Development of an Innovative Flare Concept: Catalytic Combustion of Hydrogen

Fig. 1 Mobile flare for natural gas pipeline operation [1]

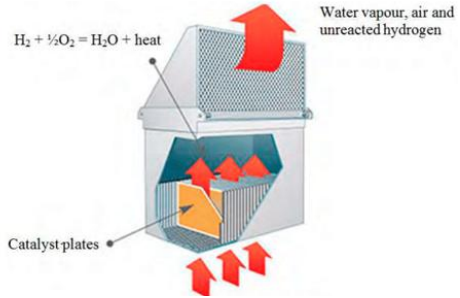

Fig. 2: Scheme of an catalytic combustion unit [2]

Description

Current methods for releasing natural gas, such as venting or flaring, pose significant challenges for hydrogen due to its unique properties (e.g., higher diffusivity, lower ignition energy, and broader explosion limits). Venting large amounts of hydrogen (>1kg H2/s) creates difficult-to-quantify hazard zones. A promising alternative to traditional flaring is catalytic combustion, which ensures complete, emissions-free conversion of hydrogen into water without the need for a thermal ignition source.

The goal of this master thesis is to develop and prototype an innovative catalytic flare concept for hydrogen combustion, evaluate its technical feasibility, and explore its potential for industrial applications in hydrogen infrastructure.

Content / Time table:

- Concept Development: Design a catalytic flare concept for hydrogen, focusing on the flare geometry and catalyst materials.
- Simulation: Model the fluid dynamics and thermodynamics of the system to optimize hydrogen-air mixing and combustion efficiency.
- Prototype Construction: Build and test a prototype of the catalytic flare, selecting appropriate catalyst materials and structures.
- Evaluation: Conduct experimental tests to assess performance, efficiency, and emission levels, comparing the catalytic flare to traditional flaring methods.

Start: as of now

Duration: approximately 6 months

Paid Master Thesis

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[1] https://www.zeeco.com/services/pipeline-services

[2] Kozhukhova, Alina E.; Du Preez, Stephanus P.; Bessarabov, Dmitri G. (2021): Catalytic Hydrogen Combustion for Domestic and Safety Applications: A Critical Review of Catalyst Materials and Technologies. In: Energies 14 (16), S. 4897. DOI: 10.3390/en14164897.