

IMPROVING DYNAMIC HYPOXIA TRAINING

A tankless pressure on demand system.

Hypoxia, or oxygen deprivation as a result of high altitude flying, can cause rapid loss of mental, physical and psychomotor abilities by the pilot and crew. Such symptoms have been and continue to be a costly problem for the U.S. Navy. Due to the potentially catastrophic outcomes of these episodes, training continues to be a necessary part of the solution. Current Navy curriculum uses several approaches to training including annual, biennial and quadrennial classroom-based and experiential training through the Dynamic Hypoxia Training (DHT) devices. While data supports the effectiveness of existing training solutions, efforts are underway leveraging state-of-the-art technology to increase training effectiveness, reduce logistical requirements, and increase the availability of training through increased portability.

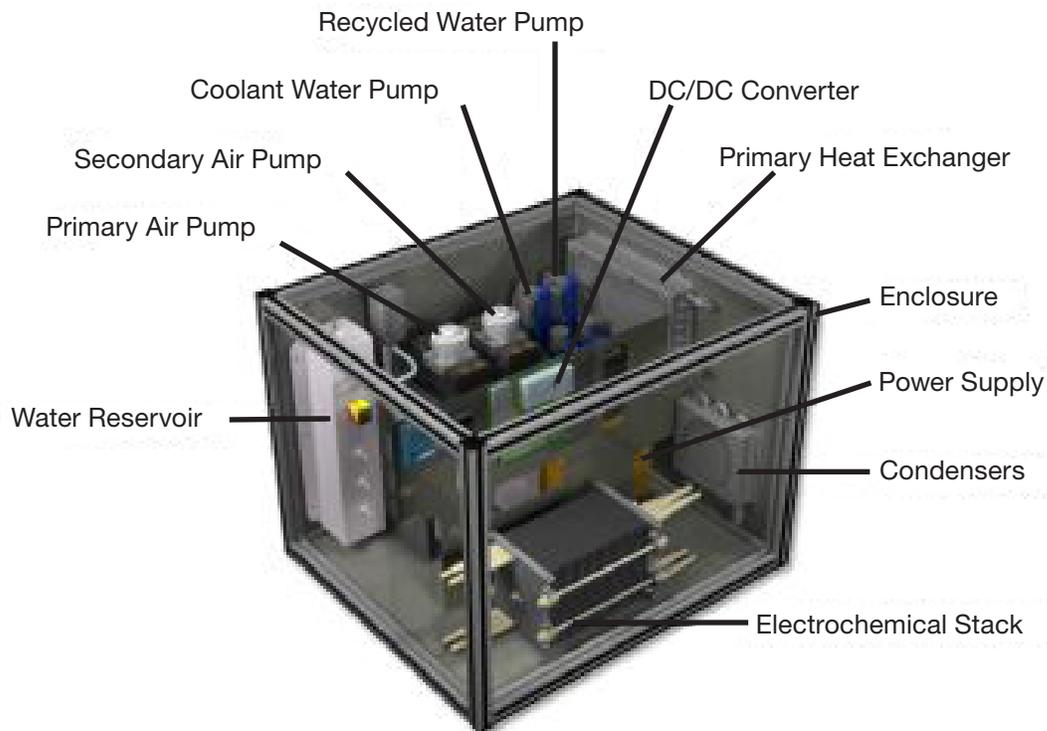


NORMOBARIC HYPOXIA TRAINING (NHT)

Currently, Normobaric Hypoxia Training (NHT) involves the use of a Reduced Oxygen Breathing Device (ROBD). With an oxygen mask to deliver breathing air, the ROBD device adjusts the concentration of medical grade air and nitrogen from compressed gas tanks, thereby replicating altitude to induce hypoxia at sea level. The design of the ROBD enables hypoxia awareness and mitigation strategies to be trained while the student interacts with a simulated flight environment. While this greatly improves the fidelity of hypoxia training beyond the historical hypobaric chamber, there remains room for improvement due to logistical challenges (e.g., maintenance, buying gases) and potential constraints for delivering training in high fidelity simulator environments. Additionally, training gaps exist – the lack of pressure in the mask can result in air hunger and false identification of hypoxia symptoms.

NEXT GENERATION NORMOBARIC HYPOXIA TRAINING

In response to the aforementioned challenges, PMA-205, researchers from the Naval Air Warfare Center Training Systems Division (NAWCTSD), and Training Officers at the Naval Safety Training Institute (NSTI) leveraged the Small Business Innovative Research program to identify novel training solutions.



In FY2013, a topic was released that sought proposals for developing a tankless, portable hypoxia breathing device. Several promising approaches were identified including:

- Cyclical Fluid Exchange Process
- Electrochemical Oxygen Separator
- Modern Gas Separation / Filtration Technology

As a result of this effort, a prototype system has been developed based on the electrochemical oxygen separation technology to deliver a compact, portable, pressure on-demand hypoxia training device. The increased portability of the system due to the elimination of the gas tanks will support training in a wider variety of flight simulator environments. Further, the design of the system that is based on liquid water fed electrochemical cells that utilize a highly efficient oxygen evolution reaction (OER) coupled with the integration of an electronic regulator with active feedback control should eliminate the risk of oxygen starvation. In addition, the electronic regulator ensures that the system delivers pressure-on-demand further reducing the possibility of air hunger.

An existing prototype has been used in engineering tests to validate the pressure-on-demand feature of the system. Results from that test indicate the system produces a breathing experience similar to the aircraft itself.

Currently the devices are beginning additional testing to validate the solution for use in training human subject's hypoxia recognition and mitigation. If successful, the device would reduce the cost of maintenance relative to the current training system, be small enough to be used in almost any flight simulator and be transported easily making the training available to a greater population.

PARTNERS

This effort incorporates technologies from several programs of research including:

- Naval Air Systems Command (NAVAIR) Program Management office (PMA-205 AWTD)
- Naval Air Warfare Center Training Systems Division
- Navy Medicine Operational Training Center (NMOTC) Naval Survival Training Institute (NSTI)
- NAVAIR Small Business Innovative Research (SBIR) Program

The work discussed involves a collaborative team of researchers in the government, military, and industry.