

Reaction Engineering and the Catalytic Converter

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ABSTRACT

Chemical reaction engineering had a significant role in the development of the catalytic converter for automobile emission control. In turn, the development of the catalytic converter had a significant impact on the evolution of reaction engineering itself.

The first catalytic converter was installed on 1975 model year vehicles beginning in September 1974. The exotic operating conditions (such as cold start followed by high temperatures, high and transient space velocities, catalyst poisons in the feed, mechanical vibration), combined with demanding design and performance requirements (such as compact size, fast light-off, high conversions of reactants, low pressure drop, unprecedented long-term chemical and mechanical durability, economic manufacturability by the millions, sustainable materials requirements) demanded a major development effort (1). Reaction engineering was an integral and in some respects enabling component in the first commercialization (oxidation catalyst, 1974) and subsequent development (three-way catalyst, 1978) of this technology. In turn, this new and exotic catalytic reactor application provided exciting opportunities for reaction engineering to explore reactor dynamics, multiple steady states, catalyst pore structure and impregnation design strategies to combat deactivation, novel catalyst geometries, and the like, resulting both in important practical contributions and interesting phenomenological discoveries.

This talk will reminisce about reaction engineering efforts at General Motors between about 1972 and 1980, based on published work, and viewed through the author's personal experiences. Professor Rutherford Aris, U. of Minnesota, was a valued consultant and collaborator in some of these endeavors, and has remained a lifelong friend over the decades to follow. This talk was assembled to honor his memory.

(1) L. L. Hegedus, J. J. Gumbleton, CHEMTECH, October 1980, pp. 630-642