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IMPROVING DIRECTIONAL STABILITY OF TOOLS USED FOR CULTIVATING ROW COPS

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Positioning of a land cultivation unit on the field determined by the specific location of its working tools is one of the precision farming criteria used in the cultivation of row crops. The navigation system provides reference-input signals as it determines the position of the machine-tractor unit (MTU) and its implements. When the MTU moves along the treated field surface, its tools deviate from their trajectory due to the difference in density and soil moisture, as well as local inclines. The authors present a controlled mounted implement "UNU-2", which together with the navigation system installed on the tractor allows determining the location and course position relative to the coordinates specified by the navigation system. The paper also presents characteristics and operating principle of the device. Using the controllable mounted implement will allow positioning and changing the inclination angle of the tool on the prescribed flat horizontal surface. This will ensure high accuracy of operations performed by the MTU, increase its technical performance level, and reduce labor costs. Thus, the use of tractors and controllable mounted implement based on navigation systems ensures the accuracy and efficiency of such technological operations as planting and cultivating of row crops. The development of a technical device for adjusting the trajectory of mounted implements increases the efficiency of the MTU operation.

Key words: unit, directional stability, navigation, controllable mounted implement, implement position angle, operating accuracy, reduction of plant damage.

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INFLUENCE OF TRANSVERSE GROOVES OF EXTERNAL DRUM SURFACE OF CLOVER THRESHER-SCARIFIER KC-0.2 ON SEED THRESHING QUALITY

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The paper presents the research results of drum-type clover thresher and scarifier KC-0.2 with tangential feed. The drum surface consists of edged steel hexagonal rolled steel bars. To improve the efficiency of threshing clover seeds, steel bars are provided with transverse grooves. The grooves have a triangular profile, the width of which increases towards the drum's outer diameter, thereby reducing the probability of groove clogging when processing wet clover hulls, while increasing the drum contact area with the processed material, and the sharp groove edges increase the destruction efficiency of hard legume seeds. The authors have experimentally studied the effect of transverse grooves located on the trowel surface of the drum on seed wiping and crushing. At the first stage, a comparative study of seed threshing in a conventional way (without transverse drum grooves) and a new one (with transverse drum grooves) was carried out. It was found that the grooves reduce seed crushing in 2...3 times with a slight decrease in their threshing. At the second stage, the effect of the transverse groove depth and the drum speed on the seed threshing quality was studied by the method of experiment planning. The highest values of the threshing degree of red clover seeds at a nominal supply of 250 ± 15 kg/h and the

allowable crushing of seeds of 1.5% has been achieved at the following combinations: the groove depth $h = 2.0 \dots 2.8$ mm and the drum speed $n = 1545 \dots 1575$ min⁻¹.

Key words: grass seeds, grass seed threshing, clover hull, clover thresher and scarifier, quality of grass seed threshing, threshing drum.

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POWER REQUIREMENTS OF A ROTARY TILLER

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The paper studies a rotary tiller having a horizontal rotation axis of working tools, which allows to improve the quality of soil tillage as compared with passive working elements. The authors have calculated the power required for soil tillage with a rotary tiller КФГ-3.6 and determined the relationship between the power and the rotary tiller parameters: the body movement speed, the peripheral speed of a knife blade point, the depth of soil tillage, the knife feed, and the cutting arc length. Using the methods of step-by-step regression analysis, the authors determined a regression equation that adequately approximates the relationship between power per unit operating width and the studied parameters. The multiple correlation coefficient of the regression equation with the movement speed factors of the rotary tiller frame, the length of the cutting arc, the knife feed equals 0.95. It has been established that for calculating the specific power required for rotary tillage, with a given number of knives on the rotary tiller circumference, three parameters need to be taken into account: the movement speed of the cutter frame, the cutting arc length, and the knife feed. The significant effect on the specific power of the cutting arc length is explained by the fact that, along with soil cutting with a blade, power requirements are also affected by soil crushing and wedging with the knife.

Key words: rotary soil tiller, tillage power requirement.

