the JAME 2000 and the worst /3,8%/ with the TM-01. The accuracy of the measurement is the best with the AFIMILK MM 85 and with the MR 2000, however the error with the JAME 2000 and with the TM-01 is lower than ± 5% as well.

The reliability of the TM-01 was the best, only two malfunctions were found during half a year.

During the test period the JAME 2000 and the AFIMILK 85 milkmeters were found to have several malfunctions and the operators relatively frequently switched off the mentioned devices.

The MR 2000 and AFIMILK MM 85 milkmeters are equipped with a complicated claviature that contains several digits as well. The claviature is for information input and output concerning the cows. There are informative lights as well. The two mentioned milkmeters were too sophisticated for the operators of the milkmeters, they were not able to use the claviature, or rather to utilize the possibilities.

Under Hungarian conditions the electronic part and the pushbuttons of the TM-01 milkmeter meet the requirements.

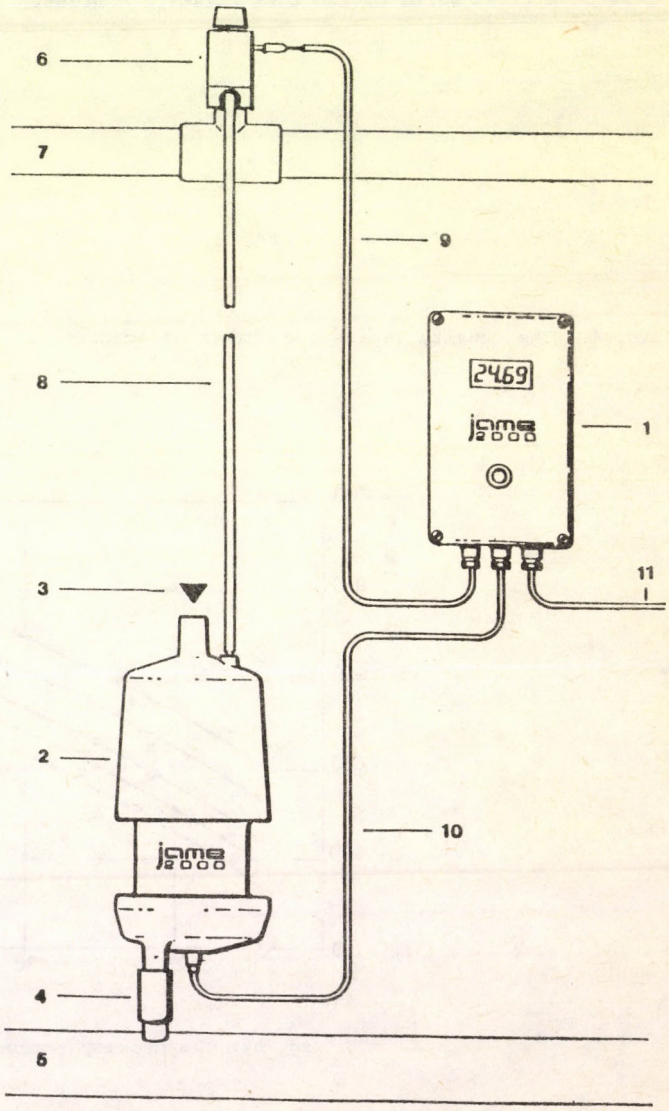

Fig. 1.: General scheme of a milkmeter

1 - electronic part including the display and the claviature
2 - measuring unit
3 - milk input
4 - milk output
5 - milk pipe
6 - control valve
7 - vacum pipe
8 - connecting tube
9 - connecting tube
10 - cable of the sensor
11 - cable for supply voltage and for data fransfer

Main technical data

Table 1

Characteristics	JAME 2000	AFIMILK MM 85	TM-OL	MR 2000
Dimensions	∅ 120x275	235x140x360	247x127x430	288x195x360
Vertical size with sampler	520	530	620	510
Sampler capacity	1 kg	0,33 kg	2,0 l	0,4 l
Cleaning	a u t o m a t i c, m e c h a n i z e d			
Most important material	synthetic	synthetic	anti-corro-sive steel	synthetic
Supply voltage	12V AC,DC	24 V AC	24 V AC	12 V DC

Table 2

Measured energetic data

Characteristics	JAME 2000	AFIMILK MM 85	TM-01
Max. current consumption, A	1,1	1,3	1,8
Max.flow, kg/min	14,2	11,2	8,1
Vacum reduction at 2,4 kg/min flow	2,1	2,2	1,7

Table 3.

Measured accuracy

Characteristics		JAME 2000	AFIMILK MM 85	TM-01	MR 2000
Relative error: /%/					
- in laboratory:	min.	-2,5	0	-2,5	-
	max.	+4,0	+2,95	+4,6	-
- in operation:	min.	-2,9	-3,1	-4,6	-3,8
	max.	-3,5	-0,9	+4,8	+1,7
Error of repeatability: /%/					
- in laboratory:	min.	0	0	0	-
	max.	1,3	1,7	3,8	-

Summarizing the results one can conclude that the JAME 2000 is the best milkmeter because of its dimensions. It is easy to disassemble and assemble the milkmeters, except for the MR 2000. The TM-01 is the best for manual cleaning.

Each milkmeter reduces the vacum level approximately at the same extent when it is connected to the vacum system. The accuracy of the AFIMILK and of the MR 2000 is the best, however the error is lower than $\pm$ 5 & with all of the milkmeters.

The reliability of the TM-01 was the best and this milkmeter provided the operator with the necessary information.

The sampling devices can be assembled and disassembled easily.

Preventing the migration of contaminants in milking equipments

Dr. L. TÓTH–Dr. J. BAK, Hungarian Institute of Agricultural Engineering, Gödöllő

Background

Complex research is being conducted in the field of machine milking. In most of the cases, development trends in research are specified by the vested interests of the developers themselves subject to the fact whether they are manufacturers, users or financiers. For the users the main problem is to stabilise and to improve the quality of the milk produced. At this point the underlying objective is to preclude any deterioration in the quality of the milk produced. At the same time, the milking machine should not cause such a trauma that would have a physiological impact upon the animals thereby affecting milk quality and the milk producing capacity of the cows.

The major problem is to reduce and to eliminate the effects of milking machines in spreading infections. The physical phenomena, generating such effects, have already been realised in a spontaneuous manner although those concerned fail to be sufficiently aware of it yet.

Manufacturers have suggested several complicated solutions for the users' problems, which invariably raise the price of the machines, increase servicing needs and, more often than not, cleaning needs and the concentration of the cleaning liquids which generates environmental problems. Research done at the Hungarian Institute of Agricultural Engineering in Gödöllő, Hungary indicate that the negative effects of the physical phenomena, once identified, can be eliminated without stepping up the complexity of the products themselves.

With respects to the milking mechanism, two basic premises need to be realised:

- one is that contaminants and infective substances, attached to the surface of the rubber teat cups, are carried from one animal to another via direct contact,
- the other is that infective substances may get back to the surface of the teats or into them as a result of aerosol movement in the milking equipment under pressure from the collectors /or possibly from the long milk tubes/.

The fundamental objective is to preclude, slow down and probably to reverse the aerosol flow.
It is to be found out what affects the the flow rate of the infective substances towards the teats. The following captions of this paper are going to present the results of research done in this direction.

The effects of the teat and teat cup size upon the aerosol flow rate

When analysing the system of operation of the two--chamber milking equipment, it is to be noted that the reverse flow of the aerosols may be triggered at the point of transition to the suction phase. At this point of transition the teat cup expands into a cylindrical form from a closed and flat shape. As a result of the expansion, there is a substantial expansion of space at the end of the teat. Air to fill this space could only come from the collector. This pehomenon as well as our calculatitons are shown in Figure 1. The extension of space due to the movement of the rubber teat cup is indicated by Q. Space Q is filled up from the collector's direction at a speed of Vs /marked with a stripped arrow/. In the course of the expansion, different speeds occur at different points of the teat cup, marked as VG_1, VG_2, VG_3. Obviously, there is a relationship between the VG and the VS speeds which means that if the VG speed increases, the VS speed would do the same, ie. the flow rate of the aerosols would also increase.

The VS speed is subject to the following factors:

- the internal diameter of he short milk tube /d/,
- the internal diameter of the teat sleave /D/,
- the length of the teat /h/,
- the length of the teat cup /l/,
- the time of space change /Δt/.

Using the above factors, the speed of the aerosol can be calculated by using the following approximative calculation:

Flow rate:

$$v_s = \frac{l - h}{\Delta t} \times \frac{D^2}{d^2}$$

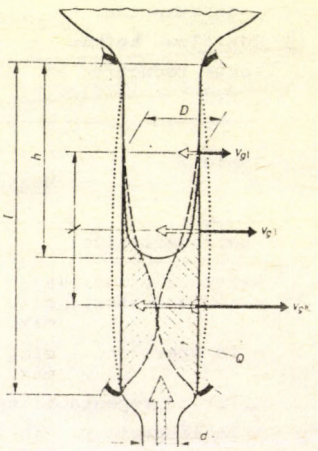

Fig. 1.: Characteristics of change in status for the teat cup

The respective values for "h" and "D are defined by the characteristics of the dairy herd. The value of "l" depends upon the teat cup design. Some teat cup sizes are given in Table 1 below. If the internal diameter of the short milk tube is increased /d/, the flow rate of the aerosol will fall.The value of "d" may be increased to 15 mm from the current 10-12 mm. Greater increases in teat cup size are precluded by the limited elasticity of rubber.
The value of Δt can be affected by the pulsators. Its value during milking is specified by the differential pressure affecting the internal and the external surfaces of the teat sleeve.

Table 1

The length and the diameter of the teat cup

Manufacturer	Length l /mm/	Length deviation from average /%/	Internal diameters vs. half length Dj /mm/	Internal diameters vs. half length deviation from average /%/
Impulsa	148	2.9	41	0.3
Impulsa /Riga/	146	1.5	41	0.3
Alfa-Laval/80/	140	2.7	38	7.0
Impulsa /F/	133	7.6	35	14.4
De-Laval /06/	142	1.3	36	12.0
Miele	147	2.1	41	0.3
Bou-Matic	146	1.5	51	24.7
Melotte	151	4 9	43	5.1
Average	143.9		40.9	

Assuming that cows and the teat cup designs are the same, ie. D, d, l and h are the same, the conclusion to be drawn that the flow rate of the aerosol is defined by the teat sleeve and its movement. That is why we have been analysing the deformation of the teat sleeves under static and dynamic conditions. This paper is specifically concerned with the static deformations.

