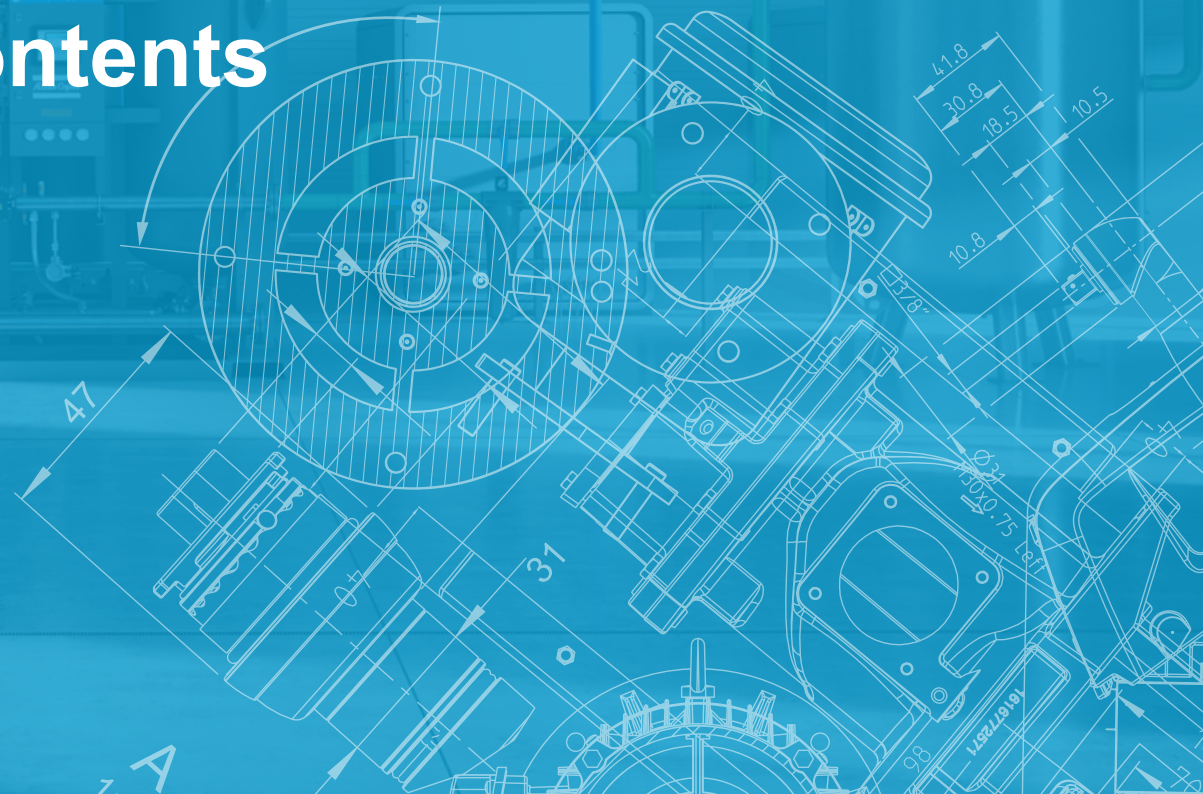


E-book Nitrogen Generation



Contents



1. Purpose of this e-book

2. Benefits of on-site nitrogen generation

3. Methods of generating nitrogen on-site

- Membrane technology
- Pressure swing adsorption (PSA)

4. Industrial applications of nitrogen

- Food and beverage packaging
- Pharmaceuticals
- Electronics
- Laboratories
- Oil and Gas
- Fire prevention
- General industry



A man in a dark shirt and white earbuds is sitting at a wooden desk, looking at a tablet. The tablet screen shows a factory floor with a yellow forklift and a blue banner that reads "A big yes to on-site nitrogen generation". In the background, there is a potted plant and an open book.

Purpose of this e-book

Purpose of this e-book

Nitrogen plays a big role in various industrial applications. It is often referred to as the fifth utility, alongside water, electricity, gas and compressed air.



This calls for two approaches: buying nitrogen from a third-party source (cylinder gas, liquid bulk gas and on-site cryo production) or on-site generation. It has become a growing trend in the market, to purchase on-site nitrogen generation solutions.

At Atlas Copco, we apply our expertise in this field, to help you save on cost, and maximize quality too. We do this by tailoring the purity of on-site generated nitrogen based on a specific required application.



This e-book will help you understand the growing trend of on-site nitrogen generation and how it can benefit your business.

The Atlas Copco logo, consisting of the company name in a white serif font between two horizontal white bars, is positioned in the top right corner of the image.

