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ANTI-COUNTERFEITING ADDITIVES

GLOBAL POLYMER DEMAND TRENDS

CARBON BLACKS THAT ARE GREEN

NEW DEVELOPMENTS IN MIXERS

Anti-counterfeiting additives and technologies are becoming more sophisticated to help fight product piracy. **Jennifer Markarian** looks at the latest developments

Plastics provide protection against piracy

Counterfeit products today are not just luxury goods like the designer watch or purse one might buy from a questionable vendor on a city sidewalk. They are, in fact, a bane to consumers and companies in a diverse range of industries including clothing, pharmaceuticals, toys, electronics, and even automotive.

Counterfeit plastic made news in February 2014 when Aston Martin expanded a recall to over 17,500 cars that it discovered used an accelerator pedal moulded from a counterfeit polyamide instead of the specified DuPont polyamide. Although no accidents or injuries were reported as a result in the Aston Martin case, counterfeit materials do have the potential to cause injury to consumers or, at the least, injure a brand's reputation and result in increased warranty claims.

Proactive measures

Companies today are more carefully evaluating the cost of counterfeiting, and management is shifting from reacting to problems to proactively preventing counterfeiting. "Businesses are getting smarter about protecting their brand," comments Sarah Skidmore, marketing manager at **Plastics Color Corp** (**PCC**). She noted at a recent conference that attitudes are changing: "It is no longer enough for brand-owners to acknowledge that counterfeiting takes place, but they must take the next steps to audit their suppliers and have a plan for corporate compliance."

Additive and masterbatch suppliers are at the forefront of anti-counterfeiting efforts in the plastics industry, with a wide range of solutions including both overt and covert technologies. Overt or visible technologies include holograms, watermarks, and laser-etched graphics that cannot be removed and are difficult to alter. Additives play a role here because some polymer types require additives to allow laser etching to take place. Covert or hidden technologies include a variety of additives compounded into a polymer and revealed under a certain light or through analytical tests. Often, multiple technologies are used to thwart counterfeiters.

The choice of anti-counterfeiting additive depends on factors such as the value of the product being counterfeited, cost of the solution, and where the detection is to take place, noted Stuart Swain, director of technology for **Chroma Corporation** in a presentation at AMI's Compounding World Forum held in Philadelphia in December 2013. Checking for authenticity of a material can be done at various stages of a product's life. For example, a company investigating products returned under a warranty claim can check whether a material is

Aston Martin recalled 17,500 cars after counterfeit polyamide was used in an accelerator pedal arm

theirs before beginning the repair process.

Anti-counterfeiting additives, particularly those embedded in packaging, may also be used to provide authentication before a product is put on a store shelf, says Mark McManus, senior engineer at **Ampacet**.

Because packaging security features can be compromised, however, securing the packaging does not ensure that the item inside is authentic. "More manufacturers are looking to embed something in the product itself that becomes an indelible, permanent feature surviving the product's life cycle," says Kent Mansfield, president of **TruTag**.

Skidmore also notes this trend to using anti-counterfeiting measures with both the package and the product itself. "Taggant in the polymer itself can be used to authenticate a product at any stage of the supply chain. OEMs or brand-owners can use the taggant as an auditing tool to check that the specified polymer is being used and used at the right level (not diluted)," she explains. Another use is authenticating product involved in litigation because of product failure.

"Where we are really seeing adoption here is where materials are required to meet certain regulatory specifications and less-than-scrupulous suppliers are attempting to pass off materials as meeting those specifications, when in reality they don't," adds James Petrie, marketing director, **PolyOne Color & Additives North America**. "Another application area affects OEM brand owners across their supply chain. They may have contractors who introduce lower quality materials in hidden components that are critical to the assembly and overall quality of the end product. These products start failing when the critical component fails, which in turn can create warranty issues, brand equity and consumer safety issues."

Covert action

Covert taggant or tracer technologies involve an additive and a means of detecting the additive. They are available at various levels of sophistication. "A low-tech and low-cost solution, for example, is to use one of many additives that fluoresce under ultraviolet light and can be detected with an inexpensive UV flashlight," explains Ampacet's McManus. "The disadvantage of simple technologies is that they are more easily counterfeited. Higher levels of sophistication are more difficult to duplicate. Both complexity and the number of different types of covert technologies have expanded in the past decade." Ampacet's SecurTrace masterbatches use a range of technologies based on the company's 25 years of experience in designing products for these applications.

