CHAPTER 14

Expendable-Mold Casting Processes

Review Questions

1. There is a variety of casting processes. Many casting process characteristics are similar but each has distinct characteristics that determine process requirements and cast part properties. Some of the factors that influence choice of casting process are

- quality of cast surface required,
- desired part dimensional precision,
- part production rate,
- the complexity of the process and process tooling that are required to produce a particular part,
- cost of mold or die,
- material characteristics as they determine feasible casting processes.

2. Using molds and patterns as process classification factors results in three general categories of casting processes

i. Single-use molds with multiple-use patterns

ii. Single-use molds with single-use patterns

- these two types of processes are often called expendible mold casting processes

iii Multiple-use molds

3. Frequently cast metals are iron, steel, aluminum, brass, bronze. magnesium, zinc alloys and nickel-based superalloys. The large range of properties and melting temperatures

indicates that almost all metals can be cast, given enough process development resources. However, there are “easy-to-cast” materials and these are typically used. Materials may be inherently “castable” or alloys specially formulated to produce acceptable parts in easily designed and controlled casting processes.

4. The most common casting process is sand casting. Green sand casting is used to produce about 90% of the casting produced in the United States. Its wide use indicates that it is probably the most versatile.

5. A casting pattern is a duplicate of the part to be made, modified in accordance with the requirements of the casting process, metal being cast, and particular molding technique that is being used.

6. The material used for construction of a casting pattern is determined primarily by the number of castings to be produced, but is also influenced by the size and shape of the casting, the desired dimensional precision, and the molding process. Wood patterns are easy to make and are used when quantities are small. Unfortunately, wood is not very dimensionally stable due to warping and swelling with changes in the humidity. Metal patterns are more expensive, but are more stable and more durable. Hard plastics, such as

urethane, have been used, and expanded polystyrene is used for single-use patterns. Expanded polystyrene and wax can be used for single-use patterns.

7. The simplest type of pattern is the one-piece or solid pattern. Since it is the simplest it

is usually the least expensive.

8. In casting a pattern is used to form the mold cavity. In making a two part mold the mold material is formed around the pattern and then the pattern is removed leaving the mold cavity. One way to form the pattern, and the form it the mold cavity, is to use a two part, or split, pattern. The two parts of the pattern are fixed to the match plate, the mold formed around the pattern-match plate, the mold halves separated and the pattern-match plate removed.

So, the match plate is a plate to which parts of the pattern are attached. It aids molding in providing a simple structure to help form the pattern and mold cavity. In a general sense the match plate is a fixture for creating the pattern.

9. With a cope-and-drag pattern, the cope and drag halves of the split pattern are mounted onto separate match-plates, thereby permitting larger molds to be handled easier or two separate machines to be simultaneously producing the two portions of the mold.

10. A loose-piece pattern is frequently used when the object to be cast has protruding sections or geometric features such that a more traditional pattern could not be removed from the molding sand.

11. The four requirements of a molding sand are: refractoriness, cohesiveness, permeability, and collapsibility. Refractoriness is provided by the basic nature of the sand. Cohesiveness is provided by coating the sand grains with clays that become cohesive when moistened. Permeability is a function of the size of the sand particles, the

amount and type of clay or other bonding agent, the moisture content, and the compacting pressure. Collapsibility is sometimes promoted by adding cereals or other organic materials that burn out when exposed to the hot metal to reduce the volume of the solid bulk and decrease the strength of the restraining sand.

12. The four requirements of a molding sand are not consistent with one another, so good molding sand is always a compromise between the various factors. The size of the sand particles, the amount of bonding agent, the moisture content, and the organic matter are all selected to attain an acceptable compromise. For example, increasing the amount of clay will enhance cohesiveness, but decrease permeability.

13. A muller is a mixing-type device designed to uniformly coat the grains of sand with the additive agents. The discharge frequently contains some form of aerator which prevents the sand from packing too hard during handling.

14. Standard tests have been developed to maintain consistent sand quality by evaluating: grain size, moisture content, clay content, compactibility, and mold hardness,

permeability and strength.

15. A "standard rammed specimen" is a 2" in diameter, 2" long sand specimen that is produced by means of a standard and reproducible form of compaction. A sufficient amount of sand is placed in a 2-inch diameter steel tube so that after a 14-pound weight is dropped three times from a height of 2-inches, the final height of the sand specimen is within 1/32 of an inch of 2 inches .

16. Permeability is a measure of how easily gases can pass through the narrow voids between the sand grains. A casting mold material must possess permeability to permit the escape of air that was in the mold before pouring, plus gases generated from the molding material itself when materials in the molding sand burn, volatilize, or deteriorate when in contact with the hot metal.