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Compressed Natural Gas (CNG) Injector Research for Dual Fuel Engine

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Abstract : Environmental considerations necessitate the search for new energy sources. One of the available solutions is a partial replacement of diesel fuel by compressed natural gas (CNG) in the compression ignition engines. This type of the engines is used mainly in vans and trucks. These units are also gaining more and more popularity in the passenger car market. In Europe, this part of the market share reaches 50%. Diesel engines are also used in industry in such vehicles as ship or locomotives. Diesel engines have higher emissions of nitrogen oxides in comparison to spark ignition engines. This can be currently limited by optimizing the combustion process and the use of additional systems such as exhaust gas recirculation or AdBlue technology. As a result of the combustion process of diesel fuel also particulate matter (PM) that are harmful to the human health are emitted. Their emission is limited by the use of a particulate filter. One of the method for toxic components emission reduction may be the use of liquid gas fuel such as propane and butane (LPG) or compressed natural gas (CNG). In addition to the environmental aspects, there are also economic reasons for the use of gaseous fuels to power diesel engines. A total or partial replacement of diesel gas is possible. Depending on the used technology and the percentage of diesel fuel replacement, it is possible to reduce the content of nitrogen oxides in the exhaust gas even by 30%, particulate matter (PM) by 95 % carbon monoxide and by 20%, in relation to original diesel fuel. The research object is prototype gas injector designed for direct injection of compressed natural gas (CNG) in compression ignition engines. The construction of the injector allows for it positioning in the glow plug socket, so that the gas is injected directly into the combustion chamber. The cycle analysis of the four-cylinder Andoria ADCR engine with a capacity of 2.6 dm3 for different crankshaft rotational speeds allowed to determine the necessary time for fuel injection. Because of that, it was possible to determine the required mass flow rate of the injector, for replacing as much of the original fuel by gaseous fuel. To ensure a high value of flow inside the injector, supply pressure equal to 1 MPa was applied. High gas supply pressure requires high value of valve opening forces. For this purpose, an injector with hydraulic control system, using a liquid under pressure for the opening process was designed. On the basis of air pressure measurements in the flow line after the injector, the analysis of opening and closing of the valve was made. Measurements of outflow mass of the injector were also carried out. The results showed that the designed injector meets the requirements necessary to supply ADCR engine by the CNG fuel.

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