AL-FARABI KAZAKH NATIONAL UNIVERSITY
Faculty of Chemistry and Chemical Technology
Chemistry and Technology of Organic Materials, Polymers and Natural Compounds

Additives for Polymeric Materials

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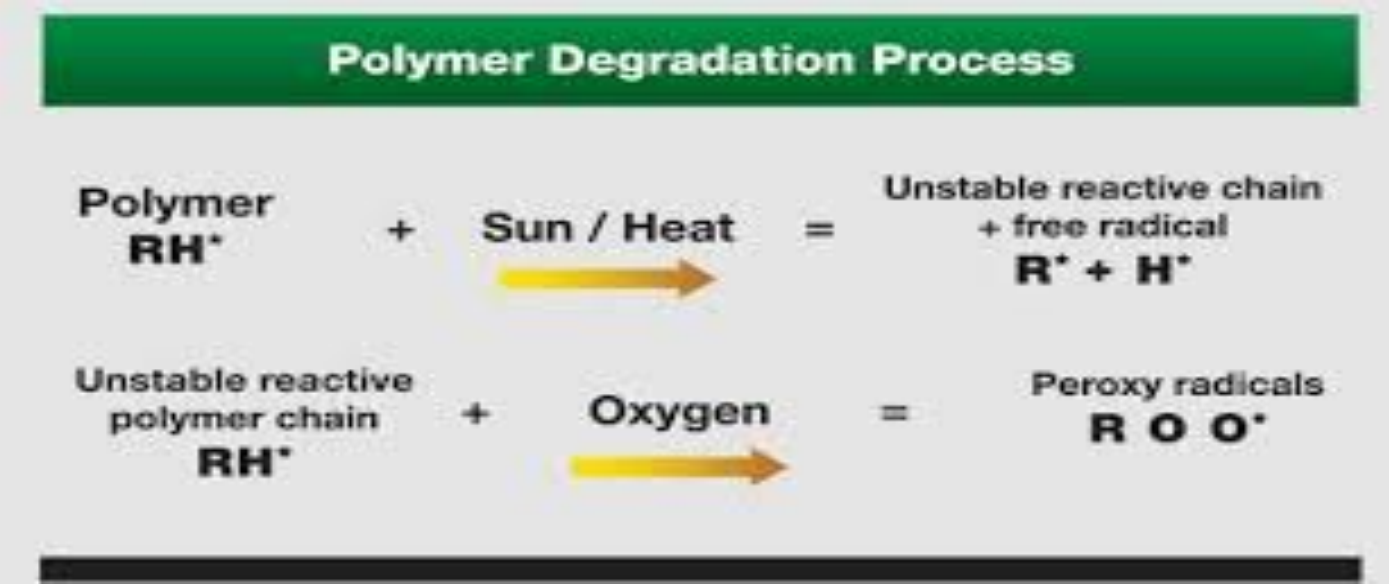
The Top 3 Plastic Additives for UV Stabilization

Over time, exposure to the UV radiation in sunlight will degrade plastics.

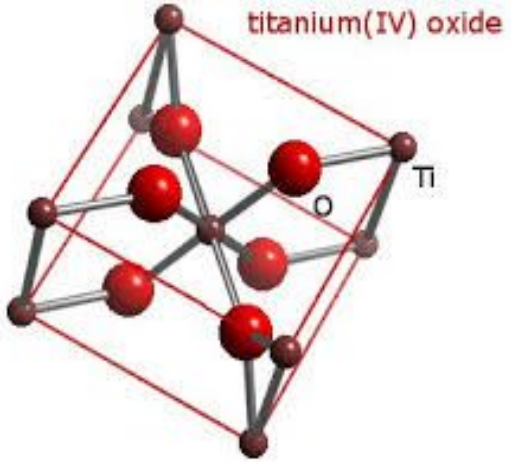
Polymer photodegradation occurs when UV light from the sun is absorbed by chemical groups in the polymer formation called chromophores.

UV stabilizers have been developed and are added to a polymer to inhibit the photoinitiation processes.

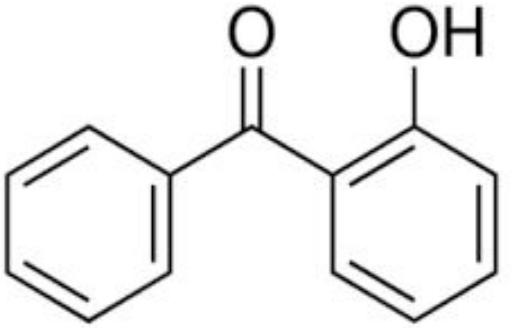


Ultraviolet Absorbers

Absorbers are a type of light stabilizer that functions by competing with the chromophores to absorb UV radiation. Absorbers change harmful UV radiation into harmless infrared radiation.



