Conditioning and Dewatering for Sewage Sludges from Treatment Fasilities in the Town of Brody in Lviv Region

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The influence of chemicals and their doses on filtration characteristics of sewage sludges in the town of Brody in Lviv region is determind.

Key words: chemicals, sludge conditioning, sludge dewatering.

I. Introduction

Nowadays, for many towns, settlements, and industrial enterprises, the problem of treatment and reclaiming of sludges which emerge during water treatment is very daunting. If offen occured, that untreated sludges were being discharged into overloaded silt sites, into spoil banks and pits, which has led to deterioration of living conditions of population.

Nowadays, in majority of sewage treating plants, huge amount of partially dewatered and insufficiently stabilized sludge forms. The treatment of sewage sludges (TSS) is conducted in order to maximally reduce their volumes and to prepare them for further placement, utilization or reclaiming with the due sanitation of environment or restoration of its favourable state [1].

Now, in Ukraine, the tehnology of sewage dewatering under natural conditions in silt sites is mainly used, that creates the phenomenon of " hot-house effect ", which is a harmful factor which influences the ecology of the region. In the light of Kioto Requirements, which is signed by Ukraine, the reclaiming of sludges with the application of modern technologies is of greate value, which, in its turn, enables us to create alternative sources of fuel for application in co-generative plants in order to generate heat and electric energy.

II. Objective of the work

Investigation of the influence of chemicals on filtration characteristics of sewage sludges and determination of their dozis.

III. Experimental plant

In order to improve water yielding capacities of sludges, it is necessary to carry out their conditioning, i. e. to change structures of their solid phases before their dewatering or reclaiming.

Usually, sludges are subjected to conditioning before their mechanical dewatering and, in special cases, before natural dewatering.

Sludge conditioning can be carried out according to chemicals methods and chemical-free methods. In chemicals method, mineral coagulants and organic flocculants are being applied.

As chemicals, iron chloride, iron sulphate, aluminium sulphate, and sodium triphosphate are used.

In order to determine water losing characteristics of sludges, the concept of *specific resistance to filtration* is defined.

The specific resistance to filtration is the resistance of a unit mass of the phase which is deposited on a unit area of the filter under constant pressure of the suspension whose liquid phase viscosity is equal to 1.0. According to modern theory of a suspension filtration, specific resistance of a sludge, which characterizes the resitance to filtration and filtrability (water loss) of sludges, is determined according to the formula [2]:

$$r = \frac{2 \cdot P \cdot F^2 \cdot b}{\eta \cdot C}, \text{ cm/g},$$

where P is the vacuum (pressure), under which the filtration procedes, Pa; F is the area of the filtering surface, cm^2; η is the viscosity of the filtrate, ps; C is concentration of the sludge, g/cm^3; b is the paramenter which depends on the conditions of the investigation:

1st way:

$$b = \frac{\left(\frac{t}{V}\right)}{V} = \frac{t}{V^2},$$

where, t is the duration of the filtration, s; V is the volume of the filtration whis emerges, cm^3.

2nd way:

The paramenter b can be determined from the graph drawn in the coordinates: $x = V$, $y = t/V$. In this case, b is the tangent of the slope angle between the curve (which is a straiqht line here) and the abscissa .

$$b = \frac{\left(\frac{t}{V}\right)}{V} = \frac{m}{n},$$

Usually, specific resistance of a sludge is determined at constant values of F, η, P. If the ratio $\frac{2 \cdot P \cdot F^2}{\eta} = K$ is a constant quantity, the formula for determining the specific resistance of sludge takes the form:

$$r = \frac{K \cdot b}{C}, \text{ cm/g},$$

During investigations of determining the filtration characteristics of TSS and the influence of chemicals on these characteristics, the experiments were carried out on a laboratory plant which is shown in Fig. 1.

As a filter cloth, the Draymad cloth was used.

During the vacuum filtration of the sludqe, the following quantities were measured and the following values of them were obtained: volume of filtrate V = 40 ml; vacuum P at which filtration procedes P=0.6 kg/cm^2; mass of mixture M = 37.4 g; humidity of mixture ω = 99.4 %; density of mixture ρ = 0.935 g/cm^3; mixture concentration sludge C = 0.00561 g/cm^3; specisic resistance r = $206.611 \cdot 10^{10}$ cm/g.

