Pilot plants

Bench Scale Hot Attrition Test (HAT) Unit

The superior method to predict catalyst losses by laboratory testing at temperature conditions similar to commercial FCC operation.

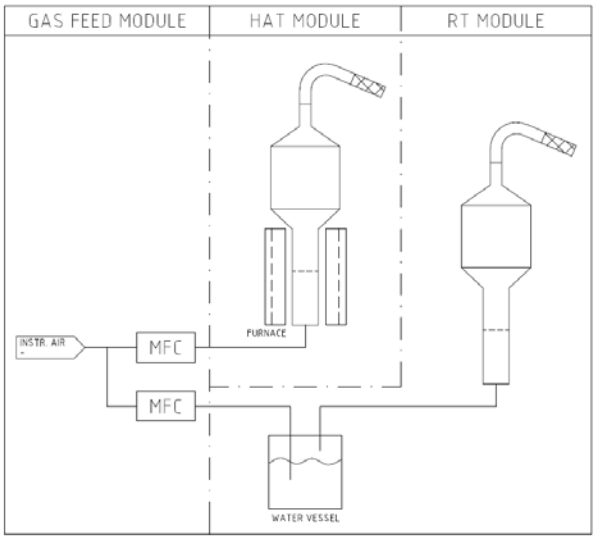
Fluid Catalytic Cracking (FCC) catalysts can undergo particle breakdown, also called attrition, which leads to the production of fines. Most FCC units have recovery systems to control the loss of these fines to the environment in order to comply with governmental emission regulations.

FCC particles are subject to attrition when forces are exerted on them. Examples of such forces are the air jets used to fluidise the catalyst bed, the inter-particle collisions in the bed or standpipe and the impact against the wall. Many parameters influence the ultimate attrition rate, such as particle properties and structure, geometry of the unit, solids concentration, flow rates and other operating conditions.

Attrition directly affects the loss of catalyst from a FCC unit making it an important factor in the operating cost in a commercial oil refinery. Therefore, it is necessary that the catalyst is sufficiently attrition resistant. To determine this resistance, tests can be done at laboratory scale to gauge the intrinsic attrition propensity of the catalyst.

Catalyst attrition behaviour at higher temperatures can be different than measured at room temperature. It is therefore of importance to carry out attrition tests at elevated temperatures (500 ºC to 750 ºC) and room pressure ambient to mimic commercial FCC operation.

The purpose of the Hot Attrition Test (HAT) unit is to operate on a scale where industrial concerns can be addressed. This technology was pioneered by Albemarle and is brought to market by 360°KAS since 2003 in the form of our bench-scale Hot Attrition Test (HAT) unit.



Typical arrangement of a Hot Attrition (HAT) combined with Room Temperature (RT-AT) Test unit (optional).

Functionality

The HAT unit typically contains the following modules:

- Air feed section to supply instrument air into the reactor section;
- Reactor section with attrition plate, furnace elutriation zone and fines collection assembly.

The catalyst bed resides on an attrition plate within an attrition tube. Air is forced through the nozzles of the attrition plate and the resulting jets bring about an upward transport of catalyst particles and generated fines.

On top of the attrition tube is an elutriation chamber where the flow dissipates, particles larger than about 16 µ fall back into the attrition tube while smaller ones make it into the collection bag. The attrition plate carries three high precision 381 µm orifices using sapphire stones.

360°KAS supplies the HAT unit in accordance with the following specifications:

Unit	
Test tube material	AISI-310
Catalyst intake per reactor	min 45 g max 80 g
Definition of fines	< 16 µ
Fluidising medium	Instrument air
Air flow	6.5 L/min @ 700 700 ºC
Type of control	PLC Controlled for sequence timing, temperature and flow
Gas flow control	DP orifices, low/high tempreature, flow
HMI & Data Acquisition	PLC interfaced
Approximate dimensions (WxDxH in mm)	600*300*2000mm

Utilities	
Power	380-400VAC, 50-60 Hz, 3-phase + neutral, 6kVA (others are possible upon request)
Instrument Air	4-10 barg, HC free, dew point < -30 ºC,max consumption: 2nm3/h per reactor section

Hot Attrition Unit according the latest design, including oven (max 700°C), reactor and control unit.

Control System

In the control system the following components can be distinguished:

- HMI screen to set flow, temperature, timing, and alarm levels. All occurring values visible on HMI screen;
- Power on/off switch;
- Automatic on/off and time settings with timer via plc control;
- Emergency Shut Down on overtemperature to protect attrition tube;
- View trends and log experiment data on USB;
- Reporting full attrition or attrition divided in initial and inherent attrition in %weight loss;

Options

The following options can be quoted upon request:

- Combination with Room Temperature Attrition Test (RT-AT). Both in one frame, sharing controls and utilities;
- Laboratory equipment such as particle size analyser, glass work, calciner, catalyst sieves and weighing scales, fume hoods;
- Services such as site installation, installation supervision, commissioning, start-up and training;
- Annual maintenance;
- Spare parts for 2 year operation;

The following Analyser & Sampling product sheets are available:

- Cyclic Deactivation (CD) Unit
- Short Contact Time – Riser Test (SCT-RT) Unit
- Hot Attrition Test (HAT) Unit

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