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N. Khopyak[1], A. Manenko[1], H. Tkachenko[2], K. Khopyak[1]
[1]*Danylo Halytsky National Medical University in Lviv, Ukraine*
[2]*Institute of Biology and Environmental Protection, Pomeranian University in Slupsk, Slupsk, Poland*

USING OF GLAUCONITE FOR NEUTRALIZATION OF FRESH POULTRY MANURE

Introduction. Epidemiological studies show that poultry meat and eggs are important sources for consumers' exposure to pathogens. There is a focus in many countries to reduce the level of human illness from food-borne pathogens [5]. Extended-spectrum β-lactamase (ESBL)-producing *Escherichia coli* has been documented in food-producing birds, including chickens, and for unknown reasons the prevalence has increased significantly during the last decade. With *E. coli* as a major opportunistic pathogen in chickens and with a potential for zoonotic transfer to human beings, ESBL-producing *E. coli* represents a major risk both to poultry production and to human health [12]. For example, the prevalence, diversity, and antimicrobial resistance (AMR) profiles of non-typhoidal *Salmonella* (NTS) and associated risk factors on 341 pig, chicken, and duck farms in Dong Thap province (Mekong Delta, Vietnam) were investigated by Tu and co-workers (2015) [13]. These researchers have demonstrated an exceptionally high prevalence and high diversity in NTS serovars across farms. Of the three species investigated, ducks had the highest NTS prevalence although pigs were associated with the highest levels of MDR. Levels of AMR were considerably high for most antimicrobials investigated, except for amoxicillin/clavulanic acid, ciprofloxacin and third-generation cephalosporins [13]. In our previous study, natural ecological sorbent glauconite was proposed for neutralization of contaminated objects [1—3; 6—11]. The purpose of this study was the evaluation of accelerated neutralization of fresh poultry manure by using ecologically clean natural mineral glauconite and receipt of this organic and mineral fertilizer.

Main part. The chemical formula of glauconite is $K(Fe^{3+}, Fe^{2+}, Mg, Al)(OH)_2(AlSiO_{10}) \cdot nH_2O$. The composition of glauconite also includes P, Ca and a wide range of trace elements. Features of the structure provide a large active surface area (96—140 m^2 / g) and high cation exchange capacity (26-41 mEq / 100 g). The contents of major oxides in glauconite (%): K_2O – 4.0 ÷ 6.4; P_2O_5 — 1.3 ÷ 2.4; CaO — 2.0 ÷ 5.0; MgO — 0.5 ÷ 1.5; SiO_2 — 75.5 ÷ 92.0; Al_2O_3 — 1.5 ÷ 6.5; Fe_2O_3 — 1.5 ÷ 6.5 [1—3; 6—11]. The adsorptive properties of glauconite raw (greensand) from deposits of Khmelnitsky region were used in our study. Glauconite raw (greensand) presented loose natural mixture of glauconite (50—80%), quartz (10—25%) and montmorillonite (5—25%). Quartz grains in glauconite raw serve as the mechanical filter. Sorption properties of montmorillonite are not inferior glauconite [6—11]. In the performance of this study following methods were used: 1) expert method for hygienic and environmental analysis of technological requirements; 2) calculation method to determine the amount of income from neutralization raw poultry manure with glauconite; 3) chemical methods for determining the useful components per 1 ton of organic fertilizers and integrated indicators, i.e. Biochemical oxygen consumption (BOC_{20}) and Chemical oxygen consumption (COC) in the aqueous extract (1 kg of poultry manure per liter of water). The obtained results were analyzed statistically using the STATISTICA 8.0 software package (StatSoft, Poland).

In fresh poultry dung is contained (%): water 50 ÷ 76 nitrogen 0,7 ÷ 1,9, phosphoric acid in terms of P_2O_5 1,5 ÷ 2,0, potassium oxide 0.8 ÷ 1.0, lime 2.4, magnesium 0.8, sulfur 0.5. After heat-dried process, the content of these macronutrients may slightly increase, sometimes twice, rarely more. Apart macroelements, the poultry manure also contains some microelements. Thus, 100 g of dry poultry manure contains (mg): Mn — 15—38; Zn — 12—39; Co — 1—1,2; Cu — 1—2,5; Fe — 300—400; as well as protein — 37%, carbohydrates — 34%, lipids — 13% and amino acids — 9.6%. In general, with the carbohydrates in the litter can contain 62—75% pectin, cellulose and similar substances. Fresh poultry manure is characterized by: 1) low concentrations of nutrients and high initial moisture content and requires, in the case of its use as a fertilizer, to use a large volumes; 2) the availability of nutrients in soluble form and low molecular weight compounds, leading to their rapid decomposition to simple elements. Humidity of the fresh litter reaches 73—76%. However, the output of poultry litter, humidity and its chemical composition in modern poultry farms with cage keeping laying hens largely depend on the technology content, giving water device and method of removing excrement. The density of manure was 1.75—1.85 t / m^3, pH 6.9—7.4, the ratio of C:N equal to 8:12; BOC_{20} — 30—35 000, COC — 150—160 000 (water extract). Fresh manure can quickly dry and could get 300—350 kg of powdered or granular organic fertilizer from 1 t of dry poultry manure with humidity of 10—20%. The dried manure largely is decontaminated and is biologically inactive, allowing you to keep it for a long time. For six months of storage, the manure has nitrogen losses (reach 50% or more). To conserve nutrients in manure, for improving its physical and mechanical properties, thermal drying in excrement carrier at 600—800°C was used. When drying to a moisture content of 10—20%, manure weight is reduced compared to the original about 3 times, and nutrient content is increased almost threefold.

