

Weldability of Copper-bearing Aging Steel

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Abstract: The weldability of copper-bearing aging steel is evaluated using calculated cracking susceptibility index Pcm, oblique Y-groove cracking test, heat-affected zone (HAZ) maximum hardness measurement, submerged arc welding (SAW) test and gas metal arc welding (GMAW) test. The results show that this copper-bearing aging steel has low hardenability and cold cracking susceptibility. SAW test of 40 mm thick plate with WS03 wire matched by CHF101 flux reveal that the welded joints obtain high strength and good impact toughness at low temperature. The HAZ has no hardening but there exists a slightly softening phenomenon. Thus, line energy should be limited or controlled strictly to avoid softening behavior in HAZ during SAW. GMAW test of 12mm and 24mm thick plates using WER70NH wire show that the tensile strength of joints reaches 720MPa, higher than the stipulated strength requirement of base metal. The average impact energy at -40°C in the welded joints is more than 140J exceeding minimum stipulated requirement by a wide margin. There are no hardening and softening behaviors in the heat-affected zones of GMAW. All weld metals exhibit acicular ferrite (AF) plus small amount of proeutectoid ferrite (PF) structure, of which the former can significantly improve impact toughness of weld metal. The predominant microstructure in coarse grain HAZ is bainite.

Key words: copper-bearing aging steel, weldability, acicular ferrite, bainite, softening

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