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Author: Dr. Gisela Detrell
Institute of Space Systems, University of Stuttgart, Germany

Dr. Stefan Belz
University of Stuttgart, Germany
Mr. Jens Bretschneider
University of Stuttgart, Germany
Dr. Reinhold Ewald
European Space Agency (ESA), Germany
Prof. Stefanos Fasoulas
University of Stuttgart, Germany

A HYBRID LIFE SUPPORT SYSTEM FOR A MOON BASE

Abstract

ESA's plan for a Moon Village implies extended human presence on the lunar surface. The Environmental Control and Life Support System (ECLSS) of the ISS might not be the most suitable one for this task, as the higher distance from the Earth increases the costs of resupply. A promising option to reduce the required resupply mass, and thus the costs, could be the use of a hybrid system, i.e. combining state-of-the-art technologies with biological components, such as greenhouses or algae bioreactors. Compared to higher plants, algae offer a higher harvest index, higher biomass productivity and require less water. At the Institute of Space Systems (IRS) of the University of Stuttgart, research on algae for space applications has been carried out since 2010. The microalgae *Chlorella vulgaris* and *scenedesmus obliquus* have been satisfactorily cultivated in Flat Plate Airlift reactors. However, before algae photobioreactors can be used as an ECLSS component, cultivation and technical issues need to be solved: long-term performance and stability, radiation effects on algae, selection of the required hardware, sizing the system, operation under Moon gravity and downstream processing to edible food. The IRS proposes several steps to solve some of these questions. A continuous cultivation in the laboratory is used to gain knowledge of long-term effects and occurring side contaminants, as well as hardware selection. An update design for the European Modular Cultivation System (EMCS) is proposed, to allow testing on Moon gravity conditions and under increased radiation load. Finally, an ECLSS simulation, the IRS software tool ELISSA (Environment for Life-Support System Simulation and Analysis) is applied to size the system and its requirements, and compare it with an ECLSS using ISS technologies. This paper gives an overview on the advancements in several research projects and their potential application on a Moon base, with special emphasis on the advantages of using a microalgae photobioreactor for a long duration mission.