Benefits of on-site nitrogen generation



Benefits of on-site nitrogen generation

Nitrogen is massively used in various industries ranging from pharmaceuticals, metal to food packaging and beyond.

Nitrogen is effectively everywhere. Manufacturers resort to ordering nitrogen, which is mostly stored in big, heavy gas cylinders based on its usage. Alternatively, they install a liquid nitrogen storage tank on the site and get it filled up periodically with purchased liquid nitrogen. These are some of the most opted techniques of obtaining nitrogen, but these methods are not always the most favorable option. Their distribution puts quite a load on the environment, the logistics on your site require time from your personnel, there's always a portion of gas that is wasted, and they come with

certain workplace risks. Above all, the total cost over a couple of years can have a significant price tag. On-site generation remedies all these shortcomings. It can be achieved at a fraction of the cost incurred when sourcing it from a vendor



Atlas Copco

6 benefits of on-site gas generation

Companies that need nitrogen on a daily basis, stand to gain a lot from on-site generation of this gas.

The benefits include:

- 1) Lowest total cost per unit of nitrogen produced - **improved bottom line**
- 2) No long-term and complex third-party supply contracts – **stable and predictable costs**

- 3) Zero gas and money wastage – **cost of gas production proportional to usage**
- 4) Absence of order processing for refills – **lower admin/logistics costs**
- 5) Total safety – **no large amounts of gas stored on site**
- 6) No storage and transportation cost – **low environmental footprint**

In summary, most companies can improve their nitrogen sourcing through self-producing this valuable gas.

The Atlas Copco logo is located in the top right corner of the image. It consists of the company name "Atlas Copco" in a white, serif font, centered within a blue rectangular box that has two horizontal white lines above and below the text.

Methods of on-site nitrogen generation

A blue rectangular banner at the bottom left of the image contains the title "Methods of on-site nitrogen generation" in white, bold, sans-serif font. The background of this banner features a faint, white technical drawing or blueprint of a mechanical component, possibly a valve or a part of a nitrogen generation system.

How does membrane technology work?

Membrane nitrogen generators are based on a simple working principle. The main part of a membrane generator is the membrane module (+- 10 cm in diameter), filled with small, hollow polymer fibers.



The dry and clean compressed air enters and due to the structure of these fibers, different components of the air flow to the outside of the fiber. This process is called permeation. During this process, water and oxygen exit through the membrane sides of the fibers. In the end, only nitrogen remains. This is possible since different molecules permeate at different speeds. H_2O will permeate very quickly; oxygen takes a little longer. Because of the permeation through the fiber wall, an overpressure would occur inside the membrane housing. The fibers would clog, and the permeation efficiency would be significantly lowered. To prevent that from happening there is an opening in the housing, the permeate vent, where these 'exhaust' gases can escape.



It is very important for the intake air to be clean and dry before it enters the membrane. If this is not the case, the shallow fibers will quickly clog. To prevent this from happening, correct air treatment of the feed air must be installed. In some cases, the needed filters and dryers will already be built into the generator itself. This would mean that, at times, no additional filters should be installed between the compressor and generator. The fibers of the membrane can handle water vapor without many problems. It is however very important that the air be devoid of liquid water, since this will have a detrimental impact on the membrane. Therefore, it is required for a good water separation solution to be in place upstream the generator, a refrigerant dryer for example. Taking care of the intake air of the generator will protect the membrane and ensure a long lifetime.

How does pressure swing adsorption (PSA) work?

Adsorption is the process in which atoms, ions or molecules from a substance (compressed air in this case) adhere to a surface of an adsorbent.

A PSA nitrogen generator isolates nitrogen, and the other gases in the compressed air stream (oxygen, CO₂ and water vapor) are adsorbed, leaving behind essentially pure nitrogen. PSA nitrogen generator technology is a simple, reliable and cost-effective approach to nitrogen generation that enables continuous, high-capacity nitrogen flow at the desired level of purity. PSA traps oxygen from the compressed air stream when molecules bind



themselves to a carbon molecular sieve. This happens in two separate pressure vessels (tower A and tower B), each filled with a carbon molecular sieve, that switch between a separation process and a regeneration process. Clean and dry compressed air enters tower A.

Since oxygen molecules are smaller than nitrogen molecules, they pass through the pores of the sieve. Nitrogen molecules cannot fit through the pores, so they bypass the sieve resulting in nitrogen of desired purity. This phase is called the adsorption or separation phase. Most of the nitrogen produced in tower A exits the system, ready for direct use or storage. Next, a small portion of the generated nitrogen is flowed into tower B in the opposite direction.

