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Investigation of factors influencing crack formation in cooling channels of injection moulds

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Cooling systems utilizing water are usually used for temperature control in injection moulding processes. To achieve short production cycle times and high surface quality of injection-moulded parts, cooling channels are designed to run close to the mould's cavity surface. While optimal cooling performance is achieved by conformal cooling channels using additive manufacturing techniques, conventional drilling methods remain a more economical option for creating these channels within moulds.
The corrosive effects of cooling water, as well as the plastic melt and its additives, place significant stress on the tooling used in these processes. Consequently, corrosion-resistant tool steels with a martensitic microstructure are frequently employed. However, in practical applications, damage occasionally due to cracks originating at cooling channels, attributed to a combination of corrosive effects and mechanical stress.
This study analyses such damage through optical microscopy and scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM/EDX). Following this analysis, corrosion tests - including aging tests and constant load tests - were conducted on a selected martensitic chromium steel under varying conditions. These tests aimed to evaluate the influence of factors such as chloride content in cooling water and the presence of brass components within the system.
The findings reveal that the observed damage stems from a form of stress corrosion cracking initiated by intergranular corrosion. The laboratory tests further indicate that the presence of copper from brass components and the chloride concentration in the cooling water significantly affect the initiation of cracks from the cooling channels.

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Primary author: ZUNKO, Horst (voestalpine Böhler Edelstahl GmbH & Co KG)

Presenter: ZUNKO, Horst (voestalpine Böhler Edelstahl GmbH & Co KG)

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