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IOT Integrated Colorimetric Oxygen Concentrator Output Gauge

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ABSTRACT

This report presents an innovative proposal to gauge and signal the output of the oxygen concentrator [1] especially in humid conditions which will go a long way in quantitative determination of efficiency at any given time.

In humid conditions, Zeolite sieves lose their functionality as and when they get wet [2].This can result in death of the patient and hence a user-friendly output monitoring and signalling mechanism is necessary. The aim of this report is to use a colour detector sensor, integrated on a development board such as Arduino along with the colorimetric analysis method to signal deficient oxygen concentrator output.

Key Words:colorimetric, colour, efficiency, humid, sensor

I.INTRODUCTION

In this industrialised age clean air is an extremely precious quantity that is shrinking in volume by the day. Along with pollution, forming of Nitrogen compounds in air is a severe problem as breathing in Nitrogen compounds and other components of impure air have adverse effects on human health.

Inefficient output from the concentrator is extremely dangerous. This report presents a new integrated built-in mechanism proposal to gauge the out- put using Internet of Things Technology so that the output remotely and efficiently.

II.RESOURCES

1Development Board (Arduino)

2Colour sensor (TCS230)

3Speaker

4An air piston (Like a pump used to fill cycle tires)

5Colorimetric Indicator (Rhodazine D and/or Indigo Carmine) and Zeolite Column

III. METHOD

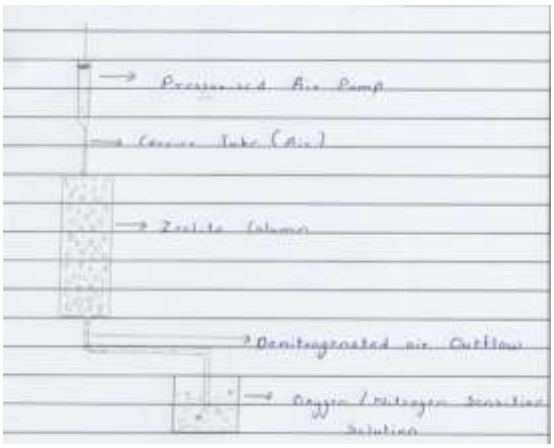
In an oxygen concentrator, air is passed through a zeolite bed (may be in the form of wound coil) at high pressure[1].Using the molecular sieve property of zeolites,nitrogen molecules in the air are trapped inside the zeolite bed and replenished oxygen rich air is obtained at the output.The colorimetric indicators Rhodazine-

D[3][4] and Indigo Carmine[3][4][5]are oxygen concentration sensitive and their colour shade depends on the DO content.

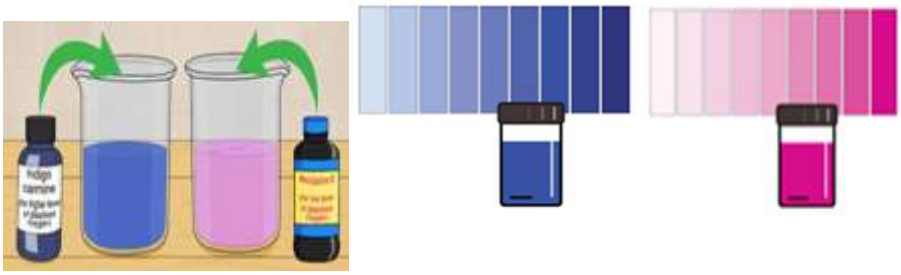
To create a reference sample inject a sample of treated air into an oxygen-sensitive colorimetric indicator solution when concentrator is working in its prime condition (Preferably new) and measure the output of the buzzer connected to the development board.

1. The sample of air is passed through the zeolite bed and is then bubbled into a beaker containing solution of water and colorimetric indicators .
2. The colour of indicators will give an idea about the concentration of oxygen and efficiency of oxygen concentrator.
3. This colour is fed as an input to the colour sensor .
4. The output of the colour sensor is fed to the development board for processing.

IV. FIGURES



Colorimetric Indication mechanism



[3][4]Indigo Carmine and Rhodazine-D colorimetric scales

V.CHEMICALS

5.1 Indigo Carmine[3][4][5] :

Indigo carmine, or 5, 5′-indigodisulfonic acid sodium salt, is an organic salt derived from indigo by sulfonation, which renders the compound soluble in water.Indigo carmine in a 0.2% aqueous solution is blue at pH 11.4 and yellow at 13.0. Indigo carmine is also a redox indicator, turning yellow upon reduction. Another use is as a dissolved ozone indicator through the conversion to isatin-5-sulfonic acid.

It is used to determine higher level of Dissolved Oxygen

5.2 Rhodazine D[3][4] :

Developed by CHEMetrics, Inc., and approved by ASTM as the reference method for ppb D.O. determination, the Rhodazine D compound in reduced form reacts with dissolved oxygen to form a bright pink reaction product. The method is not subject to salinity. Oxidizing agents, including benzoquinone, can cause high results. Reducing agents such as hydrazine and sulfite do not interfere.

It is used to determine lower level of Dissolved Oxygen

VI. PREDICTED OBSERVATIONS AND RESULTS

When the air sample coming through zeolite bed is passed through the solution the colour of the solution will change.

1. The colour change may be an increase or decrease in the intensity of the solution with respect to the reference solution.
2. The results will be tallied with a colorimetric sample when the concentrator was initially working in its prime condition, so as to enable even a layman to judge whether the machine is working to its full capacity.
3. The colour variation will act as input for the colour sensor.
4. Depending on the intensity of colour, the output will be beeping of a buzzer with varying intensity connected to the development board.

VII. DISCUSSION & CONCLUSION

Zeolites lose their molecular sieve property when they get wet [1]. In an oxygen concentrator this can have disastrous consequences. Suppose that a patient requires 90% oxygen output from a concentrator machine and suddenly the machine is delivering only 20% output.

Just like a pH paper shows different shades of colour when exposed to different hydrogen and hydroxide concentrations, our mechanism makes use of colorimetric property of Rhodazine D and Indigo Carmine to effectively show different colours on the indicator for different % output delivery of concentrator [4]. The TCS230 senses colour light with the help of an 8 x 8 array of photodiodes [6].

Then using a Current-to-Frequency Converter the readings from the photodiodes are converted into a square wave with a frequency directly proportional to the light intensity [6]. Finally, using the Arduino Board we can

read the square wave output and get the results for the colour. These results will be processed and depending on their output, speaker will emit sound of specific intensity.

Implementation of this improvement will help the user in knowing exactly when to recharge the Zeolite bed. This offered modification will help in saving lives. Every single life is precious and this suggested amendment in Oxygen concentrators is worthwhile even if a single life can be saved.

Important extensions of this work include reducing the size of oxygen concentrators which will help in making oxygen concentrators portable proving to be an important aid in high altitude mountaineering expeditions and in submarines.

VIII. ACKNOWLEDGEMENTS

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