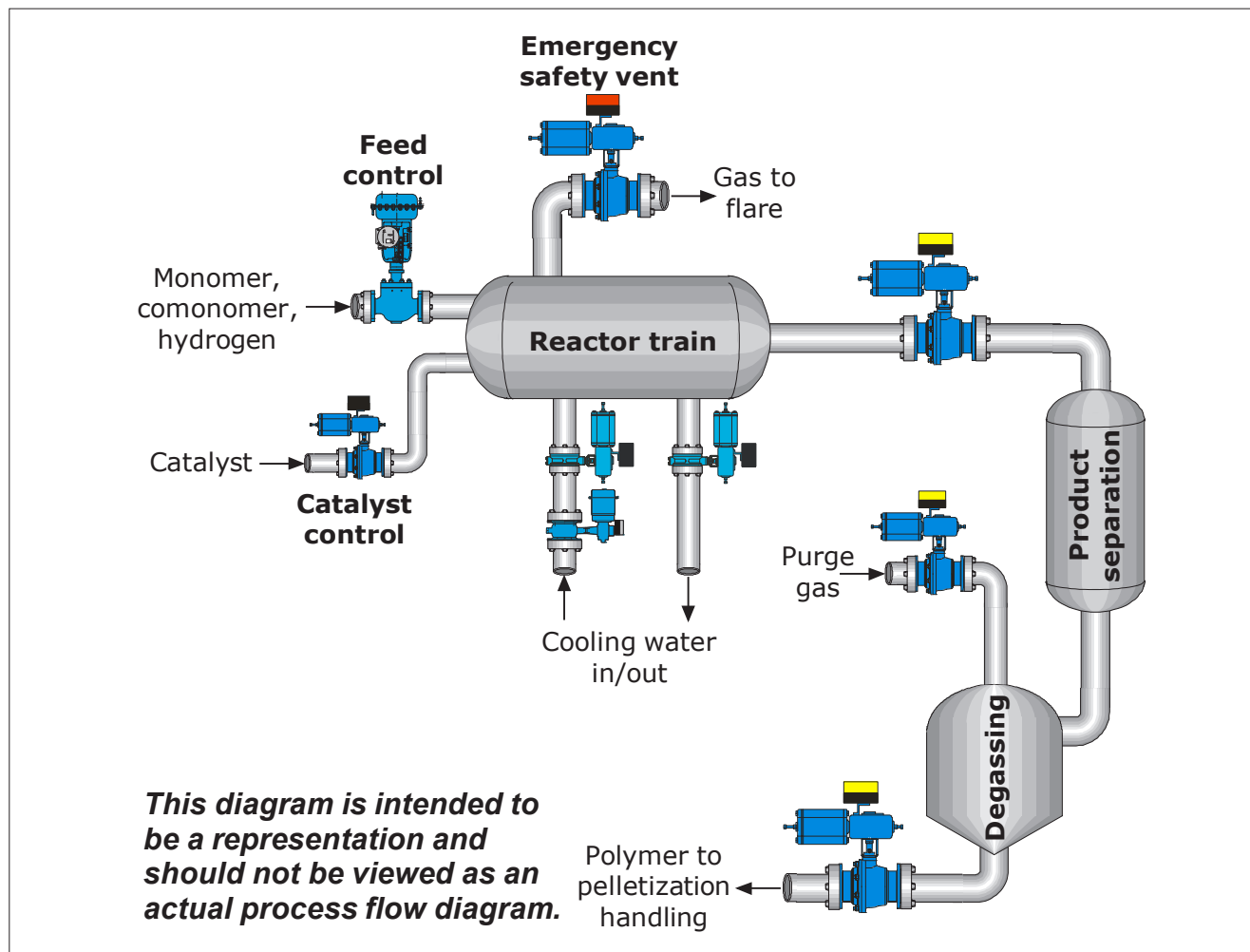


Polymerization – Control and on/off valves



Process overview

Polymerization is used to produce polymers from monomers, such as ethylene and propylene. Catalysed by proprietary catalysts, the monomers react to produce polymers. Comonomers are commonly used to alter the properties of the produced polymer and the length of polymer chains is controlled by the amount of hydrogen admitted to the process.

