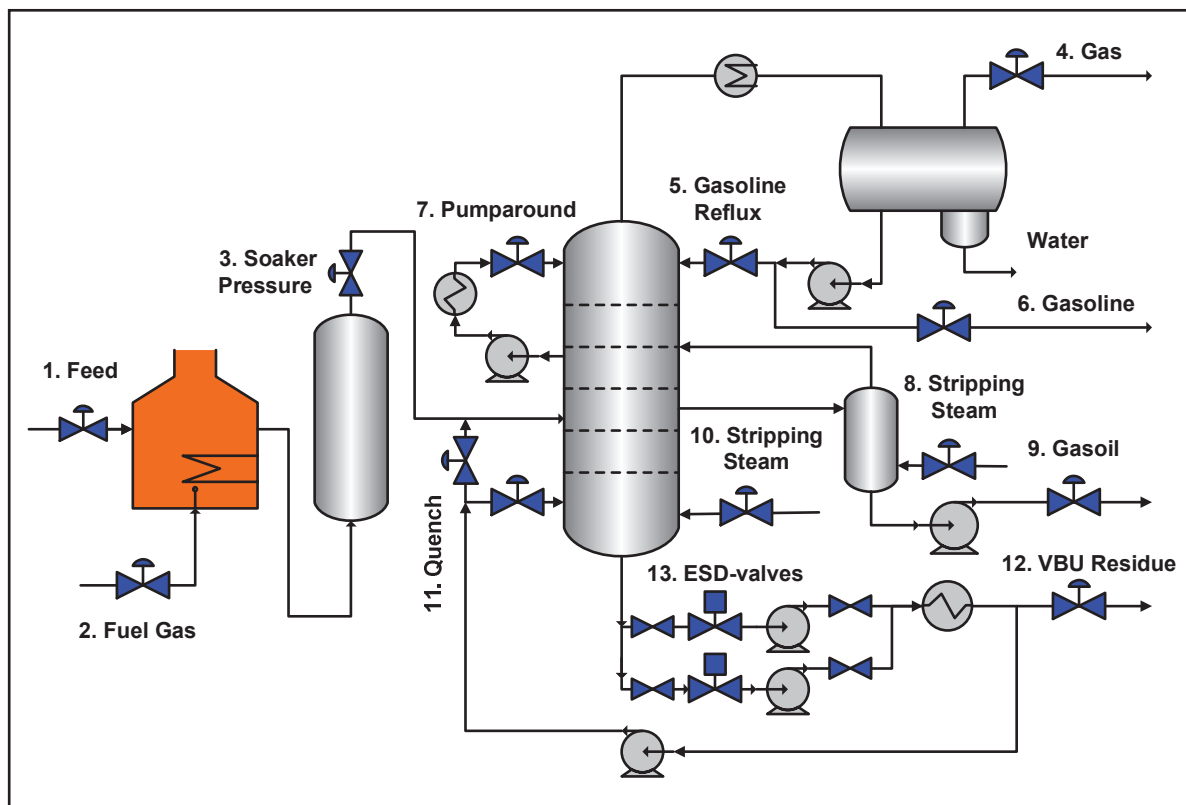


Visbreaking



Process overview

Visbreaking is a relatively mild thermal cracking process mainly used to reduce vacuum tower bottoms viscosities and pour points and to reduce the amount of cutting stock required for residue dilution to meet fuel oil specifications. Heavy fuel oil production can be reduced from 20 to 35 % and cutter stock for dilution by 20 to 30 % by visbreaking. This increases the yield of more valuable distillates directly converted from visbreaking or used as catalytic cracker feedstocks.

There are two types of visbreaker operations: coil furnace cracking and soaker cracking. Coil cracking uses higher furnace outlet temperatures (470 – 500 °C) and few minute reaction

times. Soaker cracking uses lower furnace outlet temperatures (430 – 450 °C) and longer reaction times. Soaker visbreaking has the advantages of lower energy consumption and longer run times before having to shut down to remove the coke from the furnace tubes. Disadvantage is that soaker drum cleaning is difficult and time consuming.

The feed is introduced into the furnace and heated to the desired temperature and quenched as it exits the furnace with gas oil or tower bottoms to stop the cracking reaction. In the soaker cracking the feed after furnace passes through a soaker drum for additional reaction time before it is quenched. Pressure is an important design and operating parameter, usually from 5 to 9 bar for liquid-phase visbreaking and 1 – 2 bar for partial vaporization at furnace outlet.

