High-quality dispersing agents for MASTERBATCH
Products that seem to be »only« waxes at the first sight are actually high-quality, technically convincing and essential processing aids used in the production of pigment concentrates.
A range for all your needs: specialists for coloring plastics
CERIDUST®, LICOCENE®, LICOLUB®, LICOWAX®

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Theory

MECHANISM MODEL

DISPERSION

Powdered pigments are formed in production as tiny particles (so-called »primary particles«) which have a high tendency to clump together and form aggregates or agglomerates. Serious disadvantages for the processor result from this. Pigments processed in an agglomerated condition can cause several problems in the production process, e.g.:

- Variations in color shade and color intensity
- Rapid clogging of filters and spinnerets
- Breaks in fibres (spun fibre manufacture)
- Cracks in the foil
- Inadequate firmness of welded seams, coatings and/or prints

Such problems could be solved by special delivery options of treaded pigments like pigment preparations.

The efficiency of these products depend on three adjacent or consecutive basic principles – wetting, distributing/homogenising and stabilising.

- Pigment aggregates and agglomerates are broken down into smaller particles as a result of high shear forces. This is called the dispersion process. The idea is to come as close as possible to the ideal state (i.e. 100% primary particles).
- The dispersing agents stabilizes the dispersion and prevents any fine particles of pigment, formed when dispersing, from reagglomerating as well as it prevents local overconcentrations.
- When the end-product is being colored, the optimally selected and individually agreed carrier system helps the colorant to be distributed homogeneously throughout the medium to be colored. In this way, homogenous coloring or improvement of the mechanical or application properties can be achieved.

The more comprehensive the dispersion and the more even the distribution of primary particles, the better are such features as the color yield and purity and therefore the less is the risk of later blemishes in the end use (especially with thin-walled articles and spun fibres).
WETTING OF PIGMENT AGGLOMERATES
One of the most important prerequisites for a good pigment
dispersion is the complete wetting of the pigment agglomerates –
not only of the surface of the agglomerate but also of all the
particle surfaces, inside as well as outside. Only the use of special
waxes makes optimal pigment wetting possible, so that even the
fine hollow spaces between the agglomerated particles become
accessible to the dispersing agent. In order to force the wax into
the intervening spaces of the agglomerate, the regularities of the
capillary effect apply, and it is obvious that a low viscosity wax may
offer advantages in this respect compared to a higher-viscosity wax.

The polarity of the pigment, its particle form, size and surface
are important pigment-specific factors for selecting and dosing
a suitable dispersing aid as well as its thermal and mechanical
sensitivity. Above all, attention must be paid to the complete com-
patibility between the carrier system (i.e. the wax and/or polymer)
of the pigment concentrate and the polymer to be colored.

Thanks to the low viscosity, reduced by adding the wax, intensive
longitudinal and lateral mixing in the processing machine becomes
easier. Even this aspect is of great significance, since excellent
mixing are indispensable prerequisites for the effective wetting,
distribution and homogenisation of pigment and additive particles.

Viscosity Plays a Significant Role
On the one hand, the use of a certain quantity of wax is recom-
mended to significantly improve pigment wetting and distribution.
On the other hand, this measure causes a reduction in the melt
viscosity of the concentrate. Thus better pigment distribution
and increased color yield are obtained. It is generally true that the
melt viscosity of the concentrate at processing temperature must
be lower than the viscosity of the polymer to be colored for homo-
geneous distribution by the shearing effect of the polymer melt
and the easier flow.

As far as the pigment concentrate production is concerned, the
viscosity-lowering effect of waxes also provide the opportunity of
increasing the pigment concentration of preparations without any
negative results or of mixing in fillers such as calcium carbonate.
In addition, the lower melting viscosity of the wax-containing
pigment concentrates results in a significant increase in the output
of continuously working dispersing units.

