Evaporative Pattern Casting Process (lost foam process)

The Evaporative Pattern Casting Process is also known as Full Mold Process, Lost Foam Process etc. H. F. Shroyer patented the foam patterns for metal casting on April 15, 1958. In this patent, expanded polystyrene (EPS) block was used to make the pattern and it was supported by bonded sand. M.C. Flemming in 1964, used unbounded sand with the process. This is known today as lost foam casting (LFC). With LFC, the foam pattern is molded from polystyrene beads. LFC is differentiated from full mold with the use of unbounded sand (LFC) as opposed to bonded sand (full mold process).

The pattern used in this process is made from polystyrene (this is the light, white packaging material which is used to pack electronics inside the boxes). Polystyrene foam is 95% air bubbles, and the material itself evaporates when the liquid metal is poured on it.

The pattern itself is made by molding the polystyrene beads and pentane inside an aluminum mold, and heated; it expands to fill the mold, and takes the shape of the cavity. A cycle of steam is used to fully expand. The pattern is removed, and used for the casting process, as follows:

1 The pattern is dipped in a slurry of water and clay or other refractory grains like ceramic coating is used to cover the foam cluster. The coating acts as a barrier preventing the penetration and sand erosion during pouring and it is dried to get a hard shell around the pattern. Any suitable sand can be used as long as it resists the temperature of the molten metal being poured. Silica sand, zircon sand, olivine sand and chromites can be used as molding sand.
2 Clusters are formed through assembly of the pattern sections using glue and the gating systems are also similarly glued and attached. The shell-covered pattern

or the cluster is placed in a container with bonded sand for support, and in order to ensure uniform and proper compaction, a vibrating table is used in the mold compaction. After completing this process, the cluster is packed in a flask the mould is set ready for getting poured.

3 The liquid metal is poured from a hole on top.

4 The foam evaporates as the metal fills the shell; upon cooling and solidification, the part is removed by breaking the shell.

The process is useful since it is very cheap, and yields good surface finish and complex geometry. There are no runners, risers, gating or parting lines – thus the design process is simplified.

Using unbounded sand and expandable polystyrene pattern, the EPC process is a very economical method in producing complex, close-tolerance castings.

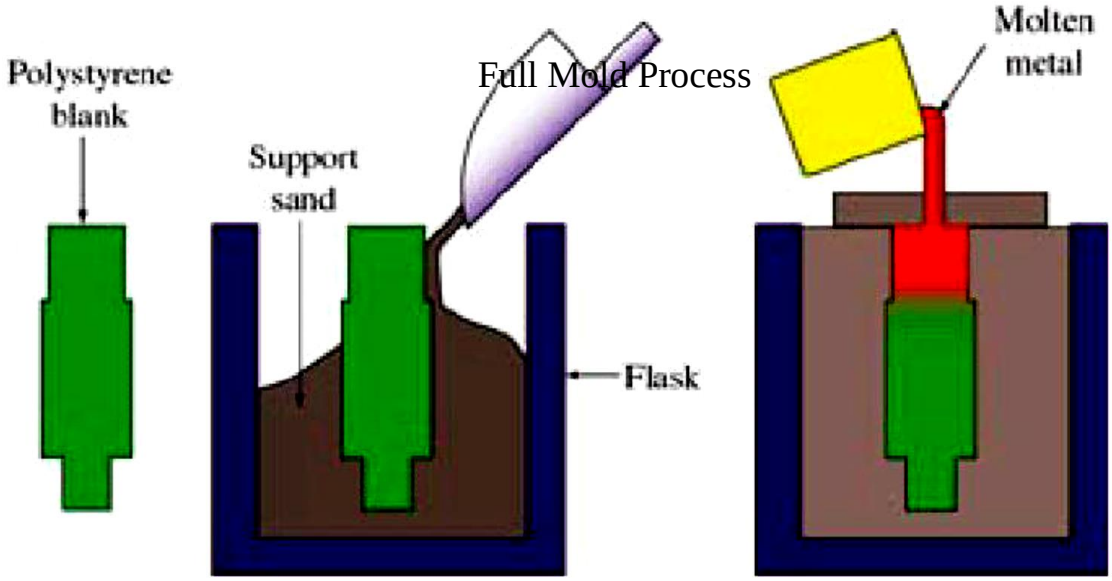
Advantages of EPC Process

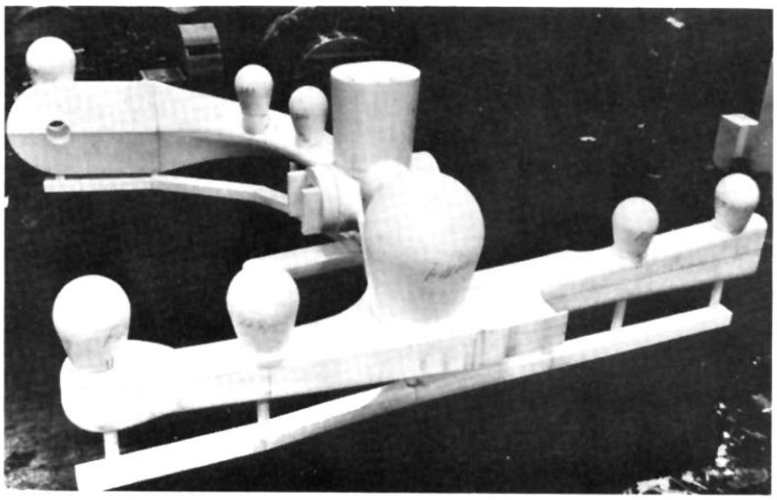
- Useful for complex castings when pattern withdrawal is not easy or pattern cost is too high.
- When compared to wood, foamed polystrene is relatively inexpensive and light. It can be easily cut and glued to obtain the desired workpiece geometry, sprue, runner, riser, etc.
- Since pattern is not withdrawn, no draft allowance is required.
- Useful for a single casting or a few castings (prototypes)
- In the EPC process, no cores are required making it the most advantageous.
- No requirement for binders or other additives, as it is a binder less process
- Complete sand reclamation is possible using very simple and inexpensive techniques
- Sand shake out is easy as the sand is unbounded

- Since the pattern used in EPC process is one piece, hence no parting line and since cores are eliminated, hence no core prints. Also, no mismatch, core shift because of the mentioned reasons
- Improved casting quality. Close tolerances are possible
- The EPC is an environmentally favorable process
- As it is a binder less process, the efforts on cleaning the molded sand are virtually nil. Therefore, the EPC process is viewed as a value-added process rather than a substitute for sand casting.

Disadvantages / Limitations of EPC Process

- Since every casting requires a new pattern, it is a costly process
- There is a limitations on the minimum section thickness of the pattern
- Quality of the casting fully depends upon the quality of the pattern
- As the sand is unbounded, during pouring, because of the difference of the evaporation rate of the metal and flow rate of the metal,sand falls down in the cavity generated. Hence, defective casting.





Complex evaporative pattern

Application of EPC Process

- It is used for making automotive components (cylinder heads, engine blocks, inlet manifolds, heat exchanger ,crank shaft)
- It is used in marine, aerospace and construction industries

Requirement for Refractory Coating Materials

- Highly permeable coating is preferred for rougher sand while medium and low permeable coating is used for finer sand.
- Quick drying preferred
- Coating should get easily stuck to the pattern, and there should be possibility of controlling and adjusting coating layer thickness.
- Appropriate strength, resistance to abrasion, resistance to cracks during storage, resistance to bending and deformation during mould making. In cases where rough sands are used for molding at high temperatures, thicker refractory coating layers are desired.