

The role of shrinkage defect in the corrosion resistance of ductile iron

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Abstract Ductile iron pipes, widely favored in urban water supply networks worldwide, now confront a formidable adversary—corrosion. This insidious threat jeopardizes both water quality and the integrity of pipe infrastructure. This study investigated the coupling mechanism of shrinkage defects and graphite on the corrosion resistance of ductile iron by electrochemical measurements, quasi-in-situ immersion tests and numerical simulations. The detrimental impact of shrinkage defects was confirmed by elevated corrosion current density and the formation of a porous corrosion product layer. Multiple-galvanic coupling effect among the matrix, graphite, and shrinkage defects serves as corrosion triggers, which is verified by scanning Kelvin probe force microscopy (SKPFM) and numerical simulations. Additionally, quasi-in-situ observations corroborate the deposition of corrosion products and Cl enrichment at defect bottoms, expediting occluded cell formation and corrosion propagation.

Keywords Ductile iron; shrinkage defect; corrosion resistance; corrosion kinetics.