

FARM MACHINERY AND TECHNOLOGIES

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DETERMINING THE PARAMETERS OF A AUGER LOADING MIXER OF ACTIVATED COMPOST

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The mixing quality of activated compost is determined by the operating parameters of working elements. The paper presents a design of an activated compost loading mixer equipped with a belt auger and a metering hopper for mineral fertilizers. The authors provide basic research results on interaction process of the auger with a compost mixture and determine the basic design and operating conditions of the considered actuating elements. They obtained formulas to determine the optimal travel speed of the activated compost loading mixer; the rotational speed and diameter of the separating teeth of the auger, as well as the number of teeth. The study proved the relationship between the auger capability of separating a portion of material from the main mass and its rotational speed and diameter, as well as the relationship between the transportation rate and the factor determined by the resistance of racks holding the teeth. The experimental study results have proved that the best mixing ratio value of 0.96 is achieved at a loader travel speed of 0.05 m/s and a rotational speed of the auger of 175 ... 215 min⁻¹, and the maximum performance value amounts to 39 kg/s at a travel speed of 0.05 m/s and an angular speed of the auger of 175 ... 15 min⁻¹.

Key words: loading mixer; activated compost; mixing quality; mixing ratio; auger, protected ground, soil mixture.

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MODELING THE OPERATION OF A DIELECTRIC SORTING DEVICE FOR THE PURIFICATION OF ALFERA SEEDS

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The study aimed at increasing the efficiency of a dielectric sorting device for cleaning alfalfa seeds by improving the design of a cleaned heap batcher. Using the general laws of mechanics, mathematical modeling and statistics, the authors carried out theoretical studies to model the movement of a heap in a dielectric sorting device when cleaning alfalfa seeds. The components of the heap of alfalfa seeds have various technological properties, which determine the difference in their trajectories during their movement inside the device. The authors determined separation conditions and the travel pattern of seed heap components passing through a casing and a chute board. It was found that at a drum diameter of 120 mm and an angular velocity of 5.22 rad/s, the separation angle of the seed heap components from the metering drum surface will amount to 80°. Therefore, the metered heap must be localized and directed to the dielectric drum surface using an additional device consisting of a casing and a chute board. Under these conditions, in order to ensure uniform supply of the cleaned heap to the dielectric drum of a sorting device, the connection coordinates of the casing with the chute board were determined as: $x_c = 24.63$ mm and $y_c = -58.02$ mm, while the inclination angle of the chute board to the horizontal plane is $\alpha = \arctg 0.4245$.

Key words: alfalfa seeds, beans, dielectric sorting device, metering device.

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ORGANIC CULTIVATION TECHNOLOGY OF ECOLOGICALLY PURE POTATOES OF EARLY VARIETIES

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One of the technologies of obtaining clean ecological products is organic farming. To obtain environmentally friendly early production of potatoes, the authors analyzed the practical use of such techniques as covering potato plantings in the initial growth period, decapitation, germination of tubers before planting and the combined use of covering and germination, which provide for fuller utilization of the crop growing capacity. Agronomic grounds for the use of technological methods were provided in 2015-2019 for the Udacha variety. The experiments were repeated 3 times. The cropping pattern used was 70×35 cm. Harvesting was carried out in 2 periods: July 15 and July 30. Statistical processing of the results was carried out by B.A. Dospikhov's method of variance analysis. The content of heavy metals and chemical composition was determined by standard methods. It was found that when using the aforementioned technological methods, the yield increases by 10.2...23.2% as compared with the control variant, depending on the dates of harvesting. The minimum increase in yield (10.2%) was observed in the variant with the germination of tubers before planting, the maximum increase (16.1%) in the variant with a combined use of germination and covering. When harvesting tubers in the second period (July 30), the trend remained, but the increase was higher and ranged from 15.3 to 23.3%. As to the chemical composition of the five variants of experimental samples of potato tubers, no differences were found. The study proved the expediency of using the technological methods to obtain early potato yield without changing the chemical composition and ensure the content of various heavy metals within acceptable standards.

Key words: potatoes, technological methods, decapitation, light germination, concealment.

