

Institute of Aerospace Medicine

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Dr. Klaus Slenzka

OHB SYSTEM AG, Head: Life Sciences,
Bremen, Germany

The ModuLES Program – 1st Modul: Photobioreactor

ModuLES is a national concept to question and verify aspects of systems biology and ecological life support systems under altered gravity conditions on Earth, in space and regarding exploration missions. The applied "bottom-up approach" clearly differentiates this modular system concept from other approaches.

Individual, independent modules serve as research systems in the laboratory scale and the ModuLES design concept makes it possible to bring them together. The systems biology approach is reinforced and leads through a gradual development to higher total ecological systems.

In the beginning of the project, interested and suitable groups of scientists have already been identified and selected, and recommendations were outlined. They accompanied the construction of the first components of such a modular system for systems biology research in parallel with their scientific research. During each project phase individual groups of scientists were selected to advise intensively the participating parties.

In the previous ModuLES phases:

I. A meandering photobioreactor (PBR) with membranes for gas exchange was developed, bound in a complex technical system and has been tested in parabolic flights;

II. Based on the results of these tests, the meandering design was withdrawn and a further developed PBR developed, as well as decoupling the inefficient gas exchange membranes from the PBR. In addition a medium recycling unit as well as a cell separation and gas exchange unit were introduced to guarantee long-term suitability. An off-line flow cytometer was integrated in-line as well as a biofilm sensing system.

III. For better control of the media recycling, new sensors and measuring systems have been developed and installed, increasing also long-term stability. A sampling and measuring unit based on the Lab-on-a-Chip technology was developed and integrated. Software and electronics are following each developmental step.

In the presentation a summary and an outline of the actual status will be given.