JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

Design synthesis on PSA base oxygen & Nitrogen cycle

Rajesh B. Jadhav[1], Akshay S.Wadekar[2], Shruti R. Jadhav[3], Sachin S. Musale[4]
[1]Department of Applied, Sciences & Humanities, MITSOC, MIT Art, Design & Technology, University, Pune,Maharashtra
[2]Product System Designe Engineer,Cummins India , Pune,Maharashtra
[3]Department of Artificial Inteligence & Data Sciences,VIIT University Pune,Maharashtra
[4]Department of Applied, Sciences & Humanities, MITSOC, MIT Art, Design & Technology, University, Pune,Maharashtra

Abstract:

Design synthesis on PSA base oxygen & Nitrogen cycle Innovative Process of Simultaneous Generation of Oxygen from air by using Zeolite minerals and Generation of Nitrogen from air by using Carbon Molecular Sieve (CMS) by Smart Design Process of Separation Techniques (SDPST).The principle used in this separation of oxygen from air is pressure swing adsorption of atmospheric nitrogen onto Zeolite minerals and release of oxygen which is collected in the Oxygen cylinder. Adsorption of oxygen on the Carbon molecular sieve (CMS) and separation of Nitrogen from CMS and collection of Nitrogen gas in the Nitrogen cylinders. Principle of PSA is a highly reliable techniques for small to mid-scale oxygen generation. Both Oxygen and Nitrogen are highly useful in the industry for various purposes. For the case of 4-column,4-step operation the result show that an optimum concentration product of oxygen and Nitrogen was above 85 % at the adsorption pressure 4.5 bar ,normal temperature. But by our newly design manufacturing process of alternate use of columns which is packed by using Zeolite minerals and Carbon molecular sieve (CMS) we are very much successful to increase yield of Oxygen and Nitrogen simultaneously.

Keywords: Oxygen, Zeolite, Carbon Molecular Sieve (CMS), Pressure swing adsorption (PSA), Air separation, Adsorption pressure, Equilibrium adsorption, adsorption, desorption

I. Introduction:

Oxygen separation from the air using Zeolite as adsorbent by using Pressure Swing Adsorption (PSA). PSA method is based on two simple principles of science one is pressure and the second is adsorption. The beautiful part of this method is, raw material used for this method is air which is available in excess and is free of cost.

Due to the fast-spreading epidemic in India, the number of infected people is continuously increasing. And in the midst of this disease, the breath of the people also rests only on the strength of oxygen. And now, due to the fast depletion of oxygen in hospitals, people's bodies are also being broken, in view of this problem, we have achieved a great success and found a solution to get rid of the oxygen

problem. We have developed new method of process of separation of oxygen from air by PSA method. Which can increase yield of oxygen tremendously with percentage purity of 93 % +- 3%.
Air compressor is used for the sucking of air through the atmosphere and passes through two columns which are packed by using a special type of chemical Zeolite. A special type of zeolite is used like sodium zeolite, lithium zeolite, and silver zeolite. As all we know, air contains 78 % nitrogen, 21 % oxygen, and 1 % other gases like argon, etc. Let us see, how Oxygen separation from the air using Zeolite as an adsorbent by using Pressure Swing Adsorption (PSA) in various stages.

II. Available method (Old method)

We have prepared oxygen from air by using Pressure Swing Adsorption by the presently available process.
Oxygen separation from the air using Zeolite as adsorbent by using Pressure Swing Adsorption (PSA).PSA method is based on two simple principles of science one is pressure and the second is adsorption. The beautiful part of this method is, that the raw material used for this method is air which is available in excess and is free of cost.

Air compressor is used for the sucking of air through the atmosphere and passes through two columns which are packed by using a special type of chemical Zeolite. Special type of zeolite is used like sodium zeolite, lithium zeolite, and silver zeolite. As all we know, air contains 78 % nitrogen,21 % oxygen, and 1 % other gases like argon, etc. Let us see, how Oxygen separation from the air uses Zeolite as an adsorbent by using Pressure Swing Adsorption (PSA) in various stages.

Stage 1: Air compressors suck air from the atmosphere and compressed air is fed into the first bed. Nitrogen molecules are trapped on the zeolite surface by adsorption (not absorption). And oxygen is allowed to flow and stored in an oxygen tank.

Stage 2: When the zeolite adsorbent in the first bed becomes saturated with nitrogen, the airflow feed is directed into the second zeolite bed.

Stage 3: The adsorbent adsorbs nitrogen to be purged out of the system and released into the atmosphere by desorption of nitrogen from the Zeolite surface.

Stage 4: After desorption of nitrogen from the first zeolite bed, compressed air is once again fed into the first bed. The second bed is depressurized releasing nitrogen molecules into the atmosphere. The process of adsorption and desorption is repeated continuously producing a constant flow of purified oxygen.