Deformation of teat sleeves under static conditions

In the dual-chamber milking machines, teat sleeves are moved by the difference in the vacuum in the space between walls and under the teat. The beginding of rubber deformation can be calculated with, rather good approximation, using the above relationship:

$$\Delta p_{kr} = \frac{E \times \delta^3}{4/1-\mu^2/ \frac{d^3 k}{2}} \quad /kPa/$$

Where:

d_k = the medium diameter of the teat sleeve /mm/
E = the elasticity modulus /kPa/
μ = the Poisson factor
δ = the wall thickness of the teat sleeve /mm/

The model to be used for the calculations can be seen in Figure 2.
The conditions for the application of the model include the following:

- $1/0.5d \geq 8$
- the teat sleeve is cylindrical.

For teat sleeves /at extreme values/:

$$\frac{130}{12.5} = 10.4 \quad 8$$

An example for the applicability of the model:

d = 27 mm
δ = 2 mm

The rigidity of the teat sleeve analysed is 45 Sh°A.

E = 2.1 MPa

$d_k = d - \delta = 27 - 2 = 25$ mm

$$\Delta p_{kr} = \frac{2.1 \times 2^3}{4/1 - 0.5^2/ \frac{25^3}{2}} = 0.00286 \text{ MPa}$$

$\Delta p_{kr} = 2.86$ kPa

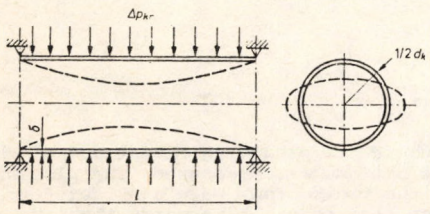

Fig. 2.: The model used for the calculations

In the course of the static tests, the deformation of the teat sleeve and the udder was measured in the contraction phase. Figure 3 depicts the teat cup in different sections. The sections on the left-hand side depict the deformation of the teat sleeve without teats when the teat sleeve can move absolutely freely in its full length. The sections on the right-hand side depict the case when the teat is in the teat sleeve.

Without describing the details of the results of static deformation tests, conducted with teat sleeves of different designs, diameters and wall thicknesses, we can state in summary that in accordance with the

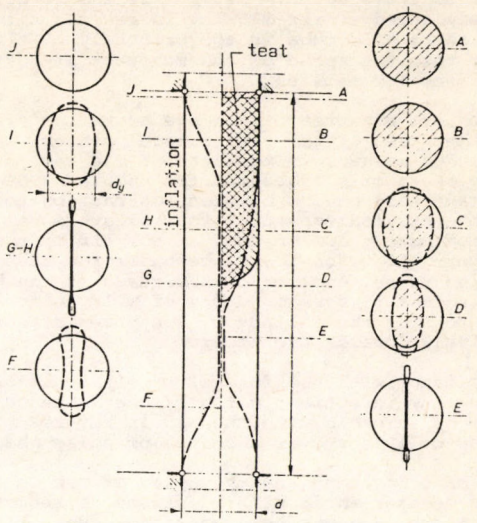

Fig. 3.: The deformation model of the teat sleeve
Sections A, B, C, D and E indicate the deformation of the teat and the teat sleeve
Sections F, G, H, I and J indicate the deformation of the teat sleeve while empty

results of the calculations teat sleeves with greater diameters and thinner walls begin to change their shapes at a pressure difference of 0.5 and 3 kPa. In the case of teat sleeves with smaller diameters and thicker walls deformation begins at a pressure difference of 4-8 kPa.

In accordance with our observations, there is no full deformation in the case of the long teats. Then the teat sleeves do not close up even at the time of full deformation as they are distorted into an elongated form with two bubbles at either end. Thus, long teats are not exempt from the mechanical effects of the vacuum in the contraction phase in the dual-chamber milking machines.

The speed of teat sleeves and aerosol flow rates in the reverse phase

The flow rate of the aerosol cannot be specified directly. We know, however, that both the time of change in the space under the teat and the speed of the aerosol is directly related to the speed of the movement of the teat sleeve. Therefore, a yardstick has been developed to measure this speed.

For lack of space, we do not reproduce the diagrams here, charted on the basis of data measured. But these are to diagrams to be used to read the amplitude of teat sleeve movement and its time for which the speed of teat sleeve movement can be calculated.

Here is the relationship between the V_g teat sleeve movement measured and the V_S speed of air flowing in the short milktube /mm/sec/:

$$V_2 = \frac{/1-h/\left[\frac{D^2 x\pi}{4} - d_g\sqrt{\frac{/Dx\pi/^2}{2} - d_g^2\,\pi^2}\right] \times dt^{-1}}{\frac{d^2\,\pi}{4}} \times \varphi$$

Where:

l = length of the teat sleeve /mm/
h = the length of the teat in the teat sleeve/mm/
d_g= v_g x dt = the value of the momentary deformation of the teat sleeve /mm/
D = the internal dia of the teat sleeve in the suction phase, while fully open /mm/,
d = the internal diameter of the short milk tube /mm/,
φ = the flow factor

Insofar as 1-h = 80, D = 22, d = 14 and φ= 0.5, the momentary speed of air flowing in reverse direction in the short milk tube is approximately 12-times greater than the speed of the movement of the teat sleeve used for milking.

Based on our measurements we are aware that in some cases the speed of the teat sleeve movement was as much as 500 mm/sec. In the case of the regular 200 mm long short milk tubes and the regular 200 m/sec long transitory phases between contraction to suction, the critical speed of teat sleeve movement is approximately 100 mm/sec. If so, air in the collector will reach the space under the teat over one pulse phase. Another disadvantage of the high speed is that it spreads drops of milk, otherwise moving towards the collector, and propels them rather intensively towards the teat.

In accordance with the foregoing, milk particles, carrying any infection, get back to the teats in the form of aerosols with the air in reverse movement from the collector over a couple of pulse phases.

Teat sleeve movement and the speed of air in reverse mode is greater while milking vacuum is reduced therefore there is a greater realistic danger of spreading infections in the case of milking machines with such properties. It is to be seen from the function that the risk of infection increases with the rise in diameter, capacity and speed of movement of teat sleeves.

The facts presented above explain why the entry of air into the collector is not enough in itself to preclude the spreading of infections.

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Mathematical statistical analysis of the ploughing resistance

Dr. B. BORSA, Hungarian Institute of Agricultural Engineering, Gödöllő

The measurement of the resistance of a tillage implement is a very common job. Concerning the ploughing resistance the character of the stochastic signals is of interest.

In the field of the technical science the utilization of the stationary - normal - ergodic model is often importan for the measurement and evaluation of stochastic processes. However there is a lack of the tests that controls the correctness of several apriori assumptions /1-6/.

The purpose of the work reported herein is to carry out the mathematical statistical analysis of the ploughing resistance, more specifically to determine that the first distribution of the measured process can be considered to be a distribution of stationary, ergodic, or normal.

Naturally the signals of the range of starting and stopping were rejected because of their instationary character. Tests were performed with a four bottom plough, where the ploughing resistance of the second and third bottoms were measured. The ploughing resistance of the two bottoms were considered to be independent on each other. Afterwards the sampling was carried out from the both sample functions at the same time to get samples without correlation /7-8/. The data were put into a matrix: where the time data are in the columns and the assembly data in the lines. The mentioned data matrix was tested by statistical methods.

The stationary character of the first distribution function was tested by the control of the assembly samples distribution. The same way was tested the hypothesis for the expected values and for the deviations.

The first distribution of the process was found to be stationary, consequently the test of the normality was performed by the use of each element of the matrix as a single sample. The result was formed on the basis of the error of first kind /9/.

The analysis of the ergodicity was carried out by the comparison of timely samples, whether the distribution is the same. The same method was used for the expected value and for the deviation as well. Further the deviations were tested whether they approximate zero value when the "T" time of the observation increases.

The field tests were performed with a semi-mounted plough /RIH 10-720-16 KMB/ that was pulled by two different tractors /T-150K and John Deere 4650/ on two different fields. For the test of the normality a lot of earlier field test results were used, where different tractors and ploughs were operated on different fields with different gears /forward speeds/ /9/.

Test of the stationary character

On the basis of two field tests the results for the ploughing resistance are as follows:

- the stationary character for the first distribution function does not contradict the observations;
- the stationary character for the expected value and for the deviation according to the tests are not contradicted.

On the basis of the errors of first kind of the tests one can assume an instationary character in the distribution function and this character should be looked for in the expected value.

Test of normality

The hypothesis test of the ploughing resistance results of the plough bottoms shows that the tested process is not of normal distribution.

Alternatively the logarithmic normal distribution was tested as well. It was concluded that this distribution does not contradict the observations /9/.

On the basis of the central limiting distribution theorem the distribution of the ploughing resistance of the whole plough was assumed to approximate the normal distribution. When using the results of many tests one can conclude that the normal distribution can be used for approximation, however the logarithmic normal distribution should not be rejected /9/.

Test of ergodicity

On the basis of 750 m to 850 m long test runs the character of ergodicity was tested with respect to the first distribution, consequently:

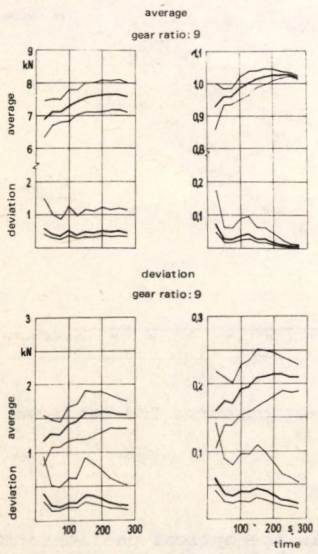

Fig. 1.: Average and deviation for the "T" period time measurements, and the average and deviation of the stochastic variables; left side: original process right side: logarithmic normalized process /Level of confidence: p = 0,95/

- the ploughing resistance of a plough bottom is not of ergodic character in the first destribution;
- the lack of ergodicity is approved for the expected value and for the deviation as well.

When normalizing by the logarithmic average and afterwards performing a retransformation, the new process will be

- of ergodic character in the first distribution;
- both the expected value and the deviation will be of ergodic character.

After the transformation performing again the test of stationary character and the test of normality, the result will be the same as the earlier ones.

Conclusions

One can conclude that the characteristics of the process should be determined from the results of serial measurements. The timeliness of the measurements contains specific characters. Consequently the determination of the characteristics should be based on the repeatability.

The logarithmic normal distribution and the normal distribution has a significant role in the calculation of the strength of the different parts and in avoiding overloading of the parts.

