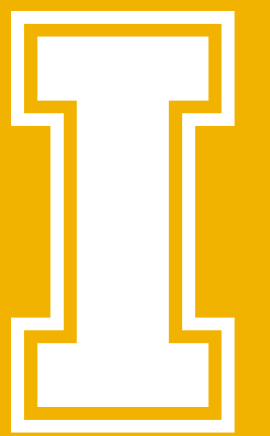


BUILDING A PSA APPARATUS TO EVALUATE VIABILITY OF ON-SITE OXYGEN GENERATION

Sara Murphy | Matthew Pyle | Kelty Shroyer

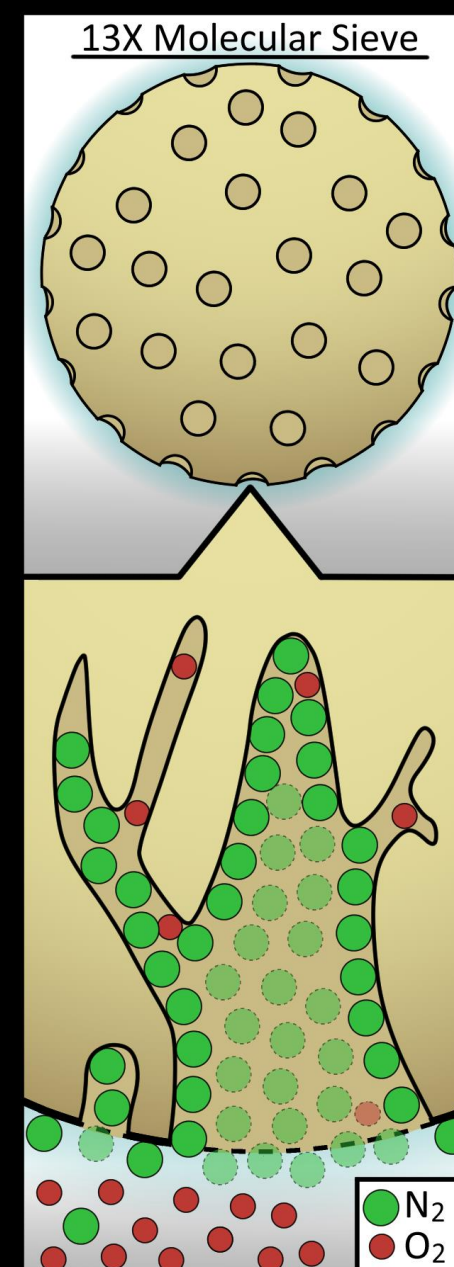


PROJECT OBJECTIVES

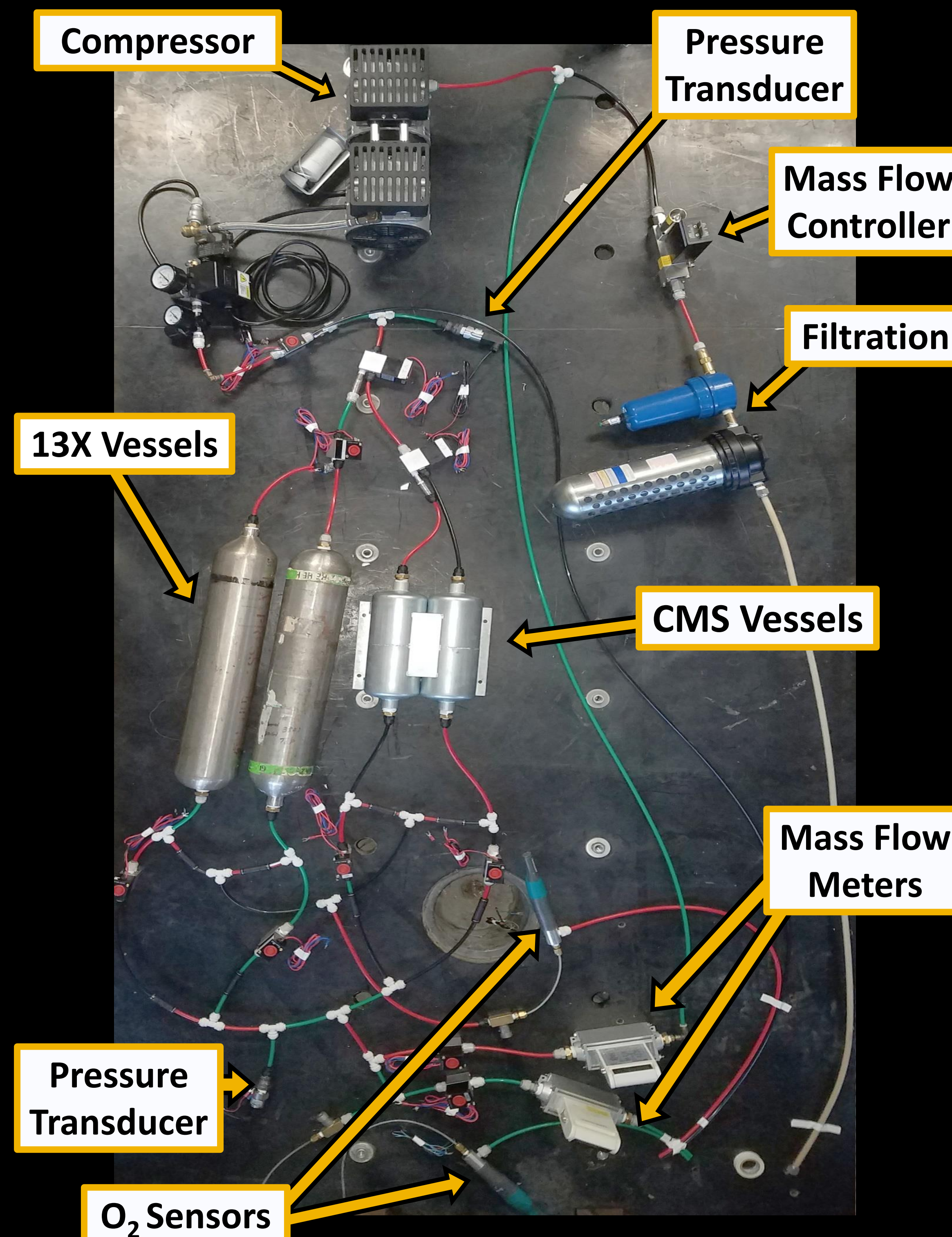
- Design and build a bench-scale pressure swing adsorption (PSA) system with the following product purities:
 - Oxygen purity of $93 \pm 3\%$
 - Nitrogen purity of $99.9\% \pm 0.1\%$
- Develop a controller and graphical user interface (GUI) so that operators can control the process from a computer
- Compile data from the bench-scale and specify optimal operating settings in an operation manual
- Design a full-scale facility to meet the oxygen demand of 10 ventilators and complete an economic analysis

