DEVELOPMENT OF SIMULTANEOUS REDUCTION SYSTEM FOR NO_X AND PARTICULATE MATTER FROM A DIESEL ENGINE

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ABSTRACT

Toyota has developed a simultaneous reduction system for NO_x and particulate matter from a diesel engine (DPNR - Diesel Particulate and NO_x Reduction system) and tested it for various applications. We have verified that the DPNR has a high potential for realizing clean diesel engine use for various market segments, such as passenger vehicles in the European market and light-duty trucks in the Japanese market.

The key technologies of the system incorporate the following: the DPNR catalyst; common rail fuel injection system to control catalyst bed temperature and air fuel ratio; an electrically controlled exhaust gas recirculation (EGR) system; and exhaust port-or-pipe injector in order to supply rich gas to the DPNR catalyst for NO_x reduction and sulfur discharging.

For the European market, Toyota has carried out a field trial project in which 60 vehicles with the DPNR system installed in 2L TDI have been tested in order to verify its operation and confirm the reliability of the system. In applying the DPNR to light-duty trucks, we have developed the DPNR for 2-ton payload trucks for the Japanese market. In this application, deterioration of the NO_x storage catalyst was a critical issue because
of its long traveling distance. For this issue, we conducted extended durability tests on an engine test bed, using 40-ppm and 7-ppm sulfur content diesel fuel. As a result, the Japanese U-LEV (75-percent reduced emission level from Japanese new short-term regulation in Japan D-13 mode) emissions standard could be achieved when using fuel with sulfur content of 7 ppm even after 1,000,000 km.

When considering applications for the U.S. market, in addition to improving the DPNR performance, the quality and specification of diesel in the market are very important in order to meet severe emission targets (i.e., Tier 2 bin 5). That is, the cetane level and aromatics content need to be at least equivalent to the level required in the European and Japanese fuel standards.