

Methane pyrolysis and decarbonization of the cement industry

Summary

The Cement and Concrete industry is responsible for 5% to 8% of total greenhouse gas emissions worldwide. The majority of its emissions are the combustion of fossil fuels to produce heat to fabricate the clinker and the clinker calcination process that releases CO₂. Therefore, any solution to decarbonize the industry has to address these two issues. On other hand, hydrogen (H₂) is becoming one of the future energy vectors of choice to replace fossil-based resources as it is a low carbon fuel. Methane pyrolysis is a way to produce H₂ from a fossil fuel without emitting CO₂, as the carbon element is captured at a solid state. This solid carbon can, therefore, be used to replace clinker at the cement and concrete mix, reducing clinker consumption. Past research shows potential concrete mechanical improvement when solid carbon is added to the mixture. If this is the case, then clinker consumption can be further reduced.

The academia and the industry has started to show recent interest for the option to use methane pyrolysis in the cement and concrete industry, resulting in a increasing number of published scientific papers in recent years. This means that Technology Readiness Level of these technologies are yet at Research and Development stage (TRL 3 to 4), and therefore, there is still room to further research and development. This PhD will answer the following research questions:

1 - What are the factors that impact the type of solid carbon from methane pyrolysis technologies (metal/salt molten and/or carbon catalysts), including quality, shape, dimension and quantity?

2 - What is the impact on the mechanical properties of concrete due to the use of carbon solids produced by methane pyrolysis technologies as supplementary cementitious materials (SCMs)?

3 - What is the life cycle impact assessment of using methane pyrolysis in cement and concrete production (Cradle to Grave)?

Keywords

Methane, pyrolysis, concrete, decarbonization.



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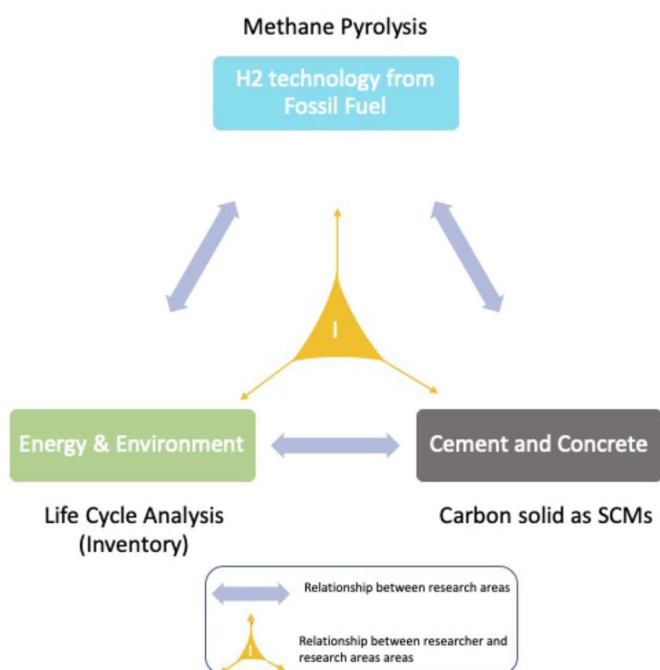
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Areas of Research in this PhD.