Pressure Swing Adsorption And It's Application

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INTRODUCTION

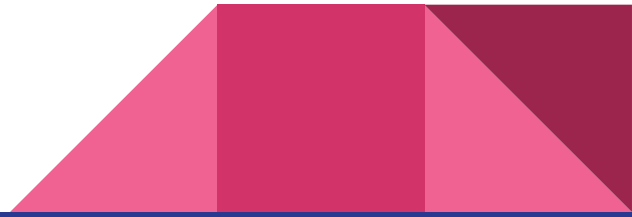
In this presentation, we'll be initially talking about Adsorption and Pressure.

Pressure Swing Adsorption, as the title itself says that it is an applied science mechanism which is used to separate a mixture of gases under appropriate pressure, which also depends on the nature of gas, its molecular properties and its affinity towards the adsorbent bed.

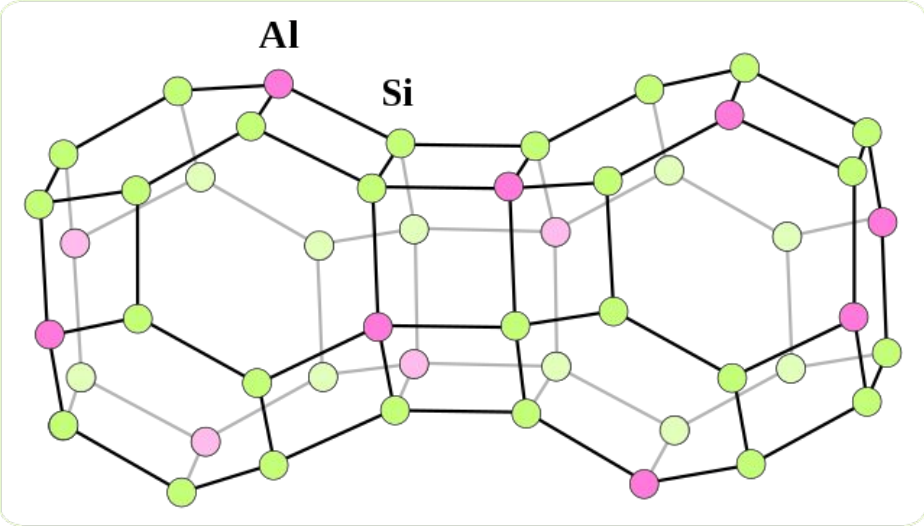
We also get an idea of swinging of the pressure, i.e change in pressure during the process.

IMPORTANT TERMS

- Pressure
- Adsorption
- Adsorption Bed
- Pressure Swing Adsorption



ADSORBENT BEDS



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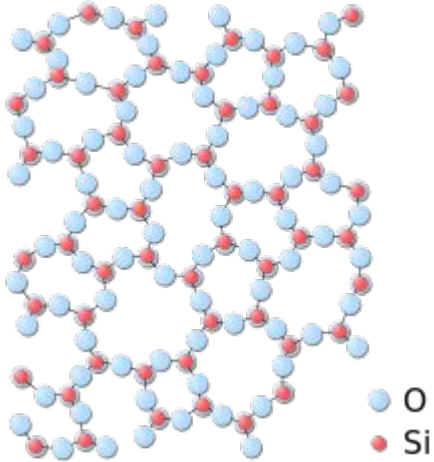

