

## Packaging dyes overview – current technology and trends

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The packaging and board sector of the paper industry appears to be showing a greater demand for higher technical properties and on-machine advantages from the dyestuffs they utilise. This is driving the trend of reduced use of traditional basic dyestuffs becoming less technically suitable for some higher-end packaging and board grades, and being replaced by more advanced products in the form of speciality modified basic and direct dyes.

### Background

For many years, the packaging market has been utilising colorants to enhance the shade properties of their products, and basic dyes have traditionally been the colorants of choice. This, due to the high colour strength, generally acceptable properties and relative economical pricing of basic dyes, has positioned them strongly as the first-point-of-call for many manufacturers.

Over the years, the product ranges of traditional basic dye suppliers have changed very little in their technology, whereas most other paper dyestuff types have developed significantly. Some manufacturers have sought to modify basic dye technology with great success, but this trend away from traditional basic dyes does not only include specially-modified versions, rather the inclusion of dyestuff types that were not considered before i.e. direct dyes. With this increased demand on other dye types, the economies of scale have brought the cost of application of more advanced dyestuffs closer to that of basic dyes.

This paper sets out to give a general overview of the dyestuff types and application of these products in the general packaging sector. It is by no means exhaustive or even accurate for every aspect of the packaging sector, merely a guideline. Discussion

In recent times, the replacement of traditional basic dyes with modified basic dyes and anionic direct dyes has seen increasing acceptance, giving both technologically and economically improved results in packaging applications.

When looking at optimising or improving the dyestuff application, the choice of dyestuff type should be looked at. There are three main classifications of dyestuff for use in packaging grades, namely: basic dyes, modified basic dyes and anionic direct dyes. However, the choice of dye type cannot be done in isolation from the choice of addition point for that dyestuff. Whether the product is to be added in the wet-end (stock addition) or to the size-press must be considered. Different technical performance is required from the dyestuff for both these different applications. Packaging colorant choice

The correct choice of packaging dye is dependant on many factors, all of which must be taken into account in order to make an informed choice of which is the best colorant to use:

- Depth and hue of target shade;
- Required technical properties such as lightfastness;
- Types and base colours of the furnish;
- Environmental and legislative considerations;
- Cost limitations. Basic dyes

The general properties of basic dyes are summarised in Table 1.

Despite their high strength and relative economy of addition, the technical drawbacks of these types of dyes can often outweigh their full cost benefit. For applications requiring higher lightfastness, such as top-end kraftliner board, the use of basic dyes is being superceded by higher lightfast options – modified basic dyes and anionic direct dyes. Modified basic dyes

These dyes, generally based on the chemistry of basic dyes, have longer molecular structures than traditional basic dyes, and thus have significantly improved properties (Table 2).

Though still cationic in nature, modified basic dyes exhibit improved fibre coverage and substantivity on many furnishes, making them ideal for packaging applications. Lightfastness is also improved considerably over traditional basic dyes, but not to the levels of direct dyes. Anionic direct dyes

Anionic direct dyes are in a completely different class of dyestuff molecule than the basic and modified basic dyestuffs.

These dyes have been specifically designed for use in paper and fine paper applications; however their superior dyeing properties also make them excellent candidates for higher-quality packaging applications. Due to their excellent substantivity, even higher-cost products can often work out to be the more cost-effective solution (Table 3).

#### Backwater coloration

The amount of dyestuff in the paper machine's backwater gives a clear indication of the suitability of the dyestuff for the application. A backwater coloration scale is employed to describe the amount of colour seen in the backwater. A value of 5 signifies that no coloration is seen in the backwater, whilst a rating of 1 indicates that strong backwater coloration is observed. A general trend of the results seen with the different dye types is shown in Figure 1. It is clear that modified basic dyes and anionic direct dyes show significantly better backwater ratings than traditional basic dyes. This subsequently will result in better effluent qualities and lower CODs.

Where a size press is employed on a board machine, size-press dyeing can bring efficiency benefits. Surface addition allows a much lower dyestuff addition rate, potentially resulting in large dye cost savings. However this method of application does have its own drawbacks. There is potential for an uneven dyeing, showing marks, splashes, stripes and streaks. Dyes applied at the size press exhibit reduced fastness properties, particularly lightfastness. To help overcome these problems, often a proportion (normally 30–50 per cent) of the dye can be added at the wet-end to help mask unevenness from the size press addition.

Size-press application of dyestuffs can, overall, bring good benefits with the correct choice of product, often yielding significant savings in dyeing costs.

To further highlight the benefits of anionic direct dyes, by means of example, the following excerpt from one of many successful applications is included: Anionic direct dyestuffs replacing basic dyes in Testliner

Basic dyes were successfully substituted by a recipe based on anionic direct dyes in a linerboard mill, resulting in the elimination of shade variations.

The mill was receiving complaints and claims from customers regarding out-of-tolerance shades. This was due to the variation in shade of Basic Orange 2 (turning redder) with changes in both pH and moisture content during storage. The mill also had concerns regarding backwater coloration and COD as they have a closed water system (Table 5).

Colour measurements were carried out during production using basic dyestuffs and the replacement anionic direct dyestuffs, both on machine and after ten days' exposure to ambient moisture.

Dyes were added continuously at the suction side of the machine chest pump, mixed and diluted in-line with a static mixer. The target shade was obtained without any problems. Dyestuff and COD levels within the water system were reduced.

#### Benefits to customer:

- Improved shade stability to pH and moisture changes;
- Recipe adjustment according to raw material colour changes resulting in improved colour consistency;
- Improved lightfastness;
- Reduced backwater coloration;
- Reduced COD values;
- Similar costs of application, giving overall cost reduction for customer.

#### Future

The future of dyes in packaging will continue to hold a mix of traditional basic dyes, speciality modified basic dyes and anionic direct dyes. With the increasing demands for higher technical properties, environmental pressures, clearer backwaters and increasing pressure on cost of production, the shift towards newer colouration technologies is already occurring. The packaging sector needs to consider optimising applications and new alternatives in order to get the best out of the dyestuffs utilised.