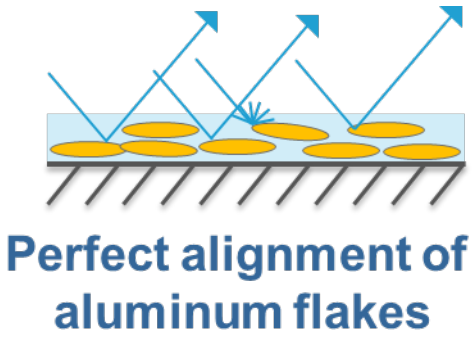
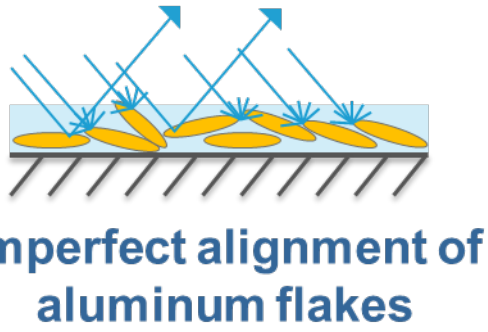
What paint can do – Part 3

In addition to pure color pigments, there are also special-effect pigments. A very prominent type of effect pigment is a metallic effect. Here, small aluminum flakes in the paint act as mirrors that specifically reflect the light rather than scattering the incoming light in all directions, as is the case for most color pigments. If these mirrors are aligned directly in front of the viewer, the light is maximally reflected in the viewer's direction and the area appears to be very bright. If the mirror surface is tilted away from the viewer, fewer rays are reflected in the direction of the viewer and the area makes an increasingly darker impression. With ideal alignment of these many minute aluminum "mirrors" parallel to the car's surface, some surfaces appear darker and others lighter. The special design of a body can therefore also be additionally highlighted by this "flip-flop effect".





If the flakes are unaligned, there will be more scattering effects at the edges, which diminishes the difference between the light and dark areas.

In addition to the metallic effect, there are pearlescent effects that mimic the shimmer of pearls that appear to come from inside, along with interference colors that appear in a different color depending on the viewing angle.

Extenders are paint components that are very similar to pigments but are transparent. While they are also powder-shaped and insoluble, they do not have a decorative purpose, but rather

enhance other properties, in particular mechanical properties such as sandability and stone-chipping and corrosion resistance.

Additives comprise a rather small but very important group of components in the paint formulation. They serve as the "pharmacy" of the paint, since in many cases just a few drops of a particular additive are enough to "heal" a paint's "disorder". The range of uses for additives is virtually limitless. There are additives that enhance the distribution of pigments or prevent them from settling or prevent the paint from foaming. Other additives improve the surface of the paint film, accelerate the baking process or offer protection from UV light, fungi or bacteria.

An important paint property that can be controlled by additives is flow behavior, referred to as rheology. When the paint is sprayed, it is subjected to high shearing forces and for optimal application, should have the lowest possible viscosity. When it is at rest, however, it is better if its viscosity is higher, since this makes it less susceptible to settling of the components during storage and keeps it from sliding off the body while it is still wet. At rest, a rheology additive establishes certain interactions that can be temporarily destroyed when there is high shearing.