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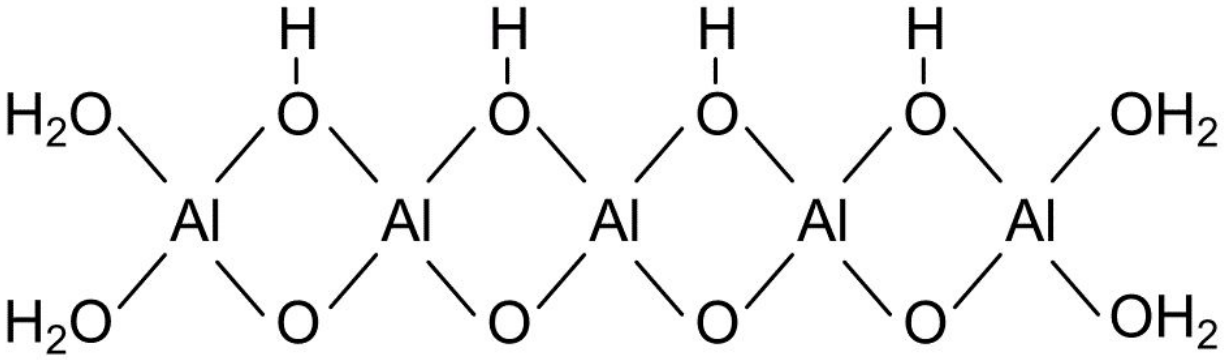
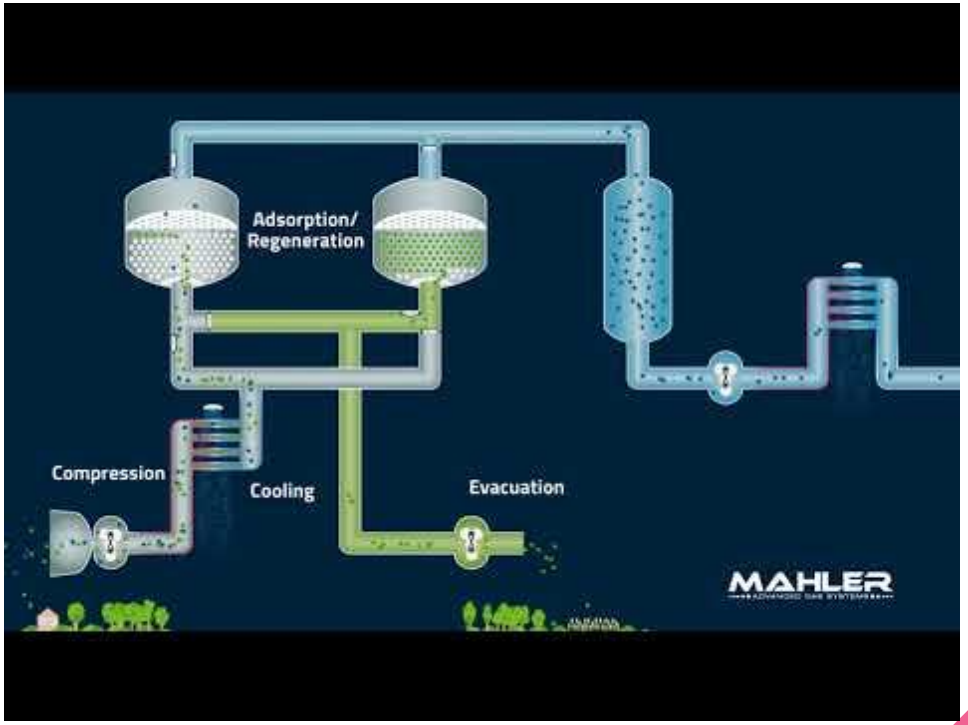


ACTIVATED CHARCOAL STRUCTURE

And many other adsorbents are used such as resins, alumina, etc. The physical property of adsorption is used here i.e. higher the pressure more the gas is adsorbed on the adsorbent.

