

IRN AP14871144 “Development of technology for processing sludge and “green” waste from urban areas into organic fertilizer using domestic biological products”

Results for 2022: A microbiological analysis of sludge sediments and plant residues was carried out on five solid nutrient media, and the number of CFU/ml was analyzed. According to the results of microbiological analysis, waste samples are widely populated by microorganisms of various groups. 45 strains of microorganisms were isolated from waste. Strains were screened to assess the possibility and intensity of growth and reproduction of microorganisms on compost mass from sludge and plant residues. Strains 8B, 9B, 10B, 12B, 36B, 47B, 48B, 49B, 56B, 61B, 63B, 66B, 67B, 72B, 73B, 74B, 75B, 76B, 78B, 79B, 80B, 81B, 83B, 84B, 86 B , 87B, 88B showed excellent growth on the sludge nutrient medium, the crops showed intensive growth. Strains of microorganisms 62B, 64B, 65B, 68B, 70B, 82B, 85B also grew on the sludge medium, but sparseness of crops and delayed growth were noted. Strains 11B, 26B, 71B showed poor growth on sludge medium; growth was inhibited due to a lack of nutrients for these microorganisms. 18 strains were selected for further research.

The species composition of 18 strains of microorganisms was determined by sequencing the 16SrRNA locus at the National Center of Biotechnology LLP. According to the destructive activity of the isolated strains of plant residues and sludge sediments, the following strains were the most active: - from “green” plant residues of urban plantings - 2 strains of bacteria (strain no.: 80, 64) were classified as highly decomposing cellulose, 3 bacterial strains ((strain no. : 78,83,85) decomposed cellulose to an average degree; - from sewage sludge - 3 strains of bacteria and 2 strains of actinomycetes (strain no. 36, 62, 72, 81, 86) showed high cellulase activity, 2 strains of bacteria and 2 strains of actinomycetes (strain no. 48, 61, 71, 88) were classified as medium-decomposing cellulose. At the Research and Production Center for Microbiology and Virology, the nitrogenase activity of 20 strains of microorganisms was determined. The catalase , protease activity of 25 strains of microorganisms, and their ability to liquefy gelatin were determined . The influence of temperature (+20°; +25°; +30°; +35°, +40°, +45°) and different pH (4.5,6,7,8,9) on the number of CFU/ml in 25 strains. As a result, optimal physical parameters were identified for the growth and development of new strains distributed on silt sediments and plant debris. The need of new strains for nitrogen sources has been determined. Brief information on the results of scientific work for 2022 has been written. An article was published in the international conference: “ Bostubaeva M.B., Nauanova A.P. Microflora of sludge sediments of the city water canal and urban “green” waste // « Academics and Science Reviews Materials ". -2022. -No. 1.- P.201 - 205. Helsinki , Finland »

Results for 2023: On the basis of the State Enterprise “Astana Su Arnasy ”, a trial treatment of 16 tons of dewatered sludge was organized and carried out. Silt sediments were stored in piles 1.0-1.5 m high, 1 m wide and 5 m long. The piles were turned by a special machine. Experimental piles were treated with various biological products prepared on different nutrient media with a titer of 10^6 cells /ml and diluted with water in a ratio of 1:4. The solution was used at the rate of 5 liters per 1 ton of sludge. A agitator was used to mix the piles , and a spray tank mounted on an agitator was used to introduce biological products . Mixing of sludge sediments was carried out every three days, depending on the humidity and chemical composition of sludge sediments, in order to saturate the biomass with oxygen and evaporate moisture. The physicochemical properties, content of heavy metals, and microbiological indicators of processed waste were determined every 10 days.

According to chemical analysis data, after 30 days of composting in experimental variants with the addition of 20% straw and the use of microbial Consortium B, the amount of total nitrogen content increased from 22% to 75%. In the control variant, on the contrary, there was a decrease in the total nitrogen content by 28.5%, due to the fact that the thermophilic phase in this variant began much later than the other variants. The phosphorus concentration in all variants increased during the composting process due to the mineralization of organic matter. The proportion of total

phosphorus in sludge compost after composting varied from 0.721 to 1.683 mg/kg. The maximum concentration values of this element were noted in the variant using the biological product “ Mikromix ”. In the variant with the addition of the biological product " Mikromix ", the increase occurred 2.4 times, in the control - 2 times, in the compost with microbial consortia A and B, the increase was 25%, in the variant with the biological product Agromix + straw, 20% was the smallest increase in phosphorus. Also, the total K content followed the trend of changes for all compostable mixtures. In terms of the content of gross forms of heavy metals, compost from sludge satisfies the requirements for use for main agricultural crops (GOST R 17.4.3.07-2001), and is accordingly suitable for use in urban landscaping.

The temperature in piles using biological products Agromix SS, Trichodermin SS, Consortium A and Consortium B quickly increased in the mesophilic phase and reached its maximum value in the thermophilic phase. High temperatures (> 60 °C) persisted for 7 days throughout the entire pile in the treatments with 10% straw content . . The same temperature trend was observed in piles containing 20% straw. During the ripening phase, the temperatures of the piles gradually dropped. At the end of the experiment, the temperature values for piles using biological products Agromix SS, Trichodermin SS, Consortium A and Consortium B reached ambient temperature, which is a sign of compost maturity. For all piles, the initial pH values were neutral. The pH then increased from an initial neutral pH to a maximum pH of 8.0 within the first 10 days. After this, the pH gradually decreased and stabilized at 6.5-6.7. During the composting process, the moisture level in all piles gradually decreased until the 20th day, water was added to all piles on the 10th day to adjust the humidity within the recommended range values (40-50%). All piles had a significant reduction in volume and weight at the end of composting.

The content of helminth eggs was assessed according to GOST 54001-2010, clostridia was determined according to GOST 26503-85, and the content of bacteria of the genus Salmonella was determined according to GOST 31659-2012. According to the results of analyses, the content of helminth eggs, the presence of clostridia and salmonella was not detected in sludge sludge before composting and in all variants of organic fertilizer after composting .

A scientific article was published in a journal included in the Scopus database :

Bostubayeva Makpal , Elmira Baimbetova , Meruyert Makenova , Nazymgul Shumenova , Roza Sarmanova , Ainash Nauanova . Screening and evaluation of potential microbial bio-activators used in sewage sludge composting //Caspian Journal of Environmental Sciences. – 2023. – Т. 21. – no. 3. – pp. 575-583. (47th percentile)

A scientific article was published in a journal included in the list of publications recommended by CQASE:

Бостубаева М., Науанова А. Лайлы тұнбалардың әртүрлі дозаларының көгал өсімдіктерінің жер үсті массасына және топырақтың сапасына әсері. 3i: intellect, idea, innovation-интеллект, идея, инновация. – 2023 – №. 2, с.87-94