Economical and High Quality

Lower Consumption with Newly Developed Combination Masterbatch

A novel color-additive combination masterbatch for ABS plastics in automotive applications allows reduced consumption rates compared to the products used in the past. In addition, the new development has better UV stabilization together with outstanding mechanical properties. The use of this masterbatch solution permits cost savings for raw materials purchasing of up to 30 %, while retaining the required high quality standard.

A newly developed color-additive combination masterbatch economically protects plastic surfaces against yellowing

(figures: Grafe)

Plastics products in everyday use are subject to a wide variety of chemical and physical influences that limit their service life. This is mainly caused by the decay of their mechanical properties due to aging. In particular, the aging induced by UV radiation results in a change of the visual appearance. Plastic surfaces exposed to sunlight therefore change color over time.

Aging and degradation processes are initiated by UV-A and UV-B light, via photooxidation. All surfaces that are directly exposed to light are irradiated with UV. Surfaces in shaded areas are protected against radiation. Window glass also protects the surfaces against the aggressive UV radiation, however UV-A radiation is transmitted. As a result, the plastic surfaces yellow, and colored surfaces appear faded, or the plastic becomes brittle (**Fig. 1**). In the process, the part loses its mechanical properties. In recent years, the automotive industry has continually increased its requirements for UV resistance.

Auto manufacturers strive to give vehicle interiors a high-quality overall appearance and maintain it over the entire service life. To realize this, it is necessary to achieve a high degree of color constancy. In the automotive industry, there are therefore a range of proprietary standards that describe the permissible color shift over a defined service time.

Stabilization for Maximum Color Constancy

When radiation encounters a surface, it may be reflected, absorbed or transmitted. The radiation component absorbed by the plastic can trigger various photochemical reactions. This chemical aging of plastics and the resulting color change cannot be entirely prevented. Instead, the aging process is slowed by the addition of UV stabilizers. Different mechanisms

are exploited. For example, UV absorbers absorb the high-energy UV radiation and emit the absorbed energy in the form of heat, while HALS stabilizers prevent rapid molecular chain degradation via a range of chemical reactions.

The additives used for stabilization are usually not completely colorless, so that the addition of additive masterbatches often has a slight influence of the color of the end product. For this reason, part manufacturers often make use of combination masterbatches that contain both coloring and stabilizing components. The color effect of the stabilizers is already taken into account in the pigmentation.

A combination masterbatch poses a particular challenge to masterbatch manufacturers. The combination of viscous plastic melt, low-viscosity additives and powder pigment must be converted into a homogeneous pellet stock by means of a stable manufacturing process. The carrier polymer is as highly filled as possible to permit a low concentration of the masterbatch in the application. Since every formulation can only be filled up to a certain extent, a combination masterbatch requires a higher dosage compared to the pure color masterbatch. A defined amount of active substance in the end product is required. It is essential to maintain the specified dosage.

Fig. 1. Plastic components with (right) and without (left) a UV additive

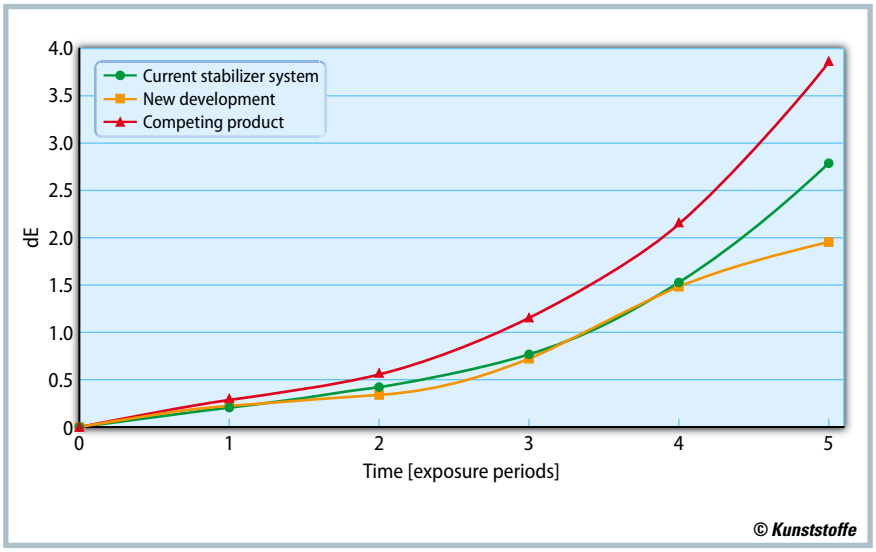

Fig. 2. Comparison of accelerated aging according to the automotive standard of the standard product, the combination masterbatch with higher dosage and the newly developed combination masterbatch

Concentration of UV Additives Reduced

The reduction of the concentration of masterbatches is an ongoing goal of development work, with two approaches: The first is to increase the degree of filling of the masterbatch. Here, however, process limits are reached quickly, which prevent the manufacture of a homogeneous pellet stock. The second approach is to develop a combination of active substances that obtain the same effect with a lower concentration in the final product.