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USE OF SALT WATER FOR IRRIGATION OF PERENNIAL CROPS

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The paper discusses the use of salt water for irrigation of perennial crops in areas adjacent to water sources with high salt content, including sections of the coast. The authors give a brief analysis of various ways to reduce the salt content in water. Particular attention is paid to the removal of salts by distillation of salt water using solar energy. Various designs of solar desalination plants patented in different countries are considered. The authors propose a method for subsoil irrigation of perennial crops with salt water, which consists in evaporating water using solar energy, saturating the air with steam and then supplying it through perforated pipes to the soil where steam condensation occurs. To implement this method, a special device has been developed. The effectiveness of the application of this method and device in agricultural production is considered using an example of the Crimea vineyards. It has been established that the subsoil water supply will reduce moisture loss by 20...30% as compared to drip irrigation by preventing evaporation from the surface of a wet spot near the dropper. Due to this, the irrigation rate can be reduced to 400...500 m³/ha or up to 50 liters per 1 m². Implementation of the proposed method will allow irrigating perennial crops with desalinated salt water and prevent salt accumulation in the soil and the loss of water by evaporation.

Key words: subsurface irrigation, methods of salt and sea water desalination, salt water desalination by distillation, use of solar energy to desalinate water.

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FEATURES OF BIOFUEL APPLICATION IN AGRICULTURAL PRODUCTION

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The paper provides study results on the properties of biofuels based on methyl ethers of vegetable oils. Using an automatic analyzer, the author determined the fractional composition of biofuel. The content of free water in ethers when assessing hygroscopicity was determined by coulometric titration according to the Fisher method. The compatibility of these products with various structural materials was determined. It was found that the fractional composition of methyl ethers of rapeseed and sunflower oil differs significantly from the indicators of commercial diesel fuel and is characterized by a narrow range of fractionation. This makes it difficult to use pure ethers instead of diesel fuel, so it is advisable to use these products in the form of mixtures with diesel fuel. When ethers come into contact with rubber parts of fuel system equipment, rubber swelling and the destruction of some parts are observed. The mass of rubber samples contacting for 12 days with ethers of vegetable oils increased by 18...25%, and the surface area - by 12...17%. It is proposed that gasket and sealing parts of equipment designed for operation with ethers should be replaced with tetrafluoroethylene (fluoroplast), etc. It is established that protective coatings made of phenolalkide enamel ФА-5278 do not withstand contact with ethers. Since ethers of vegetable oils are hygroscopic, it is recommended that they should be stored in closed containers to prevent their contact with moisture.

Key words: biofuel, rapeseed and sunflower oil, methyl ethers of sunflower and rapeseed oil.

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ORGANIZATION OF WORKPLACE AND LABOR PROCESS OF TRACTOR DRIVER IN MODERN MOBILE MACHINES USED IN AGRICULTURE

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The paper discusses some issues of changes in and specification of basic requirements for the organization of workplaces and labor process of farm tractor drivers in cabins of modern tractors and combines. It is shown that the introduction of computer control systems of the tractor and its engine, machine-tractor units and combines, dispatching operations performed in the field in an online mode with the use of global satellite and local (unmanned aerial vehicles-UAVs) control and regulation systems requires a new approach to the organization of the workplace and the process of work and rest of tractor drivers. The authors carried out an analysis of possible problems and outlined conditions for health maintenance of machine operators working under conditions of operation computerization, as well as the use of video terminals and UAVs. It is shown that the documents regulating sanitary rules relation to the design and operations of tractors and agricultural machines and "Instructions on the hygienic assessment of tractors and agricultural machines" need to be modified taking into account the actual technological changes. Recommendations are also given to increase attention to the peculiarities of labor protection of machine operators, taking into account changes in their working process.

Key words: machine-tractor unit, tractor driver, workplace, labor process, labor protection, video terminal, satellite driving system, sanitary requirements, hygienic assessment.