Advantages of Using Waxes
In Pigment Concentrates

Polyolefins
- Good pigment wetting
- Improved dispersion
- Viscosity reduction
- Increased output
- Increase in pigment concentration

Engineering plastics and styrene polymers
- Improved surface gloss
- Improved mold release
- Viscosity reduction
- Increased output
- Reduced pigment shear
- Improved dispersion
Theory for COLORING PLASTICS

MANUFACTURING PROCESS OF MASTERBATCHES AND SINGLE PIGMENT CONCENTRATES

One of the most common manners to incorporate a colorant or additive into a thermoplastic resin was during the final part manufacturing process itself. This was accomplished by tumbling, or mixing - the colorants and additives in powder form with the resin. Alternatively, one can disperse colorants/additives directly into a liquid carrier system. The resulting product will then be premixed with a thermoplastic polymer (host polymer) with proper mixers, both powders and liquids can be directly premixed with the host polymer.

If powders are used, a problem can result from the fact that automated feeding of substances at low quantities is not easy and constant. Furthermore, the use of liquid colorants/additives is not always possible depending upon the host polymer and the process. The addition of more than two percent liquid colorants/additive to an extrusion process for film can lead to screw slippage in most cases.

Today most thermoplastic polymers are processed in a granulated form (granules, pills, cylindrical pellets) with fully automated feeding systems and the most colorants and additive concentrates are supplied in pellet form.

EXPLANATION OF MASTERBATCH

A polymer, rubber, elastomer or thermoplastic mixture in which there is a high additive and/or colorant concentration, such as rubber with carbon black, or plastic with color pigment; used to proportion additives accurately into large bulks of plastic, rubber, or elastomer. General there are three groups of masterbatches:

- Colorant masterbatches, which will be used for coloring of plastic articles
- Additive masterbatches, which will be used for the generation of special properties of end articles, like UV stabilization, antistatic, antislip, etc.
- Combination masterbatches, which contains colorants as well as additives.

EXPLANATION OF SINGLE PIGMENT CONCENTRATES

Pigment preparations where dispersions of mainly one (single pigment concentrate = SPC) or more pigments exist in a polymeric carrier system are usually described as »pigment concentrates«.
Clariant offers a complete range of the most diverse types of dispersing agents for producing pigment concentrates.

The specifications listed correspond to our latest state of knowledge and is assured by continuous quality control. In addition, we monitor other application properties which cannot be expressed as technical specifications.

This quality control assures the high level of reliability for the processing of waxes from Clariant.

**FIGURE 2: Waxes used in Masterbatch**

<table>
<thead>
<tr>
<th>Product</th>
<th>Structure</th>
<th>Drop point [°C]</th>
<th>Acid number [mg KOH/g]</th>
</tr>
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<tbody>
<tr>
<td>LICOWAX PE 520</td>
<td></td>
<td>-120</td>
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<td>LICOCENE 4201</td>
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<td>-128</td>
<td></td>
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<tr>
<td>LICOCENE PE 5301</td>
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<td>-130</td>
<td></td>
</tr>
<tr>
<td>LICOCENE PP 6102</td>
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<td>-145</td>
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<table>
<thead>
<tr>
<th>Product</th>
<th>Structure</th>
<th>Drop point [°C]</th>
<th>Acid number [mg KOH/g]</th>
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</thead>
<tbody>
<tr>
<td>LICOWAX E</td>
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<td>-18</td>
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<tr>
<td>LICOWAX OP</td>
<td>C12</td>
<td>-99</td>
<td>-12</td>
</tr>
<tr>
<td>LICOLUB WE 4</td>
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<td>-80</td>
<td>-26</td>
</tr>
<tr>
<td>LICOWAX C</td>
<td></td>
<td>-142</td>
<td>&lt; 8</td>
</tr>
</tbody>
</table>

---

- Montanic acid, ~ C30
- Fatty acid, ~ C18
- Polar function
- Amide group
## Product data

