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Study of process of intensification of dehydration of secondary activated sludge for its utilization as a secondary energy source

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Abstract. The processes of intensification of dehydration of secondary activated sludge for its utilization as a secondary energy source afterword are considering in this article. Experiments have shown the effectiveness of using asymmetric period pulse action method to accelerate the necessary processesand hydro transport of condensed sludge.

1. Introduction

Modern water treatment plants have multi-stage water purification technology, including the latest biotechnologies, during operation of which a large amount of secondary sludge is formed. Secondary sludge is advisable to consider as a valuable secondary energy resource [1-3], which can be used to produce pyrolysis gas for the subsequent generation of thermal energy. However, for burning in pyrolysis furnaces, it is necessary to remove excess moisture from the activated sludge.

Active sludge is an unstable heterogeneous biological system, so the issue of removing excess moisture using traditional technologies as centrifugation, and various filtration methods, flotation, etc. do not give satisfactory results. The most common traditional method of removing moisture is settling of waste sludge in large-diameter tanks, but settling is a very slow process and there is difficulty in evacuating the settled sludge. This method allows to achieve only a slight dehydration to 98.5%. Such high humidity is due to the fact that the process takes place in a practically stationary environment, and a large amount of "bound" water in the sludge itself counteracts further dehydration.

The new approach involves mathematical modeling of the three main processes in the apparatus: sewage settling, sewage filtration, and evacuation of the polydisperse phase of condenced sludge [5-10].

The purpose of this work is to study the fast dehydration of activated sludge to find technological solution. That is possible only after a series of laboratory tests, such as determining the rheological

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properties of sludge at different humidity, selecting the optimal pulsation modes (frequency, amplitude, duty cycle), etc.

2. Instruments and methods

The object of the study was the return sludge from the water treatment plant in Naberezhnye Chelny (the time between sampling and laboratory test - 4 hours) with a flow rate of 6000 m3 / day and the mass content of dry matter is 6-10 g / l. The measurement of the dry matter content of sludge was carried out by filtering on a blue ribbon paper filter and drying of the precipitate at a temperature of 105 ° C. The result was 8.6 g / l. Next, to study the properties of the return sludge, the installation of a vibrating screen with a No. 1 sieve (cell size 0.3 mm) was used, the filtration time was 6 minutes, the colloidal phase with a mass of 31.2 g / l was selected. According to visual observations, most of the sludge left with water. When using sieve No. 2 (cell size 0.056 mm), the filtration time was 6 minutes, the colloidal phase with a mass of 98.6 g / l and a water content of 94% is isolated. When visually observed, the filtered water contained almost no suspension. Thus, it was established that the studied heterogeneous biological system is well filtered, and the apparatus should choose the largest cell in the range of 0.056 mm-0.300 mm while maintaining satisfactory characteristics of the filtered water (suspended particles, transparency, color, etc.).

The static sedimentation of sludge in a glass vessel was investigated; the sample volume was 1 liter. As a result of studies conducted after 2 h. 25 min. settling silt surfaced i. nitrification of activated sludge occurred. It can be concluded that the results of static settling are unsatisfactory, therefore, methods should be used that increase the efficiency of settling, for example, pulsating technologies.

The study of pulsating sedimentation was carried out on a laboratory bench, with a U-specimen, with a cross section of both knees of the apparatus 80x80 mm.

3. Results

The content of dry residue in condensed sludge from the bottom from the bottom of the U-sample is 18.5 g / l, from the bottom of the control tank -17 g / l, the volume of the original sludge is V = 4 l. Pulse frequency 15 pulse / min. The duration of the experiment was 3 hours and 37 minutes, the results are presented in figure.1.

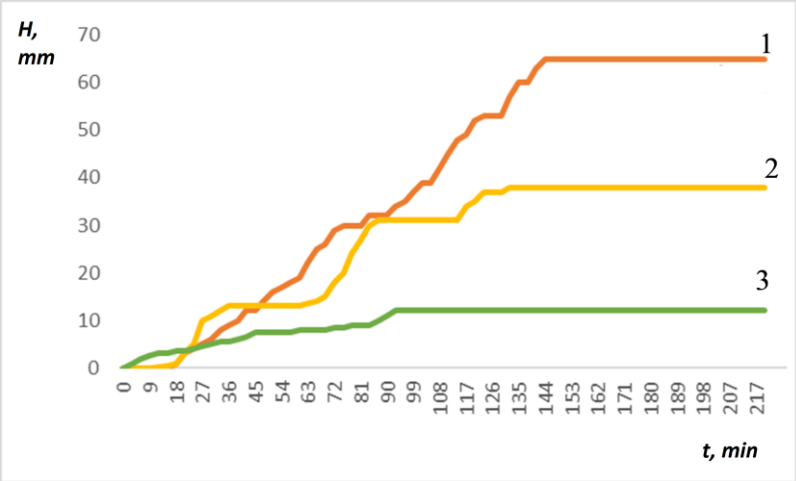


Figure 1. Dependence of the height of the column of clarified liquid on the time of exposure to biomass when pulsation is applied: 1 is the height of the column of clarified liquid in the pipe of the load , mm; 2- height of the clarified liquid column in the discharge pipe, mm; 3- height of the clarified liquid column in the measuring bowl, mm.

