Part II.

SELECTED SCIENCIFIC PAPERS

The quality and the reliability of agricultural machinery

DR. JÓZSEF JANIK – DR. OSZKÁR SZIJJÁRTÓ
(University of Agriculture, Gödöllő)

Summary

This paper summarises the major results of research assignment No. G-90608 under the Medium-term National Research and Development Plan of Hungary. Research efforts span the whole useful life of agricultural machinery and all related activities /including market research, plan targets, preparations for decision-making, design, manufacturing, trade and utilisation/. One of the results of the research effort is that the underlying processes can be described using systems theory modelling, by an energy flow equilibrium equation

$$X/t_o,t_n/=X/t_o,t_n/-Y/t_o,t_n/\pm K/t_o t_n/$$

or by a control equilibrium equation

$$\Delta V/t_o,t_n/=F_f/t_o,t_n/-V_r/t_o,t_n/$$

therefore the activities involved can be analysed in a more exact manner.

Important conclusions can be drawn on the basis of the parameters to be defined with the above equations concerning design, production, marketing activities, machine maintenance, ie. the quality and the reliability of the machinery and equipment, which is an indirect way to qualify the standard of management and supervision.

History

Basic research into the subject was started by Dr. József Janik in 1972. Stricter market conditions, rising quality requirements and greater demand for increased reliability as well as increases in production outlays justify further research into this subject, assuming that a market economy will eventually emerge in this country. There is need for a systemic approach in the analysis of machine maintenance by agricultural companies as well in order to identify opportunities to minimize costs, to maximize profits and to improve the quality of management.

Research methods

The research method is partly theoretical, partly practical. The task is rather complex, involving a great many of specific questions therefore a synthesis is considered to be fundamental.

While building up the model, machine maintenance was considered to be a complex system therefore the factors to be taken into account as well as the interrelationship among them were defined on a systemic basic while the mathematical functions among them were defined on a heuristic basis. The applicability of the theoretical model was tested and ascertained in practice at a number of different companies.

Research results

The systemic analysis of the major processes during the useful life of machinery and equipment highlights the qualitative and financial characteristics of the different nodes in an integral way /see Figure 1/ by comparing expenditures with the opportunities for savings through changes.

Since machine maintenance is located between notes Nos. 4 and 5 where the costs of changes are rather high whereas savings to be achieved are rather small, the systemic approach is self-evident in that expenditures should be kept to a minimum under marginal conditions so that corporate profits could be maximized.

Considering the above and regarding the company as an input/output model, the company's energy flow and control equilibrium equations can be defined on a heuristic basis. The control equilibrium equation-represents the company's target function as well since this defines profits which is at its maximum where expenditures are at their lowest under given marginal conditions.

The energy flow and the control equilibrium equations offer an opportunity to chart functional curves for machines as shown in Figures 2 and 3 from which important conclusions can be drawn regarding machine design, manufacturing, trade, market stability, machine operation /maintenance/as well as their optimum useful life.

The major conclusions to be drawn on the basis of the data measured and the diagrams produced include the following:

- The steepness of the curve and its position around the minimum provides a graphic picture about the reliability of the machine and its sensitivity to repairs.

- It would be expedient to write off the machine at the point where the curve reaches the minimum since its further operation and maintenance would lower profits.

- The operational characteristics of the machines facilitate for the companies to choose the ones which are the most favourable for them.

- Also, useful information is contained in the characteristic curves for the development of machine manufacturing and trading policies.

Research evaluation

The success of the research effort, expended over the past 15 years, is manifested in that a practically applicable theoretical model has been developed with which a machine's life can be monitored from the very moment when it is but a gleam in the designer's eye through actual design, manufacturing and sales till actual use and ultimate writeoff.

Recommendations

The model is recommended for use by all agricultural companies that have computers and would wish to switch over to a more objective style of corporate management, casting away subjective elements in order to boost their profits.

There is a need for manufacturers, traders and users to develop an information network that would facilitate changes in machine quality to be carried through, necessitated as a result of tests, experiences and data measured at the user companies.

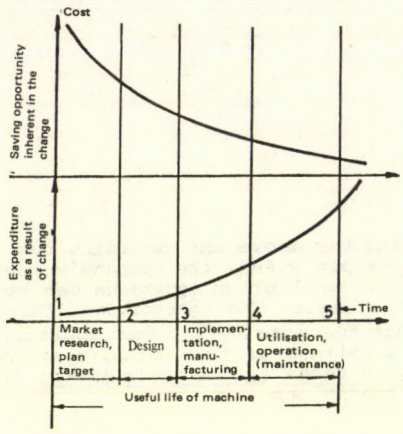


Figure 1

Financial features as related to needs in the useful life of machinery and equipment

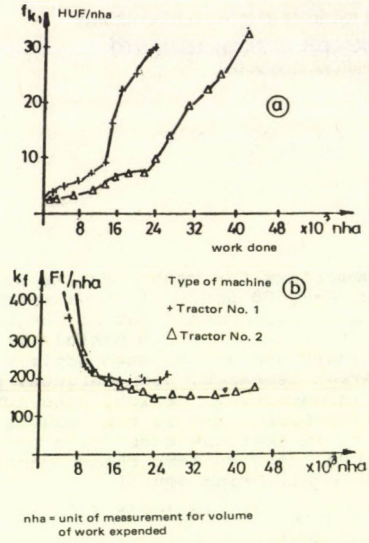


Figure 2

Specific characteristics of tractor

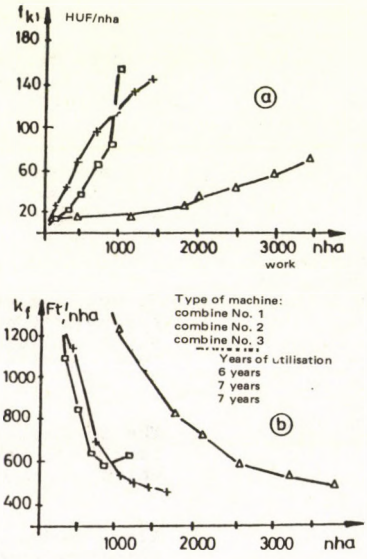


Figure 3

Specific characteristics of combines

The interrelationship between the size range and the rheological properties of alfalfa chop

DR. SZENDRŐ – DR. PETRÓCZKI – DR. NAGY – BENSE
(University of Agriculture, Gödöllő)

1. Introduction

To improve the assessment method of chaff lengths, we have started to look for physical properties in sets of chopped green feed. In order to ensure repeatability, we have noted data regarding the development of the crop, the production region and the conditions of the harvest.

2. The scope and methods of the tests

2.1 Field sampling

Samples have been collected on the V9 plot of the "Petőfi" Agricultural Co-operative of Dunavarsány, which was planted in 1987 with the "Verko" variety of alfalfa /graded officially by a government

institution/, in the course of two successive mowings by Claas Jaguar chopper. Although the actual yields of the two operations differ from one another, the dry matter content and the machine load as well as the identical plot guarantee comparability for the results obtained.
/See Table 1./

Table 1. The properties of scop samples and harvesting parameters

Measurement	Yield /t/ha/	Dry matter /%/	Material flow /t/h/	Chaff length, as set theoretical /mm/
First mowing	27.2	26.5	53.2	4.1 5.5 6.4 8.1 11 14
Second mowing	22.8	25.5	57.3	5.5 11 14

2.2 Manual evaluation

In order to control lab test results and to enable assessment of methodological reliability each sample was evaluated after manual sorting as well. An empirical distribution histogram was also produced that properly described the sample and the matematical statistical data of the individual curves were also defined. The weight of the samples processed manually was 200 grams with the number of chaff pieces being between 4,000 to 7,000. In the course of the tests we used a socalled fullscale sorting, ie. the dust fraction in the rage of 0-5mm was also taken into consideration. The samples had different characteristics, subject to the chaff lengths as set. /See Figure 1./

2.3 Rheological experiments

2.3.1 Creeping test

On the assumption that the chaff set is a visco-elastic material, our objective was to observe deformation that arises under different load conditions. For the purposes of our tests we have developed a device suitable to support the set. When designing the device the prime consideration was that its walls should have as little impact on the deformation of the chaff as possible. Another consideration was that a bit enough volume of chaff should be available in the device for compacting and recoiling. Consequently, the device is a fairly large cylinder as compared to chaff size with an overall capacity of approximately 54 dm^3.

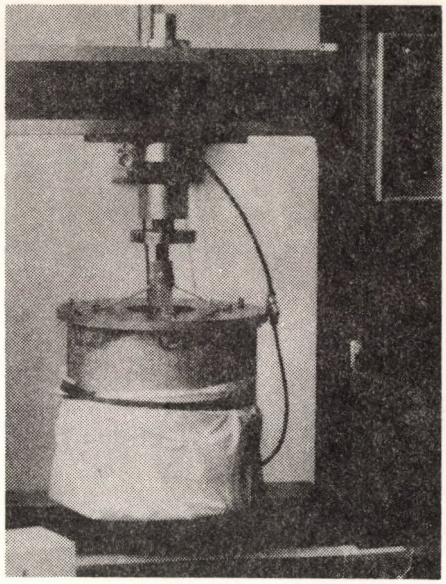


Figure 2. Device to support shop

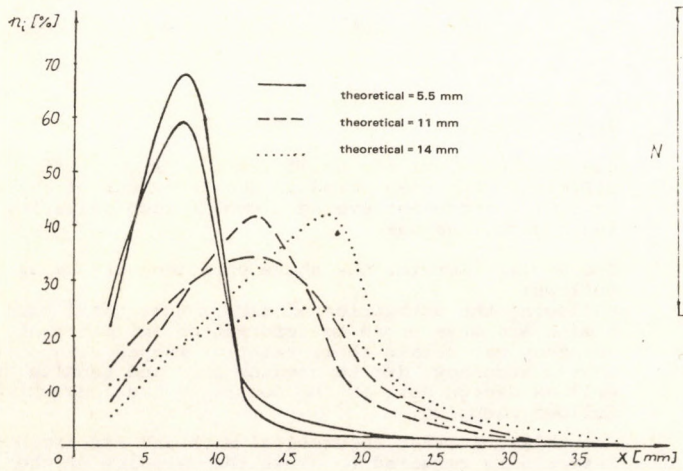
The device uses the penetrometer principle. Different loads can be put on its piston which is 150 mm in diameter.
In the first series of the deformation tests we have observed the creeping of the material. For the purpose of this test the chaff set was subjected to a 200 N force and the movement of the piston was observed over time. As soon as the creeping phase was over, force was reduced to 50 N /ie. the load due to the weight of the piston/ and recoiling was recorded. The empirical deformation/time curve received was approximated with the following function

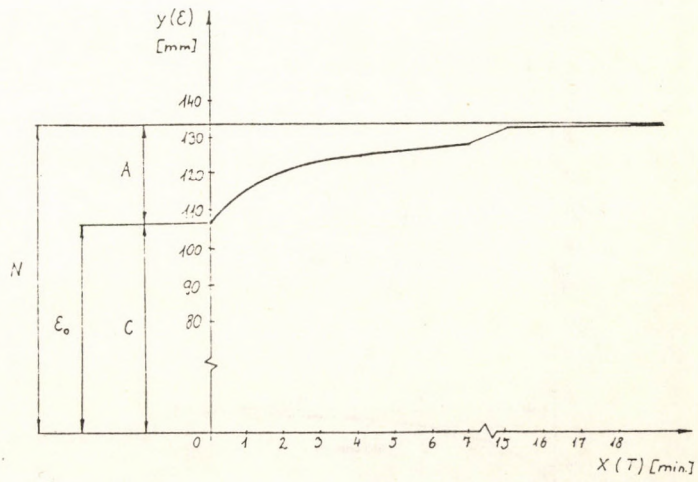
$$y = A \times /1 - e^{Bx}/ + C$$

where the parameters carry the values as defined in Figure 3. below.

Figure 3. Empirical deformation/time function in case of constant load.

Figure 1. Sample distribution by shop length.





Osobov /1967/ produced a similar model with the only difference that he approximated the deformation function in the following form:

$$\varepsilon = \varepsilon_o + /N - \varepsilon_o/ \quad / 1 - e^{-\frac{t}{T_r}} /.$$

The intendity of creeping is characterised by the T_r retardation time which in our case was

$$T_r = \frac{1}{B} .$$

Figure 4. shows the range of the retardation time.

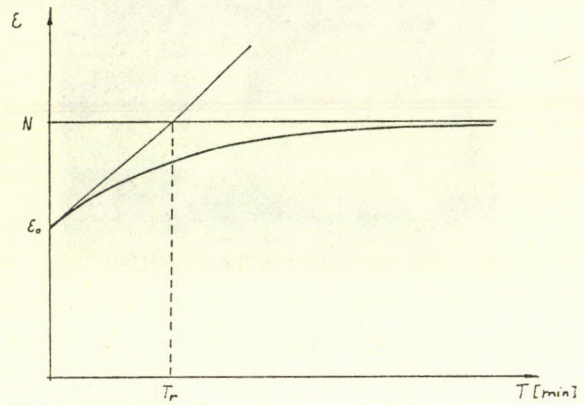


Figure 4. The range of the retardation time.

2.3.2 Relaxation

The relaxation experiments have been conducted in the material testing laboratory of the Hungarian Institute of Agricultural Engineering. In the course of these experiments the samples put into the device, described above, were subjected to loads ranging from zero to 2,000 N which were increased linearly over time in an INSTRON tensiometer. The deformation speed was found to be 50 $mm.min^{-1}$. When reaching the maximum in the load function, changes in the reaction force of the piston were recorded while keeping the deformation constant. This relaxation process is depicted in the BC section of the diagramm plotted by the tensiometer. /see Figure 5./

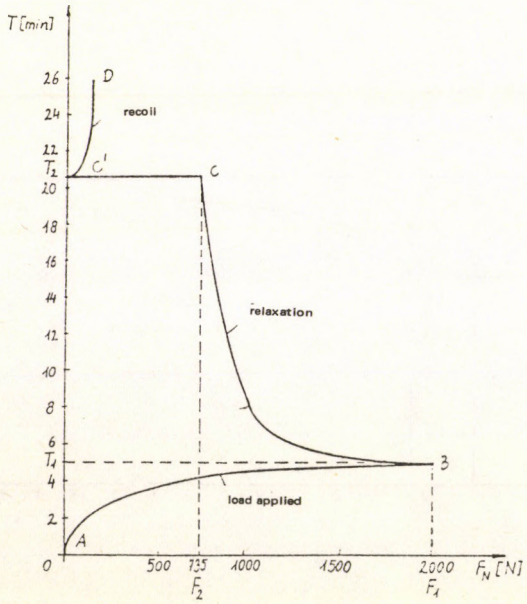


Figure 5. The load sections of the deformation tests

Following a slowdown of the reaction force, the load on the substance tested was reduced to 50 N. The third section of the curve shows the increase in the reaction force in proportion to recoiling. With regard to Sitkei /1981/, the reduction in tensile strength should be interpreted on the basis of the so-called relaxation time. This implies the period over which load is cut to an e^{th} part of its original value. In our case, the F_1 load /ie.2,000 N/ is cut to $F_2 = \frac{F}{e}$ /635.76N/ by the end of the relaxation period.

$$\Delta t = t_2 - t_1.$$

3. Evaluation of the test methods and the conclusions

The method has been developed for the analysis of green feed sets with different chaff compositions on the basis of their visco-elastic properties.The applicability of the measuring system and method was ascertained via the analysis of the assumed interrelationship.

Accordingly, the three chaff lengths, involved in the test, can be characterized with the following parameters and properties:

1. Relaxation time

Having compared the relaxation times it was found that the set with small average chaff lengths was the most flexible.

2. Creeping and retardation time

Following the comparison of retardation times for different samples the conclusion to be drawn is that the initial deformation is the most intensive for the shortest chaffs.

3. Maximum deformation

In the case of a set with a small average chaff length, the stabilization of the creeping process is achieved rapidly after the air is excluded: therefore maximum deformation is greater for longer chaff particles.
The above parameters are shown in Table 2. as the average of three measurements.

Table 2. Characteristic parameters for the deformation tests

Measurement	Average chop length /mm/	Retardation time /s/	Relaxation time /s/	Max deform. /mm/ load: 2,000N	Recoil /mm/ /load: 50N/
J 11	5.5	3.24	1106	147.8	6
J 12	11	3.38	675	165.3	4.5
J 13	14	3.43	603	165.1	5.83

4. Recoiling

Due to the relatively small load, no significant difference has been noted in the behaviour of chaff sets with different average lengths when comparing their recoil values.

The explanation for the above phenomena may be as follows:
Following the extraction of air, longer chaff particles are more prone to deformation and creeping, ie. they can retain their relative shapes with smathy accuracy, due to greater load and tension as well as damage done in the course of handling which follows chopping.

Naturally, further theoretical work and experimental research is required to prove the veracity of the above hypotheses. Undoubtedly, the methohodelogy described earlier can facilitate the quantification of significant properties of chaff in green feed.

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Akadémia Kiadó, Budapest

Test results of wheat harvesting procedure of two-height

DR. ISTVÁN SÖRÖS – SÁNDOR SALAMON
(Hungarian Institute of Agricultural Engineering, Gödöllő)

Based on results from a wheat harvesting procedure using two-height cutting, it is to be noted that the grain throughput of thrasher-harvester can be substantially improved as compared to traditional methods of harvesting and cutting. Ultimately, this may lead to fewer combine harvesters required to harvest grains. The new procedure can be especially useful in harvesting crops with long and straight stalks or whenever conditions conducive to two-height cutting and otherwise prevailent. Occasionally, straw generated as a result of two-height cutting would be smaller in volume and with shorter lengths.

As indicated by experience the rotary structure of the two-tier cutter is properly designed, although certain component parts, such as the chain drive and the air intake of the combine harvester's fan, would need some revamping. However, further instrumental and field tests and data would be required to enable final judgment about the wide-ranging applicability of the technology.

It has been noted during earlier combine harvester tests that changes in the cutting height have considerable influence on the throughput and volumetric performance of the thrasher-harvesters. Iterative tests with different types of combines have proved that increases in the cutting height increase the throughput of the machines, ie. machine load that goes with the allowable 1.5% threasher loss rises. This, however, is only one of the factors enable to capacity increase. Due to higher cutting height the increase in throughput manifests itself while harvesting crops with less straw and more grain. As a result of this dual effect, substantial increase can be expected in grain throughput due a rise in cutting height in threasher-harvesters.