MECHANISM


Adsorption/
Regeneration
Compression
Cooling
Evacuation
MAHLER

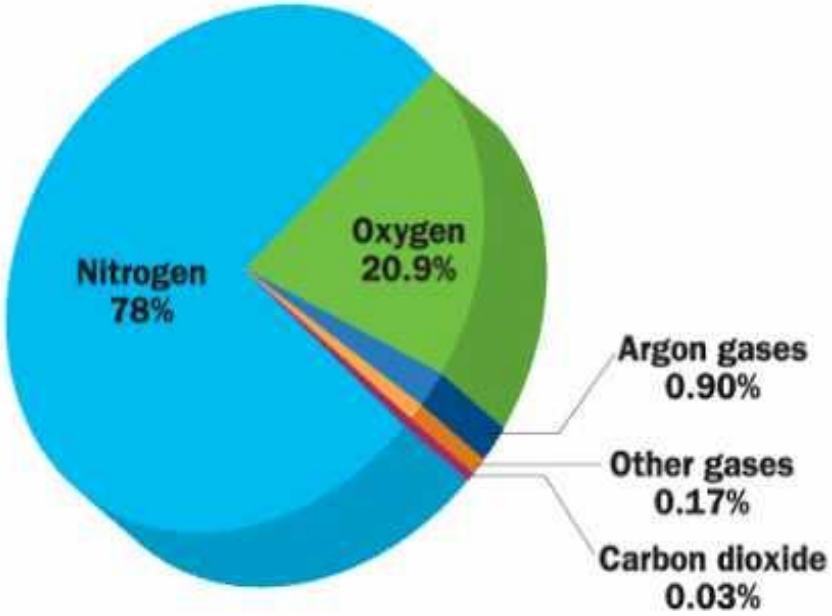
EXAMPLE

One of the major examples of Pressure Swing Adsorption technique is the separation of Oxygen or Nitrogen gas from the atmospheric air.

- ***Extracted nitrogen is used for various industrial purposes.***
- ***Oxygen enriched air is used in medical fields.***

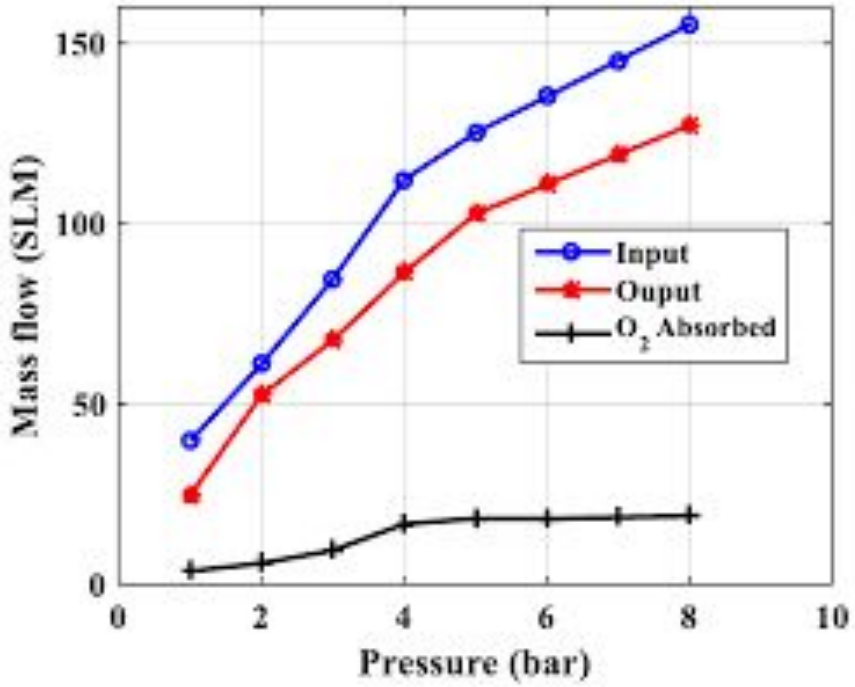
ATMOSPHERIC AIR COMPOSITION:

