Conformal Coatings – Non-VOC

(Volitile Organic Componds)

Conformal coatings are designed to protect printed circuit boards and related equipment from their environment. These coatings 'conform' to the contours of the board allowing for excellent protection and coverage, ultimately extending the working life of the PCB. The ideal conformal coating will have performance requirements that include good electrical properties, low moisture permeability, good chemical resistance and mechanical durability. The use of conformal coatings is important in automotive under-bonnet applications, particularly in safety critical areas, such as military, aerospace and industrial applications. Due to the wide range of possible applications, good thermal properties are also important, with flexibility retained at low temperatures and a high retention of mechanical properties at elevated temperatures.

Traditionally, the most widely used conformal coatings tend to be solvent based and are available in several distinct chemical types; acrylic, silicone (conventional and silicone alkyds), epoxy and polyurethane. The properties of a conformal coating stem from the selected base resin and the various additives included, optimising the performance of the cured coating. Organic solvents are used to dissolve the base resin and reduce viscosity to bring the coating within a workable range. As such, the coating dries by a simple solvent evaporation and in some cases can be further heat or moisture cured to initiate cross linking, further enhancing the coating properties.

Solvent based conformal coatings are extremely versatile and can be applied in many ways, such as dipping, spraying and brushing. By simply adjusting the solvent level the viscosity of the coating can be tailored to the required application method. In the case of spraying for example, the standard coating can be diluted within reasonable limits, using a suitable solvent, in order to obtain a low working viscosity without affecting coating performance. The downside, particularly in low solids applications, is the high VOC (Volatile Organic Compound) content of these materials and the environmental and health and safety impact their use has.

VOCs contribute towards the formation of ground-level ozone, a major component of smog. Such pollution can have many detrimental effects on the environment, in particular, damaging forests and vegetation. VOCs when not managed properly can also cause health problems. Over exposure causes them to act as irritants and in worst cases carcinogens. It is therefore fair to say that the formation of ground level ozone is a serious air pollution problem.

Volatile Organic Compounds or VOCs are carbon based compounds which vaporise easily at room temperature. They are more clearly defined by the EU Solvents Emissions Directive, which states that a VOC is "any organic compound having at 20°C a vapour pressure of 0.01kPa or more, or having a corresponding volatility under the particular conditions of use."

The EU Solvents Emissions Directive covers defined operations such as the manufacture of coatings, coating activities (such as PCB conformal coating) and surface cleaning. There is a threshold limit value for solvent use per year for coating activities such as PCB conformal coatings and manufacturers whose consumption of solvent falls below these thresholds fall outside the scope of the directive. Occupational exposure limits (OELs) in the workplace will still be apparent, however. It is therefore clear that both the

manufacturer and end user of conformal coatings are affected by the Solvents Emissions Directive.

Electrolube released a new conformal coating, NVOC (Non-VOC Coating), to the market in 2007 in order to meet the demanding requirements set down by the EU Solvent Emissions Directive. Two years on, it is still the only coating to offer a drop-in replacement for solvent based materials in selective spray applications and is now also available in a range of formats, covering all application requirements. Non-VOC Coating is based on polyurethane technology. It utilises a polyurethane pre-polymer as the base resin, a 100% solids material in the form of a high viscosity liquid. The pre-polymer is pre-reacted polyurethane and isocyanate where some of the functional groups are blocked. Upon exposure to moisture the reaction continues to completion, forming a tough, even coating.

Non-VOC Coating has been created by adapting the polyurethane pre-polymer with a blend of carefully chosen diluents to ensure that all materials are reacted within the system. The diluents chosen offer a massive reduction in viscosity creating a 100% solids material at a sprayable viscosity, similar to that of solvent based materials, without the emission of any VOCs. The cure profile starts with the polyurethane pre-polymer reacting with moisture in the air. This is then followed by a further reaction with the diluent blend, releasing only carbon dioxide from the reaction. The cross-linking nature of this coating means that the mechanical strength and abrasion resistance properties are excellent. The cured coating therefore is extremely tough and possesses excellent moisture and chemical resistance.

Due to the reaction profile of Non-VOC Coating it is supplied in a ready to use formulation for spraying applications. It has been tested by the worlds leading manufacturers of select spray equipment with extremely positive results in a variety of technologies, including film, swirl and atomising coating techniques. It has been shown that it is possible to apply the new coating via conventional methods and with little change to the set up parameters. The coating can then be cured at room temperature or accelerated by the use of an IR or conventional oven, without any delay. Non-VOC Coating offers the performance and ease of use of a solvent based coating and in addition supplies users a ready to use material with no evaporation loss. Therefore the same amount of coating will spread much further than a solvent based material and does not require costly extraction processes.

In addition to the standard NVOC (ENVOC05L) product for selective coating applications, Electrolube have launched three new products to the range at Productronica 2009. The additions include a high viscosity version (ENVOC-HV05L), a semi-thixotropic gel version (ENVOC-GL05L) and an aerosol version (ENVOC200H). These additional products provide environmentally and user-friendly alternatives to solvent based conformal coatings in a vast array of applications.

The 200ml aerosol version utilises the standard NVOC coating to provide an easy solution to manual, small-scale or rework applications. It utilises a carefully selected propellant which also offers many environmental benefits over alternative technologies. The propellant is 100% ozone friendly, with an Ozone Depleting Potential (ODP) of zero. It also has a negligible Global Warming Potential (GWP) of <5, which is extremely low in comparison with alternative propellants with GWP >1000.

The high viscosity version has been developed for applications where a thicker coating or manual application is required. These include, brush, dip and high viscosity selective spray applications; both the standard NVOC and the high viscosity version are suitable for atomising and swirl selective coat applications. The product has been created utilising the same chemistry as the standard NVOC and therefore offers the same high performance characteristics. The difference is in the level of diluents, which has been carefully adjusted to provide a coating of optimum viscosity for higher build applications.

The gel version is a single part, semi-thixotropic material designed for glob-top applications where the coating should not flow once applied. The semi-thixotropic gel cures at room or elevated temperatures upon exposure to atmospheric moisture and incorporates a UV trace to aid inspection. It is ideally suited for applications where components are difficult to coat due to size, shape and position. Applied through a syringe or needle applicator, it offers all of the benefits of the standard NVOC material, including excellent adhesion, chemical resistance and electrical properties, in a gel form.

The Non-VOC Coating range offers many advantages over other coatings on the market. It has been carefully developed to achieve above and beyond the expectations of replacements for solvent based conformal coatings. In summary, the range provides a selection of flexible coatings with excellent adhesion to a wide variety of substrates. They offer excellent mechanical and electrical properties, they can be used over a wide operating temperature range and incorporate the use of flame retardants to meet UL94 V0 approval.

The development of Non-VOC Coating has led to a new era in conformal coating. Over time, regulations will get tighter and the use of solvent based conformal coatings will lessen as the industry norm. By the continual expansion of the NVOC range, Electrolube have simplified the transition away from solvent based materials and aid conformal coating users in reducing their solvent use, thus paving the way towards a greener future within the industry of conformal coating.