FARM MACHINERY AND TECHNOLOGIES

RIDGE HEIGHT AND THE LENGTH OF A SOIL CUT ARC FORMED BY A ROTARY TILLER WITH THE MALTESE MECHANISM IN THE DRIVE

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The research object is a rotary tiller with a horizontal axis of rotation, with the Maltese mechanism installed in the drive and equipped with a cross with radial grooves. A rotary tiller with the Maltese mechanism in the drive can be used when tilling extremely wet loamy soils. Under the given depth of cutting and preset knive position, the rotor does not rotate at the moment of blades penetrating the soil and going out of it. The aim of the study is to obtain the estimates of the ridge height and the length of a soil cut arc formed by a rotary tiller knife in the plane of its rotation. The paper considers the operation of a rotary tiller equipped with the Maltese mechanism and without it. The author has obtained equations of the trajectories for two tiller knives in the plane of their rotation. The paper presents a detailed algorithm for calculating the ridge height and the length of a soil cut arc implemented in a computer model of the rotary soil tillage. It has been shown that the use of the Maltese mechanism in the rotary tiller drive could reduce the ridge height by 10…25% and ensure smoother cutting. The length of a soil cut arc formed by a rotary tiller knife has been increased by approximately 1…10%.
Keywords: rotary tiller, computer model of soil cultivation with rotary tiller, Maltese mechanism.

SIMULATING A VEHICLE SUSPENSION SYSTEM BASED ON A SHOCK ABSORBER OF REGENERATIVE ACTION

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The paper describes the structure of a vehicle suspension system with the recovery of the mechanical energy of sprung mass vibrations into electrical energy. The system consists of a set of shock absorbers with a recuperative action, power converters and a control unit for recharging the energy storage in the form of a battery. The shock absorber has a synchronous electric machine excited from permanent magnets and a converting mechanism in the form of a ballscrew. The authors present mathematical model of the vehicle suspension system based on a shock absorber of recuperative action. With the help of a mathematical model, it is possible to determine the power, which can be recuperated by the vehicle suspension system when driving on roads of variable quality (aspalt and dirt) at different speeds. It has been found that when a truck moves at a speed of 40…50 km/h along an asphalt concrete road, the average recoverable power of the system amounts to 0.011 kW, and when driving along dirt roads it is 0.206 kW. When driving on a flat asphalt road, the efficiency amounts to 0.02…0.03% and is comparable to the energy costs of the control system. When a truck was moving along a dirt road, the average efficiency was about 1% or 1.2621 kWh/100 km. The authors claim that

the offered mathematical model allows to reduce the total research test cost of the shock absorber of regenerative action.

Key words: shock absorber of regenerative action, mathematical model, converter, recharging, permanent magnet synchronous machine.

REDUCING TRACTION RESISTANCE OF AGRICULTURAL MACHINES BY MINIMALIZING ITS FLUCTUATIONS WHEN TILLING HEAVY -LOAMY SOILS

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The paper presents the results of studies aimed at reducing energy costs required for the tillage of heavy soils by reducing fluctuations in traction resistance, which occur during the operation of a machine-tractor unit. The authors propose possible ways of reducing the tractor's pull arising from the action of an agricultural machine, which inevitably lead to an increase in the overall traction resistance and cause unreasonable negative effects on the energy units and their operators, thus significantly reducing the efficiency of the units. The ways of reducing load fluctuations include: the use of elastic links provided for in the tractor linkage design; the use of elastic-damping systems in the design of working elements, as well as the development of machines with rotary working elements, the technological process of which does not cause large load fluctuations. The most effective way is to use machines with rotary working elements. The authors have obtained and present mathematical expressions for finding the total resistance arising during the operation of the automatically driven sectional working element for combing weeds and loosening the soil. According to the research results, the authors present a perfect design of a sectional working element, which is capable of eradicating weed plants by combing them together with the root and simultaneous loosening of the surface layer of heavy loamy soils to a depth of 2…10 cm. It has been found that the sectional working element has a low amplitude of self-excited vibrations during operation (0.12 kN) due to the rotation of the rotors, which has a positive effect on the technological process and the working conditions of the machine operator, as well as reduces the energy consumption for crop cultivation in 1.8…2.0 times as compared with flat-cutting paws.

Key words: soil tillage, rotor, traction resistance, resistance fluctuation, energy consumption reduction, machine-tractor unit, elastic element, tractor hitch, flat-cutting paw.

THEORETICAL DETERMINATION OF DESIGN PARAMETERS OF A COULTER WITH A SPRING-TYPE ELASTIC MECHANISM FOR EMBEDDING SEED MATERIAL WITH SOIL

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Growing onion from onion sets is the most common and most widely used way. According to the research results, the onion yield is known to be greatly influenced by the stem-down position of the onion set in the furrow and the uniform distribution of onion bulbs along the row. From the carried out patent-technical search and the analysis of the existing furrow-spreading working elements of the sowing and planting machines, no clear evidence has been found about keeping the planting material in its initial position when embedding it in the soil. In this connection, a coulter of the planting machine has been developed to provide both uniform downward embedding of onion sets to the depth of different soil types and its even distribution along the furrow, as a result of adjusting the distance between the coulter body and the embedding elements during the operation. It is noted that the installation of elements for embedding onion sets depends on the planting machine speed and the horizontal component of the onion dropping speed, as well as the dropping height. Expressions have been obtained to determine the width of the embedding element surface, the distance between the coulter body and the embedding elements, as well as the working surface area of the embedding element.

