MICHIGAN'S BRIDGE COATING SYSTEM

Michigan's highway environment is recognized as very corrosive due to the use of deicing salt and our prolonged wet seasons. This environment takes a serious toll on steel bridge members. In the early 1980s, MDOT adopted zinc-rich coating systems for painting our bridges. Zinc-rich paints are referred to as "galvanic protective coatings" since the zinc in the coating will oxidize before the steel it is in contact with, thus protecting the steel from corrosion. Through extensive laboratory testing, and shop and field painting experience, we have adopted the following system for all bridge painting.

Background

In 1984, MDOT initiated a research project to evaluate the field performance of its organic zinc-rich coating system. The system consisted of an organic zinc-rich epoxy primer, a polyamide epoxy intermediate coat, and an aliphatic polyurethane topcoat. This system had been developed through accelerated laboratory testing to provide a remedial coating system for pitted, chloride-contaminated unpainted weathering steel bridges. Michigan has in excess of 600 unpainted weathering steel bridges and in our wet, chloride-laden environment they have not provided the resistance to corrosion that was anticipated.

Due to the problems experienced with chloride-contaminated weathering steel, several alternate coating systems were studied. The coating system we were seeking would arrest corrosion and prevent further section loss or pitting, especially at critical locations. Chlorides trapped in pits in the steel surface would need a barrier from moisture to stop their corrosive action. With these criteria in mind, our current coating system was developed. Environmentally exposed weathering steel surfaces, or severely corroded previously painted surfaces, typically have areas where heavy pitting of the steel is present. Because of the known problem of trapping chlorides in the pits, a "white blast" cleaned condition was originally specified. With a white blast, the pits in the steel would theoretically be chloride free. It proved to be impossible to achieve this condition in the field, however, and a 'near white' blast condition was achievable and considered acceptable, even though small pin-hole sized rust blooms would exist at the bottom of the pits. Because of the existence of these small rust blooms, an inorganic zinc-rich primer with a vinyl topcoat was not adequate to stop the pit-based corrosion in the contaminated steel. Because of the dispersed rust blooms in the pits, and the chloride concentration, an organic zinc-rich epoxy primer coat was selected for field evaluation. It is generally recognized that organic zinc-rich primers are the most tolerant of these less-than-ideal blast cleaned conditions, and our accelerated laboratory testing confirmed this.

In the early 1980s, several organic zinc-rich systems were tested in the laboratory. The first was a two-coat system, an organic zinc-rich primer with a polyamide epoxy topcoat. This system was originally applied in the field on weathering steel bridge beam surfaces 5 ft on either side of leaking expansion joints where the corrosion rate and damage were significant.

The second type of coating system tested, which is our current system, was an organic zinc-rich epoxy primer with a polyamide epoxy intermediate coat and an aliphatic polyurethane topcoat. The organic zinc-rich primer proved to be successful in arresting the pit-based corrosion characteristics of chloride-contaminated weathering steel. This system added the extra benefit of a high gloss, low chalking topcoat that is resistant to dirt pickup and aesthetically pleasing to the traveling public.

Coating System Evaluation

The Department conducts yearly evaluations of manufacturers submitting products for the current organic zinc-rich, three-coat system (See MATES Issue No. 42). The evaluation procedure includes the following steps:

1) Submission of materials by the manufacturer (complete system),
2) Application of the material to test panels in the laboratory,
3) Laboratory testing and evaluation of paint test panels,
4) Quality assurance for field application of the accepted materials.

Each year an application package of literature outlining our specific requirements is sent to interested paint manufacturers across the U.S. and Canada, inviting them to submit paint for our structural paint evaluation program. Each coating system submitted is then subjected to a set of six performance tests. Five of the six tests involve accelerated laboratory testing. The current evaluation system results in a final overall rating, based on the application characteristics and performance ratings.

Advantages of Organic Zinc-Rich Primers

Organic zinc-rich epoxy primers are hard, tough, and solvent-resistant as well as highly adherent. Tolerance for less-than-ideal surface preparation is better than for inorganic zinc-rich primers. The zinc provides a mechanism which sacrifices itself, delaying the corrosion of the base steel.

Another advantage of organic zinc-rich coatings is their ease of application. Spraying the primer is considerably easier than spraying the inorganic zinc-rich paints using the standard airless spray equipment. Sprayability ratings are made based on spray pattern, atomization, ease of controlling the film build, and amount of plugging of the spray gun per gallon of paint used. For field application these criteria are very important. A good control of the film build and the ease of spraying of the primer can improve productivity and cut the cost of paint and labor.

Recoatability is another major advantage of organic zinc-rich primers over inorganic zinc-rich primers. Because the curing mechanism is solvent evaporation and a chemical reaction, the amount of cure of the coating can be determined fairly easily. The humidity conditions are less critical for organic coatings which depend on moisture to cure. Once the coating is cured the epoxy intermediate coat can be applied. Normally, no gassing or pinholes occur in the intermediate coat or in the polyurethane topcoat, a common problem with inorganic zinc-rich primers. This is due to the less porous nature of the organic primer coat.

Because the curing time is predetermined by temperature, dry spray of the primer will not be a problem as it is with
The objective of the study was to recommend necessary rut-resistant pavement or overlay, to conduct a research project that will determine the relative problem need to be understood prior to designing a new, of these factors and their individual contributions to the materials, environment, and wheel loadings. The interaction subjects are invited and should be directed to MsT's Technology Transfer Unit. Telephone (517) 322-1637