“PAS DE DEUX” OF HIGH-TEMPERATURE ALLOY AND 3D REACTOR TECHNOLOGY FOR STEAM CRACKING COILS: IMPACT ON PRODUCT YIELDS AND COKE FORMATION

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The production of light olefins through steam cracking is considered to be a mature technology [1]. Nevertheless, a lot of room for optimization is still available, especially in the energy consumption per ton of produced light olefins. The energy consumption of steam cracking is believed to contribute 8 % of the chemical industry’s total primary energy [2]. A significant contribution to a reduced energy efficiency is the unavoidable decoking step, because coke builds up on the reactor walls, as a result of side reactions [3].

The sole purpose of the IMPROOF project is to demonstrate the latest technological innovations in the field of coke mitigation and energy efficiency during steam cracking. These innovations include the use of new advanced high temperature alloys, in combination with novel 3D reactor technologies and the application of high emissivity coatings. Two industrial reactor materials, Centralloy® ET45 micro (chromia former) and Centralloy® HT E (alumina former) [4] were compared based on their coking resistance in a pilot plant steam cracking furnace. The HT E material, in addition, was coupled with the 3D reactor technology, SCOPE® [5] (Figure 1) to benchmark it to the bare, unprocessed, coils. In total five coking cycles were performed, for which cycle four resembled high-temperature EOR industrial conditions to metallurgical age the material. The remaining cycles resemble SOR industrial conditions. After aging, only the HT E reactors proved to be stable and even improved their coking resistance. Due to the reduced radial gradients after the application of the SCOPE® technology, the TMTs decreased. This decrease resulted in a decreased coking rate in comparison with the bare tube alternative. The combination of HT E together with SCOPE® showed an exceptional coking resistance, resulting in a coke reduction of nearly a factor 3 in comparison with the bare ET45 micro and HT E reactors.

Supplementary improvements can be obtained through the application of reactive CFD simulations. In this regard, the obtained experimental results are compared with the results of the respective CFD simulations.

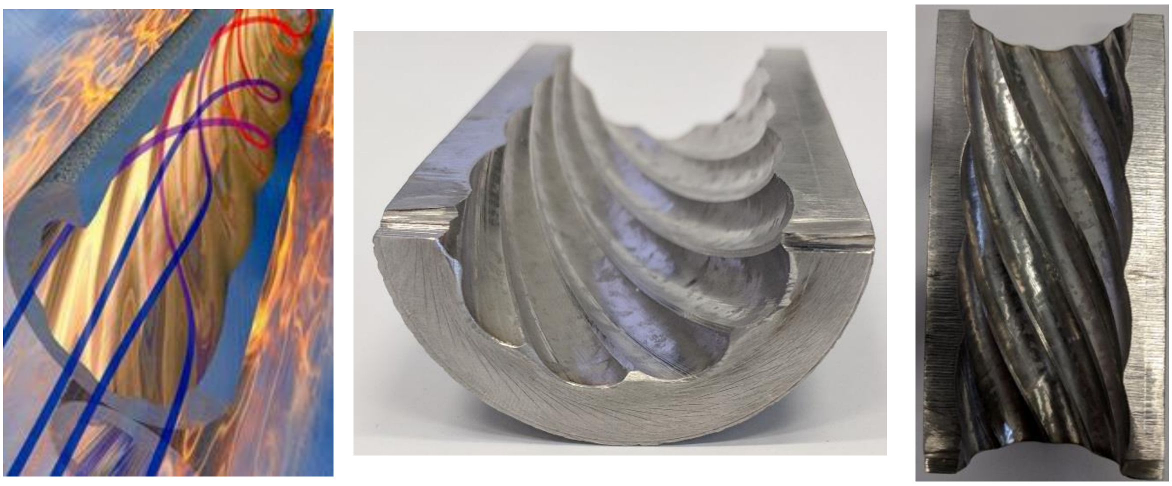

Figure 1. SCOPE® 3D reactor coil [28] technology

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