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Productive Oxygen Concentrator in Today's Scenario

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Abstract: Decades of clinical research into pulsed oxygen delivery has shown variable efficacy between users, and across a user's behaviours (sleep, rest, activity). Modern portable oxygen concentrators (POCs) have been shown as effective as other oxygen delivery devices in many circumstances. However, there are concerns that they are not effective during sleep when the breathing is shallow, and at very high respiratory rates as during physical exertion. It can be challenging to examine the determinants of POC efficacy clinically due to the heterogeneity of lung function within oxygen users, the diversity of user behaviour, and measurement issues. Representative bench testing may help identify key determinants of pulsed-oxygen device efficacy.

Keywords: Oxygen Concentrator , Efficiency , Air , Vent , etc .

1. Introduction

An oxygen concentrator is expected to give advanced oxygen on the side of clinical possibility activities for future investigation human spaceflight programs [Watkins]. It would give persistent oxygen to an evil or harmed team part in a shut lodge climate. Oxygen focus innovation is being sought after to think oxygen from the surrounding climate so oxygen as a consumable asset can be decreased. Since oxygen is a basic asset in monitored spaceflight, utilizing an oxygen concentrator to haul oxygen out of the surrounding climate as opposed to utilizing compacted oxygen can give better streamlining of assets. The general objective of this task is to foster an oxygen concentrator module that limits the equipment mass, volume, and force impression while as yet performing at the necessary clinical abilities.

2.Review Of Related Studies

It gave a brief inside through the literature which are being thoroughly read for understanding and getting an idea of work carried out by the researcher in this field. A lot of literatures including text books, journals, proceedings and websites have been reviewed. Some of the important and relevant literature findings are discussed below:

- **Vermula Rama Rao et. al [2011]** had depended on the hypothetical and trial studied they presumed that a multipurpose examination of pressing factor dropped attributes got through and PPSC estimation was planned and manufactured dependent on the data from reenactment. Quick

cycling of requested 1S among adsorption and desorption stepped was accomplished in PPSA explore.

- **Ismail Atacak et. al [2012]** the deficiency happened in the framework it is stop after a deferral of greatest around 29 second and the data about these defaulter given to the clinic or specialized athority in a brief time frame period and from the test result it is likewise demonstrated that the proposed framework supplies the ideal oxygen immaculateness at the stream speed of 1.3 liter each moment .
- **Borisov Y.A. et. al [2016]** had picked the mathematical boundaries of the fluid concentrator, the guide tube distance across and thickness must be chosen considering the test-tube internal breadth to accomplish uniformity of info and yield segment of the dissipation network. The guide tube submersion in to the test-tube has no critical impact on the dissipation rate and antagonistically influences on the maximal conceivable volume of fluid which might be put in to the test tube. In this manner, the vanishing season of certain fluid volume can either increment or reduction.
- **KOK-KeongChong et. al [2016]** had Dielectric filled CCPC was discovered have been the most reasonable sort of optional concentrator to expand the pressing component by went about as an optical pipe to controlled concentrated daylight onto sun powered cell. It shows that the normal focus proportion of CCPC focal pointed was 4. 07 when contrasted with the mathematical fixation proportion of 5. 998. The misfortune was brought about by reflectance of light after venturing out from a medium to an optically denser medium. The reflectance could've have been decreased by adding AR coat on the passageway opening of CCPC focal pointed and CPV surface .
- **P.Moraitis et. al [2018]** had the new advancement in the planned of colloidal nanocrystals the joined objective of accomplishing LCS with the expansive range inclusion and stifle the retention have had gotten possible .
- **Dion C. Martin et. al [2019]** outcomes were steady of contemporary POC setting off capacities. The distinctions appeared in extreme trigger affectability may had importance to oronasal breathing during rested or other testing situations for beat oxygen conveyance, for example, prevailing mouth breathing during effort or horrible nasal math. Every one of the three POCS performed well during mimicked breathing during effort and very still. Contrasts in setting off capacity was noted for the situation of oronasal breathing during rested.

3.Objectives Of The Study

This paper aims to :

- increase efficiency of manual concentrator.
- increase life of a concentrator.

Working :

- Ambient air (room air) going through a progression of channels is brought into the machine by a blower.
- This air is compacted into the first atomic sifter bed and all the Nitrogen is adsorbed. The atomic sifter beds are permeable and in this manner have enormous surface region because of which they adsorb huge measure of Nitrogen.

