

PSA



NITROGEN GAS SYSTEM

NUBERG offers PSA Nitrogen Gas Generators based on "BF Technology" in Technical Collaboration with M/s Carbotech Industrieservice-GmbH as their "13th Licensee" worldwide. Carbotech pioneers the highly efficient technology of Pressure Swing Adsorption (PSA) by using unique Carbon Molecular Sieves, being manufactured and supplied by them to their Licensees worldwide.

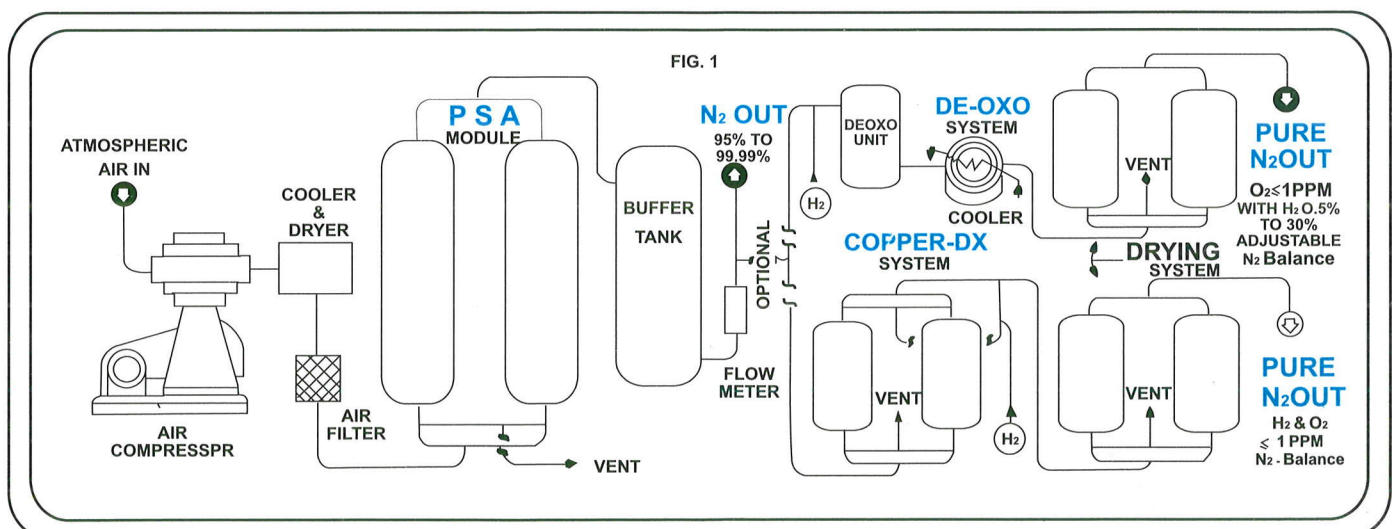
INTRODUCTION

Pressure swing adsorption (PSA) process based on Carbon Molecular Sieves, have been known for more than twenty years. The most important industrial PSA process, the Nitrogen PSA Process, has been developed during last two decades into a highly efficient technique for producing Nitrogen at site. Nitrogen is currently produced by PSA with impurities down upto the PPM level and flow rates upto 1500 NM³/Hr. The on-site supply of Nitrogen using the PSA process including purification by DEOXO SYSTEMS is an alternative to Nitrogen from either Cryogenic Process or Air-Fuel Combustion process

WHY ONLY PSA

One way of separating the Nitrogen from air gases is the Cryogenic separation process which is based on the fact that the main air gases Nitrogen, Oxygen, and Argon have different Boiling Points. But the disadvantages of cryogenic air separation is the wastage of energy (Evaporation Energy), wasting pure gas during storage, high risk potential during transit & storage and high capital cost investments. Another way of producing Nitrogen gas is by combustion of air-fuel mixtures. But its disadvantages are the presence of Hydrocarbons, Sulphur Contents & other substances in product gas, acidic & corrosive exhaust gases, fuel availability is rare and undependable system.

