Epoxy - A 30 Year Journey

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In 1972, I had my first experience working with epoxy. It proved to be a bear to deal with but, despite the poor application qualities of the product, once applied, the product did remarkable things.

*�������� Excellent adhesion
*�������� Superior chemical resistance
*�������� Extended service life in harsh conditions

The products on the market at that time were very limited and diluted with hazardous solvents such as MEK, acetone, and xylene. In short, the materials were carcinogenic and flammable making them dangerous, especially in confined space conditions.

The solvents and diluents rendered the epoxy hydrophobic and hindered adhesion to damp surfaces. All through the 70s and 80s my career led me across America and offshore working as an industrial painter in the endless battle with corrosion.

For 10 years I served as a field superintendent specializing in corrosion restoration on both concrete and metal substrates. This position gave me the opportunity to work with a wide range of lining materials from numerous suppliers. All the suppliers had one thing in common. They failed when used as concrete tank liners or when used in confined gas spaces such as closed digesters, sludge tanks, gas haunches, and pump stations.

For years there was no explanation why, No matter what product was used, be it epoxy, polyester, vinylester, polyurea, or plural urethanes, they failed when used in confined spaces. The name, the generic make up, or the applicator seemed to make no difference.

Since1984 I went to work for Anheuser Busch, Inc. as a coatings and lining inspector. The company was spending $10,000,000 annually on corrosion problems. This position made it possible to allocate the time and resources to study and understand this failure phenomenon.

In 1986 I met, by telephones Dr. John Reddner. I had been sent a study that Dr. Reddner had published based on a one of a kind study report being performed by the Los Angeles County Sanitary Sewer District based on concrete corrosion and ling failures. John and Mr. Edward Esphontes shared with me at that time what they had learned to date. Based on the conclusions of their work, it was clear that 100% solids epoxy would indeed survive in these harsh conditions. It had to be l00% solids, no solvents or solvent based diluents.

A closer study of Anheuser Busch projects revealed, under a laboratory study, that the solvent in the epoxy created pinholes in the epoxy, allowing corrosive gases and airborne bacteria a passageway to the substrate, This created a focused corrosion point that proved to be very destructive to both concrete and metal substrates. The other problem revealed was that when harsh solvents, such as hydrocarbon based solvents were trapped in the coating, the finished product had lost significant structural value in the finished resin material. The trapped solvent also continued to slowly deteriorate the finished liner. It was also learned that material with solvents had lost roughly 60 to 80% of their adhesive value in high humidity conditions.

In 1989 a project was started attempting to utilize 100% solids epoxy containing, no solvents on a coatings project in Merrimack, NH. As pointed out in John Reddner's study, 100% solids epoxy proved to be unusable on large projects because of the poor handling and application qualities of the heavy viscous material. After only 8 days of field trials the project was cancelled. At this point in time, I once again conferenced, by telephone, with John Reddner, John and I came to the mutual agreement that epoxy products would have a phenomenal future if they could be sprayed without the use of solvents. At that time, however, there were no application techniques on the world market for the application of 100% solid epoxy materials.

In 1991 plural component, high pressure, spray equipment was designed utilizing heat to reduce the viscosity of the epoxy and metering pumps to blend the multiple components making, for the first time, 100% solids epoxy sprayable and usable on large scale projects. The results were incredible. Epoxy had arrived.

For the first 3 to 5 years it was not accepted or trusted as a long-term solution for corrosion problems in sanitary collection systems. By 1995, after numerous private studies, it became clear that epoxy, when applied utilizing this technique, truly was the answer to numerous wastewater and non-wastewater related corrosion problems. The key was to use no solvent. Hydrocarbon or petroleum based solvents may become trapped in the epoxy causing pinholes and breaking bonds. This process showed a finished appearance and substrate bond beyond any process previously introduced to thc corrosion market.

The use of epoxy resin systems is now the product of choice all over the world for both large and small diameter potable water systems. Thc epoxy shows life expectancies well over 50 years with little to no maintenance costs. The 100% solids, zero VOC product has proven to be the safest product for both thc personnel and the environment for infrastructure restoration and corrosion prevention. The quick cure time and return to service, even in the harshest conditions, makes epoxy the intelligent choice for all phases of infrastructure restoration.

WHAT DOES THE FUTURE HOLD?

Warren Environmental, Inc. has developed a spray process to combine chopped fiberglass� into� the� epoxy� spray� stream,� and�� has� received�� test� grant�� monies� at� the University of South Carolina, to study this new CIP restoration process.

The initial test performed in March of 2000 consisted of 100 control beams exposed to various stages of chemical attack. Some specimens were taken to full loss of structural value. Once restored with thc monolithic glass fortified process, they showed 300% improvement in overall strength and ductility when compared to new specimens.

This process has received funding and study space for the next 3 years. Phase two will start in March of 2001. Phase two will consist of large diameter pipe restoration, historic site restoration, and erosion of concrete pilings and bridge piers in high flow abrasive conditions.

The overall loading characteristics of the glass fortified system has attracted the attention of industry leaders in concrete restoration for projects ranging, from nuclear site restoration and containment to bridge deck span restoration. The University of South Carolina will conduct a post-graduate study program. In 2000, graduate student Stanley Young, under the supervision of Dr. Ken Harries, conducted the physical testing of the 100 specimens and wrote and delivered his thesis paper and peer review. He received a PHD based on his study work with the new structural spray process,

My 30 years experience working with epoxy has been self rewarding and I take great pride in being part of an industry that will benefit humanity for many years to come and create a safer work place for those who come after in the endless battle with corrosion. I take comfort in knowing that my old friend epoxy will prevail.

This paper is dedicated to my two dear friends and mentors, Bob Imrie, PE, and Garrett Broadhead,