- *Nitrogen: 78%*
- *Oxygen: 21%*
- *Trace gases: 1%*

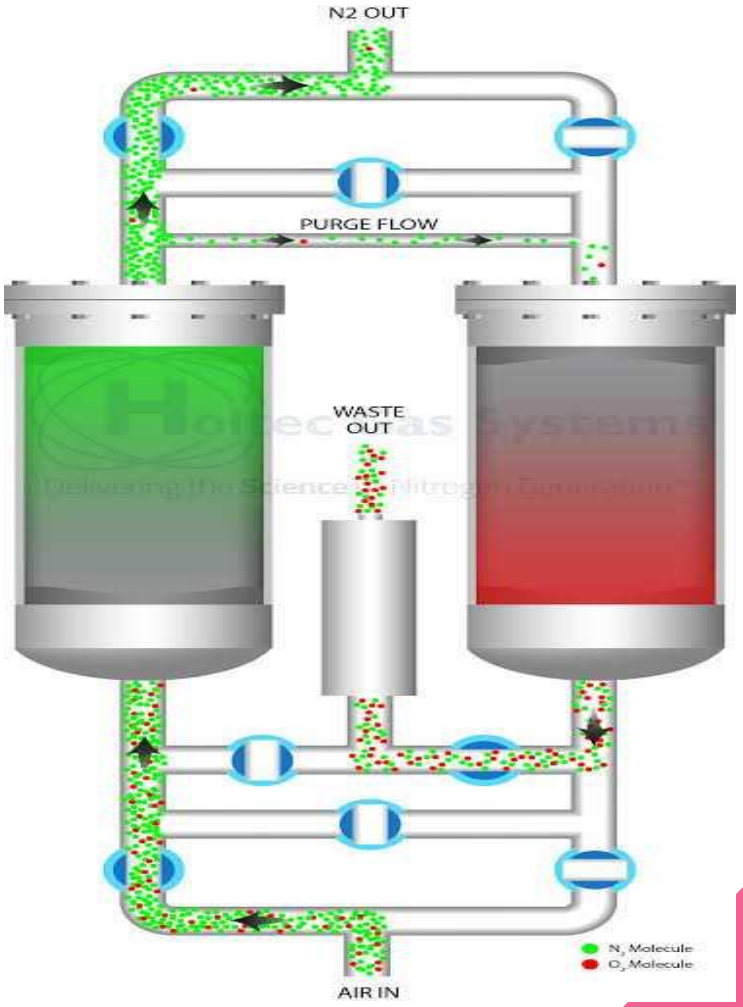


Trace gases include Carbon dioxide, argon gas, water vapour and other impurities.

Graphical Representation of adsorbing property of Nitrogen and oxygen



EXAMPLE



APPLICATIONS

- Supply of Oxygen for medical purposes.
- Used for removal of Carbon-dioxide. This is considered as one of the primary applications of PSA.
- Used for synthesis of Hydrogen for use in the oil refineries. Also used in the production of ammonia.

- Used for production of highly pure Nitrogen gas. PSA proves to be the best and most efficient technique for the same.
- PSA is used for separation of Carbon-dioxide from the Biogas. Used for increasing Methane ratio.

Glass Industry

Pulp And Paper Industry

Metallurgical And Steel Application

Chemical Industry

Waste Water Treatment
Ozone

Fish Farming

Biological Process Technology

FUTURE USES

- Sorption Enhanced Reaction Process(**SERP**).
- Capturing CO_2 generated from Coal-fired power plants, to prevent greenhouse gas production.
- Can be used in Space-suits for storage of either the required oxygen, or capturing the generated CO_2 .
- Olefin-Paraffin separation through Pressure Swing Adsorption.

SERP PROCESS

I. The **sorption-reaction** Step, passage of a mixture of hot H_2O and CH_4
II. Counter-current **Depressurization**.
III. **Evacuation** step.
IV. Counter-current **Pressurization.**

	Purity (dry)				Conversion (%)
	H_2	CH_4	CO_2	CO	
SERP concept	94.4%	5.6%	40 ppm	30 ppm	73.0
Conventional reactor	67.2%	15.7%	15.9%	1.2%	52.6

[a]Feed, 6:1 H_2O/CH_4; pressure, 26.1 psia; temperature, 490°C.

CONCLUSION

- Bright future for this concept and it will be used as a sustainable resource.
- It is expected that the synthesis of new PSA and TSA cycles using new (or modified) and old adsorbents will continue to grow in the near future. These processes will serve existing as well as new application areas.


