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Izhevsk State Agricultural Academy

60th Anniversary of Agricultural Engineering Faculty

The Agricultural Engineering Faculty of Izhevsk State Agricultural Academy dates from 1955, when the Agricultural Industry Mechanization Faculty was founded in Izhevsk Agricultural Institute. Many farms of Republic employed long-expected skilled mechanic engineers and the Institute could recruit the academic teaching staff with its own best graduates. A training ground being created, an opportunity emerged for centralized training control of non-professional drivers and multiskilled tractor drivers. Students took active part in faculty development making stands and laboratory scale-plants, assembling equipment, constructing laboratory and engineering buildings, which enlarged the working areas. Many candidate's and doctor's dissertations were based on the unique results of the newly-opened Students Engineering Design Research Office. The unique in this country fundamental research laboratory on magnetic susceptibility of various soils was founded in the Department of Physics. Nowadays there are six Departments of the Faculty, each with its own scientific field. The senior students participate in research activity and design engineering projects of the Departments, take part in Republic and all-Russia exhibitions, accomplish graduation and course papers using objective material. The alumni work in various regions of the Russian Federation and other countries handling their main problem – to increase the agricultural production output.

Key words: Izhevsk State Agricultural Academy; Agricultural Engineering Faculty; history; scientific research; teaching activity.

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Natural resources assessment by remote sensing methods for the benefit of the Udmurt Republic

The article is devoted to the research of the Earth's remote sensing (ERS) applied to the territory of the Udmurt Republic. The thematic justification is proved as the modern technologies of ERS support operating and effective control of different areas of economic activities. The historical background is considered. Due to the acceptance of "Concept of Russian ERS system development for the period until 2025" the usage of satellite observation materials in the interest of the Udmurt Republic is analyzed. The purpose and objectives of research are formulated applying appropriate IT, including those of agricultural function. The possibility of adaptation of earlier results of research and development in ERS for the Udmurt Republic is considered. The IT of digital surface model (DSM) projection is described based on the results of satellite observation materials decoding. The raster member objects of land area of Kizner district of Udmurtia are introduced (satellite photograph, topographic base, landscape map); the landscapes of the western Udmurtia are described. The fragments of DSM characteristics system are given for the creation of logical solvers. Logical indication solvers made by software subsystem implementing the given algorithm are presented. It is reported that the solvers of such kind are often realized under expert systems. This work uses the exhaustive procedure based on empirical tables of diverse data. As a result, the created logical solvers are highly objective. The results of the conducted researches showed that the reliability of the IT decoding of terrain features based on ERS materials is 1.5-2 times better than the reliability of the visual decoding. It is a good precondition for conducting further research and construction works in the territory of Udmurtia.

The scientific targets which should be solved in the interest of the Udmurt Republic are formulated:

1) to plan the acquisition of ERS materials for the Udmurt territories of interest;

2) to organize scientific groups for research and construction works and give them specific tasks for solving the problems of forestry and agriculture, such as forest and flora characteristics, types of bogs, characteristics of quaternary deposits, characteristics of hydrogeological objects;

3) to generalize the findings of conducted research works and develop the scientific recommendations for forestry and agriculture;

4) to develop the mathematical models for ERS research for their further use not only for the benefit of the Udmurt Republic but of the whole Russia.

Key words: Earth's remote sensing; satellite observation; digital surface model; information technology.

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The results of the preliminary studies of vibrational impurity trap for grain crushers

The article studies the applicability of inevitable grain crusher vibrating for separation of metal and mineral impurities from grain heaps before grain refinement. When impurities get into the grain crusher they destroy its inner tools

or lead to their intensive wearing. Current technical solutions for pre-refinement impurities removal do not meet zootechnic and techno-economic requirements. The work objective is the efficiency improvement of hummer grain crushers by means of developing the separation process of the mineral and metal impurities from grain heaps. According to the target goal the work solves the following problems: to develop a constructive technological scheme of a vibrational impurity trap and determine its characteristics experimentally. Under vibration the grain stream can be seen as "pseudoliquid" that is why impurities with higher density sink in the grain heap. The developed design of the impurity trap offers the possibility of controlling significant factors necessary for theoretical and practical basis for vibratory separator characteristics in wide range. It becomes obvious from the working process that it is necessary to determine such parameters as the minimal length of working part of a vibrating chute or the minimal distance from tanker to sill. A laboratory machine based on the proposed scheme was produced. It provides the possibility of simulating the process of impurities separation from grain heaps using vibrations, which is common for grain crushers. The research showed that with the electrical voltage increase the idle power and shaft speed grow nonlinearly; the oscillation frequency of a vibrating chute is the closest parameter to shaft speed of grain crushers. The usage of experimental data with the application of similarity theory can identify the characteristics of vibrational impurity trap for a certain grain crusher.

