Why Some Rotomolded Tanks are Black in Color
Carbon Black and Plastics

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1- Introduction:

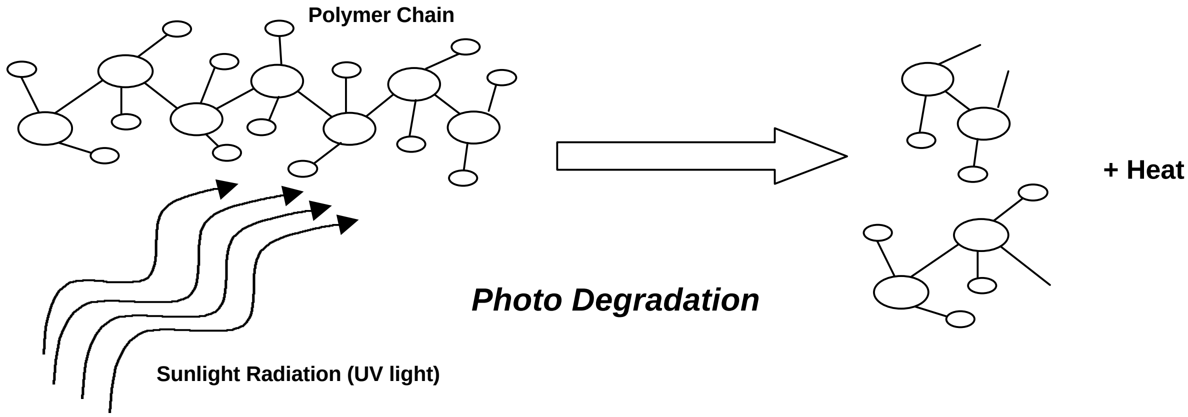
Rotomolded tanks come in a wide variety of colors or pigments. The choice of which color to use will generally depend on one, or a combination of, the following; cosmetics, customer requirements, and application or stored medium. One color that has been continuously specified for higher end applications, such as outside storage of sodium hypochlorite, is black. This color is usually achieved by dry blending carbon black with the primary powder resin prior to molding.

Carbon black (CB) is a form of nearly pure, elemental carbon. It differs in molecular structure from the more common forms of elemental carbon – graphite and diamond – and therefore also differs in physical properties. Carbon black is softer than either graphite or diamond and is intensely black in color, although the color does vary slightly depending on the manner in which it is made, the contaminants that are present, and the particle size. Carbon black is manufactured by burning hydrocarbon fuels in a controlled manner with insufficient oxygen for complete combustion. It is like the soot that forms around the top of a glass chimney of a kerosene lantern. In fact, kerosene is the most common hydrocarbon used in the manufacture of carbon black.

Carbon black has many applications in plastics. It is used as a pigment, conductive filler material, particulate reinforcement, and ultraviolet light (UV) absorber. In rotomolded tanks CB is used both as a pigment and as an ultraviolet light absorber. Carbon black has proven to be the standard against which all other pigments, such as forest green and white, and other UV absorbers are compared.

2- Weathering of Plastics:

All materials absorb sunlight radiation – it's what makes them heat up in the sunshine. While the effect of sunlight is minimal beyond just simple heating in many materials, some other materials are actually degraded by sunlight. Most plastics are in this latter group. Studies of the degradation of plastics by sunlight have shown that sunlight is a spectrum of frequencies and that the most destructive frequencies for plastics are those at the higher energy end of sunlight – in the ultraviolet range of the spectrum. The absorbed UV light breaks, or cleaves, the weak chemical bonds or molecular chains of the polymer material. This leads to shorter chains, which in turn causes the plastic material to become more brittle. This process is called, photo degradation, and it leads to loss of mechanical properties and/or discoloration, cracking, fading, and chalking. In other words photo degradation leads to weathering of plastics.



3- UV Stabilizers:

In order to protect outdoor plastic products from the damaging UV light, the plastic needs to be shielded from these harmful rays. Of course shielding from sunlight using some umbrella-like shading system is often impractical and could be very expensive. Therefore, a simple, inexpensive method is desirable and that system has been found with internal stabilizers. These stabilizers, an example of which is carbon black, are added to the plastic before molding. The stabilizers absorb or screen out the damaging UV light and transform the energy of the rays, the UV light, into heat, which is dissipated harmlessly throughout the product.

The typical failure point for general purpose is when the property of interest, in this case tensile strength, falls below 50% retention. Research and experimental data has shown that the natural material (no color added) falls below 50% in less than 6 months exposure. This can be compared to carbon black which shows that even after 30 months exposure, the product is still well above the 90% retention value, see figure 1. This clearly illustrates the effectiveness of carbon black as an excellent UV stabilizer.