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DETERMING OPERATING MODES OF AXIAL-ROTARY COMBINE HARVESTERS FOR HARVESTING MIXED CROPS

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The authors have conducted a study to determine a set of operating modes of axial-rotary combine harvesters for mixed harvesting of cereal grain and leguminous crops. The paper outlines a technological process of axial-rotary combine harvesters, lists their technical characteristics and features of operation. A mathematical model has been compiled to determine the operating modes of axial-rotary threshing and separating systems for harvesting mixed crops and transfer coefficients have been specified. The first coefficient describes complete threshing of eared grains, and the second one reflects the minimal damage to the leguminous component. The aggregation function is presented in the form of the relationship between indicators of the same level. The authors have evaluated quality indicators of harvesting mixed crops

with axial-rotary combine harvesters. The paper presents dependences of macro- and microdamages of of cereal and legume grains in mixed crops after harvesting with axial-rotary combines. The operation modes of the combine harvester PCM-181 "TORUM" for harvesting mixed crops of white lupine and triticale have been substantiated. As a result, a gap between the rotor and the deck of 35 mm and a rotor speed of 400...450 min⁻¹ are recommended.

Key words: harvesting, mixed crops, grain loss, grain damage.

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EXPERIMENTAL STUDIES OF THE PHYSICAL MODEL OF A NEW WORKING TOOL OF SUBSOIL CHIESEL PLOWS

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The purpose of developing a new working tool is to reduce traction resistances and increase the loosening extent and quality of plowed soil layers and plow pan. Experimental studies were conducted on a plot of land with a reduced model of the new two-level subsoil chisel plow. Application of the two-level design is aimed at more extended coverage of soil profile handling inside the chisel plow circuit with reduced traction resistances. The loosening degree increase is achieved by installing side panels and a working tool share at the best angle. Traction resistance were determined depending on the depth of loosening. The degree of loosening was measured taking into account the amount of soil surface inflation, as well as the cross section of a loosened plot. The experimental study results were processed using methods of statistical analysis. The analysis of the results has shown that using a new two-level subsoil chisel plow reduces traction resistance to loosening by 7...10% as compared with the basic working tool. The loosening degree has increased by 10...15%, while ensuring maximum distribution uniformity of soil lumps over the entire treatment area.

Key words: deep soil loosening, chisel plows, loosening quality, the amount of soil surface inflation after loosening, soil loosening resistance, plow pan.

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MODELING PROCESSES OF CENTRIFUGAL SEPARATION AND ULTRAFILTRATION OF WASTEWATER ON LIVESTOCK FARMS

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Ecologization of animal husbandry is determined by the efficiency of manure disposal in agricultural fields. Manure effluents are formed as a result of livestock keeping without litter and they contain pathogenic bacteria, helminth eggs and larvae. For the treatment of manure effluents as multicomponent substances, the authors have proposed a technology including their separation into solid and liquid fractions in a precipitation centrifuge with a screw sediment discharge and subsequent deworming of the liquid fraction in an ultrafiltration installation. To evaluate the effectiveness of the technology, the methods of mathematical modeling were applied. The methods are based on both original approaches to the centrifugation process with the determination of local fractional degrees of capturing and the integral degree of cleaning, and conventional ones consisting in the ultrafiltration process based on the diffusing of a substance through a semipermeable partition under the action of a pressure gradient. The research was carried out in a livestock breeding farm enterprise. According to the results of mathematical modeling, it was established that for a given performance of 3...4 m³/h all considered centrifuges of the OΓIII type provide 97 % degree of manure removal from the solid fraction, while according to the energy efficiency criterion, it is advisable to recommend the OΓIII-202K-03 machine with the drive power

of 5.5 kW. It was found that to clean the liquid fraction from pathogenic microorganisms, an increase in the operating pressure p from 0.1 to 0.7 MPa is accompanied by a decrease in the area F of the membrane filter partition of the МФАС-Б-4 and МФАС-П-2 type from 78.2 to 11.2 m² for membrane type МФАС-МА-6 – respectively from 33.0 to 4.7 m². It was found that at an operating pressure of 0.2 MPa, according to the criteria of energy intensity of the process and material capacity of the ultrafiltration installation, it is advisable to use a МФАС-П-3 membrane type with a filter partition area of 2.73 m².

