Transportation Research Part D 57 (2017) 413–421

Contents lists available at ScienceDirect

Transportation Research Part D

journal homepage: www.elsevier.com/locate/trd

Ecological analysis related to creation of gaseous emissions within transport focused on fulfilment of the future emission standards

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ARTICLE INFO

Keywords:
Ecological analysis
Emissions
Transport
Biodiesel

ABSTRACT

Questions of ecology in the area of transport are always very topical because the newest emission standards concerning the piston combustion engines are very hard with regard to protection of the environment and human health. Nowadays the most often used driving units that are applied within the road transport as well as in the marine transport are the diesel engines. In the last period occurred information about a fact that in some of the motorcars was installed a software, which enabled to hide the over-limit values of the nitrogen oxides during the emission testing process. This affair is called “dieselgate”. It is a well-known fact that the actual emission limits are very hard and there is arising a serious problem for automobile factories to meet the demanding emission requirements. Therefore it was elaborated an ecological analysis or study concerning the gaseous emissions produced in the road transport. This analysis is based on application of the experimental fuels. As the experimental combustion engine it was chosen just such kind of the motorcar engine, which is relevant to the cause “dieselgate”, i.e. the diesel piston combustion engine. The testing fuels were created by mixing of the biodiesel and the ULSDF (Ultra Low Sulphur Diesel Fuel), using various mutual ratios between these fuels. The individual measurements were performed at the various engine loading levels and engine speeds in order to investigate an influence of the experimental fuels on the real operational characteristics of the given testing engine.

1. Introduction

The vehicle industry is a strategic branch of industry within the home and international framework. It is permanently facing to the durable challenges that are presented in the form of requirements concerning efficient exploitation of the fuel energy, reduction of the emissions and application of the new technologies (Blištan et al., 2012).

In the past period occurred information about a fact that in some of the motorcars was installed a software, which enabled to hide the over-limit values of the nitrogen oxides during the emission testing process. This affair is called “dieselgate”. Officially, all the motorcars fulfil limits defined for production of the nitrogen oxides (NO_X). The emission testing process is performed in the laboratory conditions and the above-mentioned “special” software was able to overreach the testing machine. The collusive software cooperated with the engine control unit, identified the measuring process and switched the engine into the operational regime with the reduced emission values.

It is a well-known fact that the actual emission limits are very hard and there is arising a serious problem for automobile factories to meet the demanding emission requirements (Kopilčáková and Pauliková, 2008). Development of the new, better engines and

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http://dx.doi.org/10.1016/j.trd.2017.10.007

Available online 23 October 2017

application of the anti-emission measures are connected with expensive investments, together with a doubtful future (Puškár et al., 2013b). From this reason it is necessary to look for the clear fuels, e.g. biodiesel. The biodiesel is not only a renewable natural resource, but another advantage of it is a minimal content of the aromatic hydrocarbons and sulphur, high value of the cetane number, very good lubricity, high flash point, non-toxicity and possibility of biological degradation. Moreover, it is not necessary in this situation to modify the diesel engine because the biodiesel can be applied in a clear form or as a mixture. There are also known some disadvantages of the biodiesel, for example low level of the fuel efficiency, low fugitiveness, high viscosity and high value of the solidification point (Puškár et al., 2010). There are elaborated several studies that investigated environmental impacts of the biodiesel. The obtained results present the significantly reduced values of the CO-emissions, sulphur level, unburned hydrocarbons and particulate matters in the exhaust gases in comparison with the conventional diesel fuels. The biodiesel is dissolvable in the standard diesel oil and therefore it can be mixed in any ratio with the diesel oil (Balland et al., 2014).

The following research work was performed taking into consideration the affair "dieselgate" as well as with regard to a necessity to solve the questions of the NO_X emissions. This experiment is also a reaction on absence of actual research and information concerning an influence of the biodiesel on combustion and emissions of the vehicle engines. There were applied the mixed fuels with various mixing ratios between the biodiesel and the ULSDF in order to analyse the influence of various portion of the biodiesel in the engine fuel mixtures on the combustion process and on the NO_X emissions of the vehicle diesel engine (Puškár et al., 2012; Czech, 2013).

