

(R)FCC FLUE GAS CLEANING

Overview Filtration of catalyst fines has always been an important issue in refineries. Not only to protect downstream equipment, but also to meet local environmental and governmental legislations. Worldwide refiners need to revamp their FCCU regenerator off-gas systems and grassroots refineries need to implement the latest filtration technology due to the required reduction of stack emissions.

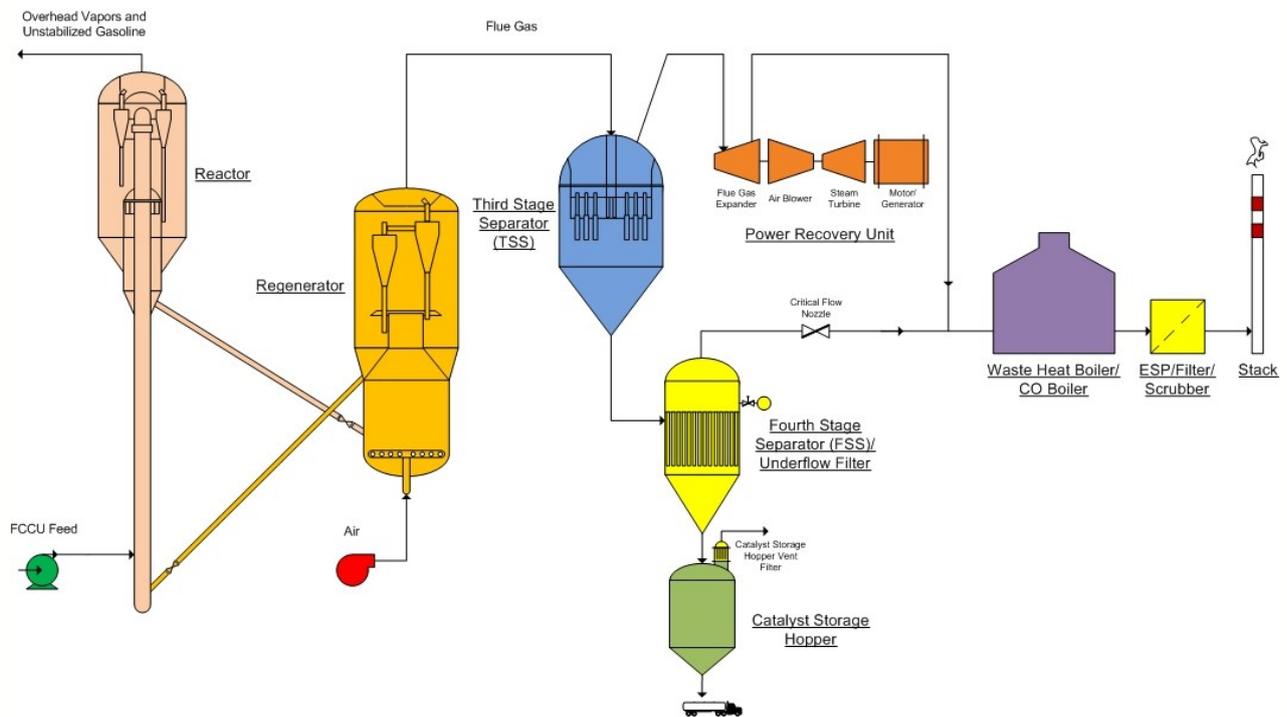
While in most countries the maximum particulate emission level is 50 mg/Nm³, some targets have already been reduced to 40 mg/Nm³ or to limitations on particulate matter (*i.e.* PM10 or PM2.5). In many cases, conventional separation technology is not sufficient anymore to meet these guidelines.

Before the flue gas leaves the stack, many FCC plants have a flue gas expander to recover energy from reducing flue gas pressure. Typically, regenerators are designed with multi-stage cyclones to capture and return entrained catalyst back to the

AUTOMATIC BLOWBACK DUST FILTRATION SYSTEMS

fluidized bed. However, the flue gas still contains high contents of catalyst fines that can do harm to the expander. A so-called Third Stage Separator (TSS) is installed upstream of the expander to protect the expander blades from undue erosion by abrasive catalyst. The TSS contains cyclonic separation technology, reducing the high amount of catalyst fines in the regenerator off-gas significantly.

For optimal performance of the TSS and conveying the collected fines, a small underflow is extracted from the bottom of the TSS. A Fourth Stage Separator (FSS) is commonly applied to remove the solids from the underflow gas and to assist the TSS in reducing the total stack emission. Currently, many systems still have FSS units based on cyclone technology. However, nowadays more efficient filtration technology is required to cope with the most stringent guidelines that govern particulate emissions from FCCU's.



Typical FCC Flue Gas Process Flow Diagram

Process Description The Fourth Stage Separator, or so-called Underflow Filter, removes cat fines from TSS underflow gas. During normal operation catalyst fines will collect on the outside of the filter elements. Over a period of time a layer of solids will build-up on the surface of the filter elements. Upon reaching a certain preset differential pressure over the filter elements, the filtration system is regenerated *in-situ* by performing several blow back pulses in reverse direction, each cleaning a number of filter elements.

The high temperature, corrosive, oxidative and dust-laden environment requires the use of advanced sintered metal filter media and a perfected filter design.

The DAHLMAN FSS features a ‘downflow’ arrangement and special gas distribution inlet section, developed based on extensive CFD analyses and tailored for the filtration of FCC flue gas. Field performance results shows that these features greatly contribute to:

- equal distribution of gas and solids inside the filter vessel, protecting the filter media against direct impact of the incoming abrasive particles;

- very low velocities inbetween the filter elements and optimized flow patterns inside the FSS;
- minimized re-entrainment of particles on the filter media during blowback cleaning; potential plugging of the filtration system is avoided.

Dahlman’s FSS utilizes high quality, sintered porous metal filter elements, which have proved to perform excellent under the severe FCC flue gas conditions. Their features include:

- special alloy filter medium with optimal resistance against mechanical & thermal shock and oxidizing environment;
- excellent *in-situ* cleaning characteristics;
- low pressure drops compared to other filter media;
- long lifetime.

The Dahlman FSS ensures a reliable and continuous filtration process without unplanned stops for a full turnaround period of at least 4 years.

Features	Benefits
‘Downflow’ filter design	Minimized wear and tear -> low operational risk
Special gas inlet distribution section	Low internal velocities & increased filter element lifetime -> low operational risk & low OPEX
Low pressure drop & excellent <i>in-situ</i> cleaning due to sintered metal fibre filter elements	Low OPEX
Special alloy filter media proven for FCC flue gas conditions	High reliability and availability (> 1 TAR)
Design for upset conditions (maximum solids load)	Enhanced operational safety & reliability
Technology selected on FCCU’s of leading licensors	Proven, reliable design