

PROBLEMS OF DESIGN AND IMPLEMENTATION OF THE FILTERING EQUIPMENT FOR MUNICIPAL DRAINS TREATMENT AND DEHYDRATION OF WATER-TREATMENT STATIONS DEPOSITS

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ABSTRACT

The problem of municipal drains treatment and dehydration of the water-work condensed deposits is very actual in many cities of Ukraine and the NIS and needs the effective decision.

Municipal and water-work condensed deposits considered as a difficult-to-filtering suspensions. Dehydration of such deposits requires, in particular, application of the filtering equipments working under superfluous pressure. In connection with significant volume of suspensions, demanding the dehydration, for water-treatment plants are required filter- presses with the big surface of filtering. For such tasks the application of specially designed chamber filter – presses with vertical plates arrangement can be the most effective.

The main requirements for the design of filtering equipment for municipal drains treatment and other industrial and municipal enterprises are:

- high productivity and compact;
- simple and reliable design;
- characterized by small duration of auxiliary operations (10-20 min on a standard size of the filter);
- effective electrical consuming, (energy saving technology);
- equipped with effective automatic devices of filtering plates regeneration without their dismantling from filter – press;
- equipped by plates with squeezing membranes that allows to intensify process of filtering and it is essential to lower humidity of a filtered deposit;
- do not demands the big areas and high flights for installation, and a lot of high qualified professionals for operation and service;
- allows to receive a deposit with humidity not above 60 %.

KEYWORDS

Chamber filter-press; Filtration; Dehydration; Municipal drains treatment

1 INTRODUCTION

The problem of municipal drain treatment and dehydration of the water-work condensed deposits is very actual in many cities of Ukraine and the NIS and needs the effective decision. Municipal and water-work condensed deposits considered as a difficult-to-filtering suspensions and serious sources of environment pollution.

Practically in all municipal water treatment stations as well as related industrial branches solve the problem of increasing the productions' efficiency, development and introduction of new, modern machines and devices, is necessary to deal with questions of separation and dehydration the weighed substances from different technological liquids with filtering them through porous partitions.

Filtering is important part of municipal drains treatment as well as many kinds of manufactures as a whole and promotes the reduction of labor and power inputs, raw material and natural resources economizing, reduction and prevention the pollution of environment. At present time heightened attention is devote to computer modeling of physical processes and geometrical aspects.

2 FEATURES OF DEPOSITS DEHYDRATION BY CHAMBER FILTER-PRESSES APPLICATION

Ukrainian and foreign operating experience of the various equipment (drum-type vacuum filters, various construction chamber filter-presses, screw-conveyor centrifuges, band-type filter-presses, etc.) at a stage mechanical dehydration of the water-work condensed deposits testifies that chamber filter-press with vertical plates of the top suspension bracket, having the big individual capacity (a surface of filtering from 80-500 m²) and designed on work at big pressure differences are preferable to the application on drains treatment stations.

Drum-type vacuum filters demand application of the powerful vacuum pumps, working continuously and consuming unfairly a much of electric power, thus results do not justify expenses: humidity of the filtered deposit to average up to 80 % (i.e. with each 1 kg of a dry deposit are unloaded 4 kg of water, and it is require additional expenses for transportation).

For effective operation of band-type filter-press it is necessary availability of special filtering grid which does not suppose presence in a dehydrated deposit of the casual subjects, capable to damage it, that will demand application of special protection devices in conditions real - time operation. Humidity of a deposit at this equipment is a little bit lower, but unsatisfactory (above 75-77 % or 3-3.5 kg of water on each 1 kg of a deposit).

Centrifuges demand special agents-flocculants and during operation the significant part of the dehydrated weighed particles slips. In this case it is necessary to return suspension in a head of clearing constructions, considerably increasing their loading. Also it is necessary to mean, that the rotor of centrifuges rather quickly fails because of erosive deterioration and needs to replacement (more than 60-70 % from total centrifuge costs). Deposits humidity in this case was above 75-80 %.

Chamber and membrane filter-presses are most simple in operation, have the minimal power consumption, do not require expensive agents-flocculants, provide the highest cleanliness of a

filtrate and the lowest humidity of the filtered deposit (70-72 % or 2.3-2.6 kg of water on 1 kg of a dry deposit). Application of such filter-presses allows to reduce transportation expenses. At the same time, for their effective work it is necessary, that filter-press equipped by top bracket of filtering plates, and plates were equipped with squeezing membranes for pressing the filtered deposit.

