SYMPHONY OF EMISSION TECHNOLOGIES

Societal impact of transportation emissions seems to be one of the main anxieties in our sustainable co-existence. To mitigate this, regulations globally have paved the way through progression of cleaner tail pipes and smaller CO₂ footprints. The rhetoric about regulations was less contentious prior to the 70s than what it is today. As such, stakeholders have been continually reinventing engine and emissions strategies, innovating control architectures and electronics, and cross deploying the 'never ever used technologies' in vehicles.

Catalyst-equipped vehicles were first introduced in the US in 1974, based on EPA regulations, and in 1985 in Europe. Emission standards mandated the installation of emission control catalysts on gasoline-fuelled cars in 1993 by the EU. In 1996, India introduced mandatory fitment of catalytic converter for cars in metros with unleaded gasoline.

In the EU, emissions limits for passenger and heavy-duty vehicles have been tightening since 1993 with Euro 1 to 6 stages and Euro I to Euro VI stages, respectively. In addition to reducing HC, CO, NO_x and PM limits, the cold starts, particulate number and CO₂ measurement are measured in emissions driving cycles. Also, Transient Operation has been added for engines in heavy-duty vehicles, stationary and off-road mobil-

ity applications. India, on the other hand, is catching up fast, has Bharat Stage (BS) emissions standards that were introduced in 2000 and closely shadow the EU regulations.

EMISSION REDUCTION

Emissions control systems – adsorbents, auto-catalysts and particulate filters – in conjunction with low-sulphur content fuel and an intelligent engine management reduce emissions to very low levels in real-driving conditions and, of course, during regulatory test cycles. Congruently, substrates technologies have vastly developed since the early 70s. The cell density of 200 cells per square inch (cpsi) went up to about 400 cpsi by the late 70s. Today 400, 600, 900 and even 1,200 cpsi substrates are available with ultra-thin wall thicknesses.

3-Way Catalysts are the prime auto-catalyst technology to control emissions in gasoline vehicles. The catalyst uses a ceramic or metallic substrate with an active coating incorporating alumina, ceria and other oxides and combinations of precious metals: palladium, platinum and rhodium.

Interestingly, SCR was originally developed and used to reduce NO_x emissions from power and marine appli-

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cations, and stationary diesel engines. Since 2000, Diesel Particulate Filters (DPFs) have become standard equipment on all new diesel cars in Europe due to Euro 5 norms, as well as in the US to meet EPA norms.

As for growing zones' regulations, Indian government is discussing direct BS VI deployment in April 2020 by skipping BS V. China is currently working on China V standards but contemplating to jump directly to China VI. Both these large Asian mobility markets have also introduced legislations to eradicate older vehicles to help soften the pollution menace.

FUEL QUALITY CONCERNS

Further, quality of fuel and lubricant affects performance of emissions control systems either by preventing the use of a technology or augmenting its positive aspects. For example, emissions significantly reduce by using unleaded gasoline for 3-Way catalyst and ultra-low sulphur fuels in diesels that combine NO_x adsorbents with DPF. Additionally, introducing ultra-low sulphur diesel and gasoline, and reducing levels of phosphorus, lead and alkali metals, improves the performance and life of 3-Way catalysts. Reduction of sulphur level close to near-zero enhances catalyst life and performance.

In general, emission control technologies are available for stoichiometric and lean-burn gasoline and diesel engines. Depending on the vehicle type, the market place and regulations, these need to be amalgamated in the product life cycle. The smartest ensemble is to compose the symphony that ensures a cleaner sustainable environment for collective co-existence.

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