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Choosing the right PVC stabilizer supplier – Consistency is Key

Stabilisers with consistent properties provide a wider processing window and greater cost-efficiency for manufacturers of PVC products.

When the PVC industry began to move away from lead-based stabilisers at the beginning of the new millennium, industry experts knew it would be a challenge to find alternatives to the highly effective (but not environmentally friendly) lead salts and soaps.

Although it took much work to create effective alternative stabiliser formulations, lead-based stabilisers have successfully been converted to calcium and zinc-based stabilisers across the globe. Choosing a stabiliser supplier with the expertise to create effective, lead-free formulations that provide the same heat stability, lubricating properties and in-service durability as lead-based formulas is key.

A supplier with the research and development capabilities to remain on the forefront of technology will be able to evolve successfully when faced with any market or regulatory changes, such as the potential for the shift away from tin-based stabilisers.

Today, the pressure is on to reduce costs by lowering the addition rate of stabiliser one-pack in PVC formulations or by using lower-cost raw materials, which tend to be less effective and thus provide lower performance.

As a result of this lower performance, the processing window is significantly narrower, which makes it more difficult for a PVC processor to produce good product and to minimise scrap production.

How can a processor identify the most cost-effective stabiliser formulation?

A processor doesn't want to pay for more stabiliser one-pack than necessary. But not enough effective stabiliser one-pack can end up being more costly because of increasing scrap.

Choosing a PVC stabiliser one pack supplier that can help optimise the dosage level and can provide highly consistent product are keys to optimizing the quality of your PVC product and the productivity of your process.

How does stabiliser consistency affect the PVC processing window?

A stabiliser one-pack for PVC contains multiple additives (such as heat stabilisers, UV stabilisers, antioxidants, internal and external lubricants, process aids and other speciality raw materials) needed to allow processing into a finished part and improve the properties of the PVC for a given application.

The black line in Figure 1 below represents the normal batch to batch variation of a stabiliser one-pack. Raw material selection, dosing accuracy, contamination and mixing efficiency can all lead to these variations.

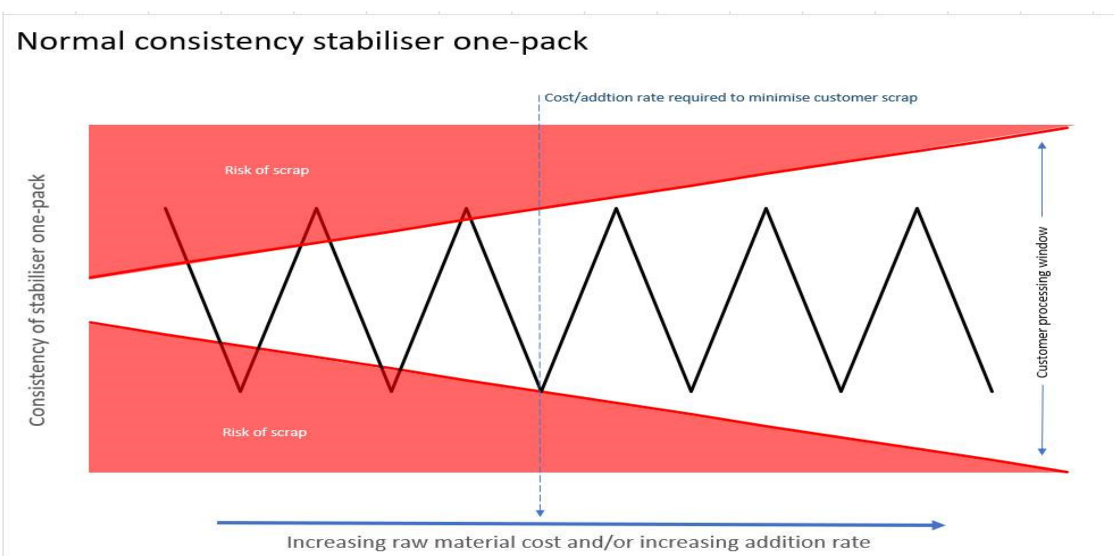
The area between the red shaded areas indicates the customer processing window, which is the range of variables such as melt temperature, melt pressure, dimensional stability, output rate and physical properties that if met, will result in a saleable product for the customer.

As can be seen in Figure 1, when a higher level of stabilisation is used (either via a higher addition rate or by using a more effective, higher-cost raw materials), the processing window is wider and can accommodate more variation in the stabiliser one pack. In this wide processing window (at the right-hand side of the graph), the natural variation in stabiliser one pack remains within the processing window, and as a result, “in spec” PVC product is made.

However, at the left-hand side of the graph, in the narrower processing window, the natural variation of the stabiliser one pack may jump outside of the process window into the red shaded area, which may result in “out of spec,” unsaleable product.

With low raw materials costs and/or low addition rates, the inconsistency of the stabiliser one-pack increases the risk of the customer producing scrap product.

