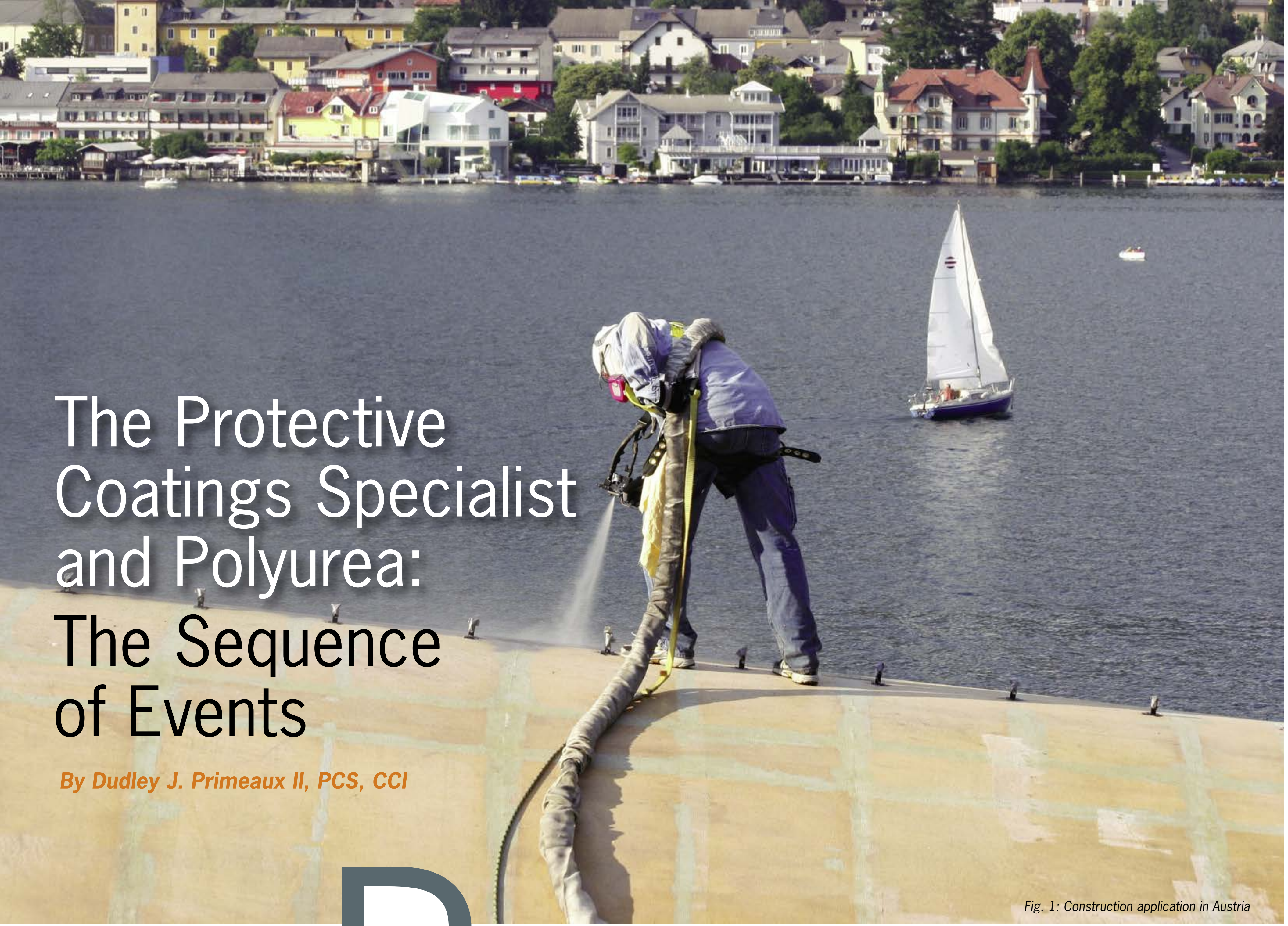

Fig. 1: Construction application in Austria

# The Protective Coatings Specialist and Polyurea: The Sequence of Events

**By Dudley J. Primeaux II, PCS, CCI**

**Editor's Note: This article, by Dudley Primeaux and his strong team of co-authors, is part of the series of Top Thinker articles appearing in *JPCL* throughout 2012. Mr. Primeaux is one of 24 recipients of *JPCL*'s 2012 Top Thinkers: The Clive Hare Honors, given for significant contributions to the protective coatings industry over the past decade. The award is named for Clive Hare, a 20-year contributor to *JPCL* who shared his encyclopedic knowledge of coatings in many forums. Professional profiles of all of the award winners, as well as an article by Clive Hare, will appear in a special 13th issue of *JPCL*, to be published in August 2012.**

Polyurea elastomer coating and lining technology has made some significant inroads since its introduction in the late 1980s. Initially, the polyurea technology had set itself in a different class of coating/lining systems compared to conventional urethane coating/lining systems. This was primarily due to the unique characteristics of the technology, both in processing and performance.