Based on test results and our recommendations, MEZŐGÉP of Orosháza had twotier cutter tables designed by MEFI, then they had one unit manufactured both in 1986 and 1987 while in 1988 six units were produced for them to be added to the CLAAS DOMINATOR 106 thrasher-harvesters. A structural feature of the unit is that the original cutter table of the combine was retained and a rotary cutter device was installed between the back plate of the cutter table and the front wheels.
The crux of the principle of operation is that while the original cutter table is operating at a rather elevated height cutting off ears of grain, stalks left behind without ears are cut by the rotary cutter behind the cutter table and either arranged in windrows or spread before the front wheels of the combine harvester.

The cutter table has a built-in relief scanner, ie. irrespective of the actual height of the grain cutter table, it is always moving ahead at the pre-set cutter height, cutting off stalks.

When using the two-tier harvesting mode, the original cutter table can be run at an elevated height and it is to be lowered only so that it could cut off all ears /even the lowest ones/ with fair accuracy. Thus, the cutter table would cut off portions of the crop containing ears of grain and forward them into the thrasher-harvester . So, the machine and its thrasher unit has to cope with ears and short stalks only therefore the harvester can achieve a higher performance level.

Operation of the cutter table at appropriate heights is guaranteed by the automatic electro-hydro-mechanival height adjuster, designed by MEFI. The plastic threads across the full width of the cutter table bend backwards when they get in touch with stalks of grain. Their mechanical movement is transormed into electrical signals which are then amplified to drive the hydraulic work cylinders that lift up the cutter table.
So, the driver of the machine no longer has to adjust the height of the cutter table.
The two-tier cutter and the height adjuster can be switched off anytime /if the crop is lying on the ground/. In such cases, the original cutter table of the harvester can be used in traditional mode.
The objective of the experiment was, as has been described above, to define the rate of increases in throughput and grain volume capacity on the basis of field tests and the reduction in specific fuel consumption to be achieved with the two-tier harvesting method. Using extended and strict operational tests, answers were to be found to the question to what extent field test results are reproducible under different conditions of operation.

In 1988, two units of the equipment manufactured by MEZŐGÉP of Orosháza were run at the "Dózsa" Agricultural Co-op of Orosháza, while another four were run at the "Széchenyi" Agricultural CO-op of Csanádapáca. Comparitive field tests were conducted with one of the units at the "Dózsa" Agricultural Co-op of Orosháza during which one patch of wheat was harvested with the combine, s original cutter table used in its traditional mode of operation, while in a next patch the two-tier cutter mode was operated and the results were also measured. Using the data obtained, we have calculated the characteristic curves for the thrasher loss in both modes of operation.

The tests were conducted, in a flat plot under GK Zombor wheat with straight stalks that was free from weeds and produced a yield of 8.3 tons per hectare with a 13.7% and 37.5% moisture content in grain and stalks, respectively. Traditional test methods and instruments have been used which are customary in combine harvester tests. Figure 1 displays the two most important characteristics of the crop: the height of ears and their density as well as the cutting heights used in the two modes of operation.

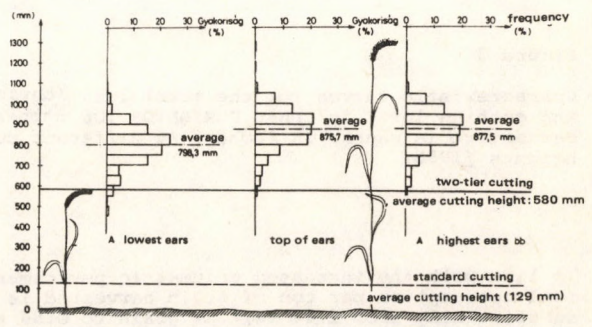

Figure 1
The range of ear heights and cutting heights applied

Characteristic curves for the threasher losses in the two modes of operation are shown in Figure 2. In these two modes, however, thrasher loss has been plotted not only as a function of machine load but as the function of grain load as well, taking into account materials with different compositions and grain volumes expressed in percentage. As indicated in the figure, throughput rose by 88% from 10.2 kg/s to 19.2 kg/s, whereas grain throughput and volumetric performance rose by 16% from 4.4 kg/s to 11.5 kg/s. Such substantial rises in volumetric performance can, of course, be achieved only if the crop to be harvested has absulutely favourable properties from the point of view of harvesting.

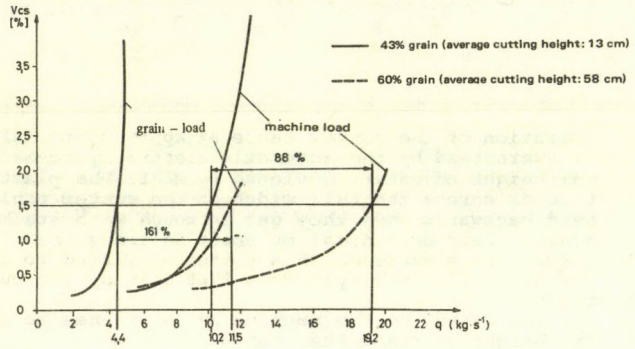

Figure 2

Characteristic curves of threasher loss in wheat for the CLAAS DOMINATOR 106 combine-harvester as a function of grain load and machine load

If not only the thrasher loss is analysed, but the cutting loss is also added and grain throughput is began to be analysed from a 2% loss level upwards, it is found that increases in performance are somewhat more moderate since there is a bigger change for uncut ears to be left in the field because of the higher cutting level. However, even if the thrasher and the cutting losses are taken together, there was an approximately 60% difference in capacities between the results of measurements achieved with the different cutting height.
/See Figure 3/

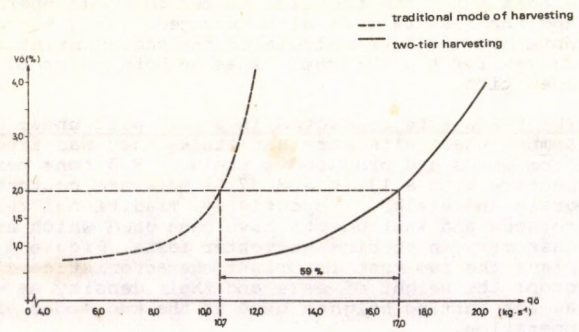

Figure 3

Characteristic curves for the total loss /thrasher and cutting loss/ in CLAAS DOMINATOR 106 combine harvesters in wheat /GK Zombor/ at different cutting heights /1988/

In line with the increased volumetric performance, fuel consumption per ton of grain harvested is cut substantially from 1.46 kg/t of grain to 0.86 kg/t of grain which implies an approximately 40% reduction.
/See Figure 4/

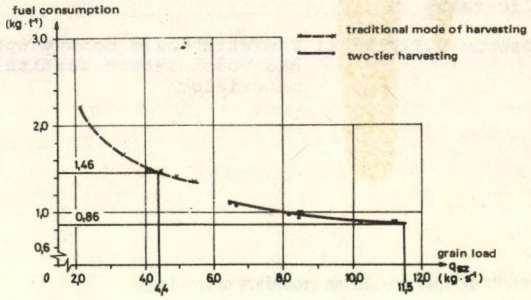

Figure 4

Specific fuel consumption of the CLAAS DOMINATOR 106 combine-harvester in wheat harvested at different cutting heights /1988/

This year strict and extended field tests have been conducted with units of machinery manufactured to define increases in volumetric capacity attainable under average farm conditions. The results obtained are considerably more modest than the ones obtained during field tests described above although they are still worth attention.

Figure 5 has been devised to chart operational performance data obtained with the same type of machinery under identical conditions in the two different modes of operation with a view to different time factors. The tests were conducted over a plot under MV-10 wheat which was free from weeds with mostly vertical stalks at an average length of 80 cm. Following traditional harvesting, stubble length was 10 cm, following the two-tier harvesting, stubble lenght was 13 cm while the cutting height of the cutter table was set at 40 cm. When calculated for base time, a 33% capacity increase could be achieved, when calculated for total service hours, the capacity increase was 26%.

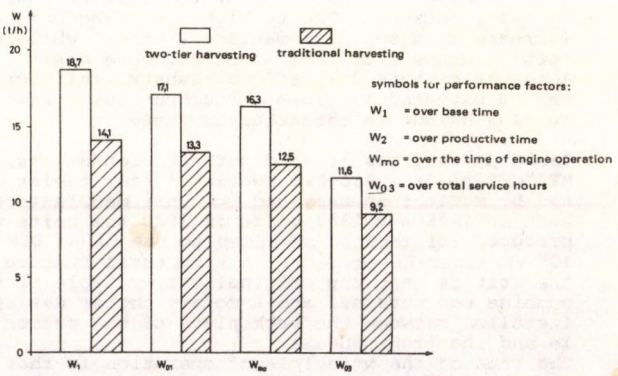

Figure 5

Comparison of the CLAAS DOMINATOR 106 combine-harvester performance data based on one day of operation /wheat harvest in 1988/

Figure 6 contains data and results for the extended and strict test period for several units of machinery used in different plots and under different harvesting conditions; for the two units such data are provided for comparison, s sake to enable analysis of performance over the total service time while for another two units data are provided for harvesting in the two-tier mode only. It is to be seen from the figure that in the case of one of the machines /no.2/ a 23% increase could be achieved in

capacity while in the case of another /No.7/ the comparable figure was almost 40% for the two-tier mode over the season, ie. the total period of grain harvest. As for the other two units of machinery, operated solely in the two-tier harvesting mode, performance was 6.5 and 10.4 t/h, respectively, of which the higher value should be given special attention, being approximately 30% over the average long-term performance of the type of machinery at issue.

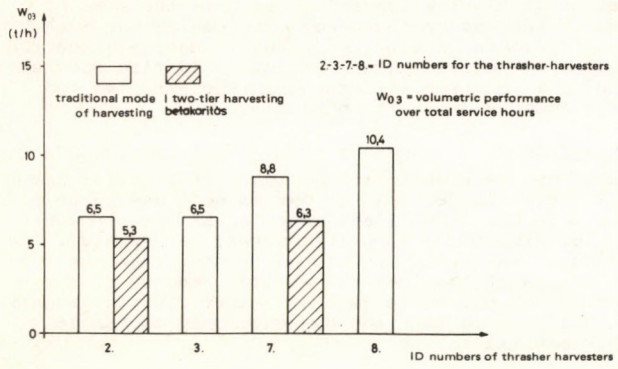

Figure 6

Comparison of CLAAS DOMINATOR 106 combine-harvesters, performance figures on the basis of a strict field test /wheat harvest in 1988/

Straw ist left-behind in windrows after the combine harvester even in the case of the two-tier harvesting mode, although the volume is somewhat lower as compared to the traditional mode of harvesting and straw lengths are much shorter. Analysing the chaff length of straw as a result of the two different modest of harvesting /Figure 7/ substantial differences can be noted between the two modes of harvesting which may be disadvantageous for bale production with large balers, considering binding, the stability of big bales, their handling and transportation as indicated by current experiences.

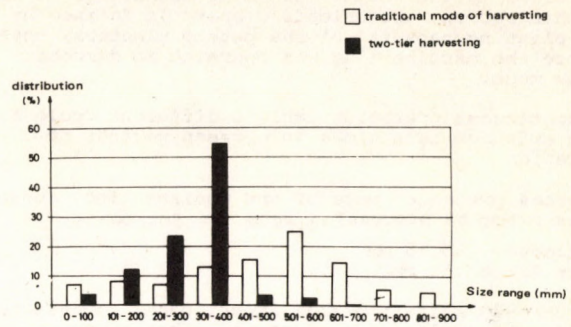

Figure 7

Percentage distribution of shop lengths at different cutting heights /1988/

Based on the results of the tests conducted up till now it is recommended that the two-tier harvesting technology be used with wheat primarily on plots with crops that have long and straight stalks and whenever the conditions conducive to two-tier cutting are prevailent.

As indicated by strict and extended field tests and the experiences gathered, the design of the rotary structure of the two-tier cutter is satisfactory although certain component parts, such as the chain drive and the air intake of the combine harvester's fan, would need some revamping.

For the purposes of a final assessment of the proposed technology's wide ranging application further instrumental and field tests are recommended with additional data collection.

Testing of front loaders for potatoes

DR. ZSOLT SZÜLE – DR. ISTVÁN SZÁSZ – DR. LÁSZLÓ FEKETE
(University of Agriculture, Gödöllő)

Summary

Tractor-operated and self-propelled front loaders are used to unload potatoes in a series of countries. Based on favourable experiences gathered abroad with front loaders, we have also set about testing a front-loader, type UNK-320 in unloading potatoes. Test results have indicated that damage to potatoes by the front loader is expected to be around 1% while the loading capacity may vary between 20-40 t/h subject to specific arrangements. Front loaders are recommended for use in warehouses with solid floors.

Background and the objectives of the tests

In some countries, like the two Germanies, front loaders are already in use for a while in unloading operations. Some farms in Hungary have also attempted to use front loaders despite the fact that neither work quality nor performance characteristics have been tested before. Now, tests have been conducted with a Type UNK-320 front loader. Work quality and performance features have been determined under operating conditions.

Test method and test conditions

In the course of the work quality analysis, damage to potatoes was measured by sorting out potatoes with slight, medium and heavy damage, using the criteria defined for seed potatoes /damage between 0-1.7 mm, 1.7-5.1 mm and over 5.1 mm, respectively/. Samples were taken at two points in the technological process between the two machine lines where damage to potatoes attributable to the front loader could be identified beyond doubt. The UNK-320 front loader, complete with its basic bucket, was forwarding potatoes from a temporary pile formed by the first unloading machine. /See Figure 1/

As regards performance characteristics, performance under standard time and total working time was calculated to define the overall utilisation of the bucket capacity and the lifting capacity of the front loader in loading potatoes.

The UNK-320 front loader was tested in April 1987 on the Béke Agricultural Co-operative of Kisláng. The front loader was used in the co-operative's

potato warehouse /nominal capacity: 5,000 tons/, installed in the potato unloading technological line. In this set-up, the unloading speed is defined by the planting capacity of the potato planters, therefore the machine line was operated in discontinuous mode.

Discontinuous operation implies different cycle times with extended idle times in between periods of operation.

Potatoes processed were of the Desiree kind. Average sizes prior to processing were the following:

- diameter: 53.15 mm
- length: 83.10 mm.

The UNK-320 self-propelled front loader is designed to load agricultural produce and other commodities with its diverse working implements. The major components of the machine include the front and rear articulated undercarriage, the front and the rear axles with the wheels, the drive engine to propel the running gear, the loading boom, the hydraulic system and the electronic components. The boom is lifted by the two double-operated hydraulic cylinders while the implements are tilted with a double-operated work cylinder. While being lifted, the implements are maintained in a fixed position by a mechanism, parallel with the lifting direction. The power source for the machine is a 6-cylinder turbo diesel-engine. The operator's cabin is located in the middle of the machine. The useful loading capacity of the machine is 3,570 kg, the capacity of the basic bucket is 1.6 cu.m.

Test results and conclusions

The capacity of the UNK-320 front loader was compared to the traditional manual potato unloading operation. A cricial difference was noted between the two operations in that performance in the manual operation was W_1= 11.6 t/h while the performance of the front loader was W_1=24.19 t/h over standard time. Performance over the total working time reflected similar differences:
W_{O3} = 7.54 t/h for the manual operation and W_{O3} = 20.16 t/h for the front loader, respectively. The highest performance over the cycle time was 40.32 t/h which equals the capacity of the front loader under the given arrangement.

When assessing work quality, damage to potatoes was measured. Heavy damage in the course of the manual operation was found to be at 3.75%, while that with the front loader was found to be at 1.1%. Damage to potatoes was caused by the loading bucket and the running gear as observed.

The lower rim of the bucket pushed into the potato pile may cause damage if the operator fails to lower the bucket in time or if the bucket is battered and worn out. The side rims of the bucket may cause damage only if they are sharp or have protruding sections or if the bucket is pushed in and removed at high speeds.

The rubber tyres, complete with air tubes, may trample down potatoes rolling off the pile if the operator fails to lower the bucket in time. Another solution may be offered by the method used at times on the BÉKE Co-operative of Kisláng when a farm handworker ng with a clearing roll, cleared away potatoes from the area in front of the pile. The specific labour requirement of the whole operation is be only a third of the all-out manual operation, even if an unskilled labourer is employed as cleaner.

The utilisation of the useful lifting capacity of the front loader /3,570 kg/ with its original bucket is at 37.6% which indicates that the size of the bucket may be increased. Increasing the bucket size would result in reductions in damage since the volume of potatoes moved around would rise substantially with a small increase in the surfaces and rims causing damage to potatoes.

Evaluation

Based on the results of the tests it is to be noted that front loaders can be put to good use in unloading potetoes from piles. they can be used in warehouses with solid floors /concrete or asphalt/. The width of the bucket should be greater than the track clearance of the loader's wheels. Because of lower density in potatoe piles, a greater capacity bucket should be used than the one developed to handle bulk materials.

In order to reduce damage rates, the lower rim of the bucket should be faultless, moving horizontally when pushed into the pile but slanted when withdrawn; the sides of the bucked should be rounded off. The latter requirement can be met by welding on a piece of pipe or steel rod.

Recommendations

Based on the above results, tractor-operated and selfpropelled front loaders are recommended for use in unloading potatoes.

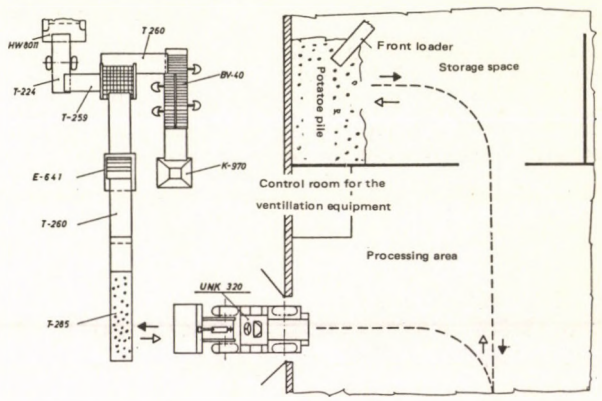

Figure 1

The process of operation of the loader Type UNK-320

Technological model for the mechanisation of apple production

SÁNDOR VELICH – MRS. ERZSÉBET GOMBOS-SZÁKÁLY – LÁSZLÓ FARKAS
(Hungarian Institute of Agricultural Engineering, Gödöllő)

History and objectives

For the purposes of the apple production technology, the closed-system approach implies the annual equilibrium between manual labour and machine utilisation. In today's technology, based on manual harvesting, the total labour requirement in the autumn peak is ten times higher than the annual average which is an unmanagable rate under conditions of large-scale production especially with regard to growing qualitative requirements. Taking into account experiences from organisational forms designed to boost incentives to individuals, different solutions to mechanisation need to be elaborated that may facilitate greater productivity for skilled labour and increase safety of harvesting.

