

Sustainable Manufacturing of Solenoid Valve Housing in Fiji: Fused Deposition Modeling (FDM) and Emergy Analysis

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Abstract : A solenoid valve is an important part of many fluid systems. Its purpose is to regulate fluid flow in a machine. Due to the crucial role of the solenoid valve and its design intricacy, it is quite expensive to obtain in Fiji and is not manufactured locally. A concern raised by the local health industry is that the housing of the solenoid valve gets damaged when machines are continuously being used and this part of the valve is very costly to replace due to the lack of availability in Fiji and many other South Pacific region countries. This study explores the agile manufacturing of a solenoid coil housing using the Fused Deposition Modeling (FDM) process. An emergy study was carried out to analyze the feasibility and sustainability of producing the part locally after estimating a Unit Emergy Value (or emergy transformity) of $1.27E+05$ sej/j for the electricity in Fiji. The total emergy of the process was calculated to be $3.05E+12$ sej, of which a majority was sourced from imported services and materials. Renewable emergy sources contributed to just 16.04% of the total emergy. Therefore, the part is suitable to be manufactured in Fiji with a reasonable quality and a cost of \$FJ 2.85. However, the loading on the local environment is found to be significant and therefore, alternative raw materials for the filament like recycled PET should be explored or alternative manufacturing processes may be analyzed before committing to fabricating the part using FDM in its analyzed state.

Keywords : emergy analysis, fused deposition modeling, solenoid valve housing, sustainable production

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