Technical Bulletin No. 3A

IPANEX Concrete Performs as Exceptional Corrosion Protection System for Reinforcing Steel on I-76

BACKGROUND

A. Technical Bulletin No. 3 prepared by IPA Systems, Inc., contains information explaining the performance of IPANEX concrete that was placed in 20 precast bridge deck slabs on the Pennsylvania Turnpike in 1973. The information in Technical Bulletin No. 3 was based upon an independent study and report by WISS, JANNEY, ELSTNER AND ASSOCIATES, INC., dated February 1991.

B. The testing conducted as part of the WJE study included but was not limited to:

ASTM C 114
"Standard Methods for Chemical Analysis of Hydraulic Cement"

ASTM C 876
"Standard Test Method for Half-Cell Potentials of Uncoated Reinforcing Steel in Concrete"

AASHTO T 277
"Rapid Determination of the Chloride Permeability of Concrete"

ASTM C 114 includes a standard procedure for measuring the actual chloride ion content of powder samples.

ASTM C 876 is a standard method for measuring the electrical half-cell potential of reinforcing steel in concrete, which provides an estimate of the corrosion activity of the steel.

AASHTO T 277 is a standard method for determination of the permeability of concrete by monitoring the amount of electrical current passed through a 3.75" diameter by 2" long core, when one end is immersed in a sodium chloride solution. A potential difference of 60V dc is maintained across the specimen for 6 hours, and the total charge passed is related to chloride permeability.

C. As stated in Technical Bulletin No. 3, the test data in all tests indicated that electrochemical corrosion of reinforcing steel would be present in the control structures as well as in the bridge containing IPANEX concrete.

D. The control structures showed extensive visible deterioration of the reinforcing steel as a result of this process. The IPANEX structure exhibited only minor steel corrosion in one small area. Cores taken from three control bridges and the IPANEX bridge verified the visual findings.

E. Additional information was required to determine the reason for the preservation of the passivating layer on the reinforcing steel in the presence of high chloride concentrations after more than 17 years of service.

FURTHER STUDY

In September of 1991, IPA Systems, Inc., obtained permission from the Pennsylvania Turnpike Commission to take additional cores from areas of the bridge deck slabs containing IPANEX concrete. These cores were removed from locations where prior WJE analysis had concluded that the electrochemical corrosion process should be evident, i.e. the acid soluble chloride ion content was above the accepted threshold value of 0.03 percent by weight of concrete for corrosion and half-cell potential measurements were between -0.25 and -0.50 volts.

TESTS

A. The cores were submitted to WJE for the following analysis:

chloride content (Acid Soluble Chloride, % by wt. of concrete)

pH Value

The table below reflects the results of that testing:

Core	Chloride Content	No. of times Threshold	pH
Slab 10	0.110%	3.7	12.34
Slab 11	0.042%	1.4	12.39

COMMENT

The indicated electrochemical and chemical corrosion processes in the bridge structure at Mile Post 133.4 containing IPANEX concrete had been prevented, even after seventeen years of exposure to an environment that caused severe corrosion in the control bridges.

The passivating oxide film on the steel in the IPANEX concrete slabs was preserved.

The pH value of the concrete at the interface of the reinforcing steel was maintained at a level in excess of 12.

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