Necessity of membranes application is connected to features of filtering process. The matter is that necessity of reception the wide surface of filtering causes a vertical arrangement of filtering plates. It in turn results to that driving force of process of filtering (difference of pressure on filtering partition) and a gravity, working on particles of a firm phase taking place in suspension, are directed under a right angle to each other. Thus particles of a firm phase move in chambers of filtering the filter-presses on compound trajectory, causing non-uniform filling by their filtered deposit.

This problem is very actual and important due to wide application of filter presses in the industry and a municipal service and high requirements to effectiveness and productivity. At the moment there are discrepancy between theoretical rating and real parameters of productivity. A series of experiments with the special dye pigment assisted have shown, that the effective area of a filtering surface is not a constant value (as it is accepted in the theory), and decreases during filling the chamber by a sediment from initial size practically down to zero. To define the true parameters of filtration, in particular, time of filtration, it is necessary to develop a model of infilling the chamber with a cake taking into account the properties of suspension: it's granulometric structure, temperature, filtration pressure.

Effective surface of filtering tends to reduction that causes the appropriate decline of productivity filter - press, and in some cases may result in a practical stop of process of filtering. The analysis of a deposit unloaded at it testifies that it represents an environment from the dense filtered deposit filled in middle with the non-filtered particles of suspension. Clearly, that the unloading, transportation and storage of such deposit creates serious difficulties in work of clearing constructions.

To avoid such negative phenomenon, it is extremely important to stop process of filtering how the mentioned effective surface of filtering will decrease to inadmissible values and to proceed to pressing a deposit by membranes. It will allow completely dehydrate sludge by high speeds of filtering process and receive dense suitable to transportation and storage a deposit.

At the same time, process of filtering in filter- presses proceeds without an opportunity of visual supervision over a condition of a deposit in its chambers, therefore definition of the moment of transition to pressing a deposit demands development of the special mathematical simulation of filtering process.

The main requirements for the design of filtering equipment for municipal drains treatment and other industrial and municipal enterprises are:

- high productivity and compact;
- simple and reliable design;
- characterized by small duration of auxiliary operations (10-20 minutes on a standard size of the filter);
- effective electrical consuming, (energy saving technology);

- equipped with effective automatic devices of filtering plates regeneration without their dismantling from filter-press;
- equipped by plates with squeezing membranes that allows to intensify process of filtering and it is essential to lower humidity of a filtered deposit;
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Our investigations of deposits dehydration processes in municipal water treatment stations in different cities and settlements of Ukraine: Kharkiv, Enakievo (Donetskiy region), Shelkino (Crimea), etc., testify, that filtering properties of deposits essentially different. Besides at various stations of aeration and water treatment in dehydration process involve as initial and secondary sediment bowls, both separately, and in common, but with a various ratio of mixed streams, and also superfluous active silt and others sludge. In such conditions successful work of a site of mechanical dehydration at each treatment station needs experimental studying filtering properties with the subsequent definition of optimum depth of chambers in filtering plates.

"SIC – EAST Ukraine" designs and manufactures the filter-press on the basis of filtering plates with depth of chambers from 7.5 up to 25 mm. It allows producing the filter - presses most appropriate to concrete conditions for each case.

Prominent feature filter-presses ChM-type, produced by "SIC – EAST Ukraine", is block system of a unloading of the filtered deposit (patents of Ukraine and Russia). The complete set of filtering plates is separated on a packages (from 2 up to 8 on a filtering surface of filter-press) and the unloading is carried out at once from a package into which enters from 10 up to 18 plates. It sharply allows to reduce duration of deposit unloading (about 3-5 minutes on a filtering surface) and accordingly to increase productivity, and also to make work of the deposit unloading mechanism completely trouble-free. Besides it essentially simplifies work of the automatic device for regeneration of filtering napkins as it is not required to move each plate separately to recycle on it a fabric, and then, having put this plate on a place to carry out the given operation for other plate.

Filter – presses ChM are equipped protective doors which during filtering automatically block lateral surfaces filter - press, protecting the personnel, and at a unloading of a deposit are translated in the position allowing visually to supervise completeness of deposit removal (copyright by patents of Ukraine and Russia).

"SIC – EAST Ukraine" – the young and innovative enterprise. For last years were developed and manufactured more than 30 completely automated filter-presses with a filtering surface from 10 up to 150 m² for various industrial and municipal enterprises and water treatment stations in Ukraine and Russia. Filter-presses ChM also work at ferrous and nonferrous metallurgy factories, in chemical manufactures, at a sugar factory, on power stations. Experts working here have long-term experience of development and introduction the filter-presses in various industries, on sewage disposal plant, treatment plant of industrial and municipal enterprises.