Mechanical Engineering Thesis Defense

Exploring ethylene generation in a micro-flow reactor with controlled temperature profile

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Abstract

Ethylene is one of the most widely used organic compounds worldwide, with ever-increasing demand. Almost all the industries currently producing ethylene globally use the method of steam cracking, which, though very efficient and cost-effective, is energy-consuming and has a high carbon footprint. This study aims to analyze microscale partial oxidation of propane as a novel approach to ethylene generation that is simpler, less energy-consuming, operates at a lower temperature, and causes minimum carbon emissions. The experimental study endeavors to maximize ethylene production by investigating the effects of variables such as temperature, flow rate, equivalence ratio, and reactor diameter. The microscale partial oxidation of propane is studied inside quarts tube reactors of 1mm and 3mm diameter at temperature range of 800 and 900 C at varying flow rates of 10 to 100 sccm and equivalence ratios of 1 to 6. The study reveals a strong dependence on all the above parameters on ethylene yield. However, the variables are not completely independent of each other. Adjusting a few variables, greater ethylene yields as high as 10% were achieved, but propane-to-ethylene conversion efficiency is approximately constant for most of the time. The investigation surely indicates promise in the application of such a method in the field of ethylene generation; however, extensive further research is needed.

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