

On-site nitrogen generators, how to buy more economically

Today, various industrial processes require large quantities of gaseous nitrogen. Sourcing sufficient quantities of the gas is therefore a key challenge for process managers/operators. Nitrogen can either be generated on site or supplied to an industrial site from an external source. This article will discuss the various options available to operators who use nitrogen in their processes.

Types of nitrogen generators

There are three main types of nitrogen generation systems available for the production of large quantities of gas

Variable Pressure Adsorption (VPS)

Membrane nitrogen generators

Fractional distillation

PSA Nitrogen Systems

This type of nitrogen system uses the principle of differential separation of gases as they flow through the adsorbent material to achieve nitrogen production. As the gas mixture (usually air) passes through the specialised adsorbent material, the individual gases are separated according to their molecular properties.

Variable pressure adsorption (PSA) technology is a two-stage process of adsorption and desorption.

Adsorption

This is the first stage of the PSA nitrogen production process. It involves the use of carbon molecular sieve material housed in two adsorption columns to selectively retain the oxygen in the air mixture while allowing the nitrogen to pass through a collection unit.

Desorption

The desorption process is essentially a reversal of the adsorption process, allowing the regeneration of the molecular sieve material for the next round of separation. The oxygen captured by the sieve is released in preparation for a new round of gas filtration.

As mentioned earlier, the PSA system contains two adsorption columns. These alternate between adsorption and desorption, with the whole process taking an average of 60 seconds.

Membrane nitrogen generators

This technology is based on the selective permeability of the different gases as they pass through the semi-permeable membrane. The various gases possess unique physical properties that affect their rate of movement through the semi-permeable medium and their absorption rate. The membranes used for nitrogen production are made up of hollow fibres, increasing their surface area and allowing for faster absorption rates.

The key components of a membrane nitrogen generator are listed below.

Feed filter agglomerator

Activated carbon filter

Particulate filter

Immersion heater

Staged distillation

This nitrogen system uses a gas unit that distills the air to produce a very high purity gas (99.999%). The air is first sub-cooled to its liquefaction point and then its component gases are distilled in order of boiling point.

Alternatives to nitrogen generators

In addition to the methods of generating nitrogen on site mentioned earlier in this article, the production process using nitrogen can be supplied in the quantities required through external supply routes. Three common alternatives to nitrogen generators are the use of gas cylinders, nitrogen dewars and bulk tanks.

Nitrogen cylinders

Nitrogen for industrial use usually needs to be available in pressurised form. Nitrogen cylinders supplied by an external supplier are a viable, but costly, alternative to on-site gas production. In addition to the recurring costs of procuring nitrogen cylinders, this method has other disadvantages, including

Safety hazards associated with the transportation, storage and handling of high pressure cylinders. The potential for various mechanical injuries at any time the cylinders are in use.

Gas wastage is common due to the impossibility of emptying cylinders. There is always a certain amount of gas remaining in "empty" cylinders, even though the facility operator pays the full cost of the cylinders.

Finally, supply chain disruptions affecting cylinder deliveries can lead to expensive workflow standstills.

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