WHAT IS PSA?

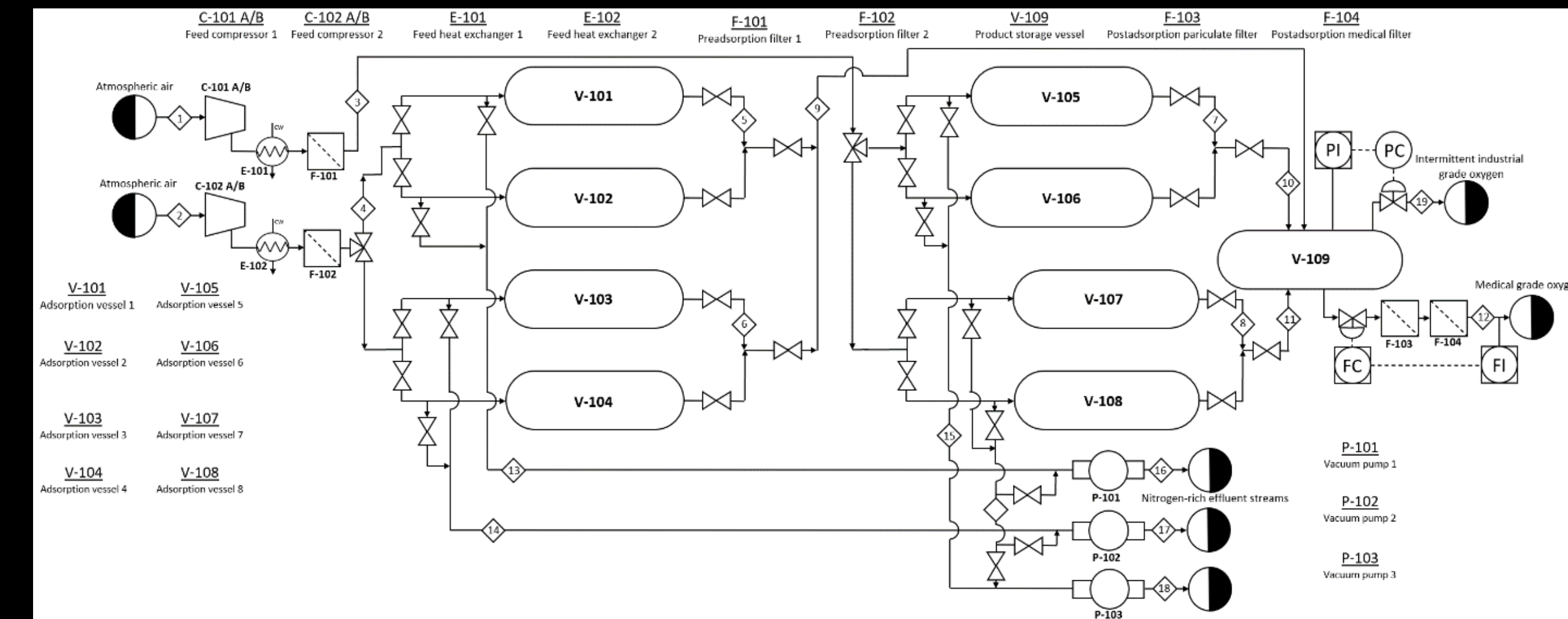
- A separation technique that generates high-purity product streams from a mixture of gases
 - Gases are adsorbed onto the surface of porous beads known as adsorbents
 - At high pressure one type of gas is preferentially adsorbed; at low pressure trapped gas molecules are released
- Common in manufacturing, food processing and even healthcare



