



Design And Development Of Support Cleaning Machine For 3D Printer

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ABSTRACT

The project "Design and Development of Support Cleaning Machine for 3D Printer" aims to create an efficient, low-cost post-processing system for removing support structures from 3D-printed parts. In additive manufacturing, supports are essential but their manual removal is tedious, inconsistent, and may damage delicate components. The proposed machine automates this process using a chemical-based cleaning system integrated with temperature control and agitation for effective support removal. The design procedure included concept generation, component selection, CAD modeling in SolidWorks, gap identification, and feasibility analysis. The optimized system ensures safe, uniform, and damage-free cleaning. Overall, the machine provides a compact, user-friendly, and sustainable solution that enhances post-processing efficiency and supports the advancement of additive manufacturing technology.

Keywords: - 3D Printing, Support Removal, Support Cleaning Machine, Chemical Cleaning System, Automated Cleaning, Temperature Control, Agitation Mechanism, CAD Design, SolidWorks, Cost-Effective Design, Sustainable Manufacturing.

1. INTRODUCTION

The Additive Manufacturing, or 3D printing, process offers the capability to create complex and intricate parts, but it also results in support structures that need to be removed later. Overall, this process - the manual removal of these support structures - is long, inconsistent, and can be detrimental to sensitive parts. In an effort to eliminate all these drawbacks associated with the post-processing of parts made by the Additive Manufacturing process, a Support Cleaning Machine has been designed that uses a combination of the chemical cleaning medium (QSR-30), temperatures, and mechanical agitation. The machine efficiently dissolves soluble supports without sacrificing part quality, such as PVA and QSR-30. Compact, yet still affordable and user-friendly, with reduced manual effort and improvement in surface finish, this innovative machine integrates mechanical, electrical, and thermal systems to enhance efficiency and reliability in 3D printing workflows.

2. LITERATURE REVIEW

A completely automated technique for the removal of supports was proposed by Nelaturi et al. [1] as part of multi-axis machining systems. The technique is based on the application of recursive algorithms that provide the optimum sequence of removal of the support structure by computing the accessibility of the tools without the occurrence of any collision.

In the comparison of the support removal process via the manual method and Wire Electrical Discharge Machining, Ameen et al. [2] used EBM to produce Ti6Al4V metal components and found the manual method to be more efficient in terms of processing time, averaging 3.08 minutes of processing in contrast to Wire EDM, which took more time (9.88 minutes).

Saigopal Nelaturi.[3] Automatic Support Removal for Additive Manufacturing Post Processing is a research study that focuses on minimizing the time taken for the support structure removal process from the additively manufactured product. The research study presents a solution for the problem using automation, which relies on computer tools to remove the support structure from the product without any damage to the product geometry.

Within the context of this research, the existing methods for support material removal in the post-processing stage in additive manufacturing have been reviewed. As per the existing research, it has been proven that the existing tools for post-processing in the additive manufacturing process have the potential to reduce the human involvement required in the post-processing stage with the help of the existing machining tools, which have the potential for accuracy and precision in the post-processing stage for the finished products using the above overall machining process, even though the processing time in the post-processing stage for the finished products is very less for the employees in the existing machining tools used for the post-processing stage in the machining process.

