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SCIENTIFIC ANALYSIS OF LOSSES IN THE INJECTION OF OIL PRODUCTS INTO A CONTAINER

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Abstract*. In this article, one of the problematic issues of our time, in the process of supplying combat vehicles and military equipment with oil products, which is one of the problematic issues of our time, is considered to be due to evaporation during bottling, which depends on a large number of factors (meteorological conditions, temperature at that time, physical and chemical properties of oil and oil products, etc.) will be released. Today, it is no secret that in the process of supplying military vehicles with petroleum products, they face a number of problems. Our current main task is to monitor the process of supplying military equipment with oil products, to create a program that meets the requirements of today's digitization. That's why we're working on creating software.*

Key word: *oil products, evaporation, process, the wind, reservoir, formula, mass.*

1. Introduction

For continental regions, a suitable empirical equation is chosen. Mass losses during the injection of AI-91 gasoline into the selected equation were theoretically calculated and compared with the results in the conditions of Uzbekistan. One of the biggest economic problems is the loss of mass of liquids in the process of bottling oil products, tank-to-tank, reservoir-to-reservoir, or conventional automobile fueling stations (AFS). In addition, the spread of oil and petroleum products into the atmosphere creates serious environmental situations. The weaving of oil and petrolum products into the ground, forming a coating (thin layer) on the surface of the soil, causes

the disruption of the exchange of substances by blocking its capillary pores. As a result, soil erosion occurs. Oil and petrolum products that have fallen into the water form a thin layer in the water and cause the death of the aquatic and animal world.

2.Materials and methods

Evaporations from oil and petroleum product spills during injection process are dependent on a number of factors (meteorological conditions, temperature at that time, physical and chemical properties of oil and petroleum products, etc.).

While evaporation refers to the process of volatilization of molecules on the surface of oil products (leaving their surface), in fact, technologically explained, evaporation is the process of transition of molecules from the liquid phase to the gaseous state. To scientifically explain the phenomenon of evaporation, all liquids retain their volume but change shape, while gases, on the other hand, retain neither their shape nor their volume [1, 2, 3].

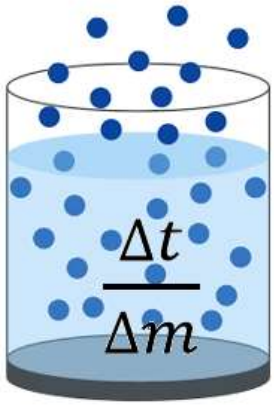

Figure 1. Process of transition of oil products from liquid phase to gas phase.

Δm- the mass of evaporating gasoline, and the reason for taking a special derivative from it is that mass is multi-functional (density, temperature, time, etc.);

3. Results and discussion

From the above picture, it can be concluded that the mass (quantity) of oil and petroleum products (liquids) decreases during the evaporation process. Usually, the speed of the evaporation process depends on the molar mass of liquids (M), conditions of storage in open or closed reservoirs, external temperature (T) and other factors. One of the most important of them is that the factor that causes the acceleration of evaporation changes depending on the wind speed, which causes changes in the layers of the atmosphere caused by external forces.

In all the literature, the evaporation process of oil and oil products is mainly considered in two cases, the first one is constant force (considered as no wind) and the second one is considered variable wind speed.

$$G = \sum_{i=1}^{N}(40{,}35 + 30{,}75U) \cdot 10^{-3} \cdot P_I \cdot x_I \cdot \sqrt{M_I} \quad (1)$$

Where,

G - the amount of hydrocarbons that evaporate, g/m^2·hour;

I – the number of fractions in the petroleum product,

U – wind speed at a height of 20 cm above the spill surface, m/s;

$\boldsymbol{P_I}$– the saturation vapor pressure of each fraction, Pa;

$\boldsymbol{x_I}$– mole fraction of each fraction in the vaporized hydrocarbon mixture;

$\boldsymbol{M_I}$– fraction molar mass, g/mol.

The formula representing the decrease in the amount of hydrocarbons in the process of evaporation of the mixtures in the state taking into account the composition and physico-chemical properties of petroleum products, as well as the wind speed (1).

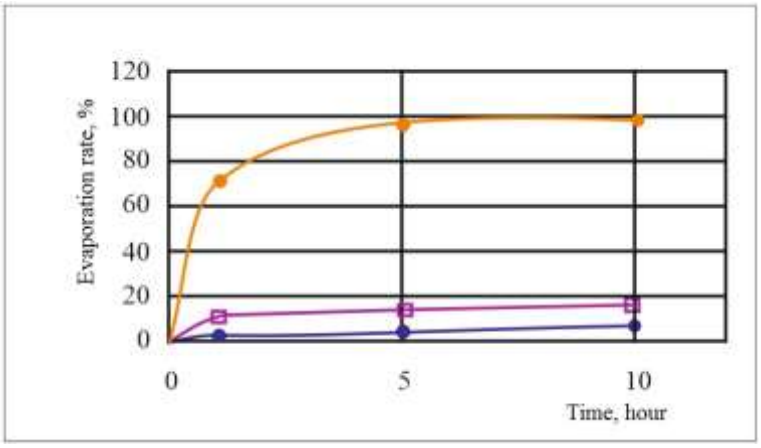

Figure 2. Evaporation of automobile gasoline AI-91 (1), automobile gasoline AI-80 (2), diesel fuel (3) at a wind speed of 0.4 m/s at the time of oil product injection.

