By Karthik Shankaran

EMISSION CONTROL THROUGH IN-CYLINDER SENSING

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Susan Anenberg, Associate Professor, George Washington University.

Research estimates that vehicle tailpipe emissions were linked to about 361,000 premature deaths from ambient PM2.5 and ozone worldwide in 2010 and about 385,000 in 2015.

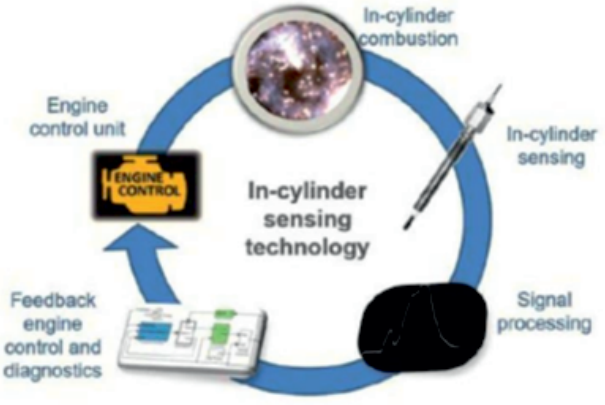
An estimated 70 per cent of these impacts occurred in the four largest vehicle markets in 2015: China, India, the European Union, and the US.

Emissions from motor vehicles have been at cross hairs of global regulatory agencies for quite many years. CNG and LNG, which are relatively cleaner than diesel, are being deployed by vehicle manufacturers. With Euro 6, after treatment systems are already in place reducing significantly Nox and PM. Hybrids and BEVs have also been part of the product mix thus helping CAFÉ norms and GHG Caps. Going forward PEMS and RDE requirements are opening up new areas where measurement of emissions needs lot of attention.

Emissions from motor vehicles are a cause of concern for air quality and also adversely affect human health. Most important part of controlling emission is to have an effective way to measure emissions. If we can do emission prediction real-time cycle to cycle with almost no modification required for engines, then we have something that can help us put together PEMS for RDE. "Transportation-attributable health impacts declined in the US, European Union, and Japan as vehicle emission standards have been implemented, but these reductions have been offset by growing impacts in China, India, and other parts of the world," said Susan Anenberg, Associate Professor, George Washington University.

According to a leading Indian daily, dated June 2019, 43 percent of all air pollution in Bangalore is by motor vehicles. According to a study it is 385,000 deaths in 2015 alone. Exhaust from vehicles is a major source of outdoor air pollution worldwide. The health impacts are immense but unevenly distributed, both geographically and among various segments of the transportation sector, such as light-duty and heavy-duty vehicles, shipping, and off-road machinery.

The technology and development of a new product: A few technology companies have been focusing on in-cylinder sensing based on sound fundamentals for predicting emissions even in multi-fuel scenarios. These efforts have resulted in an in-cylinder sensor that works for both gasoline and diesel engines. An innovative, cost-effective, plug and play in-cylinder sensor was developed which integrates with existing Powertrain with almost no change to engine structure. The prediction of emission from the sensor has been compared with test data recorded using pressure sensor, oxygen



sensor and others. The results are well correlated. These in-cylinder sensors can play a role in emission control as being PEMS for RDE. This technology is relevant for stationary engines as well as in motion powertrains, which makes it useful for passenger and commercial cars, farm equipment's, excavators, mining equipment, among others. Fuels and lubricants are an important "partner" in the combined engine and aftertreatment system. Low emissions over the life of the engine would not be possible unless fuel contaminants such as sulfur and some inorganic minerals are controlled to very low levels.

Regulation: RDE is already being implemented in certain geographies and it is in pipeline in other geographies. The in-cylinder sensor developed in India plays a critical role in predicting emissions cycle to cycle from each engine cycle. This is expected to help not only as PEMS for RDE but can work in closed-loop with ECU to control combustion parameters as well. This helps to keep emissions under check, which is the undeniable need of the hour.

The in-cylinder combustion sensor can be used in real-time applications, functioning as a timing sensor, combustion sensor, performance sensor, emissions sensor and pressure sensor, delivering accurate and reliable results on a cylinder-to-cylinder, and a cycle-by-cycle basis.

These sensors are most suitable for onboard engine diagnostics, can predict combustion, performance and engine- out emissions, and are superior to pressure transducers. They can easily be retrofitted in existing electronically controlled gasoline and diesel engines, by adapting the fuel injector or spark plug or glow plug as the sensor, without the need to drill another hole in the cylinder head. The in-cylinder combustion sensor enables performing multiple sensing tasks and real-time engine management by providing feedback to the electronic control of the engine. The volume production system results in low initial and maintenance cost compared to pressure transducers. Remote monitoring and diagnostics are also possible which help reduce the cost of inspection and repair over the lifetime of the engine.

The author is Chief Innovation Officer, Detroit Engineered Products.