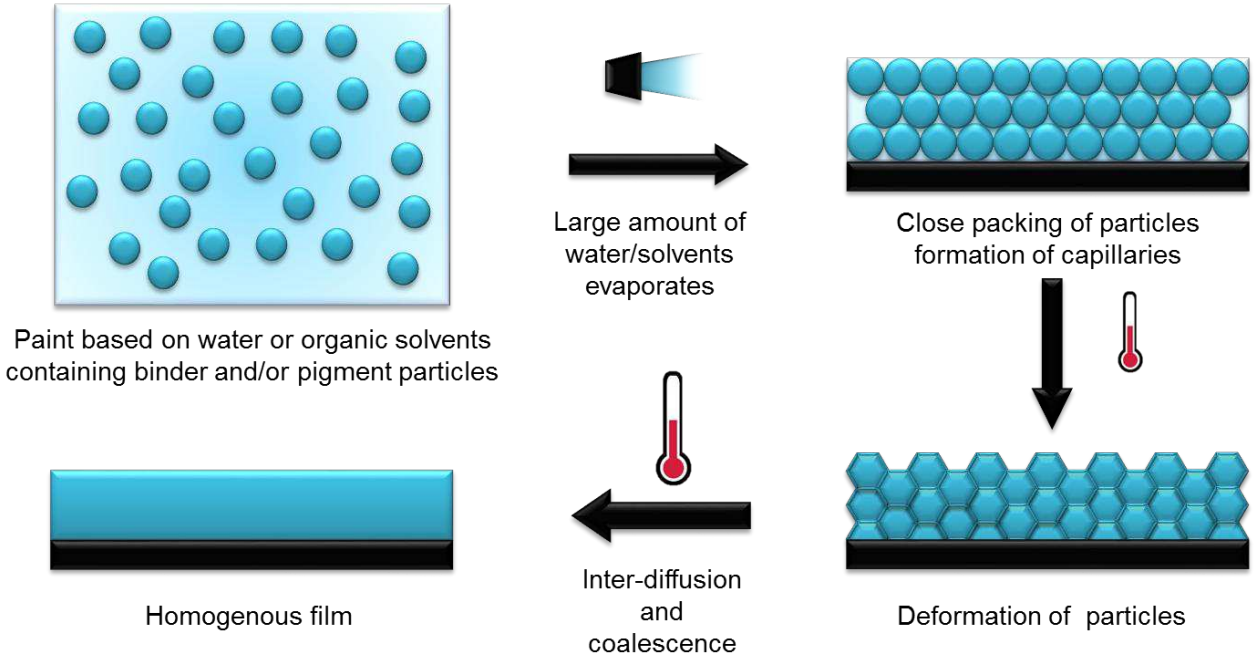
In general, a paint contains all kinds of ingredients that all contribute specifically to its properties to different degrees.

Paint formulation

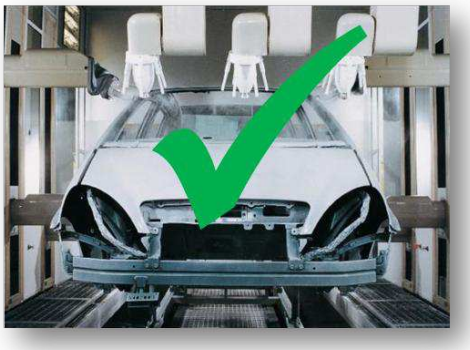
A paint cannot be reduced to the sum of its components, however. As with a recipe for the kitchen, the quality of the raw materials, as well as the order of the steps and the processing of the individual components, are important factors for the later properties. For instance, not only do insoluble components need to be integrated into a fluid system; some substances also have to be married that otherwise would not be able to be mixed at all. The interactions among different components – up to 50 of them in some cases – are complex and often difficult to analyze. For this reason, experience is also a crucial factor for developing and optimizing paint systems.

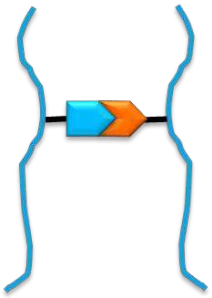
Paint application

When paint is applied to an object, it gradually changes. During the application, large quantities of the solvent or water already evaporate, so that the remaining paint components then have to move together more closely and interact. A film begins to form. If the temperature is now raised, some ingredients join together, causing the individual particles to become deformed and finally combine into a uniform film.