Today-existing technology of neutralization of poultry manure, it can transform it into waste of V hazard class at less than 1 day. At the same time, the manure is odorless technical product. The technology is simple to use, does not require significant capital costs and additional space, and integrated into any production process. Expenses for disposal of 1 ton even taking into account transport costs are insignificant compared to the purchase of the same quantity of any mineral fertilizer production proposed technology based on organic fertilizer application, glauconite. It was established that adding only 2% glauconite concentrate to mixture can get the gaseous ammonia, urea evaporation, leading to the complete disappearance of the smell. Chemical analysis indicated that accumulation of free ammonia in poultry manure was an important factor in inactivation of the pathogens.

After the adding about 10% of poultry manure (by weight of the dry weight of manure), the positive role of glauconite is as follows: 1) it binds heavy metal ions to moving forms which transform toxic manure into un-toxic form; 2) it normalizes pH, which allows bacteria to multiply that finally decompose the organic residues from feed (amount can reach 40% of the dry weight of the manure). Ultimately, a mixture of chicken manure + glauconite (sorbent) immediately after granulation stabilized manure turns into ecological organic-mineral fertilizer that meets the complex nitrogen-phosphorus-potassium fertilizer enriched with micronutrients. Similar technology is already used on poultry farms in Japan and the US. Raw chicken manure were selected on the farm. The poultry manure was sampled in poultry farm. Glauconite with essential mixed montmorillonite was dried and sieved (fraction < 0.25 mm). This mineral is naturally determined associative admixture which enhances absorption properties of the glauconite. Stages experiment included: sampling of five fresh poultry manure in chemically inert plastic ware (samples 1—5). Sample 1 — control (raw poultry manure). In 2—5 samples, glauconite was added in amounts listed in the table 2. The resulting mixture was mixed to homogeneous mass during 2—3 minutes. Immediately following the addition and mixing manure with glauconite, smell completely disappeared, humidity of the received mix also was reduced significantly. After stirring the sample left for one day for stabilization. One day later, samples were passed through filters for the granulation and dried in the oven at 100 ± 5°C. In the control sample, sharp unpleasant smell was intensified, while in samples with glauconite smell is not felt.

Fertilizer "glauconite + poultry manure" has an important agro-ecological functions: a) Does not pollute the soil and groundwater unlike unprocessed organic fertilizers; b) Contains high-class biological compounds auxin that accelerate the formation of plants in a number of necessary structures, such as chlorophyll and biological catalysts enzymes that enhance the formation of green mass of plants and photosynthesis area; c) Accumulates in the soil biologically important and necessary for rizosfera (fungi around the roots) microorganisms and plant compounds, including essential amino acids, all B vitamins and a large group of compounds of vitamin B_{12}.

In carrying out of experiments on effect on the vigor, seed germination and development of stems and roots of wheat the following data are noted: a) Seed germination was increased to 99%; roots growth was increased by two times than control seeds; b) Seed germination occurs already on the second day of the experiment, and on the fifth day wheat seeds have time to develop a strong root system.

In addition, there is evidence of the use of fertilizers as re-cultivating agent: it was received 35 c/ha of wheat after fertilizers using against 10.7 c/ha, obtained earlier. Using of organic-mineral fertilizers in the cultivation of vegetables and maize for silage leads to an increase yields of about 47—49%. A reduction in the potato growing season by about two weeks was observed. The productivity was increased at 1.5—2 times The utilization of natural fertilizers on the basis of glauconite increases crop: buckwheat — 3 kg / ha, potatoes — 18 kg / ha, tomatoes — 100 kg / ha, grain — 15—20 c / ha, increasing the yield of green mass of corn by 46.5%, the amount of dry matter, protein, fat, increased by 73—75%, the intensity for reproduction *Azotobacter* — by 50—120%, actinomycetes — to 25—100 grams, content of mobile forms of nitrogen — by 6—8%, phosphorous — by 7—25% , potassium — to 31—53% compared with control plots.

