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Geometric Optimization of Catalytic Converter

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Abstract : The growing severity of government-obligatory emissions legislation has required continuous improvement in catalysts performance and the associated reactor systems. IC engines emit a lot of harmful gases into the atmosphere. These gases are toxic in nature and a catalytic converter is used to convert these toxic gases into less harmful gases. The catalytic converter converts these gases by Oxidation and reduction reaction. Stoichiometric engines usually use the three-way catalyst (TWC) for simultaneously destroying all of the emissions. CO and NO react to form CO2 and N2 over one catalyst, and the remaining CO and HC are oxidized in a subsequent one. Literature review reveals that typically precious metals are used as a catalyst. The actual reactor is composed of a washcoated honeycomb-style substrate, with the catalyst being contained in the washcoat. The main disadvantage of a catalytic converter is that it exerts a back pressure to the exhaust gases while entering into them. The objective of this paper is to optimize the back pressure developed by the catalytic converter through geometric optimization of catalystic converter. This can be achieved by designing a catalyst with a optimum cone angle and a more surface area of the catalyst substrate. Additionally, the arrangement of the pores in the catalyst substrate can be changed. The numerical studies have been carried out using k-omega turbulence model with varying inlet angle of the catalytic converter and the length of the catalyst substrate. We observed that the geometry optimization is a meaningful objective for the lucrative design optimization of a catalytic converter for industrial applications.

Keywords : catalytic converter, emission control, reactor systems, substrate for emission control
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