A study on the rotational effects (imposition of centrifugal forces, vibration) on the spent activated sludge. The imposition of centrifugal forces increases the deposition rate by 43%. The results are presented in Fig. 2

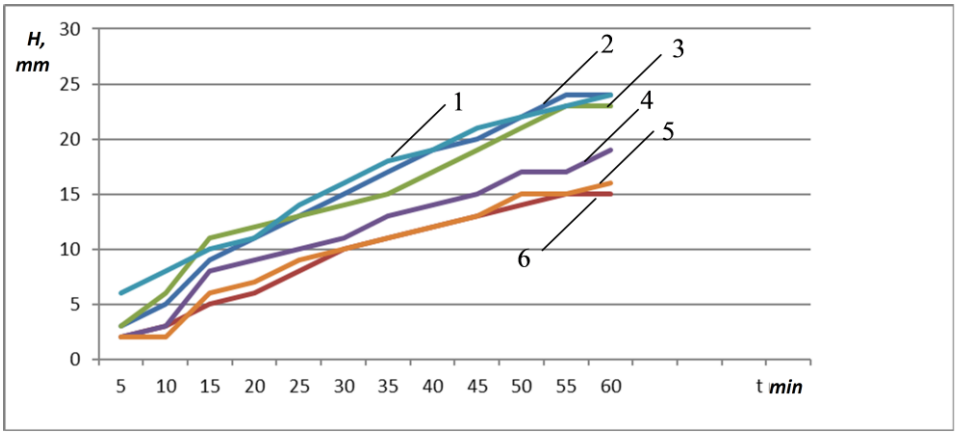


Figure 2. Dependence of the height of the column of clarified liquid on the time of exposure to biomass when applying centrifugal forces: 1- height of the column of clarified liquid at a rotation speed of 33 rpm, mm (1st experiment); 2 - the height of the column of the clarified liquid at a rotation speed of 78 rpm. mm (3rd experience); 3 - the height of the column of clarified liquid at a rotation speed of 45 rpm, mm (2nd experiment); 4,5,6 - height of the column of clarified liquid with static sedimentation, mm in the 1st, 2nd, 3rd experiments, respectively.

A study of vibration effects on spent activated sludge has been carried out. Impacts on the biomass of sludge were carried out using pulsed-oscillatory movements of the vibrating apparatus.

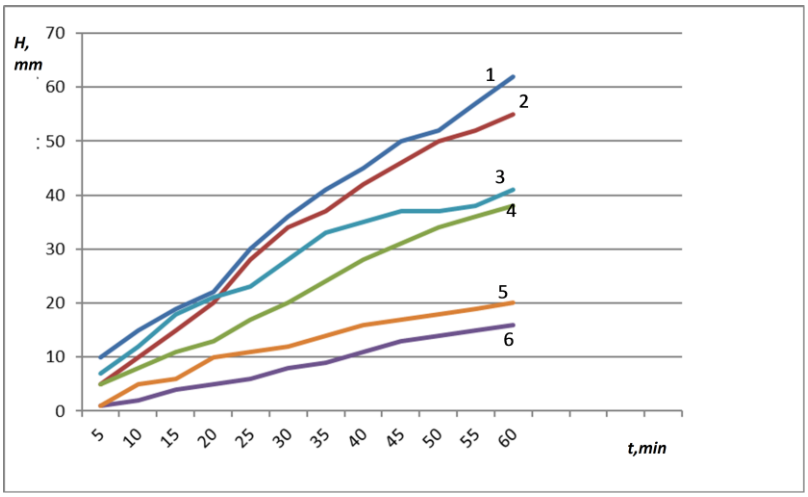


Figure 3. Dependence of the height of the column of clarified liquid on the time of exposure to biomass: when vibration 1 is the height of the column of clarified liquid under vibration exposure, mm (1st experiment); 3 - height of the clarified liquid column at a rotation speed of 78 rpm, mm (3rd experiment) 4- height of the clarified liquid column at a rotation speed of 33 rpm, mm (2nd experiment); 2,6,5 - height of the column of clarified liquid with static sedimentation, mm in the 1st, 2nd, 3rd experiments, respectively.

4. Conclusion

When pulsation is applied to the deposition zone of activated sludge, the process of water separation accelerates significantly (about twice) (in an hour - the water level is 110-120 mm with pulsation, 45-50 mm - without). Rotation (imposition of centrifugal forces) and vibration significantly accelerate (twice) the process of water separation (an hour later - the water level is 20 mm during pulsation, 10 mm - without). Low-frequency vibrations also contribute to sludge settling.

According to the results of the above experiments, it is advisable to combine rotational and pulsation stimulation of sludge sedimentation at frequencies close to the intrinsic resonant frequencies of the settler.

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