Proposals for further work:

- the identification of the specific ploughing resistance of a plough bottom, as the ratio of two different processes, maybe including the speed as well;
- to enlarge the analysis for distributions of second order;
- test of the stochastic processes for irigid tools of tillage implements: for the individual tool and for the whole implement, and further test of stochastic processes of other type /e.g. drive torque, stress/.

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Measurement of oil content of grain sunflower (Instrument: INFRAPID)

B. BARABÁS–Mrs. Dr. I. TÓTH, Hungarian Institute of Agricultural Engineering, Gödöllő

The composition determines the value of the product. It is so with sunflower, the oil content of which is influenced by the sort and by the field conditions. The measurement of the oil content is an important job. The conventional method is complicated and fire hazardous and too slow.

The farmer and the purchaser are interested in the measurement of the oil content, especially in a fast measuring method.

There are many new fast methods to determine the composition of products. Different instruments are available for the measurement of the oil centent on the basis of nuclear magnetic resonance. Another fast method is the spectrophotometric one that is based on the near infrared reflexion /NIR/. The latter one can be used to measure the components of different agricultural materials /the protein content, the moisture content, etc./. For the mentioned test the sample should be ground, usually by the means of a hammar mill. The required fineness cannot be achieved with sunflower and with some other materials.

The purpose of the work reported herein was to develop a method for the preparation of the sample and to develop a method for the measurement by the means of the instrument Infrapid 61 that is manufactured by the Factory of Laboratory Instruments Co. Ltd., Budapest.

A material of low optical disturbance was chosen to absorb the oil, this material was mixed to the grains before grinding. $CaCO_3$ was mixed with sunflower grain, where the $CaCO_3$ was analitically clean powder. The sunflower to $CaCO_3$ ratio was 20:10; 15:15; 10:20 g. This mixture was ground by a kitchen coffee mill for 30±5 s /mill: Aroma/. The meal was stored in a glass that was closed by a metal plate at room temperature.

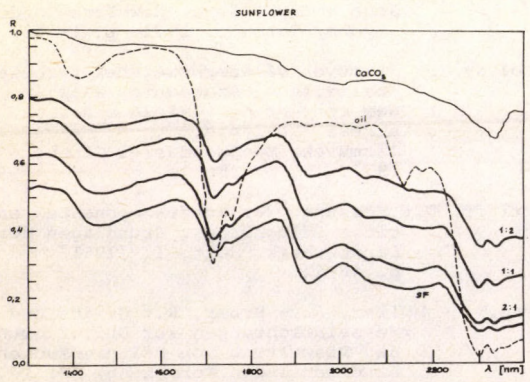


Fig. 1.: Reflection spectras: sunflower grain and $CaCO_3$ powder
mixture, ratio: 2:1; 1:1; 1:2;
natural sunflower mela /SF/
sunflower oil /oil/
$CaCO_3$ powder

The appropriate mixture ratio was determined from the optical spectra and from the visual evaluation. Fig. 1 shows that the spectra of the 1:1 and 2:1 grain sunflower/meal ratio are of similar character. The quality of the grinding is the same for the three different mixtures. On this basis 1:1 grain/meal ratio mixture was used for the measurements.

The measurements were carried out with Infrapid 61 spectrophotmeter and a Labsys 80 PC was used for the calculations. Regression relationship was determined between the oil content and the optical reflection values. Fig. 2 shows the correlation spectra. The constants of the calibration equation were determined from the three wave length values. Afterwards 30 "control" samples were measured by the instrument. The standard error and the correlation coefficient are shown in Table 1. Fig. 3. shows the the calibration curve.

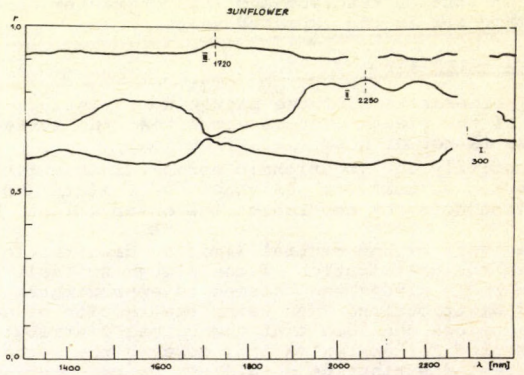


Fig. 2.: Correlation spectras

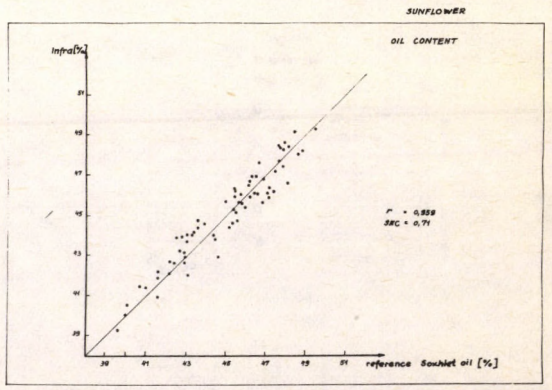


Fig. 3.: Calibration curve for sunflower oil content

The variation in the optical characeteristics of the ground samples - because of possible rancidification - was controlled by repeated measurement on the 4th and 13th day after the calibration. Such a way the repeatebility of the measurements were controlled as well. The calibration was performed the day after the grinding.
The results are shown in Table 1.

Table 1.

Accuracy of calibration

Samples	Number of samples n	Error of measurement SEC %	Error of measurement SET %	Distortion BIAS %	Correlation coefficient r
calibration	69	0,71			0,959
control:					
4th day	69		0,74	-0,21	0,956
13th day	69		0,78	-0,09	0,956
"unknown" samples	30		0,88	-0,26	0,940

Table 1 shows that the error /standard error/ of the oil content measurement is 0,9% with the used method of measurement and with the method of sample preparation. The storage of the samples for two weeks did not infuence the accuracy of the mesurement.

The test results show that the measuring accuracy of the spectrophotometer Infrapid 61 meets the practical requirements /i.e. when purchasing/. The Near Infrared Reflection method is a little bit slower than the Nuclear Magnetic Resonance one, however the NIR method can be used to determine other components /such as for protein content in extracted sunflower meal/ as well.

Influence of specialization on tractor size and construction

Dr. J. NACSA–Dr. Z. GERGELY–Dr. V. VARGA, University of Agriculture, Gödöllő

In the year of '90s, the Hungarian agriculture got on a new developing way. What can be already stated now, a developing period is over and under that changed conditions a new one steps in its place. If the marketing condition, the value system take in its place. If the marketing condition, the value system take over the role from the "hand control" and the guidance subordinated the ideology, then a different division of labour forms among the large--scale and small-scale farms, the branches of grain production and horticulture etc. What will happen with the mechanization? The question can be raised.

In those countries which have developed technolgy and capital the agricultural mechanization is on a higher level than at us. Data of Table 1. shows this effect clearly. If the economic laws will be decisive in the mechanization of our agriculture, then getting on to the new devèloping way cannot be imagined without renewal of the mechanization.

Table 1.

Distribution of tractor and tractor engine capacity for 1000 hectares of farm land

Serial No.	Country	Tractors and engine output for 1000 hectares: Tractor No.	Tractors and engine output for 1000 hectares: Engine output /kW/	1 tractor engine output /kW/
1.	BRD	124	3970	32
2.	Holland	95	3430	36
3.	Italy	71	2690	38
4.	France	49	2040	42
5.	Poland	45	1435	32
6.	GDR	25	1626	49
7.	Romania	12	614	51
8.	Bulgaria	9	462	51
9.	Hungary	8	538	67

It is likely that a new tractor-pool forms. At the earlier scientific sessions we have already viewed tractor-combine-lorry and other self-propelled machine ratios, summaries of engine performances. This has changed year by year so far. The nation-wide change in spite of the financial and investment anomalies, which were decisive in the past begins to take form.First of all, with the ceasing of former preferences and advantages taken from the relations etc., sooner or later the economic reasons decide the questions decided subjective earlier.

From technical side of view, the mechanization regarding both quantity, quality and complexity, is an objective changing process. The process can be only regarded a development if the efficacy and productivity increase due to the change of quality components.

Considering the present situation more changes can be imagined, which do not bring development and even will cause a considerable stepping back. This can also happen if meanwhile the number of tractors will increase but such situation can arise when the degree of harnessing, the value of productivity decrease is national total value.

To obtain the optimum yearly utilization of given tractors and agricultural machines, a given farm land is needed. If the best land is not available then the machine capacity will not be utilized simultaneously if the arable land is too big then the given machine capacity is not enough. In the last case if the land area is just two-times of the optimum, then two tractor-machine system can be newly used effectively.

Over a certain degree, increase of the farmland requires a new quality of mechanization and a new, greater servicing system etc. The same is right towards the minimization too. Under a certain land area the primitive form of mechanization can be only maintained economically.

Things written earlier are valid for the tractor--pool. The machine-pool of a large-scale farm producing cereals and maize likely differs from such farm which is specialized for animal husbandry. If the social politice is getting out of the employment, if the aim of the confederation of independent owners is to increase the economic result and not political reasons then the economical production determines the aim and operation of organization. The ploughing tractor and the small machine take their place. The complex mechanization can be formed for an area of 15 hectares but an area of 2500 hectares specialized for wheat production can also have a complex mechanization. However it is possible, that the complex mechanization can be planned for cereals with an area of 5000 hectares or for 2000 hectares but it cannot be an inner stage. As it can also be that the next step can be form in the case of 15000 hectares.

Every tractor and agricultural machine has a yearly capacity. Since more types of machines' harmony has to be trought about so the common multiples will be those points which definite the objective facts. The former guiding does not give suitable, practical value to forming of such mechanizational stages.

The way of looking must change, too. In the past forty years we are accustomed to the accept a certain kind of functioning capacity. Thinking differently is not easy and not easy to carry out. This question concerning the human and production conditions has an other component. If we limit the agricultural production for the land only then we get different machine need as if the farm itself does the trade.

Such production can also be imagined - e.g. specialized production - where the trader transports the artificial manure to the edge of field and take the harvested crop from the same place.

In this case the transport of crop, by chance the crop drying is not necessarily producer's task. This already belongs to other facts.

All these do not mean that the transporting machines do not belong to the global machine pool. It means much rather, that the effective utilization of transport machines can be solved in other way then earlier. An optimum transport output belongs to the effective operation of the transport machine. But this transport output is not sure in such a system where the agricultural production is the first aim and the transport only serves this.

