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ECOPACK: NEW PACKAGING SOLUTIONS FOR HUMAN EXPLORATION MISSIONS

Abstract

In the same way as packaging on Earth is an issue for humanity, it is also becoming a strategic issue for space exploration. The "closed system" approach represented by the planet Earth is amplified by the much smaller closed system of a spacecraft or a future exploration base.

Space optimization, onboard mass, waste management and end-of-life management of packaging components are major concerns. Today, most of the equipment uploaded to the international space station (ISS) is packaged in kits made with petroleum-based materials, often of single use. They are covered with a Nomex non-flammable fabric. After use, they are destroyed during the return flight and the re-entry in the Earth atmosphere.

It is essential to optimize the weight, the payload volumes but also the storage for the space exploration missions. Within the framework of the CNES-ESA Alpha mission (04/2021-11/2021) onboard ISS, a first experiment of replacement of petroleum-based materials by biodegradable and biosourced materials allowed us to develop an alternative with the same mechanical properties of protection: Parts produced by -3D printing of biosourced materials, based on polyhydroxyalkanoates. After their use, these materials will be recycled to manufacture other parts by onboard 3D printing and at the end of their "ultimate" life; they could be also used as materials to structure the compost areas necessary for future plant cultivation thanks to the honeycomb structure.

The second experiment carried out allowed us to test the replacement of petroleum-based pads by edible pads. This time, it is a question of using food with particular performances of mechanical protection such as resistance to the shocks for their first use, and in second place to provide a bonus of food to the astronauts.

We performed the experiment on three recipes: gingerbread, madeleine and Genova bread. These three materials have perfectly fulfilled their functions by presenting mechanical resistance to crushing with restitution of their initial shape as well as a good resistance to shocks (both during upload to ISS and download to Earth). During Alpha, ISS crew did not eat the food content of this kit, only the mechanical protection characteristics were assessed. Eating the flight kits will be the next step...

These two experiments carried out during the Alpha mission prove to be extremely positive and promising for the human space exploration missions.