AccessO2: An Innovative, Non-Electric, Life-Saving, Oxygen Concentrator

Thangarasu, Sanjit (School: Poolesville High School)

I have designed and constructed a human-powered oxygen concentrator based on pressure swing adsorption that operates without electricity. Millions with ailments treatable by concentrated oxygen, like hypoxemia, live in countries without access to compressed oxygen or stable electricity for oxygen generation. Although compressed oxygen cylinders are preferred, each 300 ft3 cylinder lasts only four days at 1.5 L/min flow. Portable electrical oxygen concentrators can be charged by solar power, but this may cost over $2600 for the oxygen generator, battery and solar panel plus is weather dependent. My system will cost around $500. Under pedal power my system generates oxygen concentrations ranging from 30% to 80%, typical for use in hospitals, with flow rate sufficient to supply one patient. My system compresses air into pores in zeolite (an alumina-silicate ceramic lattice with uniform pores 5x10-10 m diameter), preferentially adsorbing nitrogen based on molecular size and chemical affinity. Because nitrogen is retained, oxygen passes through at higher concentrations. The cycle is completed by purging nitrogen from the zeolite allowing repetition. Last year, I learned Zeolite 13X only absorbs nitrogen based on pore size, requiring more pressure to achieve higher oxygen concentrations. For 2019 I replaced Zeolite 13X with Zeolite LiX, and with additional design changes generated a steady state concentration of 59% with an average flow rate over 1.5 L/min. Zeolite LiX is ionized with lithium, polarizes nitrogen, and retains nitrogen better, resulting in higher concentrations. The output is usable to treat neonates and infants suffering from infant respiratory distress syndrome.

Awards Won:

U.S. Agency for International Development: USAID Science for Development First Place Award of $5,000.

Fourth Award of $500