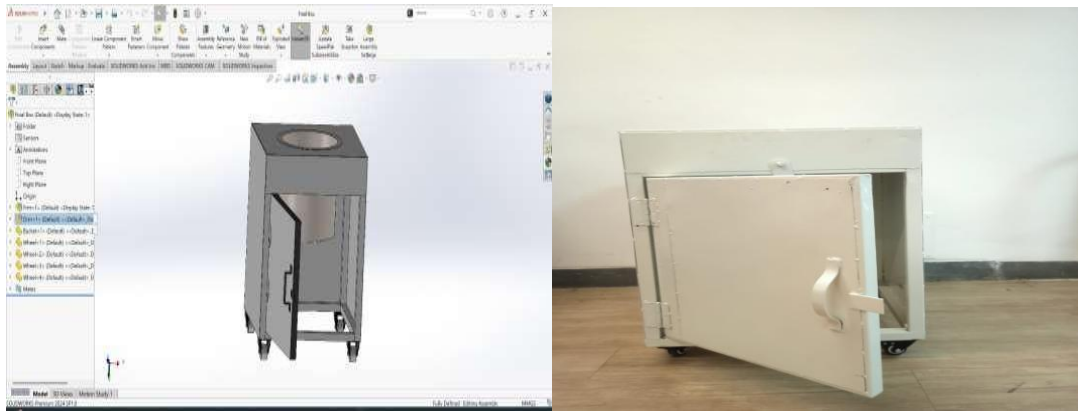


Fig -1: Conceptual Design in Solidworks And Actual Design Model

3. METHODOLOGY

The methodology for the development of the Automated Support Cleaning Machine (ASCM) involves.

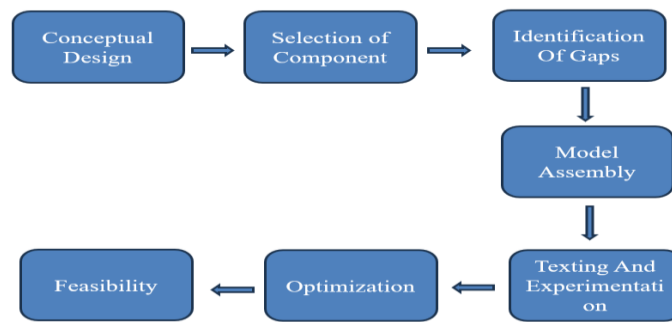


Fig -2: Methodology

3.1 Conceptual Design

The above conceptual design has been created using the software tool SolidWorks, which is useful in conceptual design for the visualization of the structure and the working principle of a system. In the conceptual phase, the strong emphasis was given to the determination of the system's layout and the functional relationships between its individual parts.

