Contribution ID: **27** Type: **Oral Presentation - an extended abstract will be submitted**

Microstructural analysis and wear resistance of Osprey® MAR 55 tool steel produced via Laser Powder Bed Fusion

Wednesday, 26 March 2025 09:30 (20 minutes)

Based on the concept of combining the advantages of standard carbon martensite with those of maraging, carbide strengthened Ni-Co-Cr-Mo steels were introduced over 40 years ago. These steels contained up to 0.4 wt.% C in combination with Ni (up to 10 wt.%), Co (up 8 wt.%) and additions of Mo, Cr and V. This development stemmed from the need to combine high yield strength, and wear resistance due to refined martensite substructure, and carbide precipitation with good toughness and adequate weldability of the Fe-Ni lath martensite. With the emergence of laser-based additive manufacturing (AM) as a viable processing route for fabricating tools with complex geometries and near surface conformal cooling channels, revisiting such compositions which bridge the gap between high strength Fe-C martensite and weldable Fe-Ni martensite seem to be a promising route. This work presents the development of Osprey® MAR 55 steel powder, a new alloy designed by Sandvik, inspired by carbide strengthening Ni-Co-Cr-Mo steels.
The study focuses on the microstructural evolution, mechanical properties, tempering resistance, and wear behaviour of this novel steel processed by laser powder bed fusion (L-PBF). Through dilatometric and Energy Dispersive X-ray Spectroscopy (EDXS) analyses, key phase transformations during heating and tempering were identified, including the precipitation of molybdenum rich M2C phases and austenite reversion driven by nickel diffusion. These transformations significantly affect the alloy's temper resistance. Comparative wear tests show that MAR 55 demonstrates superior wear performance relative to the most commercially exploited L-PBF 18Ni300, which is attributed to its optimized microstructure (C-martensite) and enhanced carbide stability. This research further highlights field test results, showing the potential of MAR 55 in as built (˜50 HRC) and heat-treated condition (˜53 HRC), as a high-performance alternative in applications requiring improved wear resistance, exceptional toughness, and enhanced weldability, making it a promising material for advanced AM processes.

Speaker Country

Italy

Are you interested in publishing the paper in a Steel Research International special issue?

No

Primary author: EMANUELLI, Lorena (Department of Industrial Engineering, University of Trento)

Co-authors: MATILAINEN, Ville-Pekka (Seco Tools); SIMON , Lövquist (AB Sandvik Coromant); MANE, Mayur (AB Sandvik Coromant; Dalarna University); RAJAN, Jijesh (AB Sandvik Coromant; Dalarna University); OLSSON, Mikael (Dalarna University); JAYAMANI, Jayaraj (Dalarna University); DEIRMINA, Faraz (Sandvik Additive Manufacturing); PELLIZZARI, Massimo (Department of Industrial Engineering, University of Trento)

Presenter: EMANUELLI, Lorena (Department of Industrial Engineering, University of Trento)

Session Classification: Additive Manufacturing

Track Classification: Processing: Additive manufacturing of tools