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Development and Use of the Index of Particulate Matter Filter Efficiency in Environmental Protection Technology for Diesel-Generator with Consumption of Biofuels

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Abstract – This paper describes the results of improving of design and method of operation of the particulate matter filter of the reciprocating internal combustion engine with a high degree of physical and moral wear in the diesel generator as an actuator of environmental protection technology. The complex of mathematical models of performance indicators of the improved filter has been improved. Index of the efficiency of the particulate filter has been developed, which combines improved mathematical models of the filter into a single complex. Environmental protection technologies have been developed for a diesel generator, the engine of which is characterized by a high degree of physical and moral wear and tear and has no or lost the executive bodies of the air protection system. Algorithm for controlling the proposed technology has been developed, in which the control of the filter regeneration processes is carried out as a function of the developed efficiency index, and a mathematical apparatus for such control according to the psychophysical scale and characteristic map of electronic automatic control system.

Key words – diesel-generator, particulate matter filter, ecological safety, biofuels, criteria based assessment, environment protection technologies

I. INTRODUCTION

The environmental protection technology (EPT) from the negative ntechnogenic impact of power generating power plants (PP) with a reciprocating internal combustion engine (RICE) during their exploitation process is the material basis for the implementation of an appropriate environmental safety management system (ESMS). The development of such EPT involves the use of the method of induction, i.e. the movement from the development of its general scheme to the development or improvement of its executing devices. Among such devices the special place is occupied by particulate matter filters (DPF). For optimization of design, working processes and, in the end, technical and economic indicators of the DPF it need to carry out experimental researches, and on the basis of them can be developed appropriate mathematical models [1–3]. Such studies are especially relevant for the case of transfer of RICE of such generators to the consumption of pure or mixed motor fuel of biological origin as a non-renewable energy re-

source, which is a separate and important factor of environmental hazard for the exploitation of such equipment with high degree of physical wear [4,5]. To protect the components of environment against such ecological threat, there is an urgent need to develop the appropriate EPT to protect atmospheric air from emissions of legislative normalized pollutants in the exhaust gas (EG) flow, in which the DPF is a required actuator. In this case, the controlling of operation of the DPF during its inter-regeneration period (IRP) should be performed with taking into account its current state, which requires the development of an appropriate electronic automatic control system (EACS). The control of regeneration processes of the I and II kind of the DPF should be carried out as a function of the corresponding complex indicator of efficiency of operation of DPF which value should be chosen on psychophysical scale and coordinated in real time with the characteristic card put in memory of the electronic control unit (ECU). However, information suitable both for a complex assessment of the efficiency of operation of the DPF, and for the controlling of its operation, in the analysis of scientific and technical, reference, patent and regulatory literature [7–12] was not found.

Purpose of the study. Development of mathematical apparatus for a complex assessment of the efficiency of the DPF of diesel RICE during its IRP and control of its regeneration processes. *Object of study.* The efficiency of the DPF of diesel RICE as the executive device of EPT. *Subject of study.* Quantitative and qualitative indicators of object of the study and their use in the control system of regeneration processes of the executive device of EPT.

II. METHODOLOGY

1. Improving the design and operation of the DPF of diesel engine of a non-traditional design

The study solves the problem of improving the system of capture of particulate matters (PM) in the EG flow of RICE with a high level of physical wear. This is due to the fact that the average operational value of their mass hourly effective specific emissions in the EG flow of such PP is significantly