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Storage Time and Venting Characteristics for Cryogenic Air Supplies after Turning Off Their Cryocoolers

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Cryogenic air supplies are one of the methods to provide breathable air and to mitigate heat and humidity buildup within refuge alternatives used in underground mines. Before cryogenic air is supplied to an occupied RA, the temperature of the cryogenic air is kept constant at -195°C (-318°F) inside a large dewar using a cryocooler, which uses electrical power. In some cases, the cryocooler might lose power due to a planned or unplanned power outrage, such as relocation of the cryogenic air supply or loss of power during a mine emergency. Without cooling provided by the cryocooler, the temperature of the liquid air will begin to rise and the pressure within the cryogenic air supply's storage dewar will increase due to the buildup of vapor pressure. Once the pressure in the dewar is high enough, the cryogenic air vents through a relief valve to ensure safety. The maximum storage time and the venting characteristics for an underground mine cryogenic air supply when cooling is interrupted needs to be determined before its deployment in a mine. In this paper, researchers at the National Institute for Occupational Safety and Health (NIOSH) investigated the maximum storage time and venting pattern on two different cryogenic systems with no cooling. The two systems differ in size and dewar orientation (horizontal vs vertical). The testing shows that about 7.7 liters of cryogenic air was lost per day by the vertical dewar system. For the horizontal dewar system, the cryogenic air vented about every 2 hours, and about 25.6 liters of cryogenic air was lost per day. The information in this paper could be useful for manufacturers and mines considering the use of a cryogenic air supply as a source of breathable air and/or heat mitigation for refuge alternatives.