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**Gulnara Sardar Mirza[1], A. Gasanov[2], Yu. Gil[2], M. Saliia[2], V. Zhukovska[2]**
*[1]Azerbaijan Architecture and Construction University*
*(Mammad Rahim, Bakı, Azerbaijan; e-mail: mirza.gulnara65@gmail.com; orcid.org/0000-0003-2820-039x)*
*[2]Kharkiv National University of Civil Engineering and Architecture*
*(Sumska st, 40, Kharkiv, 61002 Ukraine; e-mail: hasanov.aliiar@gmail.com; yuragil397@gmail.com; medeasalia@gmail.com;; orcid.org/0000-0003-3710-9811; orcid.org/0000-0003-2167-4701; orcid.org/0000-0002-2414-9016, orcid.org/0000-0003-4055-3155)*

# FACTORS AFFECTING THE KINETICS OF CONTAMINATING COMPONENTS BASED ON INDUSTRIAL WASTE

Analysis of scientific and technical sources in the field of treatment of oil-containing industrial wastewater shows that the use of the Stokes formula in determining the rate of flotation of oil particles from water is not equally accepted by scientists and experts. Therefore, it was necessary to conduct research to study the process of clarification of industrial wastewater. At the same time, it was found that the bulk of oil in the treated water of refineries depends on the small dispersed phase distributed over the entire volume of water. Oil particles with a smaller specific gravity than water float to the water surface. Some oil particles stick to mechanical mixtures and settle.

**Key words:** wastewater, oil particles, mechanical mixtures, flotation speed, oil trap, cleaning effect, thin layer oil trap.

Koganovskiy A.M. and other researchers note that the rate of subsidence of non-spherical mechanical particles depends on their radius. The results of our theoretical reports we conduct allow us to compile this dependence graphically. As can be seen from the graph given in the figure, as the radius of the mechanical particles increases, their rate of subsidence is also increased. It should be noted that this method can only be applied to mechanical particles of the same density. Using the dependence shown in the figure 1, it is possible to calculate the minimum diameter of the particles that can settle during the remaining water to be treated in the working zone of the parallel plate block in the thin layer oil trap. This, in turn, allows to determine in advance the efficiency of treatment of industrial wastewater passing through the plant.

Figure 2 shows that at values of 50-100 mm of sedimentation height in the space between the plates, most part of the mechanical particles are separated from the treated water during the first 10 minutes. The minimum diameter of the separated particles varies between 0.083-0.167 mm (H = 50 – 100mm). During the remaining period of sedimentation, the amount of residual of particles in the water remains practically unchanged and there is no significant change in the efficiency of water treatment.


*Fig. 1 Dependence of the rate of sedimentation of mechanical particles on their radius*

Specific gravity of oil and mechanical particles in the flotation of oil particles in the treated industrial waters of refineries and the sedimentation kinetics of mechanical mixtures; dimensions of floating and collapsing particles; water temperature; the ratio of the amounts of oil and mechanical particles in the water, the speed of movement of water in the relevant facilities and influence of other factors are great.. The kinetics of the separation of oil particles from water in the static state of water non-containing mechanical mixtures has been studied by various researchers since the 50s of the last century.

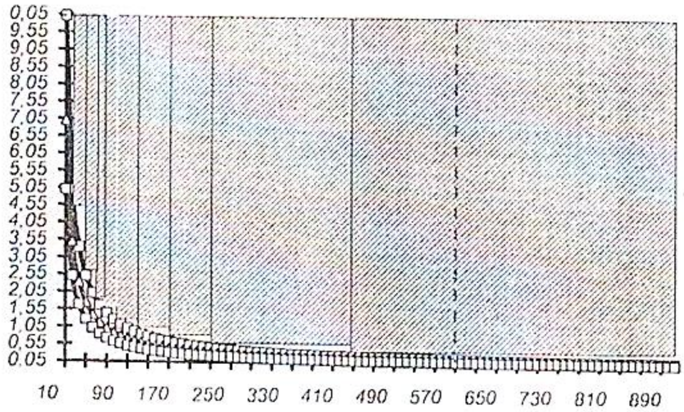


*Fig. 2 The dependence of the duration of oil particles in the space between the plates on their diameter*

Graphs of the flotation rate of oil particles of different sizes depending on the specific gravity of oil are shown in Figure 3.