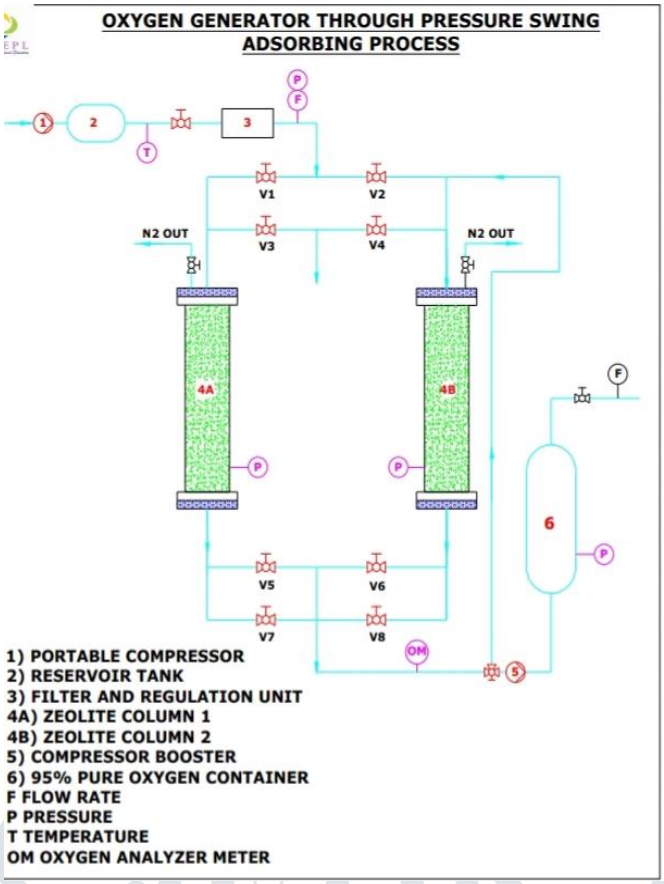

Figure 1 Available method

III. DESIGNED NEW MANUFACTURING PROCESS

There is the use of four or more alternately arranged cylinders packed by using zeolite adsorbent and carbon molecular sieve (CMS).

Stage 1:

i . Air compressors suck air from the atmosphere and compressed air is fed into the first bed packed with zeolite. Nitrogen molecules are trapped on the zeolite surface by adsorption (not absorption). And oxygen is allowed to flow and stored in an oxygen tank.

ii. Air compressors suck air from the atmosphere and compressed air is fed into the second bed packed by Carbon molecular sieve. Oxygen molecules are trapped on the Carbon molecular sieve surface by adsorption (not absorption). And nitrogen is allowed to flow and stored in a nitrogen tank.

Stage 2:

i.When the zeolite adsorbent in the first bed becomes saturated with nitrogen, the airflow feed is directed into the second zeolite bed.

ii. When the Carbon molecular sieve adsorbent in the second bed becomes saturated with oxygen, the airflow feed is directed into the next Carbon molecular sieve bed.

Stage 3:

i.The adsorbent adsorbs nitrogen to be purged out of the system by lowering the pressure and releasing nitrogen due to desorption of nitrogen from the Zeolite surface is also collected in a nitrogen tank. This is the advantage of our process is that there is no wastage of nitrogen gas.

ii. The adsorbent adsorbs oxygen to be purged out of the system by lowering the pressure and releasing oxygen due to desorption of oxygen from the Carbon molecular sieve surface is also

collected in an oxygen tank. This is the advantage of our process is that there is no wastage of oxygen gas.

Stage 4:

i. After desorption of nitrogen from the first zeolite bed, compressed air is once again fed into the first bed. The second bed is depressurized releasing nitrogen molecules into the atmosphere. The process of adsorption and desorption are repeated continuously producing a constant flow of purified oxygen.

ii. After desorption of oxygen from the first Carbon molecular sieve bed, compressed air is once again fed into the first bed. The second bed is depressurized releasing oxygen molecules into the oxygen tank. The process of adsorption and desorption is repeated continuously producing a constant flow of purified nitrogen.