### OVERVIEW

<table>
<thead>
<tr>
<th>PRODUCT NAME</th>
<th>PHYSICAL AND CHEMICAL PROPERTIES</th>
<th>Drop point [°C]</th>
<th>Acid value [mg KOH/g]</th>
<th>Density at 23°C [g/cm³]</th>
<th>Viscosity at 140°C [mPa·s]</th>
<th>Color</th>
<th>Supply forms¹</th>
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<tr>
<td><strong>Polyolefin waxes</strong></td>
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<td>LICOWAX PE 130</td>
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<td>0.97</td>
<td>350</td>
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<td>-</td>
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<td>-</td>
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<tr>
<td><strong>Amide wax</strong></td>
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<td>1.00</td>
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<td>Powder, Micro powder</td>
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<tr>
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<td>&lt; 8</td>
<td>1.00</td>
<td>-</td>
<td>Almost white</td>
<td>Powder</td>
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</table>

* Softening point
TP * Test product
### PRODUCT NAME
### PHYSICAL AND CHEMICAL PROPERTIES

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Drop point [°C]</th>
<th>Acid value [mg KOH/g]</th>
<th>Density at 23°C [g/cm³]</th>
<th>Viscosity at 100°C [mPa·s]</th>
<th>Color</th>
<th>Supply forms^[1]</th>
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<td>CERIDUST 6050 M</td>
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<td>-</td>
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<td>CERIDUST 8020</td>
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<td>Pale yellowish</td>
<td>Micronized powder</td>
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<td><strong>Montan waxes</strong></td>
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<td>-18</td>
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<td>-20</td>
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<td>Flakes, Powder</td>
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<tr>
<td>LICOLUB WE 4</td>
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<td>-</td>
<td>Pale yellowish</td>
<td>Fine grain, Powder</td>
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</table>

There are some essential differences between masterbatch production and part fabrication. Masterbatch producers are more concerned with homogeneously dispersing colorants and additives in a concentrated form. Contrary different considerations dominate the manufacture of finished parts.

In the two-stage masterbatch production, SPCs are produced in the same manner as the one-stage process. In the first stage, the process can be optimized because only one colorant is used. A single-screw extruder often meets the needs for homogeneous mixing of ingredients in this second stage.

There are other well-known processes for the manufacturing of masterbatches which can be utilized for special requirements and alternative forms.

When using highly sensitive components one can use a twin-screw extruder with a side feeding. At the end of the process the masterbatch may be generated in form of pellets using a perforated disc and a strand pelletizer, or granules respectively micro granules using an underwater pelletizer.
In general there are two main possibilities for the masterbatch carrier systems. With so called universal carrier systems a polymer matrix is chosen that is compatible with as many resins as possible. The masterbatch can then be utilized in different polymer systems. Such carrier systems consist in the first place of waxes, polyethylene & polypropylene resins or similar polymers. Such generated masterbatches are a good alternative when it is neither possible nor economical to make use of the host polymer itself – especially when coloring small quantities of raw materials.

Nowadays plastics are often specially modified for their end application and molded parts are becoming more and more complex, so special masterbatches have to be developed. Carrier systems consist of polymer that is identical to that used by the part manufacturer. This practice is often applied for the coloration of most thermoplastics.

Unfortunately, often it is impossible to use the same polymer as carrier for the masterbatch. The selection of the carrier depends strongly upon shear sensitivity, wettability, polarity and also economics.

In addition to a highly concentrated masterbatch often melts and disperses much faster if the carrier has a lower viscosity and melting point compared to the host polymer. Masterbatch producers choose the appropriate combination of carrier and dispersing agents depending upon the requirement profile of their product in order to meet the technical requirements.

Even though pigment concentrates were primarily used in coloring polyolefins and other commodity polymer. Due to constant technological development, more efficient processing plants, new areas of application, cost savings etc, there is a daily demand for new solutions and more and more efficient and sophisticated products as a result.

Only with the aims of the pigment concentrate producer remain the same: The highest possible pigment concentration at the same time as the highest possible dispersion quality. Here the use of special waxes – in particular high quality dispersing agents – and their optimal matching with the demands of the relevant pigments, carrier systems and processing technology allows the efficient and consequent realisation of these aims.
Technology III
CARRIER SYSTEMS

Manufacturing

COLD AND HOT MIX
Dust-free and free-flowing powdered pigment concentrates are required for coloring polymer powder on processing machines. They can also offer the concentrate producer the advantage of simplified, manageable intermediates for extruding and granulating pigment concentrates. They can be easily produced with a hot/cold-mixing-combination, as it is well-known from PVC preparation.

