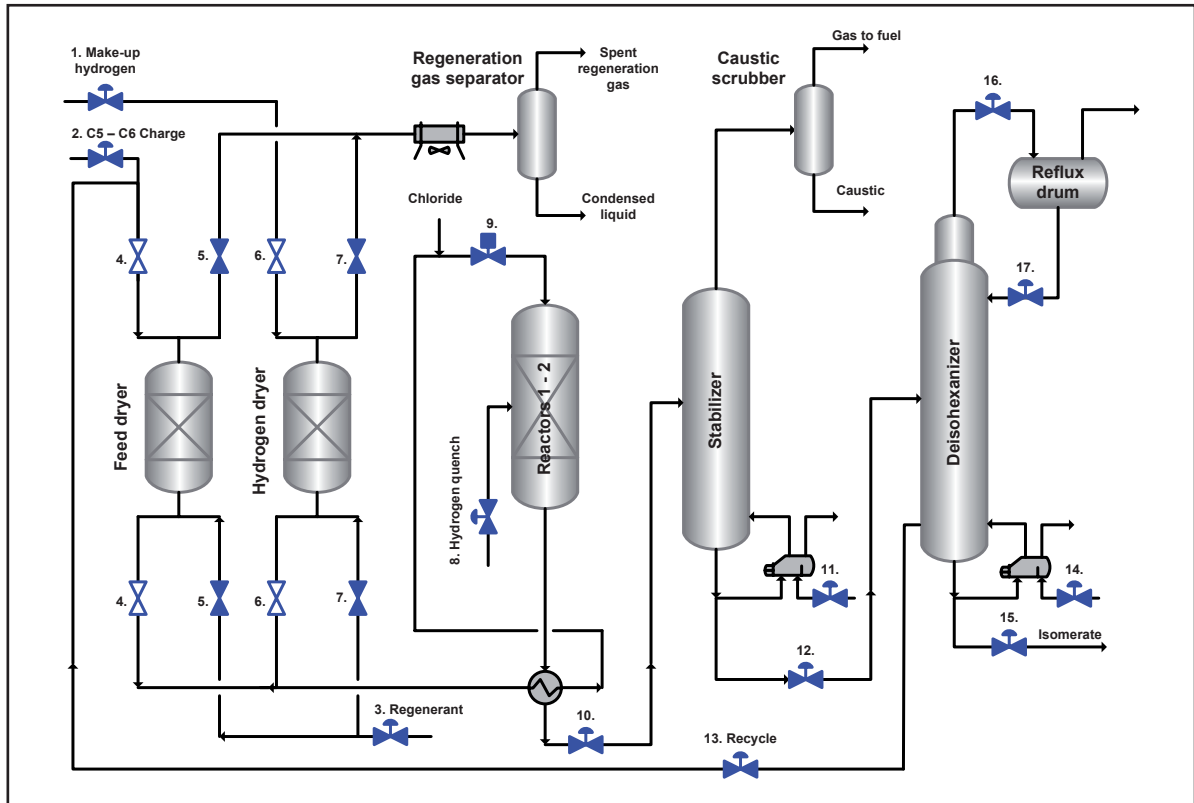


Isomerization – reactors



Process overview

The octane numbers of the light straight run naphta can be improved by the use of an isomerization process to convert normal paraffins to their isomers. In once-through isomerization the naphta octane number can be increased from 70 to about 82. If the normal components are recycled, such as in the picture above, the resulting octane numbers will be about 87 to 93.

Reaction temperatures of about 95 to 205 °C are preferred to higher temperatures to enhance the conversion to isomers. A very active catalyst is required to provide reasonable reaction rate. Some types of

catalysts require the continuous addition of very small amounts of organic chlorides to maintain high catalyst activities. This is converted to hydrogen chloride (HCl) in the reactor, and therefore the feed must be free of water and other oxygen sources to avoid catalyst deactivation and potential corrosion problems. Feed dryers filled with molecular sieves are used to remove water and protect the catalyst. Catalyst life is usually 3 years or more with all of these catalysts. An atmosphere of hydrogen is used to minimize carbon deposits on the catalyst and control reactor bed temperature. The stabilizer bottoms can be separated into normal and isoparaffin components by fractionation (deisohexanizer) or molecular-sieve separation to recycle the normal paraffins.

Isomerization challenges

The optimal performance of an isomerization unit is achieved when reactor temperatures are adjusted for favourable reaction rates and equilibrium, while meeting product specifications and minimizing recycles to allow for maximum throughput. The gas and liquid driers perform the important task of safeguarding the catalyst from water vapour and other impurities in the make-up hydrogen and hydrocarbon feed.