We are standing before a new integration. It would be lucky if the household farming could be well--mechanized and the large-scale farm could also find the tractors and machines needed on the market. Without industrial-infrastructural economic background this cannot be imagined. But the development is a serious acting force. The system can be diverted for a short time but the history verifies that the development forces its own way and forms own effective means of production. It is not likely that we shall modellize the agricultural production of any western country. Probably, a special, mechanized production forms for own conditions and will develop further. Moreover, it is probable that the tractor engine output increases together with the number of pieces concerning the unit of producing area. It is also to be expected that a new specialization process will start creating a new competitive situation which obtain new effectiveness.

Influence of screen construction on fineness of grits made by hammer mills

Dr. I. MIKECZ–L. FOGARASI, University of Agriculture, Gödöllő
C. AKDENIZ, „Ege" University, Turkey

Comminution experiments were carried out on a smaller hammer mill type Junior at laboratory conditions, in the dept, of Engineering in Animal Husbandry and Applied Electricity /University of Agricultural Sciences, Gödöllő/. The purpose of these experiments were to know more deeply the principles of the comminution process in the case of impact crushers. During the experiments, several kinds of cereals were tested at different conditions of construction and at varying running parameters.

This is a smaller but quite a typical hammer mill made in Hungary with 4x3, altogether 12 multi-edged hammers of harmers of hardened steel and designed of conventional construction.
The hammer mill is driven by a normal three-phase electric motor with a V-belt transmission between the motor and the mill axis. With that, it was possible to change the r.p.m. of the rotor i.e. its peripheral speed.
During the experiments carried out not only conventional screens were used but other screen constructions, too, taken from the literature or practice and or the authors' ideas. There were several investigations known in the literature on hammer mill running without screen, However, that running way produces quite rough grits, the measurement results as important information could be add to the investgations carried out by mill screens and it can be taken into consideration for closed corcuit operation as a possible variation of analogous controlled mill. That is why the operation of the mill without screen was tested at several measures of opening.

Basing on literature a measurement circuit was designed and realized with some solutins unknows before for measuring other parameters having special importance by the opinion of the authors, together with the known characteristic propertioes
During test series certain constructional or kinetic parameters were changed, namely the mill screens were changed or without screen operation was selected and the r. p. m. of rotor was sat in three degrees.

In the case of comminution, the quality of product means the fineness of the crushed material but the fineness can be written down by several different methods. These methods known from standards or literature vary so in their principles as in their results and they do not always give comparisable parameters for analysis.

In present examination, not the frequency curve is used but its integral /so called cumulative distribution/ curve, the relation D/x/ or the screen-retainings R/x/=1-D/x/. It is to be remarked that the simplest and oldest fineness property is the average particle size x.
It is worth mentioning that that average value approximately equals to the earlier "grits module" by Hungarian Standard. At the first looking it seems

to be a too simplified parameter which cannot be enough alone to characterize the fineness of the grits.

Without details about the basic princiles here, there was an attempt to show out that the average particle size /or any kind of nominal particle size chosen in convenient way/ is useful and the most important property for the fineness and, on certain conditions, determines the quality of the crushed material.

BÖLÖNI has shown that ROSIN-RAMMLER-SPERLING-BENETT's equation quite a well approaches the real distribution of grits made by hammer mill and in the same time it can be handled in a simpler way than the renormed-lognormal distribution function proved theorectically corrent. The equation of RRB-function is

$$R/x/ = e^{-/\frac{x}{x_o}/^n}$$

where: x_o - is the nominal particle size; the particle size at which R=1/e

n - is the uniformity factor /exponent/

e - is the natural logarithm-base

A frequently used fineness characteristic parameter is the specific surface area of the grits, $\underline{a}$. /m^2/kg/. It is possible to determine that parameter by calculation from the sieving test results directly which is called the empirical specific surface area because of the computing way of mathematical statistics. The parameters of RRB-distribution are also usable to calculate the specific surface area.

It was examined whether a hypothetic raltionship can be find between the statistical average particle size $\bar{x}$ the empirical specific surface area a_{emp}. For that purpose, the values of that two parameters belonging each to other were constructed into a common diagram /Figure 1/. As it can be seen, the points are fitted well on a regression curve. By the hypothesis of BÖLÖNI, the relationship is hyperbolic. The regression equation determined in this way is:

$$a_{empW} = \frac{7,80}{\bar{x}_W} \quad /m^2/kg/$$

where $\bar{x}_W$ - /mm/

Authors made a conclusion that a simple linear correlation must exist between the empirical average

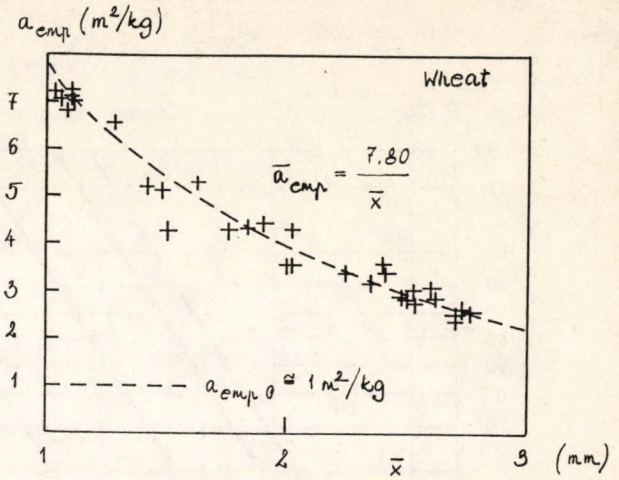


Fig. 1.: Relationship between the average particle size and the empirical specific surface area

particle size x and the nominal particle size x_o by RRB distribution.

It can be visually observed how the changings in screen construction displace the RRB-distribution curves in the Figure 2. To represent that, Figure 3 was contructed which is the same as the Figure 2 can be called fineness characteristic.
The effect of conventional screens are evident i.e. the fineness is reduced with increasing the size of openings. It can be interesting that the thickness of the screen plate how influences the fineness. The thicker screen of ϕ 3.5 /with 2 mm thichness/. However, it was not equivocal at each r.p.m.

The running ways without mill screen produce the expectable results i.e. the coarsest grits, more exactly grits mixtured with uncrushed grains. They contain from 40 % to 60% whole grains approximately and this causess the coarseness in the particle size distribution /see also Table 3/. Reducing the free opening even to its one thirteenth does not cause effective increasing in grits fineness. However, the plate WSD on which the opening area is divided into more sections along its length produces much finer material than the others, more exactly its product contain much less uncrushed grains, though its active are /72 cm^2/ is near to the WS2 /60 cm^2/.
The situation changes when the uncrushed material has been selected from the samples. The fineness of the clean grits will be better and get between the the fineness values of the screens of ϕ 7 mm and ϕ 5 mm. This can be considerable at forming closed circuit operation.

