

# AGRICULTURAL SCIENCES

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## **SECONDARY DAIRY RAW MATERIAL – AN IMPORTANT RESERVE FOR THE PRODUCTION OF DAIRY PRODUCTS**

Studies have been conducted to assess the quality of cheese whey and develop a jelly product based on it with the addition of pumpkin puree. The studies had been carried out at the Kezsky Cheese Factory OJSC and monitored at the Izhevsk State Agricultural Academy. Cheese slurry produced at the enterprise fully complies with GOST 34352–2017 Milk whey. Technical conditions.

Pumpkin puree, used for the production of the product, had a uniform consistency, a pronounced pumpkin taste and smell, an orange color. Mass fraction of soluble solids was 7.2%. For the production of jelly product, three prototypes were formed: the first sample consisting of whey and gelatin, sugar and pumpkin puree dissolved in it; Citric acid was added to the second sample, and the third sample consisted only of whey, gelatin and pumpkin puree. In the finished product, all samples had had a glossy surface, jelly-like consistency. Taste proved to remind peculiar to a product, but the third sample had appeared with poorly pronounced taste of a pumpkin. The color of the first sample was saturated orange, while that of the second and third ones was light orange. Mass fraction of titrated acids (in terms of citric acid) ranged from 1.76 to 1.89 %. According to the tasting, the highest number received sample 2–24.6 points. The highest content of proteins, carbohydrates and energy value (1.5 g; 6.2 g and 32.8 kcal, respectively) was in the second sample. The shelf life of the product would not exceed 30 days, because on the first day, the content of the number of mesophilic aerobic and facultative anaerobic microorganisms was  $0.03 \times 10^2$  CFU per gram of the product, and on the 40th day this indicator made  $1.11 \times 10^3$  CFU/g. The level of profitability of the production of jelly product has reached 238.8–248.9 %, with the cost of 20 rubles per a package (100 grams).

**Key words:** cheese whey; pumpkin puree; food gelatin; tasting evaluation; nutritional and energy value.

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## **ECOLOGICAL AND SILVICULTURAL ASPECTS OF THE SUBURBAN AREAS FORMATION IN THE AREA OF CONIFEROUS – BROADLEAVED FORESTS IN THE KAMA REGION**

The different level of forest productivity is determined by the difference in natural conditions of growth, but a large role in regulating the level of productivity rests in the directed human economic activity. Work on the creation of a trial areas system at natural and artificial plantations of the basic forest-forming species shows that differences in the conditions of growth affect the productivity of the tree-stands and affect their resistance. The basis of silvicultural-ecological monitoring was the assessment of the state and growth of plantations for different types of forests. Thus, the object of the study was the forests of Izhevsk Forestry and inter-populated areas. Implementation of field studies and processing of experimental material had been carried out in accordance with generally recognized methods in taxation and forestry. Applied were basic silvicultural and forest inventory techniques and methods of experimental and observational modelling. On the example of the permanent plots there were studied the taxonomic characteristics and soil conditions. The studies had been conducted on the basis of monitoring the field work and forest management materials. The materials of the study expand and deepen the existing understanding of the state of vegetation and soil cover in recreational areas, the system of criteria and methods for assessing their sustainability. Trial areas were selected in different types of forest and forest vegetation conditions. The influence of soil-hydrological conditions on the productivity of spruce stands was studied by the example of soil – ecological profile. The analysis of the obtained data shows that a close positive relationships are observed between the height of spruce stands and the content of physical clay in the soil. The best conditions for the growth of spruce were observed on sod-podzolic soils, in which the content of clay particles varies between 20.1–30.0 %. On all test areas of medium model trees in the first period of life, the bonitet of spruce is lower, and in the period of establishment of permanent bonitet occurs in different years, and that is due to the peculiarities of the root system formation of spruce on different soils. Light loamy soil has high-mesorational properties, and by 30-year age the spruce plantings provide the I site class. On the sandy loam soil (PL. № 1), being less fertile than light-loamy soil, spruce plantings reach I Bonita by 60 years, and on poor sandy soil (etc., PL. № 3) reaches II Bonita only at 70 years old. Research materials expand and deepen the existing understanding of the state of vegetation and soil cover in recreational areas. The scientific and practical value of the research made to create a data Bank, their updating is associated with the software, and creation of computer simulation models of silvicultural evaluation of soils for different tree species.

