Styrene-butadiene rubber

Process overview
Styrene-butadiene rubber (SBR) is the most commonly produced synthetic rubber and it is mostly used for the manufacture of tires and to substitute natural rubbers.

There are two different process types utilized for SBR production: emulsion polymerization and solution polymerization. In emulsion polymerization, the monomers polymerize in the presence of an emulsifier (fatty acid or rosin acid soap) while in solution polymerization a solvent (n-hexane or cyclopentane) is utilized.

Solution polymerization processes utilize a catalyst to initiate the reaction while emulsion processes utilize an initiator agent. The polymerization is terminated by adding chain terminators/shortstop agent to the reactor effluent to allow chain length to be controlled.

Unreacted butadiene and styrene is then recovered in a flash tank and/or a stripping column. The polymer slurry is then sent to the finishing section for blending to make the product meet the required specifications.
Process applications
In synthetic rubber plants, valves face challenges in the form of high temperatures and sticky particles with a tendency to accumulate. To ensure stable throughput, it is critical that valves are suitably designed and chosen for the applications to prevent unexpected shutdowns due to sticking valves.

Monomer feed control valves
The monomer feed control valves are used to control the amount of butadiene and styrene that is admitted into the process.
Accurate control is required, especially in continuous solution processes where the monomer ratio is tuned so that the monomers are practically depleted in the polymerization reactions. Additionally, butadiene and styrene may cause swelling in some polymeric packing materials such as PTFE.

Metso solution for monomer feed
Neles cage guided globe valves with diaphragm actuators provide reliability for monomer feed control.
- Minimize process deviations due to accurate performance of ND controller and actuator
- Eliminate swelling problems with graphite packings available as an option
- Risk of valve sticking minimized due to expanded vent space
- Fugitive emission certified according to ISO15848-1

Reactor feed shut-off valves
Polymerization reactions are exothermic, i.e. they release heat, which means that safety systems are needed to prevent runaway situations from occurring. To prevent additional heat from being generated in the reactors, the feed supply must be quickly isolated in case of a process upset.
These valves are normally open and operated seldom, but must work when needed. Quick and tight-shut off is required. Emissions also need to be minimized.

Metso solution for reactor feed shut-off
Metso trunnion mounted ball valves with a ValvGuard intelligent safety solenoid offers an efficient and reliable solution for reactor feed shut-off.
- Valve and solenoid tests, such as partial stroke testing and emergency trip tests
- Quick operation without additional accessories due to high pneumatics capacity of the intelligent safety solenoid
- Tight shut-off
- PFD/SIL calculations with field proven reliability figures for complete unit
- Single source responsibility for valve, actuator and safety solenoid
- Certified for up to SIL3 environments by 3rd party authorities

Neles globe valve
Neles metal-seated ball valve
Polymer slurry control valves
Depending on the exact process type (batch or continuous, emulsion or solution), the number of reactors can vary between one and four reactors. These reactors have control valves for adjusting the outflow from the reactors.

This slurry can have a very high polymer content of around 45 to 60 wt. %. Polymer build-up may also occur in the valve if there are cavities in which particles can accumulate. Possible catalyst traces combined with the high polymer content also means that erosion is of concern.

Metso solution for polymer slurry
Neles rotary V-port segment valves provide the optimal solution for polymer slurry control.

Metso Neles balanced cage guided globe valve with a VD spring diaphragm actuator and an ND valve controller is well suited for the application if there is limited variety in the type of fuel used and good rangeability is required

- **Adequate abrasion resistance** ensured with the availability of various hard coatings
- **Build-up resistance** due to rotary operation which scrapes possible build-up away from the seat when the valve opening is adjusted
- **Plugging resistant** even at small openings due to the shape the V-ported opening
- **Economical** – Low torque requirements reduce wear and reduces actuator size, increasing reliability and reducing costs

High cycle slurry on-off valves
Some styrene-butadiene rubber production processes utilize around ten isolation valves in the finishing section which are frequently operated.

Challenges include possible growth of polymer in cavities and grooves on the seat and bearings. Polymer content in the medium may also erode the valve. The high cycling amount causes a high amount of wear to the valve and actuator.

Metso solution for high cycle slurry on-off
Metso metal-seated rotary ball valves have been extensively used in high cycle polymerization applications.

- **Metso polymer proof metal seat**, preventing polymer from penetrating behind the seat and seizing the valve
- **Polymer build-up prevention** by having continuous contact between the seat and the ball effectively wiping the seat surfaces with every cycle
- **Special wear-resistant piston rod seal** and lever arm bearings in the actuator to deliver over two million cycles without maintenance
- **Tested and field proven** in polymerization applications with annual cycle amounts exceeding one million cycles

**Benefits**
- Improved process control, increasing product yield and profit
- Prevent unexpected shutdowns due to seizing valves with designs that prevent polymer build-up
- Lasting valve designs, even under high cycle service, reducing maintenance costs
- Rotary designs and emission certified valves minimize fugitive emissions
- Extensive portfolio of safety valves and equipment with 3rd party compliance certifications ensure plant 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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