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Analysis of Oily Dusts Emitted During Metal Surface Treatment in Laboratory Conditions

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Annotation: In this article, in order to cover the metal surface in the procedure of processing the metal surface, the procedure of processing the metal heated at high temperature with the help of motor oils is studied in laboratory conditions. In order to study this process, a laboratory device was used. Oily gases produced in laboratory conditions were studied. The obtained results were compared with the permitted concentration of gases. Absorption cleaning was recommended in order to retain gases above the permitted norm. The results obtained by the proposed new device were analyzed.

Keywords: metal, oil dust, absorption, metallurgy, gas concentration, concentration, absorber, mass transfer coefficient.

Activation of technological processes in ferrous and non-ferrous metallurgy, chemistry, mechanical engineering and other sectors, in practice, serves to increase the volume of product production, improve quality and reduce cost **[1].** Compressed gases, especially air, petroleum products are mainly used in these processes **[2, 3, 4].** Cleaning of oily gases released into the atmosphere as a result of oiling the metal surface by absorption method is considered effective. Separation mass transfer processes are widely used in industry and are mainly carried out in column-type apparatus. The absorption process is widely used to separate gas mixtures **[5].** Absorption is the selective absorption of gases or vapors by gas-phase liquid absorbers. Liquid cleaner is called absorbent. The absorbed component of the gas mixture is called absorbent. **[6].** Physico-chemical processes are the basis of oil refining technology. Calculation, design and management of such processes require knowledge of the physico-chemical properties of oil, gas condensate and their mixtures **[7].** In this case, waste gases released during the production process are generated. And the generated gas is cleaned by absorption method. Harmful and toxic gases emitted by the enterprise may vary depending on the type of production and the substances used. It is necessary to use different types of cleaning equipment depending on the characteristics and physico-chemical properties of each emitted waste gas. For example, waste gases separated by oily gases are cleaned by absorption method, and dry dust separated by cyclones.

Experimental equipment was created for the purpose of researching the process of trapping oil dusts released into the atmosphere and absorbing them into the environment in metallurgical and metalworking enterprises. The principle scheme of the equipment is presented in **Fig. 1**. The composition of the experimental device **(Fig. 1)** is a compressor for blowing smoke 1, an oven for vaporizing oil 2, a thermometer for measuring the temperature of the liquid to be connected, a heater for vaporizing the liquid to be vaporized 4, a liquid to be vaporized 5, a thermometer for measuring the temperature of the produced flue gas 6, a flue pipe 7, a glass monometer for measuring hydraulic resistance 8, a valve 9, a rotometer for measuring the volume consumption of gas 10, for spraying the gas that has passed through the rotometer nozzle 11, absorber 12 for cleaning the generated smoke, absorbent 13, nozzle 14 for increasing the gas surface, gas analyzer 15 for measuring the garden concentration in the purified gas, valve 16 for discharging used liquids, pipe 17 for releasing the purified gas, absorber temperature The adjustment consists of a reastat 18 for adjusting the spiral temperature, a spiral 19 for heating the absorber, and a regenerator 20 for regenerating the used absorber.

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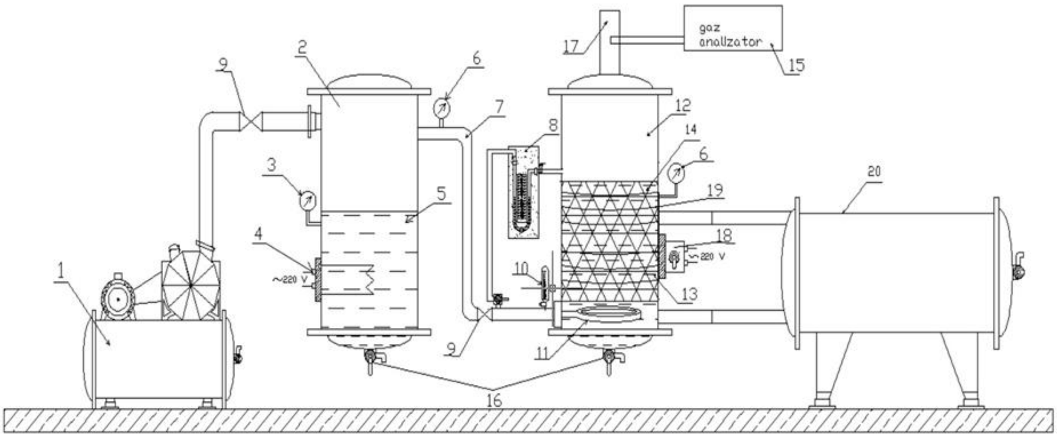

