DETERMINATION OF WATER VAPOR EMISSIONS WITH DIESEL ENGINE EXHAUST GAS FLOW

Kondratenko O.M., Botsmanovska O.S., Kapinos E.V.
National University of Civil Defense of Ukraine, Kharkiv

As is known from the analysis of studies of scientists who specialize in ensuring the ecological safety of exploitation process of power plants with reciprocating ICE, except for the legislative normalized directly indicators of its level – mass hourly emissions of particulate matter PM, nitrogen oxides NO_x, unburned hydrocarbons C_nH_m, carbon monoxide CO, exist also legislative regulated indirectly, among which the least toxic, but the most significant in volume, is the emission of water vapor H_2O as a product of complete combustion of motor fuel hydrocarbons [1]. In this case, H_2O vapor is a reagent in the formation of acid rain, increases the humidity of the atmospheric air, worsening the sanitary and hygienic conditions of work and human habitation and promotes corrosion of machine parts. To account of such emissions in the criteria-based assessment using the mathematical apparatus of the complex fuel-ecological criterion K_{fe}, the value of mass hourly emission $G(H_2O)$ and dimensionless index of the relative aggressiveness of this pollutant $A(H_2O)$ should be determined. Since there are no standards limiting the MPC of water vapor in the air, we will assume that the magnitude of this indicator is limited by the humidity standards, which, in turn, is determined by the magnitude of saturated water vapor pressure and depends on the magnitudes of barometric pressure and air temperature. Taking into account these aspects, it can be assumed that for normal conditions (φ = 80 %, t = 0 °C, P_0 = = 101325 Pa), the value of $A(H_2O)$ is $1.976 \cdot 10^{-3}$. The features of the processes leading to the formation of H_2O vapor are considered in the study and the value of $G(H_2O)$ is proposed to be determined by formula (1).

$$G(H_2O) = C_f(H) \cdot 2 \cdot \mu(H_2O) / (4 \cdot \mu(H)) = k(H_2O) \cdot G_{fuel} = 1{,}08 \cdot G_{fuel}, \text{ kg/h} \quad (1)$$

Distribution of magnitude of $G(H_2O)$ by the regimes of the ESC standardized steady test cycle (UNECE Regulation No. 49) for 2Ch10.5/12 autotractor diesel and by the field of its operating regimes obtained in this study by the proposed method is illustrated in Fig. 1.

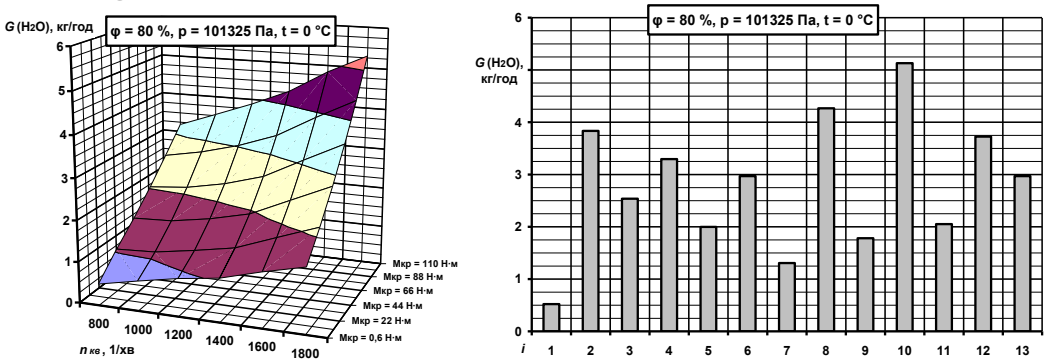

Fig. 1 – Results of the study

References:

1. Kondratenko O.M. (2019). Metrological aspects of complex criteria-based assessment of ecological safety level of exploitation of reciprocating engines of power plants: Monograph. Kharkiv. Publ. Style-Izdat. 532 p. ISBN 978-617-7738-33-5.