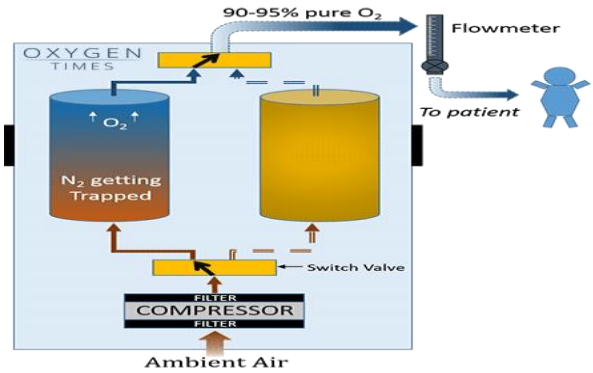


Fig 1: Air entering the blower & Nitrogen is getting trapped.

- Now in light of the fact that air had just Nitrogen and Oxygen as principle segments; the essential gas that remains is Oxygen. This Oxygen has a centralization of up to 95% and is fit to be provided to patient through Oxygen conveyance framework like Nasal Cannula, Breathing device, and so on

- The blower continues compacting air into the first sub-atomic sifter bed till it gets soaked (filled) by Nitrogen. The strainer bed normally gets immersed at pressing factor of 20 psi.

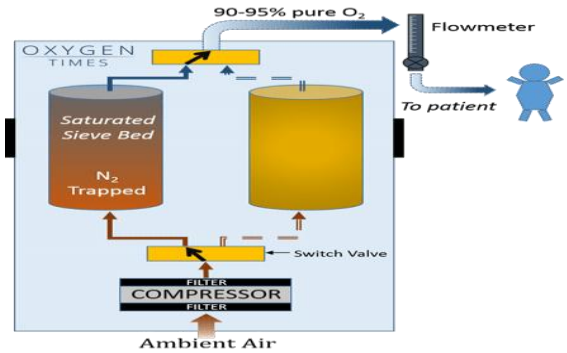


Fig 2 : Oxygen moving toward saturated sieve bed .

- Just before first atomic sifter bed gets immersed, the Switch Valve comes right into it and yield of the air blower is quickly changed to second strainer bed for example the blower begins compacting air to the second atomic sifter.

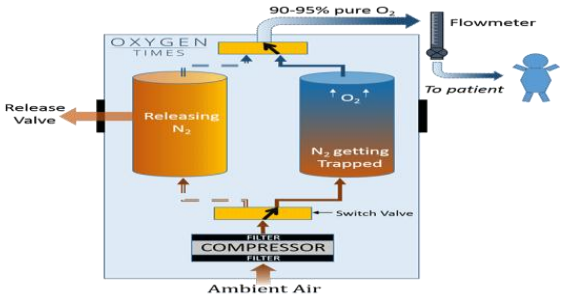


Fig 3: Blower begin compacting air to the second atomic sifter .

- While this strainer bed gets immersed by Nitrogen, the Nitrogen that was caught in the first sifter bed is vented out . The little Nitrogen that is left in the sifter bed in the wake of releasing is eliminated by back-flushing of Oxygen from the other strainer bed.
- The switch valve again switches the yield of air blower back to the first strainer bed when the second sifter bed approaches immersion.

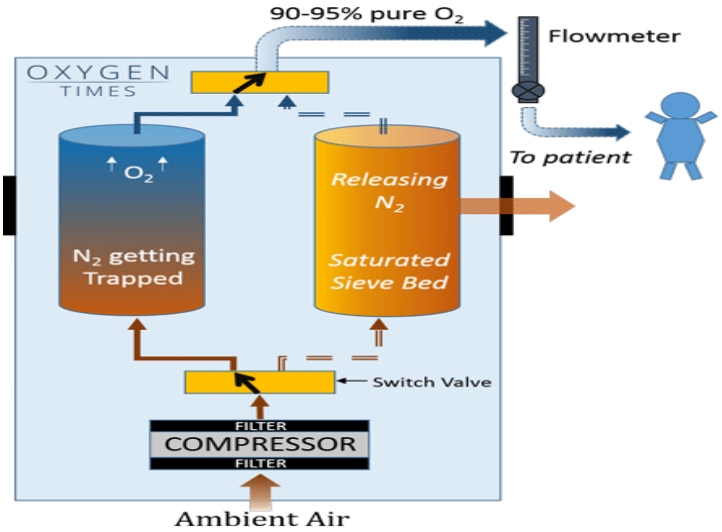


Fig 4 : Switch valve again switches the yield .