Health, Safety, Environment – Valve leaking poses both an environmental and safety issue due to risk of fire and toxicity of volatile gases. Emergency shutdown 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. Poor control valve performance reduces the accuracy of throughput control and adversely affects to the plant performance and also the downstream processes. The switching valves performance is critical for optimum dryer operation and therefore the whole process success.

Maintenance costs – Poorly performing valves in the process must be serviced because they will have a direct impact on the efficiency of the process. High sequencing valves in the driers are particularly critical. 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.

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 isomerization plants.

Safety – Metso is the only single source emergency shutdown valve supplier who has the experience and knowledge to combine intelligence with most reliable valves and actuators. Technology selections like rotary stem operation and inherently fire safe design ensure that latest emission and fire safety standards can be applied. Reliable valves with first intelligent, SIL3 approved safety valve controller and partial stroke testing system Neles ValvGuard will ensure that plant emergency shutdown 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 intelligent 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. The proven performance of Metso valves with long lasting metal seat tightness and shut-off capabilities makes them an ideal solution for control, on-off and switching applications.

Reliability – Valve performance trend data collected by our smart valve controllers and analysed by Neles FieldCare, open FDT/DTM technology based configuration and condition monitoring software, 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.



Reactor applications

After mixing with makeup hydrogen, the feed is heat-exchanged against reactor effluent. It then enters a charge heater (or heat exchanger) before entering the reactors. Two reactors normally operate in series. The reactor effluent is cooled before entering the stabilizer.

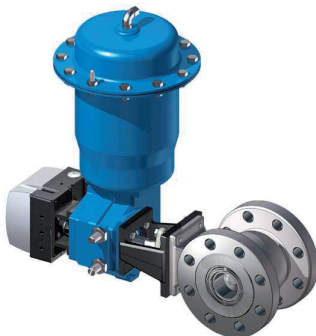
Control of an isomerization process is based on a known relationship between the octane number and temperature of a reaction at equilibrium using a specific catalyst. Control of an isomerization process is accomplished to substantially maximize the efficiency of the process both from a production standpoint and from an energy usage standpoint by maintaining the isomerization reaction at desired equilibrium conditions. Energy efficiency is improved by substantially minimizing the amount of heating fluid utilized to pre-heat the feed to the isomerization process.

Reactor hydrogen quench valve (8)

Challenge – Hydrogen quench is used to control the reactor temperature and to protect the catalyst beds from excessive coke buildup. The cold hydrogen quenches injected between the catalyst beds in the reactor are controlled to obtain equal bed outlet temperatures at lowest average bed temperature. This minimizes the catalyst deactivation rate and maximizes the yield of desired gasoline isomerate components. The flow control minimizes disturbances to the bed inlet temperature originating in the hydrogen system hydraulic balance. Transparency to valve performance is highly desirable in this application.

Metso solution – Intelligent Finetrol eccentric plug valve.

Benefits – Economic benefits will be achieved by optimizing the hydrogen usage. This can be achieved by reducing the hydrogen quench variability that ensures equal temperatures at catalyst beds. This gives potential to improve the process economics even further. More efficient catalysts may be used since more active catalysts require control system that will respond faster with less process variable dead band. Therefore the production can be increased. Process safety and reli-



Finetrol

ability can be improved with ND9000 intelligent valve controller that provides full transparency to valve performance. Wide rangeability with rotary valves ensures that hydrogen flow can be increased as need arises during the run period with single valve solution.

Reactor inlet shutoff (9)

Challenge – This safety valve is needed in order to isolate and protect the reactors and the catalyst in a case of a process upset. The ESD valves are normally open and they are expected to be available and function reliably throughout the process runs when needed.

Metso solution – Trunnion mounted ball valve with ValvGuard intelligent safety valve controller.

Benefits - Neles metal seated trunnion mounted ball valve is ideal for demanding applications such as isomerization reactor shut-off under medium and high pressures. With Neles ValvGuard partial stroke testing the emergency shutdown valves are automatically tested and diagnosed for their operability while the plant is in operation. The testing secures that target SIL can be maintained and that the system can respond to true demand. This improves the plant safety in a cost effective way. Any drop in valve performance is detected without interrupting production. High torque piston type actuator is designed to overcome static friction.



Neles ESD valve

APPLICATION REPORT

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



Neles intelligent valve controllers



Visibility to switching applications



Intelligent safety

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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