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POLYUREA NEEDS TO BUILD RECOGNITION IN EUROPE

Marc Broekaert president of the new Polyurea Development Association – Europe, reveals the group's strategy

Report by ***Liz White, editor***

The main role of PDA Europe, set up in July 2007, is to, "support the development of polyurea technology, in all applications where it is suitable … and to support the companies involved in the technology," said Marc Broekaert, PDA European president.

"Because it's a new technology, we need to build recognition, prove its performance, find new opportunities and build on that," Broekaert continued, during an interview with *Urethanes Technology International* at the first technical conference organised by PDA Europe, in Brussels, 14-16 Nov.

"We want to try to develop tools to support all the companies that are aboard," said Broekaert, pointing out that the organisation is vertically structured, from raw materials suppliers down to owners (of construction projects which use polyurea – PUA).

Such coatings projects are often difficult and long-term endeavours, Broekaert pointed out.

"What we need to focus on is to get more applicators in," said Broekaert. "We have to try and contact them and get them to attend and … develop tools that encourage them."

Training is also, "one of our major tasks," especially for applicators, he said.

Both the US and European PDAs hope to produce market data next year. Meanwhile, said Broekaert, polyurea's growth in Europe is high –15-20 percent a year – with most use in construction projects and an "intensive focus on the Middle East, eastern Europe – the emerging markets."

Marc Broekaert of PDA – Europe

In Asia there is also a lot of PUA activity, and the associations are now actively looking at "whether we need another branch out there for the Asia business," said Broekaert.

Polyurea is green technology, according to Broekaert: it uses no solvents or VOCs (volatile organic compounds). And, he stressed, it is high-performance technology because it's uncatalysed. "Catalysts tend to sit in the system and cause degradation afterwards," he said.

And since polyurea is long lasting, it's "a durable technology and good environmentally," he added. Technologies with a longer life cycle offer green benefits, "because they generate less waste, less burden," Broekaert said.

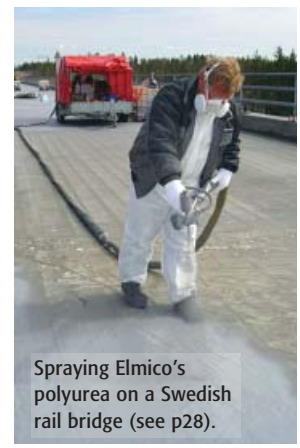
Broekaert said certain industries do ask for a 30-year warranty on coatings. PUA technology is, "not that old yet in Europe, it's only been in use for 15 years now. If we want proof [of longevity] we have to go to the US."

PUA coatings started in the US in the 1980s, but really only took off in the 1990s: there is "a five-year lag while you persuade the industry to use these materials," Broekaert said.

In new applications customers "don't want to be a guinea pig, ... You have to find partners who are interested … and are willing to share the risk," he said.

Some challenges for PUA

High raw materials costs are probably a disadvantage for PUAs, but overall, performance benefits balance out the high costs. "There are always aspects of your project that will make more money than the raw materials costs," said Broekaert.



Spraying Elmico's polyurea on a Swedish rail bridge (see p28).

"One important challenge we still see is getting approval by the relevant bodies," he said.

Projects have been started up where it is acknowledged that PUA is good, but applicators will not take the risk, because there is no back-up for the technology from specifications or government approval."

Some approvals can also take a long time, he added: a single test can take 10 000 hours.

In Europe, the rate of PUA take-up is comparable to the US history, Broekaert said. "It takes off first in construction uses, in containment, membranes." He pointed out that concrete containment is under a lot of pressure, now that any leakage is unacceptable.

In some ways the polyurea sector has been a victim of some over-zealous advocacy in the past. "There have been some crazy stories in polyurea technology," about how quick and easy and non-susceptible to moisture it is. "People have tried to do it like that and failed," Broekaert commented.

"I always say PUA is a coating next to other coating technologies and you should treat it exactly the same," he continued. "The only difference is that it is maybe a little bit faster and you can apply it under difficult conditions."