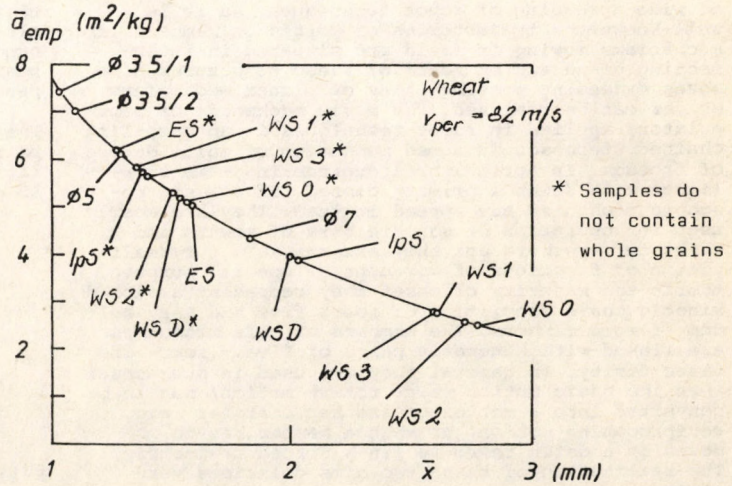


Fig. 2.: Effect of screen construction on grits fineness

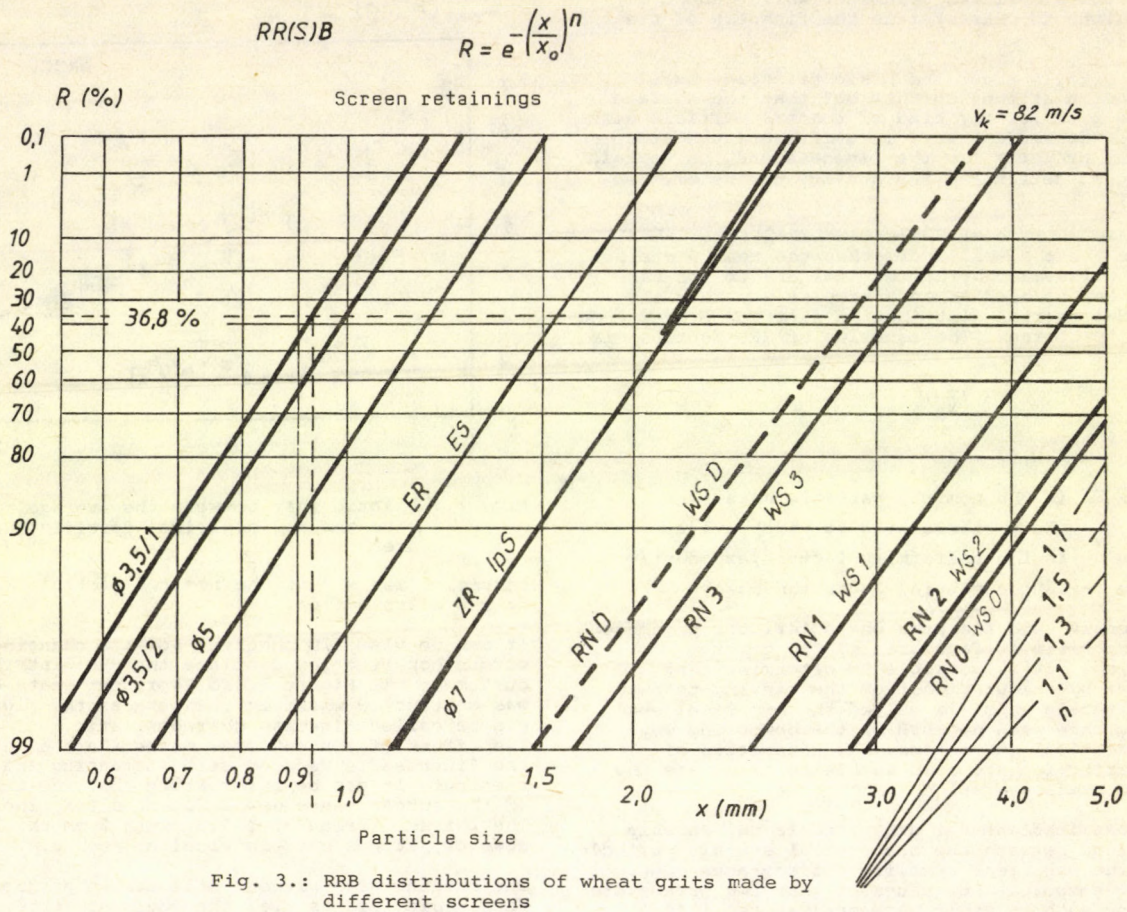


Fig. 3.: RRB distributions of wheat grits made by different screens

Computer analysis of some spatial mechanisms

Dr. J. KOLTAY–Dr. J. BENKŐ, University of Agriculture, Gödöllő

In the last few years there has been an increasing interest in stereoscopic mechanisms in consequence of wide spreading of robot techniques. As it is well-known the trajectories of points on members of mechanisms moving in field are situated in intersecting plane and by means of these structures also moves exceeding possibilities of planar mechanisms by far can be realised. The basic mechanism of manipulators applied in robot techniques is an open-link chained stereoscopic armed mechanism of multi degree of freedom. In agricultural engineering - in compliance with demands primary closed linkage stereoscopic mechanism are spread instead. They are mostly used for operation of shickle bars of mowers and harvester-treshers but they are suitable for realization of functions of movement of special purpose, too. In the majority of cases they represent a closed kinetic chain consisting of four, five and very seldom of more members. The members of this mechanism are linked with kinematic pairs of five,- four- and three fixity. In general they are used in such cases when the basic motion /e.g. rotary motion/ has to be converted into a motion of another charcter /e.g. reciprocating motion/ or when a member has to be moved in a definite route /in a forced trajectory/. The realisation of these two aims coincides very often.

The stereoscopic mechanism consisting of five members in Fig. 1. converts the motion of the crank OA in that way that the member CD performs a rectilinear alternating motion in the plane XOy. This motion can't be realised with the help of a planar crank gear as that only makes a displayment in the perpendicular plane XOZ to crank axle possible.

The OA crank is linked with the body by a kinematic pair of five-boundedness. The /A/axle of the rotating kinematic pair connecting the crank with the AB connecting rod is parallel to the axle /Oy/ of

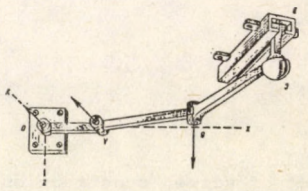


Fig. 1.: Stereoscopic cranked mechanism consisting of five members

the crank. The /B/ axle of the third rotating kinematic pair of five boundedness is perpendicular to the previous two axles, that is parallel to the X Oy plane. The BC connecting rod is linked with the sliding member by the ball /- and-socket/ joint /C/.

One'll get an other version of the previous stereoscopic cranked mechanism if pinned ball joints of four-boundedness are built in to the meshing places /Fig. 2./. In case of this structural shaping the BC connecting rod forms the pin of the ball joint B and the middle line of the slot is situated in the plane of the ABC triangle. However the pin of the ball joint C is perpendicular to BC and the middle line of the slot should be placed in a perpendicular plane to the axle OZ. By changing the build in spots of kinematic pairs of different boundedness a stereoscopic mechanism having various kinematic properties can be produced.

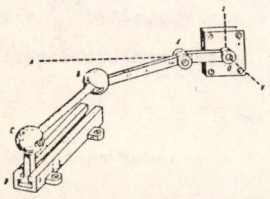


Fig. 2.: Stereoscopic cranked mechanism consisting of five membere with pinned ball joints

The tilting bearing scythe driving /Fig. 3./ has been widely used for operating scythe-mechanisms performing alternating motion because this mechanism /beside its simple construction/ is excellently suitable for converting rotating motion into swinging motion. It is easy to realize that the tilting bearing driving is equivalent to the four-member link mechanism /to the so-called crank axle oscillator/ shown in Fig. 4. from kinematic point of view. The main feature of this mechanism is that the axles of kinematic pairs allowing this rotating motion intersect each other at one point. This makes the establishing of swinging motion possible which takes place in a parallel plane to the driving axle. Stereoscopic jointed mechanisms of simple construction satisfying various requirements /grass cutter, power saw, etc./ can be produced /Fig.5/ by suitable placing kinematic pairs of 5-boundedness allowing rotating motion around the axles intersecting each other.

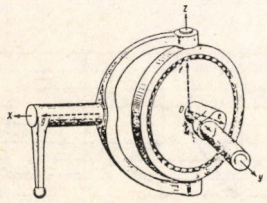


Fig. 3.: Scythe driving by means of tilting bearings

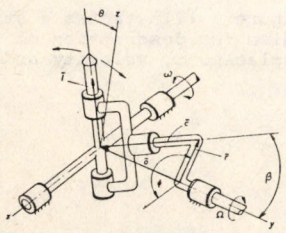


Fig. 4.: Crank exle oscillator

It is expedient to apply the methods of vector algebra for mathematical description of stereoscopic mechanisms, and so for that of crank axle oscillators. The vectors /a, r, c, l/ with the help of which the oscillators can be simply modelled are

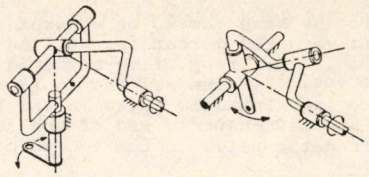


Fig. 5.: Four-membered joint mechanisms

drawn in Fig. 4. Accordinly the scalar product of the two vectors is zero, in other words

$$c\ l = 0$$

resp.

/1/ $$/a - r/\ l = 0.$$

The vectors of the driving r and the driven l axles are the ϕ, and θ the functions of the angular displacement, respectively. All these subsituting for equation /1/

/2/ $$/-a\ j - r/\cos\phi i + \sin\phi k//\ /-l/\sin\theta j + \cos\theta k//=0,$$

where i, j and k are the unit vectors.

From the equation /2/ it can be written for the relationship of the angular displacements of the driving and the driven axles ϕ and θ respectively:

$$tg\ \theta = r\ /\ a\ \sin\phi$$

from which

/3/ $$\theta = \operatorname{arctg}\ /tg\beta\ .\ \sin\phi/,$$

where 3 is the knee angle of the driving axle.

The angular velocity w and angular acceleration ε can be got with the help of derivation of the equation /3/, in other words

/4/ $$= \frac{d\theta}{dt} = \frac{tg\beta\ \cos\phi\Omega}{1 + tg^2\beta.\sin^2\phi.}$$

/5/

$$= \frac{d^2\theta}{dt^2} = \frac{-tg\beta\ \sin\phi\ /1+tg^2\beta\ /2-\sin^2\phi//\ \Omega^2}{/1 + tg^2\beta\ \sin^2\ \phi/^2}$$

where Ω is the angular velocity of the driving axle.

On the strength of /4/ it is easy to realize that the equation /3/ at $\phi = n/2$ has got an extreme value that is $\theta = \theta max = arctg\ /tg\beta/$, in other worde θmax depends only on the angle β.
Using this equations /3/-/5/ can be described as figures without dimension. Figure 6. demonstrates illustrations of equations drawn by means of com-

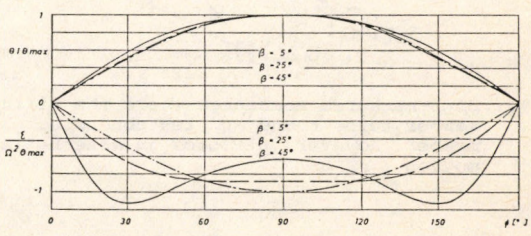


Fig. 6.: Description of the functions /3/ /5/

puter programms. In some cases it can become necessary to change the amplitude of oscillation. Concerning planar mechanism it is solved by alteration of excentricity of the crank. This disadvantage can be eliminated with application of planar mechanism. The continuos adjustment of the amplitude of oscillation during operation can be achieved in the simplest way e.g. by alteration of the knee angle β according to the equation /3/. This can be solved according to Fig. 7 in that way that the displacement of the crank axle in the direction of the bearing

axle fixed to the base should be ensured and the original four-membered mechanisms will be converted into six- /Fig. 7/a./ resp. five-membered /fig.7/b/ one. This necessitates the selting in to two five--bounded rotating kinematic pairs in the first case and that of one five-bounded and of one four-bounded cylindric kinematic pairs in the second case.

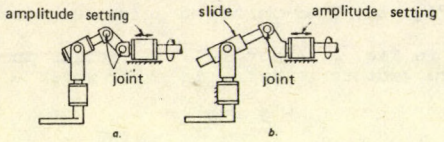


Fig. 7.: Six- and five-membered mechanisms with continuous alterability of the amplitude of oscillation

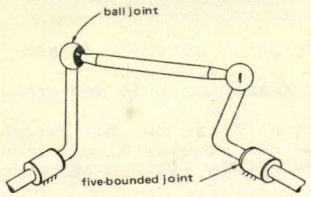


Fig. 8.: Four-membered mechanism where the axles of the fixed rotating kinematic pairs intersect each other

At steering tractors and automatives, as well as at control of carburetters such four-membered stereoscopic mechanisms are often applied that contain two five-bounded rotating kinematic pairs and two-three-bounded ball joints /Fig.8/.

At this mechanism the axles of rotating kinematic pairs fixed to the base /case/ intersect each other. This solution is applied at transmission of swinging motions first of all.

If a five-bounded kinematic pair is substituted for a kinematic pair allowing linear movement, then such a special stereoscopic crank mechanism can be produced at which the driving member can be turned round and the guided member performs a rectilinear alternating motion /Fig. 9./.

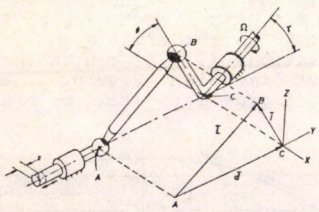


Fig. 9.: Four-membered mechanism where the diring member turns round and teh conducted member, however, performs an alternating motion

The analysis of this mechanism can be accomplished by application of the vector figure drawn in the figure according to the following:

$$d + r = L,$$

accordingly

/6/ $$/d + r/ \; /d + r/ = L\,L.$$

Substituting the relations into equation /6/

$$r = r\,/-\cos\Phi i - \sin\gamma \sin\Phi j + \cos\gamma \sin\Phi k/$$

and

$$d = d\,j$$

we'll get the expression

$$d = /L^2 - r^2\,/1 - \sin^2\gamma \sin 2\Phi//^{1/2} + r \sin\gamma \cdot \sin\Phi$$

The displacement of the conducted member is:

$$s = d - d_{/\Phi=0/} = d - /L^2 - r^2/^{1/2}.$$

By introduction of the under mentioned notations:

$$f = r \sin\gamma \cdot \sin\Phi,$$
$$g = /L^2 - r^2 + f^2/^{1/2},$$
$$h = r \sin\gamma \cdot \cos\Phi ,$$

the displacement of x direction will be

/7/ $$x = g + f - /L^2 - r^2/^{1/2}.$$

From this the velocity and acceleration of the member performing alternating motion will be

/8/ $$v = dx/dt = /f/g + 1/\,h\Omega,$$

/9/ $$a = dv/dt = - /f\,/f/g + 1/ + h^2/g\,/f^2/g^2 - 1//\Omega^2,$$

where the angular velocity of the driving member is.