BENCH-SCALE DESIGN



FULL-SCALE DESIGN



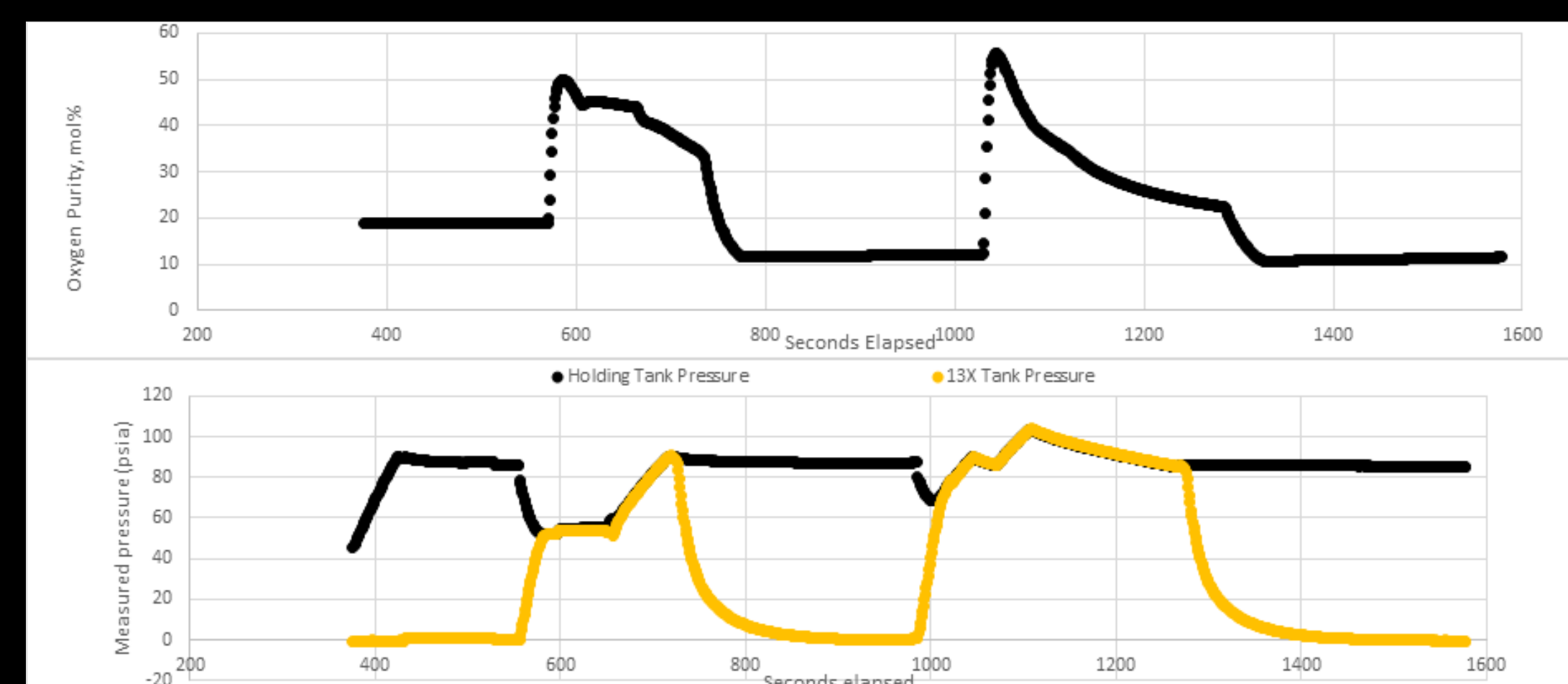
ECONOMIC ANALYSIS

- Literature data was used to design the full-scale facility since there were challenges obtaining the design purity from the bench-scale apparatus

Capital Investment & Expenses	
FCI	\$7,678,114
COM _d	\$3,711,647
Working Capital (WC)	\$742,329
Revenue	
Revenue (Offset Cost)	\$7,147,197
Profitability	
Payback Period (PBP)	3.63 years
Cumulative Cash Position (CCP)	\$33.39 MM
Rate Of Return On Investment (ROROI)	21.74%

RESULTS

- While the specified purities were not reached, testing data was used to determine the optimal operating points
- Potential issues were investigated including:
 - Moisture of feed air leading to adsorbent fouling
 - System leaks and insufficient throughput
 - Inadequate dwell time for adsorption



Evaluating 13X adsorbent vessels.

CONCLUSIONS

- Additional filters may need to be added to the bench-scale apparatus to reduce the likelihood of adsorbent fouling
- System leaks and their impacts will have to be addressed for future use
- Economic analysis shows that the full-scale design is a financially feasible method of on-site oxygen generation for medical facilities