Since polymerization is an exothermic reaction, it is necessary to provide cooling for the reactor train. Depending on the type of reactor, this may be achieved by circulating water in a jacket that is on the outside of the

reactor or in the case of gas-phase reactors by cooling the gas that circulates the reactor loop.

After the reactor train, the polymer powder enters the product separation section where unreacted monomer and left-over catalyst are recovered. This is followed by degassing, where possible adsorbed hydrocarbons are removed and trace catalyst deactivated.

After unreacted monomer and left-over catalyst has been recovered, the product is admitted to the pelletization and additive section where final adjustments to polymer properties are made before the product is sent to storage.

Process applications

In a polymerization process, there are valves controlling the feed of raw materials and cooling water. In addition, most polymerization processes utilize catalysis, and a valve is required for effective catalyst feed control. In addition, there are isolation valves present isolating the reactor or the cooler from the cooling water. Finally, emergency safety vents (ESVs) are present.

Feed control valves

The feed control valves are used to control the inlet of monomer, comonomer and hydrogen into the reaction cycle.

Good control and rangeability is required so that the properties of the resulting polymer can be properly adjusted. In the case of hydrogen, accurate control is even more process-critical since too low amounts hinder polymerization while excess amounts may hinder catalyst activity. The amount of hydrogen also affects the polymer chain length making accuracy critical for achieving desired product specifications.

Neles™ solutions for feed control

For the monomer and comonomer feed, **Neles V-port segment valves** with spring-diaphragm actuators are economical and accurate high performance quarter-turn valves.

- **Accurate control** – Steady and gentle contact between the seat and the V-ported segment minimizes friction, lowers torque requirements, and results in clearance-free movement
- **One-piece body construction**, meaning no potential leak paths within the valve even if subjected to pipe bending forces
- **Low fugitive emissions**, due to rotary operation which eliminates packing leakage
- **Produce a variety of polymer grades**, due to the wide rangeability of the valve



ND valve controller

Neles cage guided, balanced trim globe valve with a diaphragm actuator is the optimal solution for hydrogen control.

- **Best possible control accuracy**, ensuring that the hydrogen concentration can be held at just the right amount
- **Rugged one-piece body structure** to minimize the leak paths and make the valve insensitive to pipe stress
- **Wide rangeability**, allowing process parameters to be adjusted with a single valve
- **Long lasting accuracy and reliability**, achieved by using multiple springs and a rolling diaphragm in the actuator

For optimal performance, feed control valves equipped with the top-class **intelligent ND valve controller** ensures high quality products in all operating conditions with unique diagnostics and incomparable performance features.

- **Top class control accuracy**, enabling better control loop performance saving raw materials and energy and improving end product quality
- **Fast response time**, allowing quick flow adjustments with control signals
- **Linear flow characteristics**, ensuring a steady non-fluctuating feed of raw materials
- **Diagnostic features**, reducing plant downtime and cutting maintenance costs
- **Simplified installation** by installing different mechanical or inductive proximity switches inside the ND housing
- **Install to any common control system**, due to its low power consumption
- **Cold service compatible** version available, operating at temperatures as low as -53°C (-64°F)



Neles globe valve

Cooling water valves

As polymerization is an exothermic process, sufficient cooling is necessary to ensure smooth operation. Two valves are needed to isolate the cooler inlet and outlet flows. In addition, one valve is used to control the cooling water flow. Since the process parameters may be adjusted to produce a different type of polymer, the flow of cooling water also needs to be adjustable to cope with the changes. Depending on the source of the water, it may also have impurities.

Neles solutions for cooling water

For cooling water control, **Neles V-port segment valve** with a spring-diaphragm actuator is an economical and uniquely durable design well suited for the application.

