

# HIGH PURITY OXYGEN GENERATOR

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## **Executive Summary**

The objective of this project is to determine whether or not it is feasible to build an oxygen supply device using silver zeolites to separate nitrogen and argon from oxygen for >99% purity. The goal is to introduce a design into different markets to determine profitability over time.

Two consumers were focused on during the stint of the project. This produced two designs, a portable unit for individuals and a stationary unit for hospitals. Both designs incorporate the use of Pressure Swing Adsorption (PSA) with silver zeolites as the adsorbents. A portable unit that can sustain a constant flowrate of 5 L/min at 99% purity was determined to be achievable. Preliminary estimates have shown the portable unit will cost approximately \$4,200 and weigh 20.5 pounds. Future investigation is required to determine consumer preference and the economics.

The hospital unit utilizes a PSA system and is successful of producing >99% oxygen with a split bed silver zeolites LiAgX and AgA. The product is designed for 350 large hospitals in the United States consisting of 500 beds or more with the ability to sustain 5 L/min of 99% O<sub>2</sub> for 300 users.

A consumer utility maximization equation was used to determine an optimal unit price of \$250,000 for the hospital project with an estimated net present value (NPV) of \$2.8 million. The return on investment (ROI) was determined to be 12000% at a maximum consumer demand and preference over a period of 5 years. The ROI for the first year of operation is projected to be 5200% with an NPV of \$1.3 million. The ROI is large, because the FCI is low and the calculated profit is large in comparison. Another reason is because the ROI and NPV were calculated assuming no copycat competition enters the market, consumers bought on impulse, and liquid oxygen kept prices constant. The fixed capital investment is \$23,612, and the total product cost for the first year is approximately \$1.57 million. Using high advertisement expenditures, revenue peaks at \$6.3 million around the second year of operation and slowly declines until the 5<sup>th</sup> year of operation. After the 5<sup>th</sup> year of the lifetime of the unit it will need to be replaced and the revenue will climb again when consumers purchase another unit.

A preliminary risk analysis on the hospital oxygen concentrator was necessary to determine the NPV, ROI, demand, and revenue over time assuming the demand calculated with consumer utility maximization equation was less than expected due to copycat or different competition. It was found that the hospital design is still profitable if the actual demand is above 25% of the demand calculated under perfect conditions.

The average expenditure on liquid oxygen in a large hospital is \$170,000. Over 5 years it is estimated a large hospital will save \$350,000 with an average annual savings of \$70,000 with the hospital design. Since the price of the unit is \$250,000 and greater than the annual budget of a large hospital, it is recommended that the producer of such a product allow for a 2 year payment plant of \$125,000 payments each. This would allow a hospital to stay under their yearly budget and would make the hospital design more desirable.

The project is highly recommended due to the high NPV, ROI, and revenue values that have been determined. Since the market in the United States is limited to 350 large hospitals, it is recommended that other markets be investigated such as middle sized hospital and international markets. Future work needs to be put into further economic analysis of the portable device.