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Catalytic reactor with metal gauze catalysts for combustion of liquid fuel

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ABSTRACT

A design of a 400 W radial-type catalytic reactor for combustion of diesel fuel is presented. The catalyst used in the reactor was Pt/Al_2O_3 supported on a heat-resistant metal gauze. Gas-flow resistance of the gauze structures was compared with the resistance of widely used bead and honeycomb supports. The reactor design does not require an external heat supply for vaporization of liquid fuel: the heat is transferred from the catalytic unit to the evaporation unit by radiation and heat conductivity through reactor components. Temperature in the evaporation unit is maintained in the range of 400–500 °C in all operating regimes. A two-stage distributor provides a highly uniform distribution of the gas flow through the catalyst layer. Two identical implementations of the design were tested in the combustion of diesel fuels with the sulfur contents of 7 and 50 ppm. No deterioration of the reactor effectiveness, which might result from the presence of sulfur in the diesel fuel, was observed throughout a 120-hour test. Moreover, the operating ranges of both reactors were extending to lower temperatures.

Keywords*: catalytic burning of diesel, wire gauzes, gas flow distributor, diesel fuel vaporizer*

1 INTRODUCTION

A considerable part of energy nowadays is produced by combustion of hydrocarbon fuel. Catalytic combustion of fuel has some advantages over flame combustion. First, because of lowering the process temperature by some hundred degrees, catalytic combustion can prevent the formation of nitrogen oxides [1]. Second, a directed radiation and convection heat flow that can be obtained in this case is more convenient for heating purposes, particularly in the heat-exchange apparatus for heat carrier heating, for example, in the heating-water converter plants [2]. Among hydrocarbon fuels, liquid fuels are advantageous in storage and transportation. Besides, diesel fuels have high caloricity (ca. 49 MJ/kg), availability, and a reasonable price.

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