EVALUATION OF CORROSION RESISTANCE OF MICROALLOYED REINFORCING STEEL

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RESEARCH

Introduction

Corrosion of reinforcing steel is one of the major durability problems in reinforced concrete structures such as bridges. Corrosion products have a much higher volume than the original steel and force the concrete surrounding the bars to crack and spall. Chlorides applied to the bridges as de-icing salts can penetrate the concrete and cause corrosion. This study focuses on the corrosion-resistance properties of three different microalloyed steels.

Project Objective

The study was undertaken because earlier tests indicated that heat-treated, microalloyed steel corrodes at only one-half the rate of conventional reinforcing steel. The relative corrosion rate dropped to one-tenth if both steels were epoxy-coated.

Project Description

The corrosion resistance of three microalloyed steels and two conventional reinforcing steels in concrete was evaluated. One of the conventional steels and the three microalloyed steels are heat treated by the Thermex process, which includes quenching and tempering of the steel immediately after rolling, while the other conventional steel is hot-rolled. In the current study, the reinforcing steels were tested using two rapid evaluation tests: the corrosion potential and corrosion macrocell tests, and three bench-scale tests: the Southern Exposure, cracked beam, and ASTM G 109 tests. The corrosion potential, corrosion rate, and mat-to-mat resistance were used to evaluate the steel. Tension and bending tests were performed to evaluate the effect of the microalloying and heat treatment on the mechanical properties of the reinforcing steel.

Project Results

Results show that the corrosion potential of the five steels is approximately the same, indicating that they have a similar tendency to corrode. The results from the rapid macrocell test showed that the five steels had similar corrosion rates. The microalloyed steel with regular phosphorus content (CRT) exhibited consistently lower corrosion losses than conventional steel in the bench-scale tests. Although CRT appears to be much more corrosion resistant than conventional steel in the G 109 tests (64 percent less total corrosion loss after 70 weeks), its overall performance does not show such an advantage. In the cracked beam test after 70 weeks, it had only 4 percent less corrosion loss than conventional steel, which indicates that in cracked concrete the two steels behave in a similar manner. In the Southern Exposure test, CRT steel had an 11 percent lower corrosion loss than conventional steel after the same period. This improved behavior is not enough to use the steel without an epoxy coating or to justify continued research on the steel as a superior epoxy-coated material.

Report Information

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