Converting the functions of displacement, velocity and acceleration by the method similar to the previous we'll get the curves to be seen in Fig.10.

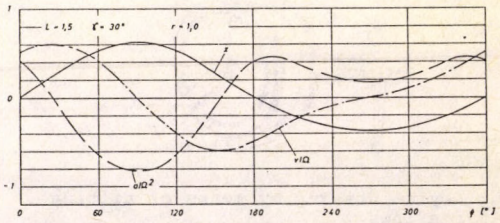


Fig.10.: The figure 9 illustrates a structural mechanism for description of the functions of displacement, velocity and acceleration

Mechanization problems of horticultural soil mixtures

Dr. B. BALÓ, University of Agriculture, Gödöllő
J. RÁKÓCZI, „Floresca" Co., Sopron

The soil or soil mixture is a cultivating medium produced artificially according to a definite recipe which satisfies special demands. It is mainly used in the large - scale floriculture, market - gardening /especially in the growing of seedlings/ and by the so - called hobby - gardeners and room - plant producres.

In our article we want to deal with some of the essential questions of the machines used in the large-scale production of soil - mixtures. We wish to refer to the various technological steps, their mechanization lines in relation to what sort of mechanizational solutious will meet the requirements the final product.

By way of introduction we outline the requirements of the final product: the aim is to produce a soil mixture, which is

- rich in utriments,
- well - sturctured,
- homogeneous,
- free from weed-seeds, parasites and the harm of chemicals.

Further on we wish to detail the most important basic materials.

The compost provides the necessary nutriment basis, the peat supplies the loose structure with good air and water balance, and besides cotu, sand, clay, artificial fertilizer and microelements are included in small proportions depending on the needs of the plants.

Among the above listed basic materials most attention should be paid to the peat both by the gardener and the mechanical engineer assembling the producing machine line. The production of soil mixture can be carried out profitably where the peat as basic material available.

The largest soil - mixture producer in Hungary is "Florasca", the Company of Environmental Management, located in Sipron, Győr - Sopron county, which used to be know as the Company of Soil Conservation.

The company posseses the licence of the production of the so - called OSLI- peat, which an extremely good basic material of soil - mixture. /Osli is a village in the Hanság./

The work of mechanical development started on the basis of these peat resourses as a results of which there is a machine line, which can be called a lage--scale one, at the above mentioned company. We have been able to take an acitve part in the developnent from the beginning.

Table 1. displays the machines of the technological process with the sketch drawings of machines.

The basic materials of peat and soil character together with the compost mean 98-99% of the final product, the rest is artificial fertilizer and microelement.

Table 2. shows the block - scheme of the technological process, according to which the technological steps related to the operations of materials handling are as follows:

- Preparation /stacking, transportation/
- Feeding
- Pounding
- Riddling
- Feeding before mixing
- Mixing
- Packaging
- Selling.

The above mentioned operation are carried out in the open air. The basic material can be processed easily or with difficulty depending on the moisture - content.

The determination of the requirements of the machines, which is a precondition of the assembly of the technological line, was considered to be a starting fact. Here border cases related to the quality of work had to be made clear and not the ones of performance character.

Obviously, with the technologies including pounding the question emerges that to what extent pounding is necessary and sufficient as it is a factor influencing the energy - profil.

We can say that during pedological and cultivation experiments values referring to the size of specks which are optimal for the plant have been defined, so pounding has to be done in the necessary and sufficient degree. It is needless to prove that even in the smallest flower - pot the basic materials must be in proportional distribution. A nut - like piece of peat or a peanut - sized piece of artificial fertilizer will naturally leave distrust in customers. Our development work will have to be concentrated on this field.

Feeding and mixing insuring homogeneity are also essential parts of the technological process. The feeding device which can be set in without stages works with 4-6 % rate of mistakes with materials of peak - soil character, and in our case it can be allowed.

The mixing operation, insuring homogeneity has to meet very strict requirements.

The importance of packaging is doubtless regarding both the formation of units and attractive appearance as well.
A lot of development is expected in this field in the future.

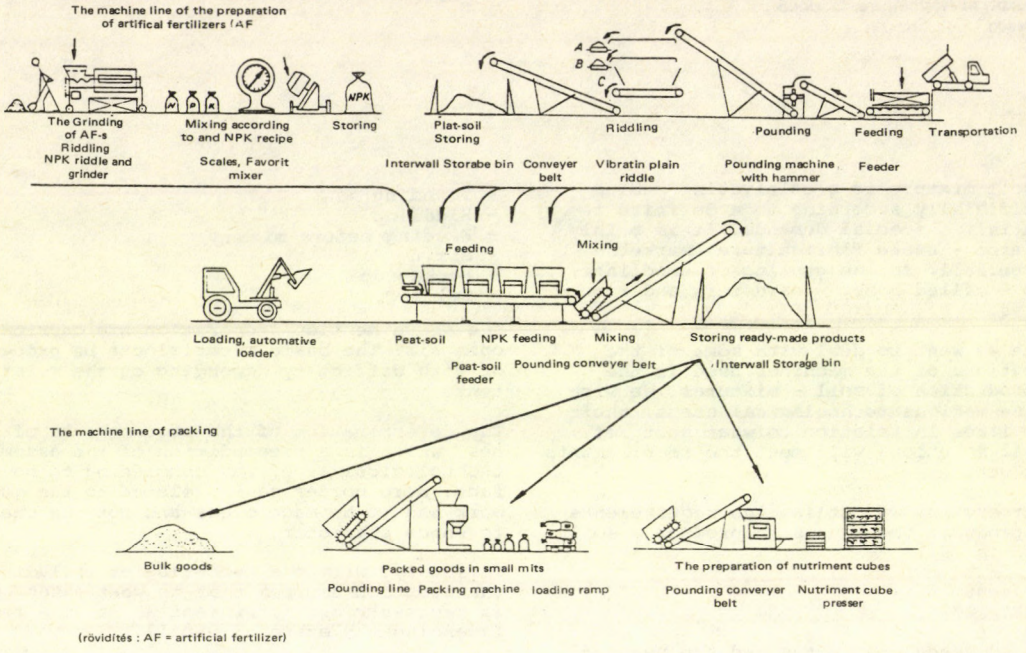
At the moment together with the traditional bulk and packed soil and nutriment mixtures several concentrates and bio-products have appeared on the market and their popularity is expected to grow.

The company is considering enlarging the scale of their production with products, too.

Here are some of the ideas and development fields which infulence the further development of the specialist field:

- It seems to be a big problem that the home mechanical industry produces only one machine for this field, so the only solution is their purchase abroad or unique production.
- From the producers point of view it can be considered to be a rightful expectation that the standardization and control of the final product should be realized.
- It would be desirable to establish national large - scale soil - miture producing centres /preferably lear cities, horticultural centres/.

The Mechanical System and the Technology of the Preparation of Soil-Mixtures



(rövidítés : AF = artificial fertilizer)

Table 1.: The mechanical system and the technology of the preparation of soil-mixtures

Asimplified Block-scheme of the Changes Caused During the preparation of Soil-Mixtures

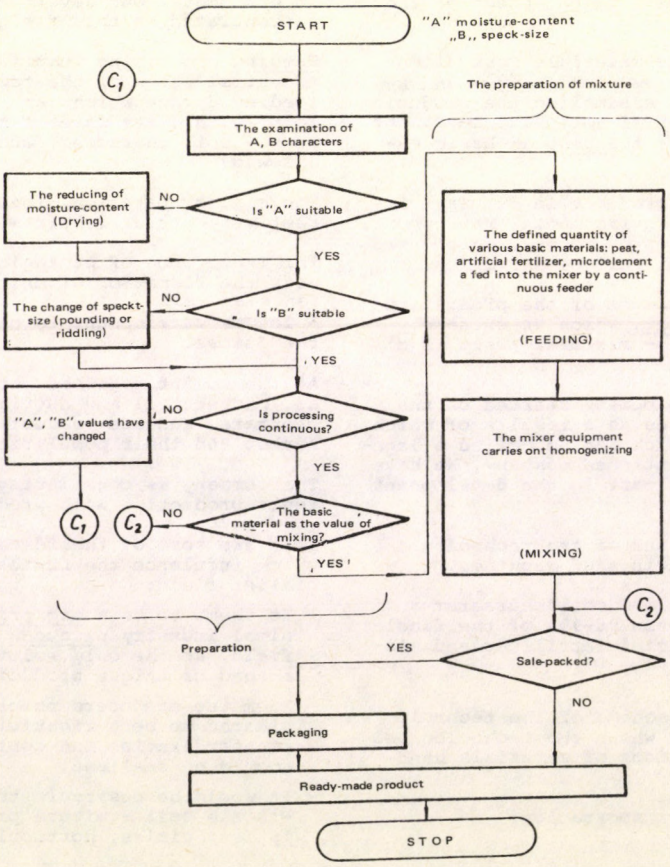


Table 2.: A simplified balck-scheme of the changes caused during the preparation of Soil-Mixtures

Simulation model for compression stroke analysis

Dr. L. JÁNOSI–C. FÜLÖP, University of Agriculture, Gödöllő

The internal combustion engines are wearing and getting older during their lifetime. Wearing causes such changes in operational parameters of engines what we are partly able to predict or to follow.

The process of getting older of an engine takes affect on the parameters of the engine so we have to take into consideration this when we evaluate the characteristics. To know the whole process is important from designing and operating point of wiew, too. But the process of getting older isn't well known in all details.

As for our preliminary conditions getting older of an engine could be characterised by its wearing state. We can write down the changing of this state by increasing the clearance between the wearing pairs like cylinder and piston. With the increasing clearance of cylinder and piston the losts are also developing, which decreases the filling degree of cylinder, the volumetric efficiency, the compression ratio and thermal efficiency, too.

The losts, listed above, show their influence during the compression stroke already.

In this paper we study the losts - originated from wearing of cylinder and piston during the compression stroke - by a simulation model.

