

Series-Bosch Technology for Oxygen Recovery During Lunar or Martian Surface Missions

Long-duration surface missions to the Moon or Mars will require life support systems that maximize resource recovery to minimize resupply from Earth. To address this need, NASA previously proposed a Series-Bosch (S-Bosch) oxygen recovery system, based on the Bosch process, which can theoretically recover 100% of the oxygen from metabolic carbon dioxide. Bosch processes have the added benefits of the potential to recover oxygen from atmospheric carbon dioxide and the use of regolith materials as catalysts, thereby eliminating the need for catalyst resupply from Earth. In 2012, NASA completed an initial design for an S-Bosch development test stand that incorporates two catalytic reactors in series including a Reverse Water-Gas Shift (RWGS) Reactor and a Carbon Formation Reactor (CFR). In 2013, fabrication of system components, with the exception of a CFR, and assembly of the test stand was initiated. Stand-alone testing of the RWGS reactor was completed to compare performance with design models. Continued testing of Lunar and Martian regolith simulants provided sufficient data to design a CFR intended to utilize these materials as catalysts. Finally, a study was conducted to explore the possibility of producing bricks from spend regolith catalysts. The results of initial demonstration testing of the RWGS reactor, results of continued catalyst performance testing of regolith simulants, and results of brick material properties testing are reported. Additionally, design considerations for a regolith-based CFR are discussed.