Agrotechnological and mechanisation developments in pruning and crown formation indicate that no substantial savings can be expected in these activities. Efficiency increases offered by new forms of crowns,

such as the 25-35% facilitated by appel "curtains" must be regarded as the upper limit. Consequently, when planning labour requirements for harvesting, that for pruning and crown development was regarded as the reference point.

Evidently, the task is to come up with a balanced labour requirement. the question, however, is whether the maintenance of current levels of machine utilisation could be taken to be a realistic objective once machines are to be substituted for manual labour.

Applied methods

Following the definition of development requirements model design and implementation, necessary modifications were effected after farm experiments. In most of the cases, manufacturers of machinery and equipment were also involved in the process. Above and beyond the standard analysis of expenditures, changes in fruit quality were monitored with a custom-designed computer software.

Test results

The most important new element, designed for our purpose, is the Type GSA-B apple harvester suitable for continual operation. As a result of the continuous mode of operation, the equipment can harvest apples from 200 trees per hour on average by using vibration. Fruits, shaken off from the trees, are loaded into trailers moving alongside with a conveyor.

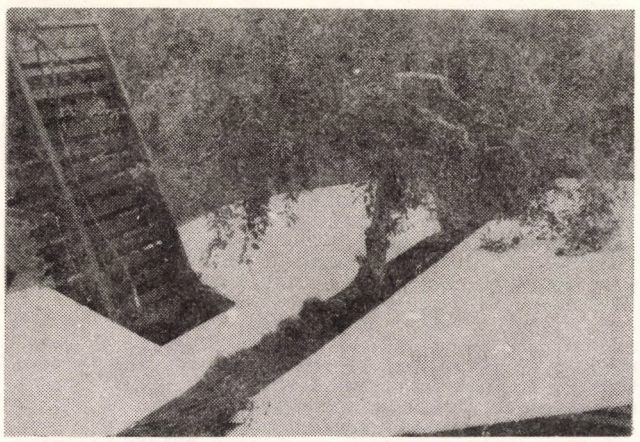

Figure 1 Continuous apple harvester, Type GSA

Apples within the total crop, suitable either for exports or for local consumption, account for 10% and 40% respectively, while about 50% of the total crop is suitable for industrial processing only.

The Type IKC-1.2 container transporter picks up containers from the ground while moving continuously in one direction. Soft unloading is guaranteed by the same device. For the purposes of the proposed technology a 100 ha plantation requires 0.6 units of the equipment.

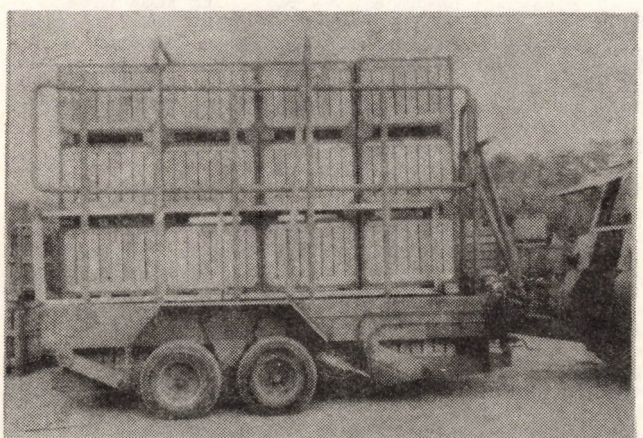

Figure 2 The Type ÖPK-5.6 self-loading fruit transporting trailer

The Type ÖPK-5.6 truck with automatic loader picks up containers placed on pick-up beams in advance and unloads them on same at their destination. In transit, containers are fixed by mechanical elements. For a 100 ha plantation the number of machines required is 0.2-0.3 for a transport distance between 2-8 kms. /Figure 2/. If the process of container removal from the rows of trees and their transportaion is regarded as one comprehensive operation, a combination of machines can be designed and selected providing the highest capacity in view of the distance between the actual plantation and the processing site.
/Figure 3/

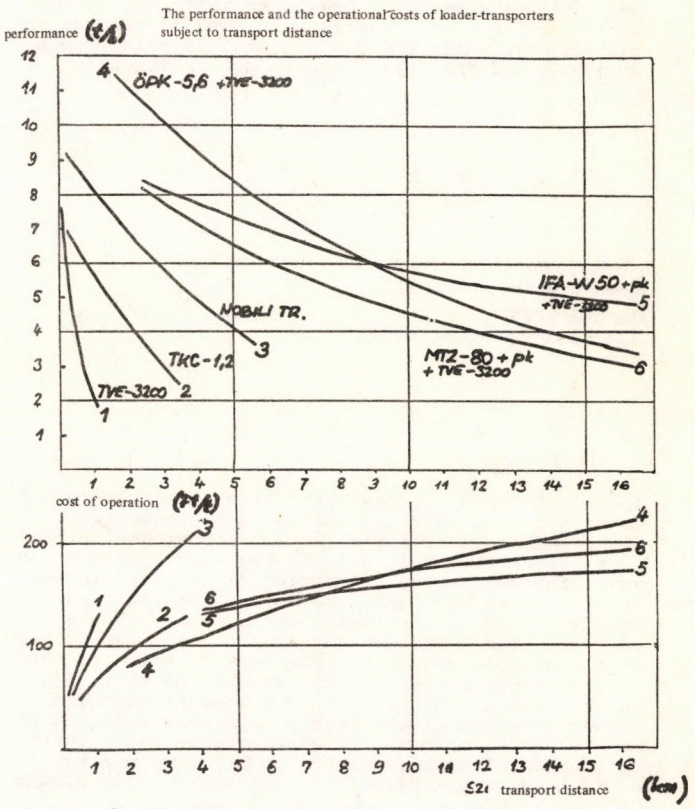

Figure 3 Changes in capacities and unit costs of fruit loading and transporting vehicles subject to transport distance

Considering the costs of operation, the results of the selection are the same as above which also proves that operational systems were correctly chosen. While it is justified to use identical machines /both/ for the in-row and the plantation/processing site transport operations within 2-3 kms, the two phases should evidently be treated separately if the distances are greater. Under such conditions, fork lifts removing containers from the rows of trees can be used to arrange containers into blocks and to load trucks directly. Here, the use of self-loading trucks is absolutely expedient since containers may be arranged in blocks even in the absence of transport vehicles and there is no need for formal harmonisation of transport equipment as regards their capacities and utilisation over time.

Incremental costs spent on the development of new containers, built around a metal frame, is recovered in about 3 years as a result of improved fruit quality through better protection.

A storage structure has been developed for the apple containers which can be sunk in the ground and is complete with natural ventilation.

For the purposes of developing the manipulation technology, a cost-effective machine has been developed which is adapted to current requirements and which processes apples softly.

Evaluation

The model technology, comprising the new harvesting elements is based on the assumption that crops harvested manually are transferred directly to the storage facilities while crops harvested with machines are processed through the pre-sorting section of the processing line to sort out an average of 50% for immediate consumption to be manipulated directly. The manipulation line can cope with apples in containers removed from the warehouse in spring for packaging.

The value of fruits thus harvested is not significantly lower as compared to the value of fruits harvested manually. This is due to the fact that the aggregate value of fruits manually harvested deteriorates significantly with a shift towards full harvesting, while the quality of industrial goods improves and harvesting losses are practically negligible. The adjustable rate of manual preharvesting in fact depends on actual sales opportunities.

Recommendations

Under a harvesting technology with a closed-system approach, manual pre-harvesting is recommended up to 30-50% of the total crop, with mechanical harvesting for the rest, ie. 50-70%. Preliminary manual harvesting should be used for the crop portion accessible from the ground. As a result, productivity is 35-40% higher as against that of full manual harvest. Fruits manually harvested in this manner can satisfy the most exacting export requirements and the 70-80% reduction in labour requirements is also worth while.

Computerized monitoring system was used for the evaluation of the technological model when it was introduced as a reference experiment.

The significance of hoof treatment and its economic impact on large scale beef production

DR. LAJOS PÉK
(University of Agriculture, Gödöllő)

Considering today's beef production technologies it is safe to say that profitable beef production is unimaginable without regular and proper hoof treatment for cattle. This entails two hoof treatments a year, the continuous monitoring of legs and intervention, treatment and cure as soon as required. When visiting cattle farms, one can see especially in units with fixed keeping systems that due to environmental factors and the lack of exercise the rate of limping cattle with leasions on their legs may be as high 20% or over. The lack of exercise causes deseases of the legs not only as a result of physiological effects, it also hinders early identification of limpness since such status can be noted only if the beasts are allowed to walk around.

Investigations with respect to the prevention of damage to legs led to research into stable floors, the mechanical and tensile strength of hooves and a review of hoof treatment methods which was conducted either under laboratory or on-farm conditions.

Floor tests have shown that there is no such thing as a perfect floor since it is expected to satisfy extreme requirements: they are not supposed to be abrasive, but they should not be slippery; they should be solid and resistant to wear and tear but they should not be hard; they should have a warm surface but should be easy to clean, etc. All these requirements cannot be met at the same time. It is especially typical for large cattle farms that the floor satisfies technological requirements/solid, resistant to wear, easy to clean/ instead of the animals' needs /flexible, not stongly abrasive, not slippery/ Thus, the most wide-spread variety is the concrete floor without bedding which is far too hard, rigid, abrasive and cold for the animals.

The mechanical and tensile strengt tests of different cattle breeds and sheep have shown that the hooves of high yielding breeds /such as the Holstein-Friesian/ are 40-50% less strong than other, traditional breeds' /sech as the Hungarian fleckered or the Costroma cattle/.

The properties measured /such as hardness, shearing strenth, resistance to dynamic impact and abrasion/ may substantially differ within the same breed as well /by as much as 80-120%/ when comparing data measured in highly soaked and dry hooves. When dry, horn is hard and resistant to abrasion although it is more rigid and more prone to breakage that wet horn would be. Therefore it has favourable as well as unfavourable properties both conditions.
With a view to the fact, however, that insufficient wear of hooves is just as bad as excessive ab raison, because of overgrowth or resultant injuries respectively, it must be evident that this riddle cannot be solved by improving the characteristic of the floor or those of the hooves alone. The only right solution could come from striking a proper balance between the growth and abraison of the hooves. This can be achieved by active intervention, by regular and proper hoof treatment, ie. by cutting off overgrown hoof sections on the one hand and by cleaning away, disinfecting and treating overworn and broken hooves on the other hand.
Findings from tests have shown that hooves must be treated twice a year even under optimum conditions. This job can be performed by people who are properly qualified and equipped with appropriate tools since unprofessional meddling would be just as detrimental to the animals thereby causing limpness as the omission of such treatment.
Hoof treatment methods have failed to keep pace with the development of cattle production. The tools available are still traditional like pairs of scissors, cutting pliers, knives, horn files as well as the traves to hinder the movement of animals. So long as the herd size is small, these traditional tools are suitable to guarantee proper quality of treatment, although substantial physical strength required to use them. If the herd is large, or hoof treatment is undertaken by a group of people as a professional pursuit or as jobwork, it would mean hard, exhausting physical labour which may be somewhat dangerous with bulky cattle. That is why a fairly versatile trave has been developed, which is easy to move /as shown is Figure 1/ together with a hydraulic hoof cutter that spares the operator hard labour /as shown is Figure 2/. These tools cost more than the traditional ones/ the hydraulic cutter and its power supply unit cost 15 to 20 times more than a simple pair of hoof scissors but its payback time would be just 1,5-2 years with continuous operation as our calculations have indicated.

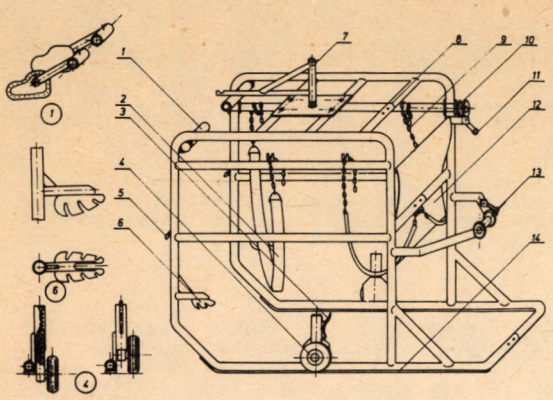

Figure 1
General-purpose, mobile trave

1. head binder
2. breast band
3. Wheel poke
4. wheel
5. peg for the front binding chain
6. front leg binder
7. tool suspension lever
8. assempbly point for the device
9. shank band
10. lever with block drive
11. block drive arm
12. protective rubber plate
13. hind leg binder
14. sliding platform

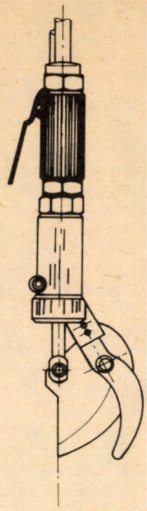

Figure 2
Hydraulic hoof cutter

Usually, farm regard the omission of hoof treatment as saving on costs but they forget that the damage done exceeds such savings many times over. Investigations have shown that a 2-4 cm overgrowth of hooves may result in a daily milk loss of 0-5-1,5 liters /q/ per cow. If the calving rate is assumed to be only 65% and the lactation period is taken to be 300 days /T_1/, the annual milk loss /$o/_{-é}$ in the case of 500 dairy cows /L/ would be as follows:

$$O_{-é} = L \times T_e \times E \times q$$

$O_{-é}$= 97,500 /liters per annum/

The costs of such a loss is 5 to 8 times above the costs of proper hoof treatment. The above data refer to minor negligence in hoof treatment only. It is often noted on farms that overgrown hooves, resulting in limpness and hoof deformation, cause much greater damage through poor pregnancy rates, poor feed conversion and the costs of medical treatment and the culling of sick animals.
Test results have shown quite clearly that cattle production, especially under large-scale farm conditions, cannot be succesful without regular and proper hoof treatment which calls for the application of up-to-date tools and the training of specialists.

Hydrothermal processing of grains

DR. JENŐ CSERMELY – DR. SÁNDOR ENDRŐDI – GYŐZŐ FERENCI – – DR. MIHÁLY HERDOVICS
(Hungarian Institute of Agricultural Engineering, Gödöllő)

Summary

The treatment of feed components /eg: different kinds of grain, etc/ prior to feeding is necessitated in animal hunsbandry in order to ensure complete deceomposition in the animals' digestive tracts as well as to impede their poisonous and feed convension blocking effects at least in some cases /eg: soya/. Under the hydrothermal grain processing issue, the Bocchi grain flaking technology, the MONEX 75/700 extruder and the Roast-A-Tron grain roaster were tested.
The Bocchi LF 25/50 E equipment /made in Italy/ is suitable for the hydrothermal and mechanical treatment of different kinds of grain. The ecuipment uses hot steam to treat soya beans which are then flaked in a mill and cooled.
The equipment comprises three major components:

1. the component comprises the boiler and steam feeding as well as the pre-cooking and the follow-up cooking units,
2. a ventilation system discharging residual steam and flue gases from the boiler, and the mill,
3. a band-type dryer and cooling system with a steam/air heat exhanger.

For the purposes of the hydrothermal treatment, the boiler produces overheated steam at 120-125°C and at a pressure of 0.8-1 bar. The grain is warmed up and moistened in the 5.2 cu.m pre-cooking tank. Then, grain is forwarded into the three-phase auger-type cooking chamber. Cooking time and the length of heat treatment can be controlled by adjusting the RPM of the mixing and forwarding augers and by adjusting the steam feeding mechanical treatment, that follows hydrothermal treatment, is effected by the L700 R.O. mill. The flaked finished products is cooled to the desirable temperature in a band-type cooler unit.

The MONEX 75/700 extruder /by the Monor State Farm/ treats grains directly with a dary process using the socalled extrusion method by pressing grains through a grinding disk.
Most of the thermal impact is produced when the grains pass through the narrow pressing channel as a result of the friction generated by the passage through the grinding disks and the reducing rings. This thermal impact is supplemented by the thermal capacity of the press head at the end of the press channel that may be heated electrically.

The Roast-A-Tron roaster /MIX-MILL-BLUFFTO, USA/

treats grain with direct heating, using the so-called dry thermal procedure. The major elements of the treatments of the equipment include the following:

- grain clearing unit,
- grain hopper and feed chamber,
- roasting chamber.

Grain enters the grain cleaner located at the top of the equipment in which larger grains of contamination as well as small broken bits and dust is filtered out. The grain is forwarded into the roating chamber via a multi-grade feeding auger. The required thermal impact can be achieved and controlled by adjusting the time the grain spends in the chamber. Another approach is to control the volume of the grain fed into the chamber. In the chamber, grains are moved and mixed by a cell-type rotary cylinder with a longitudinal axle. The roating chamber has a 3% slope. The burner of the furnace is located directly above the cell-type cylinder, thus the heat of the flame affects grains dirctly. The fan of the furnace and all other structural elements /such as the solenoid valves, etc/ are installed into the end-wall of the equipment. The equipment may be fired either with PB gas or with natural gas.

History /Objectives/

The objective of the tests was to define the performance, the work quality and the energy parameters of the equipment as well as the different hydrothermal treatment technologies, together with nutritive and feed conversion characteristics of the end products churned out with the equipment.

Description of the test methods

In order to define the technological parameters of the three hydrothermal treating technologies, their throughput and electricity and thermal energy consumption were measured. Traditional methods were used to identify the physical properties of the base materials and the finished products. The results of the heat treatment were defined by using the TI-Test. Also, nutritional and feedding experiments were conducted to find out about the feed conversion values of the feeds thus treated.

Description of test results

The major test results of the different technologies are listed in Table 1 below.

Technology	Type of grain	Throughput th^{-1}	Gas utilization m^3t^{-1}	Average specific energy consumption $kWht^{-1}$
BOCCHI	horse beans	2.57	12.6	13.2
LF 25/50 E	soya	1.68	27.8	17.0
	corn	2.3	16.6	20.4
	wheat	2.29	18.9	21.5
	peas	2.3	19.8	18.5
MONEX	soya	0.82-1.0	-	81.7
	corn	0.69	-	114.0
	corn germs	0.9	-	83.3
ROAST-A-TRON	soya	0.17-0.26	17.7-27.1	4.5

The BOCCHI flaking equipment used an average of 16.3 m^3t^{-1} of natural gas when processing horse beans at a capacity of 2.4-2.7 th^{-1} of natural gas at a throughput of 1.4-2.2 th^{-1}. When subjecting corn, wheat and peas to hydrothermal treatment, a rather similar mode of operation can be applied at a throughput of 1.9-3.0 th^{-1}. Gas utilisation varies between 16.6-19.8 m^3t^{-1} of such processing operations. The specific electricity consumption of the equipment varies between 13.2-21.5 $kWht^{-1}$ subject to the type of grain to be processed.