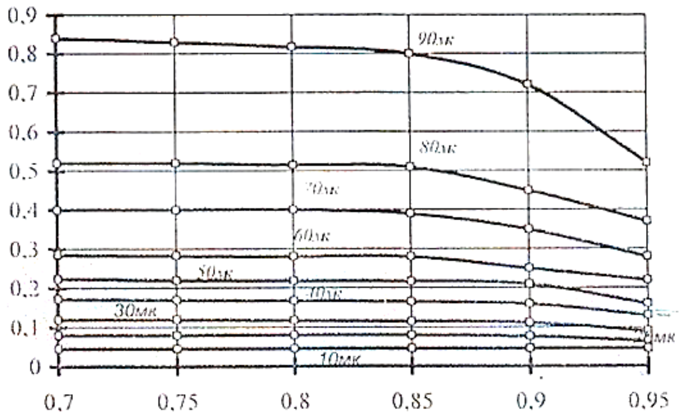


*Fig. 3 Dependence of flotation rate of oil particles on their size*

As can be seen from the graph, the change in the specific gravity of the oil in the range of 0.73-0.91 kg/m3 does not practically affect the flotation rate of particles up to 50 mc in size. As the particle size increases, this effect begins to show itself. If the specific gravity of oil particles increases to 0.94, the flotation rate of particles with a diameter of 70 mc decreases by 25%, and the flotation rate of particles with a diameter of 90 mc decreases by 35%. In all cases, changes in the diameter of oil particles affect their flotation rate. The decrease in specific gravity leads to an increase in the flotation rate of oil particles.

The viscosity of water also plays an important role in the flotation process. The latter depends on the water temperature. Using the results of the research conducted by L.A.Kulskiy, I.T.Goronovskiy, Koganovskiy A.M. and M.A.Shevchenko, this dependence was graphically formulated by us as follows (Fig. 4).

From the curves in Figure 4, it can be seen that although the increase in temperature leads to a decrease in the dynamic and kinematic viscosity of the water, the difference between their change kinetics is insignificant.

To study the effect of oil particles of viscosity on the flotation rate, sufficient research has been conducted. Mongait I.L. and Rodziller I.D. still in the 50s of the XX century, were discovered that the increase in water temperature from 10° to 30° does not affect the flotation rate of oil particles, regardless of their size. An increase in temperature up to 50° temperature leads to an increase in the flotation rate of oil particles larger than 200 mc in diameter. Usually such particles are not taken into account in the report of oil trap.

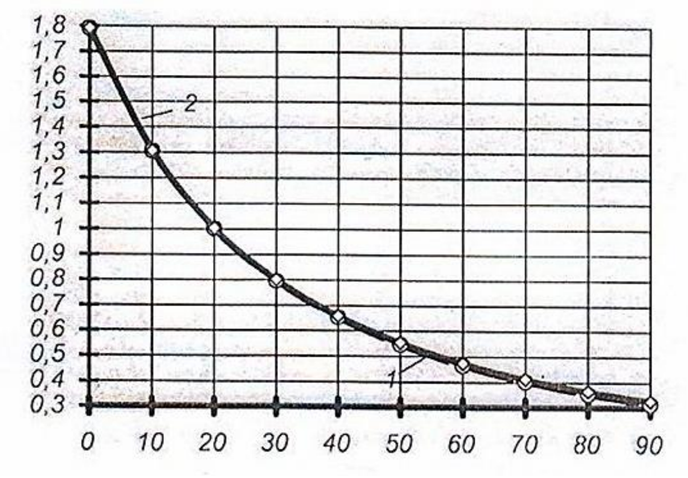


*Fig. 4 Dependence of water viscosity on temperature:*
*1-dynamic viscosity- η, mPa.san; 2-kinematic viscosity- γ, m2.sec1.10-6.*

In addition to oil and mechanical particles, aggregates consisting of oil and mechanical mixtures are also found in the wastewater of the oil industry. Such aggregates sometimes collapse and sometimes float to the surface. The size of these aggregates varies from 120 to 150 mc, and the sedimentation rates vary from 0.55 to 0.70 mm/sec., depending on their size.

