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Coke formation simulation during steam cracking

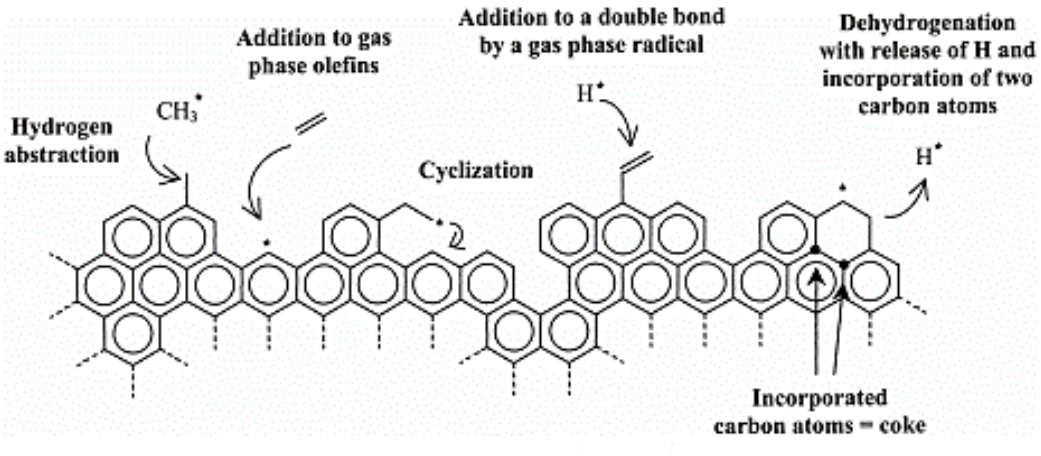
Aim

Understand the impact of sulfur additives on coke formation at different temperatures and construct a coking model to simulate the coke deposition during the steam cracking process.

Justification

Steam cracking as the primary olefin product process has been significantly improved in the past decades. The remaining challenge is the coke deposition, which occurs through the heterogeneous and homogeneous mechanisms [1], and the heterogeneous mechanism can be further divided into catalytic and free-radical mechanisms. This formed coke layer leads to higher energy consumption and intermittent operation, which are environmentally and economically unfavorable. Moreover, successive coking-decoking cycles accelerate the coke formation and harm the longevity of the reactor coil, which might have a mechanical failure after several cycles.

Several lab-scale coke reduction methods were proved efficient, but these technologies need to be assessed before applying them to the industrial plant. This evaluation can be done using the coking model, which predicts the coking rate based on operating conditions and industrial parameters. Till now, only one fundamental coking model for the heterogeneous free-radical coke formation is available [2]. However, it does not account for the effect of sulfur-containing additives, which are widely applied in the steam cracking process [3-12].



Program

1. Literature survey:
    - The thermal decomposition of sulfur-containing additives.
    - The impact of sulfur-containing additives on catalytic and pyrolytic coke formation.
    - The influence of catalytic coke formation on the pyrolytic coke formation.
2. Experimental study of the impact of sulfur additives on coke formation at different temperatures during the steam cracking of ethane.
3. Develop a coking model considering the impact of additives at different temperatures. This model will be validated by performing run length simulation of the industrial steam cracker.

Reference

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