Keywords: process modeling, centrifugation, ultrafiltration, manure effluents, pathogenic bacteria and microorganisms, fertilizers, resource-efficient machine technologies.

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PROVIDING OZONE-ION AIR INDOOR ENVIRONMENT FOR KEEPING LIVESTOCK AND POULTRY

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The paper reports on the studies carried out on the pre-incubation treatment of chicken eggs in the disinfection chamber of a hatchery using an air ozonizer. It has been established that the content of ozone and negative ions in the disinfection chamber depends on the chamber volume, the location of the ozonizer outlet and the saturation time of the disinfection chamber of a hatchery. It is noted that when the saturation of the disinfection chamber of a hatchery with ozone and ions increases, the concentration of ozone reaches up to 12 mg/m³, and ions – 2500 pC/m³. Mathematical models describing the working processes of ozone saturation and decomposition in the hatchery disinfection chamber have been obtained. The main parameters and the required operating modes of ozonizers with a concentration of 0.12 mg/m³ for ozone and 490 pC/m³ for ions have been determined. The concentration of ozone and ions in the disinfection chamber of a hatchery, depending on the operating time of the ozonizer, is represented by a power function. It has been determined that in order to ensure the ozone concentration in the chamber of 5 mg/m³ and negative ions of the order of 500 pC/m³, the ozonizer should operate for 30 minutes. At the same time, specific energy consumption for achieving the required ozone concentration in the disinfection chamber of a hatchery will amount to 2.2 kWh/g, the specific energy consumption for the production of 1000 eggs will amount to 0.0004 kWh.

Key words: ozonation, ionization, ozonizer, ionizer, ozone-ion air mixture.

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MODERN DEVELOPMENT TRENDS OF POTATO HARVESTER DESIGNS

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The paper discusses the modern methods of application and development of potato harvesting machinery in the Russian Federation. The authors outline the development trends of the considered machinery designs, singling out the following groups of modern potato-harvesting machines: small-sized machinery used in small farms; medium - trailed machines of various systems used on large farms; and complex self-propelled high-performance multi-row machinery featuring electronic process control systems and used in enterprises possessing appropriate technological service systems. The paper provides examples of all groups of the studied equipment. The authors have studied serial potato harvesting machines produced by domestic and foreign manufacturers. Despite a number of advantages of imported machinery, its disadvantage is the excessively high cost of the machines, as well as spare parts for them. It is noted that to increase the

potato production, farms of all types need reliable and easy-to-use serial equipment of domestic production adapted for domestic conditions, and also ensuring the optimal combination of price and quality.

Key words: potato harvesting machinery, development trends, domestic and foreign manufacturers, technological process, implement coupling.

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USE OF BIOLOGICALLY ACTIVE POLYFUNCTIONAL POLYMERIC COMPOUNDS IN POTATO CULTIVATION

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In the conditions of growing intensification, application of chemicals, and the use of increasingly powerful pesticides, there is a need to shift to biological agriculture developing technologies of growing ecologically safe products. Alternative farming systems are currently actively introduced – examples include the replacement of traditional pesticides to ensure the biological protection of plants and decreased application rates of mineral fertilizers. Of great importance is the use of drugs that have complex effective actions in the cultivation and protection of crops. The study was carried out in 2017-2018, in the VNIKH institute on the background of fractional-local application of mineral azophoska fertilizers with the addition of potassium magnesia at a rate of 90 : 90 : 120 with use of the “Growth Matrix” preparation (15% soluble concentrate – biologically active polyfunctional polymeric compound) in five potato varieties with different maturity stage – Red Scarlett, Ilyinsky, Golubizna, Nakra and Nikulinskiy. On average, over a two-year period, Nikulinskiy, Red Scarlett and Ilyinsky varieties showed an increase of 5.6, 4.4 and 3.8 t/ha (24, 22 and 21%), respectively. On average, when using the “Growth Matrix” preparation for all tested varieties, an increase in yield of 3.6 t/ha (18%) or up to 70 thousand rubles/ha of conditional net income was observed.

Key words: potato varieties, potato growing technology, fractional-local fertilizing, preparation-antistress agent, polyfunctional polymeric compound, yield.