Visbreaking challenges

The objective of visbreaking is to reduce the feed viscosity as much as possible without significantly affecting the fuel stability. The amount of cracking is limited, however, because if the operation is too severe, the resulting product becomes unstable and it causes filter plugging and sludge formation during storage and use. The degree of viscosity and pour point reduction is a function of the composition of the feed to the visbreaker. Feed and in particular the more unstable residue have great fouling potential that leads to coke formation in the equipment and thus can reduce the conversion ratio at which a stable fuel can be made.

Health, Safety, Environment – Valve leaking poses both an environmental and safety issue due to risk of fire and oil spills, as the sticky residue accumulates on the valve bonnet and refinery ground. ESD and on/off valves must be able to perform their action in a process or equipment failure.

Top-class products at maximum yield – The market calls for clean products and high quality. It is important that the process is stable, flexible and under control. Sticking and leaking of control valves reduces the accuracy of throughput control and adversely affects also the downstream processes.

Maintenance costs – Poorly performing valves in the process must be serviced because they will have a direct impact on the efficiency of the process. The cost of unscheduled maintenance will be quite high, up to 70 % of the cost of a new valve in some applications. Add this to the cost of removing the valve from the line and disruption of the process and the total cost will be much higher.

Plant run-time – Refineries are looking for longer plant run-times since downtime means production losses and is a remarkable cost including maintenance costs. This requires reliable equipment and process control. Run time of 3 to 6 months is typical for coil visbreakers and 6 to 18 months for soaker visbreakers.

Metso solutions

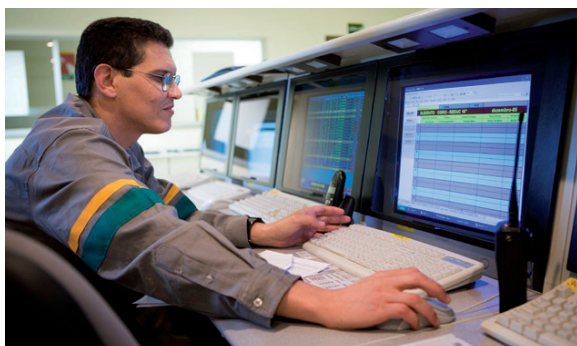
We are all tuned up to answer these challenges through our refining application experience and product offering for control, safety and automated on/off duty that ensure high valve performance in hydrocracking.

Safety – Rotary stem operation reduces fugitive emissions and protects from leaking. Packing construction meets the latest emission standards. Our products are fire tested and apply to the latest standards. Neles ValvGuard™ partial stroking will ensure that plant emergency shut-down valves will always perform properly when needed.

Efficiency – Throughput losses due to sticking and poor control performance will be avoided with high performance rotary valves. Flow through the process unit may be changed as the need arises with rangeability of 150:1 and further with full bore ball valves. Our advanced ND9000 digital valve controller ensures higher positioning accuracy and faster response to reduce process variability. Correct valve selection and sizing with our Nelprof-program we can assure the best valve performance and process control.

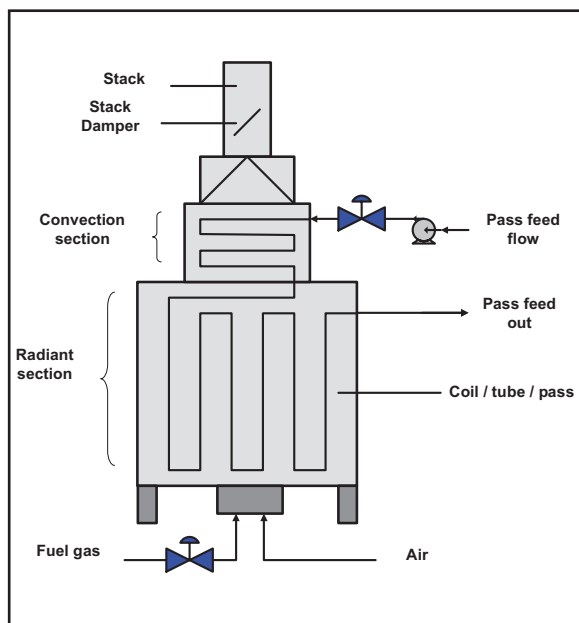
Availability – Simple rotary designs, same face-to-face dimensions, and global service network and inventory management will help you to optimize your maintenance activities. Rotary valves have been in service for several years without requiring maintenance and show no sign of leakage.