The MONEX extruder is suitable primarily for soya processing. When doing so, the capacity of the unit was found to be between 0.82-1.02 th^{-1}. A good toasting effect was noted at a throughout of 0.91 th^{-1} and at material temperatures over 137°C after extrusion. In such cases the urease activity fell below 0.1 $mgNg^{-1}$.

When firing the Roat-A-Tron with natural gas, the throughput in soya processing was found to be 0.17-0.26 th^{-1} if the grain temperature was 110-120°C and gas utilisation was 4.3-4.9 m^3h^{-1}.

Evaluation

The BOCCHI grain flaking equipment is especially suitable for the hydrothermal and mechanical processing of different kinds of grain.
Both the feed tests and the feeding tests, conducted by the Mosonmagyaróvár Faculty of the University of Agriculture, Keszthely /KATE/, support the favourable impact of the hydrothermal and mechanical treatment on feed conversion. The tests have shown that approximately 10% incremental results can be achieved when using heat treated feed with broilers.

The MONEX technology is still under development. Following improvements in the operating characteristics of the equipment and certain minor changes in the construction, 6 units of the "0" series of the equipment have been completed. Certain ancillary units of the process equipment /such as the cooler, the various extrusion heads/ are still being developed. Based on the findings it is noted here that the MONEX 75/700 extruder is appropriate for soya processing.

Deficiencies in production technology are to be phased out, the automatic control of heating is to be improved, and it would be experient to find a solution for metering the material's temperature.

The Rost-A-Tron technology is being adapted in Hungary. Based on extensive experiences in the US and local results, the equipment can be used to the advantage of smaller farms in treating soya to inactivate the tripsine inhabitor as well as to heat-treat other grains in order to facilitate better digestion. It is favourable from a storage point of view that treatment is administered while feed is in grain form.

Recommendations

As a result of our tests it is was found that the different hydrothermal procedures are suitable for the hydrothermal and the thermal treatment of different kinds of grain, primarily soya. As a result of such treatment, feed conversion is improved. Due to fluctuations in the quality of base materials and to ensure safe treatment, increased attention should be paid to the fine adjustment of the equipment, especially in the case of soya.

Every one of the units should be operated in keeping with the results of the control tests conducted with the types of feed in the laboratory. Howver, decision about the application of the technologies mentioned above is made after due consideration given to farm needs, investment opportunities and going feed prices.

Developing a feeding technology for sows combined with identification

SÁNDOR TIKOS (FARMTECH Kft.)
DR. LÁSZLÓ TÓTH (Hungarian Institute of Agricultural, Gödöllő)
DR. JÓZSEF REIBLING (Agricultural Corporation of Szekszárd)

Summary

A feeding technology has been developed for pig producers as well that uses a computerized pig identification system. Based on international and local experiences, the Hungarian Institute of Agricultural Engineering has initiated the development of a Hungarian experimental system.
When testing the Weda feeding stations under Hungarian conditions, it was found that 0.3 kg of feed could have been saved every day as compared to other, traditional sow feeding technologies.
The feeding stations are manufactured by the Agricultural Corporation of Szekszárd using the designs made by FARMTECH Kft. All electronic component parts have been designed and installed by the Hungarian Institute of Agricultural Engineering. The feeding technology based upon sow identification can be used advantegeously on large-scale pig farms and after reconstruction but it may prove to be a highly rational option even for small-scale and medium-sized farms as well.

History /objectives/

One of the biggest worries for large-scale pig farm operators these days is to guarantee proper feeding for large numbers of sows. On most farms, using group housing, it is impossible to provide feeding as required due to differences in the body weight, feeding speed, agressivity and "seniority" of sows. The initial idea for the introduction of a pig feeding technology,using a computer-controlled identification system, sprang from a similar procedure already introduced in cattle production. having realized the tempting opportunities offered by such a novel technology, the National Institute of Agricultural Engineering has launched a project to work the technological conditions required for local adaptation. As soon as the Agricultural Corporation of Szekszárd was persuaded to have a hand in the development project, a co-operation contract was made with the ultimate objektive to produce and make available, as early as in 1989, both local equipment and technology, mature enough to be put into serial production.

Descriptions of test results

Under the development project, we had an opportunity to review foreign units of equipment. We could monitor Alfa-Laval, Big-Durchman, Gascoigne-Melotte and Weda sow feeding stations in operation.

We have used a number of foreign publications, relevant to our selected theme, concentrating mostly on those documents that contain comparisons from a technological and zoo-technical point of view. We had the opportunity to test one such unit under normal farm conditions at one of Hungary's pig farms. Based on the information thus gathered, we have produced the blueprints for a truly Hungarian unit of equipment, having selected options we deemed useful.

Descriptions of test methods

Generalized experiences can be sumed up as follows, in our view.
The following major component parts are required for the operation of a computercontrolled feeding technology, using date retrieval by sow:

- feeding station,
- devices for sow identification, and
- central c ontrolling unit.

Varieties of equipment and different arrangements for feeding stations are offered today by more than 30 companies. A common feature for all designs is that the feeding stations appear to be cages. The "reverse-gear" feeding station has an entry/exit gate at its back which was produced by adding a bare minimum of modifications to feeding stations designed for cows.

The "drive-through" feeding station has become customary by today. In some designs the feeding trough is located opposite the entrance. The exit is located either on one side or at a 45° angle. If more than one feeding station is installed, the feeding trough is mounted on one side instead of being at the opposite end of the station, thereby offering a fair chance to the sow to get out of the feeding station as soon as feeding is over.

In some designs of feeding stations, exit is possible on two sides: the feeding through at the opposite and of the feeding station can be rotated at an 80° angle which defines for the sow which way to take out of the feeding station. If the feeding station has only one exit facility, a swinging gate is incorporated to cater for selection functions. As regards the construction of the entrances to feeding stations, quite a number of technological solutions have been tested. Closing of entrances with pneumatic work cylinders is the norm. Also, downward mowing gates, along with gates that swing around either horizontally or vertically can also be seen, both with a single-wing and a double-wing design. It is characteristic for almost all types of feeding stations that subsequent sows must crowd out animals occupying the feeding station. Usually, dry feed is dumped into the feeding troughs by controlling the revolution time of the feed distributor auger which, ultimately, implies distribution based on volume, The auger completes a revolution in 40-50 seconds over which approximately loo g of feed is discharged into the feeding trough. In a number of feeding stations dry feed can be moistened by adding water to it with the use of a magnetic valve. As indicated by experiences and findings, this helps shorten the time a sow would spend in the feeding station.

Currently, there are three automatic methods available for sow identification. One of them is the opto-electronic method that has not been tested as yet. The devices used in the process of identification include a computer - controlled video-camera and an activation code, copied to the pictures in the film.

The most wide-spread method is using trasponders as in dairy production which means that a passive transmitter /transponder/ is used to identify the animals, the device is attached to a neck band or some kind of a textile band. The transponder itself is mounted in a plastic box. It is called a passive transmitter since no electricity source is attached to it. Identification can, of course, be effected with an active transmitter as well. The transmitter can be installed into ear tags or neck bands. Transmiters put ito ear tags do not hinder the movement of the animals. Their only disadvantage is that they fall off and get lost easily. The battery in the transmitter is good enough for approximately 10.000 hours to supply elextricity. Electricity is consumed by the system only in the identification phase.

The central controlling unit is there to cope with control and data processing functions. The memory capacity of the most recent units allows for programs to be run that are big enough to handle as many as 1.000 sows.

In order to launch co-operation with the Agricultural Corporation of Szekszárd a Weda-Lugmair feeding station was put on stream. The feeding station comprises the feeding box, the entry and exit gates, the feeding trough, the receiving aerial, the feed tank, the signal lamp and claxon as well as the pneumatic units that drive the gates. The active transmitter and the decoder is installed in the plastic containers in the ear tags of the sows.

No. of animals by feeding station: 40
No. of feeding cycles: 2
Length of feeding cycles: 5-11.58 and 10.02-20.00
Feed portions to be issued can be varied between 1.2 and 1.8 kg.
Basic delivery by the feed distributor auger: 12 kg per hour.

Daily feed portions are given to the sows in equal amounts in two feeding cycles. Most sows claimed their portions while entering the feding station only once in a cycle /over 11 minutes on average/.

Feed residue was noted in 10% of the sows, peaking at 8-9 kg for only one sow.

Feeding time over one cycle: 6-7 hours.
Pig identification has a 100% accuracy. Deviation from the pre-set program occured only if there was a power cut on the farm, following repeated start-up of operation
Deviation in feed portions was +-1% on average if compared to the pre-set values.
Feed spill along the feeding trough was 0,6 kg per unit over a month,s period following the distribution of 4 tons of feed.

Evaulation

Based on experiences and as compared to traditional sow feeding technologies, approximately 0.3 kg of feed can be saved per sow per day with the new technology. The sows' health status has improved: progeny has become more even in quality, aggressivity has fallen, the animals in one group may number between 100 to 200: the daily program has become more precise, the health status of the animals can be checked by using remnants from feed: there is no need for extra labour. However there are still quite a number of things to be clarified by researchers with respect to technological details and etological aspects. Nevertheless, it is beyond doubt that the method will revolutionize pig production, considering the whole of the technology.
Based on the above, a set of equipment has been designed in Hungary. The blueprints have been produced by FARMTECH Kft, a small firm attached to the Institute. The experimental units are being commissioned now.

Recommendations

The new method allows for greater freedom of the sows and offers an opportunity to individual handling and feeding.
Further improvement can be achieved by incorporating identification systems into the design facilitating sow selection at the gates. From the farrowing boxes, free entry can be provided for the sows thereby providing for their feeding. The sows will also be allowed to visit the boar's box which would help define the time of heat.

Feeding technology based upon sow identification is recommended to be introduced both on large-scale and small-scale farms.

Testing for normality of the tractive resistance of ploughs

BÉLA BORSA (Hungarian Institute of Agricultural Engineering, Gödöllő)

Summary

This paper is concerned with the random changes in ploughs' drawbar pull requirements. Using different kinds of hypothesis tests, we have found that the tractive resistance of one single plough share has an abnormal distribution and logarithmically normal distribution can be used for approximation. To define the drawbar pull requirement distribution for the whole plough, the normal distribution for the whole plough, the normal distribution can be used for approximation in the case of a plough with at least four plough shares. So, these results can serve as a starting point primarily for stressing.

History and objectives

A controlled assumption is often made in practive that the phenomenon analysed is a random one. In agricultural measuring practice, examples include the normal distribution of drawbar pull and drive torque, or otherwise.

G. Getzlaff /1,2/ has conducted such tests with the drawbar pull requirements of ploughs. Based on his measurements with plough shares, he found that the drawbar pull distribution is close to normal. W. Söhne et al. /3/ have arrived at similar results. The publications mentioned above did not rely on the hypothesis tests in a strict sense; they have drawn their conclusions on the basis of graphic tests and the shape of the frequency functions.

Building on the methodology of the hypothesis tests we have chosen as the objective of our tests to find out whether the distribution function of the drawbar pull process, considered to random and stationary for ploughs under operating conditions, is in conflict with the assumption that it can either be described or at least approximated with a normal distribution.

Test methods

When performing measurements, the random drawbar pull processes were assumed to be stationary and ergodic. The hypothesis tests were performed by using independent series of samples /6/. As for individual measurements the khi square, the Kolgomolov, the Geary and the moment tests /4/ were performed.

When drawing conclusions, results from the first two tests were evaluated with Lipták's "Z" test /4/, while in the case of the Geary and the moment tests deviation from the values expected from tests on the basis of statistics were analysed with the "t" test. Tests were conducted under farm conditions with different combinations of tractors and ploughs. The ploughs had 4 006 plough bodies and were of a semi-suspended type. The total length of the tests, conducted all over the country, is around 50 kms.

Test results

Tests by plough share

The data in Table 1 about normalcy indicate that the singlepeak right-skewed empirical distribution function cannot be approximated with a normal distribution. Therefore the samples were checked to find out about the presence of logarithmically normal distribution based on the following considerations:

- under operating conditions there is no negative drawbar pull,
- the distribution has only one peak and is right-skewed, similar to the empirical distribution functions,
- our tests experiences indicate that the stressing of the plough bodies allows for the average drawbar pull requirement to occur many times over without rupture of the plough structure,

- in technical literature the log-normal distribution is recommended for the description of processes, interrelated with breaking chopping, grinding and weathering. Of course, there are cases in which ploughing is interpreted in this sense.

Table 1

The probability of resultant first-degree errors in the tests of plough body drawbar pull requirements

TEST	p	Normalcy sample no.	test no.	p	Log.normalcy sample no.	test no.
khi square	0.001	1467	10	0.083	1467	10
Kolmogorov	0.150	2405	22	0.409	2405	22
Geary	0.03	-	22	0.32	-	22
skew	0.001	-	22	0.62	-	22
flatness	0.006	-	22	0.25	-	22

Having performed the tests and their aggregation, the hypothesis of normal distribution had to be discarded at a level of 95%, and at a level of 99% in general, for one exception whereas the long-normal distribution could be maintained in the case of the five tests.

Test concerning the total drawbar pull requirements of ploughs

When measuring the drawbar pull requirements of whole ploughs, the resultant drawbar pull comprises the resistance of the ancillary elements as well /such as that of coulters and roller ploughs/. Based on the central limit distribution theorem it is expected that the distribution of the resultant drawbar pull requirement can be the better described with normal distribution the more components the resultant has.

The analysis of the frequency functions supported our assumption in that the tests hoover between the two types of distribution and judging by the size of the first-degree error, they tend towards normal distribution as opposed to log-normal distribution.

Table 2

The probability of the resultant first-degree errors in the tests of the whole plough's total drawbar pull requirements

TEST	p	Normalcy sample no.	test no.	p	Log.normalcy sample no.	test no.
khi square	0.064	1374	9	0.033	1374	9
Kolmogorov	0.714	3739	42	0.371	3739	42
Geary	0.06	-	42	0.03	-	42
skew	0.25	-	42	0.001	-	42
flatness	0.009	-	42	0.008	-	42

Evaluation

Our tests based on measurements conducted under farm conditions have produced the following results:

- the distribution of the drawbar pull distribution of plough bodies is not normal, it would be expedient to use a log-normal distribution to approximate it;
- for the purposes of approximating the distribution of the total drawbar pull of ploughs a normal distribution can be used in the case of ploughs with at least four plough bodies.

Recommendations

Based on the results of the tests, the following recommendations are made:

- for the purpose of stressing and checking ploughs, the lognormal distribution of drawbar pull requirements should be taken as the basis,
- the dynamic and stress appraisal of the tractor/plough connection should be based on the normal distribution of the drawbar pull requirement in the case of ploughs with at least four plough bodies,
- to describe the distribution of the greatest drawbar pull requirements on whole ploughs and plough bodies, which are rare but observable, the double-exponencial Frechet distribution should be used because of the exponential-type basic distribution /5,7/.

Presumably, regularities and findings in the case of ploughs will recur in the case of other tillage equipment with rigid tillage elements.

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Dynamic rheological tests

DR. ISTVÁN HUSZÁR – KÁROLY PETRÓCZKI
(University of Agriculture, Gödöllő)
DR. LÁSZLÓ FENYVESI
(Hungarian Institute of Agriculture Engineering, Gödöllő)

The relationship between load and deformation

The type of load. affecting the plant. defines the nature of the deformation as well. In the course of our tests we have concerned ourselves with periodic loads . As a result of periodic loads, the plants show periodic deformation. There is, however, a phase angle difference among the periodic signals /1/ which can be related to the rheological properties of the substances. Namely, in the case of a single-axis load, provided that the

$$\sigma = \sigma_o \sin \quad t$$

tension has a σ_o pulse height and a angular velocity, the function to be given as a response is

$$\varepsilon = \varepsilon_o \sin /\omega t - \sigma/$$

to describe the deformation.

Basically, stress analysis implies the definition of a deformation that arises as a result of pre-set load in the form of a function. Nevertheless, deformation arising as a result of cyclic loads with a constant pulse height and mean value would have a changing pulse height in general and the mean value would also change over time. The curves, received by inter connecting the maximum and the minimum points of the deformation function, would very much resemble the curve depicting creeping generated by a constant load as indicated by our tests as well, therefore it can be called dynamic creeping as well. /2/
The differential equation that describes the whole mechanical process is known from the technical literature /3/.

For the purposes of our tests we have made the assumption that plants can be characterized by the Poynting-Thomson material equation /4/ from a stress point of view. Load is applied to the object tested by a cylindrical pressure piston. The relationship between the force and the deformation can be described with the following differential equation /5/.

$$F = \frac{1}{\gamma} W + \gamma_o W - \Theta F$$

where:

W = deformation measured towards the pressure piston /mm/

γ_o = a factor to characterise flexibility /its value depends upon the diameter of the pressure piston /mm/N/,

λ_o = a factor to characterise creeping /Ns/mm/,

Θ = the relaxation factor /s/

The load is

$$F = A - A \cos \omega t$$

where:

A = the pulse height of the load /N/,
ω = the angular velocity of the load /s^{-1}/.

Therefore, the relationship between the force and the deformation in the case of the above load is the following:

$$W = b\frac{1}{a} /1-\exp/-at//+ \frac{r}{a^2 + \omega^2} \sin/\omega t+B/-\sin B \exp/-at/$$

if:

$$a = \frac{1}{\gamma_o \lambda_o}, \quad b = \frac{A}{\lambda_o}, \quad r = \sqrt{/a+\Theta\omega^2/^2 + /a\omega\Theta-\omega/^2},$$

$$tgB = \frac{a\omega\Theta - \omega}{a+\Theta\omega^2}$$

The shape of the enveloping curve:

$$W_{max} = b/K_1 - K_3 \exp/-at//,$$

$$W_{min} = b/K_2 - K_3 \exp/-at//.$$

where:

$$K_{1,2} = a^{-1} \mp r/a^2 + \omega^2/^{-1}$$

$$K_3 = a^{-1} + r/a^2 + \omega^2/^{-1} \sin B$$

With the expression received, both the difference in the phase angle and the changes in the extreme values can be described.
/Figure 1/

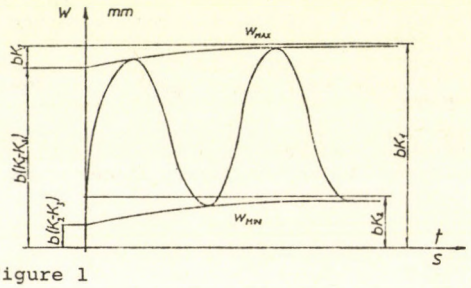

Figure 1

Variance in phase angle and the changer in extreme values

Description of the measuring device

The device designed for the purposes of the experiment is expected to generate loads as required and to measure the actural force and displacement as a function of time.

