Coloring with Masterbatches

Guidelines for Coloring with Masterbatches based on Akulon®, Arnitel®, Arnite®, Stanyl®, Xantar® or Xantar®C

a DSM Guide

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Introduction

When producing colored injection molded parts, the molder has various coloring options, from fully colored (as-delivered material) to a number of methods for coloring neutral material on the molding machine. This guide explains the factors that should be taken into account when a molder is considering coloring the material in his own operation.

In general terms, we have listed the pros and cons for self coloring.

Advantages

- **Flexibility in production, especially for small series**
- **Short lead times**
- **Proven system with good track record**
- **Potential cost savings**
- **Quality comparable to readily colored plastic compounds**

Constraints

- **Not recommended for flame retardant materials that need to meet standards**
- **Some limited investment is needed**
- **Restructuring of production unit is required**
- **Responsibility for quality is shared by the various parties (processor, suppliers of MB and natural material)**
- **Requires trained personnel**

Drive shaft weed trimmer: Akulon K-F69

Fuel tank chainsaw: Akulon F223-D

Self Coloring Concepts

The most common methods of coloring plastics during processing and their relative merits, are:

Method	Advantages	Disadvantages
Masterbatch (solid pellets)	■ **Clean, dust free** ■ **Frequently applied technique, industry standard** ■ **Many suppliers**	■ **Carrier material may influence quality and properties of end product**
Liquid colorants	■ **Good dispersion enabling use of low concentrations** ■ **Fast/easy color change** ■ **Quick solution for small lot size**	■ **Need for secure handling** ■ **Risk of reduced efficiency of plasticizing process** ■ **Carrier liquid may influence quality and properties of end product**
Dry coloring (powder colorants)	■ **No carrier material**	■ **Dust, SHE-aspects** ■ **More time needed for color changes** ■ **No guaranteed dispersion**

Coloring by Masterbatch is the most widely used method with a good track record in delivering reliable quality and consistency. Particularly for engineering plastics as supplied by DSM, this is the most common and preferred on-line processing solution.

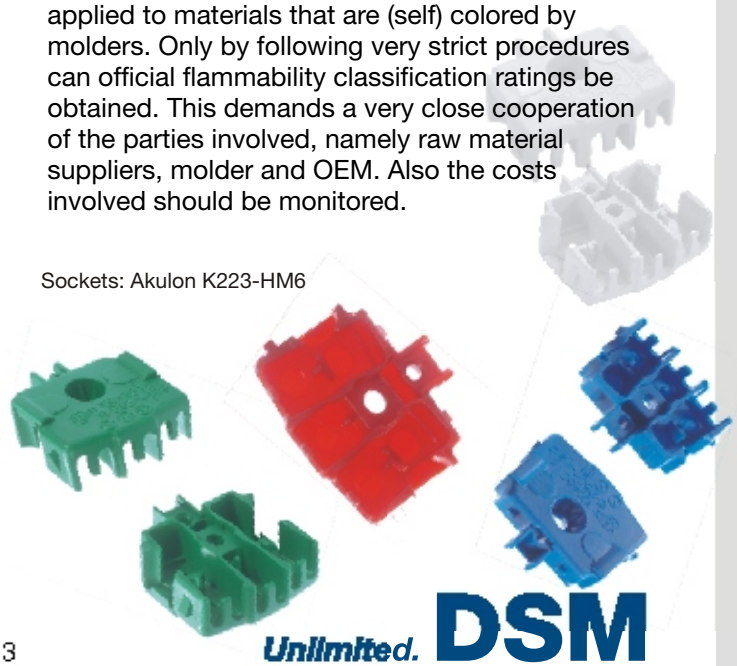
This guide provides information on coloring by masterbatches. Its aim is to assist processors considering this coloring option to take all relevant factors into account and to indicate where further, more detailed information on equipment or masterbatches can be obtained.

It is very important to check that the masterbatch and the polymer to be colored, are compatible. If there is any incompatibility, processing problems may occur or the mechanical and other properties of the polymer may suffer, or both can happen.