THANK YOU

References;

- https://youtu.be/JFsQoapc75I
- https://www.google.com/search?q=atmospheric+air+composition&safe=active&sxsrf=ALeKk007lw46TDCtrwBp0qN73TFBdsA2Bw:1591392979238&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjpxObp0OvpAhUUfH0KHc2sCMQQ_AUoAXoECBMQAw&biw=1440&bih=821#imgrc=RJuNv3jhzb99eM
- https://www.google.com/search?q=schematic+silica+gel+image&safe=active&sxsrf=ALeKk03Z-VSfAWW_HCiGrKsz09lxb7RGOA:1591393346142&source=lnms&tbm=isch&sa=X&ved=2ahUKEwjhyeCY0uvpAhVQX30KHbBQC4oQ_AUoAXoECA0QAw&biw=1440&bih=821#imgrc=j2HfuSV3qZXdOM
- https://www.google.com/search?q=framework+structure+of+zeolites&tbm=isch&ved=2ahUKEwiG94Ca0uvpAhVFIisKHeYABd4Q2-cCegQIABAA&oq=framework+structure+of+zeolites&gs_lcp=CgNpbWcQAzICCAA6BAgjECc6BQgAELEDOgQIABBDOgcIABCxAxBDOgQIABAeOgYIABAFEB46BggAEAgQHjoECAAQGFD2pA1Yt-sNYJnsDWgAcAB4AIABqQKIAakrkgEGMC4yOS4xmAEAoAEBqgELZ3dzLXdpei1pbWc&sclient=img&ei=RLzaXobFLsXErAHmgZTwDQ&bih=821&biw=1440&safe=active#imgrc=Yb7t-IQGzajE6M
- https://www.google.com/search?q=aluminium+triacetate&tbm=isch&ved=2ahUKEwiHw8_r2uvpAhXDEXIKHaymCyQQ2-cCegQIABAA&oq=aluminium+triacetate&gs_lcp=CgNpbWcQAzICCAAyBAgAEBg6BAgjECc6BAgAEEM6BQgAELEDOgcIABCxAxBDOgQIABAeOgYIABAIEB5Qu5EDWPy7A2DXvANoAXAAeACAAcQBiAGUHJIBBDAuMjCYAQCgAQGqAQtnd3Mtd2l6LWltZw&sclient=img&ei=U8XaXsfNGMOjyAOsza6gAg&bih=821&biw=1440&safe=active#imgrc=hIaoFXyKGONJ-M
- https://www.hindawi.com/journals/isrn/2012/982934/
- https://www.google.com/search?q=nitrogen+and+oxygen+separation+PSA&tbm=isch&ved=2ahUKEwjos5CK3OvpAhVSFnIKHZZgA-wQ2-cCegQIABAA&oq=nitrogen+and+oxygen+separation+PSA&gs_lcp=CgNpbWcQA1CuMFipOGC_OWgAcAB4AIABtwGIAZEEkgEDMC4zmAEAoAEBqgELZ3dzLXdpei1pbWc&sclient=img&ei=n8baXqjoMdKsyAOWwY3gDg&bih=821&biw=1440&safe=active#imgrc=n4bjIqvN8vmEkM
- https://www.google.com/search?q=thankyou+slide+chemistry&tbm=isch&ved=2ahUKEwilu7rJ3OvpAhV0EysKHaR5B_gQ2-cCegQIABAA&oq=thankyou+slide+chemistry&gs_lcp=CgNpbWcQAzIECCMQJ1CJqgFYiaoBYJmtAWgAcAB4AIABxgGIAcYBkgEDMC4xmAEAoAEBqgELZ3dzLXdpei1pbWc&sclient=img&ei=JMfaXoiZJvSmrAGk853ADw&bih=821&biw=1440&safe=active#imgrc=7gKoSyI94miHHM
- https://www.google.com/search?q=&tbm=isch&tbs=rimg:CUU8uPJOBt0vIghFPLjyTgbdLyoSCUU8uPJOBt0vEc0Bj1ZFbelGYc0Bj1ZFbelG&tbo=u&ved=2ahUKEwjAzPya3uvpAhXEfX0KHfkkBSgQiRx6BAgBEBI&ictx=1&uact=3#imgrc=IceMMj_hqN07yM&imgdii=RTy48k4G3S9v5M