Setup and operation of a cold-flow trickle bed reactor under vertical motion

Master thesis

In the context of a floating offshore wind power plant with hydrogen production and storage in LOHC, the influence of vertical movements on the flow behavior of liquids in a trickle bed reactor will be investigated.

The planned wind turbines are intended to produce hydrogen by electrolysis on floating platforms in high wind offshore areas remote from coasts, and bind this hydrogen to an LOHC through hydrogenation. The LOHC is stored in the tanks of the floating platform until exchanged by shuttle tankers. The floating platforms move due to wind and waves, causing movement of the hydrogenation reactor as well. The influence of this movement on reactor performance is yet unclear.

In preliminary work, a cold-flow setup was developed and used to study catalyst wetting under oscillatory movements of the reactor. It was shown that oscillatory movements have a significantly positive effect on catalyst wetting. This result aligns with findings from hydrogenation experiments under oscillatory movement, which also demonstrate increased productivity compared to a stationary reactor.

The cold-flow setup is to be modified and subjected to an elevator system that simulates a wave-like up-and-down motion. The influence of vertical acceleration on the wetting behavior of the liquid is to be studied. The elevator system should be capable of simulating wave heights up to approximately 5 meters and wave periods between 5 to 20 seconds. This setup aims to mimic real sea conditions for examining how vertical accelerations affect fluid behavior and catalyst wetting in the reactor.

The master's thesis will cover the following topics:

- Construction and control of the elevator system
- Adaptation of the cold-flow setup
- Investigation of the effects of different wave amplitudes and frequencies on the wetting of the catalyst bed

Prerequisites include:

- Fundamentals of trickle bed reactors
- Basics of fluid dynamics
- Programming a motor control system

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