LABORATORY FOR CHEMICAL TECHNOLOGY
Technologiepark 914, 9052 Gent, Belgium

Supervisor(s)	**Period**	**Funding**
Prof. Kevin. M. Van Geem and Prof. Geraldine Heynderickx		H2020: SPIRE 4

Title Ph.D. Integrated model guided process optimization of steam cracking furnaces (IMPROOF)

Aim

The goal of this PhD is evaluate theoretically and experimentally the potential benefit of applying high emissivity coatings in steam cracking furnace .

Justification

Steam cracking is one of the most energy intensive processes in the chemical industry. Although steam cracking technology is considered to be mature, the complexity of the process and the harsh operating conditions allow the implementation of technology developments towards substantial heat transfer enhancement. One of the main objectives of IMPROOF is to increase the energy efficiency of the radiation section of a steam cracking furnace, minimizing exergy losses. A key element to realize this is the use of high emissivity coatings manufactured and studied under real furnace conditions in the project[1]. Five 5 different high emissivity products will be applied to the furnace components identified below to realize the indicated thermal or increased operational life performance increase.

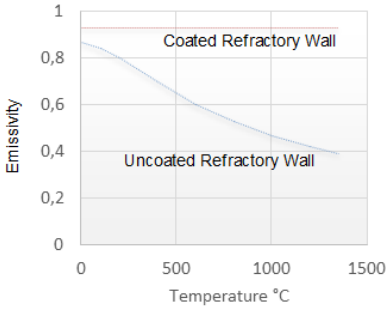

Figure 1: Principle of refractory coating applied to the surface

Program

Although the benefit of the application of high emissivity coatings is clear they are still rarely applied for steam cracking furnaces. Therefore IMPROOF will assess the results of the application of high emissivity materials on improved refractory materials on TRL5 and TRL6 level. These furnace redesigns of components and process tubes combined with CFD modelling will be a further multiplier for the potential benefit of IMPROOF. Important to stress is that also the effect of externally coating the reactor walls will be tested, to see if indeed a more uniform heat flux towards the reactor is obtained, translating in reduced fouling on the process gas side. Therefore measurements of emissivities and temperature uniformity are planned to prove that indeed a uniform heating of the tubes, with reduced hot spots and non-uniform heat flux, is attained. Moreover, the pilot tests should demonstrate that amount of coke that is formed should be significantly less, more granular and thus easy to remove.
IMPROOF seeks to further demonstrate that also existing furnaces can be retrofitted to increase their performance. At the same IMPROOF will result in optimized resource and energy efficiencies, and also less pollutant emissions. A risk is that, as a result of improvements in the radiant section by coating various components with high emissivity products, the amount of heat released to the convective section will be reduced. This will necessitate a re-evaluation of the operation of the convective section which will prompt the evaluation of high emissivity products to improve heat absorption in this area as well.

[1] *I*mpact of High-Emissivity Coatings on Process Furnace Heat Transfer, B. Adams, Dr. John Olver, Reaction Engineering International AICHE paper number 133b, Emisshield®: application to pyrolysis furnace