For the sake of exact recognition of process of getting older we decided to follow the process by a complex method what is able to take into consideration all the factors in cycle calculations influencing the operation of an engine as well as the results computed could be comapared with the results of lab experiments.

For solving the task we set up an algorithm and a simulation model which are able to describe the working of a Diesel engine while the process of getting older and wearing are taking into consideration.

The complex solution is worked up by theoretical and experimental way. The theoretical investigation is realized by the simulation model describing the operation of a CI engine /this model is called: digital engine/. Many models are well-known in literatures, but these models don't take the wearing of an engine into account or they use different coefficients.

This simulation model takes the wearing continuously and computes the losts. The basic relationships of thermodynamics, fluid mechanics and physics are applied to the algorithm. So, the laws of thermodynamics, the equations of cycles and laws of flowing gases are utilized.

The basis of working of the model is that the calculations of the continuous change of state taking place in the engine are devided into elementary events. The model calculates the various key points of each elementary events and other motoric parameters too.

Deviding of elementary events is based upon the unit turning of crankshaft. This unit can be optional between 1-0.01 degrees crankangle. Time also can be the unit.

The algorithm carry out the following calculations:

- For a given engine, on the basis of measuring the compression final pressure and other motoric parameters, a characteristic number is defined by successive approximation to characterize the wearing state of engine.
- The volume over the piston is calculated from geometric datas of engine and actual crankangle.
- The state parameters of air being in compression space /pressure, temperature, specific volume/ are calculated supposing isentropic change of state.

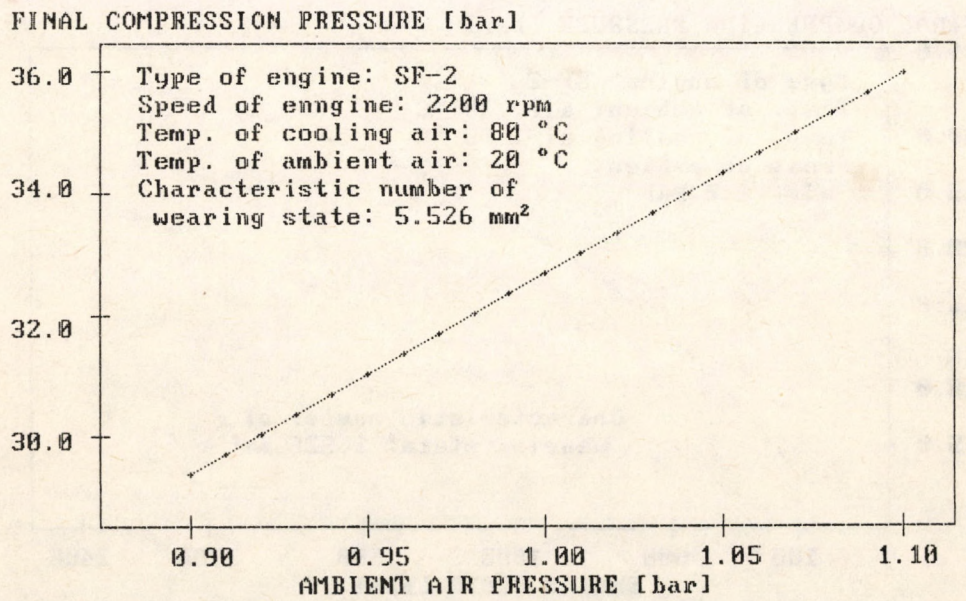


Fig. 1.: Changing of compression final pressure as a function of ambient air pressure

- Determines the quantity of flowing air coming through the gap between cylinder and piston because of the high compression pressure.
- Determines the heat flowing from the medium to the cooling water and vica-versa.
- Specifies the parameters chracterizing the air changing, included the velocity and mass of flowing air. At determining the flowing characteristics the method takes the charging areas and flowing resistance of the given engine into consideration.

After executing the calculations the program steps forward with a unit /mean: turns the shaft further/ and executes the calculations again until the limit of turning interval being set in before the cycle.

The model, because of its structure, is able to treat all the variables to be independent so it can examine their influences on dependent variables in arbitrary relations. From the cases being valuable on discipline way the tollowing connectins were investigated:

- the effect of pressure of ambient air;
- the effect of engine speed;
- the effect of wearing condition of engine

to the compression pressure and temperature.

A part of the results arised from having made the model work is simply verifiable on empirical way and with physical laws.

These results can be good references and they prove the adequate structure, the suitable operation and the appropriate algorithm of the model and also prove that the algorithm of the model fits well to the real Diesel engine.

We can observe on figure 1. the compression final pressure of a given engine /typ: SF-2/ as a function of ambient pressure of air while the other parameters /engine speed, temperature of cooling air, temperature of ambient air etc./ were constant. Looking the diagram we can determine that the engine reacts sensitively to the changing of ambient air pressure. This fact is taken into cosideration at adjusting of engines working in very high circumstances above sea level.

On figure 2. we can see the final compression pressure as a function of engine speed. This result belogs to an engine worked certain working-hour and its wearing condition is known.

The graph exactly follows the well-known saturation character being verified by measurements.

Having had the model worked we had obtained some astonishing result what for we found neither literary nor experimental datas. There is no doubt about it that the most interesting thing is shown on Fig. 3. On this figure one can see the laid out indicator diagram of compression stroke being characterized by different constant engine speed. It was experienced that not only the measure of compression final pressure was changing but also the position of peek pressure before TDC.
At the calculations we took into account the wearing status of the engine, too.
Depending on wearing status of cylinder-piston group the peek comression pressure at starting speed is developing at 30-35 crankangle degrees before TDC. This theoretical result can be one of the reasons of starting difficulties of worn engines. The Fig. 4. shows the changing of the place of peek pressure before the TDC as a function of engine speed.

Taking into consideration of losses originated from wearing takes prominent part in setting up the model. In ideal case, supposing working without losses the model computes the maximum pressure what we can achieve theoretically.

As one can takes the circumstances of measurement like: ambient parameters, speed, cooling conditions etc. into consideration, the wearing status of the engine is obtainable belonging to the peek pressure and the condition of the engine can be characterized on reliable way.

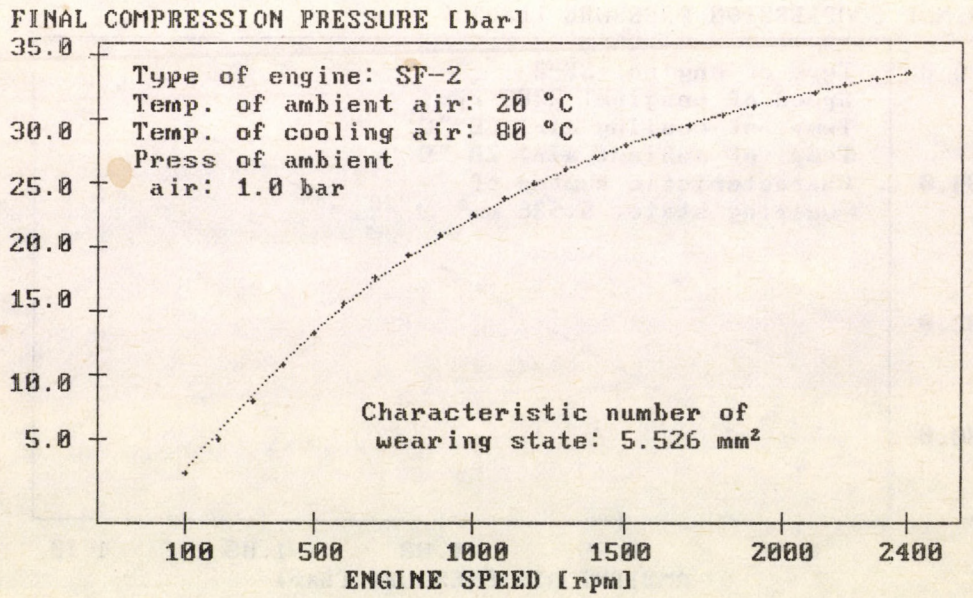


Fig. 2.: Changing of compression final pressure as a function of engine speed

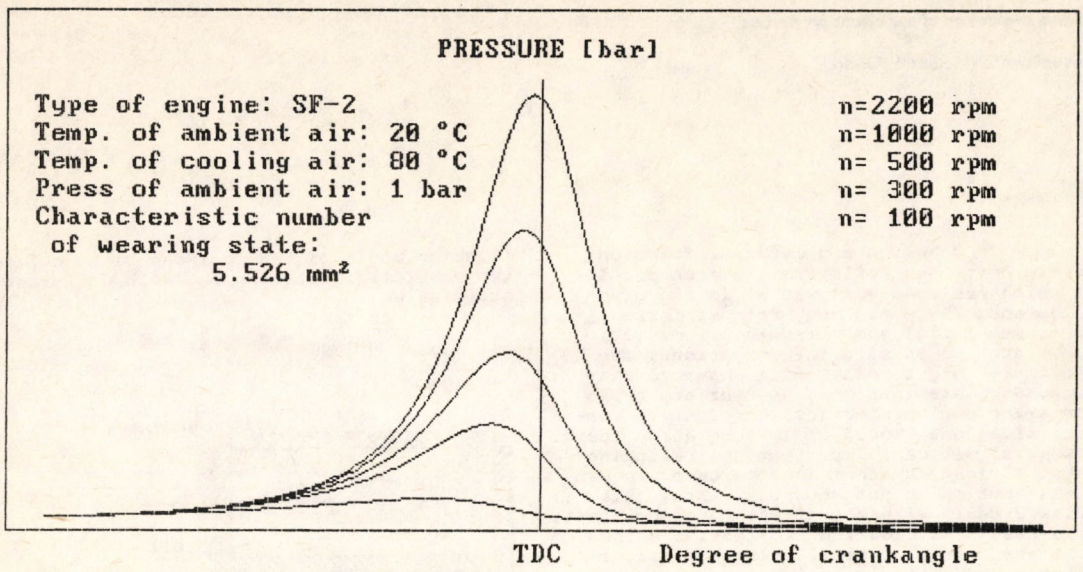


Fig. 3.: Indicator diagram of compression stroke being characterized by different costant engine speed