Key words: embedding elements, onion, design parameters, length, radius of curvature, lifting speed of soil particles.

DETERMINATION OF OPERATION MO DE PARAMETERS OF A CUTTING UNIT OF THE DEVICE FOR POTATO DECAPITATION

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The technological method of decapitation (the removal of apical shoots) helps to increase the potato yield. For carrying out decapitation a mechanised device has been designed. Agrotechnical requirements for decaptivation include a high-quality cut of apical shoots without looseness, as this injury contributes to the introduction of various, especially viral, pathogens. To prevent diseases, the cut place is treated with a disinfectant solution. An important element of the device is the cutting mechanism. The authors suggest a design algorithm of a rotary cutting device able to make free cuts. It has been determined that with an increase in the number of cutting blades, the intensity of changes in the size of the outer diameter of the rotor decreases. With an increase in the number of cutting edges from one to two, the outer diameter of the knife will decrease by 21.3%, from two to three – by 9%, from three to four – by 5%. The total length of the cutting edges of the rotor depends on its minimum radius, cutting speed and the machine speed. The authors have calculated the external diameter of the knives at different rotor speeds and the values of its internal diameter depending on the number of cutting edges. The calculated speed of the unit has amounted to 2 m/s. The authors have found that to ensure quality and reliable cutoff of potato shoots when carrying out decapitation, one should use a cutting rotor with three blades rotating with a frequency of 1200 min‑1, with the outer diameter of the cutting edges not less than 0.35 m, and the working height of the blade of 0.04 m.

Keywords: potato, cutting machine, non-pressure cut, cutting edge, speed of the unit.

INFLUENCE OF ENVIRONMENTAL FACTORS ON THE DECREASE OF PESTICIDE EFFECT ON POTATO YIELD

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In the face of growing intensification, the application of chemicals, the use of increasingly powerful pesticides, there is a growing need to shift to biologization agriculture, the development of technologies for growing of ecologically safe products. The authprs have carried out an experimental crop rotation with a reduced pesticide effect with elements of organic farming. Field experiments, records and observations were carried out and kept in accordance with the requirements of the field experience methodology and research methods for potato crops. At the experimental site, for nine years, Jerusalem artichoke was grown in a monoculture, chemical treatments were not carried out and mineral fertilizers were not introduced. Further on, Jerusalem artichoke crops were twice sown in the soil along with green manure crops: Lupin white, white mustard, and oats. After the sowing of green manure crops potato crops were planted. The study was performed on elite material of potato varieties resistant to the main diseases: late blight, early blight, scab, Rhizoctonia – Udacha (early), Vympel (mid-season), Vektar Belorusskiy (medium). It has been noted that the highest gross yield was obtained in all the studied varieties when planting potatoes after white mustard, oats and lupin. The average potato yield was 28.9, 28.3 and 25.5 t/ha, respectively. At the same time, the yield obtained after oats (grown after potatoes) mounted to 23.4 t/ha. The use of green manure crops (white mustard, white lupine, and oats) in the crop rotation after Jerusalem artichoke is estimated to allow obtaining a conditional net income of up to 90 thousand rubles/ha.

Key words: potato varieties, pesticide load reduction, green manure crops, preparations.

TECHNICAL SERVICE IN AGRICULTURE

PROTECTIVE FRAME FOR A NARROW - WIDTH TRACTOR

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The paper presents the strength test results of the protective frame of a tractor driver used on narrow-width tractors in the Republic of Serbia. The studies were conducted in the accredited laboratory of power machines and tractors of the Agricultural Faculty of the University of Novi Sad in accordance with official OECD requirements for testing the protective structures of narrow-width wheeled tractors for agriculture and forestry (Serbia). It has been found that when a maximum longitudinal load of 5.7…5.8 kN was applied to the back of the protective frame, the deflection of its elements was about 200 mm. The largest deflection of the elements in the front part of the frame was about 80 mm (with the maximum applied load of 14.2…14.3 kN). With a lateral load of 26 kN, the deflection of the structure was 74 mm. During the tests, no cracks or breaks of the protective frame elements were observed. Using the example of the narrow-width tractor PRIMA TT 830S, the authors demonstrate that its equipping with a protective frame will significantly reduce the risk of injury to the driver (including fatal injuries) when the tractor overturns. The developed protective frame can be installed on tractors of a similar class manufactured by other companies.
Key words: narrow-width tractor, overturning, protective frame, design, testing, test.

