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Riga Polytechnical Institute / RTU Alumni

**DIGEST**

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# Diesel Engine Faults Structure and Analysis of Possible Diagnostics

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**Keywords** –diesel engine, common rail injection, acoustic emission.

## I. INTRODUCTION

This review paper gives an insight in the problems associated with faults of new generation of diesel engines equipped with common rail injection systems and the possibilities to test the condition of system with non-invasive methods.

## II. CONSEQUENCES OF IMPROPER WORKING PROCESS

Today it is very important to keep engine emissions as low as possible in diesel engines. Diesel exhaust is a carcinogen and is placed by International Agency for Research on Cancer (IARC) in group 1 carcinogens. It causes lung cancer and is associated with bladder cancer. Among these pollutants, fine particle pollution it is perhaps the most important cause of diesel's deleterious health effects. Faults in fuel injectors makes not only low engine efficiency, but also high and sometimes even unacceptable level of unburned hydrocarbons caused by poor air fuel ratios. In addition, injector faults increase noise and vibration which may cause damage to engine components. Therefore, the detection injector faults at their early stage and maintain combustion performance is one of key tasks in controlling pollutant emission as an engine ages and not just its early life performance.

## III. THE AIM OF RESEARCH

A European emission standard defines the acceptable limits for exhaust emissions of new vehicles sold in European Union member states.

Diesel engine designers and manufacturers use different types of fuel injection systems most common are mechanical so-called conventional and new generation of injection systems – common rail injection system. To reach EURO5 and further demands for emissions the most appropriate system is common rail. As any mechanical system common rail system's items still have technical problems due to material quality what they are made of, fuel quality and contamination of it. The problem with system item can be found out making vehicle ECU self diagnosis. But it only shows if the item is in working condition or not however it does not show the actual working condition. The "weakest points" in the system are injectors, pressure relief valves and common rail pumps. To find faulty injector there are some tests to be done "on engine", but it can show only already broken injector or pump. To identify the condition it is necessary to dismantle the engine and make visual testing of item or put on testing equipment. These aspects are making vehicle out of service. This all abovementioned shows the loss of profit if it is used as commercial item.

Predictive or so called non-invasive maintenance can make the elimination of trouble or to "catch" the start of

deterioration process on a certain time. So the owner can calculate is it necessary to prepare spare items or to run the engine, thus reducing the maintenance and repair costs. Finding faulty injector makes reducing emissions from unburned fuel and it saves exhaust system from built up of carbon.

In predictive maintenance there are used different systems to obtain signals from mechanism. The most common and conventional is obtaining and analyzing audible signal or vibro-acoustic. However some signals can interfere with signals from other mechanisms.

By making analysis of articles and materials it has been found that acoustic emission method is good method to eliminate the problem with fuel injectors. The results from joint angular and frequency analysis has shown that AE can clearly monitor the changes in the combustion process due to its high signal to noise ratio in the high frequency range from

10kHz to 45kHz where other vibro-acoustic sources have little influence [1].

## IV. CONCLUSIONS

Many researches have carried out for engine fuel injection diagnosis based on airborne acoustics and structural borne vibration. Because of complexity of vibro-acoustic sources in a diesel engine, it is difficult to obtain detailed information regarding to fuel injection for reliable fault diagnosis. In contrast, acoustic emission (AE) from engines usually may be a more effective approach to detecting injection related faults because it is measured in high frequencies such as 100kHz above and hence has the good localization performance. AE measurement on the cylinder head is a non-intrusive method and has been successfully implemented for monitoring diesel engines. Various signal processing techniques of the AE signals are used to extract features sensitive to faults. These investigations have shown that the AE signals have a very high signal-to-noise ratio and the faults of interest can be extracted with certain effort in signal processing.

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