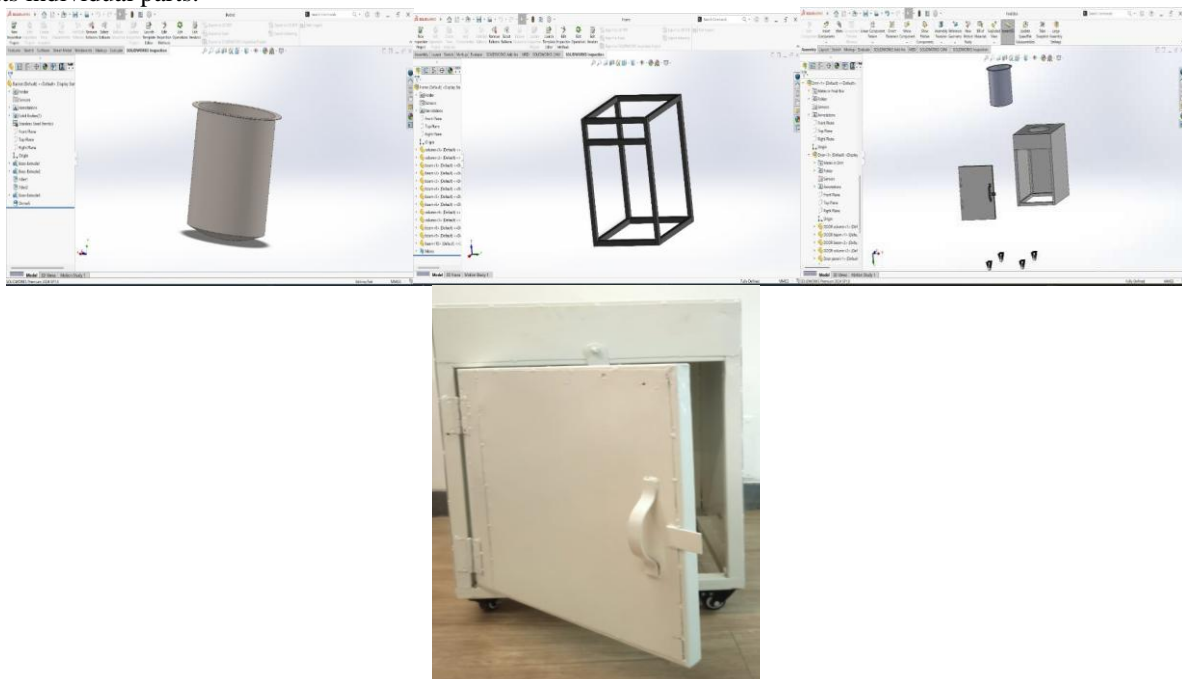


Fig -3: Model Exploded view, Model Frame, Tank



3.2 Selection of Component

In addition, at this stage, depending on the design requirement of the support cleaning machine, the most appropriate mechanical and electrical components are chosen. At the same time, the selection process is carried out for the materials used in the tank, frame, and other components of the support cleaning machine, depending on the strength, durability, and corrosion resistance of the materials. For the tank, stainless steel is used due to its excellent chemical composition when dissolved with the chosen support solvent material.

3.3 Measurement of Actual Dimensions

In addition, as far as the actual dimensions of all mechanical and structural parts of the system were concerned, they were directly measured from the system, and specific parameters such as component lengths, component widths, component heights, and component thicknesses were specifically noted.

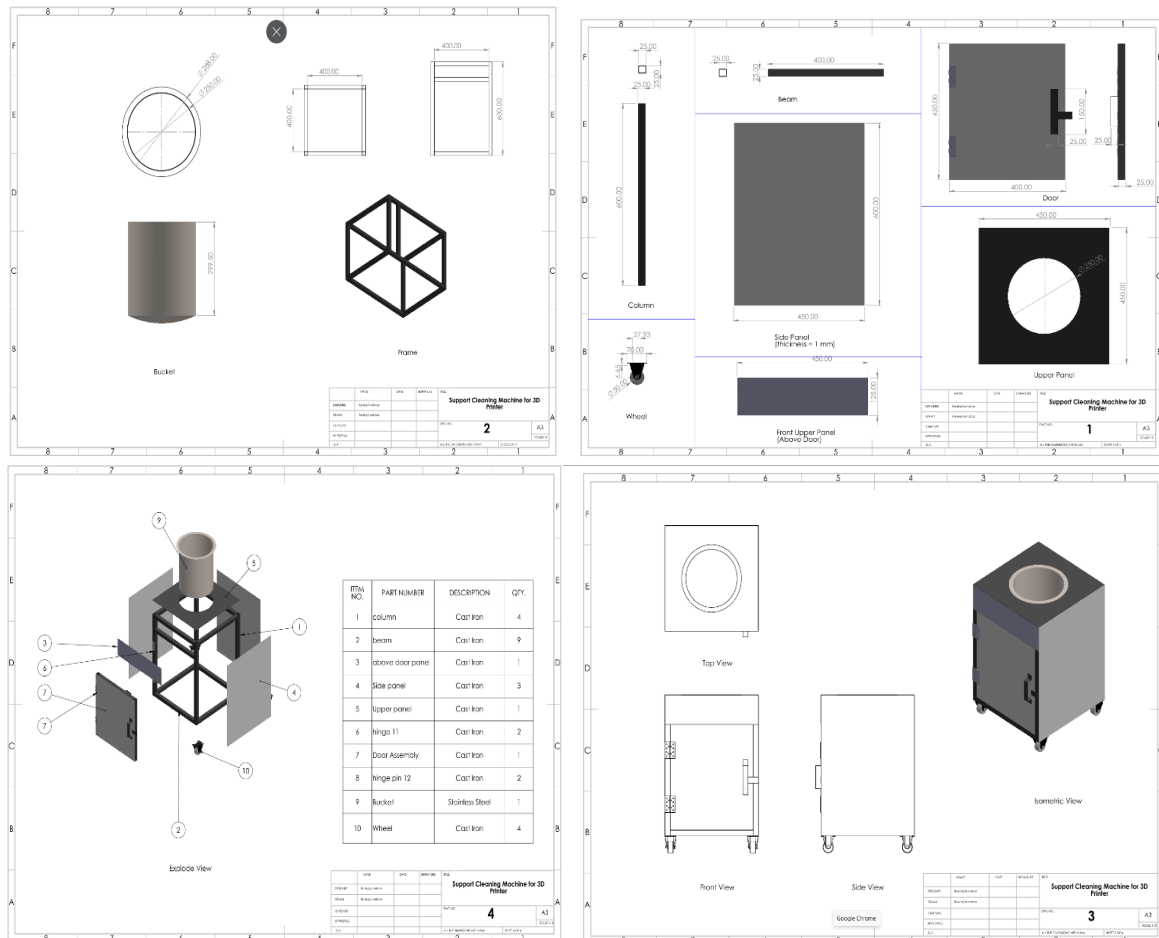
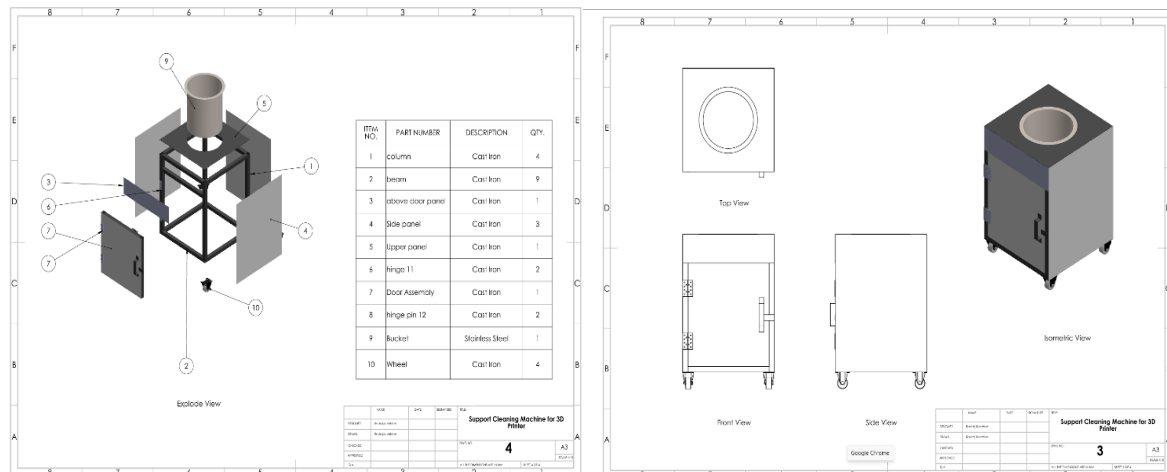