Figure 1



The red shaded areas are representations of the problematic production outcomes. The left-hand side of the graphic showing a narrow processing window caused by one of several factors; wear on machines, reduction of key additives or increased output. As the processing window gets wider, it is fair to assume that the factors affecting the processes detrimentally in a narrow processing window are addressed to allow greater tolerances, i.e. additional cost to the business of new machinery, more additives, lower output.

The black line indicates the inherent fluctuations in a typical stabiliser consistency when processes are set to their optimal parameters. It becomes apparent when over-layed, that in the case of the narrower processing window, the fluctuations in the typical stabiliser consistency push the production outcome into the problematic area, thus producing out of spec product. The only way to improve the processing window, in this case, is to invest in machinery, higher dosages of one-packs or increase potent additives incurring associated additional cost.

When Purchasing Gains Become Production Losses

To put the cost of customer scrap vs. cost of stabiliser into context, we can do some simple calculations.

Let's assume a pipe company produces 10,000t per year using a stabiliser costing £2000/t used at 2%. They will use 200t of stabiliser at a cost of £400,000.

The raw material cost of the pipe they make could be approximately £800/t which would equate to £8,000,000 per annum. Excluding overheads, every 1% of scrap is worth £80,000.

If the user moved from a more expensive stabiliser to a less efficient one, they could perhaps reduce the price from £2000/t to £1600/t, to save £80,000. However, as shown in Figure 1, this would narrow the processing window, which would likely cause more than 1% of scrap to be made, thus negating any savings.

It is worth paying a little more upfront to ensure getting a good product and making less scrap.

How can scrap be reduced without using a more expensive stabilisation package?

There is a simple answer. First, the stabiliser supply partner should optimise the stabiliser to fit an individual customer's production requirements, by understanding the upper and lower limits of the processing window.

In addition, if the stabiliser is more consistent, with as close to zero batch-to-batch variation as is possible, the minor variations and outside influences in each production cycle no longer trip the process outside of the 'saleable' window, thus ensuring the consistency of the product and subsequent output benefits.

Figure 2

In the same way, as represented in Figure 1. The graph again shows the same processing window with the detrimental factors diminishing as the perceived investment increases; new screws/barrels/dies, higher dosages of one-pack, slower running speeds.

However, the black line, in this case, shows an example of a one-pack where the consistency is greater, and therefore, the inherent variation becomes less. With the reduction of the peaks and troughs of the one-pack processing behaviour, the amount of production which strays into the red zone, the out-of-spec zone, is much less—thus providing a solution to reduce sub-standard production output without the need for an additional cost.

How can a stabiliser be made with less variation and higher consistency?

As stabilisers moved from Lead to Calcium Zinc, the number and complexity of the additives required in a stabiliser one-pack increased quite dramatically. The importance of getting the exact blend of materials has never been higher. Slight variations in the dosing of minute additions of potent additives can have a dramatic effect on the performance of the stabiliser. Similarly, contamination of different formulating chemistries can impair the performance of a stabiliser. For example, mixing some of the additives used in pipe stabilisers with those used in window profiles will reduce stability and create variation.

The way in which the stabiliser one-pack is produced will have an impact on the batch-to-batch consistency of the one-pack. Stringent control over process variables is key to minimizing variability, but the foundation of this control is high quality in the design of the one-pack manufacturing facility.

Eliminating the potential for cross-contamination, such as from additives that are not part of a given formula, is particularly important, because these unintended additions disrupt the accuracy of the intended blend, create variation, and can have negative interactions with the intended additives.

The following are some of the components of a stabiliser one-pack facility that help generate a quality product:

- Dedicated raw material vessels eliminate cross-contamination. As shown in the video, there are 28 vessels all individually dedicated to their own raw material.
- Specially designed, bespoke dosing systems for each individual raw material increase accuracy by aligning geometries and feeding with the individual raw material's density and flow characteristics in mind. Instead of a generic holding vessel that is the same for any type of raw material, each vessel is designed to aerate, allow flow, and prevent changes in bulk density, based specifically on the flow characteristics and particle size of each raw material.
- Dedicated customer product vessels eliminate cross-contamination of formulating chemistries. As shown in the video, dedicated customer product vessels are carried by forklift to the line for each campaign. These vessels then stay in rotation within the plant for the duration of the product campaign.
- Gravity-fed transfer systems eliminate cross-contamination by removing the need for transfer pipes, which can cause problems such as aeration of product or product separation and can have hang-up points that could cause cross-contamination.
- High efficiency, total dispersion mixing ensures even distribution of highly complex recipes.
- Tool-less access throughout the plant eliminates cross-contamination through safe and efficient cleaning access points.

Although equipment and systems such as these are more expensive to install, they all contribute to ensuring that each batch is produced as the R&D team designed it and is consistent, no matter what the size of the production campaign is.