A simple technology is a pigment, such as phthalocyanine, which can be detected under a specific wavelength of light, explained Chroma's Swain in his presentation at the Compounding World Forum. Other pigments cannot be seen in the visible colour spectrum but fluoresce when an ultraviolet light or "black light" is applied. These pigments, such as Chroma's Viblo (visible in black light only), are inexpensive, but because they are not light-stable they cannot be used for outdoor applications, said Swain.

Another popular technology is variochromatic pigments that dramatically shift colour, for example from blue to red, at different viewing angles. Additives that convert infrared (IR) to visible light can be detected with an inexpensive device, such as an IR laser. Another technology is isotopes or "molecular holographs" that have the same molecular weight as the material they are protecting and can only be detected with spectroscopic techniques, such as NQR or NMR. Although this is an expensive detection test, it is used to verify some raw materials in the plastics industry as well as other industries, noted Swain.

Taggants are light- and heat-stable micron-sized particles containing unique identification information; the particles are difficult to replicate and can be readily detected with various methods, such as microscopy or IR light. These "colour-coded wafers" can be used in opaque, coloured plastics and can incorporate various other technologies, such as detection with specific light wavelength. Molecular taggants are clear when compounded into resins and are detected only with special equipment. Microscopic or molecular taggants can be expensive, especially for small amounts of plastic (for example

200,000 lbs [90 tonnes] or less), says Swain. Advantages, however, are that they are highly covert and difficult to replicate.

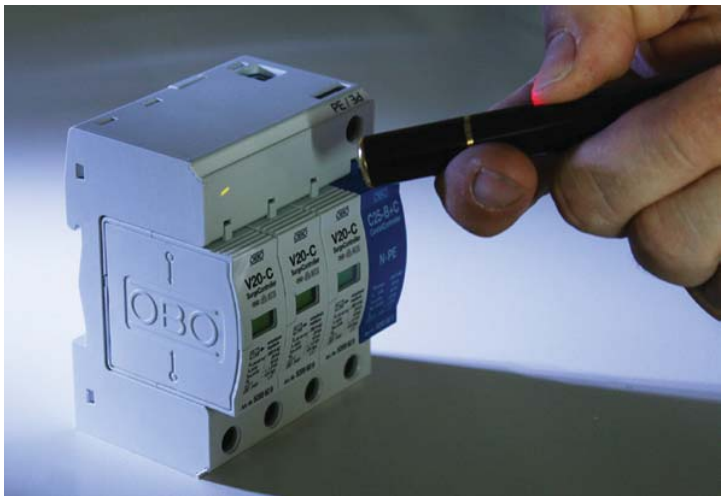
Microtrace says that its Microtaggant Identification Particles (MIP) are the original taggant technology (developed by 3M) and the origin of the term "taggant." Microtaggant particles range in size from 20-1,200 microns and contain a unique numeric code sequence represented by a multiple coloured layer particle. Microtrace also supplies additional taggant technologies that can be incorporated into each MIP as a multilevel solution. For example, up-converting phosphors that can be detected with a handheld laser-pen and UV light can be added to the particle. The company supplies Microtaggants in various forms, including masterbatches and as an additive for incorporating into a masterbatch.

Microtrace also offers Molecular Taggants, introduced in 2012, for use in authenticating and quantifying the dilution of bulk materials. Because they are used at a trace level, it is nearly impossible for a counterfeiter to detect and virtually impossible to replicate, says the company. The primary use of Molecular Taggants is to detect dilution and mix ratios of genuine product. Their primary disadvantage is the cost of the sophisticated handheld reader. Molecular Taggants are available as preformulated masterbatches.

Anti-counterfeiting additives can help identify the difference between fake and genuine goods

TruTag's spectrally coded silica microtags are measured using a portable spectrometer-based optical

Polysecure offers particle markers that can be detected using a mobile x-ray fluorescence spectrometer



reader. Each batch of taggant material can contain a different code that can be made to reference a label in a database that contains additional information about the item, thereby marking different products, factories, equipment lines, or even lot numbers, explains Mansfield.

Polysecure offers ceramic and crystalline particle markers as neat additives, for example in powder or paste form, and as masterbatches. In the end-product, the marker's characteristic fluorescence can be measured in the field with a mobile detector or made visible to the eye using a laser diode. In addition, the marker carries a numerical product code based on the chemical code of the ceramic particles and a random structural fingerprint that, in principle, cannot be copied. The product code can be detected non-destructively in the field with a mobile x-ray fluorescence spectrometer, and the fingerprint can be detected from a small piece of material in the laboratory, explains Peter Hensle, head of marketing and key account manager at Polysecure.