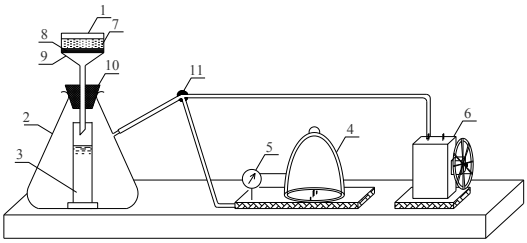

Fig.1. Laboratory device for determining the specific resistance of sludges: The laboratory device for determining the specific resistunce of sludges consists of Buchner funnel - 1, flask - 2, graduated cylinder – 3 (for filtrate collection and measuring), receiver - 4, Komovsky's pump - 6, vacuummeter – 5, investigated portion sludge – 7, filter cloth – 8, perforated bottom - 9, rubber stopper – 10, cock – 11

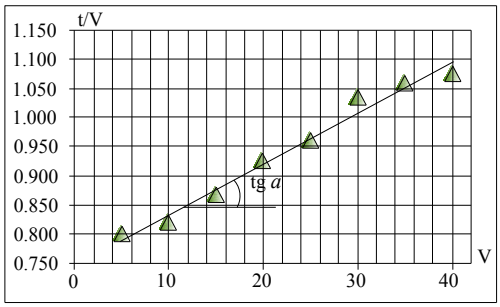

Fig. 2. Graph for determining the paramenter b as a function of t|V when Draymad is used

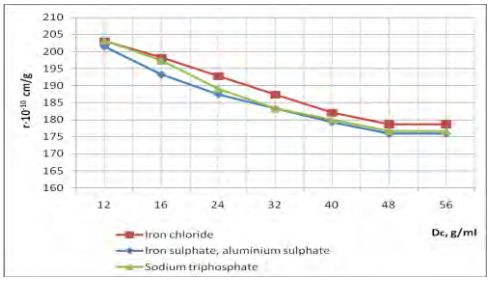

Fig. 3. Dependence of the action of specific resistance of raw primery sludge on the dose of coagulant when Draymad is applied

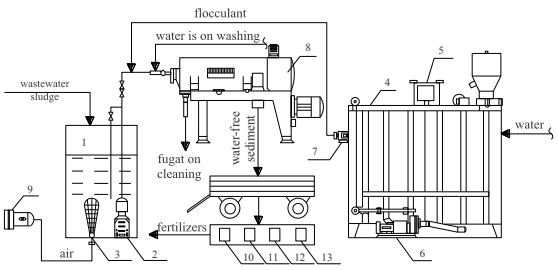

Fig. 4. Technological scheme of processing and reclaiming of sludge: 1 – aerobic stabilizer for sludge, 2 – submersible pump, 3 – aerator, 4 – plant of preparation and batching of flocculant , 5 – electric mixer, 6 – pump for discharging the flocculant concentrate into the inlet chamber, 7 – pump for discharging the working solution of the flocculant, 8 – centrifuge, 9 – blower, 10, 11, 12, 13 – compost tranches

The investigated portion of sludge 7 was carefully mixed and poured out on to previously wetted filter cloth. The cock 11 was closed. In the receiver 4, a given vacuum (600 mm of mercury) was set wich a help of Komovsky's pump, its value was controlled with the vacuummeter 5, and the cock 11 was opened; with this, partial vacuum drop took place, then this drop was risen to a needed value; with the set of the given vacuum, the stop-watch was switched on, and the reading of the initial volume of the filtrate in the cylinder was recorded. Then experiment was repeated under constant vacuum.

Readings were carried out for each 5 ml of filtrated sludge. When filtrate ceased to go, the stop-watch and vacuum pump were switched off, the volume of the filtrate and the time of the end of the experiment were recorded.

In the determination of specific resistance of the sludge, the paramenter b was determinated from the graph drawn in the coordinates shown in Fig. 2

In this case, b is the tangent of the slope angle between graph-line and the abscissa.

The doses of the chemical for sewage sludge conditioning have been determinate on a laboratory device in our research laboratory.

IV. Results from the experiment

Dependence r = f(D_c) which indicates the optimal dose of the chemical has been obtained (Fig. 3).

As a result of experimental investigations, some graphic dependences between specific resistance of sludge and different factor of influence have been plotted.

It is seen from the graph that from the chemicals the most effective are sulphates of 2-valent alumivium and iron.

The optimal dose of coagulant is considered to be D_c = 48 g/ml because with the increase of the sludge does not change.

A technological scheme of sewage sludge processing and reclaiming for treatment facilities is suggested in order to reduce their volume and to prepare them for furthem utilization or reclaiming (Fig. 4).

Conclusion

Comparative characteristics of the influence of chemicals on specific reistance of sludge to filtration is suggested.

Comparison of effectiveness of the action of filtration clothes of different types has been carried out.

A technological scheme of sewage sludges conditioning and dewatering for the town of Brody of Lviv region is suggested.

References

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