Reliability – Trend data collected by our smart valve controllers and analysed by FieldCare configuration and condition monitoring software based on open FDT/DTM technology makes it possible to predict and respond to maintenance requirements and reduce unscheduled downtime. This gives full transparency to the valve performance in process control.



Heater applications

Energy-efficient heater operations involve proper control, maintenance and monitoring of process fluid outlet temperature, draft, excess air and fuel-firing rate. It is important to keep the flow-rates in multipass heaters equal and control flow velocity for optimum residence time. Leaking valves will result in valve sticking and poor control behaviour. 1 % fuel savings in a 3 500 MMBtu/day heater saves approximately 75 000 USD/year in fuel cost.

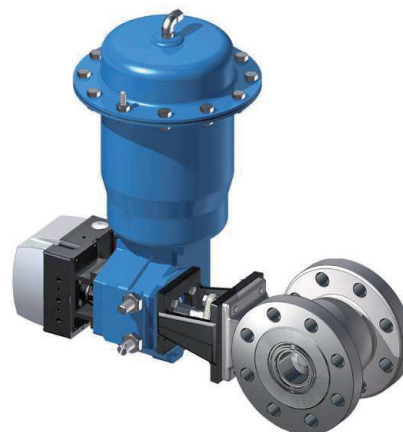


1. Heater pass flow control (V1)

Challenge – Some customers had to maintain their valves every 2 – 6 months because of gland leaks and valve sticking. This reduced heater performance and throughput control, increased risks for health, environment and safety and in some cases caused unscheduled shutdowns, when valve by-pass was not available.

Metso solution – Finetrol eccentric plug rotary valve for moderate temperature applications (< +425 °C) and Top entry valve for high temperature applications (> +425 °C).

Benefits – Our customers report remarkable savings in maintenance costs after installing our control valves. Oil leaking through gland packing has been avoided, and this obviously improved operator safety in the plant and reduced emissions to environment. Heater efficiency was improved. Average saving in maintenance costs on a 4-year process cycle is approximately 38 000 USD/valve.



Finetrol

2. Heater fuel gas control (V2)

Challenge – Reliability and accuracy is required from heater fuel gas control. It has a direct impact on the process performance and conversion, since the visbreaker feed is heated by fuel gas. A failure in the system may shutdown the whole visbreaker unit. Variations in the fuel composition can have an affect on the heating value.

Metso solution – Finetrol eccentric plug valve for general fuel gas control, RE-series segment valve for high capacity applications and Rotary globe for low capacity applications.

Benefits – Single valve solution due to wide rangeability – no need for split range control. Reliable control and reduced variability improves heater efficiency and visbreaker heater outlet temperature control, which is important in order to provide the optimum cracking temperature for the feed.

3. Soaking pressure control (V3)

Challenge – Pressure control is one important parameter in controlling the visbreaker's severity (degree of cracking). The cracking reaction occurs in the coil soaking section or in the soaker, depending on the visbreaker type. Cracking produces coke which subjects the control valve to high risk of coke build-up and in some cases also erosion.

Solution – Top entry valve. Several options available: self-flushing q-trim to avoid coke particle build-up inside the valve, hard coatings for coke particle erosive applications, scraping seat to avoid coke particles sticking.

Benefits – Reliability for soaking pressure control – reduce risk of coke build-up in gland packing and valve. Ensure valve availability in erosive applications and reduce valve life cycle costs.



