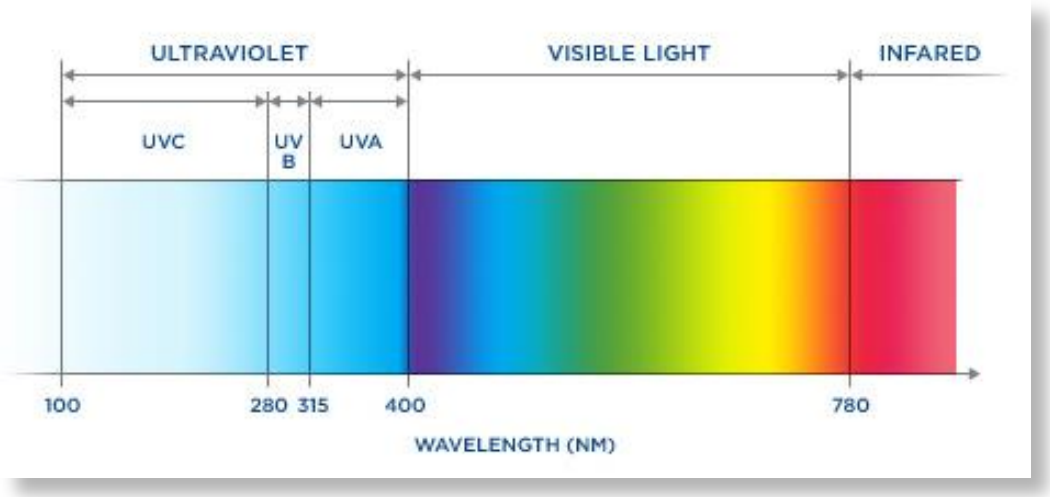
Light Stabilizers

Counteracting the damaging effects of UV radiation.

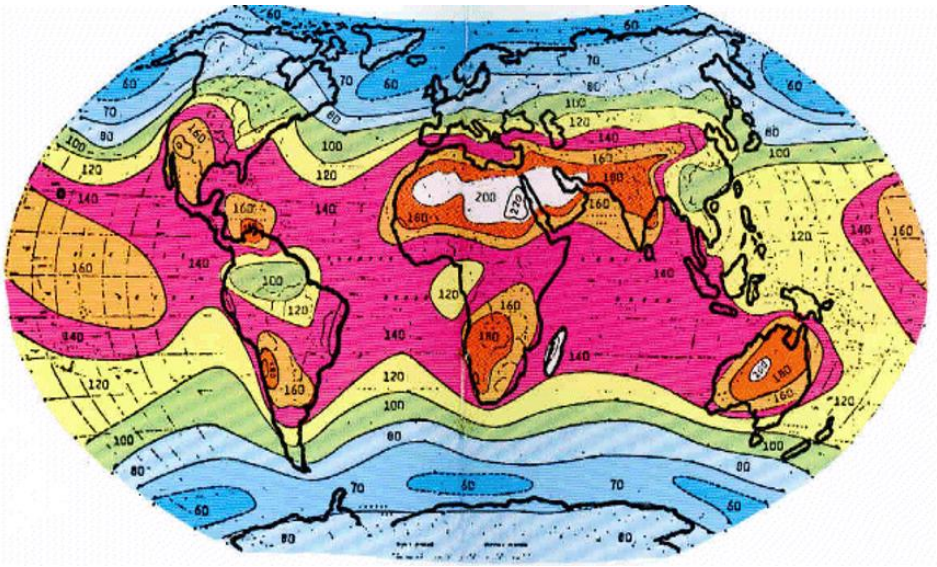
Summary

Exposure to sunlight, as well as artificial light sources, can adversely affect polyolefin products and package contents. UV radiation can break down the chemical bonds in a polymer as well as damage food, beverage, pharmaceuticals, and non-perishables. This process is referred to as photo-degradation which will ultimately cause cracking, chalking, and the overall loss of physical properties such as impact strength, tensile strength, elongation, and other properties. Light stabilizers (UVI & UVA) help protect polymers and their contents from these degradative effects of exposure to sun and weather. In some cases light from artificial sources are detrimental as well.

Ultraviolet Radiation constitutes the wavelengths of light below the visible portion of the spectrum. You cannot see or feel it, but there's enough energy to burn skin and damage bonds in polymers.



Annual sun radiation energy reaching Earth's ground depends upon geology as well as climate and weather patterns. The Sun's radiation energy is typically expressed in Kilolangley [kLy] units and varies across the Earth which can be seen below.



Product Overview

To counteract the damaging effects of UV radiation, there are two major types of light stabilizers available. These stabilizers can be categorized into two general classifications. One group of stabilizers absorb UV radiation and are called UV Absorbers (UVA) while the second group of stabilizers do not absorb radiation but rather inhibit that radiation. Chemicals in the second, more diverse group are generally referred to as UV Inhibitors (UVI) and are also known chemically as Hindered Amine Light Stabilizers.

