

## Hydrogen embrittlement behavior of high-strength mining chain steel in simulated coal mine environment

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**Abstract** Coal makes up a big portion of energy consumption in China, which is guaranteed by fully mechanized mining technology for efficient and safe production. With the increasing of chain steel strength, hydrogen embrittlement becomes a key problem in the lightweight of mining equipment in coal mines. In this experiment, two kinds of mining chain steel were tested. Combined with hydrogen thermal analysis and slow strain rate tensile testing on notched specimens, the influence of hydrogen permeation on the mechanical properties of high strength mining chain steel in coal mine service environment was explored.

The results demonstrate that as the corrosion time increased, the hydrogen content invaded into the material also increased, while the fracture stress correspondingly decreased, reaching the most extreme values after 21 days of corrosion. At a corrosion time of 21 days, the hydrogen content in the 21# and 51# chain steels reached their peak values of 0.336 wppm (21#) and 0.129 wppm (51#), respectively. The fracture stress dropped from the initial values on uncorroded specimens of 2178 MPa (21#) and 2114 MPa (51#) to the lowest values observed during the experiment, which were 1979 MPa (21#) and 1859 MPa (51#), respectively.

The fracture analysis shows that after the same time of corrosion, the severity of intergranular fracture in the fracture of 51# mining chain steel is greater than that of 21# mining chain steel, and the reduction of fracture stress is also greater than that of 21# mining chain steel, indicating that 51# is more sensitive to hydrogen.

**Keywords** High-strength mine chain steel; Hydrogen embrittlement; Simulated coal mine corrosion environment; Slow strain rate tensile testing