Figure 1. Scheme of the experimental device for studying the absorption process

*1*st compressor; *2nd evaporator; 3.6-thermometer (LATR); 4th electric tan; 5th oil; 7th pipe; 8-monometer; 9th valve; 10th rotometer; 11-nozzle; 12-absorber; 13-absorbent; 14th nozzle; 15-gas analyzer; 16-valves; 17th groove; 18th resettlement; 19th spiral; 20th regenerator.*

The experimental device works in the following order. 5 evaporating liquids (T-750, I-20, OE-26) are poured into 2 containers with a volume of 8 l. The liquid is heated to a temperature of 300-600 ℃ through 4 ten. The temperature of the produced smoke is measured by 3 thermometers. 1 compressor is connected to the evaporator to supply smoke to 12 absorbers at the required speed and pressure. In order to adjust the parameters of the smoke supplied to the absorber, the smoke pipes 9 are equipped with valves. The generated smoke is sent to the absorber 12 through the barbater 11. The smoke passed through the barbater is transferred through the absorbnet 13. The purified gas passed through the absorbent is discharged through 17 pipes. 15 (GX-3R Pro) gas analyzer was used to measure the concentration of purified smoke. 20 are sent to the regenerator to clean the absorber. The temperature of the absorber is controlled by an 18-wire coil.

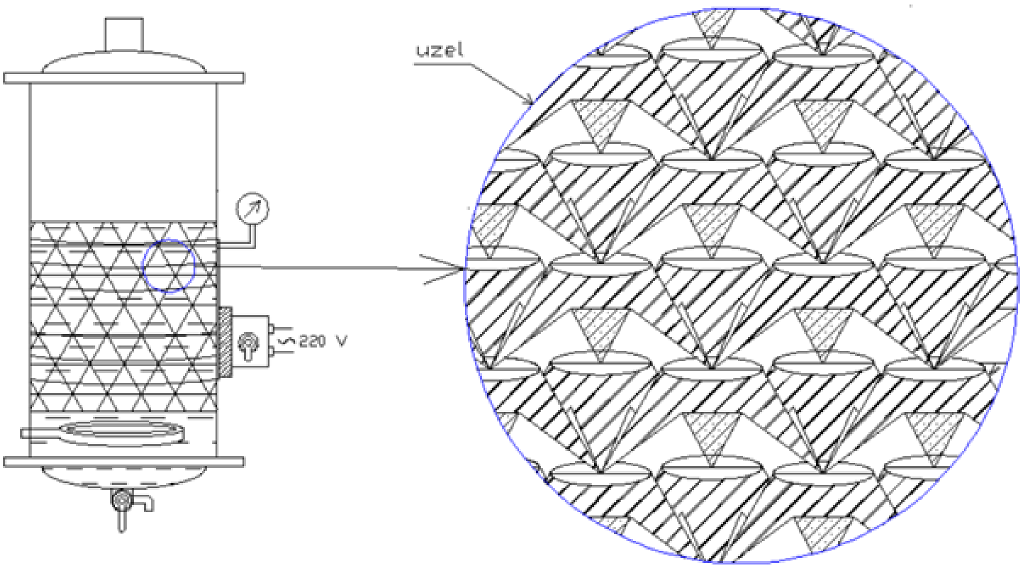

Figure 2. The view of the nozzle tower placed on the absorber

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The tower with a nozzle is designed to increase the surface area of the gas passing through the absorber, and it is designed to increase the surface area of the gas sent to the nozzle.