**Keywords:** recreation; resistance; tree-stands; ecosystem; phytocenosis; process of planting growth; soil conditions; landscape taxation. Authors:

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## **EVALUATION OF THE PRODUCTIVE QUALITIES AND EFFECTIVENESS OF MINK CULTIVATION**

When carrying out researches in Mozhginsky Fur Farm, Udmurt Republic, the purpose of work was assessment of productive qualities and effectiveness of cultivation of minks of different specific colors: standard dark brown, pastel, sapphire, silver-blue and white hedlund. To perform researches, 5 mink groups of different species, up to 20 heads each were selected (10 females and 10 males).

Females and mink males of standard dark-brown had had higher rates of alive weight. Thus, females' alive weight exceeded sapphire females by 6.1 %, pastel – by 9.9 %, silver-blue – for 6.8 %, and hedlund – by 3.3 %. STK's males had had larger alive weight compared to that of sapphire-males', pastels', silver-blues' and hedlunds' by 28.5, 24.1, 20.1 and 13.2 %, respectively. Indexes of the body length and that of the bust of the standard dark-brown mink surpassed other types by 10–15 %, in average. Meanwhile, to standard indicators there corresponded females and males of the following types: standard dark-brown and white hedlund. Sapphire, pastel and silver-blue mink had had smaller anthropometric data in comparison with the standard ones.

Females of standard dark-brown mink the square of skins was more than with sapphire type – by 8.9 %, pastel – by 8.4 %, silver-blue – by 7.5 %, and the hedlund – by 3.3 %. Similar data have been fixed for the males; the standard dark-brown type has a larger skin square compared to sapphire – by 13.2 %, pastel – by 17 %, silver-blue – by 13.9 %, and the hedlund – by 9.8 %.

The greatest profitability from mink cultivation has proved for the standard dark-brown type and for the hedlund – 63.5 % and 58.2 %, respectively, that is confirmed by the skins' and breeding material marketing prices.

**Key words:** mink, standard dark-brown, pastel, sapphire, silver-blue, white hedlund.

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## **SOIL FERTILITY CONDITIONS AND CEREAL CROP PRODUCTIVITY AT THE AGRICULTURAL PRODUCTION COOPERATIVE AFTER MICHYURIN OF THE VAVOZHISKY DISTRICT UDMURT REPUBLIC**

In modern agricultural production, while obtaining stable and high crop yields, an important task is reproduction of soil fertility. In this regard, it is important to constantly monitor soil fertility. In the conditions of Agricultural Production Cooperative after Michyurin, Vavozhsky District, in 2015 and 2017 assessment of the level of fertility of sod-podzolic soils was carried out using the key site method. The average relative index of soil cultivation according to 2015 had made 0.71; in

2017 – 0.59, that should be referred to the average and low degree of soils cultivation in the surveyed fields, respectively.

In 2015, an evident connection was determined between crop yields and agrochemical indicators of sod-medium-podzolic medium loamy soil. Multiple correlation coefficient made  $R = 0,8454$ . In the conditions of 2017, a weak correlation was obtained between the indicators considered. The paired regression equations showed a close direct correlation between the grain yield and the main agrochemical indicators; thus, correlation coefficients appeared: with a humus content of 0.60–0.68; mobile phosphorus 0.70–0.80 and mobile potassium 0.53–0.63. The correlation coefficient of grain productivity with a relative index of soil cultivation showed 0.81; then presently, in the APC after Michyurin productivity is being chiefly determined by the level of soil fertility. In 2014–2016, the average annual saturation per hectare of arable land with organic fertilizers amounted to 5.1–6.1 tns; mineral fertilizers – 48–65 kg of active substance. At the same time, a positive balance of humus was formed. A significant role in the supply of organic matter lies in the use of straw and saturation of cultivated areas' structure with perennial bean grasses (meadow clover) up to 50 %. However, in the period under review, a close to zero and negative balance of nitrogen, phosphorus, and potassium had been obtained. Consequently, in the APC after Michyurin, while high and stable cereal crop yields are obtained, soil fertility is depleted at the same time, especially in terms of providing by mobile forms of nutrients (phosphorus and potassium).

**Key words:** productivity; cereal crops; agrochemical indicators; sod-podzolic soils.

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## **PHYTORESOURCE RECOVERY POTENTIAL AND DEVELOPMENT OF LAND DISRUPTED DURING HYDRAULIC DEVELOPMENT OF SCATTERINGS**

The peculiarities of the restoration of vegetation in different conditions of the earthwaste formations have been studied. According to the results of geobotanical studies at the experimental sites, the species diversity of vegetation cover has been revealed, its dynamics within the anthropogenic morphogenesis of the relief formations have been studied. It has been established that the anthropogenic morphogenesis are characterized by a wide range of environmental conditions and are potentially suitable for vegetation settlement. Features of naturally recovering processes at the

waste landfills can be used as one of the leading diagnostic features during the development of classifications of disturbed lands.