The presence of mechanical mixtures in the water prevents the oil particles from separating from the water and floating to the surface. The results of research show that mechanical mixtures larger than 30 mc precipitate oil particles together with them, while clay particles with a dispersion of less than 15 mc float with oil particles and rise to the surface.

According to the information of V.G.Perevalov and V.A.Alekseyev, although small mechanical mixtures (sand, clay, coke particles, etc.) that remain in a dependent position in water do not reduce the surface tension at the phase boundary, they act as emulsifiers and prevent the oil particles from coming together. Since hydrophilic mechanical particles do not tend to the location on the separation surface of the phases, they adhere to the emulsified oil curtain and form a solid cover that prevents them from coming together when they collide with oil particles and forming large oil balls. As a result, the amount of oil in the form of emulsion, which is not separated from the water for a long time, increases. When the ratio of oil and mechanical particles in water is 1:1, micro-aggregates consisting of oil and mechanical particles with dimensions of 120-150 mc are formed.

The results of research show that the flotation rate of oil particles in water without mechanical mixtures exceeds the velocities calculated by the Stokes formula. While calculating modern oil trap, the correction factor β is added to the Stokes formula, which takes into account the effect of mechanical mixtures on the flotation rate of oil particles. This factor, proposed by American researchers, is calculated by the following formula:

$$\beta = \frac{4 \cdot 10^4 + 0{,}8\alpha^2}{4 \cdot 10^4 + \alpha^2}$$

where: α – the amount of the mechanical mixtures in wastewater, mq/l.

The dependence of β on the amount of mechanical mixtures in water has been graphically plotted by us (Fig. 5).

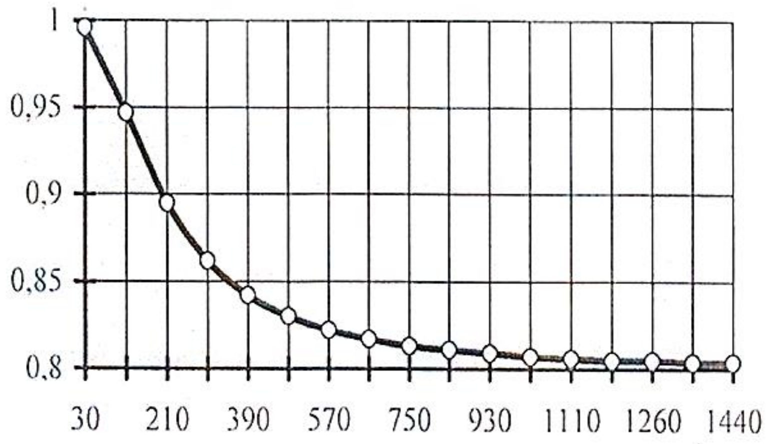


*Fig.5 The dependence of correction factor β on the amount of mechanical mixtures in the water*

The error determined by computer calculations was found to be 0.02%, the relative error 5% and the standard deviation 1%, which proves the possibility of using the graph in the relevant reporting. As can be seen from the graph, the correction factor has a practically constant value (0.804) in cases when the amount of mechanical mixtures in the water is more than 1000 mg/l.

Settlings are calculated to separate particles of a certain size from the water. In this case, it is assumed that all particles with a calculated diameter and larger than that are completely separated from the water. In modern oil traps

A study of the separation of oil and oil products shows that the flow in the separation zone of these facilities is not laminar, even at prices below the critical point of the Reynolds criterion. The main reasons for this are the unequal composition and temperature of the mixtures in the water entering the device, as well as in the separation zone, generation of local turbulent flows due to uneven distribution of water throughout the living cross-sectional area and uneven collection and disposal of treated water when entering the facility, installation and operation of additional auxiliary equipment for removal of oil and oil products trapped in the unit, as well as mechanical mixtures, errors in the construction of the unit (unevenness of the walls, incorrect technological inclinations), etc.

The difference between the water temperatures in different areas of the device leads to the formation of zones with different densities, which creates convective flows in the device. Inlet and outflow of water from one point to the device creates special stable vortex zones.

Vortex zones occur at the entrance, exit, and even the middle settling part of the device. This leads to the fact that the actual retention time of water in the separation zone of the particles is 2-3 times less than the calculated time. Therefore, in practice, the retention time of the particles in the device and the treatment efficiency of the device are evaluated by the coefficient of utilization of the volume of the separation zone. The coefficient is determined by the ratio of the actual retention time of water in the device to the calculated time.

