SPACE LIFE SCIENCES SYMPOSIUM (A1)
Life Support and EVA Systems (6)

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PHYSIOLOGICAL RESEARCH AND FUNCTIONAL VERIFICATION OF THE MODULES-PBR

Abstract

Based on a scientific demand, the German Space Agency, DLR, has initiated a programmatic approach to gather a team of scientists, ensuring the research-characteristics of ModuLES (Modular Life Support and Energy Systems). The scientific and technical development and thus understanding of Life Support and Energy Systems being based on ecological, sustainable processes is the basis for future applications in space as well as on ground.

As first part in the ModuLES concept a Photobioreactor (ModuLES-PBR) was characterized, designed and tested on ground and in parabolic flights. A Photobioreactor was chosen as first module, because microalgae serve with their photosynthetic activity for 50% of the oxygen supply on our planet. Thus it demonstrates an ideal first module for a modular life support system development. The overall goal of this ModuLES-PBR is the development of an energy-efficient and highly effective photobioreactor-system with clearly defined in- and outputs. The PBR is designed for a maximum efficiency with respect to oxygen production and carbon dioxide uptake as well as the optimization of closure-level of the nutrient loop during operation for various environmental conditions.

The core unit consists of a bioreactor that allows the cultivation of the microalga Chlamydomonas reinhardtii with highly efficient photosynthetic gas exchange rates. The efficiency of the system depends upon the quality and quantity of light, liquid mixing, gas supply and mixing, gas exchange for optimization of dissolved oxygen concentration in the algae solution to prevent bubble formation, medium composition and the growth phase of the microalgae. A second unit, which was added to the system after PBR-verification, is used for media recycling and algae filtration and is a first step for optimizing the nutrient-loop closure, which is essential for long duration operations

The two main goals of the ModuLES-PBR experiment in these flight campaigns were the verification of the PBR structural and functional design as well as the analysis and control of physiological parameters of the algae. The major components of the experiment set-up will be described in regards to the PBR and necessary sensors/support units, a filtration unit and the challenges of the technologies. Outcomes and first scientific-technical observations from ground and parabolic flight tests will also be discussed.