

FRICITION BETWEEN FERTILIZER PARTICLES AND DIFFERENT TYPES OF SURFACES

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Aims of the research

Precision crop production can not be realised without the knowledge of physical properties of agricultural materials, including fertilizers (Neményi et al., 2001.).

Physical properties of fertilizers are among the most important factors that influence the evenness of the spread pattern.

In the case of a spinning disc type fertilizer distributor, which is the most widely used type, the coefficient of friction has a considerable influence on the motion of particles on the discs, vanes and through the air. (Hofstee et al., 1992.).

This study describes the method used and device developed to measure the coefficient of friction of a fertilizer type on several surfaces, together with the measuring results.

Material and method

We performed our experiments with NPK 15-15-15 complex fertilizer and ten surfaces, paying special attention to the different properties of the chosen types. During the measurements the temperature of the laboratory was kept at 21 °C, relative humidity varied between 25-30%. The photo on the plates of different surfaces is presented in Fig. 1.

The friction-measuring device was developed (Csizmazia et al., 2001, Polyák 1998, 2001.) for measuring the coefficient of inner friction and the coefficient of friction of agricultural granular materials on different surfaces (Fig. 2.).

The device contains a shearing box, which consists of two parts, each of 200x200mm cross section and 60 mm height, with an adjustable slit between them. During the measurement the examined plate is put into this slit, while the fertilizer is placed into the upper part of the box. The lower part of the box moves between two dead points on rows of balls, to keep the resistance on a low level. The pulling frame is driven by an electric motor and a reversing switch is used. Between the pulling frame and the shearing box a flat-link chain, driven on four chain wheels, establishes connection. In the vertical part of the pulling chain a measuring cell of 1000 N measuring range is built in. The displacement and the pulling velocity are measured by a rotating incremental signaller which transmits 2000 signals per rotation. A load-measuring cell of 1000 N measuring range joined to the top of the shearing box. The normal load is applied by weights put on a tray, which is hung up on an arm system. A computational data logger through two analogue and pulse counter inputs receives the data, transmitted by the measuring cells and the signaller..

The calibration of the measuring cells was accomplished with a series of weights of F2 accuracy class. The force measured by the cells was increased in 8 steps from 12,26 N to 735,75 N. The calibration graph of the loading cell is given in Fig. 3. It can be established that the connection between the normal force and the electrical signals transmitted by the cells is linear. The excellent value of the correlation coefficient (0,99) proves the high accuracy of the cells. The calibration of the incremental

signaller was accomplished by measuring the number of signals transmitted during the displacement of the pulling frame from 5 mm to 180 mm in 5 mm, then 10 mm steps. The calibration graph is shown in Fig. 4. It can be established in this case too, that the connection between the displacement of the pulling frame and the number of transmitted signals is linear. The excellent value of the correlation coefficient (0,99) indicates the reliability of the signaller.

Evaluation of results and conclusions

The relationship between the frictional force and the loading force is shown in Fig. 5.

The value of the frictional force is significantly influenced by the nature of the frictional surface, the relationship is approximately linear.

Analysis of the values of the coefficient of friction (Fig. 6.) shows a decided decrease in the beginning in relation to loading, than it is becoming approximately constant.

Data for the coefficient of friction obtained by the described method are the next (max-min): aluminium: 0,29-0,24; stainless steel: 0,25-0,22; black steel: 0,69-0,27; galvanised steel: 0,30-0,23; teflon: 0,25-0,12; bakelite: 0,24-0,15; PVC: 0,35-0,24; glass: 0,24-0,20; plexiglass: 0,37-0,14; plywood: 0,31-0,24.

From the measurement results presented it must be concluded that the effect of the nature of the frictional surface on the value of the coefficient of friction is significant.

The measuring method discussed is a new and reliable method for measuring the coefficient of friction of different types of fertilizers on various structural surfaces.

