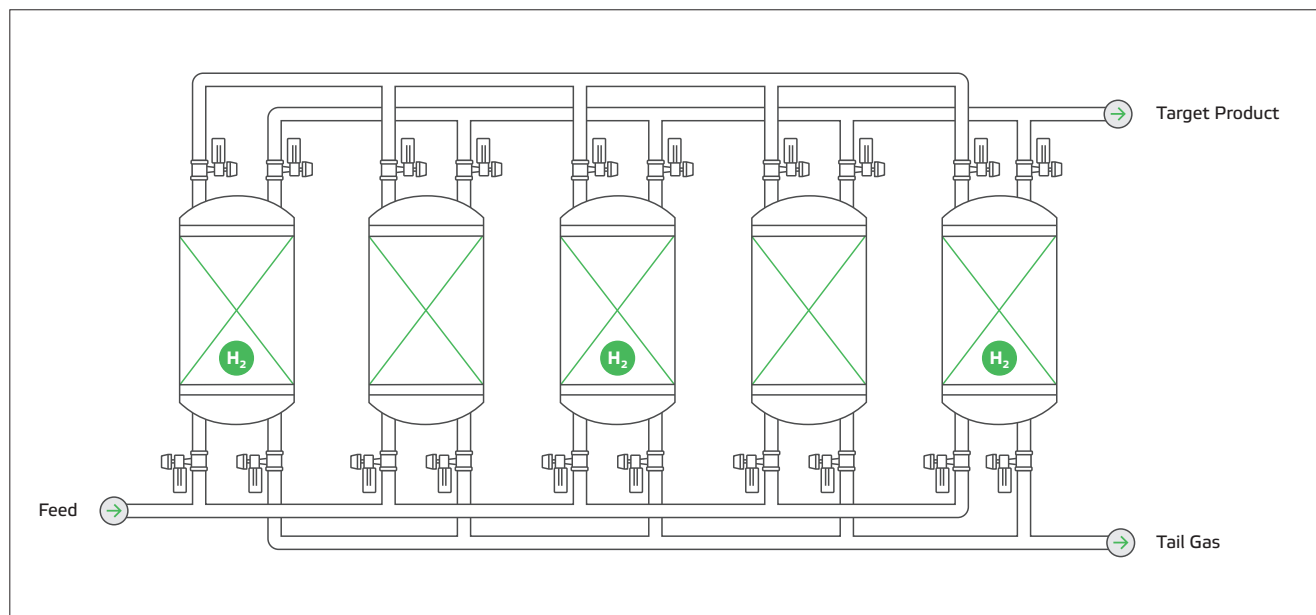


## Swing adsorption



### Process overview

Swing adsorption technologies are used to separate or clean a feed gas of impurities. These units are often found within refineries or in larger manufacturing complexes with the purpose of supplying a target gas (hydrogen, oxygen, nitrogen, etc.). With today's changing global climate, these units are also being used to capture the carbon from some of the plants' primary processes.

There are three recognized typical swing adsorption processes; Pressure Swing Adsorption (PSA); Vacuum Swing Adsorption (VSA); and Temperature Swing Adsorption (TSA). Each process has its own pros and cons, but factors like energy consumption, regeneration ability and target gas production typically determine which technology is used. These processes utilize a catalyst often referred to as a "zeolite" to target the impurities in the feed gas. The catalysts sit within a tank or "bed" in the process and are subjected to a feed gas. As the gas passes through the tank, the catalyst grabs the stream's impurities and allows the target gas to pass through the system. Over time, the catalyst becomes "saturated" and will no longer accept

additional impurities from the feed. Depending on the type of process, certain actions will be taken to allow the catalyst to "regenerate" and the process to continue. These units are normally classified by the number of "beds" being used to switch between the adsorption and regeneration steps.

**PSA** units begin with a higher pressure – typically 400 - 550 PSI – and pass the feed gas through the tank. Once the process is saturated, the pressure will be forced to "swing" to a lower pressure, which allows the catalyst to regenerate. These valves are often 300#-600# pressure classes.

**VSA** units start with a much lower pressure than PSA units. To regenerate the catalyst material, this process utilizes a vacuum to swing to even lower pressures. These valves are often 150# pressure class but see more frequent cycling (potentially over 1 million per year).

**TSA** units use a combination of pressure and temperature swings. The pressures vary between 300# and 600# pressure classes but also rely on the variance in temperature changes to assist in regenerating the catalyst.

## Pressure swing adsorption assemblies

### Challenges

**Pressure swinging** – When the pressure swings from high to low or low to high, the valve shaft may start to experience excess wear and stresses. Premature failures can occur if the construction and design do not take the pressure variance into account.