- This measure continues rehashing to guarantee persistent progression of Oxygen.
- This cycle of exchanging the sifter beds is known as Pressing factor Swing Adsorption (PSA).
- The yield of Oxygen is then controlled utilizing a flowmeter where the stream can be set physically in Liters Each Moment (LPM).
- Oxygen streams out through an outlet where an Oxygen conveyance framework like nasal cannula or a cover is generally associated by means of humidifier.

Components of oxygen concentrator:

Fundamental segment of oxygen concentrator are :

- **Series of channels**: To sift through contaminations present in air.
- **Air Blower**: To push room air into the machine and forward it to the sub-atomic sifter beds.
- **2 Sub-atomic Sifter Beds :** Zeolite (Miniature permeable Aluminosilicate mineral): Can trap Nitrogen.
- **Switch valve**: Switches the yield of blower between the 2 sub-atomic sifter beds.
- **Oxygen outlet:** An initial that gives out oxygen to the patient.
- **Flow meter :** To set the stream in Liters Each Moment (LPM).

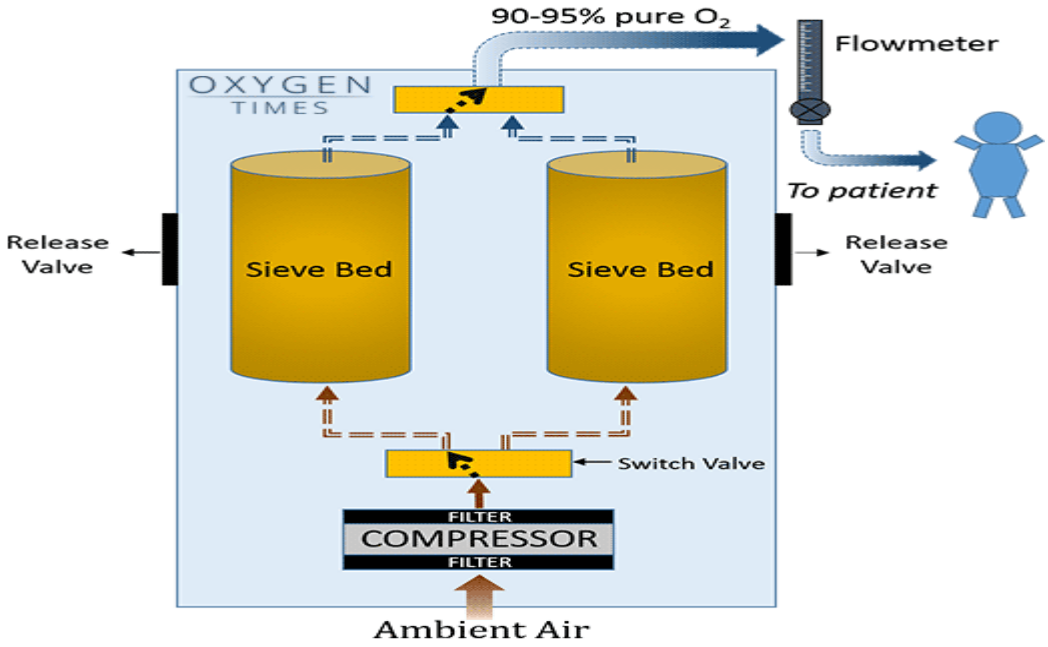


Fig5 : Component of Oxygen Concentrator.

Principle :

The arrangement of air (78% Nitrogen, 21% Oxygen and 1% different gases like Carbon Dioxide, Argon, and so forth) obviously shows that air is predominantly contained two gases: Nitrogen and Oxygen [together 99%]. On the off chance that Nitrogen is taken out from air, the essential gas remaining would be Oxygen with immaculateness of around 90-95%. An Oxygen Concentrator utilizes this thought with the essential guideline of Pressing factor Swing Adsorption (PSA) to convey 90-95% unadulterated oxygen.

