# A PERFORMANCE MODEL FOR A FLUID CATALYTIC CRACKING (FCC) UNIT

by

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# Certificate

This is to certify that the thesis titled **"A Performance Model For A Fluid Catalytic Cracking (FCC) Unit"**, being submitted by **Ajay Gupta** to the Indian Institute of Technology, Delhi for the award of degree Doctor of Philosophy in Chemical Engineering, is record of bonafide research work carried out by him. Ajay Gupta has worked under my guidance and supervision and has fulfilled the requirement for the submission of this thesis.

The results contained in the thesis have not been submitted in part or in full to any other university or institute for award of any degree or diploma.

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## Abstract

A fluid catalytic cracking unit (FCCU) comprises of a riser reactor and a regenerator. Performance models for riser and regenerator are needed to optimize/improve the performance of FCCU. A performance model to predict overall conversion and product yield profiles in an FCC riser is developed considering the effect of feed atomization (drop size generated by the feed nozzle system), heat transfer, vaporization, fluidization hydrodynamics, mass transfer and catalytic cracking kinetics. The model accounts for axial variation in

- Gas velocity due to feed vaporization and molar expansion.
- Solid and liquid holdup due to acceleration of clusters of catalyst particles/drops and associated slip between gas and clusters/drops.
- Temperature of both catalyst and gas due to feed vaporization and endothermic heat of reaction.
- Catalyst activity due to coke deposition on the catalyst surface during cracking reactions.

The most significant feature of the riser model is its capability to predict effect of initial drop size, generated by the feed nozzle, on conversion and yields. A regenerator model is adopted from literature and is used in combination with the developed riser model to simulate the entire FCCU and predict effect of feed atomization on its performance. It is predicted that overall conversion, gasoline yield and gas yield for an initial drop size (generated by the feed nozzle) of 50 microns are higher by 8.2 wt. %, 6.5 wt. % and 1.7 wt. % respectively as compared to those for an initial drop size of 500 microns.

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