While polyurea is used in certain RIM (reaction injection moulding) applications, Broekaert said that, "because of its performance in difficult conditions, there is an automatic drive to use it in field applications, in uses which are project driven."

In a factory, humidity and temperature are controllable, but in the field, where these are more variable, polyurea's speed of application and rapid development of strength can be exploited to advantage, Broekaert indicated.

Broekaert also stressed that the association must ask the membership what they want, "because we don't want to be doing things the

STANDARDS ARE VITAL

Dominique Smits

PDA committee member Dominique Smits, of Belgian construction chemicals specialist De Neef Conchem, said that standards for epoxy coatings are already in place, but not for PUA, because it is an "emerging market."

Without such certification, "users in civil engineering will soon not be able to use it," he said.

Smits updated delegates on the "fast-changing" European Standards now being implemented for concrete coatings and water-proofing membranes.

One goal of CE marking – a European quality mark – is to eliminate different test procedures across the EC, Smits said.

CE marking is a complex area, with companies needing to refer to the relevant approval bodies in the country, Smits pointed out.

The CE mark can be based on harmonised European Standards, or on ETAG (European Technical Approval Guidelines, he added.

Smits advised people to, "Talk to the approval body in your country." Meanwhile, PDAE is keeping in touch with the institutes, and keeping track of amendments being made to the Construction Products Directive, he said.

> "What does it really mean when people say PUA technology is insensitive to moisture and temperature during application?"
>
> – Dudley Primeaux

membership don't support."

PDA-Europe has 60 company members, of which six to eight are the major raw materials suppliers. Broekaert recognises that big companies have more opportunity to participate in PDA activities: "if you are a formulator or applicator, and you are a two-man band," then the time available for such activities is limited.

Polyurea formulators are basically systems houses, he said. Some are existing paint companies who see opportunities in PUA as a complementary technology. Others are dedicated systems houses, he added.

Broekaert pointed out that Europe has several companies who are formulators and applicators, while in the US, the difference between these groups is more clear cut.

"If you start up as a formulator … you have to invest in equipment to prove the technology, and you want a quick return on investment," so carrying out some initial applications makes sense, Broekaert said.

"Also you need to get expertise in the field to know how to develop the right products," he added. So formulators often start with a small project or two, do the application themselves, and generate some added value. This way, they, "give themselves some headroom, and then gradually ... move over to developing formulated products," he said. It's "a very sound way of doing it."

As is obvious from the following case studies, PUA coatings are used in quirky and challenging ways, on messy zoo floors and elephant baths, for icy Swedish railway bridges, and walls containing asbestos; it's not a technology for the faint hearted.

US experience: pitfalls to avoid

Lending support to the PDA Europe gathering was Dudley Primeaux, a well-known figure in the US polyurea sector, who now runs his own consultancy, Primeaux Associates llc. His presentation illustrated some of the beauties, as well as the pitfalls, of working with polyureas.

"As we know, PUA elastomer spray coating projects are now a weekly occurrence with excellent success," Primeaux said, but "these projects don't just start," they need preparation, submittals and field application test areas.

"Many of these projects may take up to a year from the first submittal to the first time you pull the trigger," he said.

"You must also schedule when you work ... when the environment allows, or weather, or when a project is shut down," he said.

Once a job is scheduled, "we cannot forget surface preparation," and proper training, Primeaux continued.

Primeaux described two projects which took over a year in preliminary work, including submissions, letters, application, approval forms and travel to the site for test spraying, he said.

Travel time can be important. "Many times these projects just don't happen in your back yard ... we may have to travel some distance," he said.

The PUA expert also took a look at his favourite home truth: "What does it really mean when people say PUA technology is insensitive to moisture and temperature during application?"

Site access and work schedule

In many projects. access is difficult and equipment has to be manhandled around, while getting power supply can also be an issue, said Primeaux. Applicators can also have to work around existing production.

