EVONIK INDUSTRIES

Smart Formulating Journal

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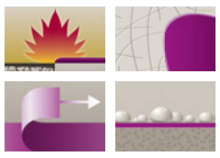

Minimizing the Carbon Footprint of Road Markings

Environmental issues are increasingly becoming important in managing any public or private operation today. Recognition for the potential of Green Public Procurement (GPP) as an effective instrument for stimulating sustainable development has grown.

GPP guidelines implemented by the European Union, for example, are calling for the consideration of environmental aspects based on solid scientific evidence when deciding various product alternatives. Green purchasing is not only limited to the public sector and appears to be increasingly used as a corporate practice. Hence, decisions about product portfolio are shifting to more environmentally friendly products as the business strategy for future sustainability and competitiveness. Evonik points how to use Life Cycle Assessment (LCA) as a guideline for the development of more sustainable road marking solutions with reduced environmental impact. This method allows both an analysis of particular product options with respect to the total environmental impacts as well an assessment of the significance of the individual phases of a product life cycle.

As a major supplier of road marking binders, Evonik Industries has conducted a comprehensive analysis of road marking systems based on the four major road marking material technologies used in the European market: solvent-borne (SB) paint; water-borne (WB) paint; thermoplastic (TP) and thermo spray plastic (TSP); and cold plastic (CP) and cold spray plastic (CSP) [1,2]. Impacts originating from both the marking material and the glass beads broadcasted onto it during application to achieve retro-reflection, respectively night-time visibility of the road marking have been taken into account. The method for this analysis is the life-cycle assessment (LCA) as outlined in ISO 14040 and 14044. This method is evaluating the environmental impact of a product considering all raw material and energy inputs throughout its entire life from cradle to grave.

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Editorial

Dr. Thomas Haeberle
Member of the Executive
Board of Evonik Industries AG

Dear Readers,

You are holding the tenth issue of our customer magazine for the coatings and paint market in your hands. With this magazine, we want to inform you about the latest developments from Evonik for this important market.

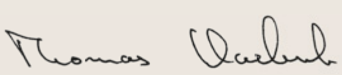
As an innovative industrial company, Evonik gears its business towards the key megatrends. For us, they are the global social issues of the future and with our business we want to make a real contribution towards finding solutions. In our eyes, these megatrends are not only social developments that bring with them great change, they are also business areas with exceptionally high growth potential for both us and our customers. Evonik has identified three global megatrends: resource efficiency, health and nutrition, and globalization. Within the megatrend of resource efficiency, for example, an essential goal is to be the number one cooperation partner when it comes to developing new paints in collaboration with our customers or improving existing formulas in close cooperation with our customers.

In order to implement this cooperative approach with our customers – the manufacturers of coatings and paints – on a global scale, we have set up application labs in all regions, most recently in Brazil. We are also establishing new plants around the world, such as the isophorone production facility which is currently being set up in Shanghai. In addition, we are investing in our network of paint experts who develop new formulas in close collaboration with you, our customers, as well as new methods, for example the life cycle analysis featured in our report in the current issue.

We look forward to receiving your comments and continuing our intensive dialog.

We hope you enjoying reading this issue!

Best regards,



Dynasylan® SIVO 140 – A Novel Binder for Water-Borne Zinc Dust Paints

In 2011 over half of the worldwide coating consumption was based on water-borne systems. Most of the zinc dust paints are still solvent-borne but increasing environmental awareness and new statutory provisions are putting pressure on the use of solvent-borne systems.

Corrosion can be extremely costly and it is not just limited to metals; other materials such as glass, plastics and concrete can also be affected. Therefore corrosion protection is of great importance and a lot of research and development is done in this field. Nearly all metals or metal alloys like aluminium, magnesium, iron and steel need to be protected against corrosion.

Iron and steel are usually protected against corrosion by using zinc in different forms. For hot dip galvanized steel the steel components are chemically cleaned by an acid to remove rust and millscale before being immersed in a bath of molten zinc at approximately 450 °C. When the steel is withdrawn, a layer of molten zinc remains on the surface. In the electrogalvanizing process (zinc plating) the zinc coating is deposited onto the cleaned steel from a solution of zinc salts. This process is usually used for smaller parts like nuts and screws.

Zinc-rich paints are formulated with a binder and zinc dust. The concentration of the zinc dust is high so that the zinc particles are connected resulting in a dry film which is conductive. The layer acts to some degree as metallic coating. The zinc dust paint is mainly used on ship's hulls, parts of the car body and also for protection of factory steel work. The steel has to be cleaned before the application of the reduced zinc or zinc rich paint by abrasive blasting.

Different binders can be used for zinc rich paints. Apart from organic binders such as polyester or epoxy resins, inorganic binders based on silicic acid esters are used. Zinc dust paints based on silicic acid esters are heat resistant in contrast to their counterparts based on organic binders. Zinc dust paints formulated with inorganic binders are available as two-pack and one-pack systems. The one-pack system e. g. Dynasylan® MKS is stable for at least half a year when formulated and cures with the help of moisture at room temperature. Zinc rich paints based on inorganic binders do have a good chemical resistance, heat resistance and UV stability. The advantages of inorganic binders like silicic acid esters are obvious but formulations based on these inorganic binders still contain organic solvents.