However, over the years, there has been a melding of the various technologies, and many people have now classified, or implied that, polyureas are the same as urethane systems, urethane/urea systems, or both types of system. But the unique characteristics of polyureas have shown promise in some special coating/lining work. These systems are excellent coating and lining materials when properly used. Couple proper use with industry training, standards, and new performance specifications, and you have an excellent choice for many application areas.

## The Story

Many may not realize this, but I have a unique position in this polyurea world and coatings/linings industry. I have worked on the pure research and development side, technical sales/marketing, material development, supply, and support, as well as inspection and training work. This experience has afforded me the opportunity to travel the world and witness a variety of coating and lining application work as well as give numerous presentations on the technology (Fig. 1).

I am also a firm believer in continuing education and keeping up with new industry techniques and technologies. I have pursued various certifications relating to protective coatings and linings as well as application equipment. The major highlight of my career was not so much the polyurea technology, but my certification as an SSPC Protective Coatings Specialist (PCS) and as an SSPC Concrete Coating Inspector (CCI). These certifications affirmed my qualifications in this industry and in relation to the polyurea technology.

When the polyurea spray elastomer coating technology was first demonstrated in the mid-80s, some individuals within the development company that said this concept, while very interesting, would go nowhere. The future for the polyurea technology was in automotive Reaction Injection Moulding (RIM) work. By the mid-90s, however, the use of certain key raw materials in polyurea spray application rose to a point that exceeded the use of the same raw materials used in the RIM work, and that use has continued to grow since. The use of polyurea coating and lining technology today far exceeds that of polyurea RIM, and it has come a long way from the initial intended use as a high-performance protective coating system for spray-applied polyurethane foam.[1]

More recently, doubt has been cast on the suitability of polyurea systems for use in immersion applications because of failures noted in this application area. But much of the problem with these failures can be attributed to improper specification and incorrect material selection for the specific application. Even when a proper system is selected and applied,

Fig. 2: Grand Isle, LA, beach rehabilitation

improper surface preparation, spray application technique, or both can lead to application failures. The same is true for other coating/lining technologies. Possessing the proper training, material selection, and guidance can lead to a successful application. The bottom line is that properly formulated polyurea systems are performing satisfactorily in immersion applications, including potable water, wastewater, and oil- and gas-related tank lining work.[2]

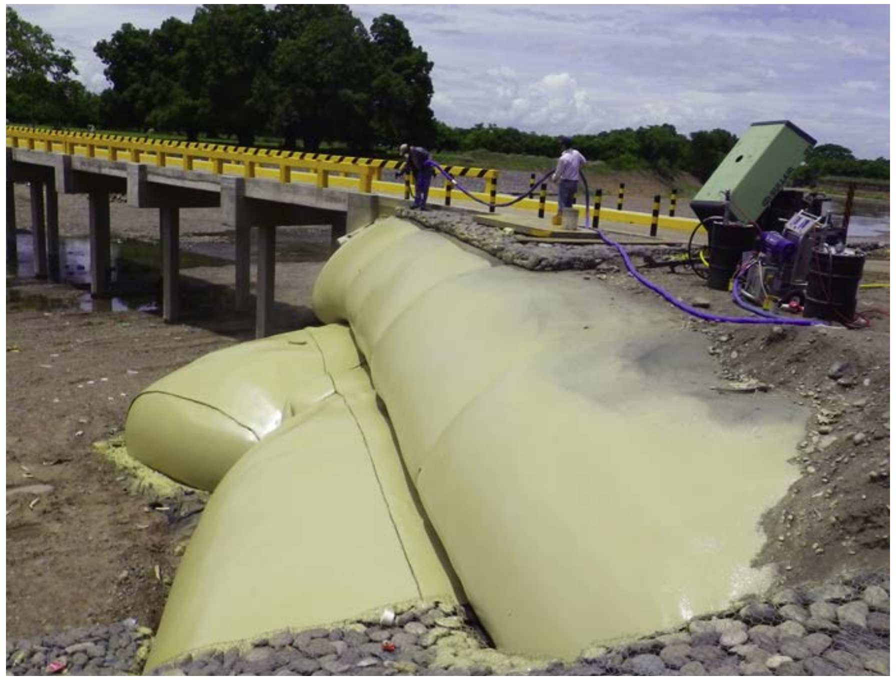
Fig. 3: Honduras geotube coating

## Application of the Technology

Outside of the typical application areas that one might consider for coating and lining work, there are other interesting applications of the technology. One such application is the use of the polyurea technology as a protective coating system for geotextile fabrics. This combination has been used in a variety of secondary and primary liner containment applications with excellent success. One area of work in particular is coating a proprietary woven polyethylene geotextile container technology used in soil stabilization/infrastructure rehabilitation. The polyurea spray is applied to the surface of the geotextile container to protect the thermoplastic system from sunlight deterioration and puncture damage, as well as seal the woven structure.