UL Yellow cards

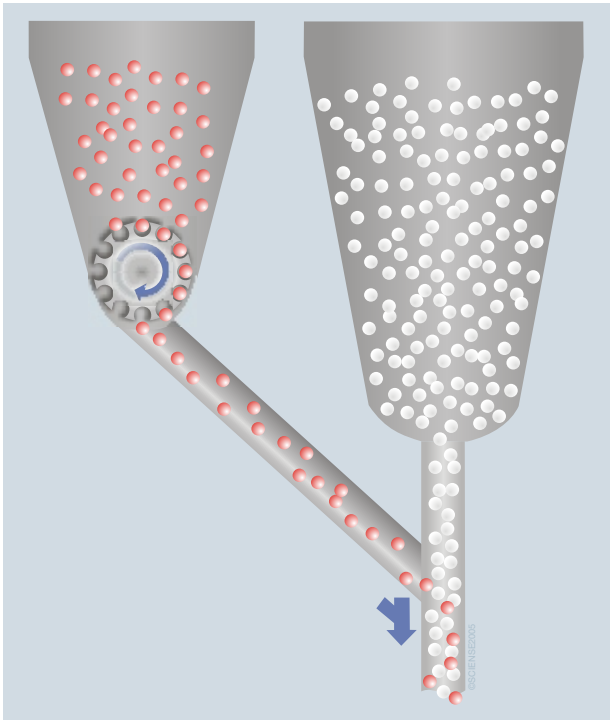
When UL recognition is a requirement, the DSM yellow card approvals cannot generally be applied to materials that are (self) colored by molders. Only by following very strict procedures can official flammability classification ratings be obtained. This demands a very close cooperation of the parties involved, namely raw material suppliers, molder and OEM. Also the costs involved should be monitored.

Sockets: Akulon K223-HM6

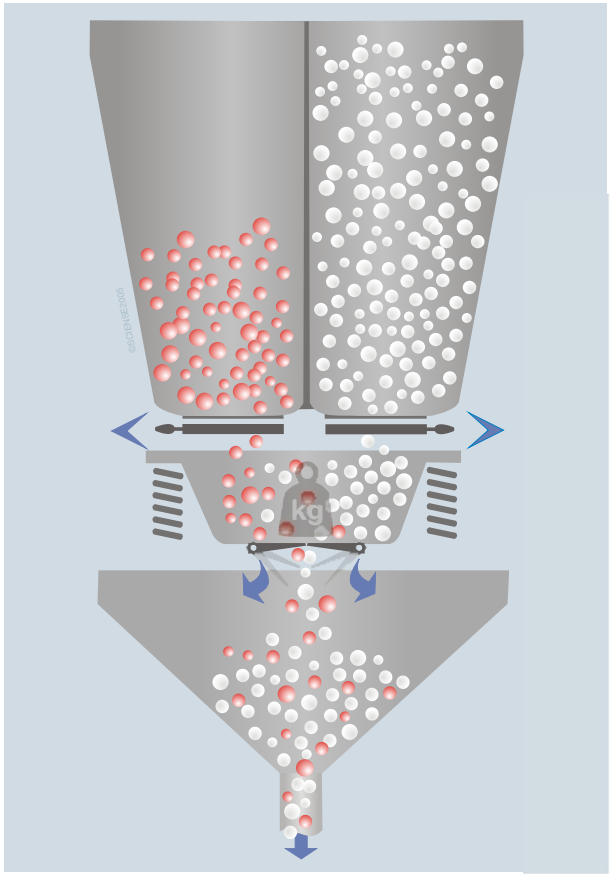


Mixing and Dosing

Volumetric dosing



Gravimetric dosing



All DSM polymers (PA6, PA66, PA46, PC/ABS, PC, PBT, PET and TPE) can be successfully colored using masterbatches.

The efficiency of coloring is influenced by the correct choice of dosing equipment. Two alternative systems are available, volumetric or gravimetric dosing of masterbatches.

Volumetric dosing provides a dosing accuracy that is very repeatable and consistent when an adequate chamber/metering device is used.

In gravimetric dosing systems the components are weighed and dosed. It is most suited to blending granulates and can also be used with differently sized pellets. Gravimetric dosing systems require a higher investment but the systems are more robust, give better reproducibility and are less sensitive to variations.

Good dosing accuracy and consistency improves end product quality, saves money by using less masterbatch and reduces scrap.

Toolhandles: Arnitel EL740

Homogenizing

The processing equipment plays a big part in reaching consistent and even (i.e. homogeneous) colored end products. This can be particularly difficult when using short plasticizing units.
In general the longer a plasticizing screw is, the more homogeneous the color obtained.

The use of screws equipped with static or dynamic mixing elements has proved to be effective in reaching better color and surface quality. The pictures show some commercially available mixing devices.

