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Project Title: **Utilization of GAP as a plasticizer for a Hybrid Rocket Applications**

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Abstract: **Utilization of GAP as a Plasticizer for Hybrid Rocket Application**

Hybrid rocket motors are propulsion systems that combine solid and liquid (or gaseous) propellants to generate thrust. The benefit of this hybrid rocket system includes thrust control, economic efficiency, safety, and simplicity. However, hybrid rockets have challenges such as low regression rate, lower combustion efficiency, and poor thrust-to-weight ratio. In order to overcome these issues various attempts has been made by the researchers which includes addition of metal additives, using varying grain configuration, utilizing oxidizer in limited quantities. Common fuels used in the hybrid rocket are the HTPB, PE, HDPE, Wax etc. Recently use of glycidyl azide polymer (GAP) as a plasticizer in hydroxyl-terminated Polybutadiene (HTPB) has already been investigated for the solid propellant application. GAP can be used as binder as well as plasticizer based on the preparation and its molecular weight. The integration of GAP aims to enhance the mechanical properties and regression rates of HTPB based fuels, hence mitigating the limitations of traditional hybrid rocket propellants. The effect of varying concentrations of GAP on combustion efficiency, specific impulse, and structural integrity of the fuel grains would be evaluated by static fire experiments and thermal analysis. This research examines the efficacy of glycidyl azide polymer (GAP) as a plasticizer in hydroxyl-terminated polybutadiene (HTPB)-based propellant compositions for hybrid rocket engines. The biggest challenge observed with the GAP based propellant is its synthesis and preparation of a perfectly cured solid fuel. All the challenges would be addressed in this project proposal.

The objective is to improve the energy qualities and regression rate of the HTPB-based fuel while preserving satisfactory mechanical and rheological attributes. The method of preparation of GAP as plasticizer has to be optimized and scale up studies for preparing a minimum of 250 ml of GAP would also be optimised. The propellant grain formulation, preparation process and curing time have to be optimized to obtain a proper grain. The prepared GAP and the propellant would be subjected to various characterization techniques for ascertaining its chemical, mechanical and combustion properties. Experimental studies would be conducted utilizing a laboratory-scale hybrid rocket engine employing two types of oxidizer that is gaseous oxygen (GOX) and hydrogen peroxide (H_2O_2). The binder used in the present study is hydroxyl terminated Polybutadiene (HTPB). The HTPB-DOA propellant is used as the base propellants its performance would be compared with HTPB-GAP propellants for both the types of the oxidizer. Apart from this performance would also be estimated by adding aluminium as the metal additive.