Ultraviolet Absorbers (UVA): UVAs slow down the degradation process by absorbing harmful UV radiation and dissipating it as thermal energy. This ability results in their widespread use as a UV filter e.g. protecting what's behind the plastic. UVAs are sacrificial so the gauge and expected lifespan of the protected product must be considered when making a recommendation. A typical minimum gauge of 6-8 mils is required for traditional UVAs to perform efficiently however there are newer chemistries which can perform at lower gauges. There are two main UVA chemistries which are predominant today:

- **Benzophenones** are the least effective and yield an undesirable yellow tint. Due to their cost-effective economics, they are still in limited use.
- **Benzotriazoles** are very effective and widely used. In thick section applications, they may yield a slight yellow tint.

Ultraviolet Inhibitors (UVI) / Hindered Amine Light Stabilizers (HALS): HALS are the most effective of the light stabilizers to protect polyolefins. They are available in a wide range of molecular weights and structures suitable for almost any application. They do not absorb UV radiation but instead they act to inhibit degradation of the polymer which has already formed free-radicals. Their ability to inhibit the auto-oxidation cycle has led to their labelling as UV inhibitors. HALS are for the most part colorless, highly efficient at low concentrations, and come in synergistic blends.

The gauge of the product, geographic location of exposure, and the chemical environment are the most critical factors in recommending the type and amount of HALS. The chemistries available are differentiated by volatility, migration characteristics, and chemical resistance.

There are three main types of HALS chemistries:

- **NR/NH**
  - The most cost-effective general purpose HALS suitable for a wide range of applications
- **NR**
  - High molecular weight HALS with low volatility and high migration resistance. These are preferred for color critical applications such as PP fiber.
- **NOR**
  - The most chemically stable and least reactive HALS for chemically severe environments, mulch film, pool covers, etc.

Representative Product Applications

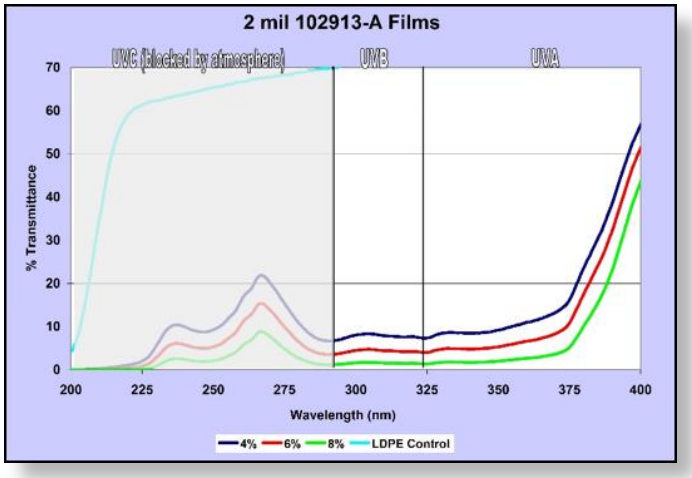
- Food packaging
- Beverages bottles
- Pharmaceuticals
- Non-perishables packaging
- Agricultural films
- Outdoor exposure for flexible films and rigid parts

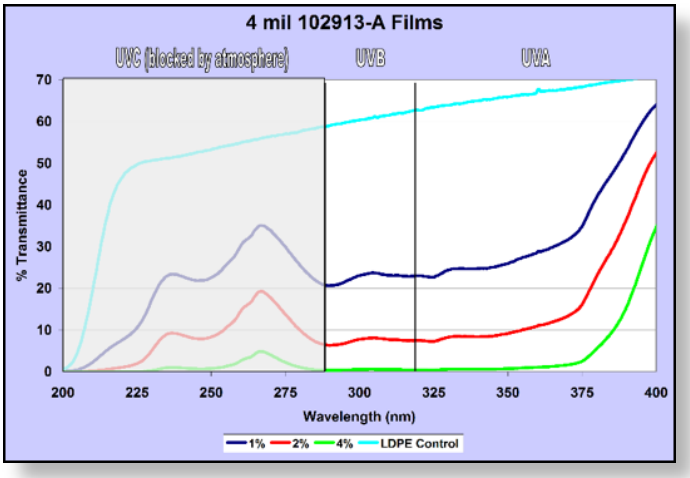
Products/Codes

Production Code	Resin	Chemistry	Application	FDA
100977 UVA	LLDPE	10% Benzotriazole	Medical and dry food packaging	Application dependent
100325 UVA	LLDPE	10% Benzotriazole	Non-food molding applications	None
10057 UVA		10% Benzophenone	Good economics	Application dependent
102913-A UVA	LLDPE	10% Proprietary	Least migratory UVA for food applications down to 2 mil thickness	Application dependent
UVI products				
100600	LLDPE	10% HALS NR/NH	Basic protection; no chemical exposure	
101949	LLDPE	20% HALS NR + 1% AO	Increased protection; no chemical exposure	
100840-NA	LLDPE	20% HALS NR + 6% AO	High-end Agricultural applications	
400943	PP	15% HALS NR/NH	Basic protection; no chemical exposure	
101690	LLDPE	20% HALS NOR + 6% AO	Chemical exposure	

Performance Data Details

- Ampacet 102913-A mono-layer LDPE blown film 2 mil & 4 mil
  - UV-Vis data showing absorbance of UVA & UVB radiation for food packaging





For more information on **Light Stabilizers** recommendations for use, and complete Regulatory Status of Ampacet Light Stabilizers, please contact your Ampacet Account Executive or visit **www.ampacet.com.**

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