The major parameters of the device include the following:

+- 20N of force,
+- 5 mm of displacement over a frequency range of 0-50Hz.

Using the device, the following load patterns can be developed:

- square,
- triangular, and
- cosinus.

The maximum load value as well as the bias is adjustable. Loads may be single or periodic which allows for the generation of a load funcion required for static and dynamic measurements.

Materials to be tested are enbedded in gypsum prior to insertion into the device. This allows for materials to be supported evenly, over a large surface.

The diagram of the measuring device can be seen in Figure 2. A large capacity loudspeaker is used to generate the force. This functions as an electro-mechanical transformer, transforming electrical signals into force. Force is transmitted from the moving coil of the loudspeaker via a metal rod. The rod contains an electro-tenzometric force sensor and an inductive way tansmitter to measure force and deformation. The electromechanical transformer, the rod, the sensors and the materials to be tested are attached to a rigid frame. The electro-mechanical transformer is driven by computer-controlled performance amplifier. The sensors are connected to measuring amplifiers which are also linked up with the computer.

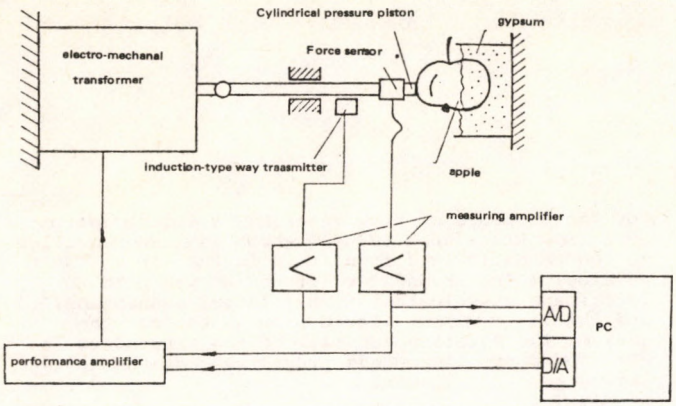

Figure 2

The circuit diagram of the measuring instrument

The signal of the required load and that of the actual /ie. measured/ load can be displayed on the computer monitor in any size. The data measured can be stored as necessary. The software can display data already stored in the computer's memory.

Results of the measuring operation

The tests were conducted with apples of the "Jonathan" variety. The load was administered via a piston which had a diameter of 3 mm. The test was performed at the median of the apple, at the stalk and at the sepals. Deformation measured at the stalk in the case of periodic loads with a sinus /a/, a triangular /b/ and a square pattern /c/, is shown in Figure 3. The frequency of the load was 0.5Hz, its pulse height was 10N, its time was 120 s.

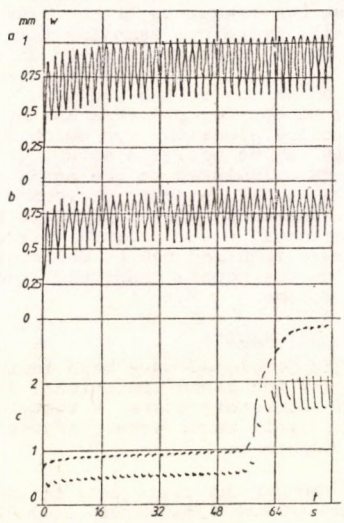

Figure 3

Characteristic dimensions of deformation

The curves plotted show the major characteristics of the deformation: the dynamic creeping, the deformation that corresponds to the load. In the case of the square pattern load, the skin of the apple was broken.

In our case no significant phase angle difference was measured between the load and the deformation. /Figure 4/ The test was conducted at a load frequency of 20Hz, with a load pulse height of 10N.

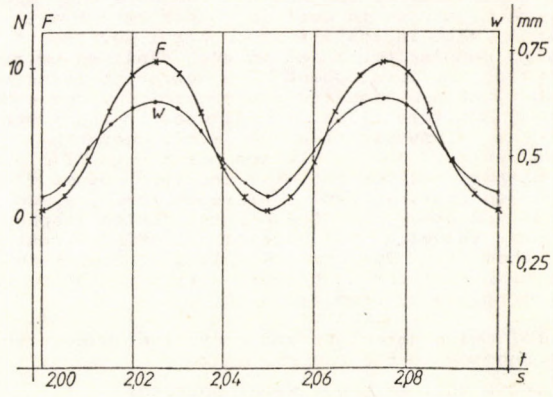

Figure 4

The interrelation between load and deformation

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Development and testing of liquid fertilizer control systems

LAJOS KOVÁCS – JÁNOS MIHÁLYI – LAJOS GAMBÁR
(Hungarian Institute of Agricultural Engineering, Gödöllő)

It is vital to use efficient and material-saving technologies for the distribution. The development, automation and instrumentation of plant protection machinery is effected in order to facilitate savings. When reviewing the subject one can note that machinery manufactured in western countries are all equipped with indicators and control devices of varying complexity. Based on such findings we are aiming at the development of a series of instruments, which contain diagnostic and control devices and display monitors alike. The diagnostic instrument measures volumetric flow /dm^3/min/, operating pressure /bar/ and revolution per minute /1/min/. The display monitor measures specific volume distributed /dm^3/ha/, operating pressure /bar/, speed /km/h/ and area /ha/. The control device displays the same values as the monitor and effects control over them, too. The control unit is the most important member of the instrument series therefore we will continue by discussing it.

The following detectors and control elements can be connected to the control unit:

- wheel signal emitter: metal detector
- flow meter: metal detector
- pressure detector: active or passive element
- control element: butterfly valve

In 1988 the instruments were tested under farm conditions. Three units of the equipment, complete with a display monitor, were used when distributing liquid fertilizers over about 4,500 ha and two units of the control device were used over an area of 4,000 ha. As from 1989, the equipment complete with control device is manufactured jointly with the Herceghalmi Pilot Farm. The investments are mounted on HUNIPER machines under the code name HUNITRONIK.

History and objectives

The objective is to develop instrument series comprising devices classified into three categories that can be used to meter and control parameters during pesticide and liquid fertilizer distribution. The instrument series comprise diagnostic and control devices as well as display monitors. Installation of instruments on pesticide and fertilizer distributor equipment was started several years ago in western countries. Assorted types can be found there starting from simple nomogram detectors through signaling equipment to control devices.

The following western comapnies are addressing these issues:

- LESTRADET AIRPAM
- HESSEL
- RDS
- DICKEY JOHN
- RAU, and so on.

Description of the control device

/Figure 1/

The HUNITRONIK control device operates on the basis of the double-metering principle, measuring both pressure and flow and effecting control as a result of the combined results.

Speed is measured by using the most appropriate method, relying on the revolutions by the hauled wheel via a drilled disk attached to the rotor and an inductive proximity switch attached to the stator.

Two types of pressure sensors can be used to measure pressure, either a semi-conductor sensor developed by MEV or a general-purpose pressure transducer manufactured by GANZ KMGY. In both cases, membrane-type liquid separation should be used.

For the purposes of flow metering, a recirculation-type flow transducer is used which is less sensitive to contamination and impurities in the liquid. When developing the transducer, attention was paid to facilitate easy installation /flanged connection/ and the large volume liquid flowing through the device. The metering accuracy of the transducer is $\pm$5%. The controller needs programmed data as well including the following:

- allowable maximum pressure /bar/
- allowable minimum pressure /bar/
- working width /distributor frame /m/
- hauled wheel diameter /cm/
- specific distributed volume required /dm^3/ha/.

The central electronic unit operates an engine-powered butterfly valve on the basis of the measured and preprogrammed data, which is installed into the recirculation line. The engine-powered butterfly valve has also been developed by ourselves by transforming a manually-operated general-purpose ISC valve. By operating the valve, constant volumes of liquid can be distributed per hectare of land irrespective of the speed of the equipment.

The adjustment of specific distribution capacities can be started in manual mode using the flow meter with its appropriate accuracy. After initial adjustment, control can be effected in automatic mode on the basis of the authentic flow volume signal sample; then, when in operation, control can be effected as a result of pressure changes measured. It is to be mentioned that the frequency of the flow meter signal is rather small, therefore sampling time is used. In display mode it is acceptable; in control mode, however, further intervention is required. One of the possible solutions to the problem, chosen by ourselves, is to opt for pressure as the base signal for the controlled algorithm for which a one-second sampling cycle can be set. The actual volumes distributed are calculated on the basis of the flow control device signal in every 5 seconds in the same manner. The accompanying pressure and the required distributed volume figures are also available. The pressure required can be unequivocally calculated from the square characteristic curves of pressure and volume.

Test methods and results

The instruments developed have been tested both under laboratory and field conditions. For the purposes of the laboratory tests, a test bench has been produced. Field tests were conducted with HUNIPER-3000 machines.

It was found during the tests that by changing the auger elements of the flow meter, both the impulse count and the p pressure loss changes. In a given range, the accuracy of the flow meter is within $\pm$5% which is characteristic of all augers. It was also found that the 10-400 dm^3/min flow range can be measured in stages only.

Under farm conditions specific distribution volumes can be maintained only with a $\pm$6% accuracy.

Evaluation

Based on the experiences of field tests, it is to be stated that machine operators can quickly learn to operate the devices and use them flexibly both in manual and automatic modes. The hook-up of sensors facilitates quick replacement. Because of its internal structure, the device is easy to service as it contains up-to-date ICs and an I8085 microprocessor.

In 1988, three units of the display monitor variety and 2 units of the control device variety were used. In the case of the display monitor version, liquid fertilizers were distributed over an area of 4,500

Correction:

On the 8., 31. and 60 pages the employer of the authors of the paper "Electronic seed counter" is as follows:
Agricultural Engineering Faculty (MgFK) of Agricultural University, Mezőtúr
(manuscript error)

ha, while in the case of the control device version the area serviced was 4,000 ha. No breakdown other than cable rupture was registered and no wear and tear was noted in the flow meters.

Recommendations

In the first quarter of 1989, ten units of the equipment were manufactured jointly with the Herceghalom Pilot Farm. As an important consideration, it is recommended that the operation of the devices should be monitored and findings be utilized in the course of producing further units of the same equipment.

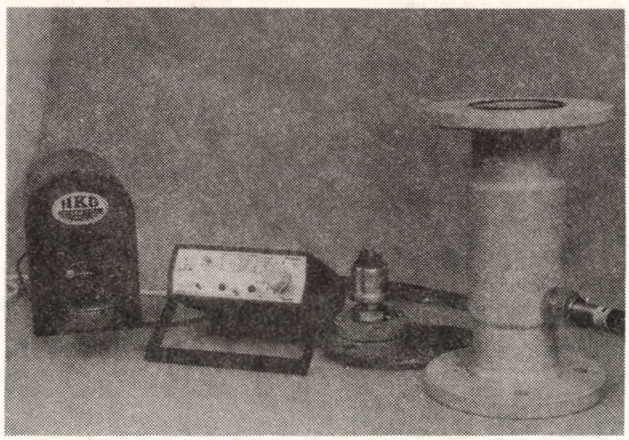


Figure 1 The control device and its accessories

Electronic seed counter

GÁBOR FEKETE
(KITE Corn and Industrial Plant Production System, Nádudvar)
DR. JÓZSEF KRIZSÁN
(Faculty of Agricultural Engineering University of Agriculture, Gödöllő)

KITE, a technologically-oriented production system, has suggested that a seed counter be developed which can be used as a substitute for the NUMIGRAL type equipment, procured from convertible currency sources. The objective of the design and experimental engineering work, performed under commision, was to ensure

- counting of seeds with a diameter over 4 mm,
- a feeding rate of 5 seeds per second,
- an adjustable feeding rate subject to seed diameter, and
- a max. error rate in seed counting to be at 0.1%.

Mechanical section

Seeds are fed by a circular feeder along a rising spiral, driven by two electro-magnets. A variable-width chute is used to preclude double feeding.

Seeds are detected by an opto-electronic device located at the bottom of a 45° chute. There is a special container at the bottom of the chute to hold seeds already counted.

Electrical section

Description of operation:
The operation of the equipment /Fig.1./ can be traced in the block diagram attached. Once connected to the 220 V mains, the equipment becomes operational as soon as the main switch is turned on. Counting can be started by pushing the START /3/ button. If the display indicates irrelevant or false information, the display can be cleared with the RESET /1/ button. In case a set volume of seeds is to be counted, the limit value should be set accordingly, using switch /9/.

When the forwarding device /10/ works, the seeds pass by the detector /4/ which transforms the changes in light intensity into electrical pulses via its opto-electronic component. The signal generator/processor /6/ generates electrical pulses with assorted shapes and amplitudes while sorts out the diverse scrambling factors. The series of pulses, appearing on the signal generator's output are regular and well defined and provide correct input for the counter /8/.

The counter /8/ has four digits /0-9999/ to count pulses at its input and uses two-segment LED displays to display value counted. When teh number of seeds counted tallies with the value set on the limit value switch /9/, the counter remits a command signal to the logic network /8/ to stop the forwarding device /10/. The operation of the forwarding device can be monitored with the feedback unit /11/ as well.

If the process of counting is to be halted, the STOP button /2/ is to be depressed.

The drop-out rate of the seeds can be adjusted between wide margins with knob /7/ of the electronic control unit.

Electrical structure

The central unit of the system is the logic network /5/ comprising TTL digital ICs. This controls the system, using the incoming commands. The unit, made up of DC transistor control and solid-state relay, drives the electro-magnetic mechanism.

The photo-electronic detector is connected to an

amplified, built from transistors, and a signal generator. The counter and the digital display constitute a compact unit as one single TTL digital circuit. The limit value control is a decimal code disk on a flange whell.

The equipment works with a 220V supply voltage, received from the electric mains. The electro-magnetic mechanism is energized directly from the electric mains via the control unit, while the rest of the units in the equipment receive +5V and +12V supply voltage, respectively, via a transformer and voltage stabilizer.

Test findings

Three such counter equipment have been produced to accomodate an order by KITE; the operating experiences available relate to a six-month period, and include the following findings:

- the equipment meets the parameters set forth among the objectives,
- no breakdown was noted.

As a deficiency of the equipment, it is to be mentioned that it is sencitive to contamination among the seeds; the presence of a dressing component affects the accuracy of counting and seeds with diameters below 4 mm are detected only with a high error rate.
Further efforts are being made to improve the counter.

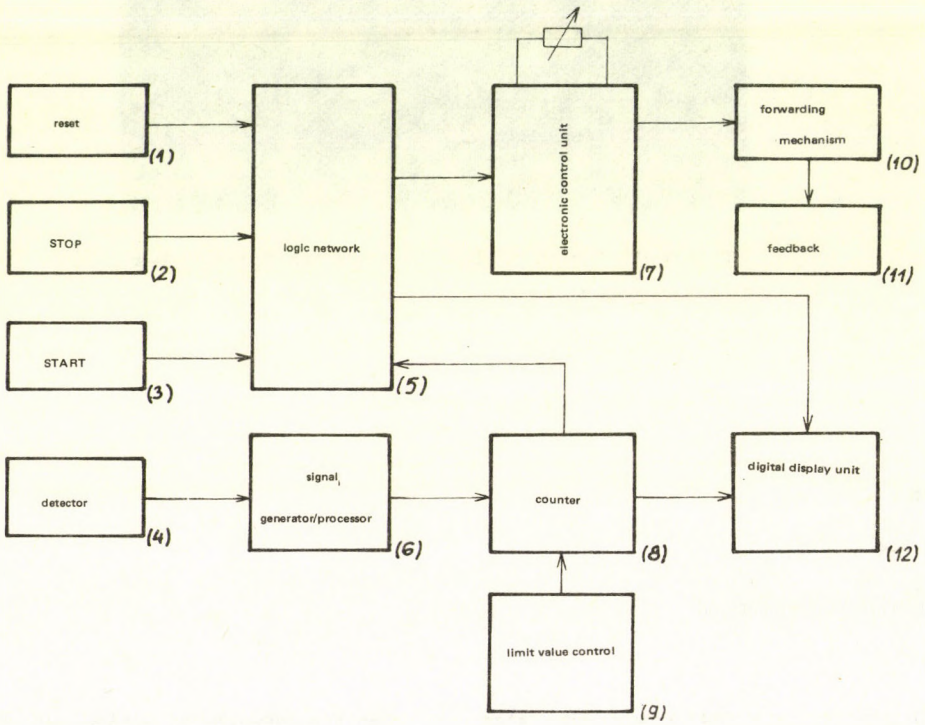


Figure 1: Operational scheme of electronic seed counter

New results in the development of machines in co-operation between ERTI and FALCO

DR. JÓZSEF PETHŐ
(FALCO, Wood Processing Corporation, Szombathely)

During its 15 years of existence, ERTI has always played an important role in the development of the silviculture sector of the Wood Processing Corporation /FALCO/. The assignments given to development staff reflect the company's committment to long-term silviculture although successive shifts in emphasis in different years can also be traced in management activities.

Naturally, for the purposes of technology development and adaptation hitherto unidentified areas are the prime targets. So, the idea of larger seedlings in containers /H = 50 cm/, which may facilitate a faster growth for newly planted forests, compels us to embark on the development of a novel forrestation "tool". As a result of our joint efforts, the Type EG-2 forest planter was developed that can be classified into the double-row hole drill category based on classification adopted by Dr. Antal Bodor in his book "Forest plantation and renewal". The base of the machine is an MTZ-82 tractor with the drills mounted on the two sides while the seedling container is attached to a frame installed on the suspension device. The two drills are parallologram structures operated from separated hydraulic loops. The drill bit is adapted to the shape and size of the FALCO container /80/300m 100/300/ and is complete with a device to form water retention circles around the seedlings. The machine is easy to operate, the achievable performance per shift is 1,200 holes for seedlings. The end result of the effort is a plantation with a 2.7 m row clearance.

The paper reports on the development of machines for the silviculture, to improve the efficiency of the operations.