In Primeaux's first example, the aim was to encapsulate an 8000-m^2 wall containing asbestos at a coal-fired power station, with a 2.5-mm film.

For this contract, the applicator was in

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"The moisture myth"

"When we were on project no 1, that's an indoor project right so no weather problems? Problem was that this was an uninsulated building, done in October/November, and on the 11 th floor.

The team had moved to the second building, when the project engineer raised a problem: "The polyurea's falling off the wall," he told Primeaux. "I was having a hard time envisaging what he meant … maybe it's a small blister or a little area that's peeling," Primeaux said.

"No," he said, "it's falling off the wall. The engineer was right, Primeaux said, showing a photograph of the coating doing exactly that.

"We identified the problem and had to remove this piece – which incidentally was pretty easy to do," Primeaux said wryly, to much laughter from the audience.


"The polyurea's falling off the wall"

"Then we had to prep and respray. So what happened? The temperature of the wall was not above the dew point," Primeaux explained. "Because the substrate was cool and there was a lot of humidity in the air, from heating wet coal, and humidity levels in the building were actually anywhere between 50-80 percent." So the dew point temperature was high, and a sheet of ice had collected on this surface, he said.

This happened despite monitoring of temperature and dew point; the day the team didn't do it was the day this spraying was done.

"The lesson is that the substrate temperature must be 5°F or 3°C above the dew point and rising," to eliminate the chance of any moisture condensing on the surface. "Moisture inhibits bonding, PUA does not react with it, but it stops bonding," Primeaux stressed.

Cincinatti, and the project was 1700 km, or a 20 h drive, away in Amarillo, Texas.

This project was on the 11th floor on two buildings, with no freight elevators. The spray hose would not reach, so the team had to move the spray equipment and scissor lifts to the 11th floor. Also, the plant was in operation, so the applicators had to work round that since coal dust presents a fire and explosion hazard.

The PUA used here was a very fast-set aromatic system. Since this was indoors, it was not going to be exposed to sunlight so colour stability was not that important, Primeaux said.

But the system was designed for thermal stability "because we are in a coal-fired power plant," said Primeaux, adding that it also had a finish with low surface energy, so it would be easy to clean and maintain daily.

To prepare the asbestos-containing wall, the contractors simply washed it with water to remove coal dust.

Project 1 had a problem with the resin heater pumps, but because the contractors had been on a training course, they recognised that the spray pattern had changed and stopped, so that only a small area had to be fixed, said Primeaux .

The lesson is that it's, "Real important to pay attention when you're spraying," said Primeaux .

Project 1 took 26 days, finishing seven ahead of schedule, because the contractor was prepared and trained. Most of the time was spent moving equipment. For the repair described in the box above, the team spent six days disassembling, moving, reassembling, to spray for half an hour.

Geotextile for fuel storage area

Primeaux's second project was a 1.8mm coating on a 38000-m^2 PUA/ geotextile lining project for secondary-containment at a fuel storage area. The contractor was in Fort Myers, Florida, with the project in Albany, New York, 2200 km, or a 24 h drive, away.

The project was in a wide-open area near the Hudson River, using asphalt-based mats. "This was an active fuel storage area, so on days when the fuel was being unloaded, we could not work, for fear of causing a spark," said Primeaux. Here it was important to unroll the rolls of geotextile only gradually, as the project moved into place, to keep it dry.

The geotextile system used had very high elongation and good tensile strength "because it was going to accept some vehicular traffic, not just foot traffic." It also had to be flexible at low temperature because the project was in New York and "it snows there," Primeaux said.

Most importantly, for spraying over geotextile, this system had linear shrinkage of less than 1 percent, Primeaux said. Many PUA projects with geotextile exhibit 3 percent shrinkage , which is 30 m out of 3000m, he pointed out.

Surface preparation involved removing excess gravel using power tool cleaning.

This project was affected by water, but not dew point. At one stage, instead of a film, "we were making foam," Primeaux said. Rain water had got in the drums, and a few areas had to be cut out and resprayed.