Key words: metal and mineral impurities; vibrational impurity trap; characteristics; density; speed; sinking; grain crushers.

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 Classification of planting machines according to main functioning characteristics

 Nowadays the majority of planting machines in Russia are foreign-manufactured, consequently they have high service costs and depend on foreign manufacturers. The article is focused on searching for main distinguishing characteristic features of existent planting machines, sorting them into different groups and making an appropriate classification. This research allows determining the most efficient way of planting machines construction developing and formulating specified requirements for them. The analysis of modern Russian and foreign planting machines is conducted; their advantages and disadvantages are also mentioned. The main competitor of Russian machines is an Italian enterprise «Hortech». During the research it became clear that the most demanded planting machines in farms are semi-automatic ones. These machines combine the automatic and hand-power work principles. Due to this fact the human factor influence on the planting process decreases, but at the same time a human controls this process on all stages and can correct it in time when it is necessary. As a result of analysis the classification based on main functioning characteristics was offered. The following functioning characteristics were considered as most important and prospective: sheet movement of sprouts in a planting machine and embodiment of machine working parts. The requirements to the planting machine selection in specific agricultural situations are formulated.

Key words: planting machines construction; characteristics; classification of planting machines according to main functioning characteristics; machine working parts.

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Modern farm equipment safety improvement

The possibility of being injured in the agricultural sector due to road traffic accidents and while working with moving, flying and revolving objects and details is very high. New farm equipment and operational manuals should satisfy the demands of legal requirements for reducing the injury possibility. The article gives recommendations on design development of the potato digging and gathering machine KSK-2M and operational manuals for it. Recommendations on construction development are the following: to provide the availability of wheel chocks; to install cat's eyes, alarm lights; to apply the speed limitation sign; to install the protective covers on all dangerous zones; to provide the availability of special cleaning instruments; to identify the direction of adjusting screw turning when moving up (down) a supporting wheel; to mark the lubrication points; to provide the storage area for keeping wheel chocks; to provide the mark for discharge gear in a machine construction or a technical description. For the technical manual improvement it is recommended to complement it with drafts showing the places for lifting mechanism fastening; requirements for maintenance space; decipherment of type codes and signs on the machine; prepared machine qualification documents and attach them to instruction; information on particular risks in some cases of specific fittings application and protective measures; information on individual means of protection; information on maintenance diagnostics, repair and restarting after fault handling; pictures illustrating proper operations and maintenance; information on machine removal from service, disassembling and utilization; information on emergency situations; strictly divided information on activities of qualified and unqualified staff. Keeping to the recommendations decreases the possibility of injuries and increases marketability of equipment.
Key words: injury prevention; potato digging and gathering machine; construction; instruction; requirements; real situation; recommendations.

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Study of tribotechnical characteristics of metal-polymeric coatings of «B83-MoS2-F4» system

The article studies the problems of creating more modern and effective coatings on machine details surface having the mechanical and physical characteristics for working both in normal and extreme conditions. The new technology of antifriction coating application on machine parts with laser processing of composite powdered materials of «B83-MoS2-F4» system is suggested. The selection of primary components was made on the ground of antifriction materials analysis for coatings preparation. The methodology of metal-polymeric coatings application is developed as well as the laboratory procedures under the conditions of hydrodynamic and dry friction. The results of laboratory and experimental researches of coatings under the conditions of hydrodynamic and dry friction are presented. The results obtained show that metal-polymeric coatings of «B83-MoS2-F4» system have better tribotechnical characteristics and bearing strength as compared to traditional coatings. Particularly they have a lower friction coefficient and wear rate under the conditions of oil starvation and high unit loading.

Key words: laser processing; babbit B-83; stannum; molybdenum disulphide; molykote grease; machine parts surface; tribotechnical tests; wearability; coefficient of friction; coating.

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Classification of rotary working elements of agricultural machines
The article analyzes the modern and most popular rotary working elements and machines, and classifies the working elements according to two main principles: the energy transferred to the working element and the spacing of a rotative axis. The working elements can be rotary reactive and rotary active depending on the energy transferred to them. When the energy is transferred from the motor to the rotor through the cardan shaft, hydraulic or electric actuator, the rotor spinning becomes active and the working element is called rotary active. When the energy is transferred from the tractor to the rotary working element through tractor draft force and the working element gets spin from passive interaction with ground, i.e. influenced by external reactive force, these working elements are called rotary reactive. Working elements are divided into three groups and seven subgroups A, B, C, D, E, F, G based on a position of a rotative axis. This classification describes all varieties of working elements and possible spacing of their rotative axis. It facilitates the further arrangement of theoretical researches.
Key words: classification; rotor; energy; rotative axis; machines; tools.

