



Introduction: Oxide inclusions, a common defect in castings, can contribute ~20% to the cost of a steel casting. When not detected during production, they can contribute to premature failure of steel castings. The quality of steel castings is improved by minimizing inclusion formation during pouring. This is done by using well-designed gating systems. A simulation model to predict the formation and locations of inclusions during the pouring of steel castings has been developed, experimentally validated and transitioned to commercial software to facilitate design of improved pouring systems.

SUCCESS STORY

Problem: Non-metallic oxide inclusions form when liquid metal interacts with entrained air and oxygen during metal casting processes. These troublesome and severe defects in steel castings result in poor surface quality, reduced mechanical properties, and reduced service performance & machinability.

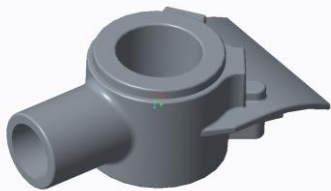


Inclusions Marked for Repair on Casting Cope Surface

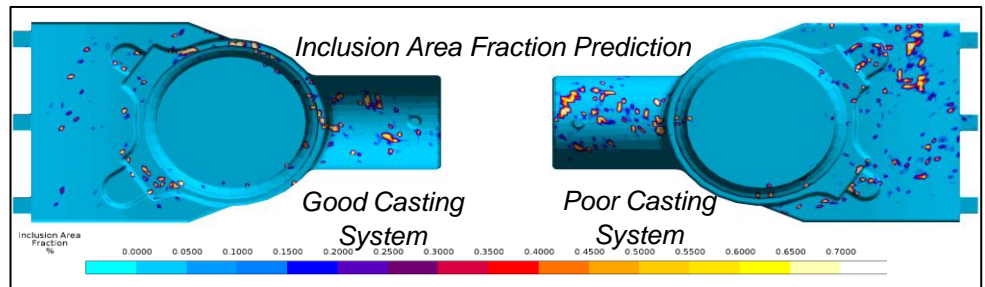


Inclusions Marked for Repair

Solution: Under AMC's Innovative Casting Technologies (ICT) program, the University of Iowa developed and applied modeling to reduce inclusions in steel casting by design of improved pouring systems, demonstrating the benefits of modeling air entrainment and inclusion formation in casting processes.



Case Study of Qualification Casting for US Navy



Benefits: The ability to predict air entrainment and resulting inclusions will directly affect our ability to design better mold filling systems and reduce reoxidation inclusions. Experiments and modeling show that a well-design pouring system can reduce the amount of surface area inclusions from 2.2% to 0.4% coverage. DoD applications where air entrainment modeling have been applied include track shoe pouring system designs for Bradley and M1, and foundry improvement applications with Newport News Shipbuilding.

“Reoxidation products in steel are one of the primary concerns in steel casting quality. Inclusions result in reduced mechanical properties, increased lead time to the customer, and overall increased cost of manufacturing.”
 --Shawn Martin, Melt and Lab Operations Manager, Harrison Steel