INVESTIGATION OF AN OXIDATION CATALYST/ZEOLITE SYSTEMA FOR TREATING DIESEL EXHAUST

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Catalytic converters have become a viable post treatment system for reducing emissions from on-highway diesel engines. This investigation attempts to develop and test a catalyst (copper ion-exchanged ZSM-5 zeolite) system for its ability to effectively treat diesel exhaust gas. During the first phase of this investigation catalyst/zeolites were used in a laboratory scale plug flow reactor system to treat synthetic diesel exhaust gas maintaining operating temperature at 200-300^oF, pressures at 6 psig and 12 psig, and the space velocity through the reactor at ~8000 hr^{-1}. The exhaust gas composition was monitored before and after passing through the catalyst system using gas chromatography technique. Despite relatively low operating temperature, the hydrocarbons (particularly methane) removal efficiency was fairly good, ranged from 30% to 80% depending upon the variation in the composition of the catalyst samples/Zeolite structures. Therefore this catalyst system seemed promising for large reduction of HC from the diesel exhaust. Taking into consideration the drawbacks from the preliminary work, two modified catalysts were prepared which involved incorporating CeO_2 and ZrO_2 as the external coating on the previously made Cu-ZSM-5 catalysts. The size and shape of new catalysts were changed to help minimize pressure drop as well as catalyst loss from the system at high back pressure. The conversion efficiency of methane was tested using both catalysts for temperatures in the range from 200 to 800^oF at four different space velocities (from ~10,000 to ~25,000 hr^{-1}) and also the conversion efficiency of butane was tested at the same temperature range and the space velocity of ~ 30,000 hr^{-1}. The new catalysts showed very good performance for methane conversion and efficiencies up to 100% were achieved. Results of removal of synthetic diesel fuel (using methane and butane gas sample separately) for two different catalysts at different operating conditions are presented to support the conclusions of this research work.