The pigment is intensively mixed with a powdered wax, compatible with the host polymer to be colored, and is warmed up until a temperature close to the softening point of the wax is reached. If the ratio of pigment and wax has been correctly selected, dust-free, spherical and free-flowing preparation agglomerates with a diameter of between one and two millimetres are formed. In order to prevent these agglomerates to cake together solidly, only as much wax may be added as required to cover the pigment particles completely.

The agglomeration process is completed within a few seconds and can be identified by the rapidly increasing energy consumption of the mixer drive. Then, just like a PVC dry blend, the batch have to be cooled down to room temperature.

The required quantity of wax always depends on the pigment to be wetted and its surface.

QUALITY CRITERIA
The determination and comparison of pigment-dispersion-quality can be done according to
· determination of the filter pressure value (FPV) like DIN EN 13900-5 and others
· determination of the rel. color yield like DIN 55986 and others
· determination of specks and surface irregularities at a blown film (internal norm)

In general the lower the FPV the better is the pigment dispersion and the higher is the rel. color yield.

Various technologies are used in the production of pigment concentrates. Depending on the carrier system, one may distinguish between three types:

· Pigment concentrates based on host polymer/resin
· Pigment concentrates based on wax as dispersing agent and host polymer/resin
· Pigment concentrates based on wax as sole carrier
Pigment concentrates based on resin provide poor dispersion. They are produced either by mixing in the pigments in an internal mixer followed by granulation of the homogenous mixture, or by extruding the premix consisting of pigment and resin on a continuous dispersing unit (compounding extruder). The polymer which has to be colored with the relevant concentrate is usually used as the carrier resin.

Such products usually have a comparatively low pigment content and high viscosity.

The low price of such concentrates can sometimes appear to be advantageous. But when factors such as pigment use or scope of use and processing of the concentrate are taken into consideration, the apparent advantage can rapidly prove to be the opposite. As a rule, resin-based pigment concentrates can be used only for the polymer for which they have been developed. On the other hand, if the concentrate producer wants to open up a wider spectrum of use on this basis, he must develop and stock up a correspondingly large variety of types of concentrates of the various polymers.

Therefore such pigment concentrates are almost exclusively used in the commodity area or for coloring thick-walled plastic articles with a comparatively low requirement for dispersion quality.
Technology III  
CARRIER SYSTEMS

Pigment concentrates based on wax as dispersing agent and resin

Because of its high dispersion quality, efficiency and wide range of application, this type of concentrate is widely used.

In general, concentrates of this type contain between 5% and 30% wax, as long as a polyolefin carrier system is involved. With styrenics and engineering plastics, between 1% and 5% of a suitable wax is used.

By using a combination of wax and resin, the advantages of the other two concentrate types are combined. The wax component – partly used in micronized form – allows high pigment concentrations as well as a good pigment wetting and thus helps to reach a good dispersion. The carrier resin makes the handling of the concentrate easier.

Both technical and commercial advantages over the first mentioned type of concentrate can be obtained by judicious selection of both of these components and by optimal conformity to the specific demands of pigment, processing technology and areas of application.

The processing of the three components (wax, carrier resin and pigment) is carried out either in an internal mixer or after producing a premix with an extruder. The uncomplicated handling and high dispersion quality have resulted in their widespread use for the most sophisticated applications in diverse polymers.

The »breading« procedure is also possible with easily dispersible pigments and concentrates for thick-walled parts without any demand for high quality. This involves about 40% polymer, roughly the same amount of pigment and about 20% of wax being mixed in a high speed mixer until the wax softening point is reached by warming up the mixture.

