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Hidden vehicle emissions from catalytic converters

Levels of exhaust gases and particles emitted from vehicles are strongly influenced by driving patterns and the performance of catalytic converters and particle filters, according to recent research. However, these patterns are not yet taken into account in setting levels for overall vehicle emissions under European regulations. In this study, detailed experiments were conducted to measure the extra emissions produced periodically in cars when post combustion systems such as catalytic converters are operating in regeneration mode.

Regenerating after-treatment systems for particle emissions and exhaust gases, such as carbon monoxide, hydrocarbons and nitrogen oxides, are increasingly used in passenger cars so that they comply with regulatory emissions standards. These systems work in a non-continuous manner, storing pollutants during normal engine operation and then chemically decomposing and releasing them in a process known as regeneration. According to the researchers, the regeneration processes and the resulting emissions are key issues that need to be understood for overall vehicle emissions to be calculated accurately

The study gives detailed measurements of the performance of four representative cars of the Euro 4 category[1],one petrol-fuelled and three diesel-powered, employing the following types of regeneration systems:

- Petrol-fuelled vehicle – NO_x storage catalytic converter (NSCC) designed to prevent high NO_x emissions
- Diesel-fuelled vehicle – NO_x storage catalytic converter combined with a diesel particle filter (DPNR)
- Diesel-fuelled vehicle – catalytic coated particle filter which provides the heat for particle burnout inside the unit
- Diesel-fuelled vehicle – iron-based fuel borne catalyst with particle filter

Measurements of emissions were taken at two points in the exhaust system of each car – before the regeneration unit, and after, at the tailpipe. The data were recorded at various constant speeds – 50 km/h, 80 km/h and 120 km/h. They were also taken under simulated normal driving conditions in urban and rural environments and on motorways. Particle emission peaks were also measured in the diesel-powered cars.

Regeneration caused substantial extra emissions which may not be identified using standard testing procedures. The two cars fitted with catalytic converters (one petrol-fuelled and one diesel-fuelled vehicle) had short regeneration times which would be included in the emissions inventory using standard measurement techniques. However, the remaining two diesel vehicles showed long time periods between regenerations. Emissions from such regenerations would not necessarily be detected using the latest European test procedures[2] as these employ a standard test cycle. Taking account of these extra emissions may require additional test cycles or testing of larger numbers of cars with comparable treatment systems. The authors also suggest further development of these technologies will be required to meet the European NO_2 limits which enter into force from 2010.

1. Cars which comply with current EU emissions regulations for light-duty vehicles, as defined by Directive 98/70/EC. For more information on European vehicle emissions standards see: http://ec.europa.eu/environment/air/transport/road.htm
2. Council Regulation ECE-R 83, Annex 13 November 2007 Emissions test procedure for vehicles equipped with a periodically regenerating after-treatment system (November 2007): http://eur-lex.europa.eu/Result.do?RechType=RECH_celex&lang=en&ihmlang=en&code=32003L0076. Council Directive 70/220/EEC of January 2008 on the approximation of the laws of the Member States relating to measures to be taken against air pollution by gases from positive-ignition engines of motor vehicles (January 2008) http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:31970L0220:EN:NOT

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