The MAN hTGX. Picture credit: MAN

PLATINUM IN HYDROGEN ENGINES

Platinum catalysts are supporting the reduction of NOx emissions in hydrogen combustion engines, as adoption of this decarbonising technology expands

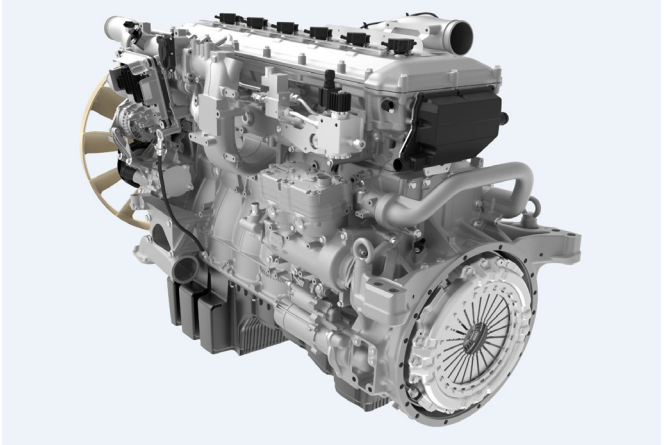
In September, the MAN hTGX – a heavy-duty truck with a hydrogen combustion engine (H2-ICE) – won International Truck of the Year's Truck Innovation Award 2025. The hTGX is equipped with a 16.8-litre hydrogen engine and has a range of around 600 km provided by 56 kg of hydrogen contained in its 700 bar pressurised tanks.

Mahle – a supplier to the automotive industry – has been awarded a contract to provide components for the hTGX. In its view, the use of hydrogen in the combustion engine is another important lever for decarbonisation, especially in the commercial vehicle sector, alongside battery electric vehicles and hydrogen fuel cell electric vehicles (FCEVs).

MAN is not alone in developing an H2-ICE; Mahle is currently working on almost 30 hydrogen engine projects for customers in the on- and off-highway sectors. In a world first, Liebherr debuted its prototype H2-ICE large wheel loader earlier this year, while JCB and Cummins have also developed H2-ICE powertrains for heavy-duty applications. Rolls-Royce is working with easyJet to develop a gas turbine H2-ICE for aircraft.

H2-ICEs not only look and sound like an internal combustion engine, but their parts are also similar to those used in existing vehicle designs, making for more straightforward integration for vehicle manufacturers. They run on zero-carbon hydrogen fuel and generate extremely low emissions, which makes them a key technology to meet global carbon reduction goals.

However, unlike hydrogen FCEVs, H2-ICEs are not entirely emissions-free as they produce nitrogen oxides during the high-temperature combustion process. Nitrogen oxides react with other compounds in the atmosphere to form harmful ozone and fine particulate matter, which can negatively impact air quality. Like diesel engines, H2-ICEs are fitted with after-treatment systems (catalytic converters) to reduce the risk of nitrogen oxide (NOx) emissions.



The MAN hTGX hydrogen combustion engine. Picture credit: MAN

Low-cost method

In a recent study, scientists at the University of California, Riverside have discovered a low-cost method to significantly reduce NOx emissions from hydrogen engines by improving the efficiency of their catalytic converters. They found that infusing platinum in catalytic converters into a highly porous material called Y zeolites greatly enhances the reactions between nitrogen oxides and hydrogen, converting them into the harmless by-products nitrogen gas and water vapour.

Zeolites are low-cost materials with a well-defined crystalline structure composed primarily of silicon, aluminium, and oxygen atoms. Their large surface area and three-dimensional, cage-like framework of uniform pores and channels allow for more efficient breakdown of pollutants. The zeolite enhances the effectiveness of the platinum catalyst by creating a water-rich environment. This water-rich environment promotes hydrogen activation, which is key to improving nitrogen reduction efficiency.

The study found that the benefit of combining a platinum catalyst with zeolite, in comparison to a catalytic converter without zeolites, resulted in the amount of nitrogen oxides converted to harmless substances increasing by four to five times at an engine temperature of 250 degrees Celsius. The system was also particularly effective at lower temperatures, which is crucial for reducing pollution when engines first start up and are still relatively cool.

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