FIG. 1



PSA technology overcome all these disadvantages. This is a "Non-Cryogenic on-site supply" system better known as the OSS System. With the OSS system the consumer gets the gas required at the right time, at the right purity, at the desired flow, at low cost and with minimal risks. Besides the consumer is not dependent on an external gas supply.

OTHER ADVANTAGES OF PSA NITROGEN GENERATOR

- Nitrogen generation cost by cryogenic plant is Rs. 10/- to Rs. 12/- per m^3 compared to the cost of PSA Nitrogen gas as Rs. 2/- per m^3 only.
- Industries production hampers many a times due to dependency on availability of gas cylinders. But installation of PSA Nitrogen Gas Plant ensures the continuous availability of quality Nitrogen gas all the time.
- Nitrogen gas purity varies cylinder to cylinder and hence not reliable but in PSA Nitrogen Plant, gas purity is always steady and constant.
- Transportation and Handling of Gas Cylinder is quite cumbersome and risky whereas PSA Nitrogen plants are meant for in-house Nitrogen generation.

THE PRINCIPLE OF PSA

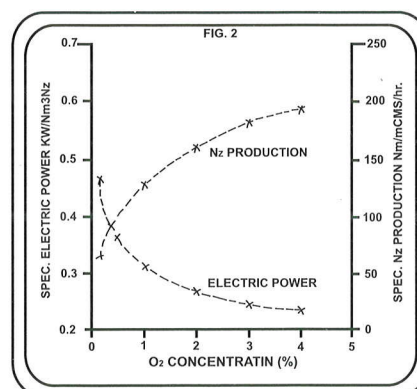
Central to the all PSA Systems (Fig. 1) are the adsorption towers, filled with cms and equipped with incoming air pipes and outgoing Nitrogen pipes and valves. Air compressed to 8 bar enters the cms bed in one adsorber. On passing over the cms, oxygen is adsorbed and Nitrogen leaves the vessel. The gas flow velocity through the cms bed determines the remaining oxygen concentration in the Nitrogen produced. During adsorption in one vessel, a second vessel is regenerated by reducing the pressure to ambient pressure. After a certain adsorption time (60 to 120s), the Oxygen starts to break through the cms bed at the top of adsorption vessel. At this stage the adsorption step is stopped.

Before starting the adsorption step in the second adsorber, a pressure equalization step equalize the pressure of both adsorbers to pre-pressure the second adsorber. Because of this pressure swing from one adsorber to the other the process is called a "Pressure swing adsorption process"

A typical Nitrogen PSA system as shown in (fig. 1) provides a fully automatically controlled Nitrogen Generator. After installation of the unit on site no personnel for controlling and running the system is necessary. Nitrogen production starts and stops automatically on demand and Nitrogen quality is continuously measured and indicated by the controllers.

A complete PSA System consists of four major parts (Fig. 1):

- Air supply and purification.
- Adsorptive air separation.
- Gas purification unit (optional)
- Nitrogen storage and supply.



HIGH PURITY NITROGEN PSA SYSTEM

To produce high-purity Nitrogen three different processes can be used:

- Directly with a PSA System.
- A PSA System with additional palladium deoxo unit.
- A PSA System with additional copper-deoxo unit.

PSA SYSTEM

The First Option can be used to produce low flow rates (upto 5 Nm³/hr.) of high purity Nitrogen at the PPM level. At higher flow rates the energy consumption and especially the capital cost increase tremendously; it is then more economical to use a PSA system running at a percentage level (0.1 to 2% oxygen) and to reduce the oxygen concentration in a second step by adding 'Deoxo Unit'.

DEOXO SYSTEM

The palladium-deoxo unit, used industrially, ran with additional hydrogen feed, for the exothermic reaction.



is run with one reactor filled with the Palladium Catalyst. The Nitrogen, coming directly from the PSA System with the remaining oxygen, is mixed over stoichiometrically with hydrogen before entering the catalyst reactor. At the catalyst surface the oxygen reacts with the Hydrogen to produce water and Heat. The heat and water have to be removed by a standard after - cooler and gas dryer to required level. The remaining hydrogen concentration in the Nitrogen is around 0.5 to 1 % minimum.

