



Is Bottled Nitrogen a Greenhouse Gas?

Parker Balston

High purity nitrogen gas can be obtained using an “in-house” system with a hollow fiber membrane which separates the nitrogen from oxygen and water vapor in compressed air. A small compressor is used which requires considerably less energy than fractional distillation of air and transporting tanks to the end-user’s facility. In addition to reducing the energy requirements and contribution to greenhouse gases, the use of an “in-house” system is a safer, more convenient and less expensive approach than the use of bottled nitrogen.

The generation of nitrogen gas for the laboratory provides an excellent example of how a significant reduction in the generation of greenhouse gases can be obtained by selecting an alternative process that consumes less energy. High purity nitrogen gas is commonly obtained by the fractional distillation of air, which involves compression, chilling, re-vaporization, bottling and transporting to the end-user site. A hollow fiber membrane can generate nitrogen “in-house” with an high degree of purity and a considerably smaller energy input.

Nitrogen Generation using Hollow Fiber Membranes

A hollow fiber membrane preferentially allows oxygen and water vapor to permeate a membrane wall (Figure 1) while nitrogen travels through the membrane. “In-house” generation of nitrogen involves:

- Withdrawing air from the atmosphere using a compressor.
- Removing of water vapor/particulates.
- Removing hydrocarbons via an activated carbon filter
- Separating the oxygen and remaining water vapor via hollow fiber membranes
- Filtering the gas to provide a clean supply of high purity nitrogen
- Porting the gas to the end device (e.g. LC-MS)

A typical system (Parker Balston N2-14 Nitrogen Generator) contains thousands of membrane fibers to provide >99.5% N₂ at flow rates up to 467 L/min at 100 psig. The schematic of a system is shown in Figure 2. In addition, membranes used to dry air and a nitrogen generating system can be combined to supply individual streams of dry air, source exhaust air and nitrogen (e.g. for an LC/MS system).

Energy Considerations for Obtaining Nitrogen via Fractional Distillation of Air

Obtaining nitrogen using fractional distillation and transport of the bottles is energy intensive. For example, if 100 bottles are delivered by a truck that travels 50 miles and gets 10 miles/gallon, 0.05 gallons of fuel/bottle is required and 0.05 gallons to return bottles, a total of 0.1 gal/bottle.

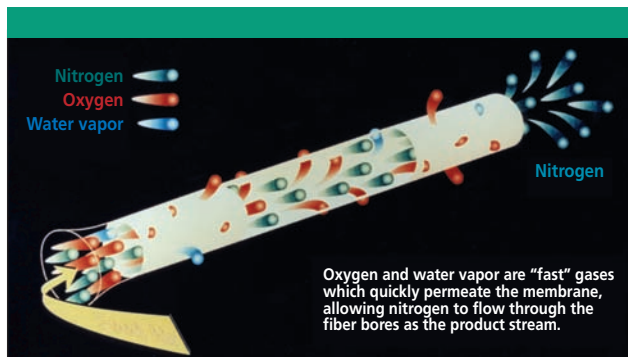


Figure 1: Hollow Fiber Membrane Bundle Separates Nitrogen from Air.

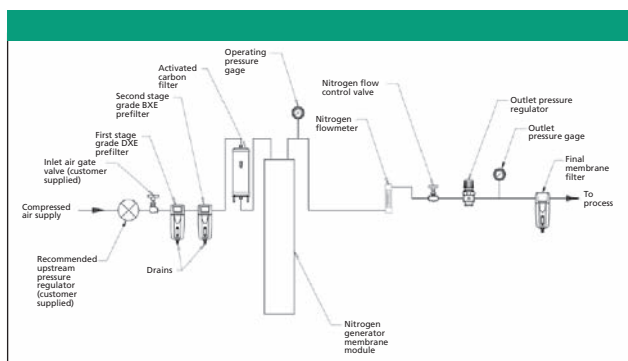


Figure 2: Schematic of Parker Balston N2-14 Nitrogen Generator

Energy Considerations for Obtaining Nitrogen via Hollow Fiber Membranes

When a hollow fiber membrane system generates nitrogen, energy is needed for an air compressor. If a 3 hp compressor is employed with a 50% duty cycle, 25 kWh are used to generate the equivalent of five 9000 liter gas tanks/day.

Comparing the Greenhouse Gas Contribution with Fractional Distillation and a Hollow Fiber Membrane

Since more energy is employed for fractional distillation and transport of bottles than using hollow fiber membranes, more greenhouse gases are generated. In house generation of nitrogen gas using hollow fiber membrane bundles is an effective, environmentally preferred approach to providing pure, clean, dry nitrogen gas.

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