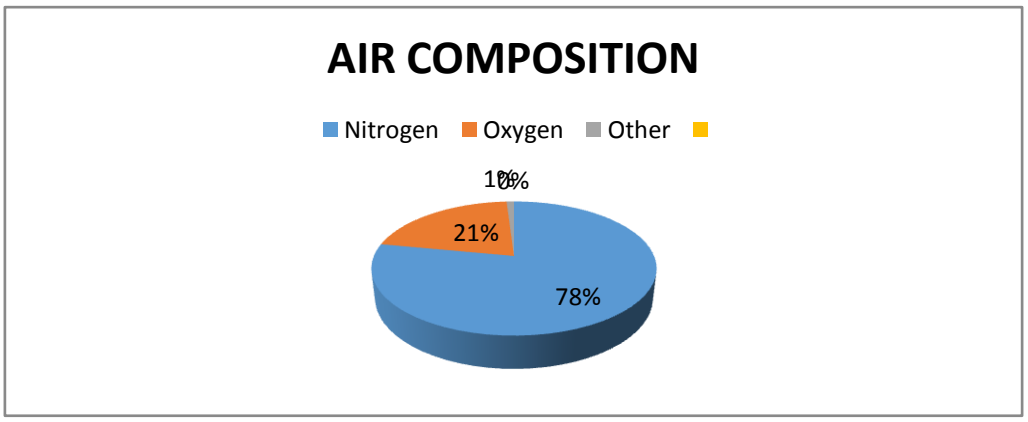


Fig 6 : Air Composition .

Nitrogen removing process :

Techniques were discovered that dependably discrete explicit gas components. One of these has been received for most oxygen fixation frameworks. PSA (Pressing factor Swing Adsorption) makes this

division happen utilizing pressure, as the name suggests. Pressing factor alone doesn't play out the sorcery. A unique material was likewise evolved to accomplish the difficult work. This material is called Zeolite and is really an infinitesimal 3D shape with openings on every one of the six sides. Nitrogen particles artificially cling to its surfaces as they go through; letting just Oxygen and 'Other' components course through unhampered.

The Zeolite is housed in impenetrable chambers called 'strainer beds'. Most oxygen concentrators utilize two of these 'beds' (more on that later). Obviously, when the Zeolite has adsorbed its most extreme heap of Nitrogen atoms it can't stop the remainder of the Nitrogen from going through.

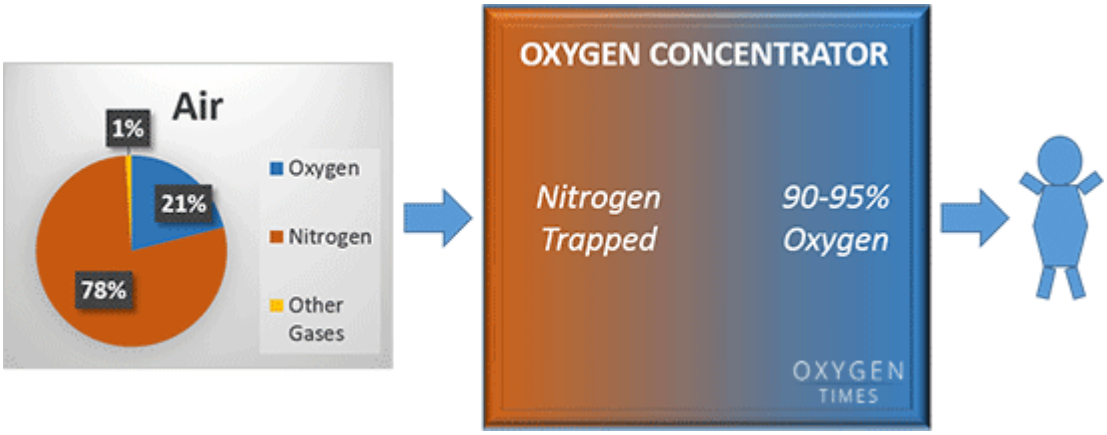


Fig7 : Purification of Air .

Types of Oxygen Concentrators :

In general, there are two types of oxygen concentrators: stationary and portable.

