

HUMAN EXPLORATION OF THE SOLAR SYSTEM SYMPOSIUM (A5)  
Human Mars Exploration (2)

Author: Mr. Daniel Schubert

Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR), Germany, daniel.schubert@dlr.de

EDEN - EVOLUTION AND DESIGN OF ENVIRONMENTALLY-CLOSED NUTRITION-SOURCES

**Abstract**

The EDEN project is one pillar of the DLR's ambition to develop bio regenerative life support systems for human long-term space missions. EDEN combines different CEA Technologies (Controlled Environmental Agriculture) within an automatic planetary Greenhouse-Module (GHM). The GHM can not only produce continuously food for the crew, but can also fulfil other tasks like grey water purification, Oxygen production, waste management and even psychological crew health support. This way the GHM plays a vital part within a planetary base infrastructure.

The paper gives an overview of the latest GHM design approaches that were undertaken at the DLR Institute of Space Systems (Bremen, Germany). As an example the new biological cleanroom, suitable for different plant experiments will be highlighted. This laboratory will be the nucleus for a variety of plant cultivation experiments within closed environments (e.g. testing of different light - irrigation systems). Furthermore, the paper gives a status report of DLR's C.R.O.P. project, which is the general frame program of the EDEN project. CROP, which stands for Combined Regenerative Organic-food Production, deals with the decomposition of human urine and biological waste to a fertilizer solution. Aim of this project is to develop a water based compost system for using in regional conurbations, isolated environments and also space stations. The major problem in closed systems like in space stations is the regenerative use of nitrogen, phosphate and other elements containing in human urine. The current method is to extract the water from the urine to recycle it in the water system. All ions and elements solved in the urine were discarding. The CROP-System tries to recycle the whole urine to a fertilizer solution, which can then be used in the cultivation chambers of the GHM.

For post-processing procedures a special Food Processing Facility (FPF) was investigated. Within this facility the raw material from the GHM is cleaned and processed to intermediate products, like for example oil, our and soymilk as well as ready-to-eat meals for the crew. This way the FPF functions as an interface towards the remaining habitat infrastructure.