IMPROVING THE WEAR RESISTANCE OF PARTS WITH ELECTROMECHANICAL SURFACE HARDENING

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The hardening of parts made of steel and cast iron by electromechanical surface treatment is one of the effective technologies for hardening the important surfaces of products with concentrated energy flows. The paper presents the results of comparative wear tests of steel 38Х2МЮА samples after hardening of their outer diameter by concentrated energy flows by nitriding and electromechanical surface hardening (EMSH). The test duration was 60, 120, 240 and 480 seconds. Nitriding was carried out for 18 hours at a temperature of 550°C. EMSH of cylindrical shaped samples was carried out at a temperature of 1000…1100°C in the "tool-surface" contact zone and an optimum force was 400 N in the contact zone of the instrument and samples. Comparative tests of the wear resistance of the treated surface of the samples were carried out on a friction machine according to the method of the American Society for Testing and Materials (ASTM G65). The results of the wear tests of the samples indicate a

high efficiency of the technology as compared to the original samples: the wear rate of the samples for 240 s of tests by nitriding was 3.8 mg/min, and after the EMSH – 4.8 mg/min; for the period of tests 240‑480 with the wear intensity of the samples by nitriding was 2.6 mg/min, and after the EMSH – 2.55 mg/min. The practical significance of the research is connected with a possibility of replacing the nitriding process with a less expensive technology. The effectiveness of the electromechanical surface hardening technology is associated with a possibility of implementing the method on metal-cutting machines with the formation of high quality indicators for the surface layer of parts in terms of hardness, metal structure and the depth of hardening. The implementation of research results allows the use of electromechanical surface hardening in the manufacturing and restoration of shafts, sleeves, gear wheels, gear shafts and other farm machinery parts in mechanical repair shops.

Key words: wear, electromechanical treatment, nitridation, heat treatment, hardening.

ECONOMY AND ORGANIZATION OF AGRICULTURAL ENGINEERING SYSTEMS

ECONOMIC RATIONALE FOR GRAIN LOSSES SUBJECT TO WEATHER CONDITIONS AND HARVESTING TIMEFRAME

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The development of the grain producrion sub-industry is of great importance in view of ensuring food security. The adaptation to new economic conditions requires the development of a number of theoretical and methodological provisions aimed at making a new methodological approach to productivity forcasting, taking account of zonal agro-climatic conditions of the crop cultivation and harvesting. The authors offer a mathematical model that takes into account weather conditions and lost economic benefits. The model provides for quick decision making in mechanized cultivation of crops on the implementation of necessary technological processes, including the time frames of crop harvesting. Taking into account weather conditions will help minimize economic losses.

Key words: grain crops, agrometeorological conditions, biological losses, zonal conditions, harvesting timeframe.

DISTRIBUTION PATTERNS OF LEVELING ACCRUALS IN ASSESSING AGRICULTURAL MACHINERY QUALITY

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The author has analyzed the total cost per unit of work performed or products manufactured, revealing the increasing regularity and reduced efficiency of the machine use. It has been determined that its quality may be reduced in different ways depending on the use of the machine in specific natural and climatic conditions and the time interval. The author has considereda conceptual approach

to scientific support of the considered problems of improving economic relations of partners based on mutual interest, as well as assessing the changing quality of the machinery throughout the service life. A methodology of assessing the quality of new machinery based on the calculation of compensatory costs and levelling accruals and their changing patterns in the use of aging technology has been offered. It is shown that the levelling accruals reflecting the changing quality of machines can be used to adjust the depreciation methods.

POWER SUPPLY AND AUT OMATION OF AGRICULTU RAL PRODUCTION

ELECTRO TECHNOLOGICAL METHOD OF CONTROLLING BURNING IN PYROLYS BOILERS

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The electric field has a significant effect on the speed and character of the combustion of solid fuels. Depending on the field strength and polarity of the electrodes, both an intensifying and an inhibiting effect can be achieved. The dependence of the combustion parameters on an electric field can be used in pyrolysis boilers. The first stage of fuel combustion in such boilersis carried out with insufficient oxygen, which is accompanied by the release of carbon monoxide and the risk of its penetration into the room. At the same time, an increase in the oxygen content leads to fuel ignition and pyrolysis disturbance. As a result of the experiment, it was found that a decrease in the oxygen content can be replaced by the action of a longitudinal electric field with a strength of 1 to 7 kV/cm. With such an effect, combustion is suppressed (there is a flame failure) due to the termination of fission chain reactions of charged radicals of ignited substances. At the same time, the release of carbon monoxide does not increase. The electrotechnological method of combustion control is techinically implemented using an industrial solid fuel boiler of low power. An experimental sample of this boiler is equipped with a box-shaped reservoir for burning solid fuel, made of a conductive material. Above the reservoir, there is a grid electrode able to move relative to the reservoir with the help of a controlled electric drive. When a flame appears, the voltage between the reservoir and the grid electrode increases, and the distance between them decreases. The strength of the longitudinal electric field increases, which leads to the suppression of the flame and the pyrolysis mode restoration.