This project took 47 days and ended on schedule.

Primeaux concluded that people are doing PUA projects every day, successful projects, but "there's always a lot of preparation involved, especially if it's a major project."

Proper training is most important, Primeaux said, "to enable you to recognise when you have a problem in spraying and stop to sort it out, not continue." This approach reduces rework and costs, he said.

Bridges for Bothnia line have PUA coating

Success with a recent project to coat railway bridges in the north of Sweden may mean that small PUA firm Elmico AS gets more such work.

And the task illustrates some of difficulties with such projects, including the need to meet non-standard specifications from the customer, under severe climatic conditions.


Hunting new markets – Elisabet Michelson

Elmico initially devised its own highly individual test routines for this project, and managing director Elisabet Michelson was relieved when the authorities later issued a standard for such coatings.

The company worked on three bridges for the new Bothnia line from Kramfors to Umea, the biggest rail project in

NORWEGIAN FIRM LOVES PUA

Elmico is a small Norwegian systems house with five employees, making PU, PUA and epoxy materials, with the epoxies commonly used as a primer for the PUAs, said Elisabet Michelson, managing director and part owner.

Michelson owns 42 percent of the NKr 11.7-million ($2.1-million turnover) company, based in Skarnes, some 60 km north of Oslo. A colleague also owns 42 percent with an investor owning the remainder.

Michelson feels she will need to do more marketing in future, to make the company better known in a wider community.

One new product is a PUA coating to protect the insulation on pipes for LNG (liquid natural gas) transport. In a recent project Elmico coated pipes for a subsea pipeline from Wales to Ireland.

"Elmico plans to expand but not to be big," Michelson said: she has a vision of expanding the range of technologies the company can offer, and taking on perhaps another five to ten workers.


Coating pipes with polyurea

The market is widespread and a lot of growth in construction currently is in the Middle East – a rather difficult area for a woman to sell into, Michelson indicated. At present most of the company's business is in Scandinavia, with a little in the Baltic countries and Russia, she added.


Spraying work on one of the Bothnia bridges

modern Sweden, said Michelson. This 190-km single-track line, with 140 bridges and 25 km of tunnels, is the far north of the country, where it is very cold and the application season is short, she said.

"We have three bridges on this line, which are a specialist combination of concrete and steel, and we hope to get more," Michelson said.

"As we heard before, we have all these standards in different countries," and it costs a lot to meet them, she added. Also, the demands are not always linked to standards, she said.

Michelson listed the Swedish rail authorities' demands, which included: a 5mm thickness of coating to cope with water pressure and give good wear resistance; resistant to water, oil and UV radiation; non-corrosive to steel; good adhesive strength, and no brittleness at -70°C. Elongation at break of 100 percent was specified, with minimum tensile strength of 9 MPa at low temperatures.

The rail group also specified: no damage or leakage from load/friction from train-loaded ballast; resistance to repeated dynamic compression from track plates placed directly on the membrane; fully hardened within 24 h of application; and no quality change after a year of accelerated ageing at 70ºC. A further demand was no emission of material dangerous to the environment or human beings.

Such non-standard properties are hard to test for and Elmico put some methods together to approximate to the conditions demanded, so that it could perform the evaluations in-house.

Michelson explained that this involved a lot of work, with some requirements, "very difficult to meet," such as those for no brittleness at -70°C, for no materials dangerous to the environment and the accelerated ageing specification.

Elmico trialled its Micorea coating at -15°C in January in a lot of snow and ice. Since Michelson thought the company had no chance to get the bridge project, she went hunting: this was when the railroad company called her to come and sign the contract, she said.

Elmico started work in May, using Gusmer machines to apply the PUA.

Bridge preparation was complex, said Michelson. She used an epoxy-based primer both to give better adhesion and cover some of the pores in the concrete.

During application, Elmico did a lot of quality control, with daily reports as well as recording temperature, dew point and events, with a quality plan and regular reports on progress.

The last bridge Elmico worked on was coated in November, at -8°C, with some ice crystals on the surface at around 5 pm, when Elmico had to heat the surface before spraying.

The coating work was very successful, and now, to Michelson's delight, the railway administration in Sweden has produced a new standard. Elmico is having its materials tested with "really good results so far," she said.

The company's Micorea passed the low-temperature flexibility demand and on all tests "proved to perform way above the demands," she added.

Michelson concluded that the initial tests on Micorea showed it had sufficient quality, while the job execution proves its suitability, "even under severe climatic conditions."

Now laboratory tests to the new Swedish standard also, "underline the outstanding character of polyurea," for waterproofing bridges, she said.

Different challenges with zoos

In a study of zoo floorings using polyurea, Hubert Tomz and Gebhard Rauter, of Hercules GmbH, described the use of Hertec Horsefloor systems in the Vienna and Aalborg zoos, using systems from Polyvers.


Chaotic projects: Gebhard Rauter

For the Rhino house at Vienna, the team had earlier, in 2005, installed a 4-5 mm thick, seamless coating with high wear resistance, and 100 percent hydrolysis resistance.

Such barn floors have to resist animal urine, excrement, mud and cleaning chemicals, said Rauter. Also they must be able to cope with routine movement of Bob-Cats vehicles during cleaning, as well as the wear caused by the animals, and also with steam cleaning every day.

The system succeeded completely, said Tomz.

So when the elephant house project came up at Vienna Zoo, plus highland cattle barns, the company was the obvious choice. The team also renovated floors at the elephant house at Aalborg Zoo in Denmark

Such projects are a little chaotic, Rauter pointed out, with many features having to be masked, including artificial tree trunks all over

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VIENNA, AALBORG ZOO TASKS

• Project supervisor: Hercules GmbH, Villach.
• Applicator(s): Fastsetpowerunits, Landskron, Alpina GmbH, Bodensdorf.
• Polyurea system applied: PV380, PolyVers Int., for the elephant house and PV320 for the cattle barns.
• Substrate: 650m² refinished rubber-granulate and concrete for the elephant house, and 550m² of rubber-granulate, concrete and wood for the cattle barns.


Elephants at Vienna put the polyurea coated floor through a tough trial

Before coating started, the all-Austrian team cleaned all areas and then masked them.

The team coated the damaged floor in the elephant house with a rubber granulate layer, using a special binder to ensure adhesion to the concrete.

The contractors then sprayed 4 mm of PUA, adding an 'overspray' for an anti-skid surface.

The team used a GAMA Evolution G-250 H spraygun and a Palm Gun from Pentech for details.

The job was done in three days (masking, rolling binders, pre-works concrete, etc). Spraying was only done on the third day.

Similarly, the team used rubber granulate for the cattle barns, and rolled epoxy binder, premixed with quartz sand, on concrete walls and primed wood with wood-primer.

Hercules applied its Hertec UREA Horsefloor System as a 3-4 mm layer on the floors, and a 1-2mm layer to a height of about 30cm on the walls. An overspray for the floor added an anti-skid surface: the project was done in two days.

Hercules also treated floors of three rooms in the elephant-house of Aalborg Zoo in Denmark, including vertical sidewalls up to 3m in height, a total area of 400 m² on damaged and worn concrete substrate. Here, Hercules laid special rubber mats, cut to shape and joined together, as a substrate for the coating.

the elephant house. Some obstacles just have to be worked around – for example a cow calving as the cattle project got under way, he said.

The team had to wrap whole areas in plastic film – "Playing Christo," Rauter joked, referring to projects the well-known artist has done in cities all over the world.

Concrete preparation is important, Rauter stressed, reminding the audience of Bernd Dietz's dictum: 'successful coating begins with substrate preparation.' Hercules sprays its Horsefloor system either on rubber granulate, applied initially, as at Vienna, or on specially cut rubber mats, as at Aalborg.