**Quick operating and life cycle** – PSA units normally cycle at speeds of two seconds or less and may experience hundreds of thousands of cycles before their next scheduled maintenance.

**Controllability of the assembly** – The process often requires fine-tuning and control of the complete assembly to accurately swap between the adsorption and regeneration stages. In some cases, different step responses and slower operating speeds are required.

**Material selection** – The feed gas may contain trace amounts of H<sub>2</sub>S and may be corrosive to specific materials. Sulfide cracking and stress can become a major concern.

**Tight sealing** – Emission standards are becoming stricter and often require longevity in the allowable leakage ratings. The valve is also required to maintain its sealing capabilities to extend the period between maintenance in an attempt to prevent emergency shutdowns.

### Solutions

Shaft material upgrades from the standard 17-4PH to Inconel 718 are available, but will be depend on process pressures. Special shaft to disc designs are also available to further extend the valve's internal life expectancy.



High-cycle constructions for both the valve and actuator are offered as a standard for PSA units. Our predefined constructions provide the necessary bearing and soft goods to meet the required life cycle for our Jamesbury 800-series butterfly valves. Our high-cycle Neles B-series actuators also come equipped with the correct bearing material and design to withstand millions of cycles as standard.

Our high-cycle 800-series Jamesbury Wafer-Sphere valves can be used in both on/off and control applications. The butterfly design provides high capacity flow and allows the fine-tuning of the assembly. We offer the complete package, which includes the 800-series butterfly valve with our Neles B-series actuator and smart controller Neles NDX 2.0. The NDX also comes equipped with onboard PSA specific settings for further control adjustments.



To combat H<sub>2</sub>S in the feed, our standard material offering complies with NACE MR0103. In special cases where the feed gas may present concerns with the material of construction, further review and upgrading is available to combat the problems.

Our Jamesbury 800-series valves are bi-directional bubble-tight and comply with ISO emission standards.

## Vacuum swing adsorption assemblies

### Challenges

**Cycle frequency** – These units can often cycle up to a million times per year. To achieve this speed and cycles, the assemblies may be required to move in less than one second, causing a considerable amount of vibration and extra stress.

**Vacuum conditions** – When pulling a vacuum across the system, the valve must maintain its capability to provide a tight seal in both seat leakage and emissions.

**Larger diameter valves** – This process normally ranges from 3" – 24" but has been known to require larger sizes in special cases.

**Special cleaning** – VSAs are often used to separate oxygen from a feed stream. When subjected to oxygen-related services, special cleaning precautions and proceeds are needed to prevent contamination.

## Solutions

The vibrations can be found to affect the entire assembly. The weaker points have been identified to apply to the mechanical connections or linkages between components. For our valve to actuator connection, we offer our high-cycle no-play linkages with upgraded materials to withstand the constant vibrations. In addition, the Neles NDX 2.0 comes with a contactless sensor as standard, which provides the same control, minus the physical components to wear out. Outside the upgraded linkage kit designs, the valve assembly is identical to the PSA's.

Our standard high-cycle construction is capable of maintaining the bi-directional sealing and ISO emission ratings when a vacuum is applied.

In the larger diameter units, our typical range is 3" – 24" but is available up to 36" on request.

We offer top-of-the-line cleaning rooms and have the appropriate cleaning procedures in place to handle the special requirements for oxygen service valves.

## Temperature swing adsorption assemblies

### Challenges

**Thermal stress** – The temperature variance may not be suitable for all types of standard materials.

**Material compatibility** – TSAs are often used to separate CO<sub>2</sub> from feed streams. In some cases, CO<sub>2</sub> may be corrosive and require specific attention in material selection.

**Controllability** – With the temperature and pressure swings, the valve assembly must be able to maintain fine-tuned control throughout the process.

### NOTE:

Butterfly valves are often the main valve of choice for these applications. However, for special designed units, ball valves are known to be a great valve alternative. When ball valves are used, the cycle frequency and count are often much less and allow the use of our Rack and Pinion actuator Jamesbury VPVL-series. The Stonel Axiom valve controller also helps reduce the accessories needed to complete the package.

## Solutions

When operating temperatures are less than 260 C° (500 °F), our standard Jamesbury 800-series butterfly valves are an ideal choice. Because the temperatures often swing higher than 260 C° (500 °F) and are comparable to dryer switching valves, a triple offset Neles LG/LW/L6 butterfly valve is a great alternative. These assemblies will utilize the standard Neles B-series actuators from the PSA and VSA units.

All materials are appropriately selected based on material compatibility to prevent concerns and emergency shutdowns.

Although not required to cycle fast, our standard offering includes our Neles NDX 2.0 for fine-tuned controllability of the assembly and quick operating as necessary.



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