The disadvantage of this method is the assumption about the constancy of the evaporation of the oil product over time and the unavailability of information about the error in the calculation of variability.

Assessment of the acceptability of equation (1) as a basis for calculating the evaporation of petroleum products is carried out by us in two stages. In the first stage, the principles of the equation are applied, in the second stage, a change in the solution of the problem based on the equation (1) was adopted, taking into account the gradual evaporation of oil products with a change in its composition.

We considered it the goal of our scientific work to consider as an example the reduction of the mass amount of gasoline in vapors in tanks located in a horizontal

position. In turn, the rapid change in the mass of gasoline poured from tanks to military equipment depends on its density, gas consumption, pressure change, kinetic viscosity, the concentration of the evaporating product during the saturation time, and its average vaporization concentration.

Scientific investigations have led to the fact that several literatures have provided information and equations on the reduction of the mass of petroleum products during the transfer of oil products from the reservoir to the reservoir or from the reservoir to the tank or from automobile fueling station by mass. So, there are several empirical equations for mass loss and evaporation, In order to find out which of them is suitable for the conditions of Uzbekistan, we considered it the main task to make a theoretical scientific analysis in order to find out how oil products change during the pouring process when the temperature and wind are constantly changing due to a sharp content change. The first of them was a modification of the oil product, that is, in a word, the AI-91 or AI-80 brand of gasoline was obtained, from a chemical point of view, the molar mass is clear, and secondly, the most important temperature change depends on the external temperature of the environment and the internal temperature of the reservoir where the oil product is stored. It also depends on the effect of wind speed as an external force that accelerates the process of evaporation. The most important thing is to estimate the mass loss of oil products using the empirical formulas developed by scientists, knowing the concentration of saturated gasoline vapors and the average concentration of saturated gasoline vapors.

We set a goal to study empirical formulas developed by scientists in the theoretical aspect, which equation is closest to us in our country, which has a dramatically changing continentality in the conditions of Uzbekistan. For this, the oil product given to us is a complex liquid and does not have a specific formula. Petroleum products are mostly physical in nature, when the number of carbon atoms in the composition is equal to 4...5, if the appearance is brown, light aromatic gasoline is obtained. If the number of carbon atoms is close to 10, then such an oil product is obtained only by a chemical method (cracking method). In turn, colored compounds of oil are diesel fuel. Diesel fuel is also complex, in which the average molecular mass of hydrocarbons is in the range (110...230), boiling point (170...380)°C. In addition, lubricants, which are several times heavier by mass, are obtained from diesel fuel, and at the end, fuel oil and asphalt are obtained. Therefore, oil products differ by country. Based on this, the mass is also variable. If we consider mass as a function, then mass depends on several parameters.

The surface area S_t (m^2) spilled on the ground during the injection of inorganic liquids is the formula for its determination

$$S_t=f_qV_s \quad (2)$$

Where, f_{q-} spillage coefficient

V_s – volume of liquid

given and presented in works by the following authors [4,5]. The authors proposed to calculate the intensity of evaporation using the following empirical formula.

$$W = 10^{-6} \cdot \eta \cdot \sqrt{M} \cdot P_H \quad (3)$$

Where,

η- The coefficient of acceptance of the dependence of the temperature and speed of evaporation on the surface of gasoline on the surface of the air is taken as 1 if the liquid is outside;

M – the molar mass of gasoline is kg/mol;

P_H – pressure of gasoline at saturated temperature, kPa.

Then η=1 because it is in the open air at the time of pouring, the above formula will look like this.

$$W = 10^{-6} \cdot \sqrt{M} \cdot P_H \quad (4)$$

[4,5] the literature states that the density of gasoline at 15 ºC is 725-780 kg/m3, but at other temperatures [-10...+40 ºC] the density of petroleum products varies with temperature [6].

According to the analysis of the literature and the conclusion of the authors, the change in the mass of oil products during the pouring process depends on the concrete (exact one) brand of oil products, and it is emphasized that the temperature depends on the volume of the oil products being poured and the time of pouring.

$$G_\tau(t_q, V_s, \tau) = 10^{-6} \cdot \sqrt{M} \cdot \left(10^{A-\frac{B}{C+t_q}}\right) \cdot f_q \cdot V_s \cdot \tau \quad (5)$$

Using the above formula, the relationship between the injection process and the mass for the AI-91 brand of gasoline is given in the table below.

4. Conclusions

In conclusion, it should be said that in the article, scientific comments were made on the literature analysis of the evaporation processes of oil and petroleum products during injection. Also, the theoretical equations of mass losses of oil and petroleum products injection processes were studied and the appropriate empiric equation was selected for sharp continental regions. Mass losses during the injection of AI-91 gasoline into the equation (formula) were theoretically calculated and compared with the practical results in the conditions of Uzbekistan.

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