

Innovative and reliable separation designs for heavy fouling applications

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Internals vendors have been involved in providing grassroots and revamp designs for heavy oil and bitumen upgrading for over 25 years. The knowledge gained from these experiences in fouling services has translated into sound design principles and internals offerings. With the current and planned increase in processing heavier, more sour crudes, there is a corresponding increase in development work for distillation internals in fouling service.

This paper discusses fouling—the most significant issue facing the sustainable operation of Upgrading/Extraction separations; the tools, with examples, that are currently available to mitigate fouling; and the development capabilities available to further improve separation internals in severe service.

Impact of Fouling on Separation Processes

Over the last century of distillation, there have been many documented cases of distillation tower malfunctions. A database with over 900 cases has been compiled¹. The largest incidence of reported cases of tower malfunctions (over 15%) has been attributed to fouling (coking, scaling, and plugging). The occurrence of reported fouling malfunctions has increased over the last three decades. Possible causes include:

- ▶ More challenging (heavier, unstable, particulates) crudes are being processed.
- ▶ Operators are pushing their plants to increase yields.
- ▶ Design guidelines to factor in the changing crude and operating realities have not been comprehensively updated.

Fouling by coking or plugging results from operating conditions in the plant (temperature, pressure and temperature differences between liquid and vapour), and particulates in the feed. Coking and plugging are exacerbated by liquid/vapor flow mal-distribution.

- ▶ Coking results from hydrocarbon being exposed to temperatures at given pressures that cause a burning/charring of the carbon molecules.
- ▶ Plugging occurs from particulates (sands, salts, corrosion by-products) introduced into or generated in the column.

Fouling impacts plant profitability in the following ways:

- ▶ Loss of throughput (reduced production)
 - Pressure increases due to reduced open area (during operation)
 - Additional turnaround time to remove
- ▶ Frequent replacement of equipment.
- ▶ Increase in safety hazards, such as fires during maintenance work.
- ▶ Increased requirements for cleaning and disposing of toxic wastes.

Tools to Mitigate Fouling

Removing the cause of fouling outside the separation column would be the ideal solution. However, with the significant impact of fouling on plant profitability and the increased number of fouling incidents, internals vendors have developed process tools and internals to mitigate the consequences of fouling in severe service applications.

- ▶ Process tools available to mitigate fouling include:
 - Design guidelines
 - Computational Fluid Dynamics (CFD) modeling
 - Inside-Out design approach
- ▶ Specific Tower Internals Design

Ongoing R&D to determine best internals features to mitigate fouling will also be shared

References

- [1] Kister, H., IChemE (2003)
- [2] Remesat, D., Hydrocarbon Processing (2006)
- [3] Hauser, R., AIChE Spring National Meeting New Orleans(2003)