Advice & Counsel

Frank Altmayer, MSF, AESF Fellow
AESF Technical Education Director
Scientific Control Labs, Inc.
3158 Kolin Ave.
Chicago, IL 60623-4889
E-mail: faltmayer@sclweb.com

Die Casting & Plating – Part I

Dear Advice & Counsel,

I would like to be armed with some basic information as to what operational conditions in producing "castings" are related to defects that may cause plating related problems. Our company plates mostly onto aluminum die castings, and a small part of our work is made of cast iron. I know little about the relationship between casting quality and plating quality.

Signed,
Ms. Mucho Porus

Dear Ms. Porus,

With some assistance from "Metals Handbook" (American Society for Metals or ASM International), I will attempt to provide a primer for you.

Casting

Pouring a molten metal into any type of mold will produce a casting of some type. Most metals begin their existence this way. If an object is permitted to retain its as-cast shape, and is altered only by machining or other surface finishing operations, the object is called a casting. In addition to mold/sand casting, other techniques include die casting, centrifugal casting and vacuum casting. Casting requirements for producing quality castings include proper chemical composition, grain size, density, cleanliness and mechanical properties that must be met. To accomplish mold-casting there are a multitude of design and processing steps that must be administered in a reproducible manner. As an example, cast iron parts are typically produced using mold/sand casting methods. These castings contain high carbon (2 to 4%), silicon (1 to 3%), the balance being iron. High carbon irons and steels tend to form tough-to-remove smuts during cleaning. Aggressive cleaning and pickling can dissolve away the iron, baring carbon stringers that can produce nodules or blisters (Fig. 1).

All castings may evidence a high level of porosity at or near the surface. Casting porosity levels can be reduced at the source by proper control over the process.

Even the best casting will contain some pores near the surface. Excessive polishing may cut through the skin on a casting and travel down to the porous layer, as shown in Fig. 2. Plating over these pores or fissures usually results in blistering and/or peeling, as surface pores can trap chemicals in the cleaning and acid pickling operations and can be held in place through the rinsing operations by a phenomenon called "capillary action." After plating, chemical compounds trapped in these pores can slowly leak out through cracks in the plated deposit causing staining or the trapped chemicals can push on the plated metal layers creating a blister.

Because of the high level of carbon content, cast iron alloys have a low hydrogen overvoltage potential in some plating solutions (cyanide zinc, for example). This hydrogen overvoltage potential is so low, that only hydrogen is produced when voltage is applied to the part. Pickling cast iron should be conducted only in inhibited acid to avoid cracking and minimize smut formation. Keep pickling time to a minimum. Alloys containing silicon need to be pickled in sulfuric-hydrofluoric or sulfuric-bifluoride acid mixtures.

Die casting

Die casting is the primary method of producing complex shapes from aluminum, zinc and sometimes copper and other metals. Aluminum and zinc die castings are commonly electroplated for appearance and corrosion protection purposes.

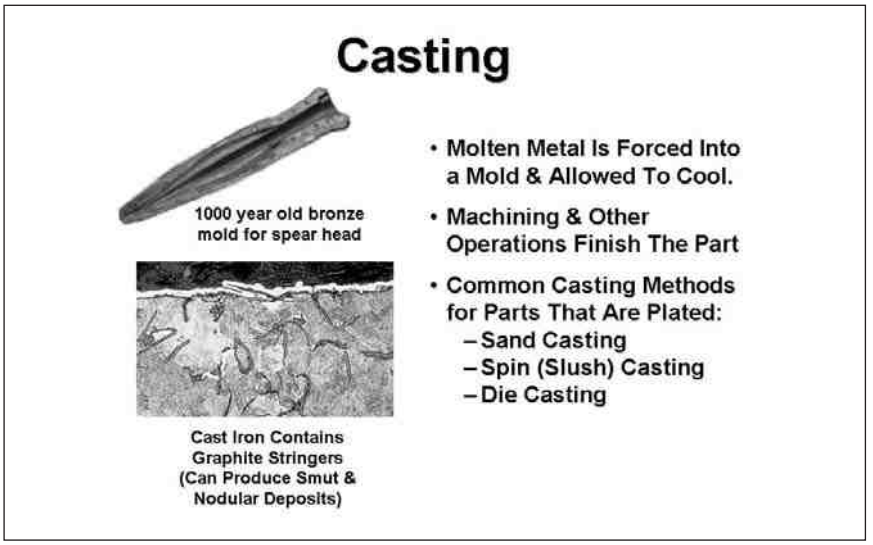

Figure 1—Casting (Spearhead photo courtesy of Wikipedia.com, second photo by F. Altmayer)

