

Reducing scrap in long rolled round steel bars using Genetic Programming after ultrasonic testing

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ABSTRACT

At Štore Steel Ltd., continuously cast billets (180 mm × 180 mm) are reheated and rolled after cooling to room temperature. Hot-rolled bars are controlled as they cool to room temperature in specially designed cooling chambers, minimizing residual stresses and the development of pre-existing surface and internal defects. The bar ends can be additionally covered with insulating material. The cooled, rolled bars undergo examination using automated control lines to detect surface and internal defects, which primarily originate from the casting process. Internal defects are identified using ultrasonic testing. Between January 2022 and June 2023, 1550.0 tons of 61SiCr7 rolled bars, with diameters ranging from 53 mm to 72 mm and lengths from 7010 mm to 7955 mm, were examined using ultrasonic testing. The scrap was 109.6 tons (7.07 %). After collecting data on chemical composition (C, Si, Mn, Cr, Mo, Ni content), the casting process (casting temperature, cooling water pressure and flow in the first, second, and third zones of secondary cooling, as well as the temperature difference between input and output mould cooling water), and rolled bar geometry (diameter, length), scrap modelling after ultrasonic testing was carried using genetic programming. The genetic programming model suggested reducing the length of the rolled bar. Due to length multiplication, it was possible to reduce the rolled bar length from the initial lengths of 7010-7955 mm to the current lengths of 4558-6720 mm in June 2023. Based on this adjustment, a new production of rolled bars was established. By August 2024, 1251.9 tons of 61SiCr7 rolled bars were produced with the mentioned length adjustments. These rolled bars were subsequently examined using ultrasonic testing. The scrap was reduced by nearly 14 times, amounting to only 8.1 tons (0.64 %).

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