One of the most problematic areas of forest plantation is seedling care. ERTI's Type FKH-2x0.9 and FKH-1.8 double-row and single-row roll with a suspended blade developed in 1987 is but one of the numerous possible solutions to this problem, and this is not meant at all to qualify /or downgrade/ the unit blades are mounted on the roll between blocks in a frame. The tractor hauls the roll with the hydraulic system switched to "floating", so the roll has no active, driven working elements. Therefore the quality of row cultivation largely depends on the sharpness of the blades and the load, provided by additional weights. The most important, however, is to carry out this operation in time and not to neglect the plantation. If moisture in the soil is appropriate, the row cultivator can control weeds. It will form a blanket over the soil that prevents weed growth and reduces moisture loss in the upper soil layer. Under average conditions its performance is 0.24 ha/hour. The more mobile double--row version is the more promising which is more suitable for use in areas with tree trunks and roots left over.

One of the company's systems, vying for special attention, is the pruning chopper. As for this unit, draggers predominante along with the purpose-built elements. Accordingly development efforts were focussed on them, therefore the Type HC-35 front--mounted hydraulic tractor winch was developed for the MTZ-82 tractors. The structure is already known to specialists in this field since it was launched last year at a similar event. The novel arrangement of the structural components of the winch, the practicality of the hydraulic system and the suitability of the support designed to prevent roll-back on slopes render the machine viable under general conditions as well as under conditions when moving loads made up of less than standard-sized trees /max. 2 cu.m/load/. As damage may be caused, the general approach is not acceptable to me when pruning samplings. This should not be emphasized too strongly for performance reasons either /39.1 cu.m/ha for felling, which amounts to 1.34 cu.m/h if the average is around 0.018 cu.m/unit/.

The Type SZV-1 clamping head-block dragger was also developed as a new member of the dragger series half a year ago. The three main units of the equipment include the following: the Zetor 12145 tractor with a medium traction capacity, the KCR-4010 crane and the head-block mounted on a hydraulically driven trailer. The novelty of the design is in the double-axle rigid-suspension undercarriage, the removable /Valmet/ head-block and the positioning of the KCR 4010 crane. The running gear has a tandem structure with IFA wheels driven by four Rexroth hydro-engines. The hydraulic system on the head-block comprises two sections that can be used either in crane mode or in ancillary drive mode subject to the mode selection. The machine can be used either to drag or to arrange whole trees, tree tunks, crowns and logs over 5 m. With appropriate preparations, the machine can be used to move about 50 cu.m of wood a day.

In the late 1970s FALCO opted for forwarders as the main machines for transportation in the forests. Regular wood processing is possible only with transporting machines -that can cope with all difficulties of terrain. Since then practice has proven the validity of the idea. At the time of start-up it offered splendid opportunities and the Valmet products have confirmed our most daring hopes. However, economic effects that have arisen meanwhile did not spare this area either. We had to look for new solutions and opted for Varuta in 1984. Then, the range was further expanded and as from 1986 ERTI's DRP-series were added to our stock of equipment. The first unit to make its debut was the DPR-40 H trailer for short logs with MTZ-82 and Zetor 62-45 general-purpose tractors and KCR-2000 crane. The trailer is 5,440 mm long with rigid undercarriage, single axle and hydraulic ancillary drive. The 40 kN nominal load is made up of trees in the range of 14 m in length. The machine is especially efficient in pruning samplings and in transporting less than standard-sized trees with a capacity of 3.0 cu.m/h at a cost of HUF 130/cu.m.

The Type DPR-80 H with an overall loading capacity of 80 kN delivery train/made up of general-purpose agricultural tractors /like the Zetor 161-45/ and a trailer complete with a KCR 4010 crane and hydraulic ancillary drive can be used to address more exacting tasks. The change effected is important for ergonomic reasons: the reversable seat guarantees greater comfort for the operator. The machine can be used for heavy-duty operations with a capacity of 3.5-4 cu.m/h.

Well, all this has arisen as a result of co-operation over two years. But the real test will come just now. An objective value judgement can be expected only if we continue to co-operate in the day-to-day operations with the objective of further improvement.

Possibility to improve the service for agricultural machines

DR. ISTVÁN HUSTI
(University of Agriculture, Gödöllő)

History

In recent years, after-sales services have been the hottest debated issues within technological services for agricultural machinery. This has been mostly due to two factors:

- On the one hand, agricultural companies in Hungary using agricultural machinery deep a keep eye on what they spend money for and are hitherto more sensitive to get their money's worth because of their deteriorating financial positions.

On the other hand, after-sales services for agricultural machinery and equipment receive increasing criticism. Differences in the standards of after-sales services in respect of machinery procured from different sources are addressed with particular vehemence.

As a result, the need has arisen to sume up with a systemic summary of major actions to be taken to remedy the problems.

Test method

The tests conducted have been aimed at identifying current practices in Hungary as well as to compare them against international norms. The present recommendations relate primarily to areas where the widest gaps have been noted.

Test results and recommendations

In line with current customs, after-sales services represent the responsibility of manufacturer both in Hungary and abroad. /This is especially well expressed in the term applied since the activites involved focuss on "rendering services for the customer"./

Manufacturers undoubtedly have a comprehensive and interest in it:

- after-sales services must be developed in order to retain market share; if such services are rendered in a reliable manner and at high standards, it is easier to retain customers' confidence and manufacturers may rightfully hope that their customers will not opt for the competitor's make when procuring some new machine;
- after sales services offer manufacturers an opportunity to familiarize themselves with real on-farm condisition thereby collecting information that may come in handy both in R D work and in manufacturing since they represent the users' criteria. Figure 1 is presented to indicate the nodes in the development of a new machine at which information gathered through after-sales services can be utilised.

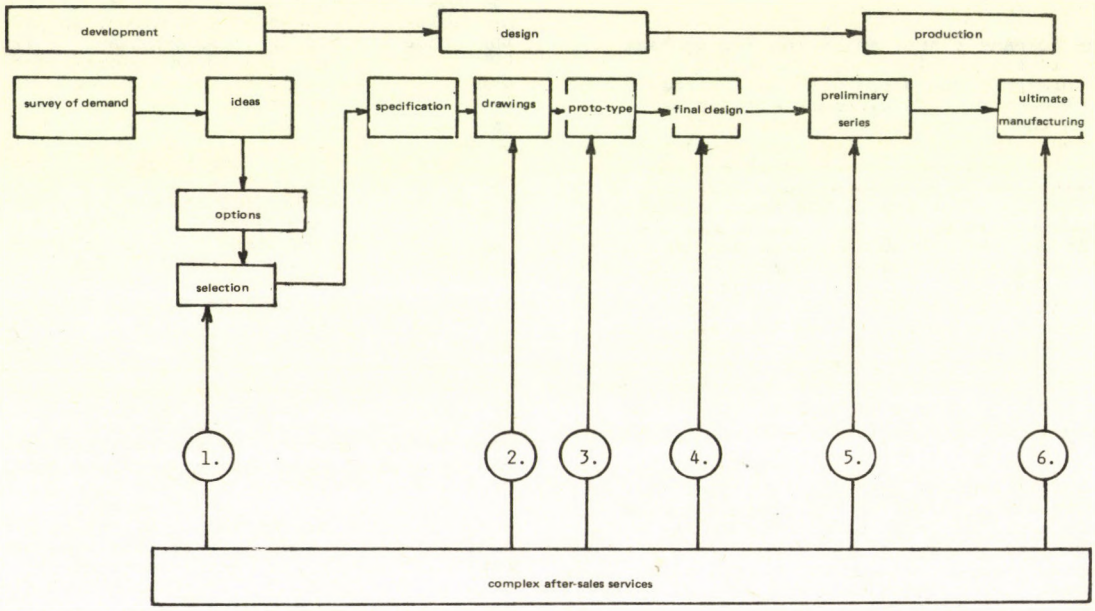


Figure 1

A possible model for the utilisation of information gathered through after-sales services /as related to the development of a new unit of equipment/

There is, however, some duality as regards the users' demands and motivations as well:

- Basically, users require professional, high-level, correct and fast after-sales services which guarantee profitable operation over the entire useful life of their machine over and above the fact they should ensure immediate repairs in case of certain unavoidable breakdowns during operation.
- While benefits accure to manufacturers, agricultural companies may also gain an insight into the manufacturers', activites and their motivations behind developing and producing some equipment. A series of experiences indicate that there are growing numbers of farms that definitely require such contacts. Also, there are plenty of examples of users' ideas turned into practical modifications in the structures of several agricultural machines.

However, it is worthwile to underscore the underlying difference between the two sides, despite the multiple linkages between them. Manufacturers want to sell. Their future depends on their market positions. As opposed to that users will be able to find themselves more and more often in a position that offers them freedom of choice from market supply and it is hardly surprising that considerations regarding after-sales services will provide hitherto sharper motivations for their value judgements. Although "two sides" have been mentioned, it is to be emphasized that nevetheless there is one ultimate objective: to use good machines and to produce proper goods. Consequently, after-sales services have to be "machine-oriented" to help manufacturers develop, produce and service good machines that can be put to efficient use by their respective users.

The machine-oriented after-sales services' linkage to the different phases of the machines' life cycle is shown in Figure 2.

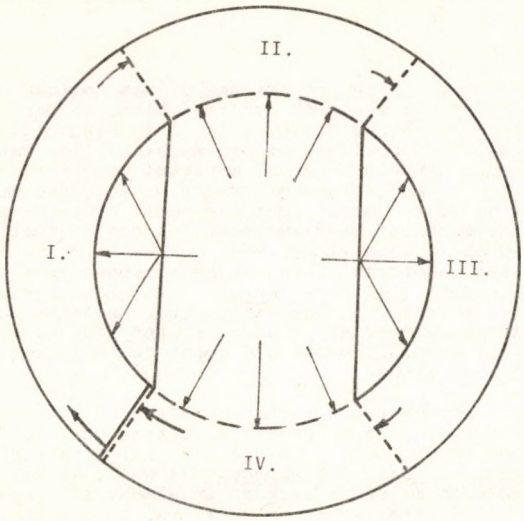


Figure 2

The interrelationship between machine-oriented after-sales services and the different phases in the maxhine's life cycle

I. R&D manufacturing
II. Sales
III. Primary utilisation
IV. Secondary utilisation /second-hand machines, units written off/

Here are some of the features of an after-sales services model that would be desirable.

- Under the current conditions of Hungary's agriculture, the primary role and responsibility of manufacturers needs to be emphasized in the expansion of the after-sales services networks and the improvement in the standarads of such services. Unfortunately, the differences in standards can often be related to the differences in manufacturers' and traders' behaviour as well as corporate cultures and customs that differ country by country. This situation needs to be rectified by using international norms for reference.

- It seems to be especially justified to change poor practices developed in the trade of agricultural machinery and equipment among socialist countries. It is recommended to replace inter-governmental agreements by contracts with manufacturers for the supply of concrete units of machinery. Direct contacts between companies within CMEA could ofter a good starting point for this.

- It is evident that the basis for successful after-sales services in Hungary is the provision of spare parts both within the guarantee period and within the useful life of the machine. Again in this field it is the manufacturers' behaviour and their underlying interests that may trigger positive changes. Experiences in Hungary have proven that no viable solution is possible without consignment stores.

Manufacturers should be made to realize that instead of their "end-product" approach focussing on complete machinery, they should concrete on satisfying market demand including the improvement of applicability of the machines they churn out.

In order to improve spare parts supply in Hungary it would be expedient to specialize in certain types of machinery at least in the service networks run by the capital equipment trading companies. Further, better coordination would be required in procurement and production as well. To achieve this, an all-inclusive information chain would be required. Also, an information center needs to be set up that could offer information on a day-to-day basis about what component parts are available where. /The conditions for setting up such a system are already present in Hungary./

- It is in the users' interest to be in contact with the smallest possible number of service companies which means that any service unit should undertake to provide warranty services for the widest possible range of machinery types. This demand should be taken into account when revamping the local organisation structure of after-sales services.

- Existing organisations must improve their service in general as well as their speed, instrumentation and tool kits, professionality and correctness in particular.

And last but not least, the basis for high-level after-sales services is that the service organisation should feel responsible for the machinery it services. Without such commitment no organisation can function with the fastness, precision and reliability required of it. Service companies should be able to regard users' concerns as if it were their own, they should monitor the commissioning and daily use of machines committed to their "care", keeping an eye on users to see whether their machines are used properly, observing operational instructions.

Thus, after-sales services, better to say the organisation rendering such services, can act as intermediaries, interfacing between manufacturers turning our machinery and farms using same. All this calls for concerted efforts towards improving after-sales services, turning them into a complex pursuit, bearing in mind the law of the minimum.

Reduction of the costs of material handling and product distribution by logistic methods

DR. IMRE KNOLL
(University of Agriculture, Gödöllő)

It is a prime objective in any "production/consumption" system /ie. in the so-called P/C process/ that transport, loading/unloading vehicles and storage facilities /ie. material handling equipment/ be merged with the operations in the manufacturing technology so that they sould also help keep unit costs of the products to be sold at a minimum.That is why theoretical systemic methods have been developed for the compilation of material handling lines and to help organise the distribution and transportation of goods, which was followed by adaptation tests in plants using different kinds of agricultural produce and food industry products. The evaluation of the data collected as well as conclusions and recommendations propsed comprise an organic part of this work.

Now, let us get down to the details. Cost reductions in material handling and distribution systems can be achieved only if equipment costs /ie. vehicles, loaders, etc./ per unit of materials handled are cut, if material handling/ transport routes are optimized or the shortest possible routes are used, equipment productivity is maximized, the number of vehicles required is minimized and all the plans made are actually implemented in practice.

The novel logistic methods applied have mightily contributed towards the success of our research efforts expended in recent years, following the above principles.

Logistics, introduced gradually over the past few years in countries with up-to-date technologies, implies an approach or a range of activites that addresses the complex set of "raw material supply, production and distribution" in a comprehensive manner. Its implementation requires four resources, such as materials, energy, labour and information. Hence logistics is a mix of activities connected to the optimum flow, management and value analysis of the above resources, properly programmed within - or among - P/C systems.

The block diagram /Figure 1/ depicts assumed connections, placing emphasis on inter-actions. The calssic material handling principle dominates even in this approach which postulates that products must be delivered to their destination in a quality required, at the appropriate time and with the least cost.

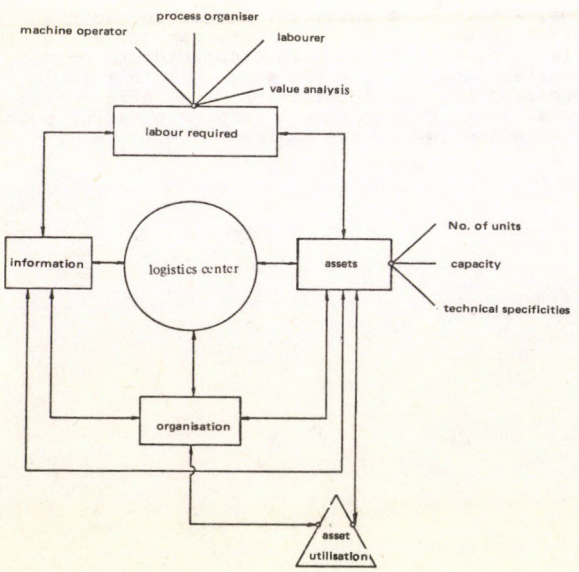


Figure 1
The scheme of the logistics center

The "Log-org diagram" /Figure 2/ was deviced as a result of our research efforts which, in part, follows the principles set forth in Figure 1, emphasising the importance of organisation. The latter one must embrace internal material handling, stock piling, packaging and distribution to consumers. This helps to ensure that the performance parameters of the material handling vehicles are at their optimum while lead times among Points A, B and C are at their shortest. This can be achieved through an independent logistics center, created within a corporate structure, that can produce in-depth value analysis by relying on an incessant flow of information, mutually exchanged among the different corporate divisions.

Both our research efforts and actual field tests have proven that attempts at cutting unit costs can be successful only if proper attention is given to infrastructural /IS/ aspects as well. As we are faced with major IS factors in almost all areas of our daily life, it is only natural to say that IS, material handling /MH/ and logistics /LOG/ are intertwined and they interact with one another. Figure 3 highlights the four major areas of IS, every one of which figures as a prime cost factor in the distribution of goods which is at issue now.

As inherent feature of this logistic interrellation ship is that desired and optimum unit costs can be calculated only if individual factors are thoroughly analysed by using extensive and relevant information.

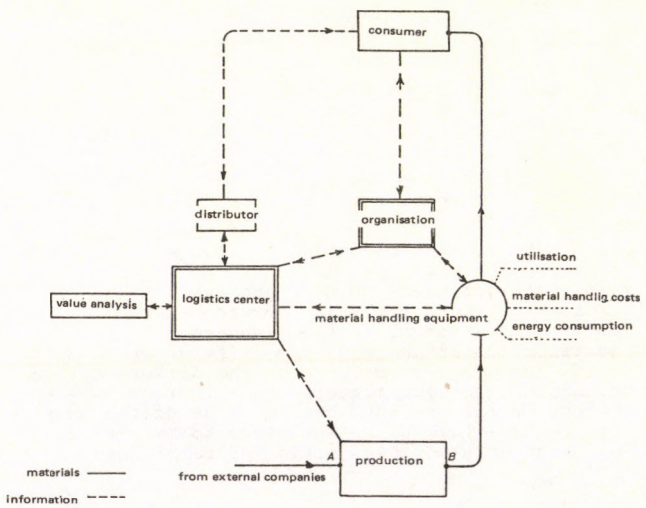


Figure 2
The "Log-org" diagram

As a result of our research efforts, I will present a case for warehousing, which is almost always involved in the P/C process of agricultural produce and which was evaluated as one of the major cost factors, using a complex approach /Figure 4/. The four scenarios and the nine factors constitute a decision-making model with which an optimum solution can be selected, relying on the merit points already defined.

