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WAX PRINTING

1) Explain in detail about wax printing with a neat diagram and also mention its advantage and disadvantag

Introduction:

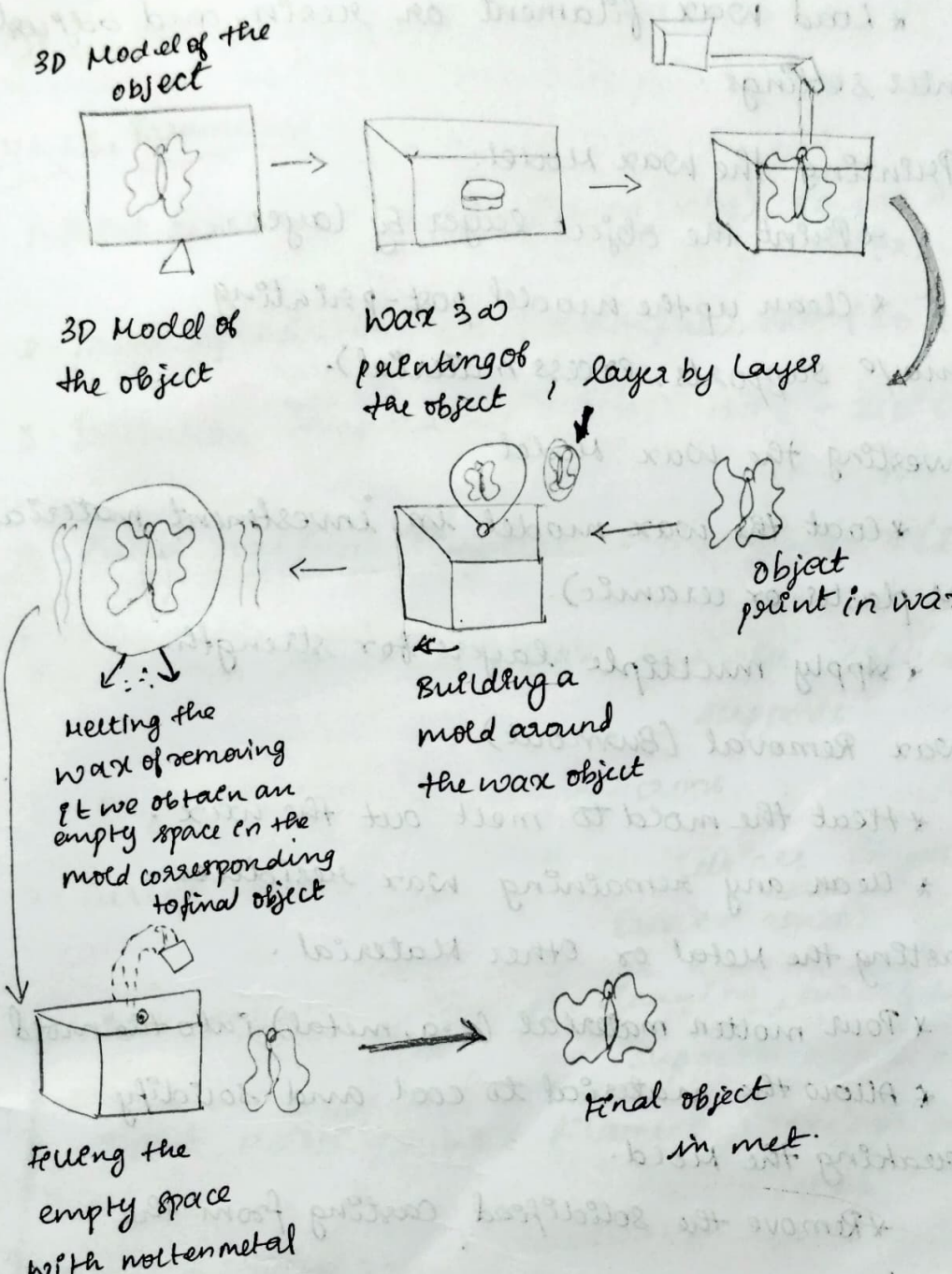
In AM, wax printing involves using wax to create detailed shapes or patterns layer by layer, much like a 3D printer. This process is especially popular in making molds and prototypes, especially for jewelry and casting, because wax is easy to shape and later remove. Wax printing is precise, allowing for complex and delicate designs that are hard to achieve with other methods.

Working Principle:

In wax printing for AM, a 3D printer builds an object layer by layer precisely depositing or curing wax based on a digital model. Each layer solidifies and bonds to the previous one, gradually forming a detailed, high-precision wax pattern. This pattern can then be used as a moed for casting by covering it in ceramic, melting out the wax, and filling the hollow moed with metal or other materials.

This process is popular in industries like jewelry and prototyping because it allows for intricate, smooth designs that are otherwise difficult to achieve.

Diagram:



Step by Step Process:

1. Design the Model [CAD]

* Use CAD software (e.g., Solidworks, Rhino) to design the model. Consider casting needs like shrinkage.

* Export to compatible file formats (.STL, OBJ)

2. Preparing the 3D printer

* Choose a wax-compatible 3D printer (SLA or FDM)

* Load wax filament or resin, and adjust printer settings

3. Printing the Wax Model

* Print the object layer by layer

* Clean up the model post-printing (remove supports, excess material).

4. Investing the Wax Model

* Coat the wax model in investment material (fine plaster or ceramic).

* Apply multiple layers for strength.

5. Wax Removal (Burnout)

* Heat the mold to melt out the wax.

* Clean any remaining wax residues.

6. Casting the Metal or Other Material.

* Pour molten material (e.g, metal) into the mold

* Allow the material to cool and solidify.

7. Breaking the Mold.

* Remove the solidified casting from the model.

* Break away the investment material (plaster or ceramic).

8. Finishing the Casted Part

* Perform sanding, polishing, and any heat treatments.

* Refine the surface and shape of the cast part.

9. Final Inspection

* Inspect the final casting for quality, dimensions, and defects

Machine Parameters :-

1. Print Resolution : 20-50 microns (x/y), 20-100 microns (z)

2. Print Speed : SLA (10-30 mm/hr), FDM (20-80 mm/s)

3. Extrusion Temperature (FDM) : 160°C - 210°C (wax filament).

4. Build Platform Temperature : 40°C - 60°C (FDM heated bed)

5. Support Structures : Wax or water-soluble supports :

6. Layer Height : 20-100 microns

7. Curing Time (SLA) : 1-15 seconds per layer (UV exposure).

8. Post-processing Settings : Cleaning, curing, and support removal.

9. Print Material : Wax filament (FDM) or wax resin (SLA).

Process-parameters :-

* Layer height
* Print speed
* Extruder temperature
* Bed Temperature
* Cooling Rate

Advantages:-

1) High precision and detail:

Achieves fine details and smooth surface finishes, ideal for intricate designs.

2) Excellent surface finish:

Produces parts with minimal post-processing, reducing polishing and finish work.

3) Easy Burnout for casting:

Wax models are easy to burn out without leaving residues, making them ideal for investment casting.

4) Material Reusability:

Excess wax material can often be recycled and reused, minimizing waste.

5) Fast prototyping:

Quick turn around times for producing prototypes, enabling faster design iterations.

6) Low Thermal Expansions:

~~wax exhibits~~

Disadvantages:-

1) Limited Material Strength.

2) Limited Application

3) Post-processing Requirements.

4) Higher costs

5) Limited printer Availability.

6) Lower Resolution Compared to other Methods