Most of these colorants would also have a UV screening agent added to assist in protecting the plastic material. While these UV screening agents are quite effective, they can be costly and are usually less effective than carbon black by itself.

Even though black tanks tend to have a higher overall temperature than light or white tanks, the UV protection from carbon black outweighs any temperature effects, as demonstrated by the superior retention of properties upon exposure. The benefits gained in extending the life of the tank and reducing the possibility of catastrophic failure due to the degradation of the plastic, make carbon black the preferred pigment, especially for higher-end applications, such as the storage of harsh chemicals like sodium hypochlorite.

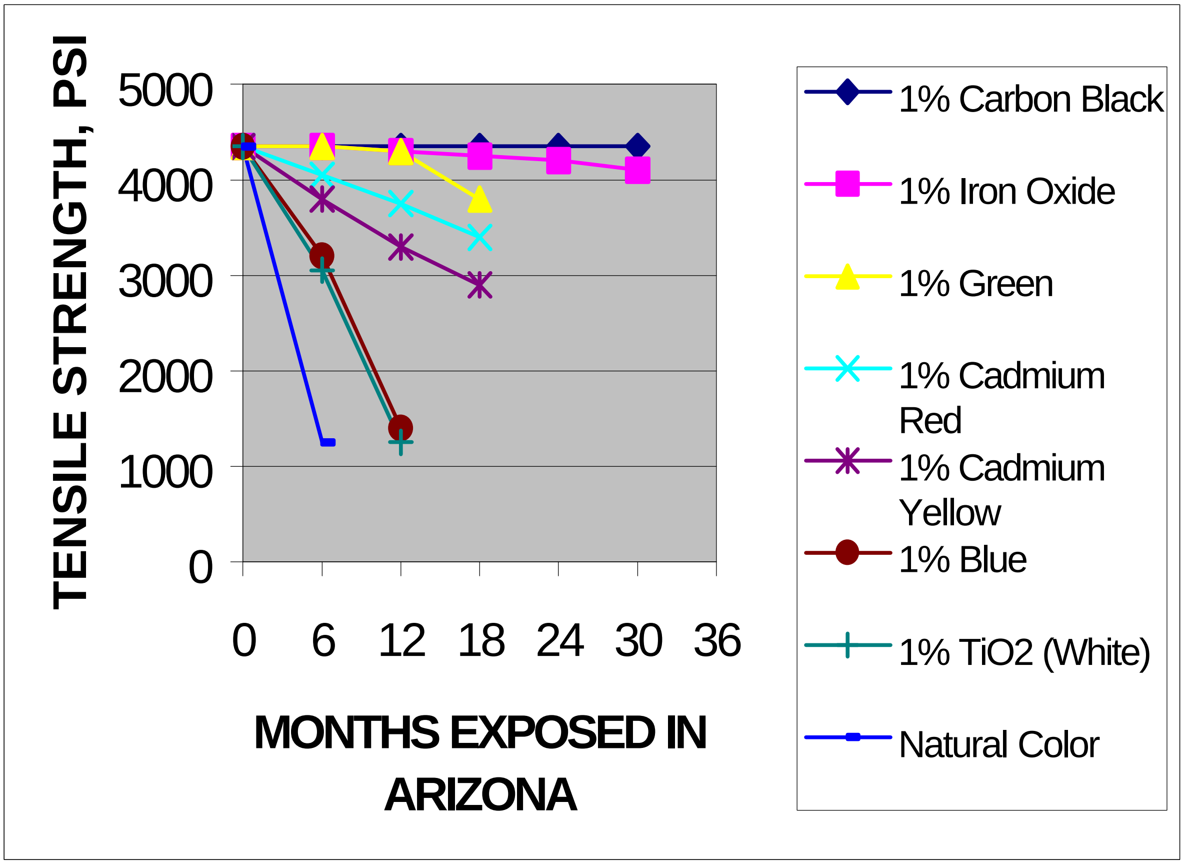


Figure 1: Effect of Pigments on UV stabalization of HDPE PE resins.

Source ExxonMobil "Tip from Technology, UV Effect on Polyethylene"

4- UV Index:

One method to gauge or quantify a UV stabilizer's ability to prohibit UV degradation is to give it an UV-X index value or rating. The larger the X value, the better the UV protection is and the longer the plastic material can be exposed to UV light without significant loss in its mechanical properties. To determine the UV index, the plastic product/material is exposed to simulated environmental conditions in a Weather-O-Meter. When the chosen mechanical property for evaluating the performance, elongation at break or tensile strength, reaches 50%, the X value is established and is usually expressed as a multiple of 1000 hours of exposure. For example, a material having an X value of 8, UV-8, means that it withstood 8000 hours of exposure to UV light before the elongation at break was reduced to 50% of the original value.