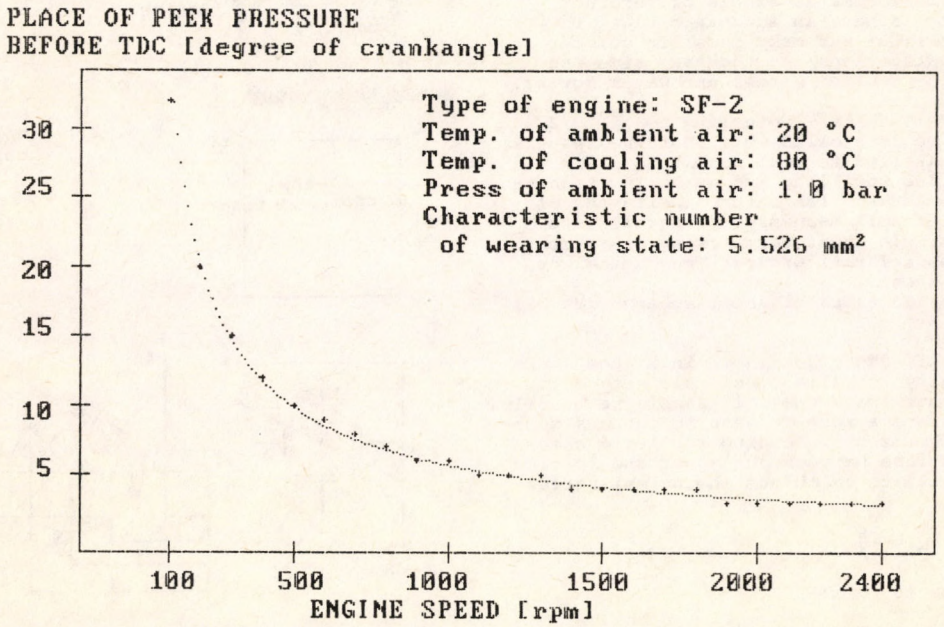


Fig. 4.: Changing of the place of peek pressure before the TDC as a function of engine speed

Measurement and evaluation of soil shear properties

F. KASZA, University of Agriculture, Gödöllő

The shear strength, cohesion and internal friction angle of grain heaps and soils are the mechanical properties which are used most widely in the practical development. There are many methods formed to test their mechanical and strength properties. Most of them, such as in situ investigations, are not very suitable to get values of mechanical characteristics. Such examinations, however are essen tial in comparing soil properties. In order to measure exact values one should apply laboratory tests. There are some significant imperfections belonging to the tests. I might say that in some cases we can measure finely but we do not know what. From this point of view I dealt with the direct shear box test. I tried to establish a closer approximative stress state of the shear test as usual. Also the direct shear apparatus was compared to the simple shear device. Considering the principals of the two test tools the simple one is found more applicable.

In accordance with the references /1/, /2/, /3/ quoted there are many possibilities to measure shear characteristics of soil, and the most important of them are ring, plate, blade, cone and pin type shear tools. They may be formed as simple or recorder devices. These tools have an advantage that they test the soil in situ; and make possible quicker and cheaper investigations. At the same time one cannot coltrol the applied stress and water moving.

The laboratory soil tests - referring to /1/, /2/, /3/ again - can be controlled well, but the results might be hardly applied to real soils. So it is desirable to refine modelling and measuring techniques. The most important laboratory appliances of the measurement of soil mechanics properties are the direct and simple shear boxes /ring or frame types/ as well as triaxial devices /mechanical or hydromechanical ones/.
Further only the two types of shear apparatuses will be dealt with.

The direct /normal/ shear box shown in figure 1 are used most generally to collect soil property data. A compression plate loads the soil sample vertically in it. This generate a more or less homogenous normal stress. The horizontal loading results a shear stress in the surface between the upper and lower frames. It is usual to calculate the normal stress by

$$\sigma_y = \frac{F_v}{A}$$

and the shear one is

$$\tau_{xy} = \frac{F_h}{A}$$

Although these formulas are simple, but they are far from the reality and may be found unapplicable whilst analyzing loading conditions.

The simple shear box developed in Cambridge is shown in figure 2 /the Norvegian shear ring are theoretically quite similar/ /3/. The loadings are pure shear and vertical compression. The stresses should be calculated in the same way as before. The only significant difference is that the expressions are theoretically correct in this case.

The figure 3 is a representation of the Mohr - Coulomb fracture theory by showing stress circles in failure and the failure limit curves /approximated by straight lines/. According to the theory the soil is in the failure limit state when its stress circle is tangential to the limit curve. In a shear box test the y direction normal and the xy planar shear stresses are determined in failure limit states. Theoretically the cohesion and the internal friction angle of the soil can be calculated from two mesurements carried out with different normal stresses as

$$\tau_{xyi} = c + \sigma_{yi} \operatorname{tg}\Phi$$

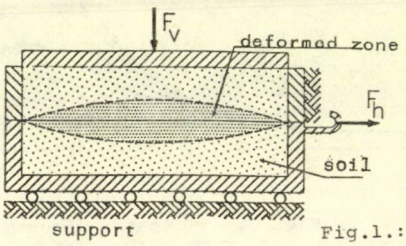


Fig.1.: Direct shear box

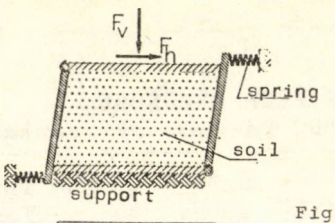
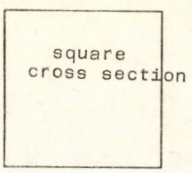


Fig. 2.: Simple /Cambridge/ shear box



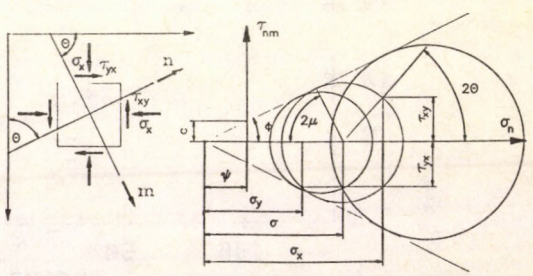


Fig. 3.: Mohr - Coulomb failure

for the ith test. In the expression c is the cohesion and Φ is the internal friction angle. Not detailing the simple evaluation procedure let us compare the possibilities of the two shear boxes. In the direct shear box it is impossible to form such a stress state which could be the theoretical basis of the usual evaluation as there is no reason for a homogenous stress state in the plane between the two frames. It is obstructed by the lower moving frame as it transmits the load to the sample in the form of some kind of distributed load; in any other way it is impossible. It is easy to see that a single horizontal force is not enough to balance the soil reaction, so that an extra loading should arise. This extra force should be balanced on the moving frame. Between the two frames must not exist any force. Another snag is that the sample is supported perpendicularly to the xy examination plane i.e. the third principal stress is not equal to zero. The conditions cause rather plane strain than plane

stess as it is provided. In addition to the theoretical problems the practical application of forces is a serious question.

The two types of shear boxes were compared making use of the most up-to-date numerical method the bondary elements. The mathematical model of the soil material was a linearly elastic one. The result of modeling gave some important findings. The results with the simple shear box proved that the shear stress should be homogenous in this device. For the direct shear box the stress distribution in the shear plane are shown in figure 4. In the computer modeling of soil samples extreme value material, constants were used. E = 1 MPa, E = 1 GPa Young modulus and $\nu = 0.2$, $\nu = 0.45$ Poisson coefficient values were combined in the four calculation. The real pactical values fall between those. The boundary conditions of a direct shear box can be approximated in the way as it is shown in figure 4. The vertical load was considered as equally distributed. The lower frame forces the sample to move horizontally with an identical displacement. At the other side of the upper frame the horizontal displacement is zero and the bottom vertical displacement is zero, as well.

On the basis of the numerical modeling and calculation of the direct shear box two coefficient can be introduced. χ is the ratio of the maximum shear stress to the mean one. This tell us how times higher the shear stength of soil as we calculated when provided homogenous stess distribution . λ coefficient is the analoguous ratio for the normal stess.

$$\chi = \frac{\tau_{max}}{\tau_k}$$

$$\lambda = \frac{\sigma_{max}}{\sigma_k}$$

The coefficient values are written in the table of figure 4 for the applied material constants. The coefficients depends on the friction properties of the frame. The values given are valid only for frictionless frame. In reality χ is less and λ is higher.

Collecting the experiences and numeric results one can state that although direct shear box values can be improve, it is difficult to gain reliable values. For example the stress concentrations and plastic flow near edges cannot be ignored.
It seems to be better to develop the Cambridge simple shear device. According to the experiences with numeric calculations and measurements the following suggestions can be taken

1. The surfaces connecting to the soil should be as rough as possible.
2. Not only vertical but horizontal load should be applied to make investigations more versetile.

The evaluation can be made also using Mohr - Coulomb failure theory. On the basis of at least two tests the radius of the
stress circle:

$$r_i = \frac{1}{2} \sqrt{\sigma_{xi} - \sigma_{ui}^2 - 4 \tau_{xyi}^2}$$

and the origin:

$$s_i = \frac{1}{2} |\sigma_{xi} - \sigma_{yi}|, \quad /i = 1, 2/,$$

and using the value gained above:

$$\sin\Phi = \frac{r_1 - r_1}{s_2 - s_1},$$

$$\Psi = \frac{r_2 s_1 - r_1 s_2}{r_1 - r_2}$$

$$c = \Psi \operatorname{tg} \Phi$$

Of course in the case of more then two tests statistical evaluation should be used.

3. Applying another loading perpendicular to the plane considered can also be used and so triaxial investigation can be carried out.

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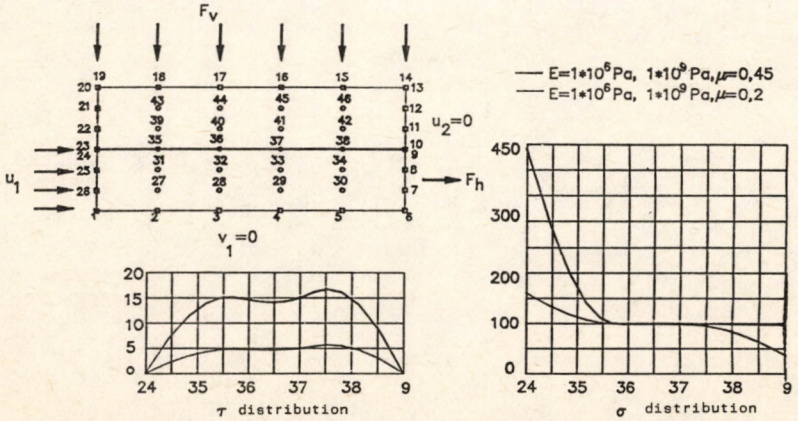
Fig. 4.



	τ_{max}	σ_{max}	τ_{mean}	σ_{mean}	κ	λ
μ =0,2	7,17	159,4	4,21	104,7	1,7	1,5
μ =0,45	20,8	440	12,9	125,2	1,6	3,5