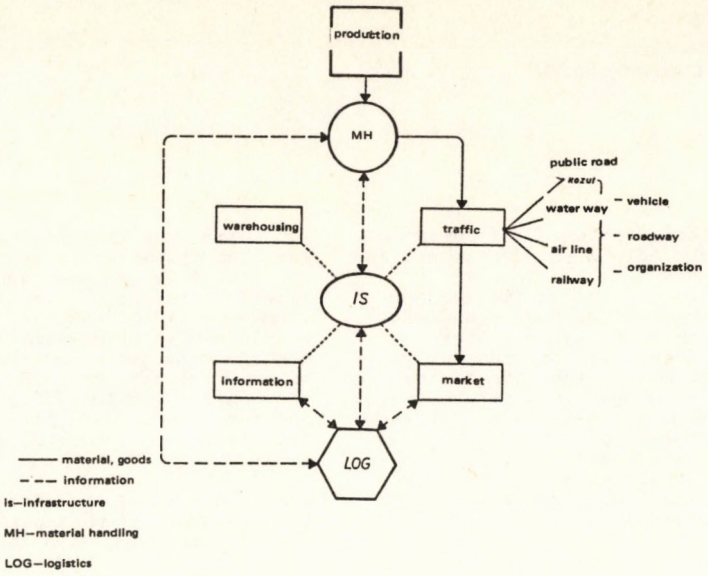


Figure 3
Infrastructural connections

Features \ Types of storage facilities	Storage sheds	Flat stores	Metal silos	Reinforced concrete silos
Total specific project costs HUF/ton	8	6	4	3
Specific energy requirement, kWh/ton	8	4	3	3
Specific operating costs, HUF/ton/year	8	5	4	3
Specific maintenance costs, HUF/ton/year	9	6	4	7
Specific ventilation costs, HUF/ton/year	5	3	7	9
Rate of mechanisation	1	8	10	8
Environmental considera-tions	2	4	6	8
Useful life	3	6	7	9
Utility, versatility	7	10	3	3

Values:

o - 3 unfavourable, ie. high specific costs

4 - 6 medium

7 -10 favourable, ie. low specific costs.

Figure 4

Evaluation of grain storage facilities

If every one of the interrelationships in material handling, infrastructure and logistics, shown in the diagrams, is taken into account in an analogous manner, these basic logistic steps will lead us to the most favourable economic solution in material handling and distribution as well.

Since this issue is being extensively debated these months in the European Logistics Association /ELA/ on the basis of our paper and with our supervision, allow us to propose that these new methods that have brought positive results up to this date, be promoted & introduced both in Hungary and abroad in all possible sectors of the economy.

How to cut harvesting losses over slopes

DR. ISTVÁN SÖRÖS – SÁNDOR SALAMON
(Hungarian Institute of Agricultural Engineering, Gödöllő)

Standard combine harvesters, designed for operation over plain areas, can work only with lower speed and therefore with lower capacity over slopes since crops harvested would swing around in the machine along the slope while the whole unit of equipment moves along. If harvesters move at right angles to the slope; substantial losses are incurred due to the accumulation of materials on the side facing the slope since the machine is unable to separate grains from the large volumes of other naterials that accumulate there. Whenever moving up slopes, grain would flow out faster from the machine which is tilted backwards; again, substantial losses are incurred since under such conditions less time is available to thrash out grains properly.

Detailed technological and economic tests, aimed at cutting such losses, became the order of the day recently and number of specially designed thrasher-harvesters have been put on the market that can harvest crops, grown over slopes, with small losses.

The objective of the test was to define performance improvements /reduction in losses/ to be achieved with the new combine harvesters, suitable for grain harvesting over slopes; by comparing these figures with the higher machine price, the conditions for profitable operation of such combine harvesters can be stimulated.

All the tests were conducted jointly with KSZE and KITE on their memberfarms, the "Közös Ut" Agricultural Co-op of Belvárdgyula, the "Petõfi"Agricultural Co-op of Gyönk, the "Béke Õre" Agricultural Co-op Gödre, the "Völgység Népe" Agricultural Co-op Mõcsény, the "Kossuth" Agricultural Co-op of Felsõnána, the "Zselici Táj" Agricultural Co-op Szenna and the Bikal State Farm. The tests were conducted between 1981 and 1988.

The tests were conducted with combine harvesters fitted out with accessories to harvest crops over slopes and with specially designed thrasher-harvesters, which are often called "Mountain combine harvesters".

The accessories include a three-dimentional sieve shaker /3O/ and an "Up-Hill Attachment" /UH/. Both are used by CLAAS with its threasher harvesters. The three-dimensional sieve shaker is used both in its traditional thrasher-harvesters complete with straw shaker boxes as well as in units with the CS system, that have separator drums but do not have the straw shaker. The "Up-Hill Attachment" is installed only into units that are complete with separator drums. The important element in the operation of the three-dimentional sieve shaker is that the sieve will move not only forward and backward and-up and down, buth sideways as well, along the slope. As a results of this complex movement, materials would be evenly distributed on the sieve even when there is a sideways slope and the sieve will not be overloaded slope-wise.There is a hydromechanic control device ensure positioning as required by the slope.

The up-hill attachment ensures horizontal position for the equipment by either lifting up or lowering the rear of the machine when it moves uphill or downhill.

As for the specifically designed "mountain combine harvesters", the running and cutting gear of the machine is always adjusted as required by the slope while all other units of the machine, especially its main section, are automatically adjusted horizontally by an automatic device. Level adjustment is provided both crossways and longitudinally. Crops on slopes can be harvested from any direction with the machines that provide from horizontal level adjustment from both these directions.

The tests were conducted with CLAAS DOMINATOR 1O6 and 1O8L threasher harvesters, that have a traditional structure and are complete with the three-dimensional sieve shaker, as well as with the CLAAS COMMANDOR 114 CS thrasher harvesters which are complete with three-dimensional sieve shaker and the up-hill attachment and the separator drums but have no straw shaker. From the mountain harvester category, the CLASS DOMINATOR 76H with dual level correction and the Laverda 3350 AL were included in the test. The tests were conducted while harvesting wheat and maize.

Based on the results received it is to be noted that the troughput of thrasher-harvesters can be significantly improved with the use of a level correction system or the attachment.

If the slope is only moderate, the increase in throughput is also moderate; if the slope is steeper, the increase is also greater. Up to a crossways slope of 20%, the increase in throughput and capacity may be as much as 30 to 40% while harvesting wheat, which may rise to as much as 60% over steeper slopes.

When harvesting maize, the rise in throughput and capacity is greater than in the case of wheat. The corresponding increase may be over 100%.

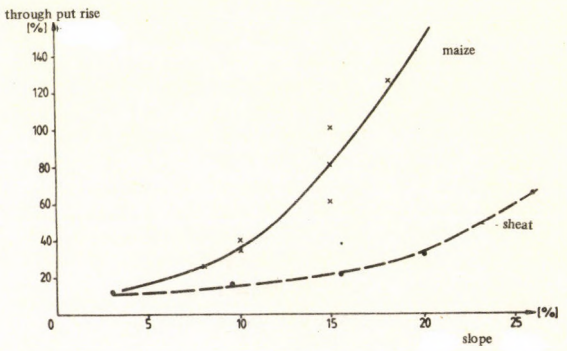


Figure 1

The interrelation between rises in throughput and changes in slope

While effecting a technological and economic comparison of data derived from the tests conducted with combine harvesters designed for plain areas but fitted out with attachments and with specially-built hillside harvesters, the conclusion to be drawn is that up to the limit of a 20% slope, combine harvesters, designed originally for operation in the plains but equipped with three-dimensional sieve shakers and up-hill attachment should be used. Due to small losses and greater performance the use of such machines is more profitable over slopes of 5% than the use of the standard units designed for use in plain areas only. However, they can be put to economical use up to a 20% slope limit instead of the specially-built but rather expensive hillside combines. The investment cost of the specially built hillside combines will not recover during the life of the combine. The hillside combines should only be used over very steep slopes, ie. over 20%.

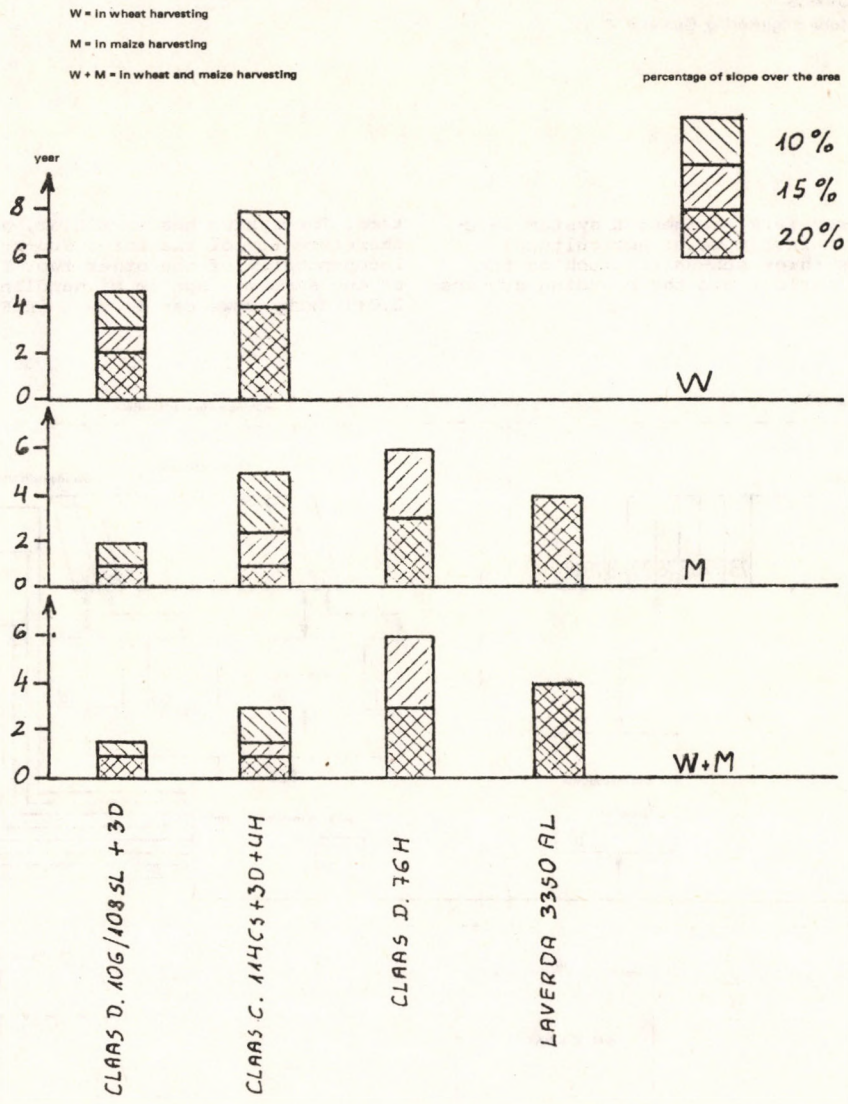


Figure 2
Payback period for extra capital costs

When harvesting maize with combines complete with the level adjustment system, adapter losses can be cut substantially due to more accurate row scanning.

Specific fuel consumption, calculated for grain volume harvested, can be 15-30% lower in harvesting wheat and approximately 60% lower in harvesting maize in case either harvesters with attachments or mountain combines are used.

As for mountain combine harvesters, the machine is easier to drive and steer if the automatic level correction is on. Thrasher-harvesters complete with a dual level correction system can run over the terrain in any direction /provided that there is no need to scan the rows of the crop/. Combined together, these features will facilitate a better throughput and better utilisation of working hours which allow for higher performance to be achieved. When the automatic level correction is on, mountain combines are safer to operate, there is less danger of slip or turning over. Level adjustment for the central section of the harvester provides greater comfort for the driver and greater safety. All in all this allows for greater speed of operation and greater performance.

Computerized dairy farm management system developed in Hungary

DR. JÁNOS BAK – LAJOS KOVÁCS
(Hungarian Institute of Agricultural Engineering, Gödöllő)

The computerized dairey farm management system developed by the Hungarian Institute of Agricultural Engineering comprises three sub-units, such as the feeding, the milking parlour and the breeding sub-systems. The system has a modular, hierarchic structure, therefore any of the three sub-systems can be used independently of the other two. The block diagram of the system, capable of handling and identifying 2,047 dairy cows can be seen in Figure 1.

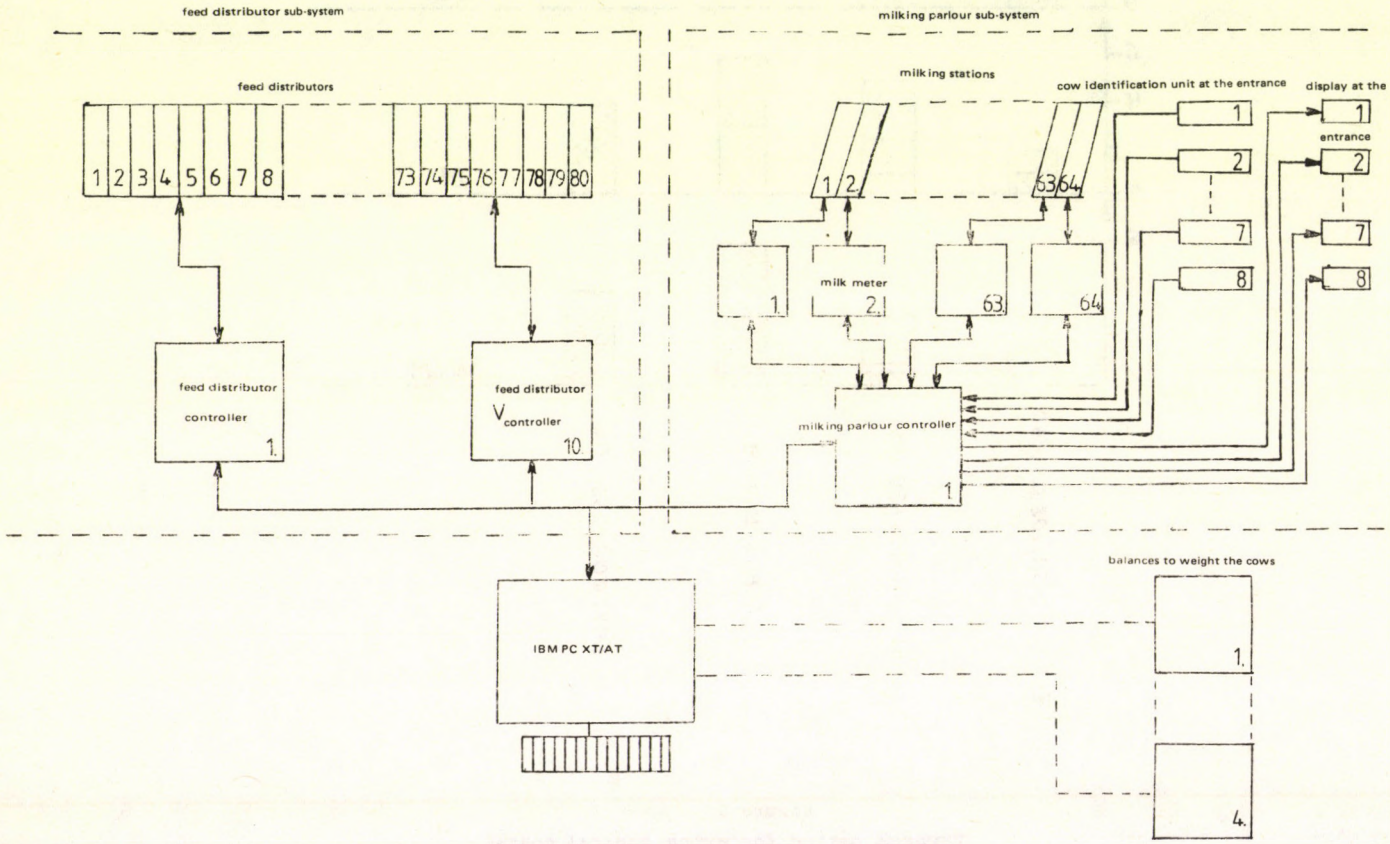


Figure 1

The block diagram of the computerized dairy farm management system developed in Hungary

Below, you can find the major characteristics of the sub-units of the system:

The transponders, using numeric codes for the identification of the dairy cows, are contained in the plastic boxes attached to the neck bands of the cows. The numerical codes of the dairy cows are pre-programmed into the transponders, Supply voltage required for the operation of the transponder circuitry is provided from the receiver unit by using induction.

The receiver which picks up the numerical codes emitted by the transponders is located in a box which also houses the supply voltage emitter as well as the battery controlling the feed distribution control engine. There is a serial output for the receiver code in the form of a 20 mA electricity loop. The numeric code comprises 16 bits, 3 of which are the start bits, 11 are the information bits and there are 2 stop bits.

The feed distributor auger in the feeding unit,which distributes feed to the dairy cows as pre-programmed, discharges 90 grams of bran feed by every revolution. The feeder engine uses 12V DC.

The individual milk meter uses the volume metering principle and operates as a flow meter. The four-digit display in the electric unit of the milk meter displays the following data:

- the ID number of the daily cow,
- identification failed,
- the dairy cow in the milking must not be milked,
- volume of milk received with a decimal accuracy,
- end of milking, and
- the code number of the dairy cow.

The milking parlour hardware is almost identical with that used in the feeding controlled unit. The feeding controller manages eight feeding stations.

The feeding station can handle two types of feed components. The feeding controller can handle 13 functions, while the milking parlour controller can handle 8 different functions.
Identification in the milking parlour is effected at the entrance of every milking station.
The IBM PC/XT compatible computer and its peripherals used to retrieve data, to program the sub-system controllers and to run the breeding software, have the following parameters. The CPU has a memory capacity of 640 kbyt /RAM/. The memory capacity of the floppy drives is 360 kbyte or 1.2 Mbyte, the Winchester capacity is 27 Mbte. In addition to the above units, there are a colour monitor, an Epson FX 1000 printer and a Multi I/O card as well.

The feeding controller and the milking parlour subsystems are controlled by the control software. There is a separate piece of software to program the feed distributor, to retrieve data, to process data received from the milk meter and to handle production, hygienic and breeding data. This software can be used not only on automated dairy farms it can also be run as a standalone system as well without automatic back-up. By applying the method described above, 96 different bits of information can be stored, processed, evaluated and arranged in statistical groups about every single cow.
Users can produce print-outs containing the data, collected by using the data retrieval and statistical program that goes with the system.

The software package ensures that individual cows separated from the rest of the herd for any reason could be identified and all the data about any of the cows, accumulated during the animal's lifetime should be accessible at any time.

Fermentation and treatment of grape-juice controlled temperature

ANDRÁS FARAGÓ
(Hungarian Institute of Agricultural Engineering, Gödöllő)

1. SUMMARY

A process technology for the fermentation of grape--juice has been worked out at controlled temperatures. The ultimate objective of the research effort was to implement a fermentation technology for grape-juice at controlled temperature that ensures fermentation at optimum temperatures.

