

A Review:

Using Pyrolysis and its Bioproducts to Help Close the Loop in Sustainable Life Support Systems

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The next step in human exploration of space is beyond low Earth orbit and possibly to sites such as the Moon and Mars. Resupply of critical life support components for missions such as these are difficult or impossible. Life support processes for closing the loop of water, oxygen and carbon have to be identified. Currently, there are many technologies proposed for terrestrial missions for waste, water, air processing and the creation of consumables. There are a variety of different approaches, but few address all of these issues simultaneously. One candidate is pyrolysis; a method where waste streams can be heated in the absence of oxygen to undergo a thermochemical conversion producing a series of bioproducts. Bioproducts like biochar made from non-edible biomass and human solid waste can possibly provide valuable benefits such as waste reduction, regolith fertilization for increased food production, and become a consumable for water processing and air revitalization systems. Syngas containing hydrogen, carbon monoxide and carbon dioxide, can be converted to methane and dimethyl ether to create propellants. Bio-oils can be utilized as a heating fuel or fed to bioreactors that utilize oil-eating microbes. Issues such as carbon sequestration and subsequent carbon balance of the closed system and identifying ideal process methods to achieve the highest quality products, whilst being energy friendly, will also be addressed.

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