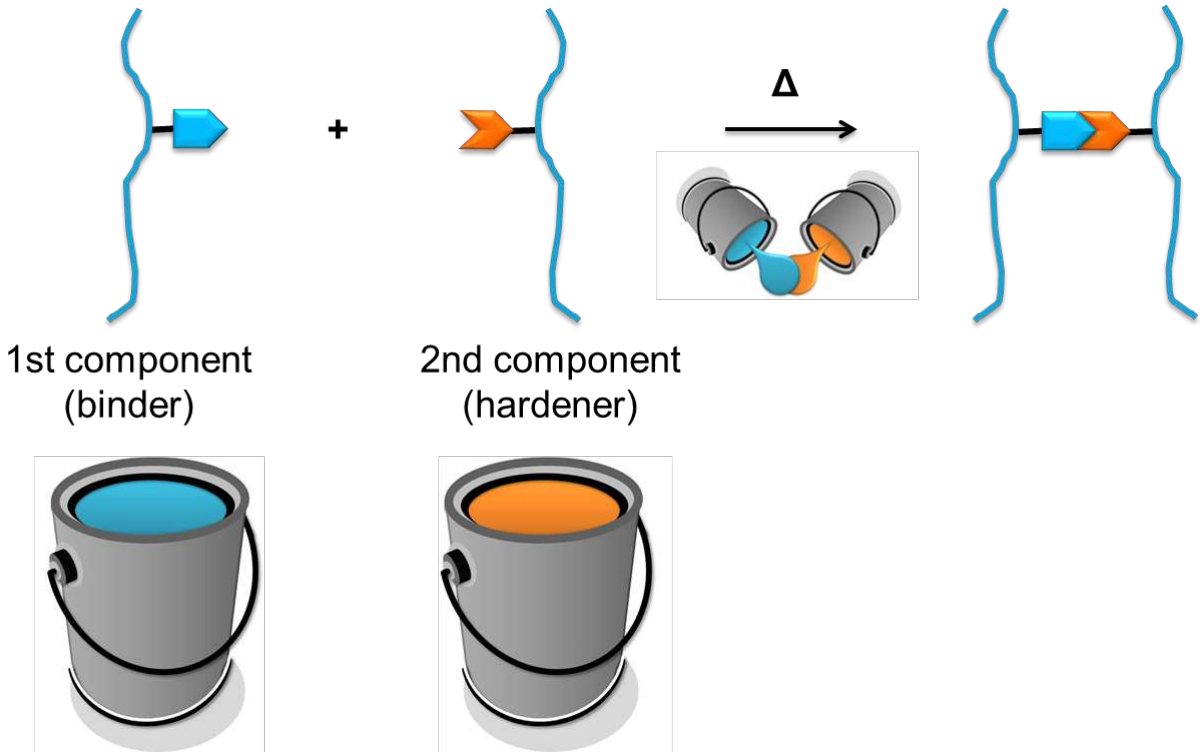


During the baking process, after the melting, cross-linking takes place between the binder and the hardener. For this, very reactive systems are preferred that do not require particularly high temperatures or long baking times. The particular challenge involves keeping these reactive components from reacting until the reaction is needed and not before – in other words, during storage. A paint formulation that is already chemically cross-linked would be highly viscous and no longer sprayable. Highly reactive systems are not very stable and vice versa. These two properties must thus be well balanced.