TECHNICAL SERVICE IN AGRICULTURE

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TECHNIQUE OF SELECTING THE OPTIMUM MODES OF ELECTROCONTACT WELDING

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The authors developed a technique of selecting rational parameters of electrical contact welding (ECW) to ensure the quality of coatings produced on the parts of agricultural machines during their restoration and/or hardening. They determined factors that have the greatest influence on the quality and properties of coatings – the ECW mode parameters: compression force of welding electrodes, welding current, welding pulse and pause duration, welding speed, material feed, or feed rate, and coolant flow rate. By means of the proposed method, the ploughshare from 65Г steel of GOST 1133-71 was strengthened with coating from Y12A steel of GOST 2283-79. The following parameters of the EPW mode were obtained: a welding current value of 6.9 kA, a pulse time of 0.06 s, a pause duration of 0.08 s, and a coolant flow rate of 1.8 l/min, the overlap coefficient of weld spots in a row of 0.635, the overlap coefficient of weld spots between rows of 0.76, the coating area welded per pulse of 6.49 mm², a welding speed of 0.986 m/min and the maximum performance of the ECW process of 22.48 cm²/min. The hardness of the obtained coatings was 60 ... 62 HRC_{0.1}, and the relative wear resistance was more than 4 times higher than that of steel 45 (180 HB). The study has experimentally confirmed the feasibility of using the developed technique for selecting rational EPW parameters to ensure the quality of coatings produced on the parts of agricultural machines during their restoration and/or hardening.

Key words: restoration, hardening, repair, electrical contact welding, metal strip, optimization of modes, performance, overlap coefficients.

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METHOD OF RESTORING THE WORN SURFACE OF A REDUCTION GEAR SHAFT IN A ‘SHAFT-TO-COLLAR’ CONNECTION USING A REPAIR BUSHING AND POLYMERIC MATERIALS

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The authors prove the feasibility of applying a method for restoring the worn surface of a reduction gear shaft in a “shaft-sleeve” connection using a repair bushing and a polymer material. It is recommended to use selective assembly with a transition fit with the maximum possible interference fit of 0.02 mm, and the maximum possible clearance of 0.16 mm. The experimental samples of repair bushings are made of thin-walled high-quality pipes made of steel 30ХГСА GOST 8734-75. The sleeve was fixed on the shaft using the Unigerm-6 anaerobic polymer composition. An analysis of the test results showed that the shear strength does not correspond to the manufacturer's data for the considered size of the fit, but the strength values are higher than permissible ones. The dispersion of the obtained force values is not large and correlates with the clearance sizes in the samples. The study confirmed the composition polymerization in a clearance of approximately 0.3 mm. The recommended maximum possible clearance of 0.16 mm ensures sufficient strength of the coupling and the centering accuracy of the workpiece on the shaft (at the maximum possible shaft runout of 0.18 mm). To ensure tightness in the fit, it is proposed to heat the bushing before installation to 150°C, which is sufficient enough to obtain an interference fit but does not affect the properties of the polymer composition.

Keywords: restoration, shaft, sleeve, bushing, polymer, anaerobe.

ECONOMY AND ORGANIZATION OF AGRICULTURAL ENGINEERING SYSTEMS

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OBSTACLES TO INNOVATIVE AND TECHNOLOGICAL DEVELOPMENT OF RUSSIAN AGRICULTURE

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Russian economy and agriculture, in particular, are noticeably lagging behind in innovative and technological development. The aim of the study is to identify the causes of this lag and offer proposals to overcome it. The author outlines a conceptual scheme of organizing the promotion of imported innovative products on the market, which is distinguished by its complexity and high controllability on a global scale. The study has identified the dependence of many

Russian farmers on foreign technologies, which poses a threat to national food security. The main reasons for the competitive loss of domestic innovations and the technological backlog of agriculture include: a closed system for organizing scientific research; lack of funding for scientific research; lack of an extensive technology transfer system; low profitability of agricultural producers. Measures are proposed to overcome the innovative and technological lag, including establishing modern institutions of innovative development, in particular, "technological valleys"; providing effective information and consulting services; redistribution of state financing in favor of those who produce competitive scientific products developed into technological solutions; organization of the training of innovation-oriented specialists in educational institutions; implementation of package offers for arm producers through the agricultural leasing system; launching a national agricultural extension system; normalization of economic relations of farm enterprises with their counterparties. Conclusion is drawn about the possibility of overcoming the innovation and technological backwardness of Russian agriculture on condition a range of organizational decisions are made and relevant state support is provided.

Key words: innovation, technology, agriculture, farm industry, efficiency.

