

Analysis of exhaust gas flow through a particulate filter in the exhaust of the spark ignition direct injection engine

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Abstract. In September 2017, the Euro 6c homologation standard was introduced for PC class vehicles. It presents the RDE test, i.e. the procedure for testing toxic emissions in real operating conditions and restrictions regarding particulate emissions in the number range for engines with direct gasoline injection. The use of direct fuel injection has reduced fuel consumption and increased specific torque and power. Shortening the time of evaporation of the fuel caused an increase in particulate matter emission, which in comparison to compression-ignition engines are characterized by smaller diameters due to faster evaporation of gasoline. This makes it necessary to limit them, due to the significant influence of solid particles on people's health and lives. One of the solutions used by manufacturers is the use of a diesel particulate filter, which is mounted in all Diesel engines that meet the Euro 5 and further standards. In petrol vehicles, these solutions are already installed, often resulting in the temporary suspension of production of new vehicles. This article presents the results of simulations of the exhaust gases flow through a ceramic carrier placed in the exhaust system of the engine with direct fuel injection. The AVL Fire Aftertreatment software was used for the simulation of non-engine CI and SI exhaust gas systems. The model created for the purposes of simulation is shown in Fig. 1. The introduced concentrations of specific harmful compounds were selected on the basis of previous tests in real operating conditions in the urban cycle. This cycle was chosen because of its association with the lowest exhaust gas temperature. As part of the article, the exhaust gases flow through the filter, whose volume was selected on the basis of the displacement volume of a turbocharged combustion engine, was examined. The filter cannot have a large diameter because the exhaust gases flow is not carried out with its entire surface. These assumptions were dictated by problems with regeneration of diesel particulate filters in low-temperature exhaust gases. The variable was primarily the temperature of the exhaust gases and the carrier itself, the number of cells per square inch (200 CPSI) was constant. The view of one of the conducted simulations in the scope of changing the temperature distribution on the filter surface is shown in Fig. 2.

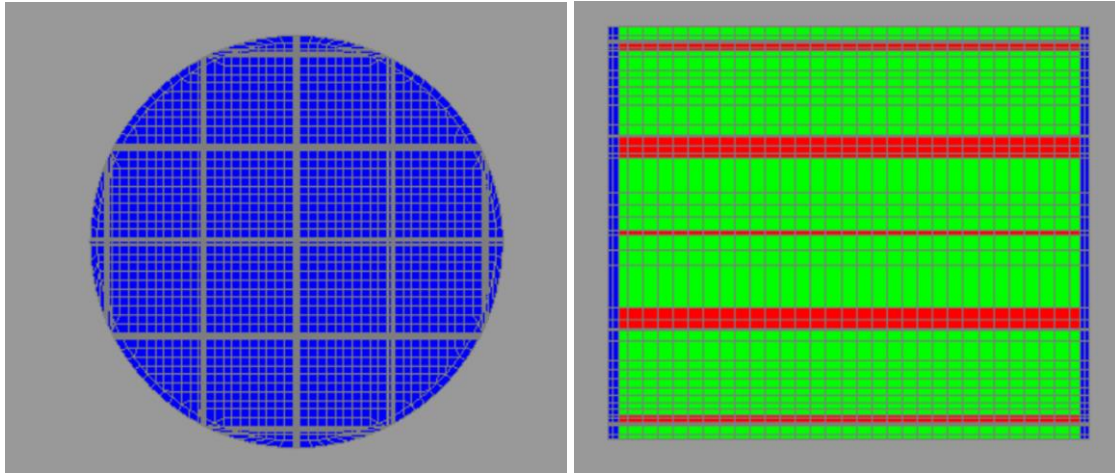


Fig. 1. View of the filter used for simulations

a)

b)

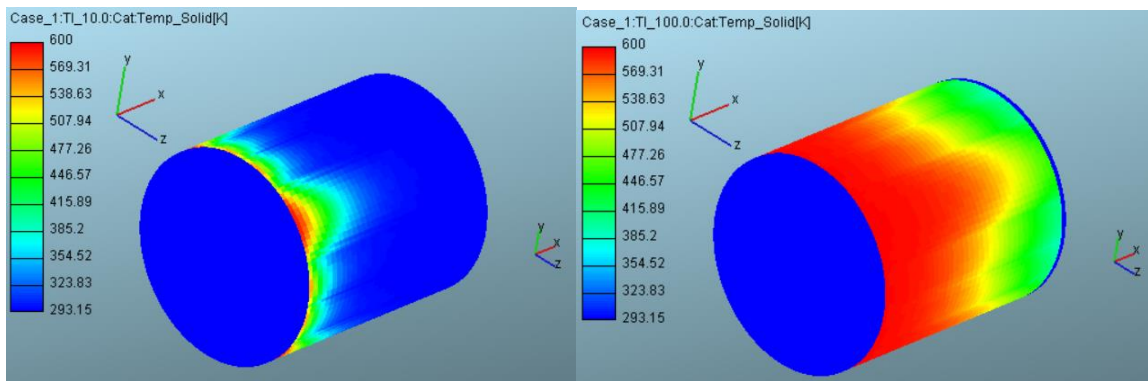


Fig. 2. View of the filter after a) 10 seconds b) 100 seconds of the simulation

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