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The usage of fiber-glass bars in the elevators of potato harvesters

Generally potato hand harvesting prevails in individual and farm households. That is why small-size machines suiting special conditions of crop cultivating are necessary for this kind of household management. The aim of research was the increase of the functional reliability and efficiency of a potato-digger as well as costs reduction of potatoes. Nowadays the potato-digger KTN-2B is the most commonly used. The drawback of this type is the great bar mass which increases the gravity of the whole construction complicating the machine control. It is suggested to modernize the KTN-2B potato-digger replacing the bush-roller elevator apron with the belt one and the steel bars with bars made of fiber-glass. It will make it possible to increase the operating life of the elevator three times, reduce the overall weight of a potato-digger by 90 kg, and improve controllability of a tractor during harvest-work and maneuvering. During field tests in 2014 the whole updated potato-digger as well as its cleaning and cascaded elevators made of fiberglass bars showed high level of efficiency. It allowed reducing the fuel consumption by 7% during harvesting. Fiber-glass bars were proved to be

hardwearing, reliable and their usage contributed to the potato tubers damage reduction to 3%. The drawbacks are: pileup of furrow slice, low reliability of potato-digger mounting, low reliability of connecting links of the bars.

Key words: KTN-2B potato-digger; modernization; flat belt elevator; fiber-glass bars; fuel saving.

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Possibilities of agricultural labor automation

Nowadays the technical development of agriculture follows the way of expanding capacities of agricultural machines. The aim of research was the analysis of agricultural problems and robotization as one of their solutions. The analysis of agricultural robotization in foreign countries revealed a number of obvious advantages, namely, removal of human factor; improvement of quality and ecological properties of goods; production costs reduction; power inputs reduction; increasing of productiveness and labour efficiency; increasing of production predictability and controllability. Productiveness increase and labour efficiency in agricultural industry with the use of robotization can be achieved only on the base

of automation of routine and algorithmized operations in intellectual and productive human activities under the complete integrated automation of flexible manufacturing systems. One of the main reasons of high attention to robots reliability in agricultural industry is connected with difficulties of technical maintenance and repair, lack of facilities and experts. The gap between Russian and world robot technology is observed not only in terms of reliability but also in materials and energy consumption, productivity, speed, accuracy. This is especially noticeable in the element base of operating devices, gears, software support, training systems. There are no objective methods of economic efficiency evaluation. There are drawbacks in scientific research organization and conduction. The only solution is to transfer the scientific researches on commercial principle provided that the government finances fundamental works.

Key words: robot technology; agricultural labor automation; advantages and disadvantages of robotization; working operations; controlling devices; software.

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Regulation factors of ignition advance angle in overcompressed engine
One of the ways to gain in performance of a petrol internal combustion engine is to increase the expansion ratio of a working medium. The radical method of increasing the expansion ratio is higher compression and engine conversion to the overcompressed cycle. To reveal the trends of change in ignition advance angle in

the overcompressed cycle the peculiarities of two cycles of a four-stroke petrol engine were compared and analyzed – the classical cycle and the overcompressed one. The calculations are given for VAZ-2106 engine with various degrees of compression. The results show that the overcompressed cycle differs essentially from the classical engine cycle with electric ignition. The range of regulations for ignition advance angle in the overcompressed cycle is narrower than in the classical one. The narrower ranges of regulations involve the higher setting accuracy of ignition, i.e. a microprocessor ignition timing system is required. The cylinder pressure which should be measured while in operation for the accurate determination of ignition angle is the most informative parameter of ignition advance angle in the overcompressed engine. It is better to measure the cylinder pressure with indirect indication of an engine with the help of a sensor set on one of the load-bearing members of an engine cylinder head.

Key words: four-stroke petrol internal combustion engine; ignition advance angle; classical engine cycle; overcompressed engine cycle.

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S-LINES AND ENTROPIC NOMOGRAMS

The concept of the entropy of spatial-energy interactions is used similarly to the ideas of thermodynamics on the static entropy. The idea of entropy appeared on the base of the second law of thermodynamics and ideas of the adduced quantity of heat. These rules are general assertions independent of microscopic models. Therefore, their application and consideration can result in a large number of consequences which are most fruitfully used in statistic thermodynamics. In this research we are trying to apply the concept of entropy to assess the degree of spatial-energy interactions using their graphic dependence and in other fields. The nomogram assessing the entropy of different processes is obtained. The diversity of entropy manifestations is discussed including biochemical processes, economics and engineering systems.

Key words: entropy; nomogram; spatial-energy parameter; biophysical processes; business; engineering systems.

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