

ENGINEERING NEWS

Treatment makes magnesium last longer

CAMBRIDGE, ENGLAND—Magnesium continues to gain support from design engineers who appreciate its strength-to-weight ratio and suitability for high-volume manufacturing. Yet this light metal still has some hurdles to clear before it can be adopted more widely, particularly in automotive applications. Untreated

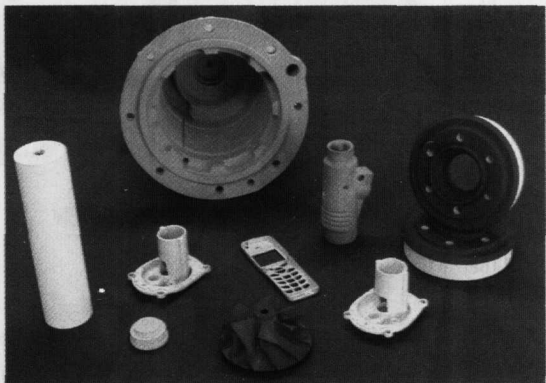
magnesium doesn't hold up well in corrosive environments, and it does a better job resisting paint adhesion than it does wear. But a patented conversion coating from Keronite Ltd. addresses all three shortcomings.

Keronite's process uses a plasma discharge in a liquid electrolyte to transform the surface of magnesium parts into magnesium oxide ($MgAl_2O_4$). "We essentially convert the substrate into its oxide," says Pavel Shashkov, Keronite's technical director. In some ways, the resulting coating functions like the anodized and chromate coatings that have been used on magnesium for years, but there are some key differences. Keronite processing takes place at room temperature in a relatively innocuous, low-concentration alkaline solution. So

it steers clear of the toxicity problems now threatening chromate treatments, and avoids some of the environmental concerns associated with conventional anodizing. "In fact, our process is not really an anodizing process at all," Shashkov stresses, explaining that Keronite uses bipolar pulses rather than the usual anode-and-cathode arrangement.

Keronite's surface treatment has a host of useful properties, including the ability to withstand voltages up to 1,000V dc and temperatures up to 1,000C. So far, though, most of the attention has focused on the treatment's ability to improve corrosion resistance. In salt-spray testing, for example, Keronite-coated AZ91 D alloy has managed to survive standard 1,000-hr tests with "no visible effects" compared to less than 100 hrs for untreated magnesium, Shashkov reports.

Beyond corrosion resistance, the coating



Magnesium is a favorite with OEMs who use materials with high strength-to-weight ratios. But it needs help before it's used in certain automotive parts.

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holds out the promise of wear resistance, too. Keronite has a micro hardness between 400 and 600 Vickers and a coefficient of friction less than 0.15 against steel, rendering it a good choice for abrasive and sliding wear conditions, Shashkov says. "It's too early to discuss specific wear applications for magnesium," he says, but he does cite turbine and automotive engine components as two likely application areas.

Layers of protection.

While it appears to the naked eye as a uniformly hard, dense ceramic surface, Keronite actually consists of three distinct layers—each with its own functional role. The innermost layer provides an atomic bond to the original substrate, Shashkov reports. A dense intermediate layer provides the bulk of the surface's protective capabilities. And the topmost layer of the converted surface is porous. Together, the three layers make up a coating that can

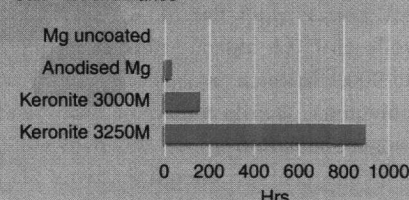
vary from 1 to 60µ thick, depending on the application. A 35µ coating would be typical.

