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EVALUATING THE VALUE AND FEASIBILITY OF LUNAR ISRU PLANTS INCLUDING POWER SUPPLY FACILITIES BY JAPANESE PLANT ENGINEERING COMPANY.

Abstract

The JGC Group, which is celebrating its 96th anniversary, is an EPC (engineering, procurement and construction) contractor that has carried out 20,000 projects in more than 80 countries around the world, including extremely harsh environments such as deserts, permafrost and jungles. Now, JGC is taking on a new challenge that expands its activities to the moon and aim to develop a lunar In-Situ Resource Utilization (ISRU) plant. In this paper, we will discuss the feasibility and values of a lunar ISRU plant based on the experience gained through numerous plant EPC projects. The GER (Global Exploration Roadmap) of the ISECG suggests an annual manned lunar exploration program from the end of the 2020s to the 2030s. On the other hand, the transportation fee to the Moon is generally estimated to be around 1MUSD/kg, and the compaction of transport mass is an important issue for realizing frequent manned traffic between the Moon and the Earth. A typical solution is ISRU (In-Situ Resource Utilization), i.e. the utilization of local resources, and the letters ISRU can be seen in the aforementioned GER. Typical examples of resources available on the Moon are metal oxide (regolith) and ice, but this paper focuses on the economic feasibility study of 'propellant (liquid hydrogen and liquid oxygen) production from ice resources', which is mentioned in the GER and JAXA's future space exploration scenario 2021. There are not many studies where the importance of the system has been fully discussed from multiple perspectives. Therefore, in this paper, we first discuss the necessity of the ISRU plant from multiple perspectives, including qualitative aspects. The main points of discussion are transportation costs, mission flexibility, and psychological safety for astronauts. Next, we studied the transportation costs, which are relatively easy to discuss quantitatively. This feasibility study was carried out not only for the ISRU plant, but also for the power supply facility. The indicator for this study was the comparison of the total mass of the facility and the total mass of the propellant produced over the lifetime of the facility. As a result, it was shown that, depending on the configuration of the power supply facility, a significant cost advantage can be obtained even when development costs are taken into account.