Efficiency of Manual Powered Oxygen Concentrator

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INTRODUCTION

- Oxygen concentrators remove nitrogen from the air leaving nearly pure oxygen.
- One downside to these concentrators is that they require a continuous, reliable power source.
- A manual powered oxygen concentrator could be used as a backup source of oxygen in case of power failure.
- We analyzed the power consumption and efficiency of a manual, bicycle powered oxygen concentrator.

METHODS

- The output flow rate of air from the compressor of the manual, bicycle powered, oxygen concentrator was measured while peddling at a constant 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:

$$P = \frac{W}{t}$$

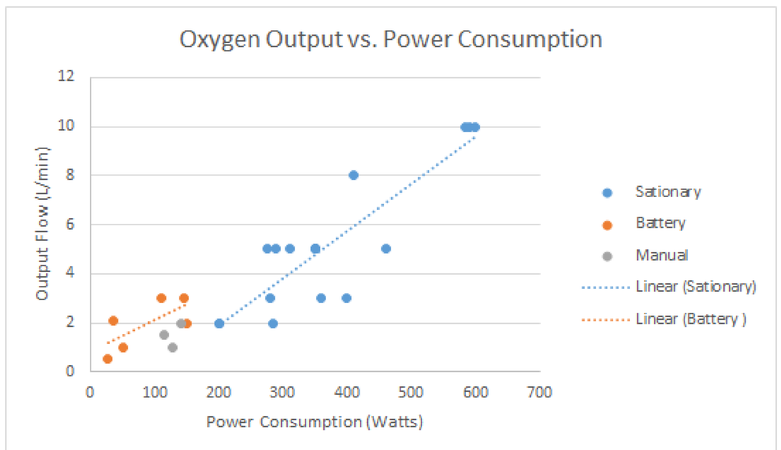
- This was done for oxygen output flow rates of 1, 1.5, and 2.0 L/min.
- Power consumptions and oxygen output flow rates were found for 16 electrically powered stationary commercial oxygen concentrators, and 8 battery powered commercial oxygen concentrators.
- The oxygen output flow rates of each kind of oxygen concentrator were compared as a function of power consumption.

RESULTS

Table 1: Power consumption values from the manual oxygen concentrator for output flow rates of 1.0, 1.5, and 2.0 L/min.

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

Figure 1: Plot of power consumptions and output flow rates for each of the stationary, battery powered, and manually powered oxygen concentrators.



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: $y = 0.0129x - 0.818$

DISCUSSION

- 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.

Reference

- Oxygen Therapy For Children. Geneva, Switzerland: WHO Document Production Services, 2016. Print.