Из таблицы видно, что не по всем загрязнениям действующие очистные сооруже-ния обеспечивают требуемую степень очистки. Особенно неудовлетворительна рабо-та очистных сооружений по хлоридам и содержанию красителей. Используемые в на-стоящее время на очистных сооружениях способы обработки сточных вод основаны на электрокоагуляции и применении химических реагентов (коагулянтов и флокулян-тов). При этом эффективность применения полиакриламида, используемого в качест-ве флокулянта, является крайне низкой. При существующем режиме очистки сточных вод во флотаторах отделение взвешенных веществ малоэффективно, а их осаждению в технологических емкостях препятствуют высокие скорости движения сточной вод.

Проведенные исследования эффективности работы очистных сооружений сточ-ных вод текстильного предприятия показали, что они не позволяют обеспечить тре-буемую степень очистки. Данная проблема должна решаться путем совершенствова-ния существующих технологий очистки сточных вод с применением более эффектив-ных реагентов, фильтрующих материалов для доочистки и оптимизации режима ра-боты очистных сооружений [2].

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УДК 628. 33

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EXPERIMENTAL RESEARCH ON SORPTION OF PETROLEUM PRODUCTS FROM STORM WATER BY FILTRATION

Abstract. This article describes the analyses, which were accomplished with the help of the device of experimental filtration, when pollutants from wastewater were being removed by filtration wastewater through sorbents FIBROIL^R filler in filtering rate 30 m/h. The re-sults showed how efficiently and how much time, under described conditions, it can be cleaned by filtrating wastewater which is variously contaminated (based on the concentra-tions of petroleum products and suspended solids), until the concentration of petroleum products in filtrate will be ≤5 mg/L.

Lately in Lithuania and other countries, one of the most polluting substances in the depths of the earth, are petroleum products [1, 2, 3,]. This runoff must be cleaned. Filters reduce the separation time of petroleum products, which may lead to reduced capacity and runoff contamination by petroleum products length of stay in it. For this purpose, the petroleum trap design included one more stage – i.e. final disposal of petroleum products with sorption filter, which can be used with different sorbents. Application of sorption processes in removing various pollutants from storm water is now the subject of environmental science [2, 4-6]. Also it is important to examine, how much contaminated (based on turbidity and SS) storm water is appropriate to clean by sorbent filtration. The scientific literature contains a lot of information about the application of various sorbents to remove petroleum from the waters surface or aqueous solutions in a static way (collecting petroleum spills, when the concentration of petroleum products is high enough) [2, 7-9]. Scientific experiments are also underway, when the sorbents are used as filter filler, but the filtration rate is low: 0.3-0.4 m/h, [10]; 0.5-1.5 m/h [12].

In reality, the flow of storm water is uneven, constantly changing the concentration of runoff pollutants. To ensure efficient use of absorptive materials, it is necessary to evaluate storm water contamination by suspended solids or turbidity [11, 12] by adjusting filtered runoff content properly, otherwise sorbent acts as a mechanical filter [1, 4].

The purpose of the experiments that have been described in this article – to find out how effective absorption fibrous material FIBROIL^R removes petroleum products from various pollution levels storm water (according to turbidity, SS and concentration of petroleum products), when runoff is filtered through FIBROIL filler in selected rates.

The object of the researches that have been described in this article – absorption fibrous material FIBROIL^R and its application possibilities to petroleum products removal from aqueous solutions (compounds) by filtering. It is stated that the FIBROIL^R is a material which does not get wet and it doesn't absorb water that is why it can be used for filter fillers, when water and petroleum products' compounds are filtered. The scientific literature does not indicate what would be the settings of filtering through fibroil fillers. At the same time FIBROIL^R is quite expensive material (20 Lt/kg) that is why it is important to explore how storm water characteristics affects the efficiency of petroleum products absorption.

This article describes the smooth way of insertion of petroleum products in filtering runoff or water, when in the filtering device with help of pumps in constant rates (yields) runoff (or water) and petroleum products are supplied. Thus it was possible to prepare compounds with high concentrations of petroleum products (~50, ~100, ~150 mg/L). To achieve above-described objectives, in Vilnius Gediminas Technical University laboratory filtration device was installed, which is shown schematically in Fig.1.

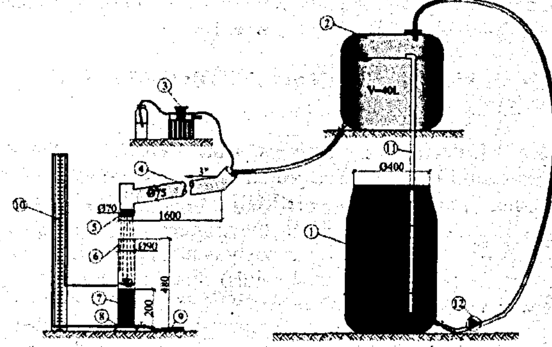

Fig.1 – Filtering device: 1 - 100 liters receptacle for storm water pouring; 2 - 50 liters tank; 3 – vessel filled with diesel; 4 – pipe, through which run-off with inserted petroleum products are delivered to the filter; 5 – percolator; 6 – filtering cylinder; 7 – fibroil filler; 8 – chip layer which maintain filler; 9 – flexible hose for taking filtrate's samples; 10 – piezometer; 11 – overflow pipe; 12 – pump

