

PSA Plants a Boon for Healthcare in Modern Times

Saurabh Sharma

Department of Anesthesiology and Critical care, Civil Hospital Palampur, Himachal Pradesh, India

Corresponding Author Email: [dr.saurabh.sh303\[at\]gmail.com](mailto:dr.saurabh.sh303[at]gmail.com)

Abstract: Oxygen as a gas is present in our atmosphere in the percentage of around 21%. It is essential to sustain all the life present on this planet. But when COVID19 erupted it busted our myth of easy availability of this natural entity available to us. COVID 19 pandemic swept across all the world killing millions of people, primarily due to lack of Medical Oxygen. This disease put forth an unprecedented stress on the healthcare system and professionals and demanded a new way to counter this disease. Before this era though medical oxygen was considered as an essential entity but it is during the COVID era need and demand for this increased manifold. As they say that new challenges require new ways. Medical oxygen primarily was available in our system in the form of cylinders. Big hospitals and medical colleges had cryogenic liquid oxygen tanks but they were limited to only few. Then came in Picture PSA plants, full form Pressure Swing Adsorption technology, which extracted oxygen from the air and provided purity upto 96%. these plants not only proved to be life savior but also cost effective in post COVID era.

Keywords: PSA plant, oxygen, medical air, zeolite, carbon and bacterial filter, compressor, air dryer, pressure, Medical Gas pipeline system

1. PSA a Life savior

PSA plant installed in various health facilities had capacity ranging from 500ltrs/min to 1000ltrs/min. The main benefit of this technology is that once installed it remains operational for a very long time, courtesy to zeolite crystals which is the main component for extracting oxygen needs replacement usually after 8-10 years. Other parts like air and oil filters, oil and other consumables are replaced from time to time. This not only reduces overall operational cost of the plant but also reduces the chances that the plant may remain shut down for maintenance. The PSA plant installed in our facility is of 1000ltrs capacity which can cater up to 65

patients on 15 ltrs of oxygen/ patient. During the COVID era our hospital catered to all the COVID and non COVID patients and our institution remained on high to be declared as a COVID care facility. Due to all these developments oxygen demand which was only around 6 to 8 ltrs/ patient during the non COVID era shot up to 12-15 ltrs/patient in COVID times. The general layout of the plant installed at our premises consist of the components in the following order compressor, pre filter, air dryer, air receiver, fine particulate and carbon filter, oxygen generation tanks, oxygen receiver, another fine filter and bacterial filter as shown in the figure 1.