TECHNICAL SERVICE IN AGRICULTURE

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ANTICORROSION PROTECTION OF THE HEAT-EXCHANGE EQUIPMENT OF FARM PROCESSING ENTERPRISES WITH REPAIR AND RECOVERY COATINGS

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Analysis of repair methods of shell-and-tube heat exchangers (STHE) has shown the necessity to develop a new approach to the repair and reconditioning organization of STHE heat transfer tubes. One of the promising ways to restore and protect STHE tubes is to treat them with polymer compounds especially with heat-dissipating plastics – polymers with greatly increased thermal conductivity. In the research, a method for corrosion protection and restoration of STHE surfaces is proposed. This method consists in using liquid reactive oligomers or monomers to form a coating in the treated circuit without using special in-tube devices. To initiate curing, a coolant with a temperature equal to or higher than the curing temperature of the coating material is introduced into the adjacent STHE circuit. Heat transfer process was modeled from the coolant to the material (compound) through the separating wall, which allowed to determine the requirements for the compound necessary to implement the discussed method. According to the established requirements, the authors have proposed a compound and its curing technology with recommendations on the use of latent hardeners based on Lewis acids in the temperature ranges of 80...100°C and 120...140°C. The proposed method of protecting and reconditioning STHE tubes allows to apply a uniform coating with a predefined elasticity, resistant to linear expansion of the tube metal and with a thickness sufficient to seal through-wall defects.

Key words: anticorrosive protection, heat exchange equipment, repair method, strength, use, repair and restoration coatings, compound, stress corrosion cracking.

ECONOMY AND ORGANIZATION OF AGRICULTURAL ENGINEERING SYSTEMS

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ECONOMIC ASPECTS AND ACTUAL TRENDS OF TECHNICAL PROGRESS IN AGRICULTURE AT THE PRESENT STAGE

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The paper covers topical issues relating to with scientific and technological progress in the agricultural branch of national economy. The author examines main development trends associated with technical progress and states the role of entrepreneurship in scientific and technological progress. Technical and technological innovations are classified into fundamentally new ones; new ones of a modern scientific and technical level but having analogues; new ones developed as a result of modernization and innovation activities. The author reveals characteristic features of the modern innovative stage of development of automated agricultural production: complex automation, widespread use of robots, computerization, etc. Data of the agro-holding GC "Agropromkomplektatsiya" serve as an example of modern automated agro-industrial production. The agricultural holding increased the volume of meat processing from 997.5 to 83.4 thousand tons. (more than 80 times) through the use of innovative technologies and machinery from 2003 to 2018. "Dmitrova Gora" agrofirma of the same agricultural holding has tripled milk production for 2010-2018. Due to the introduction of modern production technologies based on the digital economy, there was not only an increase in efficiency, but also a rapid increase in production volumes.

Key words: scientific and technical progress, farm industry, innovative machinery and technologies, computerization of production, labor productivity, labor intensity and production costs, economic evaluation of machinery and technology.

POWER SUPPLY AND AUTOMATION OF AGRICULTURAL PRODUCTION

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ELECTRIC PROPERTIES OF WATER

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The paper considers the dynamics of water exposure to an electric field of low intensity (up to 3.0 V). It has been established that the process of changing the electric current in an aqueous medium is exponential: the higher the applied voltage, the higher the exponent is located above the x-axis. It is shown that the exponents have time constants within 60 s, moreover, a change in the polarity of electrodes has a slight effect on their values. It is determined that the presence of impurities in water affects the position of the exponents. The cleaner the water is, the closer the exponent is to the x-axis. The effect of the polarity of electrodes on the dynamics of changes in the electric current when the electrode system is connected to a constant current source is studied. As a result of this process, the steady-state current values depend on the applied voltage. It is found that the difference in steady-state current values between the electrodes with substantially changing polarity changes in value and sign depending on the the applied voltage. It is noted that the highest indicators of the difference of the steady-state values of current when the polarity of the coaxial system of graphite electrodes is changing are observed near the electric potential value of the experimental system determined by the standard electrolysis potentials of water and graphite. The results obtained can be used in research and design of electro-hydraulic installations and water electroactivators.

Key words: water, coaxial system of graphite electrodes, electric current, exponent.