This flow pushes out the oxygen that was captured in the previous adsorption phase of tower B. By releasing the pressure in tower B, the carbon molecular sieves lose their ability to hold the oxygen molecules, which detach from the sieves and get carried away by the small nitrogen flow coming from tower A. This 'cleaning' process makes room for new oxygen molecules

to attach to the sieves in a next adsorption phase. The two tower PSA system switches between separation and regeneration to provide continuous nitrogen production at a desired purity level. The Atlas Copco NGP+ nitrogen gas generator provides all the advantages of PSA

technology in a reliable and efficient plug-and-play solution.

It is important to understand the level of purity that is needed for each application to purposefully generate on-site nitrogen. Nonetheless, there are some general requirements regarding the intake air. The compressed air must be clean and dry before entering the nitrogen generator, as this positively

PSA vs Membrane generator

	PSA	MEMBRANE
ACHIEVABLE PURITY	EFFICIENTLY UP TO 99.999%	EFFICIENTLY UP TO 99.5%
EFFICIENCY	HIGHER	HIGH
PERFORMANCE VS. TEMP.	LOWER AT HIGH TEMP.	HIGHER AT HIGH TEMP.
SYSTEM COMPLEXITY	MEDIUM	LOW
SERVICE INTENSITY	LOW	VERY LOW
PRESSURE STABILITY	STABLE WITH EXTRA TANKS	STABLE WITHOUT EXTRA TANK

FLOW STABILITY

Open full table in browser:

