Florida Department of Transportation Research

Corrosion of Spiral Rib Aluminized Pipe
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Large diameter, corrugated steel pipes are a common sight in the culverts that run alongside many Florida roads. Spiral-ribbed aluminized pipe (SRAP) has been widely specified by the Florida Department of Transportation (FDOT) for runoff drainage. These pipes are expected to have a long service life, up to 75 years. However, the durability of SRAP has been challenged by a series of premature pipe failures due to corrosion. FDOT contracted University of South Florida researchers to study these failures and find their causes.

Initial studies (FDOT project BD497) divided pipe failures into either Mode A or Mode B, depending on soil context. Mode A failures occurred in near-neutral soil environments and were often associated with gross manufacturing defects, such as helical cuts, or corrosion concentration near the ribs. Mode B failures took place in pipes in contact with limestone backfill, and corrosion damage was in the form of perforations; this damage was not associated preferentially with pipe ribs or with manufacturing deficiencies.

In this follow-up study, researchers sought to establish to what extent Mode A incidents result from manufacturing defects that can be rectified by appropriate quality control, compared to SRAP's vulnerability to corrosion due to ordinary forming stains. For Mode B, they sought the mechanism behind the corrosion and the role that limestone backfill plays. The study was conducted in the laboratory with experiments replicating conditions for Mode A and Mode B corrosion.

In Mode A experiments, results depended on the degree of pipe deformation. Corrosion as severe as what was seen in the field was observed in severely deformed aluminized steel. However, moderately strong deformation, such as that involved in the normal forming of SRAP ribs, did not consistently result in severe corrosion. SRAP showed some rib corrosion, but overall, performed similarly to regular corrugated pipe, which is not subjected to as much forming as SRAP.

Extensive corrosion and mechanical damage are evident in this SRAP set in limestone backfill.

Experiments confirmed that aluminized coating provides limited galvanic protection to steel at points of mechanical distress. However, the protection was not enhanced in lower resistivity environments. This and previous work suggested that much Mode A corrosion damage was due more to manufacturing deficiencies and less to inherent susceptibility of corrosion at the ribs of SRAP produced under appropriate quality control.

Investigating Mode B corrosion revealed that pH values high enough to dissolve aluminum's passive film can develop under exposure of limestone to flowing natural water. Under these conditions, extensive coating loss was observed over short time periods. In contrast, exposure to water in contact with sand did not result in alkaline conditions, and in the absence of mechanical deformation, aluminized steel remained essentially corrosion free. These findings substantiate for the first time an important vulnerability of aluminized steel in limestone soils and explain the rapid deterioration observed in the field under Mode B. The findings strongly support service guidelines to disallow the use of limestone bedding for aluminized steel pipe, including SRAP.

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