- ✓ **STATIONARY :** Most fixed oxygen concentrators weigh under 27 kg and have wheelswith the goal that they are effectively mobile by the client. They are selfcontainedgadgetsthat inventory an affordable, consistent stream of oxygen at stream rates up to 10 liters each moment (LPM). Low streams, down to 0.1 LPM, might be conveyed through the underlying flowmeter or with extra embellishments. Most concentrators that are proper for wellbeing offices can convey in any event 5 LPM and work on exchanging flow power, and burn-through roughly 280 - 600 watts (W), contingent upon the model (Allude underneath table). Separate models for 110 - 120 VAC (ordinarily 60 Hz) and 220 - 240 VAC (normally 50 Hz) are for the most part accessible from the maker to coordinate with the voltage and recurrence of the nearby matrix power7.

Fig8 : Stationary Concentrator .

- ✓ **PORTABLE** : Portable oxygen concentrators have a lower yield limit (3 LPM or less), burn-through less force than their fixed partners (around 40 - 130 W) and are utilized by singular patients as wandering oxygen frameworks. They may contain batteries fit for working on direct current (DC)7.

Fig9 : Portable concentrator .

4. PROPOSED METHODOLOGY :

The oxygen concentrator will be fit for conveying a persistent stream at a centralization of oxygen more prominent than 82%. The base oxygen fixation will be kept up at the greatest evaluated stream rate, at 40 °C, 95% relative stickiness (RH) and air pressure addressing a height of 2000 m above ocean level.

- The yield stream pace of air from the blower of the manual, bike controlled, oxygen concentrator was estimated while hawking at a consistent rate.
- Rates were chosen that could produce an output of over 90% oxygen.
- The work done in one hour was calculated by multiplying the volume of air per hour from the compressor of the oxygen concentrator, by the pressure of the tank that this air was compressed into, using the equation:
  $W = -P\Delta V$
- The power consumption was found by the equation:
  $P = Wt$
- This was done for oxygen output flow rates of 1, 1.5, and 2.0 L/min.
- Power consumptions and oxygen output flow rates were found for 16 electrically powered stationary commercial oxygen concentrators, and 8 battery powered commercial oxygen concentrators.
- The oxygen output flow rates of each kind of oxygen concentrator were compared as a function of power consumption.

Comparison between Oxygen Cylinder & Oxygen Concentrator :

	Oxygen concentrators	Compressed oxygen cylinders
Power source required	Yes, continuously (according to model: 100–600 W)	No
Transport required	Only at the time of installation	Yes, regularly; heavy and costly to transport
Exhaustible oxygen supply	No, continuous supply as long as power remains uninterrupted	Yes, depending on the size, storage pressure, and patient needs
User care	Moderate: cleaning of filters and device exterior, and minimise fire hazard	Minimal: regular checking, minimise fire hazard (no grease or flammables)
Operational costs	Small: electricity and maintenance	High: cylinder refills and transport from refilling station to a hospital
Maintenance	Moderate: check for low oxygen output with analyser	Moderate: check for pressure leaks with gauge

Table 1 : Comparision between Oxygen Concentrator & Compressed Oxygen Cylinder .