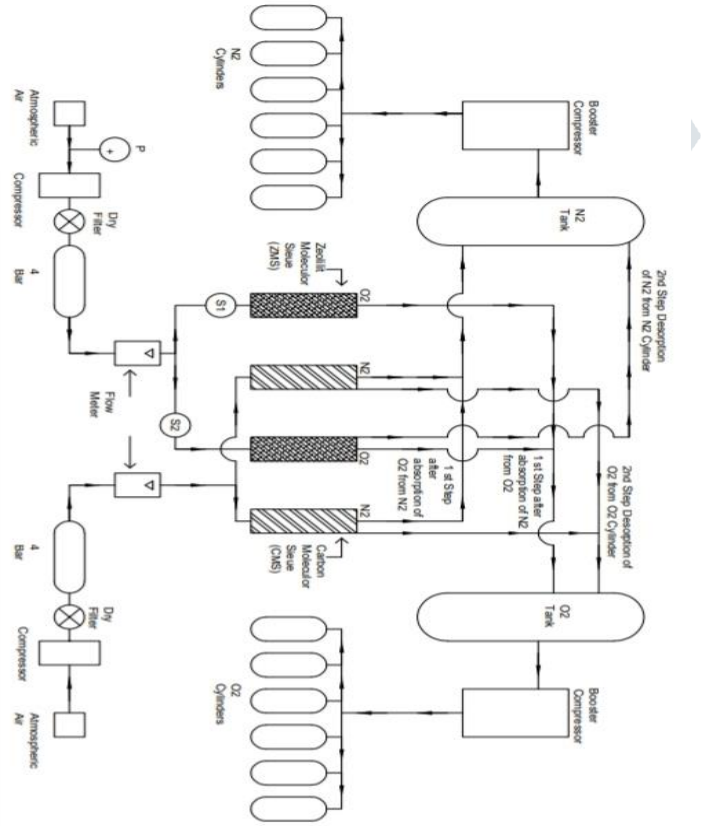

FIGURE 2 **Designed New Manufacturing Process**

IV. RESULT & DISCUSSIONS

The principle used in this separation of oxygen from air is rapid pressure swing adsorption of atmospheric nitrogen onto Zeolite minerals and release of oxygen which is collected in the Oxygen cylinder. Adsorption of oxygen on the Carbon molecular sieve (CMS) and separation of Nitrogen from CMS and collection of Nirogen gas in the Nitrogen cylinders. Principle of PSA is a highly reliable techniques for small to mid-scale oxygen generation .But by our newly design manufacturing

process of alternate use of columns which is packed by using Zeolite minerals and Carbon molecular sieve (CMS) we are very much successful to increase yield of Oxygen and Nitrogen simultaneously. Both Oxygen and Nitrogen are highly useful in the industry for various purposes.

V. CONLUSIONS

PSA based Cycle can be used in many ways to improve the efficiency of the production of oxygen and Nitrogen purity and yield of the gas. After collecting oxygen and nitrogen gas, we can refine the both the gas by PSA and collect maximum gas with higher purity which is more than 95 % with maximize the yield of the both the gas. As a result we can apply 2, 3 & 4 Pairs in PSA towers for better production of Oxygen and Nitrogen. Our research for various methods used in PSA can be applied for pilot production plants.

VI. REFERENCES

[1] Moghadazadeh Zahra, TowfighiJafar, and MofarahiMasoud, "Study of a four-Bed Pressure Swing Adsorption for Oxygen Separation from air", In. J. Chem. Bio. Eng. 1.3 (2008).

[2] Masoud Mofarahi, EhsanJavadiShokroo, "COMPARISION OF TWO PRESSURE ADSORPTION PROCESS FOR AIR SEPARATION UZING ZEOLITE 5A AND ZEOLIT 13X".Petrolum & Coal 55(3)216-225, (2013).

[3] Kirk-Othmer, Encyclopedia of Chemical Technology, volume 1,4th edition, John-Wiley & Sons (1991-1998).

[4] Sircar, S., "Air Fractionation by Adsorption,

Separation Science &Technology", 23(14 & 15), pp.

2379-2396, (1988).

[5] Skarstrom, C. W., "Use of adsorption phenomena in automatic plant-type gas analyzers". Ann. N.Y. Acad. Sci. 72, 751, (1959).

[6] Skarstrom, C. W., U.S. patent 2,444,627 (to ESSO

Research and Engng Co.), (1960).

[7] Skarstrom, C. W., "Heatless fractionation of gases over solid adsorbents", in Recent Developments in Separation Science, Vol. 2. CRC Press, Cleveland, Ohio, 1972.*2*, 95-106 (1972).

[8] Ruthven, D. M.; Farooq, S.; Knaebel, K. S. "Pressure Swing Adsorption". VCH Publishers: New York, (1994).

[9] Pressure Swing Adsorption Technology. Retrieved March 15, (2007), from Oxygen Generating System Intl. Web site:

http: www.ogsi.com/pressure_swing_adsorption_technology.php. (2007).

[10] Pramuk, F. S., Hoke, R. C., &Skarstrom, C. W., "Pressure equalization depressurizing in heatless adsorption". US Patent No. 3 142 547, (1964).

[11] Berlin, N. H., “Method for providing an oxygen-enriched environment”. US Patent No. 3 280 536, (1966).

[12] Wagner, J. L.," Selective adsorption process". US Patent No.3430418 (1969).

[13] Cruz, P., Santos, J. C., Magalhaes, F. D. and Mendes, A.," Cyclic adsorption separation processes: analysis strategy and optimization procedure", Chem. Eng. Sci., 58, 3143 – 3158, (2003).

[14] Santos J.C., Cruz P, Regala T., Magalhaes F.D., and Mendes A., "High- Purity Oxygen Production by Pressure Swing Adsorption", IndEngchem 46, pp 591-599, (2007).

[15] Rege, S.U., and Yang, R.T.," Limits for Air Separation by Adsorption with LiX Zeolite", Ind. Eng. Chem. Res., 36, 5358-5365, (1997).

[16] Anant J. Songsde and R. V. Prajapati.,"Pressure swing adsorption a Cleaner techniques to reduce emission", *IJSRD*, vol.1, Issue 3, (2013).