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Solid Ground Curing

Solid Ground Curing process is also called as Solid Base Curing. This process was first developed and commercialized by Cubital, Israel. Solid Ground Curing (SGC) is used for fabricating parts from photo-polymers. The entire cross-section, in a single operation, is exposed using photo-masks. (In SLA each cross-section is made using a laser light, layer by layer.) SGC is an unique process in that entire slices of a part are manufactured at one time. Hence, large throughput is obtained and productivity of SGC process is also high. This is also an expensive process.

Process Description (Fig. 5.1)

1. A slice is created by the computer software, a mask of the slice is printed on a glass sheet by the use of an electrostatic (toner printing process similar to laser printing). A mask is required, since the area of the slice where a solid material is required remains transparent. (Steps A, B and C)
2. While the mask is being prepared, a thin layer of photo-reactor polymer is laid down on the work surface and spread uniformly. (Step 1)
3. The photo mask is placed over the work surface, and an UV (ultra-violet) light beam is projected through the mask (Step 2). Wherever the mask is clear (transparent), the light cures the polymer and makes the desired slice to be hardened. (Step D)

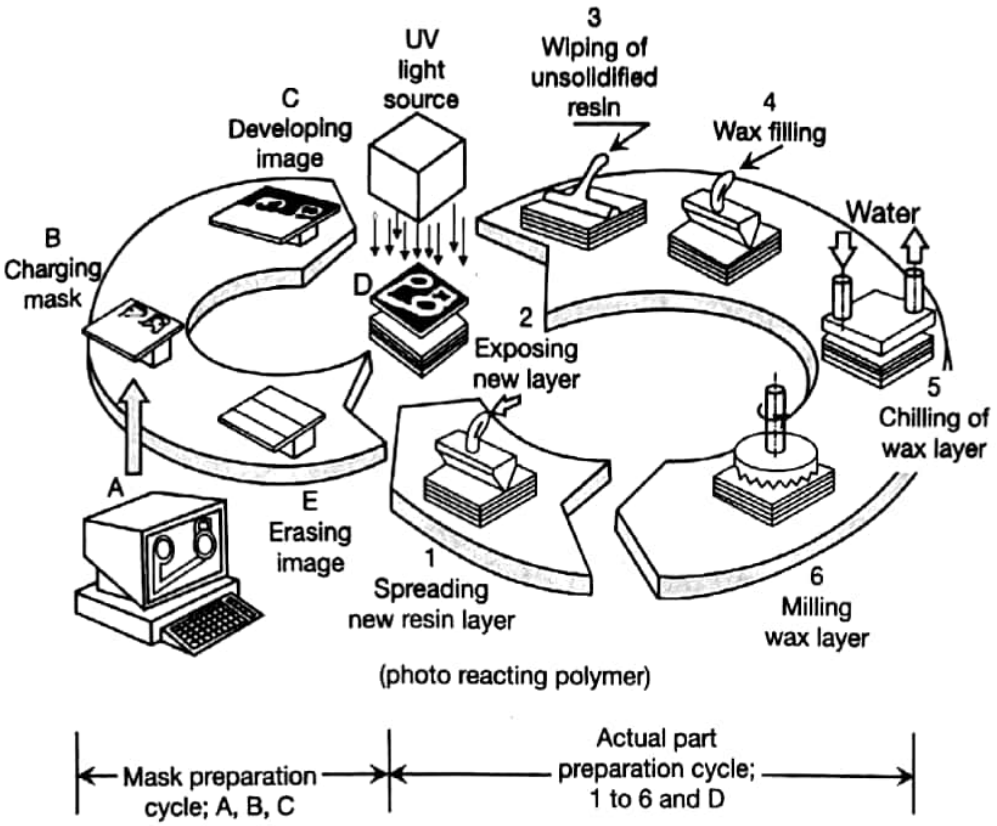

Fig. 5.1: Solid Ground Curing (SGC) (also called Solid Base Curing). Polymer Layer is cured by UV Light

4. The unaffected resin (in liquid stage) is wiped off from the surface using vacuum. (Step 3)
5. A water soluble liquid wax (with low melting point) is spread across the work area, filling the cavities previously occupied by the unexposed liquid polymer. (Step 4)
6. The workpiece is kept on a chilling plate, in which cold water is circulated, the workpiece remains cool and the wax hardens quickly. (Step 5)
7. The solidified or cured layer is milled to get the desired thickness and a good flat surface. (Step 6)
8. The process is repeated, layer by layer, until the part is completed.

Solid Base Curing has the advantage of high production rate; because the entire slices are produced at once and two glass screens are used simultaneously. That is, while one mask is being used to expose the polymer, the next mask is being

prepared simultaneously and it is ready as soon as the milling operation is completed.

The wax support is water soluble, it can be removed immediately or can be kept in place as protection during handling of the part. With wax support, any type of part (such as an object-in-the-bottle) can be made since it is water soluble, (sacrificial support). Generally, no finishing operation is done, but occasionally the polymer will be cleaned in acidic solution to bleach the surface and to get smooth finish.

The SGC process involves two cycles:

i. for the preparation of mask, and
ii. for the preparation of the physical object and support parts of the layer.

Multiple parts in a single batch, by packing them one above the other, can be built within the working space volume.

The pattern on the exposed mask can be erased by wiping off the tower (Step E) and the entire process can be repeated.

Advantages of SGC Process

- This is one of the fastest processes since curing takes place simultaneously at all desired points. Hence, productivity of the process is high.
- Build-time is independent of the number of parts being made at a time. Therefore, it can act as a production machine.
- No external support structures are required.
- No warping or curling of the part takes place, as there is no post-curing operation.
- Large variety of photo-polymers can be used for building the parts.
- Accuracy of parts is good.

Limitations

- There is lot of wastage of material and wax. The resin picked up by the wiper and vacuum during the milling process cannot be reused. The material which does not

form the part of the model, but gets exposed to the UV light needs to be replaced. Only fifty percent of this affected material can be converted into usable form.

- The cost of the machine is the highest amongst all RP machines since it involves several systems such as photo-masking system, UV source, vacuum system, milling system, etc.
- The process operation is complex and maintenance cost is high since it has several sub-systems.
- It requires a huge compressor and its operation is noisy.
- Monitoring of the building process is required.
- The wax material has a finite shelf life and needs to be replaced after a certain period, even if not used.
- Wax is sticky and difficult to remove.

EVALUATIVE QUESTIONS

1. What are the steps involved in producing a part by solid-base curing?
2. Why is solid-base curing process is not as popular as other rapid prototyping techniques?
3. Give a brief description of Solid Ground Curing process.
4. What is the heat source used in this process?
5. What is the unique advantage of this method over SLA process?
6. The SGC process involves two separate cycles. What are these two separate cycles?
7. What are the advantages and limitations of the process Solid Ground Curing?
8. What is meant by the term "curing" as used in this process nomenclature?