CURRENT TECHNOLOGY

Correctly colouring and conditioning

Bioplastics

TREFFERT®

Colour follows function

What are bioplastics exactly?

The terms ‘bioplastics’ and ‘biopolymers’ are not yet protected and as a result they are not used consistently. In general, however, they are used to refer to plastics made predominantly from renewable raw materials. Bioplastics may be biodegradable, but do not have to be. If they are not, they may be attractive to industry as plastics with a longer service life.

How long have bioplastics existed?

Bioplastics have been around for a very long time. The first industrially produced plastics were based on cellulose, which is extracted from plants such as cotton. As early as 1869, the Hyatt brothers produced the bioplastic celluloid in the USA, and a few years later cellulose film, better known by its trade name cellophane, began to be mass-produced. However, the discovery at the beginning of the 20th century that plastics could be manufactured from crude oil led to the rapid supplanting of bioplastics, which remained on the back burner for many decades, since producing plastic from crude oil was significantly cheaper. It was not until the 1980s that rising crude oil prices, coupled with gradually emerging ecological awareness, led to interesting new developments in the field of bioplastics.

Significance of bioplastics for plastics demand

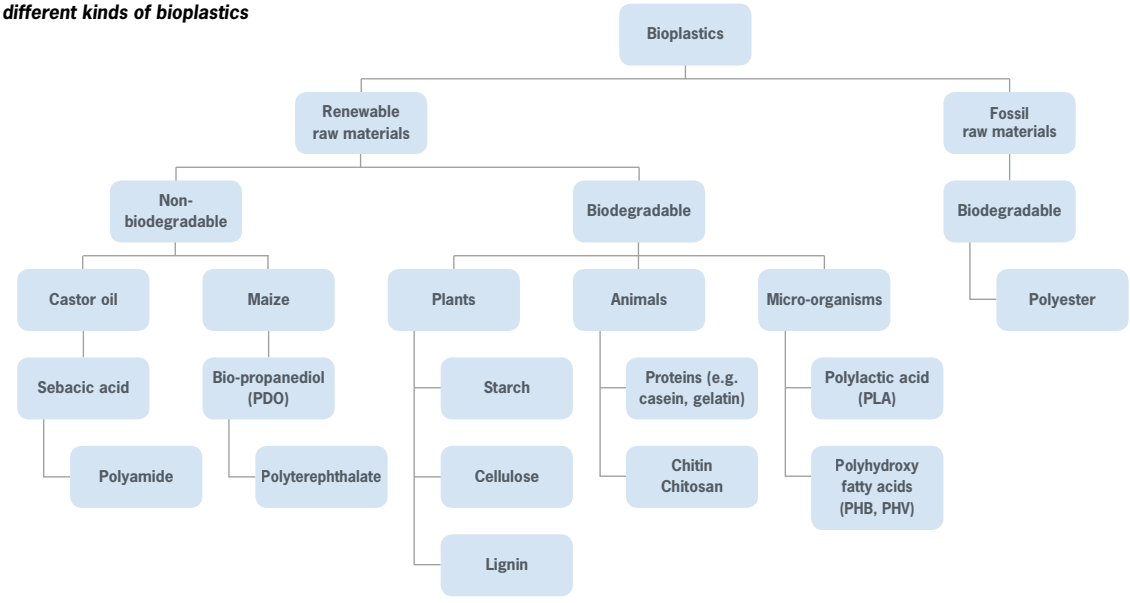
Worldwide demand for plastics is currently around 225 million metric tons per year and growing. At around one quarter, Europe accounts for a major portion of this demand. The fact that plastics can have so many different properties makes them the material of choice for many everyday products. To date, bioplastics have only been manufactured in very small quantities, and at 900,000 metric tons their 2011 share of the worldwide plastics market remains minimal. However, their importance is growing rapidly and consistently, because in many applications bioplastics can replace plastics hitherto produced from crude oil. A lot of packaging, cutlery, products for medical use and other products with a short service life are already made from bioplastics because their potential biodegradability gives them a key advantage over plastics with little or no biodegradability. These levels of biodegradability are defined by various standards. The European standard, for instance, permits a maximum of five per cent non-biodegradable materials and a maximum concentration of one per cent of any filler used. Further restrictions concerning the proportions of other substances, metals in particular, also have to be borne in mind.

Bioplastics for long-life products

As material properties such as durability and degradability can be controlled during manufacture, bioplastics are also attractive for the production of long-life items, and because of this bioplastics are already used to produce such things as keyboards, shoe heels and plastic cases for electrical appliances.

Unlike fossil raw materials, bioplastics are classified as largely carbon-neutral since the plants from which they are produced only release the CO_2 that they absorbed while they were growing. Bioplastics are especially sustainable if they can be put to what is known as a thermal use at the end of their lifetimes. Alongside these environmental benefits, their greatest value lies in the fact that they reduce our dependency on crude oil, supplies of which are increasingly scarce and associated with ever more hazardous extraction processes.