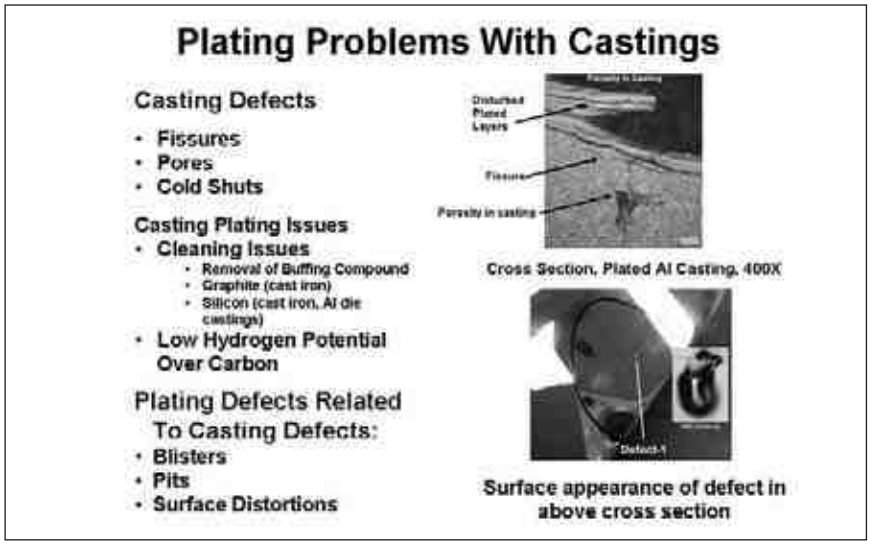

Figure 2—Plating problems with castings.

Figure 3 shows, in schematic form, a horizontal, cold chamber, die casting process, which is commonly used for producing aluminum castings. Zinc die castings are produced using a hot chamber casting machine (molten zinc is drawn into the chamber directly from the pot of molten metal), but the basic process is the same.

Step 1:
The molten aluminum is poured into the shot chamber. Just the right amount of metal must be poured to avoid casting flaws.

Step 2:
The plunger rod closes off the pouring hole and then compresses the metal into the die. The die is designed to deliver molten metal smoothly throughout the cavity and eliminate air from the cavity as the molten metal enters. If this is not done well, porosity, cold shuts (metal that has not completely melted to itself) and flow lines will be produced in the final product. At this point, the molten metal is allowed to solidify inside the cavity.

Step 3
After the solidification dwell time, the ejector half of the die opens and the plunger pushes on the solidified casting, releasing the part and attached "biscuit" of un-cast metal from the shot chamber from the die cavity. After application of mold release compound, the die halves close and the process can begin to produce the next part.

Next month, I will discuss the various casting flaws that can arise and how they can be minimized or even eliminated through proper part and mold design and casting operation. *P&SF*

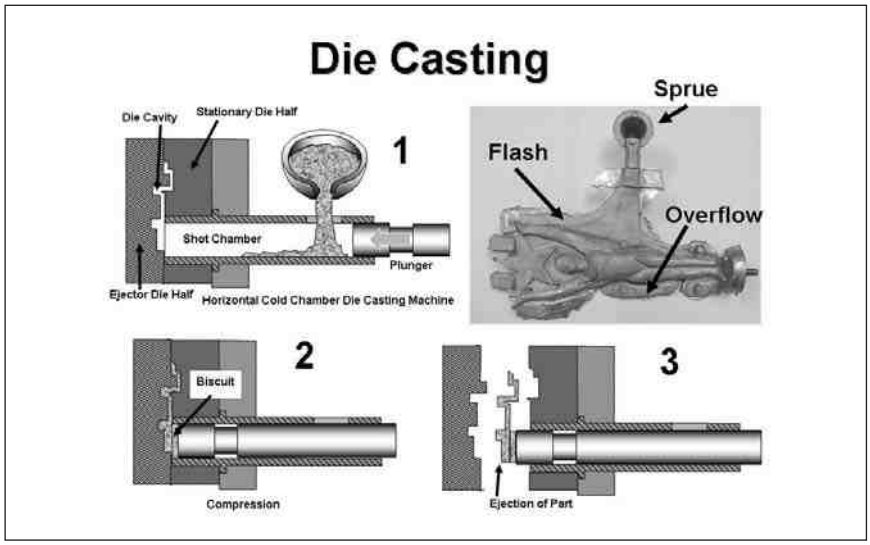

Figure 3—Die casting principles.