AMC
AMERICAN METALCASTING CONSORTIUM

The University of Iowa Minimizes Oxide Films in High Alloy Castings

PROGRAM OVERVIEW AND OBJECTIVES

The objective of the ongoing AMC project at the University of Iowa is developing a simulation model to predict the extent and location of oxide films in high-alloy steel castings. The model is being validated using specially designed casting experiments and industrial case studies.

> "If successful, this research will develop insights regarding the nature of oxide film quality details. This would enable foundries to optimize their rigging to reduce or eliminate oxide film quality details." – Caelan Kennedy, SFSA Research Manager

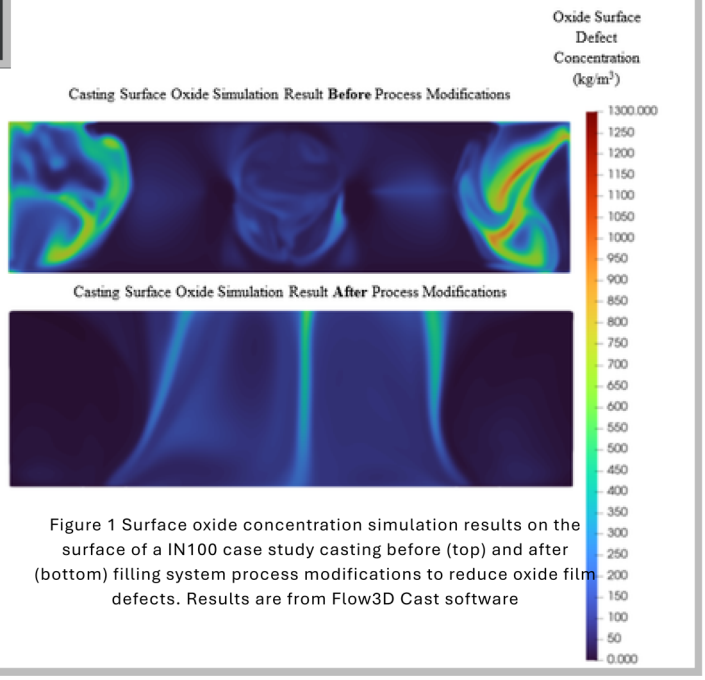

Figure 1 Surface oxide concentration simulation results on the surface of a IN100 case study casting before (top) and after (bottom) filling system process modifications to reduce oxide film defects. Results are from Flow3D Cast software

PROBLEM

Oxide films are among the most prevalent and severe defects in high-alloy steel castings. Mitigating them accounts for up to 25% of production costs. They form during the turbulent pouring of liquid steel into the mold. Current methods for preventing oxide films are empirical and rely on trial and error. No casting process simulation software reliably predicts oxide films.

SOLUTION

A case study performed for a Steel Founders' Society of America member foundry demonstrated that the models provide results consistent with the foundry's experience. Oxide film defects were a problem with the foundry's original gating system. The foundry used a trial-and-error approach to improve the gating, resulting in an improved system that did observe any oxide film defects on the casting. Simulation results for the original gating are labeled "before" and results for the improved gating are labeled "after." In the case study, oxide defect modeling was performed using the software packages being used to develop the new modeling capability, FLOW-3D CAST and MAGMAsoft. The oxide film concentration results from Flow3D Cast are shown in Figure 1.

BENEFIT

Use of the modified gating is predicted to substantially reduce oxide film defects. Using the inclusion area fraction results from MAGMAsoft, the "before" system is predicted to have substantial oxides in Figure 2. The MAGMAsoft results after the gating system modification are predicted to greatly reduce oxide defects. This study shows that foundry engineers can use the models being developed to design pouring and gating systems that minimize oxide films in high alloy castings.

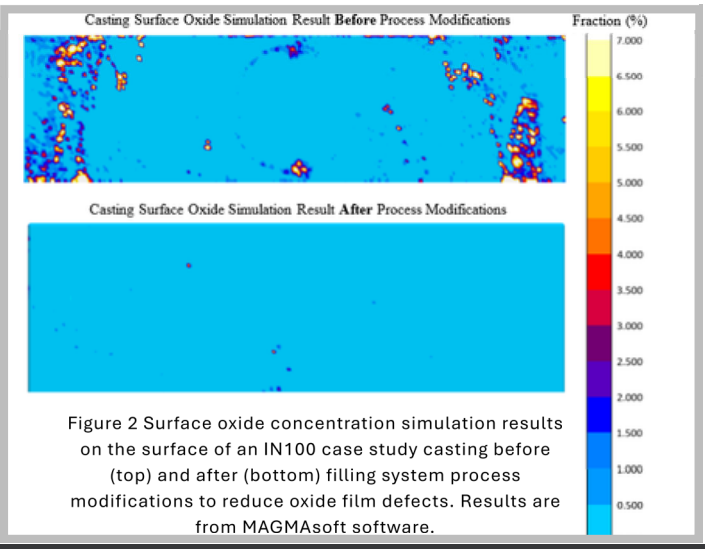

Figure 2 Surface oxide concentration simulation results on the surface of an IN100 case study casting before (top) and after (bottom) filling system process modifications to reduce oxide film defects. Results are from MAGMAsoft software.

MANAGED BY ATI ADVANCED TECHNOLOGY INTERNATIONAL

For more information about AMC go to https://amc.ati.org/
Research and events are sponsored by the Defense Logistics Agency Information Operations, J68, Research & Development Office, Ft. Belvoir, VA. and the DLA Troop Support, Philadelphia, PA.