

# Industrial nitrogen generators

Nitrogen generators for industrial applications can be divided into three types depending on the classification method, namely deep-cooled air separation, molecular sieve air separation (PSA) and membrane air separation.

## Deep-cooled air separation for nitrogen production

Deep-cooled nitrogen separation is a traditional nitrogen production method that has a history of nearly decades. It uses air as the raw material, compresses it, purifies it and then uses heat exchange to liquefy the air into liquid air. Liquid air is mainly a mixture of liquid oxygen and liquid nitrogen, using the different boiling points of liquid oxygen and liquid nitrogen (at 1 atm, the boiling point of the former is  $-183^{\circ}\text{C}$ , the latter is  $-196^{\circ}\text{C}$ ), through the distillation of liquid air, so that they are separated to obtain nitrogen. Deep-cooled air separation nitrogen equipment is complex, covers an area of large, high infrastructure costs, more one-time investment in equipment, higher operating costs, slow gas production (12 ~ 24h), high installation requirements, longer cycle time. Comprehensive equipment, installation and infrastructure factors, 3500Nm<sup>3</sup>/h or less, the same specifications of the PSA device investment scale than the deep-cooled air separation device 20% to 50% lower. Deep-cooled air separation nitrogen plants are suitable for large-scale industrial nitrogen production, while medium and small-scale nitrogen production does not appear to be economical.

## Molecular sieve air separation nitrogen production

Using air as raw material, carbon molecular sieve as adsorbent, using the principle of variable pressure adsorption, the use of carbon molecular sieve on the selective adsorption

of oxygen and nitrogen and nitrogen and oxygen separation method, commonly known as PSA nitrogen. This method is a new nitrogen production technology that was rapidly developed in the 1970s. Compared with the traditional nitrogen production method, it has a simple process, high degree of automation, fast gas production (15-30 minutes), low energy consumption, product purity can be adjusted in a wide range according to user needs, easy to operate and maintain, lower operating costs, the device is more adaptable, etc., so in the nitrogen production equipment below 1000Nm<sup>3</sup>/h is quite competitive, more and more popular with small and medium-sized nitrogen users PSA nitrogen production has become the preferred method for small and medium-sized nitrogen users.

#### Membrane air separation nitrogen production

Using air as the raw material, oxygen and nitrogen are separated under certain pressure conditions by using the different permeation rates of gases with different properties in the membrane. It has the advantages of simpler structure, smaller volume, no switching valve, less maintenance, faster gas production ( $\leq 3$  minutes) and easy capacity increase compared to other nitrogen production equipment, it is especially suitable for medium and small nitrogen users with nitrogen purity  $\leq 98\%$  and has the best function to price ratio. When the nitrogen purity is above 98%, it is more than 15% more expensive compared to PSA nitrogen generators of the same specification.

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