Before starting the experiment, the mass of the substances used was measured on a CAS WM' 3000 model electronic scale. After the experiment, the used substances are removed from the device. The composition and weight of used oil and absorbent are constantly measured. During the measurement, the working time of the absorbent is also taken into account.

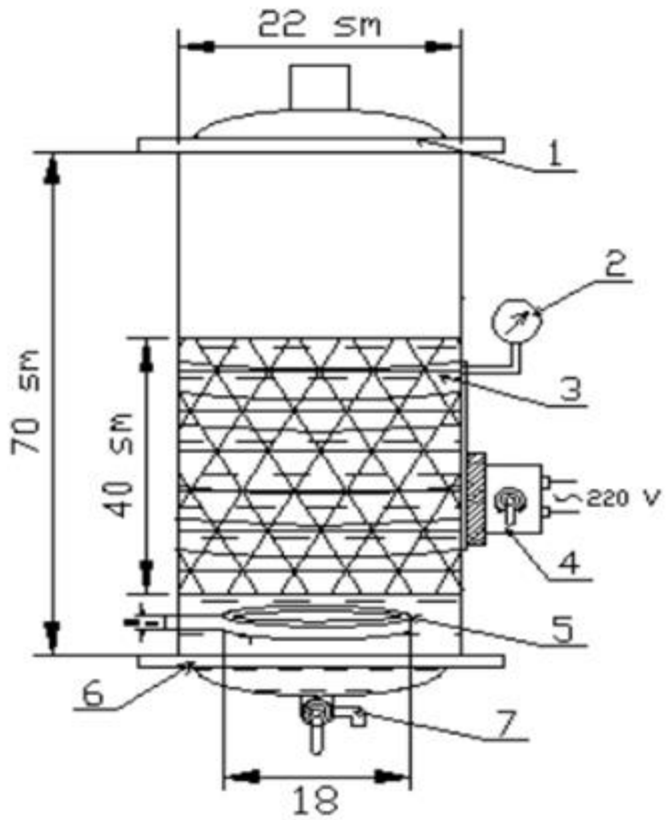

Figure 3. 1.6- hood, 2- thermometer, 3- nozzle, 4- electric heater, 5- bubbler, 7- faucet.

Figure 2 shows the assembled absorber for the experiment. The main geometric dimensions of the absorption device are as follows: device diameter D=22 cm, height H=70 cm, nozzle height (changes) h=20...50 cm, barbater diameter d1 =18 cm, d2=10 cm. The device is designed for the absorption process. A cylindrical metal case and additional devices necessary for the process are connected to it. The absorber body consists of 1, a tank 3 of a certain volume placed inside it, a monometer 2 connected to it, an electric heater for temperature control 4, a bubbler for driving gas 5, a cover 6, and a tap for removing liquid 7.

The device works as follows. The gas transmitted through the 5 bubbler interacts with the absorbent through the 3 nozzles and is expelled after mass exchange. The temperature of the device is controlled by 4 electric heaters. The pressure of the device is measured by 2 gauges. The size of the absorber is calculated based on the volume

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consumption of gas. The nozzle installed on the absorber is specially designed for gas distribution, and through this device, the gas passing through the barbatyer is evenly distributed by volume.

The laboratory device was tested for volume consumption (Q=0.08 m3/s). It is optimized to change the consumption and adjust to the normal operation of the device.

There are different types of nozzles for gas distribution, and each nozzle is selected depending on the operating environment and operating conditions of the device. The proposed nozzle is typed in one row and and placed on the device.

