

22nd IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND
DEVELOPMENT (D3)Systems and Infrastructures to Implement Sustainable Space Development and Settlement - Technologies
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Politecnico di Torino - Thales Alenia Space Italia - ISAE Supaero Toulouse, ItalyTESTING WASTE MANAGEMENT AND RECYCLING TECHNOLOGIES FOR MARS
EXPLORATION IN THE FRAMEWORK OF MISSION TO THE MOON**Abstract**

Human deep space missions require an elevated and unprecedented level of autonomy to be realized. In this regard, a fundamental issue will be the way in which the available resources and the unavoidable produced waste will be managed. Nowadays it is manifest that the endeavour of the space community is oriented to return the man on the Moon, but this as to be seen as an intermediate step to reach an even more inspiring, long-term objective: the human exploration of Mars. Hypothesizing a medium-long term human mission on Mars, self-sufficiency and reutilization will be some of the most crucial requirements that will have to be satisfied, considering the level of isolation in which the crew will have to live and to the impossibility of any intervention from Earth. In addition, cost, weight and limited payload capacity of launchers make the transportation from Earth of all the supplies needed for an extended stay extremely impractical: this is the reason the amount of waste will have to be reduced to the minimum. In this paper the main technologies necessary to recycle waste and reconvert it into reusable resources for a Mars mission are explored, focusing on those for which verification and testing procedures will be potentially implemented already during forthcoming lunar missions. Different ways in which these technologies can be applied and tested on the Moon are thoroughly described. A closed-loop approach is adopted, with the aim to minimize waste production, maximize products repurpose, and embrace sustainability and preservation of the explored environment. In addition, the reusability of the mission key elements is considered to complement the effort of achieving in future the dream of extraterrestrial lunar settlements. This study is carried out in the framework of II Level Master's programme SEEDS (Space Exploration and Development Systems), a project born from the collaboration between the Politecnico di Torino (PoliTo), the Institut Supérieur de l'Aéronautique et de l'Espace (ISAE) and the University of Leicester, with the participation of Agenzia Spaziale Italiana (ASI), Centre National D'Etudes Spatiales (CNES), European Space Agency (ESA), Thales Alenia Space and Altec.