References

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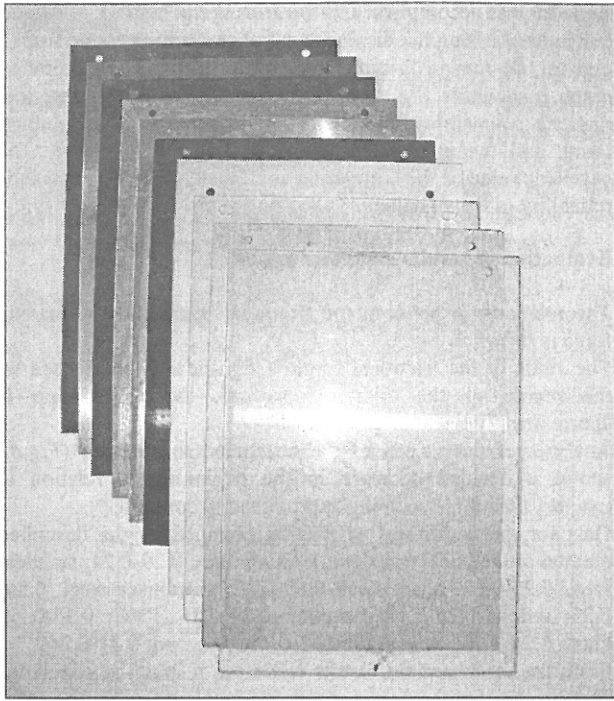


