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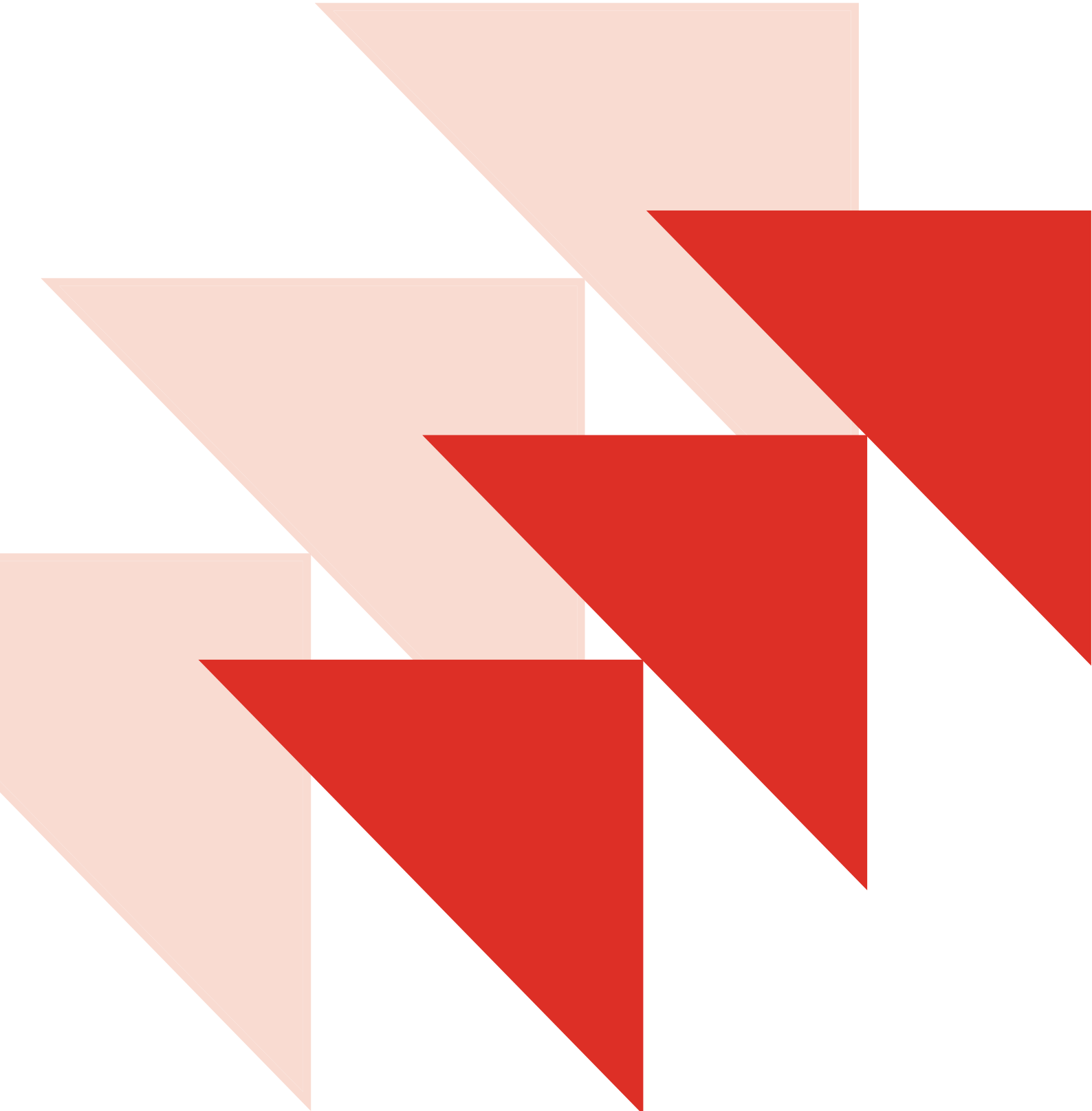
GENERATING OXYGEN FOR HOSPITALS



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Oxygen: Critical for hospitals

Oxygen is a very important clinical gas in health care centres and hospitals. It is an essential resource for administration of general anaesthesia and for mechanical ventilation. Oxygen happens to be one of the most heavily consumed components in hospitals.

Source: https://healdove.com/health-care-industry/Insiders-Guide-to-General-Anesthesia

Conventionally, liquid-oxygen supply systems and high-pressure cylinders have been used to provide the oxygen used in hospitals. One of the major costs incurred by hospitals is associated with supplying oxygen using these systems. The choice of oxygen supply system can be critical to the running of a hospital.

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Oxygen can be produced on-site at hospitals: The PSA process

Hospitals, clinics and health care centres now have the option of generating medical oxygen on-site, in a highly cost-effective manner. This option uses pressure swing adsorption (PSA), a method used for commercial production of gaseous oxygen. Using PSA, a health care center can generate all the oxygen it requires.

The PSA process is very safe. Further, the energy and area requirements are moderate compared with those of oxygen production using conventional methods.