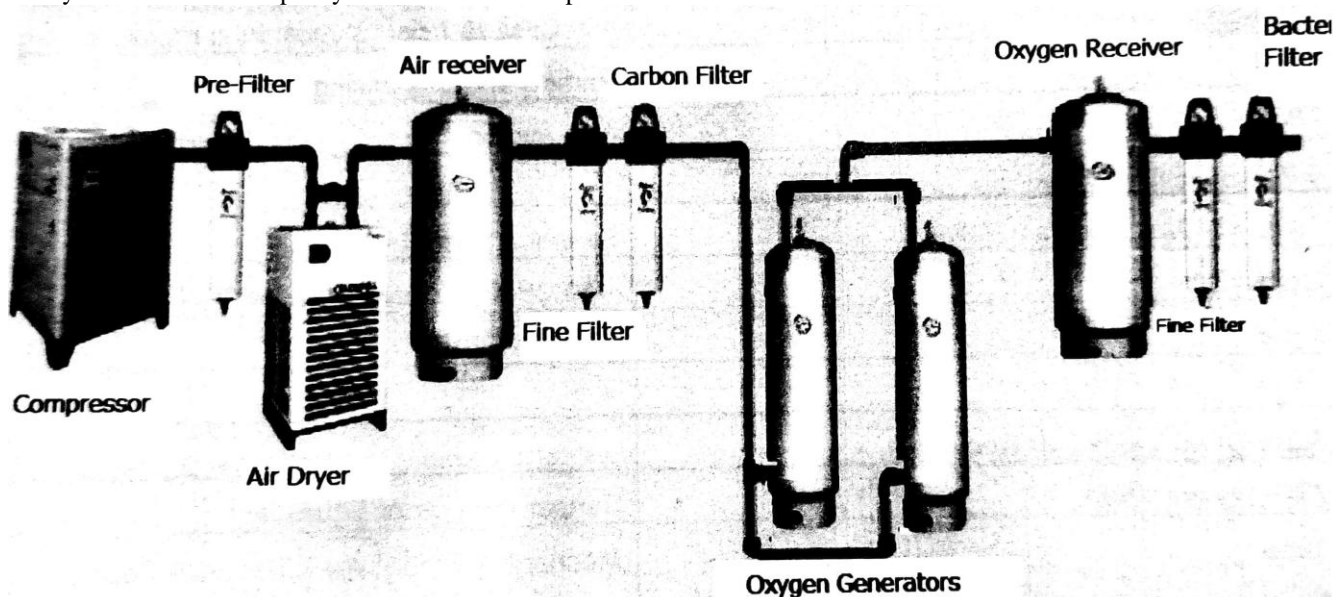


Figure 1

We will be discussing the functionality of each part in detail:-

- 1) Compressor-it is the component through which the atmospheric ambient air is sucked in and transferred after filtration to the air dryer. Here we have two compressors that run alternately each for 4 hours with auto switch function.
- 2) Air Dryer-It is the component which as the name suggests dries the filtered air received from compressor, driving out the moisture to maintain the humidity between defined levels.
- 3) Air Receiver-after drying the purified air is reaches air receiver tank where is temporarily stored.

Volume 12 Issue 2, February 2023

www.ijsr.net

Licensed Under Creative Commons Attribution CC BY

- 4) Oxygen Generators-from air receiver tank it passes through fine particulate filter and carbon filter to reach the main component of the PSA plant which is oxygen generator. This component is based on the of Pressure Swing Adsorption technology in which zeolite crystals are embedded in the mesh which adsorbs oxygen from the received air. This step is essentially denitrogenation or removal of nitrogen from air and increase the concentration of oxygen to the desired levels. Pure oxygen is produced and purity can be reached between 92%-96% after this step which was initially only 21%. This is partially same as enrichment of oxygen from air by oxygen concentrator, only done at large scale.
- 5) Oxygen Receiver-from here the purified oxygen reaches the oxygen receiver tank either for temporary storage or direct utilization at the time of generation if there is high demand. After this the generated oxygen is passes from another set of filters which include fine particulate and bacterial filters.

Caution must be maintained to monitor the PSA plant 24x7 as in case of power failure or development of technical snag, which if remains unnoticed even for few seconds to minutes may lead to catastrophic results. For this there is a uninterrupted power supply available at our facility along with diesel genset as backup. Regular monitoring of the plant along with maintenance is required.

The range of various important parameters required are the following (Fig 2, 3):-

- 1) Oxygen Purity 94% to 98%
- 2) Oxygen Pressure 4.2 bar to 5 bar
- 3) Oxygen flow 60ltrs/min to 1000ltr/min



Figure 2: Menu Display



Figure 3: Monitors showing various parameters

The benefit of this technology is that real time production of oxygen in large quantities right at the site of need, minimizing the wastage of life saving gas. It also reduces the gap between the demand and supply of oxygen seen with oxygen cylinders and other modalities. It saves the cost of logistics and transportation of cylinders.

2. Future of PSA in Post COVID Era

PSA plants proved to be life saviors during the pandemic specially when the availability of oxygen was in short supply and unprecedented demand for it was seen, which the world has not seen any such thing in the recent past. Post COVID these plants are proving very useful in cutting down cost of regular filling of oxygen cylinders, as it is generating almost the quantity of oxygen needed in the pre COVID era. Moreover in some hospitals oxygen bottling plants have been installed which are proving boon to reduce the expenditure done on movement and procurement of this life saving gas.

PSA has also been discussed as a future alternative to the non-regenerable sorbent technology used in space suit, primary life support system, in order to save weight and to extend the operating time of the suit (1)

Declaration of consent

Author certifies that all appropriate consents were taken. The patient understands that the name and identity will not be published and all efforts to conceal the identity will be taken but anonymity cannot be guaranteed.

Financial support and sponsorship

Nil.

Conflict of interest

There are no conflicts of interest.

References

- [1] Alptekin, Gokhan (2005-01-08). "An Advanced Rapid Cycling CO₂ and H₂O Control System for PLSS". NASA. Retrieved 2007-02-24