The introduction of Catalytic Converters in the mid 1970s has led to a dramatic reduction in the emissions from both gasoline and diesel powered vehicles (termed mobile emission sources). The emission components eliminated by the converter include carbon monoxide (CO), hydrocarbons (HCs), nitrogen oxides (NO & NO2) and particulates (PM). In the case of gasoline vehicles the most recent EPA legislated emission standards for 2025 will result in greater than a 99.5% average reduction in tailpipe HC + NOx emissions as compared to an average gasoline powered vehicle without a catalytic converter in the 1960s. For CO the mandated emission reductions will be of the order of 85%.

Eliminating all three emissions simultaneously from the engine exhaust requires we simultaneously oxidation CO & HCs to CO2 and H2O while at the same time achieve the reduction NOx to N2. This simultaneous oxidation-reduction catalysis requires highly specialized catalysts and can only be achieved by the use of expensive and rare metals known as the precious group metals (platinum, palladium and rhodium). Further, unlike more typical idealized industrial catalytic systems, the catalytic converter has an operating temperature range varying from room temperature to over 1000oC, high and varying exhaust gas velocities, varying exhaust composition as determined by the vehicle operation as we go from cold start (initial engine ignition) to high speed driving inclusive of large accelerations and deaccelerations.

The seminar will focus on the state-of-the-art strategies used to meet the legislated emissions standards from the catalyst development point of view. These standards must be met at the mandated end of life of the vehicle (150,000 miles of driving) while at the same time minimizing the cost of the emission system, especially in terms of precious metal usage. Achieving these targets has resulted in the development of highly specialized supports for the precious metals, especially Rh and the introduction of advanced “oxygen storage materials” that enable essentially 100% conversion over varying exhaust composition ranges.

Currently there is a major concern about the availability and cost of the precious metals, especially Rh. Automotive emission control catalysts current utilize most of the Rh mined in the world. Today its cost per tr oz ($31.1035 grams) is in the range of $14,000/tr oz as compared to $1,900 for gold.

Dr. John Nunan
Technology Director, North America; Umicore Autocat USA

Wednesday, October 28, 2020 | 11am - 12pm | Platform - Zoom Meeting

Join Zoom Meeting @ tinyurl.com/y3zick7n
Meeting ID: 978 9827 9970 | Passcode: MSEFall20

This seminar will also be presented live in room 157 of the Helmerich Research Center