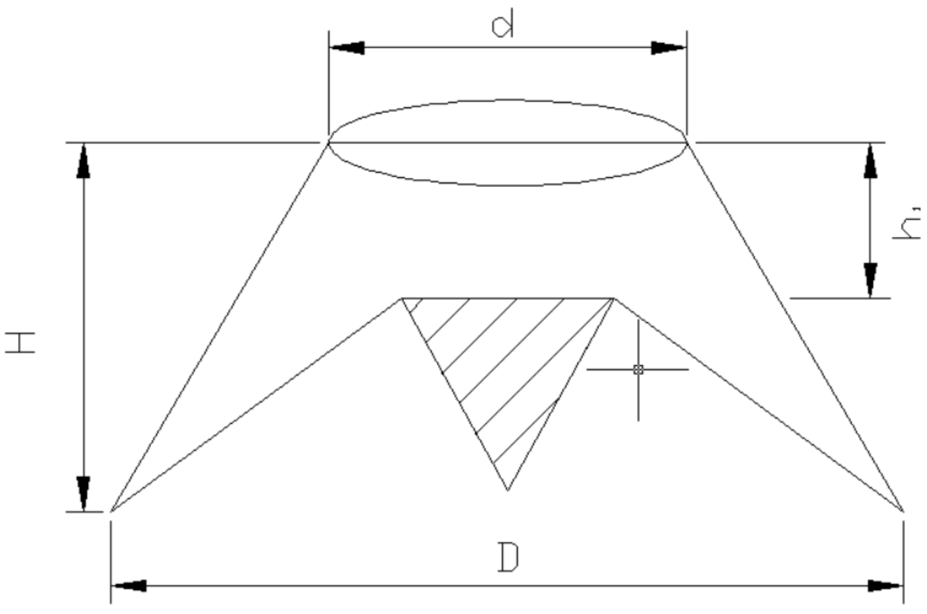

Figure 4. General view of nozzle

Figure 4 shows the proposed nozzle. The size of the nozzle is the optimal size based on experience. The calculation of the proposed nozzle was determined mathematically and experimentally. Taking into account that the nozzle has a cone shape and is made by dividing the cone parts, the calculation of the nozzle was performed based on the calculation of the cone. First, the full volume and equivalent diameter of the nozzle were determined. In addition, the free volume of the nozzle and the wetting coefficient were determined experimentally. The results will have the following value. The three-base nozzle with the size of 66*66*40 has a comparative surface d=65 m2/m3, free volume n=0.07 m3/m3, equivalent diameter d=0.0043 m.

Through the proposed nozzle, the mass transfer coefficient was determined using different absorbents. For this, absorbers with constant pressure and the same geometric dimensions were used for each nozzle. I-20, OE-26, T-750 oils were used for the experiment, and the mass transfer coefficient was determined. For this process, the geometric dimensions of the nozzle were kept the same for each experiment. The mass transfer coefficient is one of the main parameters of the nozzle. This process represents physical and chemical processes between the liquid and gas phases. It is the main value that shows the interaction of phases that are important for physical processes.

For this, the following calculations were carried out**. [8]** The mass transfer coefficient of the nozzle is determined by the following formula:

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$$Kxf = \frac{1}{\frac{1}{\beta xf}+\frac{1}{m\beta xf}} \quad (1)$$

Here, Kxf-mass transfer coefficient, bxf-gas phase mass transfer coefficient, m-level indicator are equal to 0.05-4.6h. **[9,10,11].**

The change of the mass transfer coefficient of each absorbent under the influence of temperature was determined. The determined parameters are used to obtain the geometric dimensions for each absorbent for the application environment and maximum performance.

The results of mass distribution are presented in **Figure 5** below.

