

Tool Failure in Die Casting

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ABSTRACT

Dies are made of hot work tool steel to withstand high thermal wear. In non-ferrous casting, dies are exposed to severe mechanical, thermal, and chemical loads which limit the dies service life and capacity. This article reviews major failure modes in die casting tools are thermal fatigue, gross cracking (brittle cracking), heat checks (thermal fatigue cracking), and corrosion from rapid molten metal flow. Thermal expansion and contraction from heating and cooling cycles of dies generate stress and strain field. The hardness and strength properties of dies decrease when in contact with high-temperature-high-pressure molten metal and lead to surface and subsurface crack propagation. Crack networks appear on the surfaces that are exposed to thermal cycles. With the continuous use of the dies, these crack networks grow and propagate; hence, affecting the quality of the die and cast surfaces as a result of mechanical loads, thermal loads, and erosion. Local failures can accumulate from local plastic deformations; the cracks originate and propagate with a further usage of the dies. The local failure of materials appears first at the critical die locations. These are the locations where there is an abrupt change in the shape and geometry of the material, and the associated residual stresses due to the tool production.

KEYWORDS

Corrosion; Crack; Heat checks; Soldering; Thermal wear

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