Fig -4: Dimensions of Support Cleaning Machine For 3D Printer

3.4 Result And Discussion

The “Design and Development of Support Cleaning Machine for 3D Printer” The support cleaning machine designed and developed in this project performed very well in removing the QSR material from the 3D-printed object. The heating process in the machine hastened the dissolution of the QSR solution, and simultaneously, there was agitation in the process that took place, ensuring that the chemical flowed evenly around the 3D-printed object.

The data obtained from the support cleaning machine clearly indicates that the post-processing of the 3-D printed object is highly dependent on the controlled process parameter. The controlled temperature and rate of agitation ensured that there was an improvement in the interaction of the chemicals with the QSR support. This, therefore, enabled a faster removal of the support material. First, the automated process ensured that there was a



minimized variability level associated with human factors, as it is more difficult to make mistakes when using a manual process, hence a clear indication of a better repeatability of results.



Fig -5: Support Material Removal Model (After) and Support material Model (Before)

4. CONCLUSIONS

In the project "Design and Development of Support Cleaning Machine for 3D Printer," the objective was to design an automated post-processing system that would be utilized to remove support material from 3D-printed parts efficiently. The designed system would be capable of processing medium-scale printed parts made of water-soluble support material, SR-30, using an EcoWorks cleaning solution. The cleaning tank made of stainless steel (SS304) ensures strength, corrosion resistance, and efficient heat transfer during the operation of the system. The machine's frame structure is made of mild steel, ensuring the system has the necessary strength and stability. Anti-vibration mounts minimize system vibrations during operation.



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