According to Shashkov, Keronite's dense ceramic layer inherently provides a barrier to corrosion and improves paint adhesion. But the material's topmost porous layer can make the coating even more valuable. Shashkov notes that the porous layer traps paint and powder coatings, improving scratch resistance of the finished sur-

face. What's more, Keronite has come up with a variety of composite coatings by impregnating the porous layer with sealers and polymers, further boosting the corrosion or wear resistance of the ceramic itself. Shashkov notes, for example, that one such composite coating doubled salt-spray endurance to 2,000 hrs with no visible sign of corrosion. One of Keronite Ltd.'s most recent composite coatings features a Teflon PTFE impregnation, which

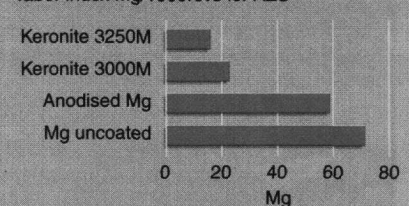
Keronite flights corrosion

Salt mist endurance



...abrasive friction

Taber index Mg/1000revs for AZS



Keronite coatings show promise in imparting the corrosion and wear resistance that magnesium needs to go into new applications.

increases resistance to sliding friction and corrosion. This coating technology recently won a Plunkett Award for innovative use of Teflon.

If the process has a downside right now, it's cost. "It's fair to say that the process isn't cheap," says Trevor Amos, vice president of Poeton Industries Ltd., a Keronite licensee based in Gloucester, England. Amos estimates that it carries a 30-40% price premium over

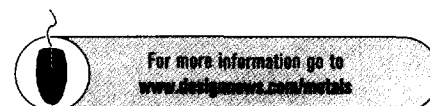
conventional anodizing and chromate-based processes. But for those applications requiring a non-toxic alternative with superior properties, it may be worth every penny. "It's the best of the best when you consider its properties and its environmental attributes."

More coatings. Keronite isn't the only advanced electrolytic surface treatment that can serve as an alternative to traditional anodizing and chromate-based treatments. New Zealand's Magnesium Technology Licensing Ltd. offers the Anomag process, while Germany's AHC GmbH has

Material	Coefficient of Friction	Wear Factor
Mg Alloy AZ91	0.45	10
Keronite 3000M	0.35	5
Keronite 3250M	0.20	4
Keronite 3260M	0.10	0.5

its Magoxid-Coat technology. Keronite will soon, however, become readily available in North America. After working with the process in the United Kingdom for the past two years, Poeton will soon open a Keronite facility at its Madison, WI-based subsidiary, Magnesium Coating Corp. There, the company will apply Keronite in conjunction with proprietary topcoats that can add color without painting as well as functional attributes such as wear resistance. Poeton has long worked on a variety of surface treatments for performance racing engine components and has already applied Keronite to the bearing surfaces of oil and water pumps. Amos says the company is also exploring Keronite for engine blocks, pistons, and rings. Applied to piston crowns, the coating may even work as a thermal barrier, he adds.

As for the value of any coatings, it's true that untreated magnesium parts already serve successfully in a variety of applica-



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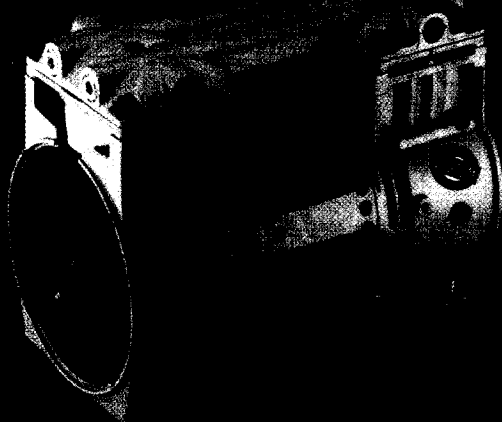
tions, including some structural automotive components. "In dry environments, like automotive interiors, there's no problem at all," says Steve LeBeau, vice president of Thixomat Inc., the Ann Arbor, MI, company that licenses Thixomolding magnesium molding technology. But the availability of better surface treatments now promises to extend magnesium components into exterior, cosmetic, and wear applications. "Advances in coatings technologies will make it even easier to adopt magnesium in the future," LeBeau predicts. **DN**

—Joseph Ogando, Senior Editor

For more information about magnesium surface treatments from Keronite Ltd., www.keronite.com: Enter542

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