OxyGen: A Low-Cost Oxygen Concentrator for Low-Resource Settings

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CLINICAL NEED

Hypoxemia: Inadequate supply of blood oxygen, can lead to brain & organ damage[1,2]

- **Nepal:** 20-30% of adults affected, accounts for 1/3 of hospital visits[3]

Hypoxemia in Low-Resource Settings

- Lack of oxygen supply for treatment

Piped Systems

- Expensive to implement and maintain[4]

Oxygen Cylinders

- Difficult to transport[4]

Oxygen Concentrators

- Ideal WHO price: $450; Devilbiss 525 series: $585[2]

PROPOSED SOLUTION

Needs Statement: Construct a durable and portable oxygen concentrator that provides oxygen at 85% purity.

Goals

- >85% oxygen purity
- >10 L/min output
- <20 pounds, portable

Implementation

- 2 cylinder Pressure Swing Adsorption (PSA)
- Zeolite adsorbent

MARKET ANALYSIS & DEVICE COST

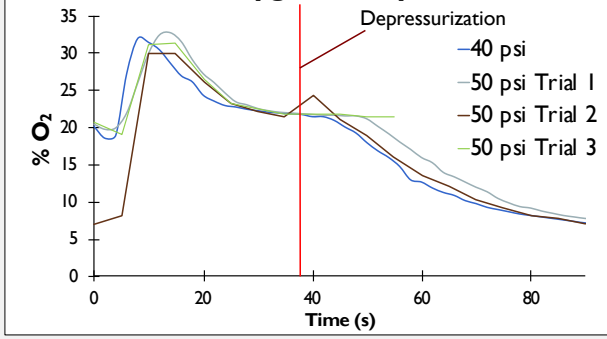
- Estimated market for oxygen concentrators in Nepal: ~8 million patients
  - Based on the incidence of hypoxemia for adults in Nepal

Parts	Price	Quantity	Total Price
Solenoid Valve	$20.88	6	$125.28
Polyethylene Tubing	$0.25	10	$2.50
Compressor	$50	1	$50.00
Arduino Uno/Logic Board	$30	1	$30.00
Zeolite	$30	1.3	$39.00
Pressure Vessel	$1.42	2	$2.84
Total Cost			$249.62

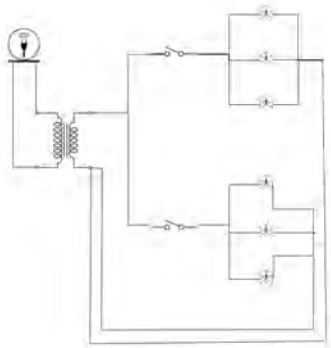
RESULTS

Single-Bed System Testing

Table 1: Oxygen Purity vs. Time



Design of Electrical



1. Arduino controls relays
2. Relays control solenoid valves
3. Solenoid valves cycle to control PSA
4. Valves powered through transformer

Figure 1: Schematic of circuit

Implementation of Dual-Bed System

Figure 2a: Maximum oxygen purity achieved (left)
Figure 2b: Fully wired dual-bed system with PSA (right)

CONCLUSIONS

- Identified LiX zeolite to be best option for nitrogen adsorption
- Designed circuit for controlling solenoid valves
- Progressed from single-bed purification system to dual-bed system with pressure swing
- **Achieved 32.5% purity oxygen with dual-bed pressure swing system**
- **Optimal cycle time: 8 seconds**
- **Optimal starting pressure: 50 psi**

FUTURE WORKS

Next Priority

- Increase purity of oxygen output to >85%
- Use air filter to purify input air

Long-term

- Increase volumetric flow output of oxygen to accommodate multiple patients
- Develop portable casing

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