Then the pigment is wetted with the wax, which makes the mixture virtually dust-free. When the temperature is raised further by about 10 Kelvin, the pigment-wax mixture forms a thin skin around the polymer granulate, with the result that the wax functions as a binder. So that the skin is not peeled or the mixture is made lumpy as a result of uneven cooling, the »coated« granulate must be cooled down gently in a controlled manner.
Pigment concentrates based on wax as sole carrier

The production of high-filled concentrates of basic pigments in pure wax provide an economical and technically convincing solution – in particular for the production of smaller quantities of pigment concentrates. These can then be mixed in accordance with the desired shade of color, blended with the polymer to be colored and diluted to a certain concentration required for easy dosage.
Besides good pigment wetting and dispersion, wax-based pigment concentrates can provide a series of further advantages:

**HIGH PIGMENT CONCENTRATIONS:**
According to the pigment and the production process involved, pigment loadings above 50% pigment content can be comfortably produced.

**WIDE SCOPE FOR USE WITH HIGH COMPATIBILITY**
More than ever metallocene-catalysed polyolefin waxes as convenient carrier enables the use of standard processing equipment to generate highfilled color and additive formulations. As example Licocene Performance Polymers (LPP) carrier are compatible with various polymers, like polyolefins and elastomers.

**LOW RISK OF PIGMENT DAMAGE**
Licocene based pigment concentrates improve process reliability as the polymer batch composition melts at lower temperatures that allows it to distribute more efficiently and provide better processability.

**LOW FILTER PRESSURE VALUE AND HIGH RELATIVE COLOR YIELDS**
LPP used as sole carrier – especially for pigment concentrates leads to highest color yields at a minimum of pigment consumption. Licocene works as a dispersing agent as well as a carrier.

### FIGURE 6: Single pigment concentrate (SPC) of Graphtol Yellow GR (50%)

<table>
<thead>
<tr>
<th>Pigment</th>
<th>Filter pressure value μm</th>
<th>Rel. color yield [%]</th>
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<tbody>
<tr>
<td>LICOCENE</td>
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</tr>
<tr>
<td>Licowax PE 520</td>
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</tr>
<tr>
<td>Licocene PP 6102</td>
<td>2.0</td>
<td>110</td>
</tr>
<tr>
<td>Ceridust 6050 M</td>
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<td>105</td>
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<tr>
<td>LICOCENE</td>
<td>1.0</td>
<td>100</td>
</tr>
<tr>
<td>LLDPE</td>
<td>0.5</td>
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<td>90</td>
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<tr>
<td>LLDPE</td>
<td>3.0</td>
<td>85</td>
</tr>
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</table>

**Extruder:** Berstorff ZE 25 x 48 D: Screw CP3 / 48 L-D, speed 500 min⁻¹, 5 kg/h  
**Temperature:** Licocene 90-140-150-100-100-120-120-120°C, Die: 130°C, LLD-PE polymer MB 120-140°C
Under the tradename Ceridust Clariant offers a wide range of micronized waxes with a particle size below 40 μm. Ceridust particles are closer in size to those of organic pigments than all fine grain or powder grade wax particles.

Finer particles give a better statistical distribution than bigger ones. The fine Ceridust particles can act as »distance keeper« between the pigment particles. The micronized wax particles, sidewise close to the pigment particles and being (almost) statistically ideally distributed, show a high likeliness to find a place between pigment particles, thus separating them from each other. Consequently those pigment particles will not form agglomerates.

When the mixture is being processed, e.g. when passing kneading blocks in the metering zone of an extruder, the distance keeping, micronized wax particles will melt right where they are. This means between the »agglomeration prone« pigment particles are coated with a fine film of wax. This kind of particle coating neutralizes the binding forces of the pigment particles, prevents them from re-agglomerating, eases pigment dispersion and, last but not least, stabilizes the dispersion.

A mixture of standard powder and Ceridust already improves the dispersion remarkably. Therefore for the first trials we recommend the use of a combination of two parts Licocene/Licolub/Licowax in powder form and one part of Ceridust as micronized-powder form.

The remarkable increase in color strength allows a possible reduction in amount of pigment. This will be the way to have economical formulation costs and a good performance without processing problems.