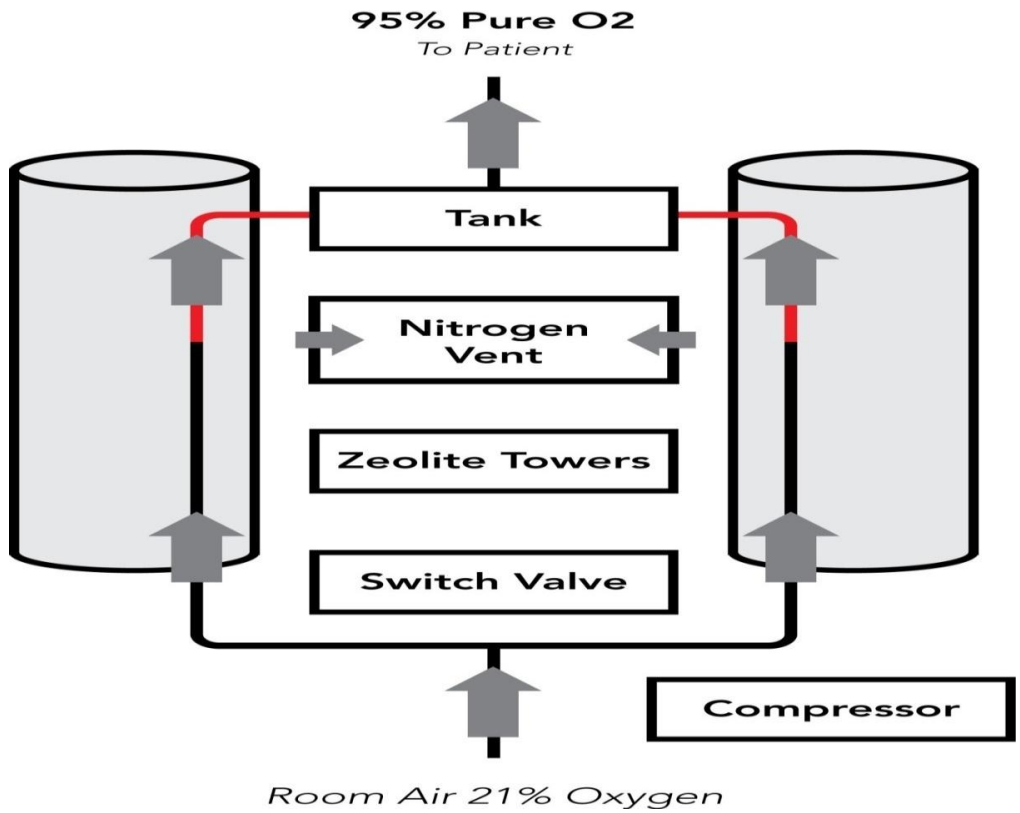


Fig10 : Block diagram of typical oxygen concentrator.

The regular oxygen concentrator, comprise of an air blower, two chambers loaded up with zeolite pellets, a pressing factor evening out repository, valves and tubing. Typical room air is roughly siphoned into a chamber where the nitrogen and carbon dioxide are consumed by the pellets and 90%+ unadulterated oxygen is siphoned into a supply. As the oxygen is exhausted in one chamber, it then, at that point delivers the nitrogen back into the air. Right now the other chamber goes through a

similar interaction. Together, they make a rotating stream of oxygen into the repository where is stays until the clients relaxes.

Advantages of an Oxygen Concentrator :

Concentrators are intended for ceaseless activity and can deliver oxygen 24 hours out of every day, 7 days of the week, for as long as 5 years or more. These gadgets can be utilized at any degree of wellbeing office. Be that as it may, not utilized in profoundly particular consideration units like ICUs,, where unified oxygen supply is liked. They are exceptionally material in circumstances which require locally established supplementation is demonstrated, for example, COPD, Rest Apnea and so on For these there is a requirement for persistent wellspring of solid force and a framework for standard cleaning and upkeep by clients and specialized faculty the same. While most oxygen concentrators work by similar standards, spare parts are not tradable between various models .

Drawbacks of an Oxygen Concentrator :

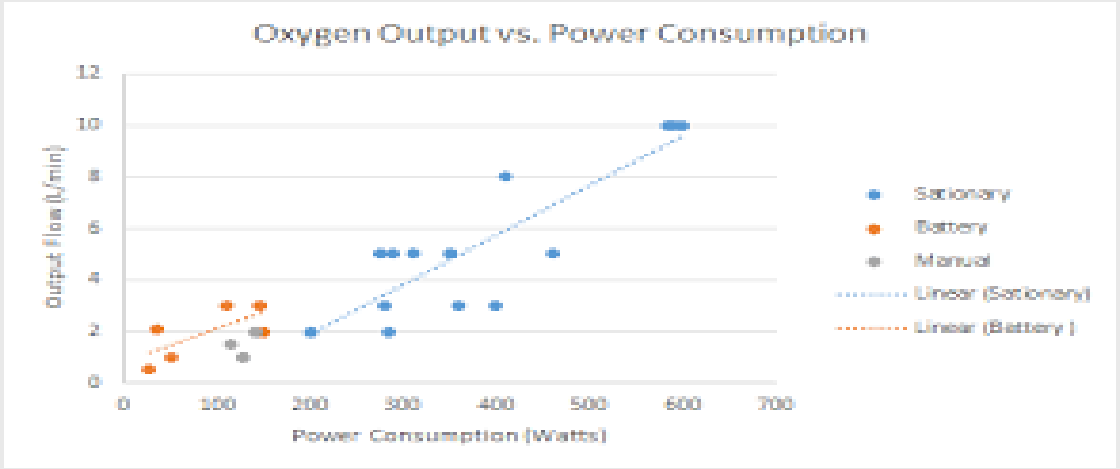
Because of their low stream limit, they are not appropriate for concurrent use by numerous patients. What's more, numerous compact gadgets contain a system that permits oxygen conveyance just during motivation. This sort of stream, known as beat portion or irregular stream, rations oxygen and battery power. Note that a few babies and little youngsters may not create sufficient negative pressing factor during motivation to dependably trigger oxygen stream .