**Key words:** anthropogenic morphogenesis, earthwaste formation, hydraulic landfill, man-made relief, age period of development, phytoresource potential, reconstructive dynamics, self-growth of dumps, anthropogenic morphogenesis of the neo-ecotope.

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## **GROWTH DYNAMICS OF CALVES AND THEIR MORPHO-BIOLOGICAL CHARACTERISTICS OF BLOOD WHEN USED IN FEEDING GRAIN MOLASSES**

The article provides information on the effect of feeding calves in the Kholmogory breed of molasses on the intensity of growth and development, as well as an analysis of biochemical and hematological indicators of animal blood. The studies were conducted on the basis of the Rybkhoz «Pikhtovka» in the Votkinsk district of the Udmurt Republic during 2017–2018. Grain molasses was produced at the enterprise with the help of an innovative small-sized grinding plant based on cavitation technology. To conduct research, two groups of heifers of the Kholmogory breed (10 animals each) were formed on the basis of analogue pairs. The calves of the experimental group 3 liters of milk, was replaced by 3 liters of molasses, feeding was also three times a day. The introduction of calf molasses into the diet of calves made it possible to increase the level of glucose in the blood to 5.12 mmol/l, which increased the intensity of oxidation-reduction processes in the body. The number of leukocytes in the experimental group decreased to the level of  $8,45 \cdot 10^9/l$ , which is less than in the control group by  $0,69 \cdot 10^9/l$ . The number of red blood cells in the blood of experimental calves after the experiment was within the normal range of  $7,74\text{--}7,91 \cdot 10^{12}/l$ . A slight increase in red blood cells was recorded in the experimental group, however, these results are not statistically reliable. A similar trend was recorded for hemoglobin. In the experimental group, this indicator was 119.3 g, which is 3.4 g more than in the control group. The use of molasses made it possible to increase the average daily gain in the experimental group to 789.6 g, which is 126.6 grams more in the control group (\* –  $P \geq 0.95$ ).

**Key words:** calves, feeding, molasses grain, blood, hill-mountain breed.

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## TECHNICAL SCIENCES

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### EFFECT OF HIGH-RATE LASER RECRYSTALLIZATION ON THE STRUCTURE AND PROPERTIES OF THE IRON-CARBON COMPOSITES

The mechanical properties of the machines' parts are determined by the structure of a thin surface layer whose thickness does not exceed 0.1 mm. Therefore, the existing technological processes of hardening of machine parts by implementing the methods of bulk hardening and chemical-heat treatment have lost its advantage and relevance. The majority of "traditional" methods of hardening provide metastable phases of pearlite, or martensitic class of mechanical properties, which are limited to a temperature not exceeding 200 °C. In this paper, the author considers the possibility of hardening the surface layers of steel parts of machines by a concentrated energy source-laser radiation. Laser radiation is widely enough used in modern engineering. However, in recent years, the range of industrial lasers with distinctive energy and kinematic characteristics has been significantly expanded that made it possible to implement new methods of hardening – high-speed laser hardening, in particular. High cooling rates of local material volumes, the outer surface layer of machine parts, provide fine-dispersed structures, up to nano-scaled. To realize the possibility of analyzing the structure and surface properties of machine parts after high-speed recrystallization, a technique for obtaining an iron-carbon composite based on carbonyl iron and crystalline by long-term sintering in a protective, reducing medium have been developed. The resulting composite was subsequently further on subjected to high-rate laser processing at speeds from 1 to 4 m/s. To determine the characteristics of the samples, the latter were subjected to laboratory testing. The results of the research have confirmed the possibility of obtaining structures as per mechanisms different from traditional ones. In the zone of high-rate laser processing, there was a tendency observed for abrupt change in phase transformations, the latter being transferred to another morphological type of solidification at a certain rate of solidification. At the same time, mechanical properties also have been also changing: the micro-hardness drops abruptly, and that indicates the transition to a completely different structural formation, most likely – the transition to a structureless, amorphous type, as the most stable morphological state.

