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# A NOVEL H2O2 AND PRESSURANT GAS TRANSFER TECHNOLOGY FOR REFUELLING IN LOW AND ZERO GRAVITY ENVIRONMENTS

**Abstract**

With the ever-growing number of spacecraft being launched into orbit, alongside the growing desire for propulsion systems on many of these craft, an emerging opportunity is present in the potential servicing and refuelling of these spacecraft. Proposals for propellant resupply services are growing in abundancy, primarily with architectures involving craft launching from the Earth's surface to transfer their cargo of propellant to in-orbit customers. SolvGE, a start-up based at TU Delft in the Netherlands, has proposed a sustainable architecture involving the production of high concentration hydrogen peroxide (H2O2) from water ice present at off-Earth locations (e.g. the Moon, Mars, Phobos and Deimos).

While Hydrazine has featured as an in-space propellant of choice, this popularity is dwindling with the European Chemicals Agency considering outlawing it due to its toxic and carcinogenic nature. While H2O2 does possess a lower specific impulse than Hydrazine, it does have a number of other attractive characteristics such as its high density, storability, nontoxicity, lack of reactivity with the atmosphere, low vapour pressure, high specific heat, high O/F ratio, compatibility with many pressurant gasses and ease of handling. With the production of H2O2 at off Earth locations, a system is envisaged where resupply craft are utilised to transport the propellant from the production segments to the customer craft at certain locations (e.g. Low Lunar Orbit, Earth-Moon L1 or L2, and Low Martian Orbit).

This would require the transfer of the propellant in both low and zero gravity environments. Alongside the resupply of propellant, gasses produced during the H2O2 production may be supplied to customers as pressurant gas. A propellant transfer mechanism capable of operating in both low and zero gravity environments that is suitable for use with H2O2 and utilises the gasses provided by the H2O2 production segment is presented. This mechanism shall be capable of transferring the propellant and pressurant gasses, from the production segment present in a variety of gravitational environments, to the resupply craft, and from the resupply craft to either a depot or customer vehicle. A prototype of this transfer mechanism has been developed and used to verify a model of the system. The lessons learned from this prototype, as well as the model developed, will support the implementation of this transfer mechanism in SolvGE's refuelling system to potentially help facilitate expanding humanity's horizons further out into the solar system by providing a network of fuel stations in space.