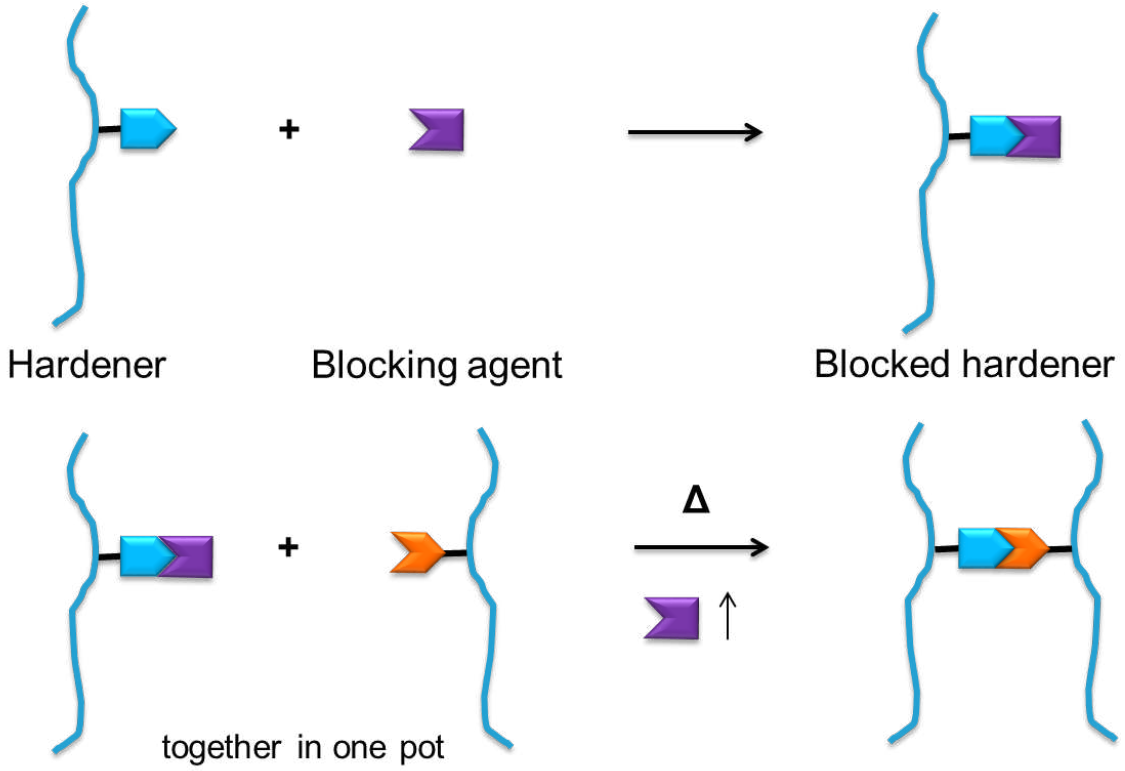




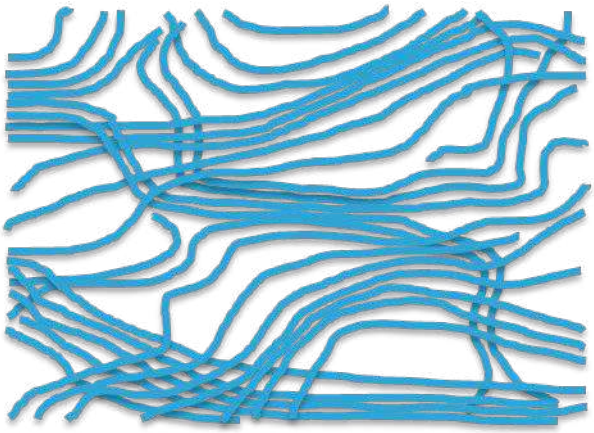
In order to achieve this, two options are basically available. For two-component systems, the binder and hardener are stored separately and are not mixed until just before application. The advantage of this option is that highly reactive components can be used. The downside is the higher storage and mixing efforts. This technology is mainly used for automotive refinishing.



If you want to store reactive components as a mixture, you have to use a trick. This involves combining the hardener in the paint with a blocking agent prior to use, which initially contains its high reactivity. This allows it to be combined with the binder and be stored in a container. The blocking agent does not evaporate until during baking, which permits the reactive group to now react with the binder. This approach often makes the components somewhat more costly, since it involves an additional step. However, it offers the advantage that the storage and mixing efforts are lower. This is the classic technology used in automotive OEM coating.



In addition to the chemical cross-linking reaction, physical drying also always takes place during baking. In so doing, the individual polymer chains loop around and become entangled, giving rise to an additional network that, however, is somewhat less robust. For some applications, this physical drying is already sufficient, however.



Innovations

In general, paints are very sophisticated high-tech systems that have continually improved over time. So you might wonder whether any more research is even necessary. In fact, there are numerous requirements that will also make innovations in the paint sector necessary in the future.

One reason is the increasing demand for improved quality, such as even better resistance to scratches or environmental impacts. At the same time, the application processes are also changing, becoming shorter and more efficient, so that the paint systems also have to be adapted to them.

The very first cars were only available with paints and coatings from the coach era. Since then, a lot has changed, and the desire for ever more individualized design has culminated in a veritable explosion of different colors. This means that paint systems have to be prepared that will also withstand the future expectations for appearance without simultaneously increasing complexity.

This complexity is, after all, a high cost factor. In order to stay competitive in the long term, both car and paint manufacturers have no choice but to continue to scrutinize their own processes and adapt them as needed. This also impacts the paint composition and production.

The bottom line is the desire for sustainable products that save energy and resources and, at the same time, can be produced and applied under safe working conditions. This desire is driven not just by legislation, though. Promoting sustainable solutions is also an important impetus for research and development in the area of paint systems.

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