The first water-borne zinc rich paints based on organic binders are entering the market; however these new systems do not have good heat resistance. Therefore Evonik developed Dynasylan® SIVO 140, a novel water-borne organic-inorganic binder for two-pack zinc rich paints with a higher heat resistance than water-borne organic binders.

Zinc rich paints based on this novel binder are nearly VOC-free, heat resistant and cure at room temperature. Dynasylan® SIVO 140 is an improvement for the environment as there is almost zero organic solvent emitted to the atmosphere.

Dynasylan® SIVO 140 is the result of the latest SIVO SOL Technology and combines different silanes in a water-borne, stable and defined binder. The combination of different silanes used in the hydrolysis and co-condensation process opens the way for a water-borne binder system with a designed reactivity, flexibility and a good compatibility with fillers and polymers.

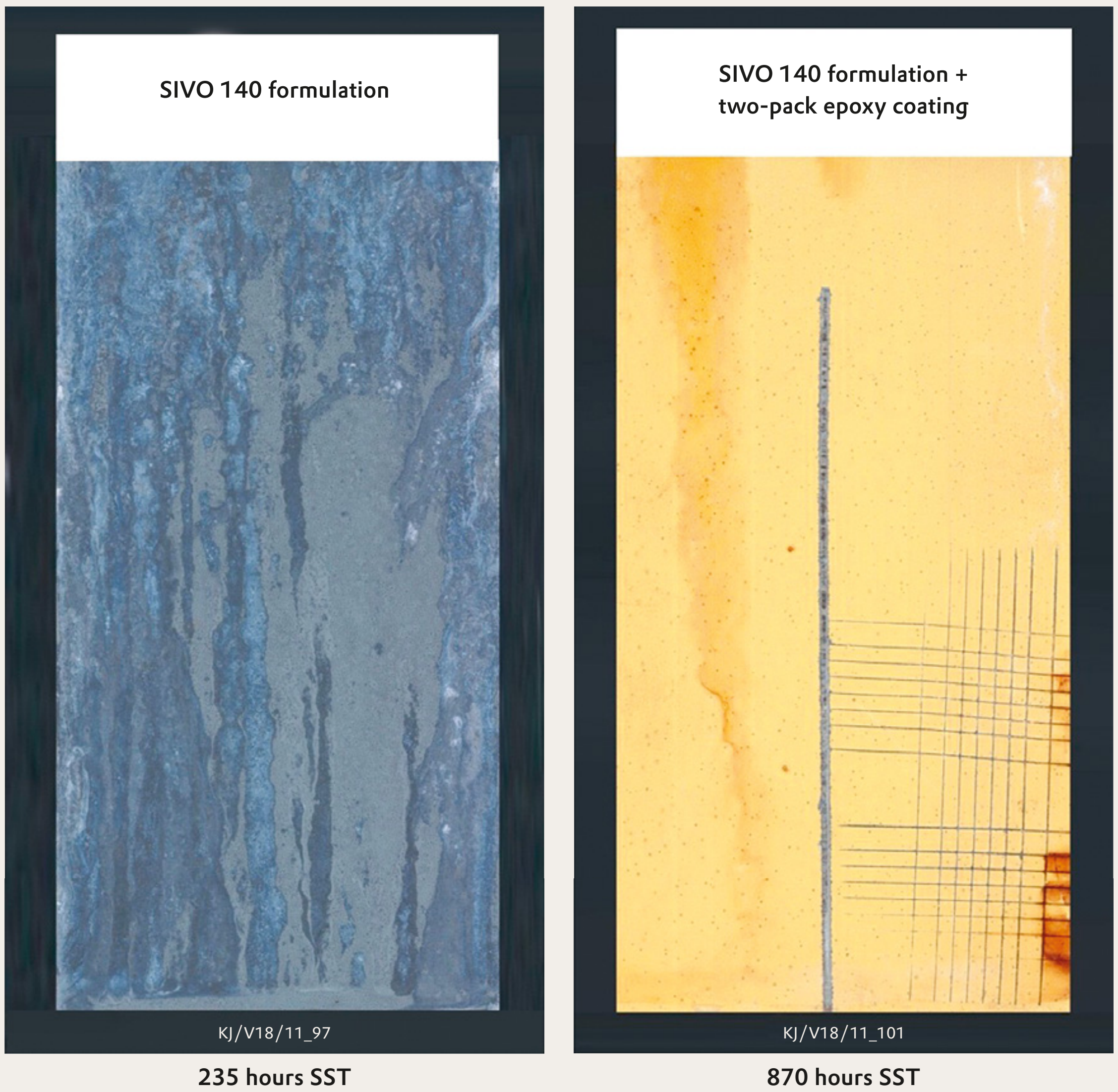


Figure 1: Cold rolled steel panels coated with a formulation based on the water-borne binder Dynasylan® SIVO 140.
Procedure: Alkaline cleaning (60 s, pH 11, 60 °C). Corrosion protection formulation: 17 % (w/w) Dynasylan® SIVO 140 with a solid content of 25 % (w/w), 83 % zinc dust. The curing was done at 20 °C for 1 day (dry film thickness ~ 35 µm). The right panel was coated with the Dynasylan® SIVO 140 formulation, cured for 1 day (dry film thickness ~ 35 µm) and overcoated with a two-pack epoxy coating cured at 60 °C for 2 hours (dry film thickness ~ 60 µm). The coated panels were placed in the salt spray chamber and tested according to EN 9227.

