

OXYGEN CONCENTRATORS AND THE NEED FOR IT IN TIMES OF COVID 19

Shashwat Singh

Shikshantar Senior Secondary School

DOI: 10.46609/IJSSER.2022.v07i11.017 URL: <https://doi.org/10.46609/IJSSER.2022.v07i11.017>

Received: 15 November 2022 / Accepted: 29 November 2022 / Published: 2 December 2022

ABSTRACT

The outbreak of the Novel Corona Virus in 2019 resulted in global concern. It impacted the economy of various countries. People were facing challenges in keeping their health intact as the virus was impacting their respiratory systems. Infected people were developing many problems, and the major concern was breathing problems. This research paper highlights the importance of oxygen concentrators which became a dire need during the covid times, and their technical use followed by explaining the process of making oxygen concentrators. The paper concludes that an oxygen concentrator can be made using Arduino uno and can provide 65% purity of oxygen if lower grade zeolite is used. If the higher grade of zeolite (13x grade) is used, this would result in 95-98% purity of oxygen when the flow rate is under 30L/min.

Keywords: Covid 19, Oxygen Concentrator, Oxygen shortage, Healthcare

Introduction

The year 2019 can never be forgotten as this was the year when the entire world witnessed a deadly virus that started claiming the lives of many people. The Covid-19 Virus engulfed the entire world which was put under lockdown to curb the spread of this deadly virus. However, it was impossible to contain this virus as it was so contagious that it was spreading even without any physical contact with the infected person. Those who were infected with this virus were facing difficulties in breathing and had various other symptoms like high fever, headache, etc. It was the second wave of Covid-19 when the huge need for oxygen concentrators was felt as the infected people were unable to breathe properly. This shortage of oxygen was putting the lives of the infected and other people at risk hence people were struggling to arrange oxygen concentrators as it was acting as an elixir at that time. (Dive, 2021)

Importance of Oxygen Concentrators and their Technical use along with the Impact

Oxygen concentrators were in high demand during Covid times when the virus was attacking the lungs of the host and making them experience breathing disorders. An oxygen concentrator can be used as a medical device for providing treatment to sick people as well as in industries for different activities (Smith et al., 2020). An oxygen concentrator is a device that filters out nitrogen so that the amount of oxygen can be increased. Another use of oxygen concentrators is in the pharma industry, manufacturing of glass, and treating water.

Methodology

My family was also not left untouched by the effect of this virus. My grandfather also got infected with this virus and fell ill. Since we knew that there was limited oxygen availability in the market and hospitals, hence understanding the gravity of the situation, I attempted to make the oxygen concentrator. The confidence to make an oxygen concentrator came from my father who motivated and helped me make the prototype of an oxygen concentrator. It also helped that I had a good knowledge of materials and their properties. Below is the methodology explained for making oxygen concentrators:

I used a simple line diagram which can be easily found in online sources. Additionally, I used valve operation times for making an oxygen concentrator. Since I did not use fine-grade zeolite, the purity recorded was only about 65%. However, by using fine-grade zeolite, the purity can be increased.

The Materials used:

VALVES & REGULATOR
3-Way Solenoid Valve 3/8" NPT
2-Way Direct Acting Solenoid Valve 1/4" NPT
Miniature Air Pressure Regulator 1/4" NPT
Low-Pressure Regulator
Pressure Gauge
Oxygen Air Gas Flowmeter

FITTINGS

3/8" Male NPT to 3/8" Push to Connect – Strait

3/8" Male NPT to 3/8" Push to Connect - 90 Elbow

3/8" Push to Connect to 3/8" Push to Connect to 3/8" Push to
Connect - Tee

3/8" Push to Connect to 3/8" Push to Connect to 3/8" Push to
Connect - Y

1/4" Male NPT to 3/8" Push to Connect - 90 Elbow

1/4" Male NPT to 3/8" Push to Connect – Strait

Brass/Stainless 3/8-Inch tube PTC x 1/4-Inch Male NPT - Coupler

TUBING

High Density Polyethylene Tubing, 1/4" ID, 3/8" OD

Clear Vinyl tube, 1/4" ID, 3/8" per roll OD

1.5mm orifices

BRAIN COMPONENTS

Arduino Uno Board

4 relays board (DC)

12V 40-watt power supply

Wire for cabling

HEAT/HUMIDITY MANAGEMENT COMPONENTS

3/8" OD Copper Tubing
12V DC 120mm High-Speed Cooling Fan
Humidifier Water Bottle
COMPRESSOR
Air Compressor (25 to 30 L per min)
SIEVE PVC PARTS
3" Diameter PVC Pipe Female Adapter
End Covers for 3" pipe
SIEVE INTERNAL PARTS
2" Diameter x 3" Tall - Compression Springs with 50 lb per inch tension
304 Stainless Steel Woven 100 Mesh 0.18mm to 0.2mm Hole Disk 75mm
304 Stainless Steel Woven 100 Mesh 0.18mm to 0.2mm Hole Disk 71mm
Non-woven Filter Material
PVC Solvent
10Kg Zeolite (13 x grade for higher purity)

Process

The principle used in the process is PSA (pressure swing adsorption) technology. The impure air enters the compressor from the inlet. The air then moves to the water filter. At this stage, all the moisture gets removed and the air enters the valve which opens sieve A & B alternatively. This is done so that the filtered oxygen passes through sieve A and in the mean time sieve B gets time to recharge by releasing the Nitrogen accumulated after filtering the natural air. The pressure is reduced in Sieve tube A / B. This allows for the nitrogen to escape into the environment. This sequence happens alternatively with sieve A & B. Both the sieves have zeolite which allows oxygen to pass but blocks nitrogen. From both the sieves the oxygen gets accumulated in sieve C

which serves the purpose of storage. From sieve C the oxygen is then extracted for desired applications.

Result and Discussion

After putting an oxygen purity meter at the outlet of the oxygen concentrator, it was observed that at a below flow rate of 30 liters/min the purity of oxygen was more than when the concentrator was running at full output. The purity was 65% with impure zeolite and the purity can potentially be increased to 95-98% (flowrate 30L/min) if pure zeolite (13x grade) is used. From this process, the oxygen concentrator which has been made can prove substantially beneficial for people who are suffering with breathing disorders and diseases and need oxygen. The hospitals and other sectors where oxygen concentrators are used can get an advantage from this oxygen concentrator. This oxygen concentrator is easy to use as it does not involve any complexities.

Conclusion

To sum up, Covid 19 left the healthcare sector crippled, and weakened many other sectors. Everywhere there was chaos and people were running here and there to save the lives of their near and dear ones. For at least three consecutive years this virus has adversely impacted our lives and claimed millions of lives across the world. During such terrible times, oxygen concentrators can bring relief to people and provide support so that their health can be improved. Simultaneously, many researchers, scientists, and doctors worked day and night to develop a vaccine. It was after many months of hard work a ray of hope was seen when a vaccine was developed. It finally provided some ease to people. The people resumed their work and the economy also started becoming stable. The world slowly entered a new stage where everyone uses masks and sanitizers.

References

Dive. (2021, March 25). COVID-19 Study: Oxygen Cylinder and Concentrator Market Portable product are expected to grow at a notable rate in coming years. openPR.com. Retrieved November 9, 2022, from <https://www.openpr.com/news/2261727/covid-19-study-oxygen-cylinder-and-concentrator-market>

Smith, Baker, Demombynes, & Yadav. (2020, May 5). *COVID-19 and Oxygen: Selecting*

Supply Options in LMICs that Balance Immediate Needs with Long-Term Cost-Effectiveness. cgdev.org.