COPPER-DEOXO SYSTEM

The second type of Deoxo Unit needs two externally heated reactors filled with Copper as catalyst for the Endothermic Reaction.



The loaded copper bed can be regenerated by adding Hydrogen during the Regeneration Step. For this two-step process (Deoxidation and Regeneration), two reactors are necessary to achieve a continuously operating Deoxo System. The Nitrogen from the PSA system with the remaining oxygen passes one of the reactors without adding Hydrogen. On passing through the Reactor, the oxygen is removed by reacting with the copper surface. The advantage of the Deoxo unit based on Copper is that the high purity Nitrogen leaves the unit absolutely dry & without any remaining Hydrogen.

HYDROGEN GAS

In DX and Copper-DX model of Nitrogen Plants, Hydrogen Gas is required for removal of Oxygen in DX-Model with Palladium catalyst and for regeneration of Copper Catalyst in Copper-DX model.







The Hydrogen gas can be supplied either from battery of Hydrogen Gas cylinders or by having own captive Hydrogen generation unit based on Ammonia cracker unit or water electrolysis unit type.

In Ammonia cracker unit, Ammonia gas dissociates and gives a gas mixture of 75% Hydrogen & 25% Nitrogen. This is a very simple unit. The most suitable & commonly used for requirement of Hydrogen gas in PSA Nitrogen Systems

Select the model of Nitrogen Gas plant to suit your application from the table as under:

| | MX-Model | Dx-Model | Cu-Dx Model |
|------------------------|-----------------------------|-----------------------------|-----------------------------|
| FLOW CAPACITY | 1-1000 Nm ³ /Hr. | 1-1000 Nm ³ /Hr. | 1-1000 Nm ³ /Hr. |
| GAS COMPOSITION | | | |
| Nitrogen | 95-99.99% | Balance | 99.9997% |
| Oxygen | 5%-0.01% | 1PPM | 1PPM |
| Hydrogen | Nil | 0.5% onwards (Adjustable) | < = 1PPM |
| Dew Point | (-)40°C To (-)60°C | (-)60 °C To (-)80°C | (-)60 °C To (-)80°C |
| PRESSURE | 5-25 bar | 5-25 bar | 5-25 bar |

APPLICATIONS

-  **Metallurgical Heat Treatment** : Controlled atmosphere for Ferrous/Non-Ferrous Metallurgical processes.
-  **Electronic Industry** : Manufacture of Ferrite & Electronic/Electrical components in inert atmosphere.
-  **Food industry** : Packaging of Food and controlled atmosphere for storage and transport.
-  **Pharmaceuticals Industry** : Blanketing of vessels, transferring chemicals and packaging.
-  **Material Handling Process** : Prevention of Dust Explosions in silos and coal bins.
-  **Synthetic, Polyester & Fibre Industries** : Blanketing of vessels, controlled atmosphere, packaging.

SALIENT FEATURES

- ★ Simplicity & compact design
- ★ Fully automatic & safe
- ★ Independent Nitrogen source
- ★ Safe operation; low working pressures
- ★ Individual Nitrogen purity
- ★ Ambient temperature operation
- ★ Need only electrical power & cooling water
- ★ No fuel, oil or natural gas required
- ★ On-line gas monitoring analysers
- ★ Efficient turn down system available
- ★ Purity 99 to 99.9997 %
- ★ Nitrogen @ 1000 Nm³/hr can be realized

OTHER ACTIVITIES

- ★ Nitrogen/Inert gas generators
- ★ Air/gas drying units
- ★ Air-heaters; Electrical/fuel fired
- ★ Oxygen generators
- ★ De-oxo & gas purification units
- ★ Ammonia cracker units
- ★ Hydrogen gas plants
- ★ Dehumidifiers



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In Technical Collaboration with



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