



## Mixing and compounding masterbatches

by Norman Dyer - Normandy R & D

### Definition

A master batch is a product in which pigments and/or other additives are already optimally dispersed in a carrier material, that is compatible with the main plastic in which it will be let down and is supplied in either a granule or prill form.

### Carrier material

The carrier material generally used, is likely to be one of the following:

low density polyethylene, polypropylene, polystyrene, EVA, low molecular weight wax, an alkyd resin, or a more polymer specific material.

### Let down ratio

This can vary with the type of pigment/additive strength required in the final product, and can be from below 1% for some types of UV. additives and colour tints, to above 50% as is the case with some types of flame retardants. In general, for most coloured products, 1-3% is the norm. Your masterbatch producer will always give advice on what ratio is required to obtain the given colour, or additive strength.

A legitimate question that is often raised is whether pigment/additive concentrates give greater economy, since in relation to pigment/additive content they are always more expensive than the corresponding powdered product. Although with masterbatches the application costs are naturally higher, savings can be made in the time and energy required in the purchase of expensive dispersing units as well as labour.

In addition, the plastics processor is given greater assurance from the colouration/additive aspect, and in many cases the costs can be lowered as a result of the increase in tinctorial strength yield.

Also to be taken into consideration, is the environmental aspect of having a dust free, fully dispersed material, which can be processed on less sophisticated equipment, so that savings can also be shown to the independent compounder in processing coloured or additive compounds, as well as the injection, blow moulder, film, fibre and sheet extruder.

## Dispersion

The most effective method of dispersing pigments and additives involves compounding with a high melt index resin which is compatible with the end use material. A wide variety of equipment can be used, but in general it should provide a high degree of shear with good mixing and temperature control.

In the mechanics of mixing, the most accepted theory emphasises the threshold of flux as the most critical phase. Mixing is best accomplished at the highest level of viscosity of the polymer used. This maximum is at the threshold just beyond the point of flux. Subsequent mixing beyond this point results in temperature rise and viscosity reduction.

To be properly dispersed pigment/additives should be melt compounded, and where large scale production is required, the most common type of mixer is the internal mixer such as the Banbury.

Internal continuous mixers and twin-screw extruders are also used, as to some extent are reciprocating single screw machines such as the Buss Ko-Kneader. Other methods include high speed mixers used in conjunction with single screw extruders.

## Processing

There are several distinct stages in the manufacture of masterbatches, and these are mainly as follows:

Firstly, and most important is the colour formulation - or additive ratio, for without this, one cannot proceed. Today most competent producers use colour computers to give all the required information.

Secondly all the necessary ingredients are weighed and where necessary pre-mixed or fed to individual hoppers. In some instances, these are high speed mixed to produce a more homogeneous product.

To regulate the rate at which this pre-mix is fed to the extruder, it is necessary to have a screw fed system, matched to the extruder's output. As extruders are starve fed devices, the feeder is an important control variable.

The melt mixing stage needs to be carried out at exact pre-determined temperatures where the barrel is set to just liquefy the resin mixture. Too high or too low will give a poor shear with poor pigment dispersion.

The end masterbatch must be in an extremely consistent form to permit volumetric metering at the end user plant stage, so that sieving is necessary to ensure that no oversize or extraneous matter is present in the final granule form.

## Types of masterbatch available

Today there are a wide variety of masterbatches available, from various sources, and the following products are among those that can be found.

Antioxidants	Light stabilisers	Lubricants
Processing aids	Impact modifiers	Fillers and reinforcements
Colourants	Flame retardants	Antistatic agents
Blowing agents	Cross linking agents	Slip, antislip, antiblock agents

© Normandy R & D 1999