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Coach	**Supervisor(s)**	**Funding**
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Design of an electrically heated steam cracking reactor

Aim

The research goal is to develop and optimize an electrified steam cracking reactor concept, in which heating elements are enclosed in multiple channels/tubes or heat is provided by a rotor.

Justification

Steam cracking is the predominant process for the production of some important bulk chemicals including ethene, propene and butadiene. Over the last several decades, extensive research has greatly optimized the process. However, there are still several issues, among others coke deposition on the tube surface and the emission of polluting components from the furnace.

For the former one, contemporary cracking coils are typically made from an alloy containing Ni which can promote the formation of coke. Changing the metallic material to ceramics, such as silicon carbide, can reduce coking and increase the run length of the steam cracking process. In addition, the ceramic material allows a higher reaction temperature compared to the metal materials, which is beneficial to the endothermic cracking reactions. For the latter one, the use of radiant heat delivered by burning gas and oil fuels in current steam cracking process is an indirect means to control the temperature. It is considered to be less accurate and inevitably causes a temperature gradient over the reaction zone. Hot spots, which accelerate coke formation, can be formed. This can be mitigated by electrical heating, where the heating elements are arranged in layers parallel to each other and perpendicular to the flow direction of feed gas mixture to maximize the heat transfer. A rectangular process temperature profile is expected.

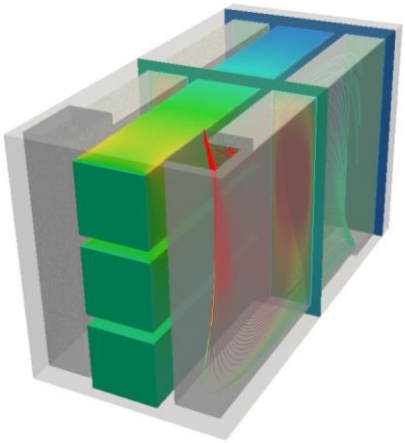

Figure 1:Part of the geometry of a honeycomb reactor

Program

- Literature study on the honeycomb type steam cracking furnace with electrical heating and put forward different designs of the reaction zone (shape of the channel/tube, spacing between the heating element and the wall, thickness of the wall/tube, heating power, etc.).
- Based on the designs, steam cracking simulation will be performed via open source code OpenFOAM. The temperature profile, pressure drop, coking rate, and olefin yield are investigated.
- Benchmark this technology to the COOLbrook technology (https://coolbrook.com/)
- Compare the results with that from current process, and optimize the design.

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