Figure 1 Plates of different surfaces

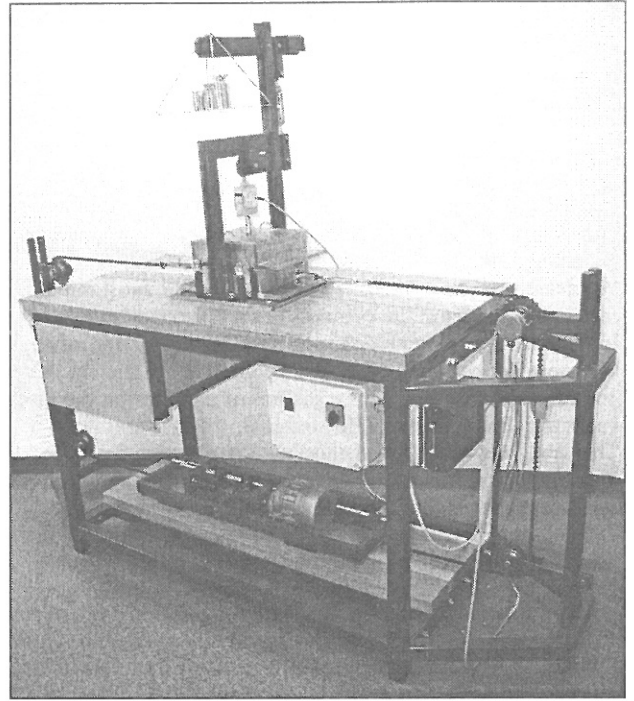


Figure 2 Friction measuring devices with shearing box

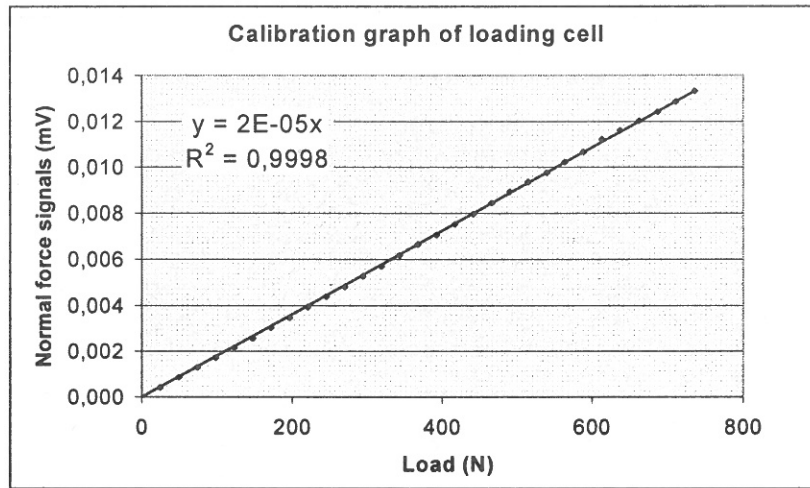


Figure 3

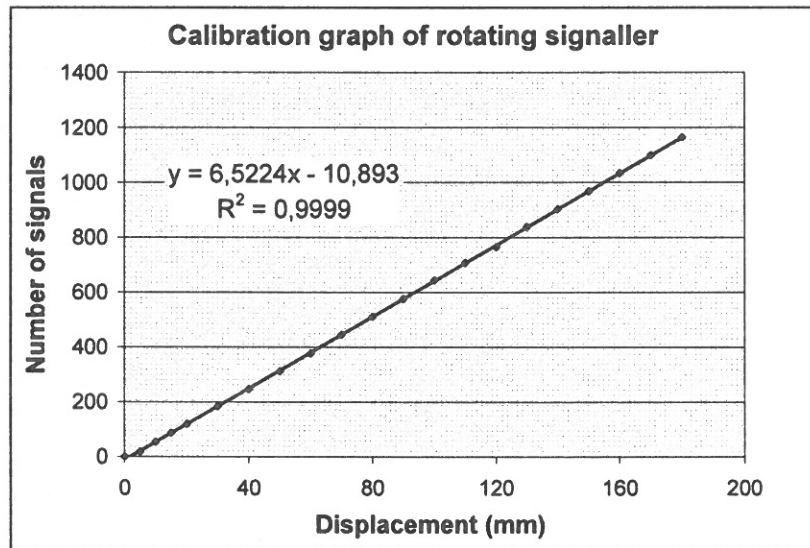


Figure 4

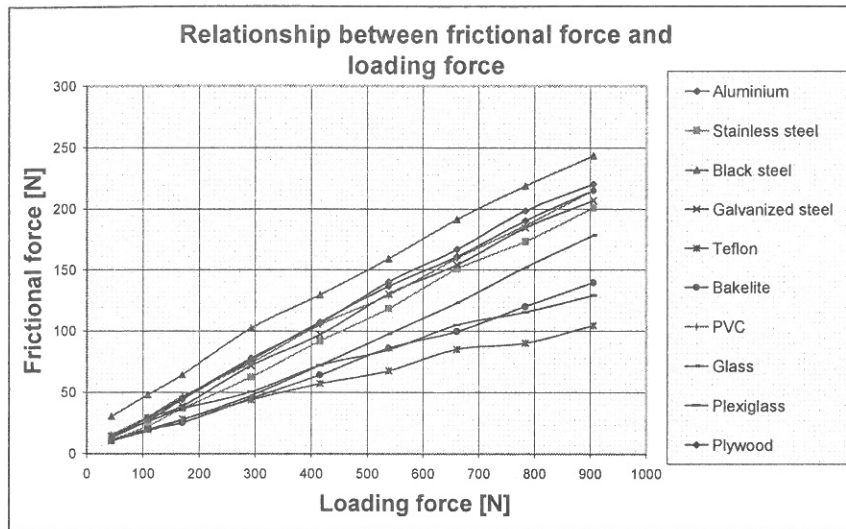


Figure 5

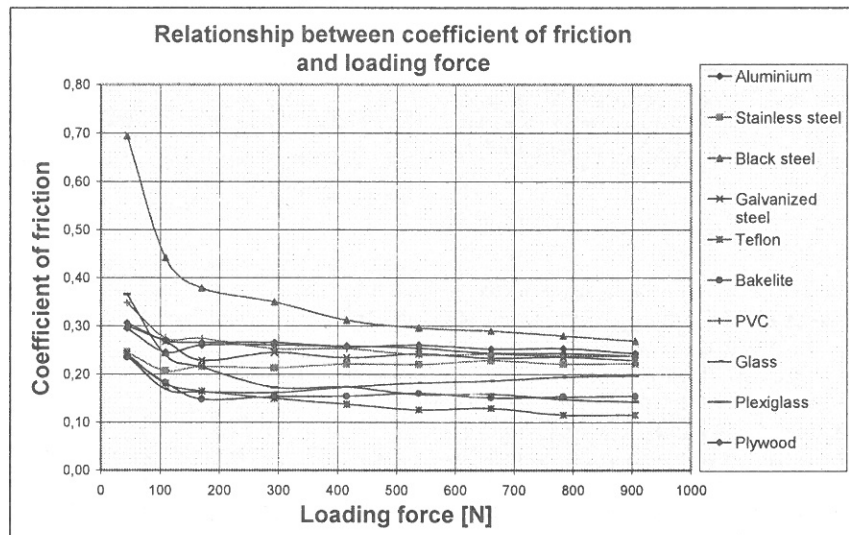


Figure 6