The following steps of the process were analysed:

- options for treating grape-juice prior to fermentation,
- chagges in the fermentation temperature of grape--juice as a result of various grape-juice purification operations,
- changes in the fermentation temperature of grape-juice with and without cooling,
- definition of heat volume and intensity, generated by grape-juice in fermentation,
- options for discharging undesirable heat, generated by grape-juice in fermentation, by using energy-saving methods,
- the quality of wine produced from grape-juice, fermented at controlled temperatures,
- the economic evaluation of grape-juice fermentation at controlled temperatures.

The investment cost for the new technology, presumably, will be recovered in 6 to 8 years' time.

2. OBJECTIVE

Grape processing plants and wineries in Hungary produce 4-4.5 million hl of wine annually, 30% of which falls into the high quality category Grapes, harvested on the large-scale farms or purchased from small-scale producers, are processed with high-capacity machine lines; the grape-juice is the fermented in tanks with capacities above the optimum. As high--capacity machine lines are used, large quantities of sediment get into the liquid which increases internal surfaces. The increase in internal surfaces together with large size of the tanks results in undesirably high temperatures and rapid fermentation.

As a result of the high fermentation temperature /28-40°C/ the taste and flavour of thee wines becomes non-descript. However, consumers prefer wines with natural flavours and taste. This may, in part, be the reason that Hungary's wine exports have slumped in recent years and the country has lost some of its markets. Sales can, for sure, be boosted if a grape--juice fermentation technology is used that can cope with increased quality requirements. Consequently the need has arisen to develop such a new fermentation technology.

3. TEST METHODS

Research and development efforts, aimed at producint a new technology, were put in under farm conditions at the Kiskunhalas State Farm. To reduce the sediment content of the grape-juice we use arched sieves. 50 m^3 tanks for fermentation and evaporative condensers and heat exchangers for temperatures control.

Grape-juice temperature is monitored with platunum heat sensors, and values metered are plotted with a compenzograph.

4. TEST RESULTS

Over the past 3 years, the National Institute of Agricultural Engineering, in co-operation with the Kiskunhalas State Farm and the Badacsony State Farm, tested a wide range of equipment in both farms in order to develop a technology for grape-juice fermentation at controlled temperatures.

The long-term farm observations, the detailed data capture and the profitability calculations have all allowed for technological and economic conclusions to be drawn on proper bases.

The entire technology, elaborated and proposed by the Institute and the co-operating farms, is based on locally manufactured machinery and equipment which are available commercially in Hungary. The complex technology of grape-juice fermentation at controlled temperatures was implemented in practice at the Tajó farm of the Kiskunhalas State Farm.

The farm is complete with machine lines that can process grapes either in continuous or in intermittent mode. Grape-juice, produced with the machine lines, is transferred to a fermentation hall, equipped with facilities for fermentation at controlled temperature where optimum fermetation temperatures are produced by cooling.

The fermentation hall of the farm is complete with the following units of machinery and equipment:

- grape-juice pump,
- grape-juice tanks,
- arched sieve,
- sediment tanks,
- fermentation tanks,
- evaporative condenser cooler,
- compressor cooler,
- temperature monitoring, display and plotting system.

The most important data of the above units of equipment are listed in Table 1.

Table 1

Major data of the machinery and equipment at the Tajó plant of the Kiskunhalas State Farm

Item	Description	Unit	Major data Value	Type	Note
1	Grape-juice tank capacity	m^3	30	reinforced concrete made on the farm	height: 5 m dia: 3.1 m
2	Arched sieve throughput	m^3/h	20	Vicheri Bauer Hydrasiere 552	active filter area: 1.2 sq.m
3	Sediment tank capacity	m^3	12 5	concrete, cast on the farm	height: 1 m dia: 4 m
4	Fermentation tank capacity	m^3	50	TE-50; TE-100	height: 8 m dia: 3.1 m
5	Throughput of the evaporative condenser tank	m^3/h	20	KLIMA KM-600	Temperature reduction: 3-5°C
6	Throughput of the compressor cooler	m^3/h	20	FHV-140	temperature reduction: 0-15°C
7	Cooling medium tank capacity	m^3	100		
8	Pump delivery	m^3/h	20	BORISZ 300/165 2H	energy requirement: 5 kW

In keeping the technology used on the farm, grape-juice produced with a liquid separator and press is transferred into the grapejuice tank, made of concrete. In order to remove larger sediment particles, grape-juice collected there is transferred to the arched sieve or to the drum sieve where grape-juice goes through preliminary filtering. Then, pre-filtered grape-juice enters the fermentation tank where it is treated prior to fermentation.

Thereafter, in order to guarantee optimum temperature for the grape-juice, cooling is provided by the manually controlled evaporative condenser coolers and the compressor coolers, attached to the fermentation tanks.

The technological flow-chart is shown in Figure 1.

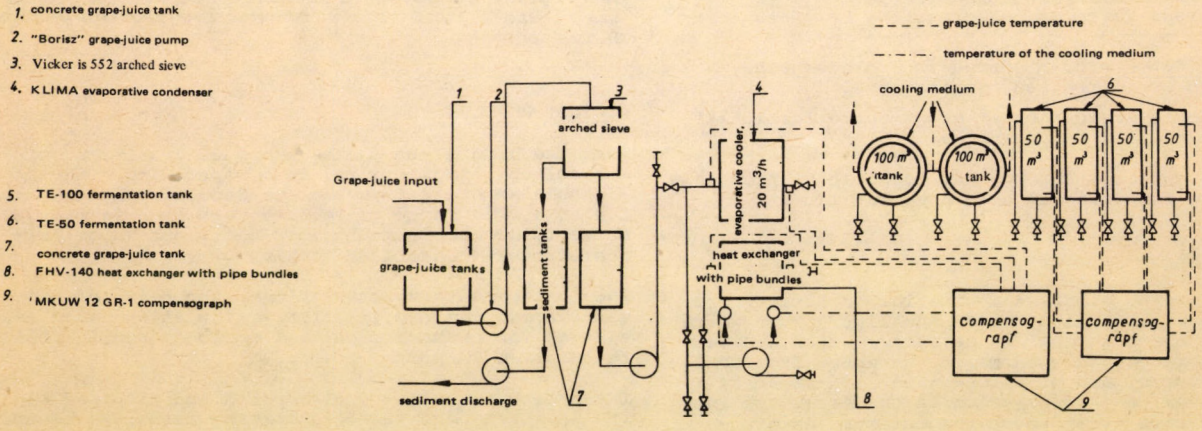


Figure 1

The technological flow-chart of grape-juice fermentation at controlled temperatures

In order to save on energy costs, a combination of cooling methods should be used to control the fermentation temperature of grape-juice.

The actual cooling method to be used should always be selected in accordance with the pace at which grape-juice temperature rises.

Possible combinations of cooling methods, as required by grape-juice temperature rise, are shown in Table 2.

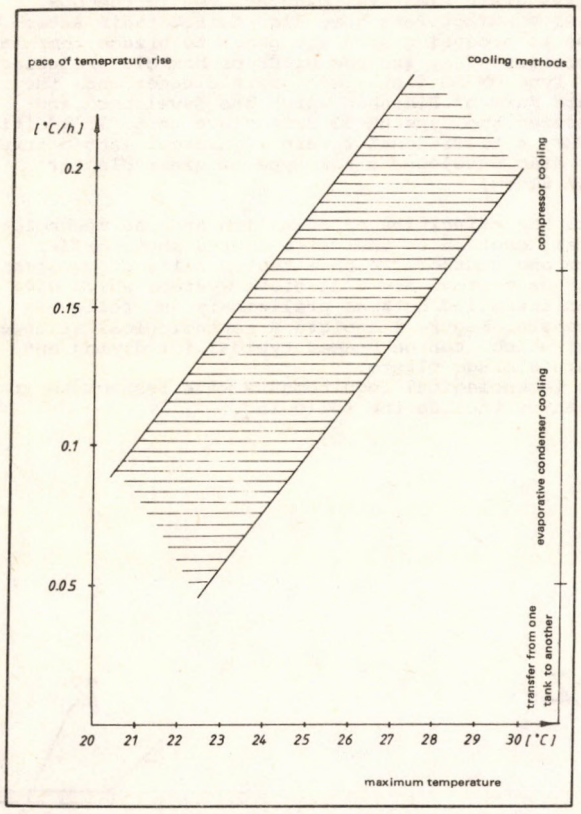


Table 2

Changes in the pace of temperature rise and the possible ways of cooling for fermenting grape-juice

5. EVALUATION

The technology contains a summary of grape-juice treatment before fermentation followed by fermentation at controlled temperatures. The special drum sieve, necommended for filtering grape-juice before fermentation, as well as the equipment proposed for temperature regulation are available commercially. The machinery and equipment developed during the R&D period have been used by the farms participating in the effort.

When developing the technology, emphasis was put on filtering out rough sediments that may clog the grape-juice pipeline and the cooling of the grape-juice.

Drum filters are capable of filtering out rough sediments /such as seeds and hull/ which is used to filter grape-juice prior to fermentation.

For the purposes of grape-juice fermentation 50-100 m^3 capacity metal tanks sh uld be used in Hungary's wineries as their heat conductivity is excellent Optimum fermentation temperatures, however, cannot be ensured without cooling even though such tanks are used.

Detrimental excess heat developed during fermentation, can be discharged with the evaporative condenser-type and the condenser-type coolers.
The application of combinations of the above cooling methods is justified by climatic and profitablility considerations.

The evaporative condenser type cooling can be used effectively only if the ambient temperature is favourable. However, at the beginning of the harvesting season the ambient temperature is characteristically high therefore priority should be given to the compressor-type cooling. In accordance with our findings, grape-juice fermentation at controlled temperatures leads to improved wine quality which results in an expansion of market opportunities and better economic achievements.

6. RECOMMENDATIONS

The implementation of the technology is recommended primarily for wineries where grape-juice is produced for fermentation from grape-varieties suitable for high-quality wine production.

Wineries, already equipped with compressor-type cooling systems to be used for heat-treating their grape-juice, should develop their fermentation halls nearby as this will allow for the interconnection of their heat exchangers with their already existent cooling systems, thereby facilitating substantial reductions in capital costs.

Test results for grain cleaners

DR. MIHÁLY HERDOVICS
(Hungarian Institute of Agricultural Engineering, Gödöllő)

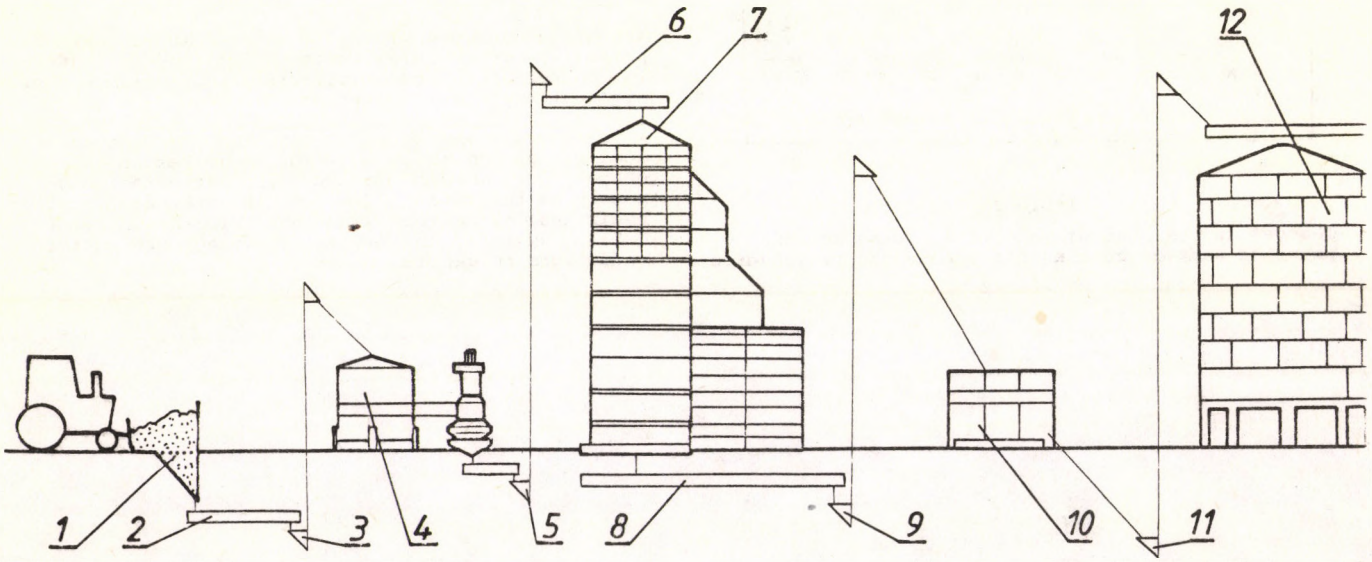
Introduction

Over the past few years substantial progress has been made both in the development and the production of grain cleaners in Hungary used primarily in grain drying units of farms. The very first step towards the current production of grain cleaners was taken when the licence for drum sieve cleaners, type SHT, was procured.
Starting from 1902, AGRIKON of Kecskemét has launched the production of cleaning equipment in different types and capacities on the basis of a licence for the Damas-Sigma grain cleaner series of Denmark.
The first unit of the series to have been manufactured was the Type SHT-754 with a medium capacity of 75 t/h, to be followed by a larger unit, the SHT-1004 with a capacity of 100 t/h and a smaller units, the SHT-753 and SHT-752 with capacities of 60 t/h and 50 t/h, respectively last year.

These grain cleaners were installed as preliminary cleaner units in grain drying plants, although they have been used in the Grain Storage Project financed by the World Bank as well.

Due to uncertainties in the availability of the Petkus grain cleaners, manufactured in the GDR, other manufacturers have also turned their attention to producing such equipment to bridge temporary shortages. They include DIGÉP of Miskolc producing the Type DM-50 flat-sieve grain cleaner and the State Farm of Hidashát which has developmed and produced the Type HR-50 drum sieve unit. In addition ÉLGÉP, a traditional feeding equipment manufacturer, has also developed a new type of grain cleaner /the ST-50/.

Both the principles of operation and the technological location of the units listed above differ from one another. We have tested units of equipment with drum-sieve and flat-sieve systems which have been been installed both as preliminary and follow-up cleaners. Figure 1 depicts a technological arrangement which can be deemed typical for drying and grain storage plants.
The technological requirements with respect to grain cleaners include the following.



A grain drying and storage plant

1. receiving hopper
2. chain conveyor
3. bucket elevator
4. preliminary cleaner
5. bucket elevator
6. chain conveyor
7. dryer
8. chain conveyor
9. bucket elevator
10. follow-up cleaner
11. bucket elevator
12. grain storage plant

Preliminary cleaning

This implies the cleaning of grains delivered sither to the drying or to the storage plant to spearate large-sized contamination /such as ears corn leaves, broken cobs, etc./.

Preliminary cleaning is expected to achieve a level of purity so that no clogging would occur in the successive stages of processing operations due to large-sized contaminants. Grain without preliminary cleaning, stored in heaps, may become compacted which may preclude even flow of cooling air, as a result of which hot spots may develop in heaps, resulting in damage to grain quality.
When processing uncleaned grain in the drying units, clogging may occur that may cause trouble in operation due to the presence of foreign matter, stones and pieces of metal in the grain .

Follow-up cleaning

This implies the removal of foreign matter from grain already dried prior to storage or utilisation All foreign matter, endangering safety of storage or representing no value for further utilisation /such as dust, broken grains, contamination, empty shells/ will have to be removed. The ultimate objective of follow-up cleaning is to minimize the volume of dust and contaminants generated in the drying stage.Follow-up dryers will effect ventillation and cooling as well when processing grain, discharged from the dryer at relatively high temperatures.

Test results

The SHT series of grain cleaners /SHT-753, SHT-754 and the SHT-1004/ can satisfy requirements across a rather wide capacity range. The maximum capacities of the respective units in the segies /at 60, 80 and a 100 ton per hour in wheat cleaning/ can be achieved only partially due to the lower capacities of material handling equipment and drying units. Maximum capacities in corn drying are around 30, 40 and 50 tons per hour, respectively. The units were tested in preliminary cleaning.

The functional tests have shown clearly that the units listed have favourable work quality parameters. Cleaners prooved to be efficient in separating inflammable materials /such as cobs, marts of stalks, ears, etc./; also, it could remove most of the empty shells from corn cobs due to its centrifugal force.

The Type ST-50 grain cleaner could be tested as a follow-up cleaner only in a milling technology. The capacity of the cleaner was found to have been 60 tons per hour where work quality parameters were acceptable. The dimensions of the air cleaner unit in the equipment were, however, unsatisfactory, The equipment would, probably, be unsuitable for removing alrger volumes of broken seeds. With a view to the requirements concerninv the location, the installation and the suspension of the sieve box as well as the rough conditions on most farms, the equipment is recommeded to be used primarily in grain mills and not on farms.

The Type DM-50 grain cleaner was developed as a substitute for the Petkus K-525 grain dryer, made in the GDR. The results obtained during the functional testing of the unit were essentially identical with the paramters of the original unit, although severe operational problems were noted with equipment produced in parger series; they included breakages which indicate fluctuations in quality and deficiences in the production technology.

When used for the preliminary cleaning of wheat, the capacity of the unit was 50 tons per hour, while in follow-up cleaning, the capacity was 25 tons per hour.

The Type HR-50 grain cleaner has a simply structure, therefore it appears to be a reliable unit of equipment. The unit was found to be suitable to effect preliminary cleaning of corn and wheat with a moisture content of 25-28%; in follow-up cleaning, however, the grading sieve has a poor efficiency and the percentage of broken grains separated is low. Due to the identification of theseeproblems, the manufacturer has modified his structure.
In the preliminary cleaning of wheat, the capacity was found to be abound 50 tons per hour; in follow-up cleaning, the capacity was 25 tons per hour at which commercial purity /98%/ could be achieved.

Experiences

Based on the findings of the tests, the SHT grain cleaners, complete with vertical drum sieves, can clearly be recommended for preliminary cleaning operations.
The Type SHT-753 equipment can be recommended to be used together with the B1-15 and Sirocco 2000 dryers which are the most wide spread in Hungary. In such instances, the nominal capacity in corn drying is 15 tons per hour. The Type SHT-754 equipment can be recommended to be used together with the BERICO-1260 dryer /capacity: 20 tons per hour/, while the Type SHT-1004 can be recommended to be used with twin dryers /such as the B1-15/.

The ST-50, the DM-50 flat-sieve cleaners and the HR-50 horintal drum cleaners are recommended for follow-up cleaning, although they fail to have parameters equal to those of the Petkus K-525 and K-527 cleaners, made in the GDR, for assorted reasons /eg.: poorer reliability/.