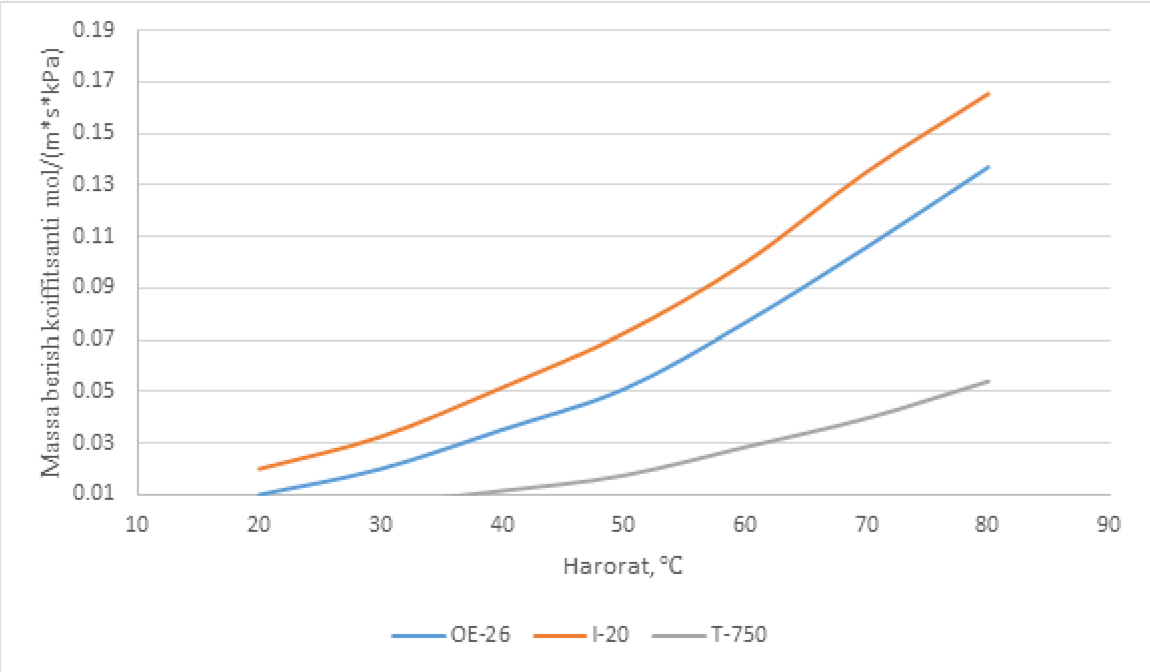

Figure 5. Change of mass transfer coefficient of absorbents depending on temperature.

The mass transfer coefficient depends on the shape and type of each nozzle, properties of the material from which the nozzle is made. When the experiment was carried out in a conical nozzle at 20 °C, it was determined that the mass transfer coefficient was equal to 0.02, 0.01, 0.004 mol/(m*s*kPa) in each absorbent I-20, OE-26, T-750, respectively. The temperature was gradually increased and when it was taken to 80 0C, the mass transfer coefficient was found to be 0.1655, 0.137, 0.054 mol/(m*s*kPa), respectively. Based on the obtained results, it is possible to determine the efficiency index based on the mass transfer coefficient. The following formula was used for this.

$$K_{kf}=\frac{N1-N2}{N1} \quad (2)$$

Here, Kkf is the efficiency coefficient, N1 is the mass transfer coefficient of the first absorber, and N2 is the mass transfer coefficient of the second absorber. Based on the above equation, the mass transfer coefficient at a temperature of 20 °C was determined through a conical nozzle. In this process, all indicators are compared to I-20 oil. When comparing the efficiency index of OE-26 and T-750 oils in relation to I-20, the following indicators were obtained. OE-26-50% T-750-80%. It can be seen from the above indicators. When the temperature is increased to 60 °C, it was found that the mass transfer coefficient is higher in I-20 oil than in OE-26, T-750 oils.

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Discussion and analysis. Experiments show that the cone-shaped nozzle has great efficiency in liquids with high viscosity. As the temperature increases, the mass yield index of the oils taken for the experiment changes. Based on these indicators, optimal conditions are determined and absorbers are selected based on the mass transfer coefficient.

Summary. In short, various oils and organic additives are released under the influence of heat in heavy industrial machines, asphalt production plants, and cooking plants that currently operate at high temperatures. As a result of the condensation of these organic oil dusts at low temperature, the environment and industrial enterprises exceed the established norms. Absorption process is effective for cleaning these oils. In the above article, an effective device for cleaning oily dust emitted in the industry was created in a laboratory method and based on ecological standards. In order to effectively clean oils, the absorption process was used. Absorbers selected for effective cleaning of emitted harmful gases should be used in industrial enterprises and their cost should be reasonable**.**

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