POWER SUPPLY AND AUTOMATION OF AGRICULTURAL PRODUCTION

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PROSPECTS OF APPLYING ELECTROTECHNOLOGY IN GARDENING

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The paper presents some application fields and examples of applying electrotechnology in agricultural production as exemplified by the use of electric, magnetic and electromagnetic fields. The authors determined promising research areas concerning the application of electrotechnology in gardening: the use of magnetized water for watering tree crops and bushes; the use of a strong electric field of high voltage to produce a fine electroaerosol in the form of fog or cloud of electrically charged solution droplets (chemical preparation to combat diseases and pests of garden crops) to increase the preparation efficiency (from 25 to 75%) and reduce the environmental impact. The paper presents the designs of technical devices for obtaining magnetized water. The authors offer an original magnetic field source consisting of an inductor with windings and a ferrite core and having additional features for regulating the rotation speed of the magnetic field, and the formation of magnetic fields with different harmonic composition, depending on the shape of the output voltage of a transistor frequency converter. The paper also provides a description of an electric circuit (powered by a battery or a low-power rectifier) of a small-sized source of a strong electric field using high-frequency transformers, the mass and size of which are reduced twice at such frequencies.

Key words: electromagnetic field, environment, electric field, aerosol generator, ferrite, electric charge, magnetic field, high-frequency transformer.

THEORY AND METHODOLOGY OF PROFESSIONAL EDUCATION

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METHODOLOGY OF HIGHER AGRICULTURAL EDUCATION: POLYPARADIGMAL APPROACH

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The authors analyze the current state and prospects of development of the agricultural sector, consider the role of higher agricultural education in the innovative development of the agricultural sector, determine the need to improve the

theory and practice of higher agricultural education, including the study of its methodological foundations. The study aims at analyzing the possibilities of using a polyparadigmatic approach as the basis of the methodology of modern higher agricultural education. The authors overview the transformation process of the educational paradigm in the vocational education system in recent decades; consider the core of cognitive, technocratic, and humanistic educational paradigms; and evaluate the possibilities of combining them within the framework of a polyparadigmatic approach to provide grounds for the theory and practice of higher agricultural education. The authors prove the expediency of applying the ideas of systemic, synergetic, personality-oriented, competency-based, and design-targeted approaches within the framework of a polyparadigmatic approach. The implementation of a polyparadigmatic approach in the development of pedagogical systems in higher agricultural education provides opportunities to meet the requirements of modern society for the training of qualitatively new specialists: highly qualified, competent, competitive, cultural, proactive, creative, entrepreneurial, communicative, capable and willing to perform their professional functions in a highly efficient manner, socially mobile, easily adaptable to changes and quickly mastering new technology of modern high-tech agricultural production.

Key words: methodology, educational methodology, agricultural education, educational paradigm, technocratic educational paradigm, humanistic educational paradigm, polyparadigmatic approach, digitalization of education.

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INCREASING COGNITIVE MOTIVATION OF AGRICULTURAL UNIVERSITY STUDENTS IN THE IMPLEMENTATION OF COURSE PROJECTS

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Cognitive motivation is an essential part of the personality structure of an active, creative, competent specialist who is capable of self-development. There is great demand for such specialists in agriculture at present. Therefore, the development of cognitive motivation of students remains a relevant task of modern agricultural education. The paper shows that the method of course projects is highly promising in terms of increasing cognitive motivation of students. When students perform a course project solving a number of diverse and at the same time personally significant problems they show cognitive activity and creativity. When organizing this kind of learning activity, teachers should follow a systematic approach and to comply with the following conditions: the themes of course projects should be interesting and practice-oriented, methodical recommendations should provide full information support to students regarding planning and making the right layout of the project. The paper shows the role of the themes of course projects for increasing the cognitive motivation of students and describes the structure and content of the corresponding methodical recommendations for students. The authors present the research results on the changes in the development level of cognitive motivation differentiated according to three criteria: regulatory, content-activity, and emotional. The experiment was conducted in three stages and showed a significant increase in cognitive motivation among students performing their course projects.

Key words: cognitive motivation, motivation for carrying out educational activities, university study process, project method, methodological support of the study process, course projects.