UNIVERSITY OF ALABAMA

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What's the best way to fill the mold?

Two speakers at last year's Center Industry Seminar on Cast Iron emphasized the importance of proper pouring techniques to produce defect-free castings. Dr. Charles Bates, of the University of Alabama in Birmingham (UAB), and Dan Quick, of the University of Northern Iowa, described the problems conventional pouring techniques give foundrymen.

Dan demonstrated to the audience that conventional down-the-sprue pouring techniques entrain substantial quantities of air, up to 30 percent of the total volume of metal poured. Dr. Bates reported on his research results, which showed that most pouring ladle designs entrain air, no matter now carefully they are used. One of the worst for entraining air is the bottom pour ladle, which entrains a quantity of air nearly equal to the amount of metal poured.

When air is entrained, the oxygen it contains reacts with the metal to form inclusions. In steel, research has shown that these reoxidation reactions are the primary cause of inclusions in castings. In aluminum, oxygen in the air forms a film of aluminum oxide which, if it solidifies in the casting, substantially lowers casting properties.

In addition, entrained air contains moisture and nitrogen; if these elements enter the liquid they can cause porosity defects in both ferrous and nonferrous castings.

There are a variety of solutions which have been proposed to overcome air entrainment during pouring. Because most involve the extra expense of pumping the metal *up* into the mold from below, foundries have been reluctant to use them. After all, gravity is free, and it works quite well in filling molds.

Unfortunately, gravity isn't "free" when it produces castings which must be scrapped or repaired. Increasingly, quality foundries are turning to counter-gravity mold filling techniques, which prevent air entrainment. These have been most popular for aluminum castings, but they are also found in steel and superalloy investment casting foundries.

Aluminum foundries that use counter-gravity methods report that scrap levels from inclusions and porosity defects approach zero percent. Even better, property scatter is substantially eliminated, and the reliability of castings made this way equals that of forgings.

The UAB work showed that elimination of air entrainment usually reduces casting repair costs by 50 - 65 percent. Returns from machining sources also drop dramatically.

The message is clear: mold filling which entrains air (pouring over-the-lip down a sprue) produces casting defects. Despite the increased "up-front" costs associated with counter-gravity pouring and revised ladle designs, changing your pouring methods may pay off in reduced manufacturing costs and increased customer satisfaction.

If you would like more information about ways of avoiding air entrainment during pouring, you can contact Dan Quick at (319) 273-2981, or Dr. Bates at (205) 975-8120.