Filtration technology

In order to achieve effective and reliable removal of the solid concentration in FCC bottom product, DAHLMAN designed, engineered and fabricated a FCC Slurry Oil Filter package, consisting of the following main components:

- two for three filter vessels
- backwash receiver vessel
- gas accumulator tank
- interconnecting piping
- control and maintenance valves
- instrumentation
- controls (PLC)

The filter vessels are suitable for processing 100% of the design flow rate and contain Dahlman’s high quality sintered porous metal filter media retaining the catalyst fines on the inner surface of the elements. Clean filtrate passes through the built-up solids “cake” and filter medium and differential pressure increases.

Once the pressure drop across the filter has reached its pre-set maximum value after normal filtration mode, the cleaning sequence is automatically started. The feed and filtered product connections are both closed and, subsequently, the valve connecting a gas accumulator will open towards the FCC Slurry Oil filter vessel. This results in pressurization of the slurry oil contained in the filter vessel. When a quick-opening valve installed below the filter vessel opens, the gas pocket pressurizing the FCC SO from above, rapidly expands. This results in a reverse flow of the slurry oil, from the outside to the inside of the filter elements.

As a consequence, the collected particles/filter cake dislodges over the entire surface of the filter tubes. Together with the filtered liquid, the solids are forced further back by the expanding gas, and are transferred to the backwash receiver vessel in a matter of seconds.
DAHLMAN’s gas-assisted backwash technology eliminates channeling and incomplete cleaning. It is considered to be the most effective and efficient in-situ cleaning method. The operating temperature is critical for the reliability of the filtration process; for instance asphaltene precipitation on the filter media may occur when operating at too low temperatures, resulting in reduced cycle times and the need for undesirable in-situ cleaning of the filter element.

With DAHLMAN’s filtration technology, the sludge, disposed in the backwash receiver vessel, can be redirected to the riser, while maintaining a continuous flow rate.

Field results The full scale filter package was started up early 2004 by DAHLMAN in close cooperation with the refiner. The site acceptance test demonstrated that DAHLMAN’s slurry oil filtration technology reduces the solid content in the bottom product to far below the required and guaranteed 80 ppm wt. based on ash content (ASTM D482-95). Now that the slurry oil filter is in operation, the refiner is able to feed the LC Finer unit with 60% of primary VGO and 40% of cracked, and filtered VGO. Upgrading of the slurry oil significantly contributes to a high return on investment for the refiner.

Injection of backwashed sludge to the FCC riser is accomplished via a dedicated feed nozzle (part of total feed distribution system). At present this amounts to approx. 3,5 m³/hr. Continuous introduction and feed is guaranteed, by using hydroprocessed VGO as carrier medium.

Conclusion After nearly 8 years of operation it can be concluded that DAHLMAN’s FCC Slurry Oil filtration package has provided a financially attractive and satisfactory solution to the refiner. The system continuously operates above its design values, meaning with significantly higher flow rates and solid concentrations.

Filtration cycle times of more than 6 hours are achieved while the vast majority of the original elements are still in place. The installed technology has proven that combining highly efficient filtration and gas-assisted in-situ backwash cleaning, results in a reliable and effective reduction of the solids content to very low levels of 10 - 30 ppm wt.

![Fig. 1: After two TAR’s DAHLMAN’s Slurry Oil Filtration Package still achieves filtration cycle times of more than 6 hours](image)

### Main operational figures (Q4, 2011)

<table>
<thead>
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<th></th>
<th>7 up to 15 m³/h</th>
<th>original design 10 m³/h</th>
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<tr>
<td><strong>Flow rate</strong></td>
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<td><strong>Operating temperature</strong></td>
<td>280 - 285 °C</td>
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<td><strong>Inlet solids concentration</strong></td>
<td>1000 up to 1700 ppm wt.</td>
<td>original design 800 ppm wt.</td>
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<tr>
<td><strong>Outlet solids concentration</strong></td>
<td>&lt; 10 - 30 ppm wt. based on ash content (ASTM D482-95)</td>
<td>original guarantee 80 ppm wt.</td>
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<td><strong>Filtration cycle time</strong></td>
<td>at present approx. 6 hours (see fig. 1)</td>
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