### Figure 7: Influence of Ceridust 3620 in LLDPE

<table>
<thead>
<tr>
<th>CERIDUST TYPES</th>
<th>APPROXIMATE PARTICLE SIZE (d_{50} μm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CERIDUST 3620</td>
<td>8.5</td>
</tr>
<tr>
<td>CERIDUST 3910</td>
<td>6.5</td>
</tr>
<tr>
<td>CERIDUST 5551</td>
<td>8.5</td>
</tr>
<tr>
<td>CERIDUST 6050 M</td>
<td>9.5</td>
</tr>
<tr>
<td>CERIDUST 8020</td>
<td>8.0</td>
</tr>
</tbody>
</table>

Formulation: 40% Pigment Red 57.1
60% - x% LLDPE (MFR 25)
x% Test product

Filter value: DIN-EN 13900-5
Filter: 25 μm
Premix: Cold mix
Color yield: DIN 55986
Recommendations for POLYOLEFINS

Pigment concentrates for polypropylene (PP) – in particular for PP spin fibres or snap-in closures for bottles

Pigment concentrates for spin dyeing must meet very high demands. Thus excellent filterability, for example, to obtain long filter lives and fine titers, is an indispensable requirement for using a pigment concentrate. To avoid any fibre breaking, the concentrates should not contain any kind of pigment agglomerates or aggregates. In addition, there must be no sweating of the carrier materials or processing aids during thermal after-treatment nor any negative influence on the physical textile fibre parameters.

At the same time, pigment concentrates used for this purpose must be perfectly suitable for the rheology of the material to be colored. There is an abundance of different requirements which can be definitively accommodated using waxes from Clariant.

For use in fine and finest filaments, when producing fibres on modern high-performance spinning machines with take-off speed of > 1500 m/min and above or when producing partially or fully stretched fibres, the use of metallocene-catalysed polypropylene waxes like Licocene PP 6102 and Ceridust 6050 M are absolutely recommended in PP-based fibres.

**FIGURE 8:** Licocene and Ceridust for concentrates and masterbatches (40% Disazo condensation in PP)

<table>
<thead>
<tr>
<th>Filter pressure value [bar/g]</th>
<th>Internal method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>10 (bad)</td>
</tr>
</tbody>
</table>

- **Formulation:** 40% Pigment Yellow 155
- **60% - x% Polypropylene**
- **x% Test product**
- **Filter value:** DIN-EN 13900-5
- **Filter:** 14 μm, 725 mesh
- **Premix:** Hot mix
- **Film note:** Clariant norm
Using Licocene PP 6102 for carpet fibres is also advantageous because, unlike polyethylene waxes, it provides the additional advantage of not adversely affecting the restoring force of the fibres. Pigment concentrates with Licocene PP 6102 and Ceridust 6050 M can be produced by means of the same processes as were specified for PE, except that the higher melting point is to be taken into consideration accordingly.

Licocene PP 6102 offers the concentrate producer the advantage of good wetting capability at the same time as high thermostability plus an improved pigment wetting thanks to its significantly lower viscosity. In addition, as far as melting behaviour and viscosity are concerned, it is obviously superior for the manufacturing of high-quality pigment concentrates.

For the fine filaments (< 10 dtex single fibre titer) in general and for high-quality fibres, finer titer and BCF yarns for soft, fleecy fitted carpeting and textile outer wear in particular, Licocene PP 6102 and Ceridust 6050 M are always preferable to a polyethylene wax. Their high thermostability, low viscosity a decisive necessity for use in spun fibre production, is only one of the positive properties resulting therefrom.
Recommendations for POLYOLEFINS

Pigment concentrates for polyethylene (PE)

Thanks to their well balanced properties, Licowax PE 520 and Ceridust 3620 are universally suitable for pigment concentrates to color polyolefins. Being a polyethylene wax, it is fully compatible with high necessary compliance with our customers’ specific demands; our service team is at their disposal for discussion. Compared with various competitive polyethylene waxes, Licowax PE 520 is characterised by its advantageous thermostability, which in practice becomes noticeable in good color fastness when melting as well as in absence of smell. Depending on pigment and type of application, the following basic recipes can be recommended:

<table>
<thead>
<tr>
<th>POLYOLEFIN [%]</th>
<th>Organic pigment</th>
<th>Carbon black</th>
<th>TiO₂</th>
<th>PE 520</th>
<th>PE resin</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>40</td>
<td>--</td>
<td>--</td>
<td>-20</td>
<td>~ 40</td>
</tr>
<tr>
<td></td>
<td>25</td>
<td>30</td>
<td>--</td>
<td>15</td>
<td>~ 65</td>
</tr>
<tr>
<td></td>
<td>--</td>
<td>--</td>
<td>70</td>
<td>--</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>--</td>
<td>--</td>
<td>60</td>
<td>--</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>--</td>
<td>20</td>
<td>10</td>
<td>--</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

**FIGURE 10:** Influence of particle size and amount of wax (30% Cu-Phtalocyanine in LLDPE) – Decrease of filter pressure value (FPV) due to finer particle size and higher amount of wax

<table>
<thead>
<tr>
<th>Filter pressure value [bar/g]</th>
<th>Internal method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Without 10 % Licowax PE 520</td>
<td>16</td>
</tr>
<tr>
<td>15 % Licowax PE 520</td>
<td>12</td>
</tr>
<tr>
<td>20 % Licowax PE 520</td>
<td>8</td>
</tr>
<tr>
<td>15 % Licowax PE 520 + Ceridust 3620 (2:1)</td>
<td>4</td>
</tr>
<tr>
<td>20 % Licowax PE 520 + Ceridust 3620 (2:1)</td>
<td>4</td>
</tr>
</tbody>
</table>

Formulation:
30% Pigment Blue 15:1
70% - x% LLDPE (MRF 25)
x% Test product
Filter value: DIN-EN 13900-5
Filter: 40 μm, 725 mesh
Premix: Cold mix
**Figure 11:** Guide formulations for engineering plastics

<table>
<thead>
<tr>
<th>Dispersion Quality</th>
<th>Standard Quality [%]</th>
<th>High Demand Applications [%]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Polyamide</strong></td>
<td>65</td>
<td>65</td>
</tr>
<tr>
<td><strong>Polycarbonate</strong></td>
<td></td>
<td>77</td>
</tr>
<tr>
<td><strong>Polyester</strong></td>
<td>67</td>
<td>67</td>
</tr>
<tr>
<td><strong>Polystyrene</strong></td>
<td></td>
<td>65</td>
</tr>
<tr>
<td><strong>Tpu</strong></td>
<td>65</td>
<td></td>
</tr>
<tr>
<td><strong>Pigment</strong></td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Ceridust 3910</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceridust 5551</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Licowax C</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>Licowax E</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Licolub WE 4</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>Licolub WE 40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Licolub WM 31</td>
<td>(5)</td>
<td>3</td>
</tr>
<tr>
<td>Licomont Cav 102</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Pigment concentrates for polyamide (PA)

For a pigment concentrate with 30% (w/w) of pigments in Polyamide we recommend a wax dosage of 3 – 5% (w/w). The use of Ceridust 5551 in combination with Licomont® CaV 102 shows the best results, Licomont CaV 102 acts also as a nucleating agent in the final article. This leads to a reduced cycle time on an injection molding article. Both products act in the final applications as a internal and external lubricant, they improve the flow of the melt and the demolding of the parts.

**FIGURE 12:** Pigment dispersion in polyamide 6 using Licowax, Licomont and Ceridust

---

**Formulation:** Polyamide 6
+ 30% Pigment Blue 15:1
+ x% Test product

**Filter value:** DIN-EN 13900-5

**Filter:** 14 μm

**Extrusion:**
Temperature: 240 -> 250 °C
Screw speed: 500 rpm
Throughput: 6 kg/h
Screw: MB 6
Co-rotating twinscrew extruder ø 25 mm
L/D= 40, cold mix
Pigment concentrates for polyethylenenterephtalat (PET)

Pigment masterbatches of engineering resins are often produced without any wax, leading to a high filter value. Adding of 3 % (w/w) wax reduces the filter pressure dramatically and increases the color yield. The recommendation for this polymer is Licolub WE 4 in combination with Ceridust 5551 (2:1).

