Experimental termographic investigation for a dry and high-speed turning of SAF2507 Steel

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Abstract. This scientific communication investigates the temperature distribution for a dry and high-speed turning for a SAF 2507 super-duplex stainless (S-DS) steel using an infrared camera. The Oil&Gas sector widely uses the super-duplex stainless steels since their combination of high mechanical characteristics and corrosion resistance for a wide range of temperature. In metal cutting, such as in turning machining case, the temperature is a crucial factor for the tool life; hence it is essential knowing its distribution on the tool-workpiece interface with reliable techniques. The challenges associated with high-speed cutting operations for super-duplex steels are directly related to high temperatures. Due to the low thermal conductivity of the alloy, there is a higher concentration of the heat on the tool during cutting operations, and the generated heat causes an increase in the tool temperature influencing the quality of the products and the tool life of the inserts used. In this investigation, to determine the temperatures distribution of the SAF2507 super-duplex stainless steel during a dry turning process an infrared thermographic tests campaign was conducted and a mixed level Design of Experiments gave the experimental points. The advantage of using the thermography is to accurately capture the evolution of the tool and workpiece temperatures and record the chip shaping and chip breaking phases during machining. Once all the temperature data were gathered and post-processed, through a statistical methodology framework, the dependence of the cutting temperature from the machining parameters (such as cutting speed, feed rate, and depth of cut) was analysed, and a temperature surrogate model was built and then experimentally validated.

Keywords: Infrared Thermography, High-Speed Turning Machining, SAF2507 steel, statistical methodology framework, surrogate models.