iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 11 **Issue:** IV **Month of publication:** April 2023

DOI: https://doi.org/10.22214/ijraset.2023.50215

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 11 Issue IV Apr 2023- Available at www.ijraset.com

Zeolite Based Portable Oxygen Concentrator

K Poornima Kamath[1], Prakash Bhajantri[2]
[1, 2]*Dept. of Electronics and Communication, B.M.S. Evening College of Engineering*

Abstract: Everyone here has begun to rethink about sustainability and self-sufficiency of oxygen due to the demand for it and the inadequacy brought on by the second wave of the Corona outbreak. For individuals with severe COVID symptoms, medical oxygen therapy is a common treatment. At the global stages, strategies must be made to ensure a steady supply of oxygen to fulfil the escalating demand for the oxygen. A device called an oxygen concentrator can deliver pure oxygen for therapeutic purposes. The issue of hospital bed shortages during the pandemic, which resulted in the deaths of thousands of people nationwide, served as our inspiration for this project. As a result, the concept of an economical oxygen concentrator was conceived. This oxygen concentrator makes use of zeolite granules and an air-tight system so that there is no leakage or the purity of oxygen is not jeopardized.

Keywords: Oxygen Concentrator, Zeolite, Portable

I. INTRODUCTION

The breathing and metabolic functions of living organisms both depend critically on oxygen. Today, misuse of oxygen cylinders is a major cause for worry. A symptom of respiratory distress could be when the blood saturation level fails below 94%. For patients with lung disorders like COVID-19, chronic obstructive pulmonary disease, pneumonia, chronic bronchitis, among others, oxygen concentrators have found widespread application in aiding home- based oxygen therapy. More than 20 million instances of Covid-19 had been reported in India by May 2021, prompting healthcare practitioners to explore outside the norm for oxygen solutions. Nearly 15% of Covid-19 patients, by WHO estimations, need oxygen therapy[1].

II. SOURCES OF OXYGEN SUPPLY IN HOSPITAL

A. Oxygen Cylinders

The oxygen that we breathe in through the air is essential for human survival. Lung disorders can restrict a patient from getting enough oxygen in their blood, leaving them short of breath and putting their organs at risk. In the context of oxygen therapy, this is where oxygen cylinders are relevant. An oxygen cylinder is a storage container which supplies oxygen to a patient through a surgical mask over the nasal cannula.

Oxygen cylinders are available in different capacities and they are chosen depending upon the condition of the patient. The cylinders don't need a power source or expensive maintenance when they are filled. As a result, regular maintenance is important and will be carried out by the gas suppliers upon replenishment. During COVID-19, due to frequent transit between production sites, warehouses, medical institutions, shops, and eventually a patient's bed, the use of oxygen cylinders may increase the risk of a fall or rupture, as they must be refilled on regular basis.

B. Liquid Oxygen Tanks

The oxygen is stored in a vacuum insulated evaporator at a pressure of 5-10 atmospheres in a thermally insulated vessel at temperatures ranging from – 150◦Cto - 170◦C. At one atmospheric pressure, one L of liquid oxygen at 15◦C can produce 842 L of gas. A typical VIE holds 5000–10,000 litres of liquid oxygen. A full 10,000 L tank of liquid oxygen could be equivalent to 1200 “J” type 6800 L cylinders.

C. Oxygen Concentrators

They are of two types 1. Pressure Swing Adsorption (PSA)
2. Portable oxygen Concentrators (POC)

They necessitate a constant supply of electricity as well as routine maintenance. Power stabilisers or an uninterruptible power supply (UPS) may be required when power supplies are insufficient or susceptible to voltage fluctuations. They do not need to be re-supplied on a regular basis once installed, but they do need to be maintained on a regular basis. These devices produce up to 95.5 percent concentrated oxygen and can be used to provide oxygen therapy at any level of health facility. [2]