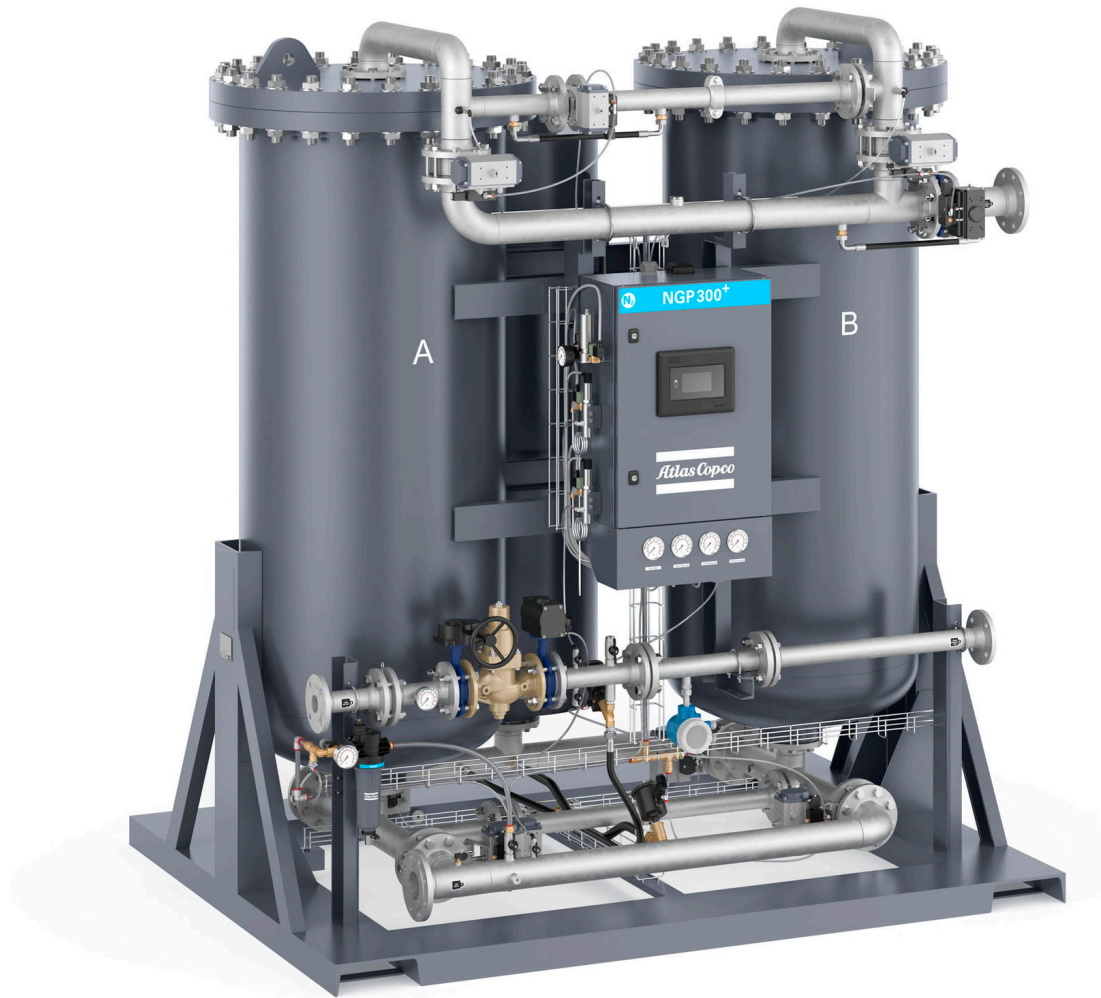
STABLE WITHOUT EXTRA TANK

<https://ebooks.atlascopco.com/story/e-book-nitrogen-generation-en-us/page/5/4>

START-UP SPEED AFTER SHUTDOWN

MEDIUM

FAST



affects the nitrogen quality and also prevents the CMS from being damaged by moisture.

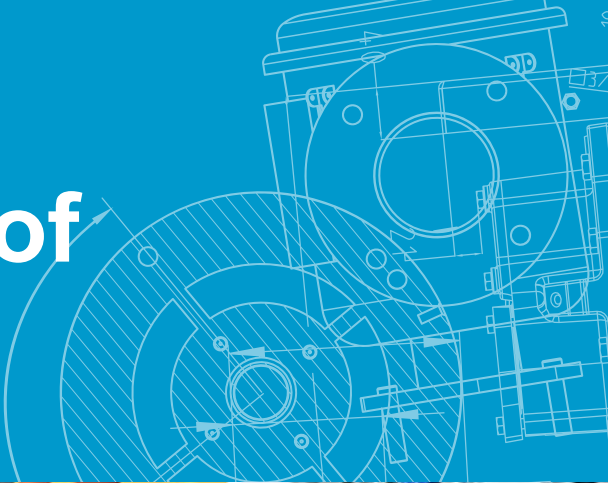
To treat the air properly, there should be a dryer between the compressor and the generator. If the intake air is generated by an oil lubricated compressor installing an oil coalescing and carbon filter will get rid of any impurities prior to the compressed air reaching the nitrogen generator. Pressure, temperature and pressure dew point sensors can be installed in the generators as a fail-safe, preventing contaminated air from entering the PSA system and therefore ensuring a long lifetime.



Atlas Copco



Industrial applications of nitrogen



Industrial application of nitrogen

Being an inert gas, nitrogen is suited for a wide range of uses in many different industries including oil and gas, electronics, food and beverage packaging, laboratories, fire prevention, pharmaceutical, marine and general industry. This is because one of the most unique properties of this colorless and odorless gas is its low reactivity, which can benefit many processes. Listed below are a few of the industrial applications of nitrogen.



Food and beverage packaging

Nitrogen is mainly used in food & beverage as a filler gas, to displace oxygen. Preserving the taste, aromas and the quality in general is one important aspect where N_2 does the job, by keeping out O_2 , the main culprit in the air that causes spoilage. Another main task is to increase the shelf life of the packaged product.

Pharmaceutical

During the pharmaceutical production process, oxygen can cause unwanted reactions in the product. Nitrogen is a dry, inert gas that doesn't react with other elements and affect product quality. Nitrogen helps pharmaceutical companies save cost and live up to the high standards that are required in the industry.



Electronics

The margin for error in electronics manufacturing is extremely small. In order to create a precise, controlled environment for packaging, assembly, and storage as well as the soldering processes itself, the use of nitrogen is key. Nitrogen creates a protective environment, prevents oxidization of components and the soldering material, therefore improving the quality and reducing rejected parts in production, among many other benefits in use.

Laboratories

Different analysis techniques in a laboratory or university environment require the use of Nitrogen, to create a protective and neutral atmosphere that is not influencing the measurement done. LC-MS is an example of an analysis technique where nitrogen is used to eliminate solvents from a sample.

Oil and gas

The oil and gas industry uses nitrogen to enhance safety and reduce the risk hazards facilities of operation. Nitrogen is used to purge compressor systems, pipelines, and reactors to avoid fires and

explosions. Other applications in oil and gas include blanketing storage tanks and oil and gas drilling.

Fire prevention

Nitrogen is a key component in fire safety across the world. The gas can expel oxygen to a level below the LOC (Limiting Oxygen Concentration), as a result a normally flammable substance can no longer burn because there's not enough oxygen available to support the burning process.

General industry

The use of nitrogen is spread across the entire landscape of general industry. You will find nitrogen in every corner because of its highly inert properties. In general industry we find nitrogen usage for automotive, construction, metal fabrication, aerospace, battery & renewables, and many more industries.

Thank you for reading

E-book Nitrogen Generation

We hope you enjoyed reading this e-book. Would you like to speak to an expert for more information and support? Fill in the form and we will get back to you shortly.

