

Generating Breathable Air Through Dissociation of N₂O

Air-supply systems can be made to weigh less and/or operate longer.

Lyndon B. Johnson Space Center, Houston, Texas

A nitrous oxide-based oxygen-supply system (NOBOSS) is an apparatus in which a breathable mixture comprising 2/3 volume parts of N₂ and 1/3 volume part of O₂ is generated through dissociation of N₂O. The NOBOSS concept can be adapted to a variety of applications in which there are requirements for relatively compact, lightweight systems to supply breathable air. These could include air-supply systems for firefighters, divers, astronauts, and workers who must be protected against biological and chemical hazards.

A NOBOSS stands in contrast to compressed-gas and cryogenic air-supply systems. Compressed-gas systems necessarily include massive tanks that can hold only relatively small amounts of gases. Alternatively, gases can be stored compactly in greater quantities and at low pressures when they are liquefied, but then cryogenic equipment is needed to maintain them in liquid form. Overcoming the disadvantages of both compressed-gas and cryogenic systems, the NOBOSS exploits the fact that N₂O can be stored in liquid form at room temperature and moderate pressure. The mass of N₂O that can be stored in a tank of a given mass is about 20 times the mass of compressed

air that can be stored in a tank of equal mass.

In a NOBOSS, N₂O is exothermically dissociated to N₂ and O₂ in a main catalytic reactor. In order to ensure the dissociation of N₂O to the maximum possible extent, the temperature of the reactor must be kept above 400 °C. At the same time, to minimize concentrations of nitrogen oxides (which are toxic), it is necessary to keep the reactor temperature at or below 540 °C. To keep the temperature within the required range throughout the reactor and, in particular, to prevent the formation of hot spots that would be generated by local concentrations of the exothermic dissociation reaction, the N₂O is introduced into the reactor through an injector tube that features carefully spaced holes to distribute the input flow of N₂O widely throughout the reactor.

A NOBOSS includes one or more "destroyer" subsystems for removing any nitrogen oxides that remain downstream of the main N₂O-dissociation reactor. A destroyer includes a carbon bed in series with a catalytic reactor, and is in thermal contact with the main N₂O-dissociation reactor. The gas mixture that leaves the main reactor first goes through a carbon

bed, which adsorbs all of the trace NO and most of the trace NO₂. The gas mixture then goes through the destroyer catalytic reactor, wherein most or all of the remaining NO₂ is dissociated.

A NOBOSS can be designed to regulate its reactor temperature across a range of flow rates. One such system includes three destroyer loops; these loops act, in combination with a heat sink, to remove heat from the main N₂O-dissociation reactor. In this system, the N₂O and product gases play an additional role as coolants; thus, as needed, the coolant flow increases in proportion to the rate of generation of heat, helping to keep the main-reactor temperature below 540 °C.

This work was done by Robert Zubrin and Brian Frankie of Pioneer Astronautics for Johnson Space Center.

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High-Performance Scanning Acousto-Ultrasonic System

This system reveals flaws that cannot otherwise be detected nondestructively.

John H. Glenn Research Center, Cleveland, Ohio

A high-performance scanning acousto-ultrasonic system, now undergoing development, is designed to afford enhanced capabilities for imaging microstructural features, including flaws, inside plate specimens of materials. The system is expected to be especially helpful in analyzing defects that contribute to failures in polymer- and ceramic-matrix composite materials, which are difficult to characterize by conventional scanning ultrasonic techniques and other conventional nonde-

structive testing techniques.

Selected aspects of the acousto-ultrasonic method have been described in several *NASA Tech Briefs* articles in recent years. Summarizing briefly: The acousto-ultrasonic method involves the use of an apparatus like the one depicted in the figure (or an apparatus of similar functionality). Pulses are excited at one location on a surface of a plate specimen by use of a broadband transmitting ultrasonic transducer. The stress waves associated with these pulses propagate along

the specimen to a receiving transducer at a different location on the same surface. Along the way, the stress waves interact with the microstructure and flaws present between the transducers. The received signal is analyzed to evaluate the microstructure and flaws.

The specific variant of the acousto-ultrasonic method implemented in the present developmental system goes beyond the basic principle described above to include the following major additional features: