

## **Polyurethane technology: because of its versatility, the spread of polyurethane technology into new markets is not a question of if, but when, according to industry insiders.**

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Today's coatings industry can really make your head spin, and we don't mean from the fumes. The list of coatings choices for end users is seemingly endless, but it is nothing compared to the list of requirements that suppliers and manufacturers must take into account when formulating products. Performance, appearance, protection, cost-effectiveness and environmental compliance are just a few of the factors paint makers and their suppliers must take into consideration.

Polyurethane technology is one coatings solution that stacks up well against this long list of demands, and is fast becoming the technology of choice, for a number of end markets.

According to the Alliance for the Polyurethane Industry, approximately 542 million pounds of polyurethane were used in coatings applications in the U.S. in 2000, an 8.4% increase in the amount of polyurethane used in coatings in 1998.

### Major benefits

What makes polyurethanes so popular? Every coatings maker and raw materials supplier *Coatings World* spoke with offered different reasons. However, all of their answers can be summed up in one word: versatility. According to industry insiders, polyurethane technology can be used in almost any formulation.

"We believe that polyurethanes are one of the most versatile polymers in the coatings formulations because of their low temperature and fast curing properties, their physical properties and their ease of application," said Michael Hughes, marketing manager for the adhesives, coatings and elastomers business for the Americas at Huntsman Polyurethanes. "I believe that the range with PU is greater than other methods."

"Polyurethane coatings contain no VOCs or CFs, don't take a complicated system to apply and have great elastomer qualities," said Kirk Jeffries, executive director, Rhino Linings USA, Inc., a provider of high-performance sprayed-on polyurethane coatings and linings, such as the coating featured on the truck bed on our cover. "The application and cure times are fast, reducing down time and it is relatively inexpensive and easy to apply."

James McCadden, vice president of sales, U.S. Coatings Company, agreed. "Polyurethane products may be formulated to a wide variety of characteristics thus offering the formulator many options," he said. "The window of options is larger than other generic classes such as epoxies and alkyds."

According to Mr. McCadden, polyurethane products can be used in numerous formulations, such as winter cure primers, high build 100% solids elastomeric secondary containment linings, high build industrial finishes, satin finish to high gloss finishes and high solids/low VOC finishes. "Today's polyurethane finishes may be formulated in solvent systems as well as water-based systems," he added.

Another term often heard when discussing polyurethane coatings is high-performance.

"Polyurethanes are generally considered high performance coatings, offering excellent color and gloss retention, and good resistance to abrasion and chemicals," said Mark Thomas, manager of product marketing for Tnemec Company, Inc. "Polyurethanes typically offer better color and gloss retention than other coating types."

John L. Williams, executive vice president, Bayer Corporation and president, coatings and colorants division, agreed, stating, "Polyurethane-based coatings formulations yield high-performance coatings systems with excellent chemical resistance, solvent resistance and outstanding durability, as well as other properties."

"A polyurethane, be it solvent- or water-based, has always been considered a premium coating system," said Mike O'Shaughnessy, vice president sales and administration, Alberdingk Boley, Inc. "The combination of resistance properties coupled with highly durable films makes this chemistry one of the most used, premium coating systems available."

This durability is one of the major selling points of polyurethane coatings. "Enhanced performance properties are gained by using polyurethane dispersions in coatings as they provide increased durability, abrasion-resistance, scrubability and other strengthening properties to the coatings customer," said Chuck Reardon, a spokesperson for Dow Polyurethanes.

Some of the resilient properties of polyurethane finishes are outstanding weathering characteristics, superior UV and acid-etch resistance and excellent chemical resistance and appearance. It's this durability that makes them ideal for end markets where protection is of paramount importance. It's no surprise then, that the construction and transportation markets are the largest users of polyurethane technologies.

According to API, construction is the major end-use for polyurethanes. The U.S. construction market consumed 165 million pounds of polyurethane coatings in 2000, mostly for wood and concrete flooring applications. Right behind it is the transportation market, which used 162 million pounds of polyurethane coatings in 2000. In the transportation market, refinish paint is the predominant application area, according to API.

"Improved durability properties for construction and transportation coatings provide large growth opportunities for innovative technologies," said Mr. Reardon.

BASF believes that these markets are key to its polyurethanes business and, as a result, concentrates most of its efforts in these areas. "Our focus is to grow in the traditional market segments for polyurethane coatings and continuously bring new technologies that add value to our customers in these areas," said Brian Searfoss, market development manager, BASF Corporation. "We do not see saturation in any existing or potential end-use market for polyurethane-based high-performance coatings. There is plenty of room for growth in key markets."

API statistics on the construction market back this up. The use of polyurethanes in the market is increasing at an average annual growth rate of 4.3%, due largely to the increasing popularity of wood floors in residential housing.

Mr. Hughes of Huntsman Polyurethanes believes that the construction and transportation markets provide the greatest opportunity for suppliers and paint formulators, but also represents a major challenge. "Our belief is that transportation and construction markets offer the greatest opportunity, challenge and reward for the manufacturer due to their overall size and scope along with their demand for continued product improvement," he said. "Although both can be technically challenging, they develop new solutions that can be applied in other markets as well."

New Markets

It is these solutions, according to Mr. Hughes, that provide much of the leverage for companies looking to expand beyond traditional markets for polyurethanes and into new ones. According to API, tanks and pipes, which used 48 million pounds of polyurethane coatings in 2000, are a high growth market for polyurethanes.

According to Curt Reichel, BASF polyurethanes marketing group, spray polyurea coatings are among the fastest growing polyurethane technologies. "This technology enables a user to apply a coating and return the area to service in a few hours rather than a day," he said.

"The use of 100% solids elastomeric urethanes for secondary containment is a fairly recent niche market to emerge," said Mr. McCadden.

Along a similar vein, Mr. Hughes of Huntsman Polyurethanes said that polyurethanes are also being used in radiation and UV curable coatings. "There are always market solutions requirements being addressed using polyurethane coatings, and this seems to be a hot topic of late," he said.

Another hot topic, according to industry insiders, is the use of polyurethanes in soft-feel coatings. "The market for soft-feel coatings, particularly in the automotive area, is beginning to grow," said Mr. Williams of Bayer.

Mr. O'Shaughnessy of Alberdingk Boley agreed. "Soft feel coatings is an excellent growth area for polyurethane dispersions," he said. Alberdingk Boley has built the soft-feeling into resins, which can help companies reduce their reliance on additives. "This makes soft-feel coatings much more cost competitive and opens up additional application areas outside of conventional automotive coatings," he added.

Expanding outside of traditional markets is an important strategy. "We are always looking to promote polyurethanes as a replacement or property enhancer for markets dominated by acrylics, epoxies or other polymers," said Mr. Hughes of Huntsman Polyurethanes. The company is starting to see results. "People are looking harder at the advantages of polyurethanes," Mr. Hughes said.

Yet, according to some industry insiders, many markets are still not making use of all that polyurethane technology has to offer.

"Wood coatings in the U.S. are still predominantly nitrocellulose and conversion varnishes. Polyurethane coatings offer much better chemical resistance and durability," said Daniel Pourreau, manager, coatings development, Lyondell Chemical. "Concerns over handling isocyanates and coating costs appear to be the two main reasons U.S. wood coaters have not yet converted to polyurethane technology."

Another market that some suppliers feel doesn't make full use of polyurethane technology is the residential paint market. "Polyurethanes offer durability and cleanability advantages they don't have with current technologies," said Mr. Searfoss of BASF Corporation. He blamed cost as the main barrier to entry into this market.

Ib Bechara, technical manager, Witcobond dispersions, Uniroyal Chemical Urethanes, believes that coil coatings are an area of possible expansion. "We feel that coil coatings could benefit from the low temperature flexibility, resistance to chipping, and the chemical and abrasion resistance imparted by polyurethane dispersions," he said.

According to Mr. McCadden, many industrial customers continue to settle for an epoxy or alkyd finish in lieu of the added performance of polyurethane due to cost. In reality, he said, "the cost difference between a two-coat alkyd system and an epoxy primer/polyurethane finish is as little as two cents per square foot."

Mr. Searfoss, who acknowledges the price battle, said, "One key hurdle to overcome is initial cost. While polyurethane coatings tend to feature a higher initial cost, their outstanding performance and durability make them highly cost effective over their life cycle."

Convincing potential buyers and specifiers is a key marketing challenge faced by all suppliers.

#### The VOC Battle

Another challenge in the coatings market is environmental impact. Suppliers and manufacturers continue to grapple with one of the industry's most prominent acronyms: VOC. The polyurethane market is no exception.

"Coating formulations across the board are being affected by tighter VOC regulations and polyurethanes are no different," said Mr. Thomas of Tnemec.

"The need to reduce VOCs is paramount," agreed Mr. Williams of Bayer, which has worked to develop high-performance waterborne polyurethane systems. In addition, Bayer is also exploring polyurethane use in powder. "We expect the use of polyurethane powder coatings to increase substantially to help meet the ever increasing demands for higher performance, more durable products, along with the need to decrease VOCs," said Mr. Williams.

"Environmental concerns have increased the number of customers demanding solvent-free raw material solutions for producing coatings," said Mr. Reardon of Dow, which has produced waterborne polyurethane dispersions that can be used for wood coatings, house paints, primers, and automotive under-body coatings and e-coats.

As a formulator of polyurethane coatings, U.S. Coatings has worked hard to keep up with and stay ahead of EPA regulations for VOCs in paint and coatings.

The Southwest Coast Air Quality Management District (SCAQMD) in California issued a mandate regarding maximum VOCs of 250 grams/liter, which goes into effect July 1, 2002 for architectural industrial maintenance (AIM) coatings. "Traditional urethanes that have met the prior regulation of 2.8 lbs/gal VOC are no longer viable, forcing many manufacturers back to the lab bench," said Mr. McCadden.

U.S. Coatings has already taken steps to meet the new SCAQMD standard. The company is preparing to release UreGrip 3400, a 1.7 VOC, thin film, high gloss aliphatic polyurethane finish designed to meet the July 1 SCAQMD mandate of 250 grams/liter restriction. Designed to replace the traditional urethane finishes that have been used in AIM markets in southern California, UreGrip 3400 will have the same outstanding weathering characteristics as traditional urethane finishes from U.S. Coatings, according to the company.

Alberdingk Boley has voiced concern about the speed at which VOC regulations are being passed without thought for consequences to the coatings industry. "Unfortunately, legislators have been quick to pass rules requiring the use of water-based systems without concern for cost or performance," said Mr. O'Shaughnessy. "The conversion to water-based systems should be driven by consumer demand and resin performance, not politicians. Forcing the technology causes companies to invest research time based on politics, not chemistry or market needs. This slows the natural conversion to water as it lengthens the development process by causing companies to invest time in areas that may not be technically feasible. The additional research time required to commercialize these waterborne systems makes the whole process cost prohibitive."

Despite concerns about environmental legislation, it is unanimously believed in the industry that polyurethane technologies will continue to grow and flourish. A number of factors will fuel that drive.

"The three key factors that have and will continue to impact polyurethanes coatings developments are quality, efficiency and ecology," said Mr. Williams of Bayer. "The demand for higher quality and cost effectiveness is unyielding, and recognition of these market realities is the key to remaining competitive."

Continued development of higher solids, low viscosity resins and curing agents coupled with higher performance characteristics will drive the polyurethanes industry. "Improved waterborne resins and curing systems will open new avenues for polyurethane products," Mr. McCadden said.

Mr. Searfoss of BASF agreed that performance issues would help to fuel growth. "Market need, coating performance, cost competitiveness and VOC regulations are all drivers for further investigation into new polyurethane coatings technologies," he said.

Research and development, said Mr. Reardon of Dow, is the major tool to building the polyurethanes industry. "Customer demand, created by their unmet needs, is the factor that initiates new polyurethane technologies. Customers gravitate toward the technology leaders in the coatings marketplace, and tend to stick with those that can provide improved product performance at lower costs through innovative chemistries.

A number of innovative polyurethane chemistries have come out of supplier labs in the past year.

New from BASF are Pluracol HP polyols, improved polyether polyols. They have lower monol content, and therefore higher functionality than conventional products, according to the company. Additionally, Pluracol HP polyols are capped with ethylene oxide for improved reactivity and processing versatility, according to BASF officials.

BASF also recently introduced an energy-saving product designed to replace pure MDI in certain applications. This new product, to be sold under the trade name Lupranate LP30 isocyanate (LP30), is a solvent-free, modified diisocyanate with optimum storage conditions between 86[degrees]F and 104 [degrees]F. It can be used as a major starting material in elastomers, sealants, adhesives and pre-polymers, according to the company.

Alberdingk Boley continues to tout its patented PUD technology based on castor oil. Castor oil-based PUDs have the ability to make very hard systems that have much lower levels of NMP when compared to conventional polyesters. Alberdingk Boley has also focused on waterborne UV curing based on polyurethane technology. With water-based technology, the applicator gets all the benefits of 100% solids systems, without any of the toxicological issues, according to the company.

Lyondell Chemical is developing a line of acrylic polyols with superior crosslinking ability and low VOCs for polyurethane coatings, based on allylic alcohols instead of hydroxyfunctional acrylates. This patented, new technology and composition allows the company to produce solid, liquid and solution acrylic polyols with lower solvent demand and better crosslinking ability compared to conventional polyols, according to the company. This produces coatings with lower VOCs, improved pot life, faster cure and improved appearance and durability compared to conventional polyols.

New polyurethane raw materials from Bayer allow the formulation of automotive OEM coatings that can be baked at temperatures below 100[degrees]C. These coatings can be used to finish metal car bodies and plastic add-on components in the same operation, according to the company, and may offer a solution to the problem of color matching the systems when used on metal and plastic components.

Huntsman Polyurethanes has released improved Rubinate 9513 isocyanate, designed for use as a primer for concrete to be used with a spray polyurea topcoat. In addition to use as a concrete primer, Rubinate 9513 can be used as a primer for other substrates and, in some cases, as a topcoat for wood, metal, ceramic tile, paper and other plastics, such as expanded polystyrene and PVC,

according to the company.

Crompton's OSi Specialties has developed CoatOSil silanes for making self-crosslinking urethane coatings with excellent acid and mar resistance. These silicone products are used for flow and leveling and wetting in a wide variety of coatings from high solids to water-based, according to the company. The company is also marketing Fomrez UL-50 tin catalyst, which possesses low volatility and a very fast cure speed, according to the company.

#### Growing and Growing

The polyurethane technology market is big business for suppliers and manufacturers alike, and it's safe to say that a number of factors will continue to drive growth in the future. The major markets--construction and transportation--continue to grow, despite the somewhat sluggish economy, and new markets still can benefit from polyurethanes, which means new areas of expansion.

"Our perspective is that the market consolidation of customers, suppliers and manufacturers along with requirements for VOC reduction, fast cure and fast return to service time will continue to drive improvements in the polyurethanes coatings market," Mr. Hughes concluded.

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