- **Economical** – Low torque requirements reduce wear and reduces actuator size, resulting in better reliability and a lower cost unit
- **Wide rangeability**, allowing the amount of cooling water to be adjusted according to changes in process parameters
- **Excellent efficiency**, due to low-friction operation provided by the actuator bearings allowing virtually all of the available torque to be delivered directly to the output shaft
- **Wide range operating pressure**, as the actuator is capable of operating reliably from 1.3 bar (20 psi) up to 7 bar (100 psi)



Neles V-port segment valve

In high-pressure polymerization processes utilizing tubular reactors, cooling is usually achieved via water tanks that provide cooling water. These tanks are filled with cooling water via dozens of manual valves that are prone to flashing. For this application, **Neles Finetrol™ eccentric rotary plug valves** with reverse flow direction have been proven to perform reliably in reactor cooling.

- **Flashing damage resistant**, due to rotary plug design with reverse flow direction
- **Erosion resistant**, due to stainless steel body and tight graphite back seal
- **Insensitive to impurities**, due to robust design
- **Compact size**, easing the allocation of space for the valve in the piping design
- **Insensitive to pipe stress**, due to rugged one-piece body construction
- **Cost saving** – Minimal wear and savings from not needing an orifice plate make it a very economical valve



Neles Finetrol eccentric rotary plug valve

Catalyst feed valves

Catalyst is used in all polymerization process types except for high-pressure processes. The catalyst feed valves isolate the catalyst and possible cocatalyst chamber from the reactor. Periodic catalyst addition ensures that the polymerization occurs at a controlled rate without extreme heat generation.

It is crucial that the valves are able to withstand the abrasive nature modern catalysts. In case pyrophoric catalysts, such as triethylaluminium (TEAL), are being used, the valve needs to have a tight shaft seal to prevent catalyst from escaping via the shaft, resulting in combustion due to exposure to air.

Neles solutions for catalyst feed

Neles metal-seated ball valves, incorporating a robust stem to ball connection, with pneumatic cylinder actuators and Axiom™ on/off valve monitor are an excellent fit for this application.

- **Anti-abrasive feature**, making it the perfect choice for the harder more abrasive catalyst types
- **Heavy duty valve design**, capable of withstanding the pressure differences and piping forces in the process
- **Tight shut-off**, making it the perfect choice for pyrophoric catalysts
- **Arctic service compatibility** – in case of extreme temperature conditions, the actuator can be designed to make it applicable in temperatures as low as -55 °C (-67 °F)
- **Reduced downtime and maintenance**, with the diagnostics system offered by the Axiom valve monitor



Neles ball valve with Axiom

Gas to flare (ESV) valve

The gas to flare (ESV) valve provides the possibility to relieve pressure from the reactor in case a plant malfunction or unplanned over-pressurizing occurs. Redundant ESV valves may be present to ensure operation in case of failure. It is imperative that these valves work even after longer periods of non-operation.

Neles solutions for ESV

Neles trunnion-mounted metal-seated ball valve equipped with a cylinder actuator, and an intelligent safety solenoid ValvGuard™ (VG9000) provides a reliable and safe package.

- **Long life time**, due to robust design
- **Anti-blowout valve shaft**, ensuring the safety of personnel and equipment
- **Fire assured operation** possibility for both the valve and the actuator
- **Partial stroke test**, which can be performed by the VG9000 either automatically or manually to ensure that the valve is working properly
- **Compliance up to SIL 3** by third party certifications
- **HART & FOUNDATION fieldbus** communication compatibility
- **Advanced diagnostics** capability of the VG9000, increasing safety and allowing plant safety targets to be reached more economically



Neles ball valve with ValvGuard

Benefits

- High pressure gases vented safely to flare
- Reliable and adjustable cooling
- Accurate feed flow
- Better utilization of raw materials
- Feed flow rangeability allows different types of polymers to be produced
- Possibility to produce enhanced quality polymers that require new types of catalysts and metal seated valves
- Reduce down-time with diagnostics of intelligent valve controllers

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