Conclusions. The lack of organic matter in the permanent fallow soil cuts down the humus accumulation ratio and the counts of microorganisms. The soil cultivation intensifies the humus synthesis processes and changes the composition of microorganisms in the soil. Algae which are mainly represented by green and blue-green species are an additional source of organic substance in the soil. Decomposition of organic substances in the soil proceeds with an active participation of cellulose decomposers which are mainly represented by fungal and bacterial flora. In rare cases actinomycetes can be found. Application of mineral fertilizers intensifies the humus accumulation process and improves the qualitative and quantitative composition of microflora in all the plots [4].

Advantages of granulated organic-mineral fertilizers are: does not change its properties during prolonged storage; resistant granules, in contact with water, swell, increasing in size about twice that helps them store water in arid periods; in case of shortage of water in the soil they prefer moisture slowly, providing the plant roots and microorganisms better conditions of existence; with granulation disappear pathogens; storage granular fertilizer, even after opening the package, its chemical parameters remain unchanged for 6-8 months. BOC_{20} and COC are $< 300\ mgO_2 / dm^3$ and $< 30\ 00\ mgO_2 / dm^3$, respectively.

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N. Khopyak[1], H. Tkachenko[2], K. Khopyak[1], A. Manenko[1]
[1]*Danylo Halytsky National Medical University in Lviv, Ukraine*
[2]*Institute of Biology and Environmental Protection, Pomeranian University in Slupsk, Slupsk, Poland*

ECOLOGICAL ASSESSMENT OF USE AND REMEDIATION OF FUEL OILS

Introduction. Oil-contaminated sediments pose serious environmental hazards for both aquatic and terrestrial ecosystems [1]. Contamination by oil and oil products has caused serious harm, and increasing attention has been paid to the development and implementation of innovative technologies for the removal of these contaminants [2]. Innovative and environmentally compatible technologies are urgently required to remove oil-contaminated sediments [1]. Due to tidal and waves actions, the oil spillage affects the shorelines by adhering to the soil, making it difficult for immediate cleaning of the soil. As shoreline clean-up is the most costly component of a response operation, there is a need for effective oil remediation technologies [3]. The remediation of contaminated sites can be achieved by physicochemical or biological methods [2]. Various physical, chemical and biological technologies are investigated for the remediation of oil-contaminated sediments such as flotation and washing, coal agglomeration, thermal desorption, ultrasonic desorption, bioremediation, chemical oxidation and extraction using ionic liquids. A combination of two or more technologies is expected to provide an innovative solution that is economical, eco-friendly and adaptable [1].

Conventional physicochemical methods can rapidly remove the majority of spilled oil, but, in most cases, removal simply transfers contaminants from one environmental medium to another and can even produce toxic byproducts. Moreover, crude oil cannot be completely cleaned up with physicochemical methods. Thus, more attention is being given to biological alternatives [2]. Bioremediation is a promising technology for responding to marine oil spills [4]. Bioremediation is defined as the act of adding or improving the availability of materials (e.g., nutrients, microorganisms, or oxygen) to contaminated environments to cause an acceleration of natural biodegradative processes [5]. A majority of molecules in crude oils and refined products are biodegradable, and they will eventually leave the environment as they are consumed by microbes. Bioremediation aims to stimulate the rate of this process. Successful bioremediation efforts have so far focused on applying fertilizers to aerobic oiled shorelines to at least partially relieve the nitrogen limitation of biodegradation by indigenous microorganisms [4]. It is suggested that bioremediation should now take its place among the many techniques available for the treatment of oil spills, although there is still a clear need to set operational limits for its use [5]. Therefore, the purpose of this study was the development normative and technical documentations and measures for environmental protection in the remediation of waste oil.

Main part. The objects of this study were petroleum products, contaminated during transportation through the pipeline, the remains from the tanks for cleaning of petroleum products, waste products of petroleum refining, oil sludge, substandard oil, oil extracted from the tank during its steaming (GOST 10585-99 “Fuel petroleum. Fuel black oil. Specifications”, GOST 21046-86 “Waste oil products. General technical conditions”, State Standard 4058-2001 “Fuel petroleum. Black oil”). Elaboration of the normative and technical documentations on utilized and remediated fuel oil was performed according to RD 6-23-84 “Regulations on the production schedules of production at enterprises and organizations of the Ministry of Chemical Industry”. Toxicity indices and hazard class of waste fuel oil for remediation were determined in accordance with State standards 2.2.7.029-99 “Hygienic requirements for industrial waste management and the definition of the class of danger for public health”. Waste fuel oil by physical and chemical parameters shall meet the requirements and standards specified in the GOST 10585-99 “Fuel petroleum. Fuel black oil.