**Key words:** high-speed laser recrystallization; hardening; structure; morphological transition; micro-hardness.

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## **PROSPECTS FOR IMPLEMENTATION OF THIN-FILM COATINGS IN REPAIRING PROCESS**

The use of thin films has an undeniable advantage over traditional coatings, which is determined by high fatigue resistance, structure, “flexibility”, low dislocation activity, and high adhesion to the object. Obtaining thin coatings is mainly implemented in tool production, thus increasing the wear-and-tear resistance and redness resistance of the tool cutting edges. To obtain such coatings, PVD and CDV technologies have been implemented in practice since the 80s, which provide superhard coatings with a thickness of not more than 15 microns. The negative side of these technologies is obtaining homogeneous structures with a narrow range of physical and operational properties. In the conditions of mechanical engineering, the synthesized coatings should have a set of properties that equally resist fatigue, thermal, dynamic, etc. loading. Obtaining such coatings is associated with heterogeneity of the structure, with the presence of a multiphase composition that affects the kinetics of the processes of structure formation and thereby complicate the technology of synthesis of the coating. The authors have presented the possibility of obtaining stable thin coatings on the surface of machine parts, in order to increase their wear resistance and durability. To implement the technology, a thin-film coating technology based on the symbiosis of structural and instrumental compositions has been proposed, with the implementation of the Charpy principle. For the synthesis of a thin coating, the technology of short-pulse laser radiation had been used followed by the effect of amorphization of the structure occurring due to high crystallization rates. To obtain the coating, a powder composition based on B83 babbitt alloy doped with boron carbide was used. The percentage of boron carbide was determined based on exploratory research and was limited to 1.5 % by weight. The research results had demonstrated the stability of coatings under conditions of fatigue loading that was not inferior to traditional babbitt coatings, whereas the bearing capacity of the coating, as well as the scoring resistance, had significantly exceeded the performance of traditional coatings by more than 4 times. The micro-hardness of the coating had increased by more than 3 times, and amounted to 1080, while the structure was characterized by a finely dispersed structure with transition to amorphous one.

The results obtained are of high practical significance and can be applied to when restoring shafts and axis operating under high dynamic and kinematic conditions.

**Key words:** thin coating; anti-friction; coating; short-pulse laser processing; wear resistance; restoring.

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## **DUST-AIR MIXTURE PARAMETERS AND THEIR INFLUENCE ON THE EFFICIENCY OF CLEARING AIR WET SCRUBBERS**

Results of researches of parameters of dust-air mixture, such as concentration of dust, flow rate, composition of liquid on quality of cleaning with the wet dust collector are given. The wet dust collector is an additional cleaning device as the cyclones used in grain crushers for air purification insufficiently effectively cope with the work. Grain dust is noxious to health the operators working in feed-preparation houses as they inhale it, besides the dust soaring in air is explosive, and the accumulated dust is flammable. Research problems included studying of overall performance of the wet dust collector and influence on it of different parameters of mix of grain dust with air. Researches were conducted on laboratory installation in Izhevsk State Agricultural Academy in 2017. Installation has two steps of cleaning. Each step represents capacity with liquid. Air purification comes from grain dust at blow of the mix moving with a certain speed about the surface of liquid. Speed is reported to a flow in the crushing camera of the crusher. Results of a research showed that increase in concentration of dust in a flow and also its speed positively affected dynamics of cleaning.

**Key words:** dust, wet dust collector, concentration of dust, flow rate, efficiency.

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## **INTERACTION OF TRANSITION METALS OXIDES WITH A CYCLOPENTADIENYL. CALCULATIONS BY DENSITY FUNCTIONAL METHOD**

Mathematical models of metal - carbon nanocomposites are considered which are used as a perspective microfertilizer for preseedling processing of seeds. Geometrical model of a

nanocomposite is selected which formed by the graphite like carbon shell interacting with an ion of transition metal. Calculations of interaction energies and geometrical parameters of a model system are executed by methods of quantum chemistry with use of various basic sets. The method was approved earlier for calculations of chemically similar systems with available experimental data. The results for interaction energies are completely correspond to experimental data. Calculations of interaction energies between graphene clusters and transition metal ions show that the strongest interaction is observed for graphene sheet containing heptagonal defect and pentagonal defect with the ion located outside of a carbon shell. At the same time interaction is the strongest in the case of complexes of cobalt ion and defective graphene. Thus, presence of this ion during the synthesis of nanotubes should lead to formation of more defective and short nanoparticles. Further the possibility of hydroxylation of nanocomposites and interaction of hydroxylated systems with water were investigated. Calculations show that the presence of metal or structure defect increase the probability of joining of OH group to a graphene shell. Besides, the presence of metal strengthens interaction of a nanoparticle with water. For nickel nanocomposite the interaction energy with a water exceeds by 40 % the hydrogen bond energy in water dimer.

**Key words:** mathematical modelling, quantum chemistry, graphene, defects, transition metals, microfertilizers, hydrogen bond.

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