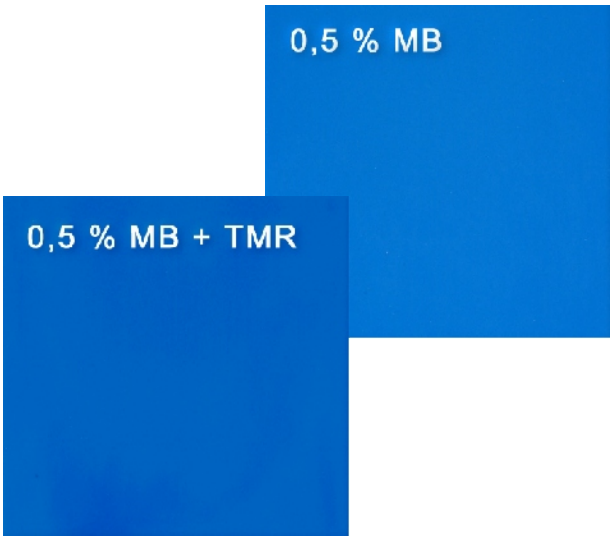
For both mixer types it is important to seek the manufacturers advice to guarantee that the plasticizing unit, material and mixing device are properly tuned.

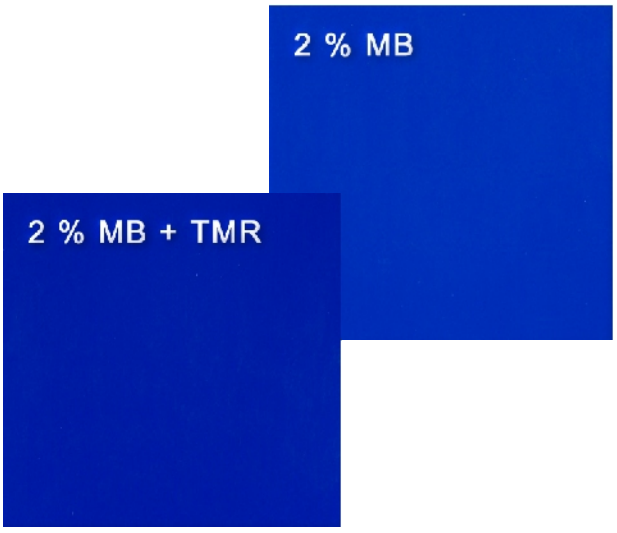
Examples of add-on mixers

Sulzer (static mixer)

Twente Mixing Ring (TMR), dynamic mixer

Hydraulic Couplings Stanyl TW200F8





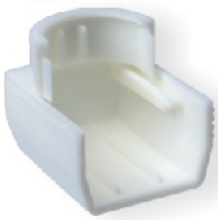
Results & Remarks

Results (see photo's of plaques) have been obtained in DSM laboratories using a 20D-screw equipped with and without a TMR. By using a TMR mixer when processing polyamide, a better color intensity is obtained in the end products for a given level of masterbatch. This can lead to savings through a reduced consumption of the masterbatch.

Some observations with respect to DSM materials.	
Material tradename	**Remarks**
Akulon® PA6 Akulon® PA66 Arnitel® TPE/TPU Arnite®	Because of the low viscosity, mixing elements in the plasticizing unit are very effective.
Stanyl® PA46	The masterbatch needs high temperature stability, as PA46 is processed > 300 °C.
Xantar® PC	Transparant crystal clear color requires small amount of masterbatch. The use of mixing devices is not recommended because of the risk of tailing effects.
Xantar®C PC/ABS-blend	Xantar C has a very bright natural color in comparison to emulsion based PC/ABS. The use of mixing devices is not recommended because of the risk of tailing effects.

Socket outlet: Xantar C MC 3700

Plugs: Akulon F 223-D



Cost Considerations

It is important to assess and rank all the factors influencing the production process. The molder should be aware of the hidden costs in a process change. Only after screening the whole process, can the right conclusions be drawn.

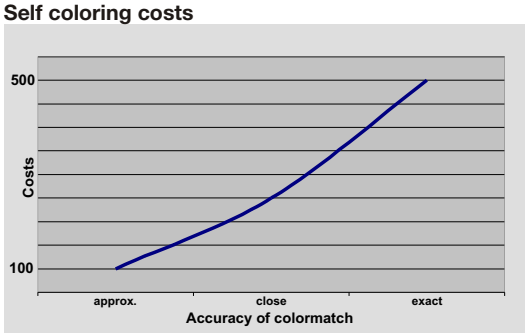
DSM has developed a cost calculation model to help guide processors reach the best decision for their circumstances. The model focuses attention on all aspects of the coloring process and not just the material cost differences. This allows the processor to check the influence of different options on their total operation and includes the following factors:

- logistics (warehouse issues/order handling)
- commercial (cost of colorants versus pre-colored material / order size)
- production (investments, depreciation, interest rates, supervision, run size).