III. PROPOSED DESIGN

A. Block Diagram

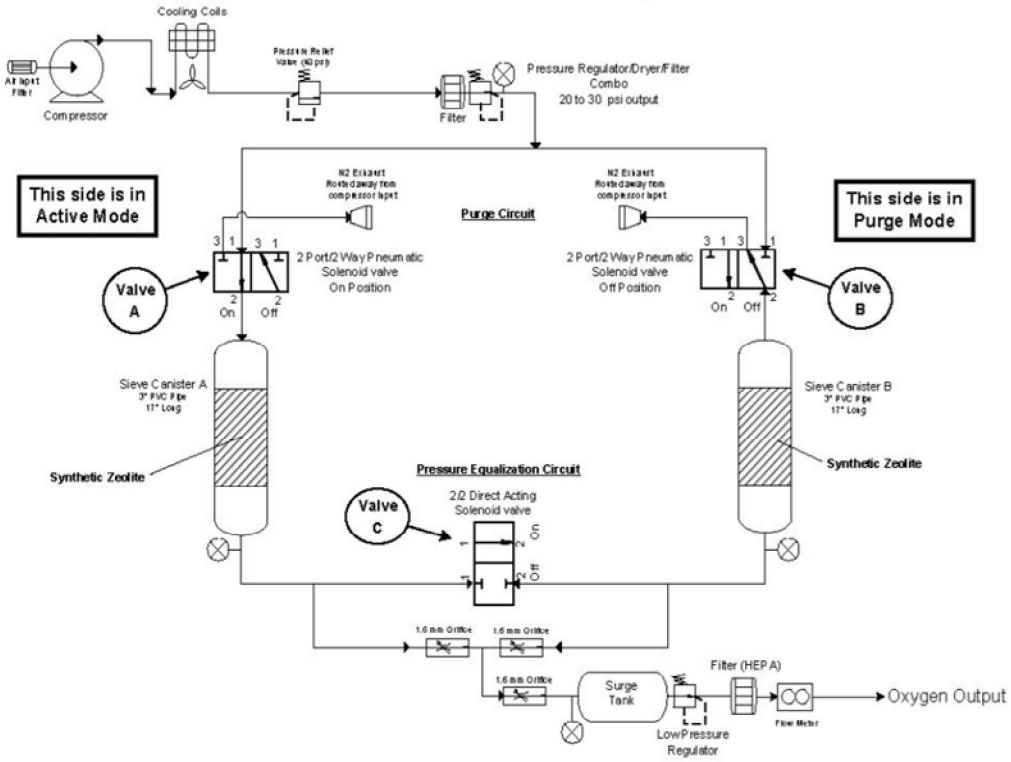


Figure 1: The block diagram of proposed oxygen concentrator

The above figure shows the block diagram of Oxygen Concentrator project. It consists of Air Compressor which helps in air intake from the atmosphere. Then the air passes through the cooling coil and fans to the 5/2way solenoid valves which are operated for the alternative half cycles. It consists of two containers which are filled with zeolite granules, which adsorbs the nitrogen molecules and allows oxygen gas to pass through it. The surge tank is used to store the pure oxygen.

An air compressor is a device that transforms power by pumping in air, expelling it, and converting air pressure into useful energy that aids in moving liquid through a pipe using a gasoline, diesel, or electric engine. As the compressed air is released and the tank depressurizes, the kinetic energy it provides can be employed for a variety of tasks, such as operating pneumatic tools. The air compressor restarts and pressurises the tank when tank pressure falls below its lowest safe level.

The compressed air is filtered into the concentrator with the help of an air filter. The air filter cleans the air by removing dust particles. A particulate air filter is a device composed of fibrous, or porous materials which removes solid particulates such as dust, pollen, Meld, and bacteria from the air. Filters containing an adsorbent or catalyst such as charcoal may also remove doors and gaseous pollutants such as volatile organic compounds or ozone.

Pressure swing adsorption (PSA) technology is used by oxygen concentrators to produce oxygen-enhanced gas that is discharged for use by patients who need medical oxygen because their blood oxygen levels are too low. So far, zeolites have not been mentioned. However, they are the heart of an oxygen concentrator. In order to absorb atmospheric nitrogen and release it into the atmosphere, oxygen concentrators use molecular sieves made of zeolites. As a result, this kind of absorption device effectively acts as a nitrogen scrubber while allowing other ambient gases to pass through. The principal gas that is still present is oxygen. The porous zeolite absorbs a lot of nitrogen under high pressure because of its enormous surface area and chemical nature. After, the oxygen and other free components are collected the pressure drops which allows nitrogen to desorb. Zeolites function as a simple nitrogen molecule filter. Natural zeolite is a sorbent used in the filtration of water. It performs better than sand and carbon filters, resulting in purer water, higher throughput rates, and less maintenance. It may be used to directly replace sand in a typical sand filter and has numerous advantages over sand.

The proposed portable oxygen concentrator developed is shown in the image below.

Figure 2: Assembled zeolite based protable oxygen concentrator

B. Result

The purity level of oxygen obtained for the design proposed is approximately 94.9 %

Figure 3 Purity level of oxygen

IV. CONCLUSIONS

Due to a massive surge in COVID-19 cases all across India, there was an acute shortage of medical oxygen. With oxygen cylinders in short supply, the concentrator has emerged as the most sought-after device for oxygen therapy. However, it is important to note that the device should only be used by people with mild COVID-19. The device is unsuitable for people with oxygen saturation levels below 85% and those with severe COVID-19. Such people should seek immediate medical attention.

Oxygen concentrators are less dangerous than oxygen cylinders. This makes them particularly advantageous for outdoor use. They are also reliable enough to be provided to patients at home. This device does away with the hassle of replenishing cylinders at regular intervals. In this way it helps to control cost of supplying oxygen to patients. The durable medical equipment industry has rapidly adopted the use and manufacture of the device.

