

Silver-exchanged Lithium-X Zeolite and PSA process increase Oxygen Concentrator Purity

Introduction:

Air Products is offering for license a crystalline silver-exchanged lithium-X zeolite material and associated Pressure Swing Adsorption (PSA) process that enable production of gaseous oxygen at greater than 99% oxygen purity. By selectively removing argon, the offering enables production of high purity oxygen, a relevant challenge facing designers and suppliers of medical oxygen concentrator technology.

Technology overview:

Crystalline zeolites in oxygen concentrators have differential selectivity with respect to the gaseous components of air, making it possible to remove nitrogen, argon and other trace elements from the feed air to the PSA process. Current oxygen concentrator technologies utilize NaX, CaX or LiX zeolites to selectively remove nitrogen from feed air in the PSA process. With such adsorbents, oxygen product purity is limited to nominally 95% because argon is not removed and concentrates in the product gas. The Air Products' pressure swing adsorption process and silver-exchanged lithium-x zeolite combine to enable the selective, initial adsorption of nitrogen over oxygen and argon and subsequently, the selective adsorption of argon over oxygen.

This process follows that of a typical pressure swing adsorption cyclic process with steps of adsorption, depressurization, evacuation, purge and repressurization. As seen in Figure 1, the inlet air stream is compressed and passed through a first zeolite, which selectively removes nitrogen from air. This nitrogen-depleted stream next passes through the silver-exchanged lithium-X zeolite, which preferentially removes argon. The highly enriched oxygen product gas collects into a storage tank and is ultimately inhaled by the user through a nasal cannula or mask. The evacuation step consists of the countercurrent venting of nitrogen and argon.

In addition to enabling production of a high purity oxygen product, the use of the silver-exchanged lithium-X zeolite also removes trace undesirable feed air contaminants introduced to the PSA. Furthermore, silver zeolites exhibit antimicrobial properties which can reduce contaminants in the oxygen product.

Features and Benefits:

- **Enables production of high purity (> 99 vol%) oxygen product**
- **Compatible with commercial PSA equipment**
 - Layer of silver-exchanged lithium-X zeolite works in combination with traditional adsorbents used for selective adsorption of nitrogen over oxygen and argon.
 - Lithium-X zeolite material and associated Pressure Swing Adsorption (PSA) processes are compatible with equipment components used in the field.
- **Reduces trace ambient air impurities passing through conventional oxygen concentrators into product oxygen**
 - Silver-exchanged lithium-X zeolites remove radon, carbon monoxide and ambient Volatile Organic Compounds.
 - Contaminant removal can reduce exposure to deleterious trace impurities for patients with compromised respiratory capability. (Note ⁽¹⁾: Smokers are common users of oxygen concentrators and have heightened risk of lung cancer with radon exposure)
- **Provides antimicrobial capability**
 - Prolonged usage of oxygen concentrators can promote buildup of bacteria within the device. Silver-exchanged lithium-X zeolite exhibits antimicrobial properties.
- **Expands oxygen concentrator product line**
 - Offers oxygen concentrator manufacturers a high end, differentiated product.

⁽¹⁾ Reference: US EPA <http://www.epa.gov/radon/healthrisks.html>

Figure 1: Schematic diagram with integration of silver exchanged lithium-X zeolite into PSA process

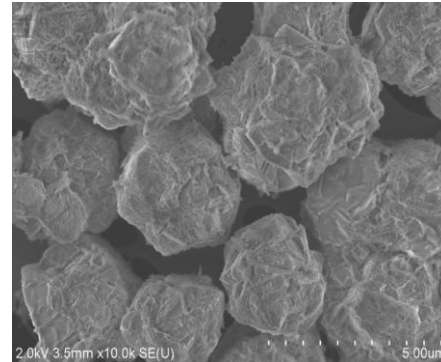
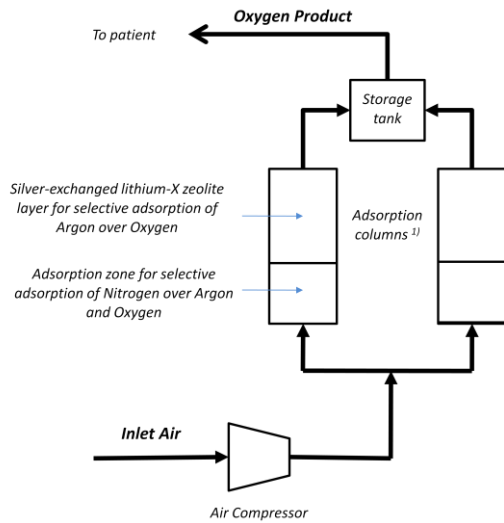


Figure 2: Scanning Electron Micrograph (SEM) of silver exchanged lithium-X zeolite

¹⁾ The process can use a single adsorber vessel with one or more storage tanks for storing gas produced earlier in the cycle for use later in the cycle for purge and/or repressurization.

Patent(s):

Patent Number	Title	Status	Filed
US 6,432,170	Argon / Oxygen Selective X-Zeolite	Issued	13 February 2001
US 6,544,318	High Purity Oxygen Production by Pressure Swing Adsorption	Issued	13 February 2001
US 7,651,549	Pressure Swing Adsorption Process with Improved Recovery of High Purity Product	Issued	13 June 2006

Stage of Development:

Silver exchanged lithium-X zeolite has been manufactured commercially.

Also Offered:

Technical process engineering expertise is available to support the successful integration of the silver-exchanged lithium-X zeolite and process information into customer oxygen concentrator products.

Find Out More:

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