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DEVELOPING A COST EFFECTIVE LAUNCH SOLUTIONS WITH HYBRID ROCKET ENGINES

Abstract

As the global space industry is rapidly growing, soon becoming the next trillion-dollar market. Small satellites are still very popular in this NewSpace, yet access to space remains very expensive for them and countries like Nepal are still struggling to place their own satellites. Many technologies have been developed, and various ventures are promising to provide affordable, dedicated and reliable access to space for small satellites. This paper studies how a low-cost technology like Hybrid rocket engines can be explored and utilized to develop cost effective small satellite launch vehicles, a better choice rather than conventional solid or liquid rockets. Hybrid rocket engine combines the pros of both solids and liquids, the simplicity and safety of solid rockets with the high performance and controllability of liquid engines, making them ideal for launching small satellites to Low Earth Orbit (LEO). Recent advancements in hybrid propulsion using paraffin wax have demonstrated high specific impulse (ISP), comparable to RP-1, while being lower-cost, safer, and more environmentally sustainable. A mixture of liquid oxygen (LOX) and paraffin wax not only delivers high thrust but also ensures cleaner combustion with reduced carbon emissions, making it a greener alternative to traditional propellants. A Nepal based startup; Mach24 Orbitals is also on the run to provide a cost-effective launch solution for small satellites weighing up to 500 kg powered by a hybrid propulsion system. The startup has already performed various lab scale tests for the first time in the country to validate the technology behind it, developing up to 10,000N engine. Leveraging the benefits of Hybrid Propulsion, Mach24 Orbitals is aiming to launch a suborbital sounding rocket next year and a small satellite launch vehicle in a few years, all designed and developed in Nepal. This paper also focuses on why developing hybrid rockets for small satellites can be a groundbreaking leap for countries like Nepal and beyond, offering a low-cost, high-performance solution that could reshape access to space in emerging markets.

Keywords: Hybrid Propulsion, Cost-Effective Launch, Small Satellites, Emerging Space Nations, Accessible space