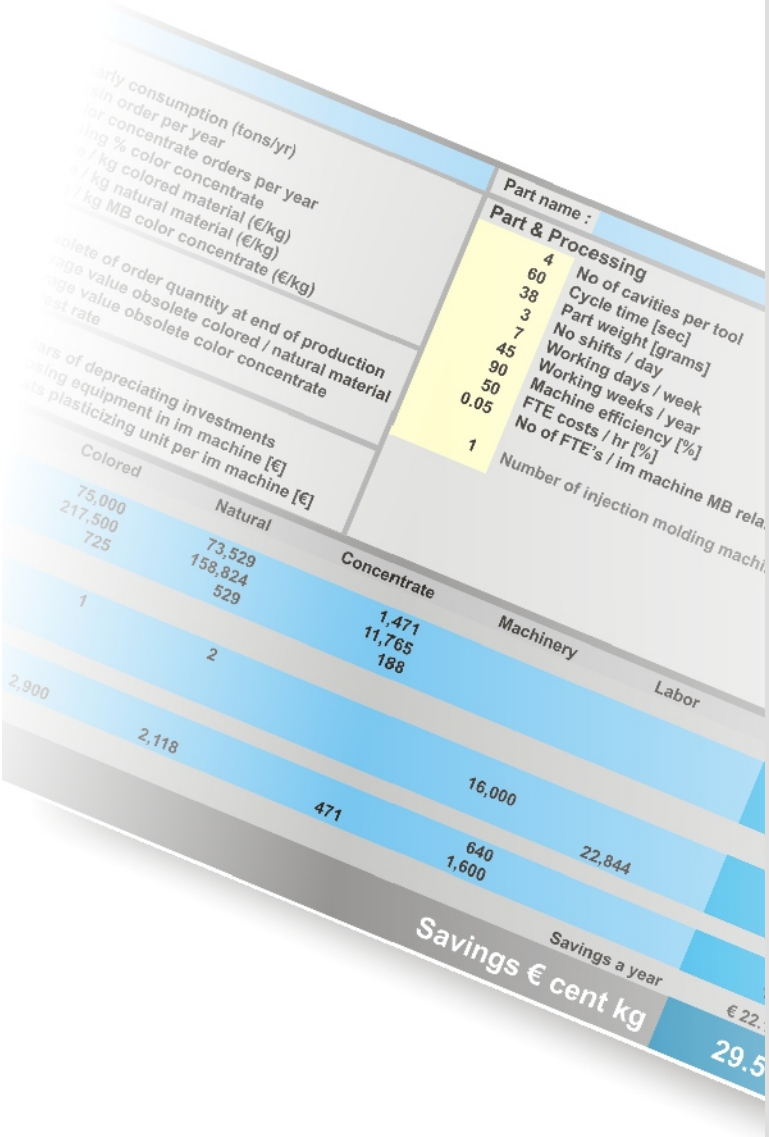
And it helps to identify where potential savings can be realized. The DSM cost calculation model is only available in discussions with DSM sales or application engineers.

The calculation model confirms the cost effectiveness of coloring by masterbatches especially for small production series where high flexibility in production is required. The attainable color quality is comparable to fully colored compounds.

Self coloring costs



The accuracy of the required color has a major impact on total costs. In technical parts, approximate or signal colors are often the requirement. These are more readily achieved than design critical colors where aesthetics are very important. The chart shows how relative costs can be influenced by the accuracy of the color match.



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Shanghai 200020, China
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Fax +86 21 6386 2198

Useful websites:

www.dsmep.com

www.akulon.com
www.arnitel.com
www arnite.com
www.stanyl.com
www.xantar.com

Examples of masterbatch producers:

www.aschulman.com
www.albis.com
www.basf.de
www.chabot-corp.com
www.clariant.com
www.colloids.co.uk
info@finke-colors.de
www.plasticoncentrates.com
www.polyone.com
www.rohadyechem.com
www.rowa-gmbh.de

Examples of producers of dosing- and mixing devices:

www.colortronic.com
www.ferlin.nl
www.koch-technik.de
www.maguire.com
www.materinternational.nl/
www.mh-protec.com
www.spiroflux.com
www.sulzerchemtech.com

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