Following the devastation from Hurricane Katrina in 2005, the coastal city of Grand Isle, Louisiana, was all but washed away. Rebuilding the area also meant rebuilding the protective sand dunes along the beachfront.


Fig. 4: Flooded river and collapsed bridge in Honduras

Following a specification from the U.S. Army Corps of Engineers, sand-filled, polyurea-coated geotextile containers (geotubes) were placed along the beachfront to rebuild about 9.6 km (~6 miles) of protective sand dune coastline area. The geotextile containers were first coated by an experienced and certified contractor in South Carolina, who used a high-performance, aromatic, polyurea spray elastomer system in a sand color. The coated containers were then placed and filled with the sand slurry, and the area now has a nice new coastline of sand dunes for protection (Fig. 2).[3]

A similar type of installation of the polyurea-coated geotextile containers was scheduled for a new river crossing, bridge construction, and header protection area in S. Honduras. The geotextile containers were already in place and filled with sand; they just needed the polyurea coating application for protection. The procedure for installing the geotextile containers can either be that they are sprayed first then sand slurry filled, as at Grand Isle, or sand filled before coating, as at S. Honduras. The choice depends on the way the containers will be installed, where they will be located, and access limitations. Because the polyurea coating is only applied on the top side of the containers, the contained "water" is able to bleed out from the bottom side of the tube, in either situation. The presence of water (from the sand slurry) is the main rea-

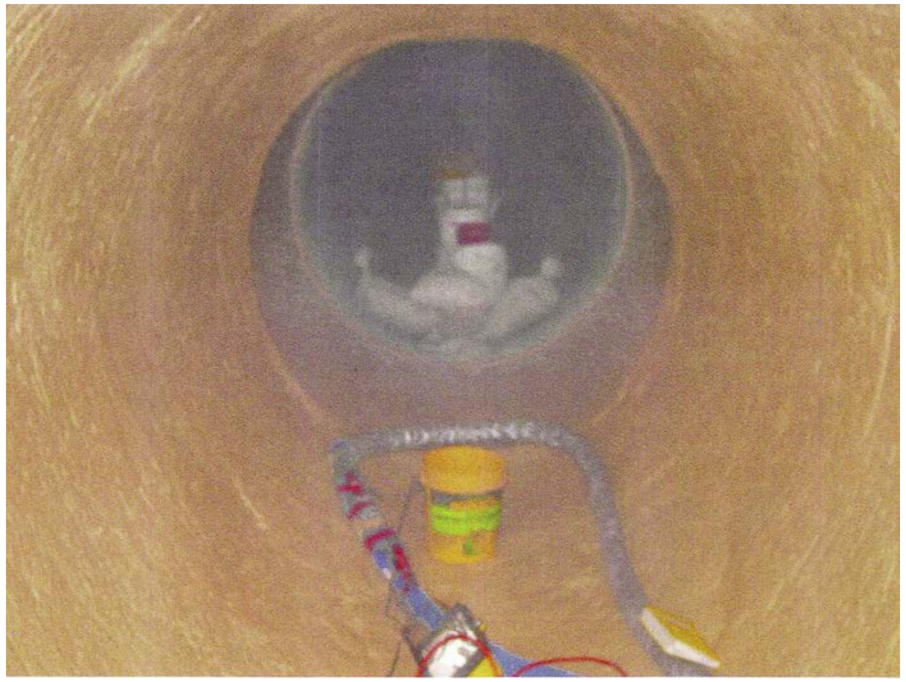

Fig. 6: Robotic sprayed-in-place pipelining


Fig. 5: Helicopter ballistic protection

son polyurea is used, because of the lack of moisture interaction with the spray system during installation. A polyurethane or even a hybrid system would have foamed.

The day after completion of the project, a message was received from Honduras with the subject line, "Amazing sequence of events with the [geotextile containers]." The message was puzzling until the last picture was viewed. Unbelievably, the new concrete bridge was gone! It had rained so much that the area flooded, and the 100-meter-wide riverbed was full of flowing (rushing) water. But the polyurea-coated containers were still in place (Figs. 3 and 4)!

