

# Advanced catalytic upgrading at VTT

**Bench-scale reactors for catalyst research and process development at  
VTT Bioruukki, Espoo, Finland**

## Applications

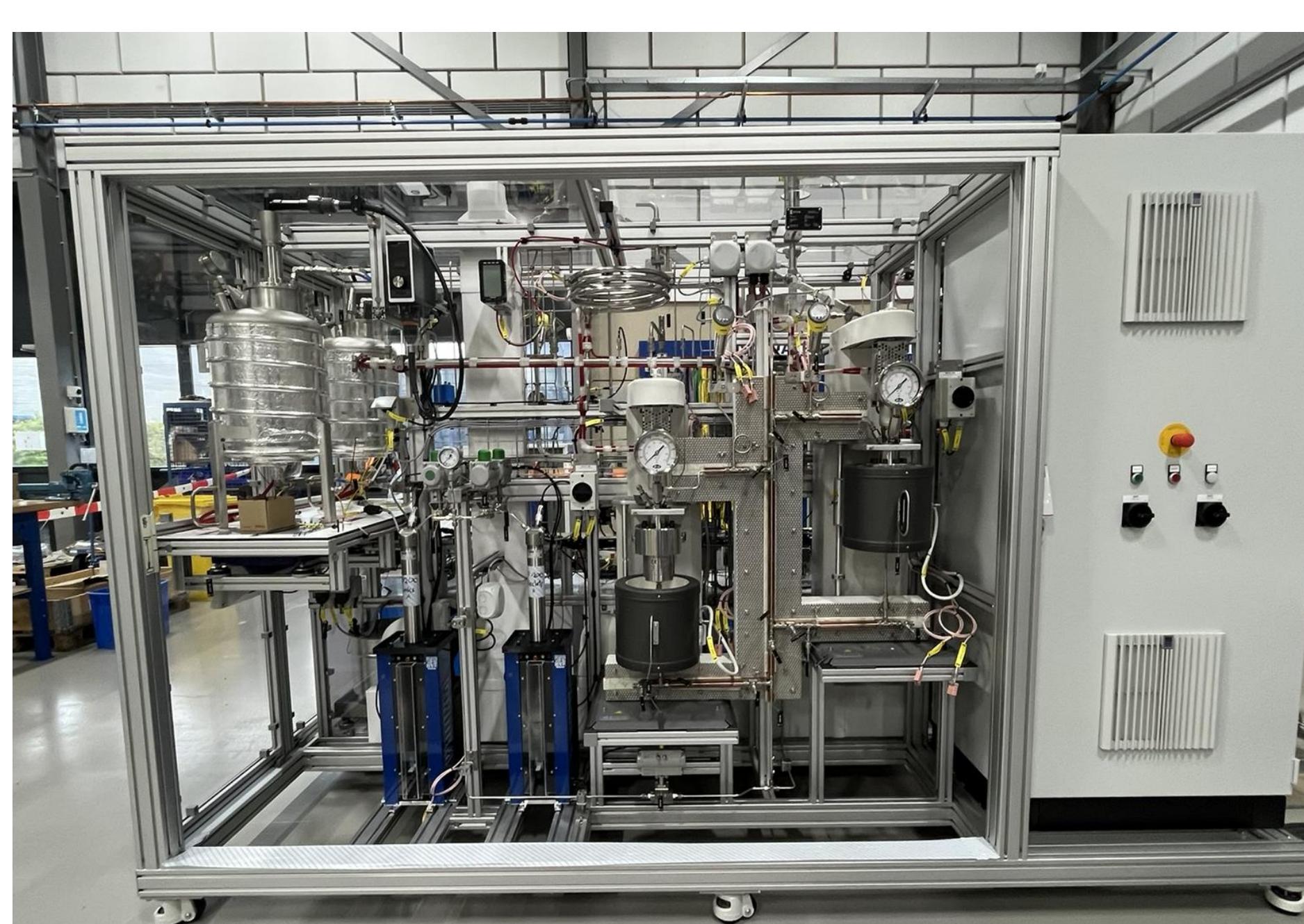
VTT has several reactors suitable for catalyst testing and optimization, feedstock screening, benchmarking, deactivation studies, hydrotreatment, hydrocracking, isomerization and sample manufacturing. Our expertise includes upgrading complex, waste- and residues-based feeds, such as plant-based oils, animal fats, gas oils, plastic and residue-derived pyrolysis oils and Fischer-Tropsch crude.

Depending on the application and feed quantity, a typical test run duration can vary from one hour with a single fixed-bed pipe reactor unit up to 3 months with the high-throughput (HTR) reactor system.

VTT experts will support the customer in selecting optimal catalyst, reactor and upgrading conditions. We develop stand-alone and co-processing upgrading strategies for a broad range of feedstocks.



*High-throughput test unit with 4 parallel fixed-bed reactors.*



*CSTR slurry miniplant for highly challenging feedstocks.*

## Equipment specifications

### High-throughput fixed-bed reactor (HTR)

- Four parallel fixed-bed reactors or two in series
- Individual operation with two separate feed pumps
- 24/7 continuous operation
- Automated data collection and sampling
- Max. reactor pressure 180 bar
- Max. reactor temperature 450 °C
- Feed lines can be heated up to 120 °C
- Max. continuous feed rate 4 ml/min
- Internal diameter of the reactors 15.5 or 18.9 mm
- Catalyst bed volume (isothermal area) up to 130 ml/per reactor

### Other fixed-bed reactors

- 4 individual lab-scale reactor units
- Manual operation and sampling
- Operation max. T 450 °C, pressure max. 100 bar
- Catalyst bed volume 10-180 ml
- Automated data collection incl. gas flow, pressure, temperature

### CSTR slurry miniplant

- Two 250 mL CSTR reactors in series
- Up to 20% solid content in feedstock
- 24/7 continuous operation
- Automated data collection and sampling
- Max. reactor pressure 180 bar
- Max. reactor temperature 470 °C
- Treating highly reactive, unstable, solid-containing feeds

## Supporting analytics

### Online GC for HTR and CSTR systems

- C1-C14 hydrocarbons, H<sub>2</sub>, O<sub>2</sub>, N<sub>2</sub>, H<sub>2</sub>S, CO, CO<sub>2</sub> and H<sub>2</sub>S

### Offline liquid analytics

- CHNSO
- Density, pour and cloud points
- Bromine index/number
- KF water titration
- Metals, halogens
- etc.

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