Innovative Technologies for Getting Composite Materials Based on Reprocessed Sewage Sludge

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Abstract: The article considers global technologies for bioslime recycling and use, gives essential bioslime characteristics and their requirements and provides with different technologies with the use of bioslime for disturbed soil recultivation, its storage on landfills and composting. Technologies for getting composite materials based on reprocessed sewage sludge can be used at all communal service enterprises and basically at the city water canals of the country.

Keywords: bioslime, municipal drainage, composite materials, purification, ecology.

During the technical treatment of wastewater in municipal services, special attention is paid to anthropogenic pollution, which has a decisive influence on the quality of the resulting biosludge. As a result of the first stage - mechanical purification - about 60–70% of the mineral impurity is separated, in addition, this stage is necessary for the formation of a systematic movement of wastewater, and also avoids fluctuations in the volume of water at the stage of biological treatment. The next stage of the process is biological treatment, which includes the degradation of the organic part of the wastewater.

To increase the parameters of water wastewater treatment, a variety of chemical methods can be used, such as additional sedimentation of phosphorus with Fe and Al salts, ozonation, and chlorination. Physicochemical methods are also effective: evaporation, electroflotation, and aerobic and anaerobic microorganisms are also used [1].

For final disinfection of wastewater intended for discharge onto a terrain or reservoir, ultraviolet irradiation systems are additionally used.

To disinfect biologically treated wastewater, along with ultraviolet irradiation, which is usually used at wastewater treatment plants in large cities, chlorine treatment is used for 30 minutes.

Currently, vast areas around cities and towns are occupied for the disposal of sewage sludge (biosludge) from municipal wastewater treatment plants (WWTP), and in almost all regions there is an acute shortage of areas allocated for these purposes. When developing a design solution, we considered global trends in the disposal and use of biosludge, the qualitative characteristics of biosludge and requirements for them, various technologies using biosludge for the reclamation of disturbed lands, the processes of storage at landfills, composting and ash production.

The technology being developed can be applied to all public utility enterprises and, first of all, to water utilities in large cities in the country. It should be borne in mind that the state of technology for processing municipal waste in the Russian Federation lags behind the world level. Thus, until the 90s of the last century, the main method of processing biosludge was its drying under natural conditions on sludge beds, followed by removal to fields or exhausted quarries and ravines, as a rule, without special preparation. This practice could justify itself only in the case when only municipal wastewater, known to be free from saturated industrial pollution, was received for treatment, although in this case there were no guarantees in terms of the ingress of microbiological inclusions [2].

At the current stage, the task is to create a fairly simple technology, taking into account the specificity of WWTP biosludge and the possibility of its wide replication and reproduction on different element bases. The development of technology for producing composite materials and its pilot industrial development at this level makes it possible to effectively use waste generated at municipal wastewater treatment plants (biosludge, sand from sand traps, ash after burning biosludge), as well as unprocessed products of organic origin: peat, leaves, wood sawdust, food and inorganic waste (CaO, etc.).

Uncontrolled by-products of combustion processes are also considered trace elements, as are additives in medicines, paints, varnishes, etc. Many of these substances were not found in the past only because they were not purposefully sought due to insufficient attention to this problem. When analyzing its current state, the technical conditions and technological processes for the disposal of biosludge were considered, including its deposition and burial after dewatering, the dewatering process itself on sludge beds and in geotubes, composting of biosludge, combustion and use of ash as a type of soil [3].

On this basis, the justification, selection of optimal options and development of individual technological solutions were carried out. In the process of selecting and preparing a technical project, various options for hydromechanization using dredgers and submersible pumps were considered. Wet and dry technologies for biosludge collection were analyzed, including control of process parameters.

The modern technological process of wastewater treatment includes several sequential operations.

1. Rough mechanical cleaning on grates allows you to isolate a range of products measuring about 5mm. The separated contaminants (plastic, textiles, rubber products, etc.) are compressed and subject to disposal at solid waste landfills.
2. Purification of water from heavy particles passing through the grates using sand traps. The settled sand is regularly transferred to sand cards. In some cases, washing the precipitated sand from contaminants is used, then after a control analysis, commercial sand is obtained.
3. As a result of water settling in primary settling tanks, primary sediment is formed. The sediment from the primary settling tanks is heterogeneous in its fractional composition. According to Moscow wastewater treatment facilities, the content of pollution particles with sizes greater than 7 mm to 10 mm ranges from 5% to 20%, with sizes from 1 mm to 7 mm - from 9% to 33%, particles with sizes less than 1 mm - from 50% to 88 % by weight of dry matter. The sludge from the primary settling tanks contains humidity in the range of 92–96%, a slightly acidic environment, and is saturated with microorganisms and helminth eggs.

The composition is heterogeneous, it is a suspension of gray or light brown color with a sour odor. Due to the large amount of organic matter, it quickly begins to rot, acquiring a dark gray or black color and emitting a strong sour odor.

4. Water treatment in aeration tanks using activated sludge. Sometimes, to increase the efficiency of the process, additional sludge activation is carried out.
5. After water settles in secondary settling tanks, activated sludge settles out. This substance is more homogeneous in its fractional composition than sediment from primary settling tanks and has within 98% (by weight) particles less than 1 mm in size. Humidity,

depending on the adopted technological scheme for sludge processing, is 95–98%. Sludge flakes, consisting of a large number of multilayered microbial cells enclosed in mucus, have a developed specific surface area, which allows them to chemisorb various compounds that are soluble in water. Activated sludge contains helminth eggs. If the organic part in the sludge from primary settling tanks is within 65–75% of the dry matter mass, then in activated sludge it is up to 75%. Ash content of sludge is 25–35%, activated sludge is 25–30%.

6. Disinfection of water after secondary settling tanks using various chemicals or ultraviolet irradiation.

At the same time, not only wet or dry technologies can be used at different production sites, but also individual elements of the resulting design solution. The main focus of the development is to maximize the convergence of the interests of housing and communal services as a manufacturer of component materials and road transport services as its consumer within one regional hub.

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