**FIGURE 13:** Licolub and Ceridust used in PET

---

**Formulation:** Polyester + 30 % Pigment  
PV Fast Green GNX + x % Test product  
**Filter value:** DIN-EN 13900-5  
**Filter:** 14 μm  
**Processing:** Screw MB 6, 300 rpm and 8 kg/h  
**Premix:** Cold mix
For the coloring of PC it is very common to disperse without wax, the polarity of the polymer wets the pigments reasonably well. As a montan wax, Licowax E ideally combines polymer compatibility, pigment wetting, lubrication and mold release when removing injection molded parts from the mold.

The proportion of wax in the pigment concentrate on the basis of the polymer to be colored should be selected in such a way that the finished product contains 0.1 to 0.3 phr Licowax E. By using Licowax E it is possible to improve the color yield considerably, but the combination with Ceridust 5551 provides even better results.
Pigment concentrates for thermoplastic polyurethane (TPU)

Immediately after processing, thermoplastic polyurethane tends to be very sticky. As a result, injection moulded parts, for example, can be removed from the mould only with great difficulty and cause blockages when being stacked.

Extruded hoses stick together when being wind up and can not be unstuck again. Here the concentrate producer is afforded the opportunity of both improving the pigment dispersion and also counteracting specific, a.m. processing problems.

Amide waxes such as Licowax C and montanic acid esters like Licowax E are generally used as internal dispersing and release agents.
Pigment concentrates for polystyrene (PS) and styrenic copolymerisates

One solution for transparent coloring can be offered by Licowax C, which not only possesses very good wetting qualities, but is a very effective, flow-enhancing lubricant, too. Furthermore, in injection molding, it facilitates mold release, and has been awarded extensive authorisations (including FDA). These properties predestine Licowax C for universal use in pigment concentrates for styrenes and their copolymers.

Licowax E, Licowax OP and Licolub WM 31 are further alternatives. If, for example, a low molecular styrene is used as the sole carrier, Licowax E is used as a lubricant and dispersing agent in quantities of 1 – 2 %.

<table>
<thead>
<tr>
<th>POLYSTYRENE</th>
<th>~65 – 67 %</th>
<th>~65 – 68 %</th>
</tr>
</thead>
<tbody>
<tr>
<td>PIGMENT</td>
<td>~30 %</td>
<td>~30 %</td>
</tr>
<tr>
<td>LICOWAX C</td>
<td>~3 – 5 %</td>
<td>–</td>
</tr>
<tr>
<td>LICOWAX E</td>
<td>–</td>
<td>~2 – 5 %</td>
</tr>
<tr>
<td>LICOLUB WM 31</td>
<td>–</td>
<td>~2 – 5 %</td>
</tr>
</tbody>
</table>

**FIGURE 15:** Licowax C in polystyrene

Formulation: Polystyrene + 30% Pigment
PV Fast (R) Green + x % Licowax C
Processing: 40/200/185/170/160/175/190/200
Screw MB 3, 300 rpm and 8 kg/h

Recommendations for STYRENIICS
The usual precautions to be taken when handling chemicals should be observed. Safety data sheet can be supplied for each individual product upon request. When handling organic powders the domestic regulations must be observed in order to prevent dust fires and dust explosions.

**TOXICOLOGICAL AND ECOLOGICAL PROPERTIES**
For data on toxicological and ecological properties of the product groups mentioned, please refer to the relevant safety data sheet or the corresponding product data sheet.

**STATUS ACCORDING TO THE EUROPEAN CHEMICALS LAW (REACH)**
The products mentioned in this leaflet or the monomers are either pre-registered, registered or as polymers exempt from registration (EC 1907/2006).

**TECHNICAL DATA**
For further information on the physical and chemical properties, detailed application and packaging of our products please refer to our product data sheets, our various application brochures and product flyers.

**STORAGE**
The products described in this leaflet have a minimum shelf life of two years after delivery when stored in a dry place at room temperature.
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