REFERENCES

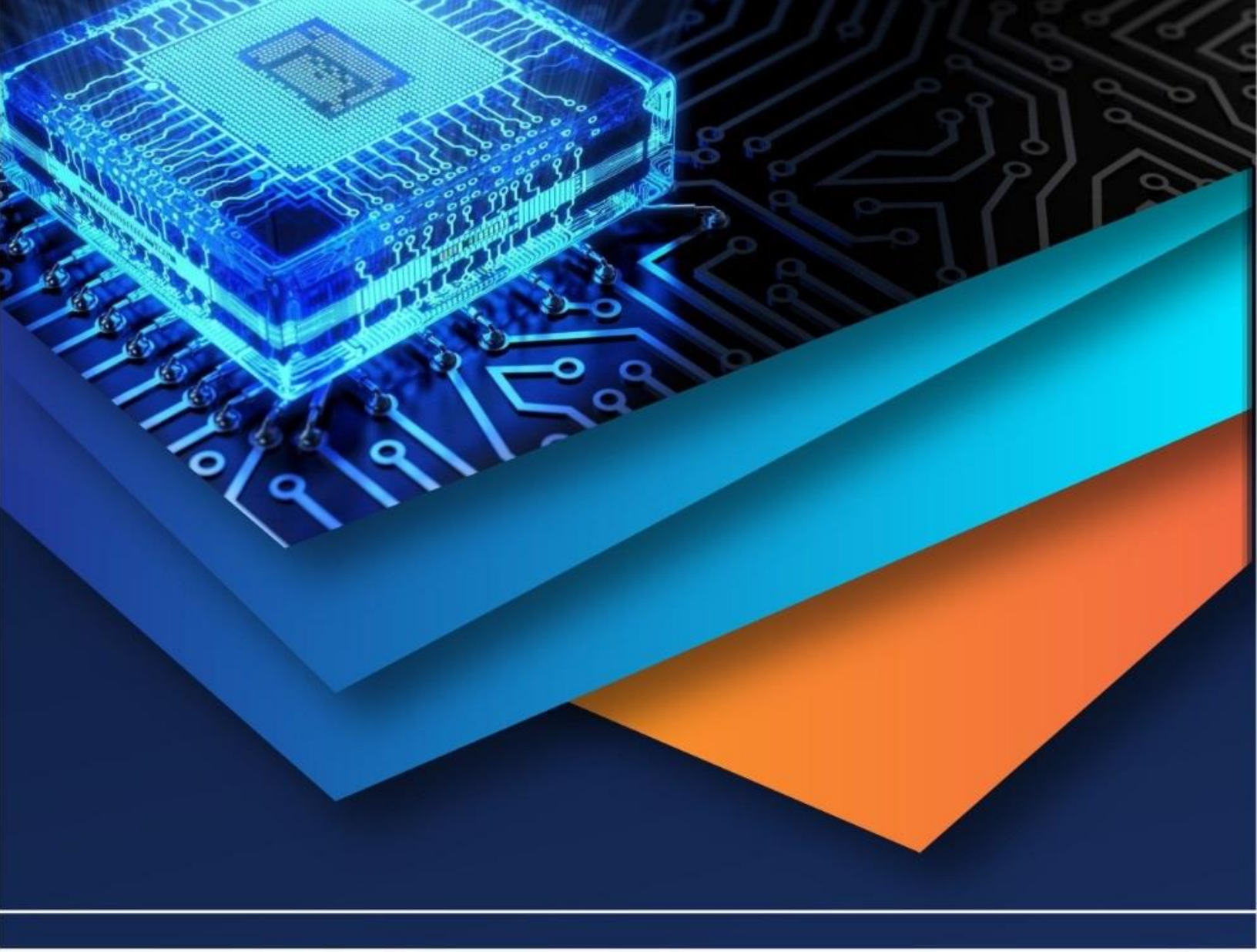
[1] The novel coronavirus pneumonia emergency response epidemiology team. Vital surveillances: the epidemiological characteristics of an outbreak of 2019 Novel Coronavirus diseases (COVID-19) –China 2020. China CDC Weekly. 2020;2(8):113–22.

[2] Technical Specifications for Pressure Swing Adsorption (PSA) Oxygen Plants . Available from: https://www.who.int/publications/i/ item/WHO-2019-nCoV-PSA_Specifications-2020.1.

[3] “A Controller Design for Oxygen Concentrator” Soohyun Kim; Hansil Kim; Donghyun Moon - 2020 International Conference on Electronics, Information, and Communication (ICEIC) DOI: 10.1109/ICEIC49074.2020.9051173

[4] “Clinical experience with the oxygen concentrator” T W Evans, J Waterhouse, and P Howard- National Library of Medicine-DOI: 10.1136/bmj.287.6390.459

[5] “Assessment of Power Availability and Development of a Low-Cost Battery-Powered Medical Oxygen Delivery System: For Use in Low-Resource Health Facilities in Developing Countries” Beverly Bradley; Yu-Ling Cheng; David Peel; Shauna Mullally; Stephen Howie DOI: 10.1109/GHTC.2011.25



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY