

The diagram illustrates a complex industrial process for reformate splitting. The main components and flow are as follows:

- Reformer effluent** enters the **Reformate splitter** (a vertical column with multiple trays).
- From the top of the splitter, the stream goes to a **Condenser**, then to a **Reflux drum**, and back to the splitter via **Reflux control**.
- From the bottom of the splitter, the stream goes to a **Reboiler furnace** (a furnace with a coil), then to a **Heavy aromatics column**.
- The **Heavy aromatics column** has two outputs: **Heavy aromatics** at the bottom and a stream that goes to **PX extraction valves**.
- The **PX extraction valves** feed into a **PX extraction** column, which produces **para-Xylene** at the bottom.
- The top product from the PX extraction column goes to a **Furnace** (a furnace with a coil).
- From the furnace, the stream goes to **Fuel gas valves**, which produce **Fuel gas**.
- The stream from the furnace also goes to an **Isomerization** column, which produces **Toluene** at the top.
- The bottom product from the isomerization column goes to a **Deheptanizer** column, which produces **Heavy aromatics** at the bottom.
- The top product from the deheptanizer column goes to a **Toluene fractionation** column, which produces **Toluene** at the top.
- The bottom product from the toluene fractionation column goes to a **Benzene fractionation** column, which produces **Benzene** at the top.
- The bottom product from the benzene fractionation column goes to an **Aromatics extraction** column, which produces **Raffinate** at the top.
- The bottom product from the aromatics extraction column goes back to the **Reboiler furnace**.

This diagram is intended to be a representation and should not be viewed as an actual process flow diagram.

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Process applications

As an aromatics complex can have very different configurations, a large variety exists in the valve applications as well. Most complexes have separate benzene and toluene extraction (BT extraction) and para-xylene (PX extraction) sections. As there are two common methods for PX extraction, the types of valve applications vary accordingly. An isomerization section is also present following the PX extraction section.

Common challenges faced by valves in an aromatics complex are caused by the nature of the fluids (toluene, p-xylene). The dry characteristic of the fluid results in high friction which has to be taken into consideration during valve design. Due to the toxicity of media handled in the complex, emissions also need to be strictly controlled.

p-Xylene separation control valves

When the heavier aromatics fraction exits the reformate splitter, it enters the p-xylene separation section. Here the composition is high in para-xylene content and may also contain suspended solids. There are various valves present permitting flow of the medium further.

The flow medium is dry and non-lubricative causing a high amount of friction. This requires appropriate construction and material selection for the valve so that it endures this friction and wearing of seating surfaces is avoided. Emission control is also a concern.

Neles™ solution for p-xylene separation control

Neles V-port segment valves with a cylinder actuator and an intelligent valve controller provide a reliable, long-lasting construction for the task.

- **Best possible rangeability**, ensuring that the same valve can be used for during low and full capacity conditions
- **Hard coatings available** which enable the valve to operate with minimal wear in the presence of dry p-xylene
- **Reduced fugitive emissions by design**, as the valve utilizes rotary operation which is inherently less prone to leaks
- **No potential leak paths** even if subjected to pipe bending forces, as the valve features a one piece body construction

Benzene and toluene extraction valves

The lighter aromatic fraction is sent to the benzene and toluene extraction (BT extraction) section. In this section, multiple columns are used to extract benzene and toluene by extractive distillation or liquid-liquid extraction. Valves are used to control the flow of extract and raffinate in the section.

Valves have to withstand half or full vacuum conditions. Emission control is also a concern due to toxicity of the flow medium.

Neles solution for BT extraction

Neles triple eccentric butterfly valves with spring diaphragm actuators and intelligent valve controllers offer an optimal solution for BT extraction control.

- **Triple eccentric design**, reducing wear and producing tight shut-off
- **Robust design with extended service life** due to heavy-duty stem and bearings
- **Emission control** with live-loaded steam seal, certified acc. to ISO 15848, TA-Luft/VDI 2440
- **Rugged single piece body** eliminating potential leak paths
- **Economical** as the weight is approximately 20% of a ball valve of the same size, reducing material and piping costs
- **Fire-tested** acc. to API 607 (6th ed.) and BS 6755 part 2



Neles triple eccentric butterfly valve

Fuel gas valves

In an aromatics complex, several columns are used for separating product. These columns have reboilers which are heated by fuel gas or fuel oil. In addition, a dedicated heater is often present for pre-heating the feed that is entering the isomerization reactor.

It is imperative that the safety (ESD) valves operate properly even after extended periods of non-operation. For both shut-off and safety valves, high temperature compatibility and fire safe design are typical valve requirements. Type approvals may also be required.

Neles solution for fuel gas valves

For safety valves, **Jamesbury™ soft-seated ball valves** with a B1-series piston actuator and a ValvGuard™ safety solenoid to ensure operability in case of an upset.

For burner shut-off valves, **Jamesbury ball valves** with a Valv-Powr™ VPVL actuator provide excellent tightness during shut-off.

- **Field proven Xtreme™ seat & Lip-Seal™ capabilities** in both continuous and on/off (switching) heating
- **Safe and reliable bubble tight shut-off** even after a million cycles and the self-relieving feature (cavity relief) provides safe operation after a long time of non-movement
- **Partial stroke testing capability** for safety-valves with the VG9000 safety solenoid
- **Fire-safe design** acc. to API 607 or ISO 10497
- **Low fugitive emission approvals** by third party authorities
- **Certified up to SIL 3** by third parties
- **Gas burner valve type approvals** acc. to EN161, EN264, ISO 23553-1, AGA, FM and CSA



Jamesbury ball valve

Crystallization valves

Crystallization is one of the two common methods used for p-xylene separation. Since p-xylene has the highest freezing point, a refrigeration system is used to crystallize the mixture and separate p-xylene from the other components. This section usually consists of several stages with valves controlling the flow of material between the stages.

High p-xylene crystal solids content, particularly in the later stages, causes the dry p-xylene to stick to surfaces and increases friction causing wear to the valve. This requires a wear-resistant valve. As the temperature is cooled during crystallization, valves have to be designed to withstand temperatures as low as -100 °C (210 °F).

Neles solution for crystallization valves

Neles metal-seated ball valves with a spring diaphragm actuator provide an excellent solution for crystallization control valves.

- **A variety of hard coating available** ensuring a long lasting valve even when subject to high solids content
- **Low temperature compatible** as bellows seat allows cryogenic operation at temperatures as low as -200 °C (-330 °F)
- **Thermal transient resistant**, due to the body and ball being constructed of A351 CF8M, ensuring the longest possible life and seat to ball tightness
- **Emission proofing**, as live loaded packings are available as standard



Neles trunnion-mounted ball valve

Simulated moving bed on/off valves

In complexes where simulated moving bed (SMB) chromatography is used for para-xylene extraction, there is a high number of on/off valves serving as inlets and outlets to the adsorbent columns. These are switched on/off sequentially, simulating the movement of the inlets and outlets along the length of the adsorbent columns.

These valves must be quick to operate and have to achieve a linear characteristic during operation. They must also be compatible with a high frequency cycling service.

Neles solution for SMB on/off

Neles metal-seated ball valves with a special high-cycle spring diaphragm actuator and an intelligent on/off valve controller SwitchGuard™ provide a field proven solution for switching applications.

- **Field proven switching capabilities** in various applications including drying, polyolefin and industrial gas applications
- **Durable two-way tightness** acc. to ISO 5208 Rate C or ANSI Class V as standard with spring-loaded metal seats
- **Emission control** with V-ring gland packing and rotary design which is inherently less prone to leaks
- **Quick response and high cycle compatibility** enabled by special high cycle actuator design
- **Opening and closing profile configuration** possible with SwitchGuard



Neles ball valve with SwitchGuard

Simulated moving bed control valves

In addition to the switching on/off valves, there are also critical control valves which adjust the flow of feed and desorbent to the columns and the flow of material between columns.

These are required to enable very precise control and must be adjustable from fully closed to fully open (or vice versa) in a short period of time. Combined with a large amount of reversals, this presents a challenging valve application. Cavitation and noise may also be a concern.

Neles solution for SMB control

Neles V-port segment valves with a spring-diaphragm actuator and an ND-series valve controller provide an optimal solution.

- **Resistant to friction damage** due to special chrome carbide coating on segment and seat surface
- **Noise/cavitation abatement** trim available
- **Accurate and good control performance** as the valve design allows clearance-free movement for the V-ported segment
- **Application compliance verified** by major 3rd party process technology licensor

As an alternative for smaller valve sizes, **Neles Finetrol™ eccentric rotary plug valves** with a spring-diaphragm rotary actuator and an ND-series intelligent valve controller.

- **Accurate control** as the plug shape is engineered to offer a constant gain
- **No plug and seat contact when controlling** meaning that there is no seat friction allowing the valve to last long even in presence of p-xylene
- **Noise attenuation and cavitation abatement** with the patented Q-Trim™



Neles segment valve

Benefits

- Reduced process variability, ensuring product yield and productivity targets are attained
- Meet noise, emission and fire safety regulations set by local authorities
- Save piping and valve costs with compact and lightweight valve solutions
- Reduce maintenance costs with long lasting valve designs and diagnostic information provided by intelligent valve controllers
- Meet process run-time targets

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