18th IAA SYMPOSIUM ON VISIONS AND STRATEGIES FOR THE FUTURE (D4)
Space Resources, the Enabler of the Earth-Moon Econosphere (5)

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WASTE MANAGEMENT FOR LUNAR RESOURCES ACTIVITIES: TOWARDS A CIRCULAR LUNAR ECONOMY

Abstract

Space resources activities are currently the objective of a thriving, cross-disciplinary, global effort aimed at assessing their role and potential in the future of humankind. New, innovative mission concepts, legal frameworks, and advanced technologies are being actively developed and proposed with the final goal of enabling profitable and efficient space resource utilization. Ultimately, these endeavors should pave the way towards a new era of sustainable and accessible space exploration, for the benefit of all Countries.

Thanks to strategic features such as proximity to Earth, reduced gravity and availability of various useful resources, the Moon will play a key role in such process. Already in the next decade, the Moon will likely become first a testing ground for innovative technologies and then an outpost for further deep space exploration.

To ensure the flourishing development of this new Earth/Moon infrastructure, sustainability of lunar resources activities seems to be an essential requirement. Accordingly, the implementation of sustainability will secure the cost-effectiveness of lunar operations and further provide for a successful model to replicate elsewhere.

Within this context, this paper will address the topic of waste management for lunar resources activities as a key issue in the sustainable development of the Earth/Moon Econo-sphere, towards the development of a lunar circular economy.

To this end, it will consider the most promising technologies for lunar resources extraction and processing - with special focus on water - correlating their waste generation potential to the scale of the efforts implemented and to the projected availability of the resources of interest.

Further, the paper will also address corollary activities of space resources activities - such as logistics and transport operations - for their implications in waste management. *Inter alia*, the paper will identify protocols and technologies with the lower waste generation potential and elaborate further scenarios for waste handling, reduction, reuse, and recycle, as well as end-of-life strategies for extraction plants.

Based on the above, the paper will conclude by presenting recommendations for the development of incremental regulation for waste management. As a starting point, these recommendations will suggest the establishment of common areas of non-interest for waste disposal, as well as the mandatory conducting of environmental impact assessments before the deployment of lunar resources activities.

Please note that the present abstract is submitted under the auspices of the Space Generation Advisory Council, as part of the activities of the Space Exploration Project Group.