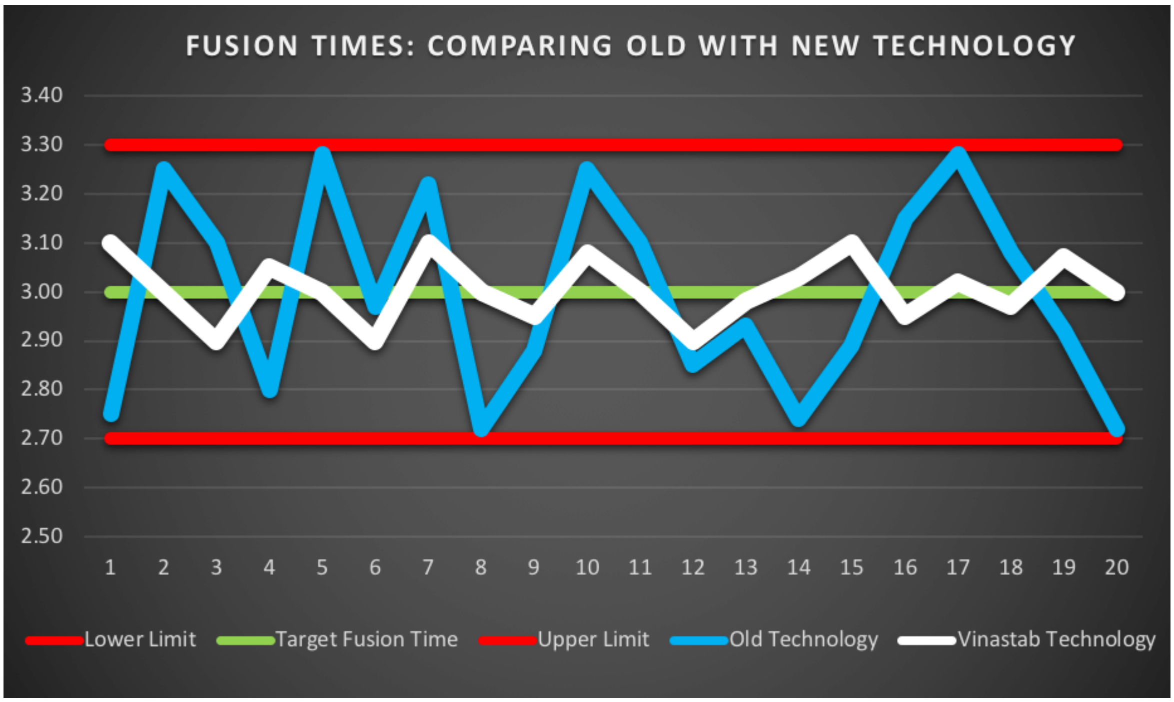
Because the vessels are dedicated, even a small amount of stabiliser can be made without requiring additional cleandowns.

Consistency at Alphagary's new manufacturing facility

Alphagary's new manufacturing facility for stabiliser one-packs has incorporated all of these design elements and as a result, has proven the ability to achieve high accuracy and consistency in weighing and mixing.

Automation of the process provides previously unachievable batch-to-batch repeatability.

As shown in Figure 3 below, the new technology (white line) results in much more consistent fusion times than the old technology (the blue line).



This consistency of the stabiliser, resulting from the facility that is designed for accurate dosing with no cross-contamination, translates to more consistent processing and better PVC products.

Want more information? Please contact us!

Image caption: Alphagary worked with AZO GmbH as the primary design partner and asset supplier, to install state-of-the-art equipment, specifically designed to provide a green footprint and incorporate the design principles—such as dedicated vessels, bespoke dosing systems, and gravity-fed transfer systems—needed to eliminate cross-contamination and ensure consistency.

The move away from vacuum transfer of powder eliminates contamination and also allows the plant to operate with 65% less energy, which reduces the carbon footprint of the stabiliser one-packs.

The new modern design of the Alphagary plant means that in comparison with a typical vacuum transfer based plant, an achievable saving of CO2 emissions in the order of 64kg per tonne of stabiliser produced. At full capacity per annum, this equates to an enormous saving of 1300 tonnes of CO2 reduction released to the atmosphere.

L to R:

Scott Elliott, Head of Business Development – With over 30 years of PVC experience spanning Stabilisers and Compounds, Scott will be working with his newly recruited Technical Sales Manager, Stuart Hope (also 30 years of experience in PVC stabilisers and Compounds) and the R&D team in Chinley to formulate stabiliser solutions which will be designed specifically to eliminate customers pain points.

Paddy Dolan, Head of Manufacturing – Paddy has a wealth of manufacturing and engineering experience from his 30 years in the PVC industry. Also being familiar with stabiliser formulations allowed Paddy to be instrumental in designing some of the key aspects of the plant which will guarantee product quality and consistency.

Phil Goodinson, Site Director – Phil has been with Alphagary since 2014, initially growing the PVC compounds side of the business. Also with over 30 years' experience in stabilisers and compounds spanning technical, commercial and business administration, Phil jumped at the opportunity to build a world-class team and a best in class facility to challenge the status quo in the stabiliser industry.