The particle size is adjustable between 0.2 and 100 µm, and particles are added at a level of between 10 and 500 ppm. Polysecure is also in the process of developing biologically generated, unique three-dimensional diatom shells as marker particles. These are not reproducible by any manufacturing process, are biocompatible and edible, and can be verified using miniature optics and a smartphone, says Hensle.

While the type of additive affects the cost and level of sophistication, the level of additive can also be varied depending on the need. Taggants used at very low levels are more difficult to detect, and therefore more covert. **PCC** recently added a greater variety of detection levels for its Mibatch anti-counterfeiting line, which can now be added from a low of 20-50 ppm up to 1,000 ppm. Skidmore says that PCC's chemical taggant technology is virtually impossible to replicate because of the patented process used to make the taggant particles. Although some processes may mill or grind taggant particles, PCC's taggants use spray pyrolysis to produce spherical, homogeneous particles with high control over the particle structure. A particle can be designed with a specific fingerprint that can be precisely replicated by the spray process PCC taggants undergo.

Applied DNA Sciences uses the complex codes inherent in botanical DNA as an anti-counterfeiting solution. The company's patented SigNature DNA can be applied as a spray or embedded in a polymer at any step of the process from polymer formation to extrusion, and it can also be added with other additives or colorants, says Dr James Hayward, president and CEO of Applied DNA Sciences.

A unique characteristic of DNA markers is that they can be detected at very low levels down to less than 1 part per trillion. Hayward says that SigNature DNA has been tested in various polymers and is able to be dispersed homogeneously. The company's patented technology stabilizes the DNA, and the product has been tested under extreme conditions by US military researchers and found to be stable. "DNA is the 'gold standard' of forensics because of its uniqueness and its capacity to store information," explains Hayward. "In principle, it cannot be copied, and this principle has been proven in practice by US Department of Defense

challenges." The technology can generate an infinite number of unique marks and is currently in trials for various plastic applications.

Anti-counterfeiting formulations

New anti-counterfeiting masterbatches, compounds, and services have been introduced in the past few years. **PolyOne** launched Percept Authentication Technologies in 2013, and it is now available globally. Percept solutions include masterbatch formulations and selection services for anti-counterfeiting options. "By incorporating design and consultative services, PolyOne can help customers understand the track and trace technologies available to them and how best to implement the right ones in their supply chain," says Petrie. Technologies available include overt solutions such as colour-shifting colorants and laser-marking additives, plus covert solutions such as energy-sensitive and microscopic taggants.

Grafe offers a product-marking masterbatch based on a combination of chemical substances that can be detected in the end-product both qualitatively and quantitatively using x-ray fluorescence analysis (XRF). The marker masterbatch can be used alone in a range of plastics, including use in synthetic yarn. Colours can also be added to the masterbatch.

Celanese announced a range of detectable polymer technologies in March 2014 to help OEMs and suppliers reduce the potential risk and loss of revenue from counterfeits in automotive parts, consumer products, medical devices, packaging and consumer electronics.

Although Celanese's analytical department has extensive testing capability for analyzing the base polymer as well as the different additives in the formulation to identify if it is an original Celanese grade, this tends to be time consuming and costly. To facilitate identification of counterfeit material by their customers, other anti-counterfeiting additives can be added to the material including UV-detectable technologies and optically verifiable pigments/microtaggants that can be chosen for a specific product, customer or application.

Grafe offers a product-marking masterbatch that can be detected using x-ray fluorescence analysis

Celanese also offers laser-markable grades that allow the final part to be marked with a visible barcode, such as manufacturer, batch number and raw material/batch.

"The decision about the choice of the anti-counterfeiting solution should be based on criteria such as does the customer want a visible or invisible marker? Is the method compatible with the existing design? Does it have to be specific to a customer/application/production site or does the customer only want to know if it is a Celanese grade? This decision should be carefully taken after detailed discussion of customer requirements," explains Kirsten Markgraf, product development leader at Celanese.

PolyOne's Versaflex CE TPEs for consumer electronics are offered with Percept Authentication Technologies

More information

Jochen Moesslein, managing director of Polysecure, will give a presentation on the latest developments in anti-counterfeiting technologies for plastics at the **Compounding World Congress**, which is being held in Cologne, Germany on 21-23 April 2015. For more details visit **http://bit.ly/cwc15**.

Click on the links for more information:

- **www.adnas.com (Applied DNA Sciences)**
- **www.ampacet.com**
- **www.celanese.com**
- **www.chromacolors.com**
- **www.grafe.com**
- **www.microtracesolutions.com**
- **www.plasticscolor.com**
- **www.polyone.com**
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