

Cutting the cost of *colouring* rigid PVC



Colouring technology used to create coloured masterbatches incorporating infrared reflective pigments

RECENT DEVELOPMENTS IN COLOUR CONCENTRATE TECHNOLOGY ENABLE PROCESSORS TO ADD COLOUR IN-HOUSE AND BENEFIT FROM INCREASED MANUFACTURING FLEXIBILITY, TIGHTER PURCHASING, REDUCED INVENTORY AND CLOSER QUALITY CONTROL. TONY GAUKROGER, MANAGING DIRECTOR OF COLOUR TONE MASTERBATCH LIMITED, EXPLAINS TO BP&R THE PROCESS BEHIND THE COLOURING OF RIGID PVC.

Traditionally, self-colouring PVCu has never been as successful as colouring commodity polymers, but there is no reason for it not to be. In-house colouring offers reduced costs by facilitating the purchase of natural polymer from a supplier of choice and reducing stock holdings of coloured compounds.

Common methods of colouring PVCu include:

- o Dye packs - a blend of pigment and dyes
- o Liquid colours - a dispersion of colourants in a liquid carrier
- o Wax dispersions - a solid dispersion of colourants in a wax
- o Masterbatches - colourants compounded into a universal or polymer specific carrier resin

Before choosing the most appropriate colouring method, the processor needs to consider a number of factors such as health and safety, as dusty powder pigments require the use of personal protection equipment. Other factors include special plant, such as dosers and pumps that might be needed to introduce the colourants to the polymer, as well as enhanced quality control to ensure the accurate addition of colourants. This could mean extra training, employing qualified staff or investing in test

equipment such as spectrophotometers. Higher levels of cleanliness may be necessary along with dedicated storage facilities with temperature and humidity control, as well as regular agitation etc. There will also be additional demands on the process to homogenise the colourants into the polymer. Finally, ease of use, which takes into account the process, application, colouring criteria and amount of colourant required.

FORMULATION OF CONCENTRATES

Formulating a colour concentrate for PVCu is not as simple as with other polymers. Although based on a PVC resin, unplasticised PVC compound formulations are complex and contain many ingredients, such as stabilisers, fillers, impact modifiers, processing aids and lubricants. The choice of these can vary immensely; even the level of compounding depends upon the application.

Many concentrates employ one ingredient as the carrier, selected for its ability to accommodate large amounts of pigment without adversely affecting processing or performance when added to the host polymer. Side effects can be undesirable, especially if the colourant carrier is also a lubricant in the PVCu.

With liquid and wax systems, care has to be taken with carrier choice to avoid plate-out, screw slip and other melt rheology problems. Some liquid carriers plasticise PVC, introducing a plasticiser to a material selected for its lack of plasticisers!

Masterbatches are equally complex. Universals generally work well in PVCp while grades created for use in PVCu can be troublesome when used at high loadings. Universal types based on high VA content EVA are fairly successful, but these too can have a plasticising effect. They are unsuitable carriers for dyestuffs.

Assuming the colour is suitable the processor then has to consider the effect

of the colour concentrate on the melt rheology of the compound as well as any evidence of incompatibility - appearing as lamination in the finished product.

Modern masterbatch technology utilises intensive mixing in a masterbatch extruder to produce highly pigmented products. Unfortunately, PVC is extremely sensitive to shear which makes it a poor carrier for masterbatches. Plasticising somewhat overcomes this and PVCp-based masterbatches can be made on conventional masterbatch equipment.

However, PVCp masterbatch in PVCu adds plasticiser into an unplasticised polymer. Traditionally, PVCu polymer specific based masterbatches were produced on PVC extruders and generally featured lower levels of pigmentation compared with other polymer specific types. A combination of resistance to flow and being prone to degradation under shear make it difficult to produce highly loaded PVCu masterbatches.

Twelve years ago, Colour Tone developed the Vynacol polymer-specific colouring system for PVCu that made it as easy to colour as any other polymer by eliminating compatibility and processing issues historically associated with adding colour to PVC. This technology employs innovative methods of modifying and manipulating the additive systems commonly used in PVCu compounds.

WHERE AND WHEN TO ADD COLOURANTS

Liquid-based colouring systems are usually pumped directly into the polymer melt. 'Dry' colourants can be added to pre-compounded pellet or dry blend, prior to compounding. Dye packs require premixing and a liquid dispersant will help to reduce dust.

However, introducing colourants into a dry blend is pointless unless the colourant (dye packs, liquid colourants and some wax dispersions) can be wetted out.

Below left: Colour pigments are dusty and may require the use of personal protection equipment



Processors can benefit from increased manufacturing flexibility by switching from coloured PVCu compound to natural resin coloured with Vynacol masterbatch

Benefits can be offset by the need for additional cleaning of colour-contaminated equipment, which will impact subsequent batches. While masterbatches and wax dispersions can also be treated in this fashion, it is more common to dose these materials directly into the polymer stream during processing.

HOW MUCH COLOUR IS REQUIRED?

Some applications require a lot of colourant. This may be for a number of reasons, for example, strong polymer colour, exterior performance, poor coverage of the pigments or opacity specification on thin wall products.

Processors should quantify the amount of dispersed pigment or dyes required because they will be mixed with a relatively large quantity of colourant carrier. It would be foolish to decide on a colouring method, which met colour requirements but introduced processing issues or reduced the physical performance of the base polymer.

Whatever the colour carrier media there are technical merits in using pre-dispersed pigments. Pigments and dyes are dusty, 'dirty' products and present a

risk of contamination. Conversely, dispersed pigments are dust free, have no health and safety issues and the dispersing process breaks down the pigment agglomerates into primary particles which give better pigment development. The net result is better dispersion, enhanced quality and increased cost efficiency.

CAN IT BE DONE?

In-house colouring is not difficult. There may be some issues but they are manageable with the assistance of a colourant supplier. PVC suppliers can take up to six weeks to deliver products while masterbatch suppliers offer immediate technical support, colour matching and delivery of usable product within 24 hours.

With the freedom to avoid extended delivery times, processors can negotiate natural polymer prices and reduce stocks of coloured compounds.

The bottom line is improved production flexibility and better service to customers.

FURTHER INFORMATION:

WWW.COLOURTONE-MASTERBATCH.CO.UK

PVC ADVANCING WITH THE TIMES

PVC is one of the oldest, most established and predictable materials for many key applications including construction, medical devices, food packaging and automotive. Its properties and durability have led to many decades of use with extensive benefits.

PVC Formulation 2012 in Düsseldorf, Germany, will see expert compounders, material suppliers, international researchers and members of the industry supply chain debate the market trends and technical developments.

With sustainability being a buzzword across the PVC industry, much focus at the conference will be on recycling targets, technical developments in additives and compounding as well as the needs of individual PVC markets worldwide.

PVC compounding and processing is in a phase of active development, an area which will be explored at the event. There are several drivers for this including the global trend towards renewable chemistry, which includes bio-based additives, as well as plans to produce more PVC resin from plant-origin feedstock.

PVC is well tested and used in many long-term applications subject to extensive weathering and other factors, which can affect colour. Colour retention and antimicrobials will be looked at in closer detail at the event.

European REACH regulations are having effects on all aspects of the chemical industry, and the consequences for the PVC industry will be considered. In addition, the legislation in various world regions to ban heavy metals in many products is affecting stabiliser selection and overall formulation, as other additives are required to achieve the same performance with the new substitute materials.

The uses of foaming and Nanotechnology for PVC will also be discussed at the event.

The PVC Formulation 2012 conference is taking place from 20-22 March 2012 at the Maritim Hotel, Düsseldorf, Germany.

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