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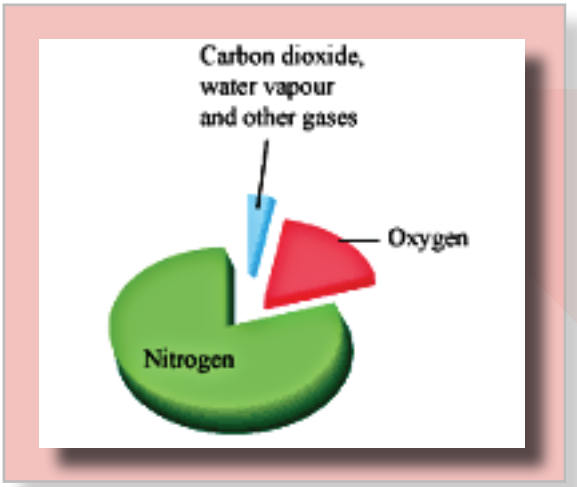
PSA uses only air: Air contains oxygen

The major input in the production of oxygen using PSA processes is air. The proportion of oxygen in dry air is 20.95% oxygen.



The other major gas present in air is nitrogen (78.09%), with argon (0.93%), carbon dioxide (0.04%) and other gases constituting the remainder. Air also contains a variable amount of water vapour: the average proportion in the entire atmosphere is 0.4% and that at sea level is 1%.

The principle of PSA: Selective adsorption at high pressures

In a PSA process, air is pressurised and passed through a solid substance. The process relies on the fact that under such conditions gases tend to be adsorbed by solids. And some materials adsorb certain gases more than they do other. For example, the absorbent used in PSA-based oxygen production attracts nitrogen more strongly than it does oxygen.

There is a limit to the amount of gas the adsorbent material can hold. It is said to be saturated when it holds this amount of gas.

If the pressure is increased, more gas is adsorbed. Conversely, reducing the pressure causes the adsorbed gas to be released ('desorbed').

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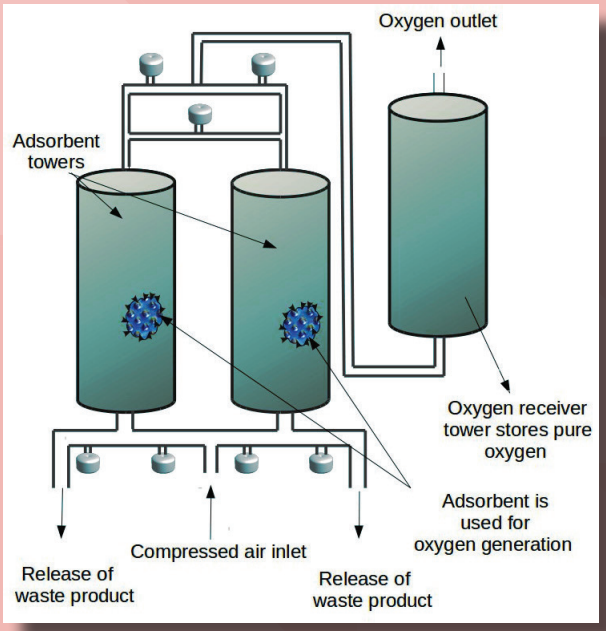
The PSA process

The steps in the PSA process of oxygen generation involve passing compressed air through a tower containing adsorbent material that absorbs nitrogen in preference to oxygen. The nitrogen in the compressed air is removed by the adsorbent material, leaving behind oxygen, which is collected and stored. When the adsorbent material is saturated, the nitrogen in it is desorbed. In practice, two towers with adsorbent material are used alternately so that the production of oxygen is continuous.



Schematic representation of a PSA system for generating oxygen

Step 1

Air drawn from the atmosphere is compressed using an air compressor. The compressed air is dried and filtered.

Step 2

The compressed, filtered air is sent through one of the towers. As it flows through the tower, the adsorbent material adsorbs the nitrogen, and the oxygen passes through to the oxygen accumulation tank.

Step 3

Just before the adsorbent material becomes saturated with nitrogen, the adsorption process is interrupted by diverting the input air to the second tower. At this point the second tower starts to adsorb nitrogen and produce oxygen.

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Step 4

Next, the pressures of the two towers are equalised. The adsorbent material in the first tower (almost saturated with nitrogen) desorbs the nitrogen (the adsorbent material is 'regenerated') as a result of the reduction in pressure. The desorbed nitrogen is vented from the system.

Step 5

The regenerated adsorbent is now purged with oxygen from the second tower. The cycle ends with this step, and the next cycle begins.
Typically, the pressure of the oxygen in the receiver tank goes up to 4–5 bar. The purity of the oxygen is in the range from 90% to 96%.

Medical-quality air from PSA

On-site oxygen production systems are governed by the ISO standards ISO 10083:2006, ISO 7396-1:2016 and IS 12827:1989 (equivalence: ISO 7396:1987).

Standard	Concentration of oxygen for medical purposes
ISO 7396-1:2016 Medical gas pipeline systems—Part 1: Pipeline systems for compressed medical gases and vacuum	Can vary between 90% and 96%
ISO 10083:2006 Oxygen concentrator supply systems for use with medical gas pipeline systems	Not less than 90%
IS12827:1989 Equivalence: ISO7396:1987 Non-flammable medical gas pipeline systems	Not less than 90%

The monographs for 93% oxygen have been included in *US Pharmacopeia* and in *European Pharmacopeia* since 2010.

PSA systems are now proving to be economic and highly reliable oxygen-supply solutions for hospitals all over the world.

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