5. RESULT :

- Our manual powered oxygen concentration system has similar efficiency of oxygen output compared to power consumption as electrically powered oxygen concentrators currently on the market.
- The output flow vs. power consumption for the manually powered oxygen concentrator was slightly higher than the trend line for stationary concentrators, and slightly below the trend line for battery powered concentrators.
- If we are able to generate more power we would expect the oxygen output to increase at a similar rate to the oxygen concentrators on the market.
- Further modifications to our bicycle oxygen concentrator system may be able to increase the efficiency.
- This system has potential to be used as a backup oxygen source in case of power failure.

Output Flow Rate (L/min)	Flow From the Compressor (L/hr)	Average Pressure (PSI)	Power Consumption (Watts)
1.0	2966	22.6	128
1.5	2966	20.0	115
2.0	3582	20.8	142

Table 2: Power consumption values from the manual oxygen concentrator for output flow rates of 1.0, 1.5, and 2.0 L/min .



- ✓ The stationary oxygen concentrator data had a linear trend line of: $y = 0.0193x - 1.9757$
- ✓ The battery powered oxygen concentrator data had a trend line of: $y = 0.0129x - 0.818$

Fig 11: Plot of power consumptions and output flow rates for each of the stationary, battery powered, and manually powered oxygen concentrators.

To increase the life of the concentrator make sure the side form filter are clean weekly and as needed. The internal filter must also be changed every six months depending on patient use. To prolong the use of your concentrator early pm should be included. Make sure the correct soft got supplies are you to alleviate any errors.

While concentrators are a very efficient means of oxygen for patients are the cylinders ability to function without needing to be connected to power makes it a great choice when a patient is in transport coma if a power outage has occurred or if a concentrator is not available.

6. CONCLUSION :

- ❖ Oxygen concentrators are less perilous than oxygen chambers. This makes them especially beneficial for open air use.
- ❖ They are likewise solid enough to be given patients at home.
- ❖ This gadget this gadget gets rid of the issue of recharging chambers at ordinary stretches.
- ❖ In this manner it assists with controlling expense of providing oxygen to the patients.
- ❖ The tough clinical hardware industry has that quickly embraced the utilization and production of the gadget.

REFERRENCE :

JOURNAL :

1. VEMULA RAMA RAO A THESIS SUBMITTED FOR THE DEGREE OF DOCTOR OF PHILOSOPHY DEPARTMENT OF CHEMICAL AND BIOMOLECULAR ENGINEERING NATIONAL UNIVERSITY OF SINGAPORE 2011.
2. ISMAIL ATACAK*, MUZAFFER KORKUSUZ† and OMER FARUK BAY‡ Department of Electronics and Computer Education Gazi University 06500 Ankara, 2012 .
3. Borisov Y.A.a *, PugachukA.S.a ,ChernyshevA.V.a a Bauman Moscow State Technical University, Baumanskaya 2-ya st., 5/1, Moscow, 105005, Russian Federation 2016 .

4. Kok-Keong Chong*, Tiong-Keat Yew, Chee-Woon Wong, Ming-Hui Tan, Woei-Chong Tan, Boon-Han Lim, An-Chow Lai Lee Kong Chian Faculty of Engineering and Science, UniversitiTunku Abdul Rahman, Bandar Sungai Long, 43000 Kajang, Selangor, Malaysia 2016 .
5. P. Moraitisa , R.E.I. Schroppb , W.G.J.H.M. van Sarka,∗ a Copernicus Institute of Sustainable Development, Utrecht University, Utrecht, The Netherlands bDebye Institute for Nanomaterials Science, Utrecht University, Utrecht, The Netherlands 2018 .
6. Dion.C.Martin ResMed Science Center, ResMed Ltd, Elizabeth Macarthur Drive, Bella Vista, Sydney, Australia 2019 .

WEBSITES :

- https://www.medicaldesignandoutsourcing.com/clippard-and-o2-concepts-build-a-better-portable-oxygen-concentrators/ .
- https://tribecacare.com/blog/how-is-oxygen-concentrator-different-from-oxygen-cylinder/.