Effect of steel manufacturing process and atmospheric corrosion on the corrosion-resistance of steel bars in concrete

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Abstract: This paper presents results of a study conducted to evaluate the effect of steel manufacturing process and the surface condition of reinforcing steel on their corrosion-resistance when embedded in concrete. Steel bars produced by water quenching and air-cooling were utilized. The corrosion-resistance of fresh bars, i.e., those that were clean and shiny, and those exposed to atmosphere and accelerated salt spray, when embedded in concrete, was evaluated. The corrosion-resistance of the clean and corroded reinforcing steel bars was assessed by measuring corrosion potentials and corrosion current density. Accelerated impressed current technique was also utilized to evaluate the corrosion-resistance of clean and corroded reinforcing steel bars in concrete. A longer time-to-initiation and lower rate of reinforcement corrosion was noted in the concrete specimens prepared with water-quenched steel bars compared to similar bars manufactured by the hot-rolling process. Similarly, the rate of reinforcement corrosion in the concrete specimens prepared with corroded steel bars, exposed to atmosphere for 12 months and salt spray, was less than that on the unexposed bars. The data developed in this study also indicate that the surface layer formed on the water-quenched steel bars, due to the cooling process, provides protection to the metal substrate as against the loose mill scale formed on the steel bars produced by the air-cooling process.