"Masking work is necessary. It takes a lot of time," said Rauter, but it protects a lot of details. It can take a day or even two in this sort of project, he added. Applicators must also be sure they can remove the masking when the coating is done. When PUA dries in 3-4 seconds, this is tough, and sometimes "we do it with a special tape with a wire in," that cuts the coating as it pulls away, he said.

Rauter showed slides of the completed projects, illustrating the attractive final floor surfaces in all three locations.

Proper preparation crucial

Bernd Dietz of Rema TipTop GmbH discussed the need for proper surface preparation before coating, listing two standards here: EN 1504, and EN 14 789, on products and systems for protection and repair of concrete surfaces.

The basic approach is to remove contaminants and roughen the surface, he said.

Contaminants covers anything from old coatings to salts and microorganisms with oil and grease as further possibilities. So cleaning can be simply brushing, water jetting or scrubbing with detergents and antimicrobials.

Next comes repair of small surface defects, including cracks, which can be done with cement and mortar. But repair with a fast-setting polymer or resin allows contractors to exploit the rapid setting of PUA coatings

Other defects which may need renovating include bugholes and honeycombs, Dietz said.


Bernd Dietz of Rema

Roughening the surface gives the best possible mechanical adhesion, Dietz added. Again it can be done in a variety of ways, including acid etching grinding, abrasive blasting and scarifying, he said.

There is a move to force the industry to accept standards for pore sizes in gap bridging, Dietz said, adding that the PUA sector needs to push the good covering properties of the material and its higher moisture tolerance.

Dietz recommended that applicators check the surface for moisture content, before applying polyurea.

Referring to 4 percent moisture content limits, Dietz said "in my experience if 4 percent was not routinely exceeded, very little coating work would be done in northern Europe."

He said 8 percent might be a more reasonable limit.

Dietz listed various advantages of polyurea coatings for concrete surfaces:
* Covering of wide shrinkage cracks and crazing areas without any prior treatment up to 2 mm;
* Higher moisture tolerance more than 4 percent humidity can be accepted;
* Bridging of gaps without any additional reinforcement or bondbreakers is possible; and
* Fastest application.

And he finished with a valuable motto for polyurea users: "Every successful project starts with proper surface preparation."

CHAIN EXTENDER CHEMISTRY

The meeting went back to the basics of polyurea technology when Dr Werner Bertleff of BASF AG described a new aliphatic chain extender with benefits to both "formulators and applicators."

PUAs are made using an isocyanate and an amine resin, with various possibilities for the composition of the latter. It can be primary amines – with polyether amine resins as the workhorses in the systems, he said. These make up 50-90 percent of the system, with a secondary amine chain extender as 10-50 percent of the amine recipe.

Other diamines such as sterically hindered diamines can offer benefits, Bertleff added.

Fully aliphatic systems offer better light stability, while aromatics are "cheaper normally and faster reacting," Bertleff said. But choice of chain extenders has been rather limited previously, he indicated.

BASF's new chain extender slows the reaction of the amine, which is normally very rapid. This gives a longer gel time, and improves stability and reliability for applicators, Bertleff said.

Other advantages include better adhesion, faster development of film properties, the systems have improved workability and the coating can also withstand higher temperatures, with a heat deflection temperature of 90°C, he added.

After initial brainstorming, BASF identified promising laboratory candidates, then took the best through scaled-up examination and carried out the necessary extensive ecotoxicity and toxicological tests, the "tedious costly way to regulatory approval," for Europe, Bertleff said. At the same time the group established that it would meet the Tosca standards in the US and the relevant Chinese government standards also.

Today the product is ready to be launched, under the Baxxodur PC 136 name, said Bertleff.


Werner Bertleff

After 2-3 minutes the film strength is sufficient for the coating to be walked on, he said. Films containing the chain extender can be varied to give a wide variety of hardnesses, and the small molecular weight of the amine and its smooth reactivity helps reduce the amount of product needed in the formulation, so it is cost effective, claimed Bertleff.

BASF worked with US Hanson Group on the materials, and Lee Hanson described application work with the new chain extender.