T-series

Column applications

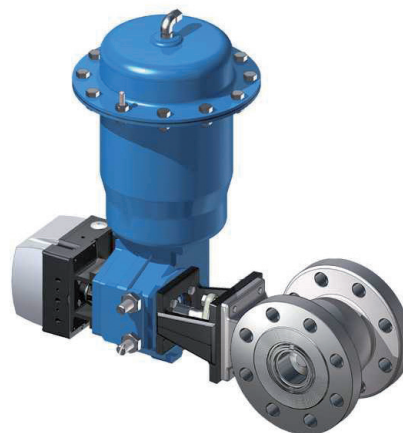
The cracked soaker effluent is quenched with a quenching medium to stop the cracking reaction and sent to visbreaker fractionator for separation. In the fractionator flash zone the liquid portion flows to the bottom of the tower and is steam-stripped to produce the bottoms product. The vapour flows up the tower where it is washed and cleaned with gasoil wash stream. Distillate is stripped in side stripper to produce the gasoil product. The pumparound can be used to reboil gas plant towers, boiler feedwater and steam generation. The overhead vapors are partially condensed and sent to gas plant. In some visbreakers the tower bottoms is sent to a vacuum tower where additional distillate products are recovered. When maximum light distillate conversion or extreme pour point is desired the vacuum gasoil is cracked in a thermal cracker and recycled back to the visbreaker fractionator.

4. Distillation control valves (V4 – 10)

Challenge – Gasoil washing removes entrained residue from the vaporized distillates. Poorly operating flash zone increases entrainment that generates black gasoil and fouls the wash bed. Flash zone operating temperature and pressure define throughput and product rates. The feed to the gasoil stripper is steam-stripped, and then a portion of it mixed with visbreaker bottoms to meet viscosity reduction requirements. Reduced variability in a control loop helps to achieve optimum operating conditions.

Metso solution – Finetrol eccentric plug valve for general control applications, Segment valve for high capacity applications and Neldisc butterfly valve for large sizes.

Benefits – With Metso Automation Finetrol valve the product variability is reduced, this provides optimum product quality and yield with no additional energy requirements. Valve plays a significant role in control loop, especially when high loop performance is targeted. 1% increase of total distillate yield means yearly increased production of about 100 000 bbl in an average size (30 000 bbl/day) visbreaker. Even a part of this increase with better valve performance means more feed that can be converted to more valuable products.



Finetrol

5. Reaction quench (V11) and column bottom (V12)

Challenge – In order to maintain a desired degree of conversion and prevent production of unstable bottoms product, it is necessary to stop the reaction at the heater outlet by quenching. Typically, the temperature of the quenched products in the flash zone will vary between 388 and 427 °C. The most frequently used quenching mediums are gas oil, residue or a combination of both. If residue quenching is used, the control valve will be exposed to a risk of coke buildup due to high temperature and the stability of the bottom product. Gasoil quench might occur in flashing conditions due to total vaporization. Bottom residue control valve will be exposed to a risk of coke buildup.

Metso solution – Finetrol eccentric plug rotary valve for moderate temperature applications (< +425 °C) – flow to close option available for flashing applications. Top entry valve for high temperature applications (> +425 °C). Available as options: self-flushing q-trim to avoid coke particle build-up inside the valve, hard coatings for coke particle erosive applications, scraping seat to avoid coke particles sticking.

Benefits – Reliability to process control – risk of coke build-up in gland packing and valve reduced remarkably. Better control of unit's overall heat and material balance – improves visbreaking productivity. Less maintenance required – reduced life cycle costs.



T-series

6. Column bottom ESD (V13) and on-off valves

Challenge – These valves must be able to perform their action in a process upset situation. The most part of the time these valves are either open or closed. The risks are related to the nature of the fluid at the column bottom, there is a risk of coke formation, erosion and valve sticking. Extreme reliability is required. In case of failure with these valves, there is a risk of shutdown the entire process. These valves are important also for the safety of the people operating the plant.

Metso solution – Seat supported X-series ball valves for demanding low pressure service; trunnion mounted D-series ball valves for high pressure service. As an option, ValveGuard for ESD-service and SwitchGuard for on/off service.

Benefits – Our metal seated, fire tested rotary valves are ideal for sticky and coking fluids in the visbreaking column bottoms. On-line testing and performance monitoring provides visibility to valve performance and reliability to process control. Thus plant up-time can be maximized and process safety risks reduced with simple and compact solution.



ESD-valve with ValveGuard ensuring customer process safety

Optimize your plant safety and visbreaking performance, reduce energy and maintenance costs and produce top-class products with our intelligent rotary control, on-off and ESD-valves.

The information provided in this bulletin is advisory in nature, and is intended as a guideline only.
For specific circumstances and more detailed information, please consult with your local automation expert at Metso.

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