Storm water was poured into the receptacle (1), pump (12) delivers to the tank (2), in which a constant volume of liquid was kept to ensure steady speed of pipe (4) flow with in- :line (3°). The rate of filtration was regulated by opening bolt more or less and yield of the iltrate was measured every 10 minutes. Petroleum products (diesel) were inserted from the vessel (3) to the flowing liquid by peristaltic pump, at such speed that initial C_0 petroleum products' concentration would form at the end of the pipe (there have been sampled). Fur- her, runoff or tap water was delivered to the cross-sectional area (0,005 m^2) of filtering cy- inder with an initial concentration of petroleum products and with support of percolator and even load. It was filtered through a 20 cm height and 70 grams (70 kg/m^3 filling weight) FI- 3ROIL ^{R} layer. For these analysis 20, 25 and 30 m/h filtering rate was chosen. Filtrates (of)) samples and compounds' A and B samples (before filtering cylinder) were collected in ars (0.5 L) every 10 minutes; these samples' contamination was measured by concentra- ions and turbidity of petroleum products and suspended solids. In filtering cylinder com- prising pressure losses was measured with assistance of piezometer (10). Each separate iltering experiment was done with new fibroil filler, weighting and filling density in the cy- inder were the same. Measurements of parameter were repeated 3-4 times. Errors of sam- pling and accuracy of devices measuring constituted errors. Samples were analyzed using tandards methods: suspended solids (SS) (LST EN 872:2000), turbidity (LST EN ISO '027:2002) and total petroleum hydrocarbons (TPH) (ISO 9377-2:2000).

During the hydraulic test of experimental stand, pressure losses in fibroil filler, filtering tap water in filtration rate of 20, 25, 30 m/h was measured. Pressure losses' dependence on filtration speed after 10 minutes (filtering tap water with a turbidity of 1 DV) is shown in Fig. 2.

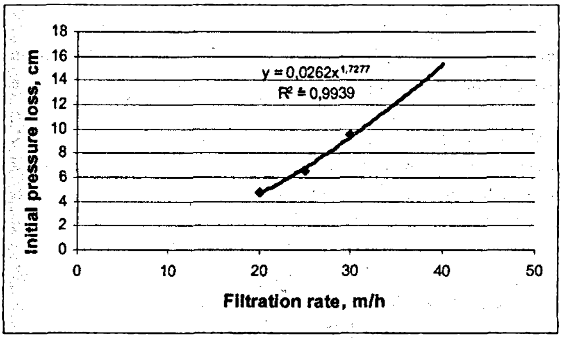

Fig.2 - Dependence on filtering rate in pressure losses filler

As it can be seen from the figure, the pressure losses directly depended on the filtration ıte: when the filtration rate was equal to 20 m/h, the pressure losses were up to 5.2 cm; 'hen the filtration rate was equal to 30 m/h, the pressure losses were up to 10.5 cm. In ›nger filtration of tap water, the pressure losses increased: one hour of filtration on the av- rage increases 0.5 cm.

The filtration of trap water and diesel compound (SS~0.5 mg/L, C_0 ~50 mg/L) in a con- ant rate of 30 m/h, through 76 g fibroil filler lasted 6 hours. During that time, the concen- ation of petroleum products in filtrate samples C_f, varied from 0.5 to 4.5 mg/L and did not kceed the regulated (5mg/L) concentration. In filtration of storm water and diesel com- ound (SS~10 mg/L), the rate of filtration (the lower, the higher the efficiency) and the initial petroleum products' concentration (the higher in the limits of analysis, the higher the efficiency) of runoff influenced the efficiency of absorption of fibroil filler. The pollution of runoff by turbidity and suspended solids influenced the term of filtration. Runoff, which has the lower contamination before filter (SS~10 mg/L, C_0 ~50 mg/L), was filtered 80 minutes longer in rate of 30 m/h, than the more polluted runoff (SS~25 mg/L, C_0 ~150 mg/L). In filtration of runoff (SS~25 mg/L, C_0 ~150 mg/L) in the rate of 30 m/h, after 100 minutes, in the samples of filtrate, petroleum products' concentration of 5 mg/L was exceeded, meanwhile, the efficiency of absorption was up to 96.6 %. In decrease of filtration rate of runoff (SS~40 mg/L, C_0 ~100 mg/L) from 30 to 15 m/h, the efficiency of absorption increased from 98.6 to 99.5 %, although the initial concentration of petroleum products increased from 100 to 158.27 mg/L. To filtrate more polluted storm water (such as SS~40 mg/L, C_0 ~100 mg/L) is beside the purpose, because of the rapid filter and the obstruction of the grid. The derived sorption and hydraulic properties of the fibroil can be used to evaluate the efficiency of operative existing storm water treatment plants as well as to design new facilities.

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