The vortices created in the body cause the water to mix, which in turn causes the concentration of the mixtures in the water to be evenly distributed over the entire depth of the flow. As a result, the difference in density in the flow is eliminated and the rate of separation of particles from water begins to weaken.

The water consumption per unit separation area does not depend on the constructive size of the unit, although it depends more on the type and size of the particle allocated, and less on the required treatment efficiency and the nature of the flow in oil trap. Pokrovskiy and

Arakcheyev insist that the separation of oil and oil products from qm industrial wastewater should be considered a key characteristic of sedimentation plants. This parameter allows to unambiguously determine the separation surface needed to purify water from particles in a given size in the required level (F =Qm / qm). The nature of the surface and its placement in the device, the organization of the water flow and the removal of the separated product depend on the constructive solution of the device in each specific situation.

From this point of view, oil traps with flows with a sedimentation depth of 20-100 mm can be considered more perspective. The main advantages of these oil traps are the spontaneous deviation of mechanical mixtures and oil and oil products from the settling zone, which are released from the water in cases of the distance between the plates forming thin layers and the angle of inclination of the plates to the horizon are chosen correctly that it does not require additional operations to do the same job, unlike other oil traps. Other advantages of these devices are their small weight, ease of manufacture, the fact that they can be operated with an oil trap of any construction in operation, or can be installed directly on their bodies. The simplicity of the report of thin layered oil traps allows them to easily determine their constructive dimensions.

The thinness and shortness of the working water flow layers between the parallel plates allow to eliminate the following undesirable factors:

diversity of composition and temperature of mixtures in water;

unlike conventional horizontal oil traps, the condensation of collapsing particles or the formation of heated water masses do not cause intensive currents of different densities.

After the short settling zones at the beginnings of the channels between the plates, a laminar flow is practically created, and it is possible to report such devices with the accuracy required for practice using the formulas available for laminar flows.

Laying the plates in horizontally direction is more convenient in terms of increasing the productivity of the device. However, in this case, only coarsely dispersed oil and oil products can be separated from the water, and the removal of precipitated mechanical mixtures from the canal creates great difficulties. Studies show that the maximum value of the treatment effect and the minimum value of the channel length are obtained when the flow enters the channels from top to bottom for oil and oil products, and for mechanical particles from the bottom to the top. It is not recommended that the Reynolds criterion for flow in such channels be more than 600.

Theoretical analysis of the kinetics of separation from the water of contaminant components (oil, oil products and mechanical mixtures) in the industrial wastewater of refineries shows that in the sufficient treatment of such waters, thin layered oil traps can be more efficient than existing structures currently in operation.

**Resume.** There are results of had made theoretical researches on some factors impact to the process of treating oil contained sewages in this.

This units occupied not large area and had enough high productivity are ensured purification of oil polluted sewages directly at the places of their forming.

It takes possibility to decrease load on whole – factory treatment, production process scrap into air through water-cooled construction, to increase quantity of absorbed from sewage matters, which return to production process.

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**Гульнара Сардар Мірза, Гсанов А., Гіль Ю., Салія М, Жуковська В. ФАКТОРИ, ЩО ВПЛИВАЮТЬ НА КІНЕТИКУ ЗАБРУДНЮЮЧИХ КОМПОНЕНТІВ НА ОСНОВІ ПРОМИСЛОВИХ ВІДХОДІВ.** Аналіз науково-технічних джерел у галузі очищення нафтовмісних промислових стічних вод показує, що використання формули Стокса при визначенні швидкості флотації частинок нафти з води не однаково прийняте вченими та експертами. Тому необхідно було провести дослідження для вивчення процесу очищення промислових стічних вод. У той же час було встановлено, що основна маса нафти в очищеній воді НПЗ залежить від невеликої дисперсної фази, розподіленої по всьому об'єму води. Частинки нафти з меншою питомою вагою, ніж вода, пливуть на поверхню води. Деякі частинки олії прилипають до механічних сумішей і осідають.



**Ключові слова:** стічні води, частинки олії, механічні суміші, швидкість флотації, маслоуловлювач, ефект очищення, тонкошарова нафтоловка.