Dynasylan® SIVO 140 is fully hydrolysed, can be thinned with water and is almost VOC-free. The active silanol groups are stabilized and the system can be formulated with fillers and pigments. The pot life of such a formulation depends on the filler type and filler concentration but typical pot life times exceed 7 hours. The Dynasylan® SIVO 140 formulation has to be applied on a clean iron or steel surface. Alkaline cleaning can be done on production lines but outdoors an abrasive blasting of the iron/steel surface is necessary. Depending on the formulation, Dynasylan® SIVO 140 systems can be sprayed or brushed. The drying time is approximately 5 minutes for an 90 µm wet film thickness at 20 °C and 50 % relative humidity. The silanol groups are activated when the water evaporates but full curing takes more time. The layer is touch-dry after 5 minutes and can be overcoated after one day. Dynasylan® SIVO 140 is flexible and formulations can be done for thin and thick film corrosion systems. Overcoating is possible with different coating systems. Especially coatings show a very good adhesion.

Figure 1 shows two cold rolled steel panels coated with a water-borne zinc rich paint based on Dynasylan® SIVO 140 (left side) and a cold rolled steel plate coated with a water-borne zinc rich paint based on Dynasylan® SIVO 140 overcoated with a two-pack epoxy system (right side).

In figure 1 the coated cold rolled steel panel at the left side shows some white rust after 235 hours in the salt spray test. The cold rolled steel panel coated with the water-borne zinc dust paint based on Dynasylan® SIVO 140 and a two-pack epoxy coating doesn't show any red or white rust at the scribe after 870 hours in the salt spray test. There are also no signs of coating delamination. These results demonstrate the high potential of this new water-borne organic-inorganic binder.

Dynasylan® SIVO 140 is a novel water-borne organic-inorganic binder designed for two-pack water-borne reduced zinc or zinc rich paints. The binder offers many formulation options with fillers and pigments. The advantages of Dynasylan® SIVO 140 are as follows:

- improved heat resistance compared to organic binders
- almost zero VOC
- low temperature curing
- low or higher film thicknesses are possible
- Dynasylan® SIVO 140 is more environmentally friendly than traditional zinc silicate coatings based on silicic acid esters

For commercial applications a detailed formulation development and stability testing is required.

Contact Dynasylan® NAFTA
kerstin.weissenbach@evonik.com

Contact Dynasylan® Europe
philipp.albert@evonik.com

Contact Dynasylan® Asia
helmut.mack@evonik.com

VISIOMER® Methacrylate Monomers – Sustainable Solutions for the Coatings Industry

Sustainable development and careful use of the world's resources are among the key issues for the future. Sustainability is also a focus of the development work in the Acrylic Monomers Business Line.

Sustainability and resource efficiency are the focuses in the Acrylic Monomers Business Line. Apart from analyzing and optimizing the carbon footprint throughout the supply chain and using and developing processes with the highest possible degree of resource efficiency, another key area is using sustainable, bio-based raw materials.

Evonik Industries already has bio-based methacrylate monomers in its product portfolio. VISIOMER® IBOMA and IBOA (isobornyl[meth]acrylates) even have a double effect on sustainability: On the one hand, the special monomers are excellent for formulating paints with a low VOC content and on the other hand, they are manufactured using the raw material camphene. This is recovered from α-pinene, a secondary product in paper and pulp production.

VISIOMER® THFMA (tetrahydrofurfuryl methacrylate) and VISIOMER® C17.4-MA (a long-chain alkyl methacrylate) are also bio-based. VISIOMER® THFMA improves the adhesion properties of adhesives and goes easy on resources because the raw material used in its manufacture is recovered from waste products from sugar and starch production. VISIOMER® C17.4-MA is a main component in polymers that are used in oil additives. The raw material used to produce VISIOMER® C17.4-MA is recovered from palm kernel oil.

Evonik is also working intensively on developing more methacrylate monomers based on renewable sources. Both monovalent and multivalent alcohols from biotechnological processes are used as starting materials for methacrylate monomers. Our motivation is not only to use a sustainable raw material basis, but also to offer added value in the end applications. There are two factors that also unite the latest development product from our pipeline: Because of its low vapor pressure, VISIOMER® GLYFOMA makes it possible for highly volatile reactive diluents in resin systems to be substituted. This is a bonus, for example, in various reactive adhesives, different types of coatings, and composite materials. Glycerol, the building block used to synthesize VISIOMER® GLYFOMA, comes from canola oil.

Evonik would also be happy to help you develop individual solutions for your special requirements with custom-made and sustainable methacrylate monomers.

Contact
Dr Gerold Schmitt
gerold.schmitt@evonik.com