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WASTE FOR ENERGY AND VOLUME RECOVERY (WEVR) USING INDUCTIVELY HEATED PLASMA GENERATOR

Abstract

This paper presents the Waste for Energy and Volume Recovery (WEVR) campaign activities initial results of the investigation predicated on waste management during future long-duration crewed space missions beyond Low Earth Orbit (LEO). The experiments were performed at the Institute of Space Systems (IRS) of the University of Stuttgart as part of the collaboration with the University of Cape Town's SpaceLab. One of the WEVR investigations utilizes waste package simulants (WPS) test samples derived from the Life Support Baseline Values and Assumptions Document (BVAD) and normalized to a mass of 25 g. The WPS were subjected to thermal decomposition through exposure to a plasma generated by an inductively heated plasma generator (IPG), operated with either oxygen or nitrogen as a test gas in the Plasma Wind Tunnel 3 (PWK3) atmospheric entry test facility at IRS. The mass of the WPS was measured before and after each test to assess the mass loss rate. Physical characteristics of the WPS were also inspected. Test samples were contained in a cylindrical, cage-type sample holder of 56 mm diameter mounted onto a 50 mm diameter water-cooled plasma probe, which was moved into the center of the plasma plume to assess the decomposition process. Test conditions for Oxygen and Nitrogen were selected for operational comparability, with test samples being placed at 228 mm from the plasma nozzle exit while the mass flow of the test gases was 3.21 g/s, with IPG input powers of 120 kW and 140 kW, respectively. The ambient test chamber pressure was maintained at 30 Pa. Test conditions were characterised using a Pitot probe, ambient pressure gauge, and a calorimeter. The decomposition of the sample was tracked via optical emission spectrometry (OES) focused on the stagnation point region, thermographic imaging and optical video. The preliminary findings of this campaign are analyzed and discussed.