The different kinds of bioplastics



Colouring bioplastics

Alongside its function and quality, a product's design plays a key role in its commercial success, and the colour scheme in turn represents an important element of that design. Colour is an individual sensory impression created by the light perceived by the eye. Objects do not radiate their own colour, but rather a light source is always needed, and the spectral distribution of wavelengths radiated by that light source creates the illumination. Objects reflect a portion of this light back, and it is this that impinges on the eye of the onlooker and is perceived as colour. According to the German DIN industrial standard, colour is a sensory impression allowing the eye to distinguish between two adjacent areas. In industrial colour laboratories, colour is viewed not as an absolute value, but rather as a comparison between a coloured product and a defined reference colour.

Enduring elegance: the heel of a woman's shoe, made of bioplastic.*

The term 'colouring agent' denotes a series of coloured substances that affect a material's appearance. Two kinds of colouring agent are used to colour plastics: pigments and dyes.

Pigments may be either organic or inorganic in structure and are insoluble both during processing of the plastics and in the end product. Organic pigments normally possess greater colour strength but lower opacity than inorganic pigments. Other factors influencing colour strength are particle size and dispersion in the plastic matrix.

Dyes, on the other hand, are organic molecules that dissolve into the substrate to which they are applied. As a result there are no visible particles and the material's transparency remains unaltered. Over the years, many colouring agents have been developed for both standard and engineering plastics, but the suitability of these colouring agents for colouring bioplastics has to be researched separately for each polymer type.

Using engineering bioplastics

Today engineering plastics designed for demanding mechanical use can be replaced by a new group of engineering bioplastics. These materials are not biodegradable, but their monomers are based on renewable raw materials such as castor oil, maize or wood. When colouring engineering bioplastics such as polyamide 6.10 (which is made up of 58% renewable raw materials), polyamide 10.10 (98% renewable raw materials), polyterephthalate, lignin-based polyester and many others, virtually the same rules apply as for colouring 'normal' engineering plastics.

Like conventional plastics, engineering bioplastics can be joined and/or marked by laser. To be suitable for laser welding, the materials used must be laser-transparent or laser-absorbing, while laser-marking technology uses special materials that are optimised for either light or dark inscription. All this can be accomplished via the colour and function formulae used by Treffert polymer technology.

However, a few limitations have to be borne in mind regarding biodegradable plastics such as PLA and cellulose, which are often used in packaging materials. Prevailing European standards limit the permitted concentrations of some substances, in particular metals, and the maximum permissible concentration of these metal ions can influence dye formulae. One example: the concentration of phthalocyanine pigments is limited by the copper concentration of 50 ppm. As a result, the maximum permissible proportion of blue pigment is 15:3 (B.P. 15:3) and of green pigment is 7 (G.P. 7), figures well below the concentrations normally used in dye formulae.

Bioplastic terrace flooring: stable, long-lasting, attractive and easy to clean.*

Master batches and bioplastics

Given the need for good dispersion in order to achieve high colour quality, the way in which the dye is delivered to the processor is hugely important. In master batches or concentrates, pigments and dyes and/or special additives are optimally distributed in a carrier in high concentrations. The plastics used here should match the material to be dyed.

What applies to fossil raw-material polymers is equally applicable to bioplastics, which can also be used as carriers for colour concentrates. The processor can fully exploit all the benefits when using master batches. As almost all plastics have their own colour, the plastic itself is always part of the colour formula, which is why Treffert not only develops its own formulae for all colours but also adapts the colouring agent to each specific bioplastic. Master batches for colour and function are always manufactured specifically to customer requirements.

The future of bioplastics

The importance of bioplastics is certain to rise steadily over the coming years, in tandem with a steady fall in crude oil reserves. Meanwhile, experts say that crude oil prices are only going to go one way: up.
Bioplastics, and in particular engineering bioplastics, already represent an environmentally sustainable alternative to plastics made from fossil raw materials, and continuing technological development plus ever-growing production volumes mean that bioplastics will soon provide an economical alternative that does not entail any compromise in the quality of the end product.

Blending in with the environment: the frame of a forest information board made of weather-resistant bioplastic.*

The Treffert Group:
Colour follows function

Virtually all the same rules apply for the colouring of bioplastics as for fossil materials. We have applied this rule at Treffert for over 80 years, and do so now as much as we ever did: colour follows function.

At our sites in France and Germany, we develop colour systems, master batches, additives and compounds for medical technology, the automobile industry, the electrical industry and many other sectors in which engineering plastics and bioplastics are used. We supply products developed for specific customers, from the smallest amounts to volumes running into tons. One strength of our business that is particularly appreciated by our customers is our acceptance of orders involving high levels of development work and technical advice.

** We would like to thank the companies TECNARO and KOSCHE for their kind support with products.*

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Colour follows function

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