In the past few years, the recent surge in activity for domestic oil and gas sources has contributed significantly to the use of polyurea technology. This usage includes work in secondary containment/frac pond liners as well as lining for oil and process chemical storage tanks.[4] As a result, standards that qualify the use of these types of systems were required. The Underwriters Laboratory of Canada (ULC) recently published the CAN/ULC-S668-12 standard relating to secondary containment work wherein the process for spray-applied liners, including polyurea systems, is noted.[5]

Polyurea technology is also being utilized to protect and save lives in our military in the form of special composite panels that actually stop projectiles. This protection includes large-caliber rounds up to .50 cal. The majority of the use of this technology has been retrofitting various types of helicopters, including those used by the 160th Special Operations Aviation Regiment ('the Night Stalkers') such as the Sikorsky MH 60 Blackhawk and the Bell 412 series (Fig. 5).[6]

The ballistic composite required the development of a polyurea spray system with some unique features. First, the material itself required high impact strength (though not bullet-proof strength). Other requirements included fire retardance and antimicrobial resistance to the chemicals and fuels associated with aircraft use. Most importantly, the fast-set technology required adhesion to the low surface energy composite substrate—not an easy order, but it was done and is performing well.[7]

There have also been some new developments and involvement related to interior pipelining work with the polyurea technology. These developments take advantage of the rapid set and cure of the systems for infrastructure rehabilitation, a serious issue, as of late.

Another unique development related to the polyurea technology has been that of robotic sprayed-in-place pipelining. Sure, the polyurea technology has been used in the past for simple robotic lining of pipe where single joints of pipe are lined either in a shop area or at a field installation site: a simple wand or spray head is inserted into the joint section, and either the pipe rotates or the spray head rotates.

The new developments are for installed sections of pipe of up to 600 feet (~180 meters) in length. And this use is not just for straight run pipe, but can also include various 45-degree and 90-degree pipe bends. Unique polyurea systems are formulated to be processed in the robotic equipment, which has the ability to line pipe from a four-inch (10-cm) diameter up to a 96-inch (2.4 meter) large diameter pipe and corrugated sections. While the primary use of the technology is for water/wastewater work in our failing infrastructure, the technology is also being performed in the industrial and chemical sectors for successful pipeline rehabilitation (Fig. 6).[8]

Evaluations have shown that the applied robotic polyurea pipelining system not only provides abrasion and corrosion resistance, but also pressure integrity to the pipe system. A three-inch (7.62 cm) diameter hole in a test pipe section was masked over with tape and then a layer of polyurea lining was applied to the inside of the host pipe. The mask was removed and the pipe sample was then pressure tested. It was found that 250 mils (6.4 mm) of applied polyurea can withstand a pressure rating of over 400 psi (27.6 bar). Failure pressure alone just for a pipe made with polyurea (no host metal pipe) is over 250 psi (17 bar) at 250 mils (6.4 mm) thickness.[9]

To further qualify the use of the technology in this application, ASTM International has a working group developing a standard related to spray-in-place pipelining systems.[10] The primary focus of this standard is to establish minimum surface preparation requirements as well as types of lining systems for pipelining conditions. Interestingly enough, there are modified polyurea systems that achieve the Class IV Structural designation (used to classify pipe rehabilitation systems, and noted in references). Class IV designation is the highest, from a stiffness/flexural modulus consideration, and would be such as like a piece of PVC. A lower class would be a more flexible lining system, like a typical sprayed polyurea elastomer), like those with flexural modulus greater than 250,000 psi (1,720 MPa). This would basically be a free-standing pipe (normally called pipe-in-pipe repair).[11,12]

## Conclusion

Polyurea technology is no longer the research lab experiment of the mid-80s, but is instead a viable and growing coating and lining technology. This change is evidenced by industry acceptance, the number of companies supplying quality polyurea coating and lining systems, and the wide range of applications. To further qualify this, SSPC has issued various documents and standards on polyurea technology through the C.1.3.D Polyurethane Committee, and has new work from the C.1.9 Polyurea Committee, and in the C.1.13 Coatings for Wastewater Facilities Committee. I am just proud to have been part of polyurea technology from the start and to have seen the progression.

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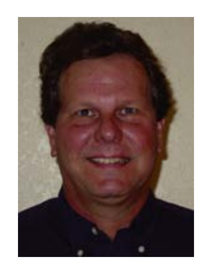

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Mr. Primeaux is active in SSPC, NACE, and PDA, where he is a past-president and a member of the Board of Directors. He has also completed the SSPC PCS Protective Coatings Specialist and SSPC CCI Concrete Coatings Inspector certifications. He is an inventor of 26 U.S. patents and 8 European patents on polyurethane and polyurea foam applications, as well as polyurea spray elastomer systems and applications. He has authored over 40 technical papers on polyurea elastomeric coating and lining technology, as well as several chapters in SSPC book publications. JPCL