2. Testing engine and measuring conditions

2.1. Testing engine and fuel mixtures

The testing engine was a 4-cylinder TDI combustion engine equipped with the common rail fuel injection system. There were tested the individual fuel mixtures with various ratios between the biodiesel and the ULSDF. Fig. 1 illustrates the given experimental model of diesel engine. The main technical parameters of the tested engine are in Table 1. The tested diesel engine was connected with a dynamometer (Toman et al., 2017; Sinay et al., 2014; Grega et al., 2015; Homisin et al., 2016).

The applied ULSDF contains less than 10 ppm of sulphur and the biodiesel fuel fulfils requirements of the European standard EN 14214 (Table 2).

The individual testing fuels were created by mixing of the biodiesel with the ULSDF using the ratio values 0%, 50%, 80% and 100%, whereas they are marked BU(0:100), BU(50:50), BU(80:20) and BU(100:0). The first kind of fuel is the clear ULSDF and the last fuel is the pure diesel oil. The experimental measurements were also performed using other ratios between the biodiesel and the ULSDF, however taking into consideration the main purpose of this study the chosen ratios are the most suitable. Content of the biodiesel below 50% in the fuel mixture does not offer the required results with regard to reduction of the emissions and therefore such ratio is neglected. The brake specific fuel consumption was measured for each of the fuels under the laboratory conditions and the detailed operational conditions are presented in Table 3.

2.2. Measuring conditions

The cylinder pressure was measured by means of the system Kistler using a measuring sensor, which was installed in the first

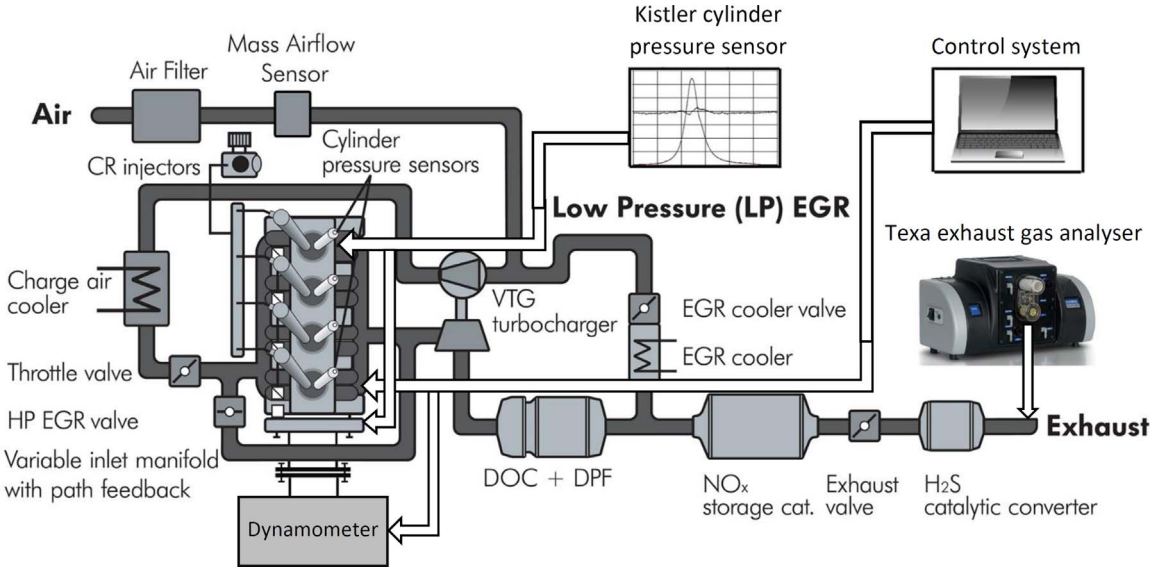

Fig. 1. Testing engine.