For example, by continuously improving existing formulations, using novel UV-stabilizing additives and selective- »

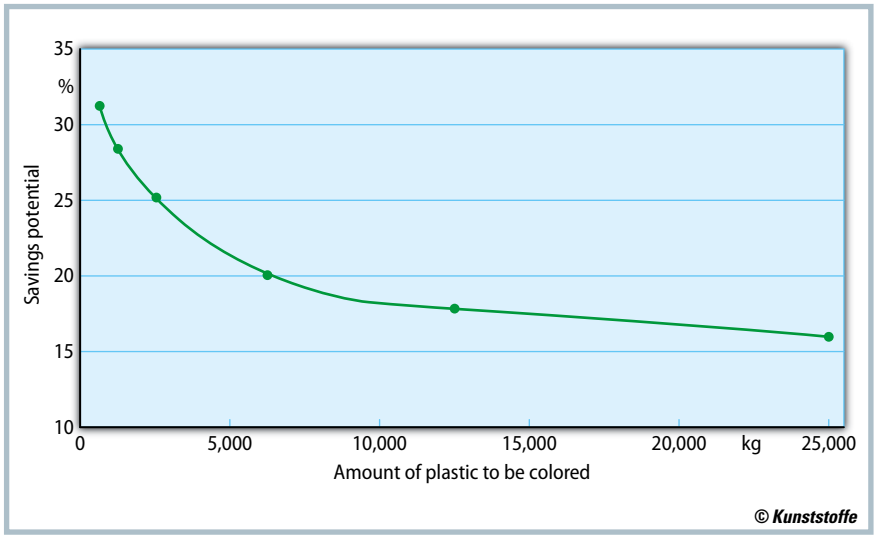

Fig. 3. Volume-related saving potential from reduced UV additive in the newly developed combination masterbatch

Fig. 4. The Suntest instrument is used for preliminary weathering testing in the applications-oriented development masterbatches and plastic compounds

UV Radiation

UV radiation is a component of sunlight; however it can also be generated by artificial radiation sources. In practice, the rays are subdivided into UV-A (315 to 380 nm), UV-B (280 to 315 nm) and UV-C (far UV: 200 to 280 nm). This shortwave violet radiation is imperceptible to the human eye. The shorter the wavelength of the UV radiation, the higher its energy and the more intensive its effect is. Visible radiation in the range from approx. 400 to 720 nm is very important for many chemical and technical processes. Its existence as a component of sunlight is essential for the existing ecological balance, and its effect in breaking down atmospheric pollutants is essential for our civilization and for life on Earth. UV-C radiation is almost completely absorbed by the ozone present in the atmosphere. UV-B light, by contrast, is only partly absorbed and UV-A light is largely transmitted by the atmosphere in clear weather conditions.

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ly exploiting synergies, the Grafe Group succeeded in reducing the concentration of UV stabilizers in the end product and thereby reducing the required dosage (**Title figure**). A combination masterbatch for a light-colored ABS application, which manages with a lower dosage, offers a higher degree of color stability and meets the requirements of the automotive manufacturers' current standards, is currently in the final sample inspection phase. The color deviations of a standard product, of a combination masterbatch in a higher dosage and of the new development were determined by accelerated weathering in accordance with automotive standards. **Figure 2** shows the comparison. The new development is still within specifications even after five exposure periods. Further polymer-specific and color-specific solutions are currently under development.

Summary

For the user, this results in a considerable cost saving potential of up to 30 % (**Fig. 3**), which is shown in the form of increased efficiency and improved competitiveness. However, the aging process of plastics is extremely complex and is the result of a wide range of different influences. It is therefore always necessary to assess an application in customer-specific colors and plastics by means of preliminary tests. The applications oriented development and optimization of masterbatches and plastic compounds with improved light protection properties at Grafe includes preliminary weathering tests with the Suntest instrument (**Fig. 4**) and the accelerated weather QUV test. The effectiveness of the masterbatches was confirmed by an accredited institute. ■