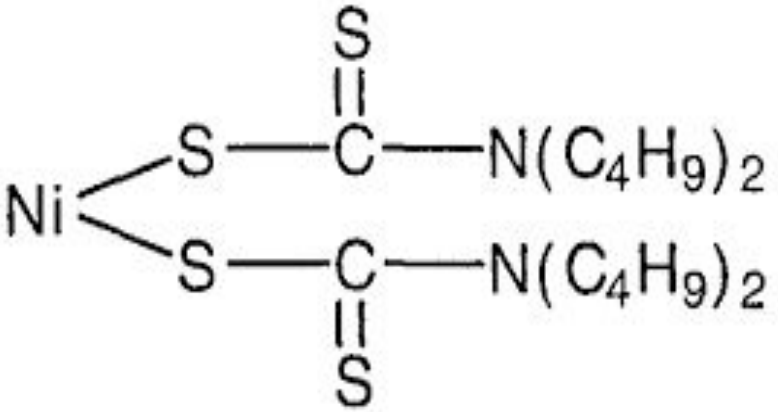
- The most effective and commonly used light absorber is – Carbon Black.
- Another UV absorber is rutile titanium oxide which is effective in the 300-400 nm range.
- Hydroxybenzophenone is also well known UV stabilizer that have the advantage of being suitable for neutral or transparent applications.



Quenchers

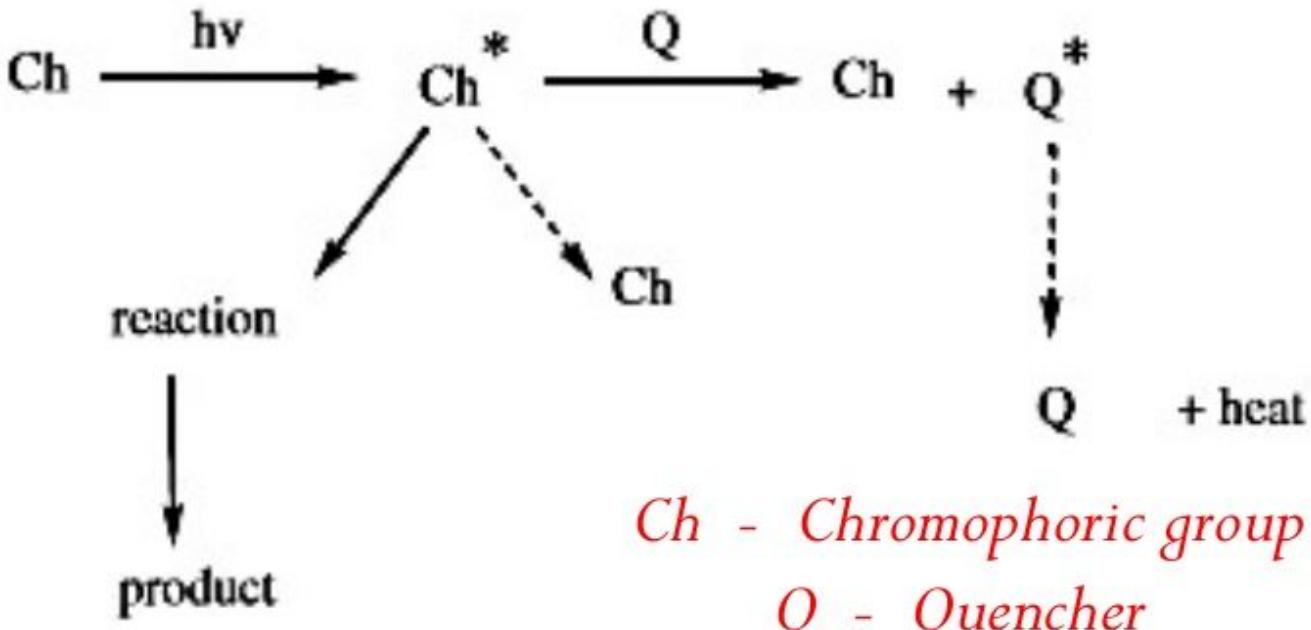
Quenchers return excited states of the chromophores to ground states by an energy transfer process. The energy transfer agent functions by quenching the excited state of a carbonyl group formed during the photo-oxidation of a plastic material and through the decomposition of hydroperoxides.

They are used in agricultural film production.



Quenching Mechanism

- There are two mechanisms:
  - Long range Energy Transfer
  - Contact (Collisional) Energy Transfer



Ch - Chromophoric group

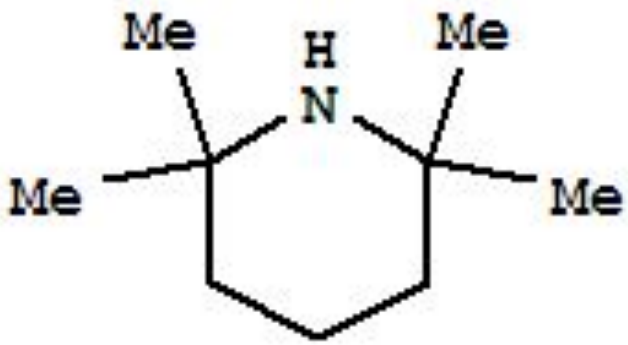
Q - Quencher

Hindered Amine Light Stabilizers (HALS)

HALS are long-term thermal stabilizers that act by trapping free radicals formed during the photo-oxidation of a plastic material and thus limiting the photodegradation process.

HALS has enabled the growth of polypropylene in the automotive industry. HALS are also very effective in polyolefins, polyethylene and polyurethane.

They are all share the 2,2,6,6-tetramethylpiperidine ring structure:



Nucleating Agents

Nucleating agents improve mechanical properties, such as stiffness, heat distortion temperature and crystallization rate.

When semi-crystalline polymers crystallize from the melt, the particles organize from a primary nucleus to form complex macro-structures called spherulites.

Properties of the polymers depend on the end size of the spherulite structures.

How do Nucleating Agents work?

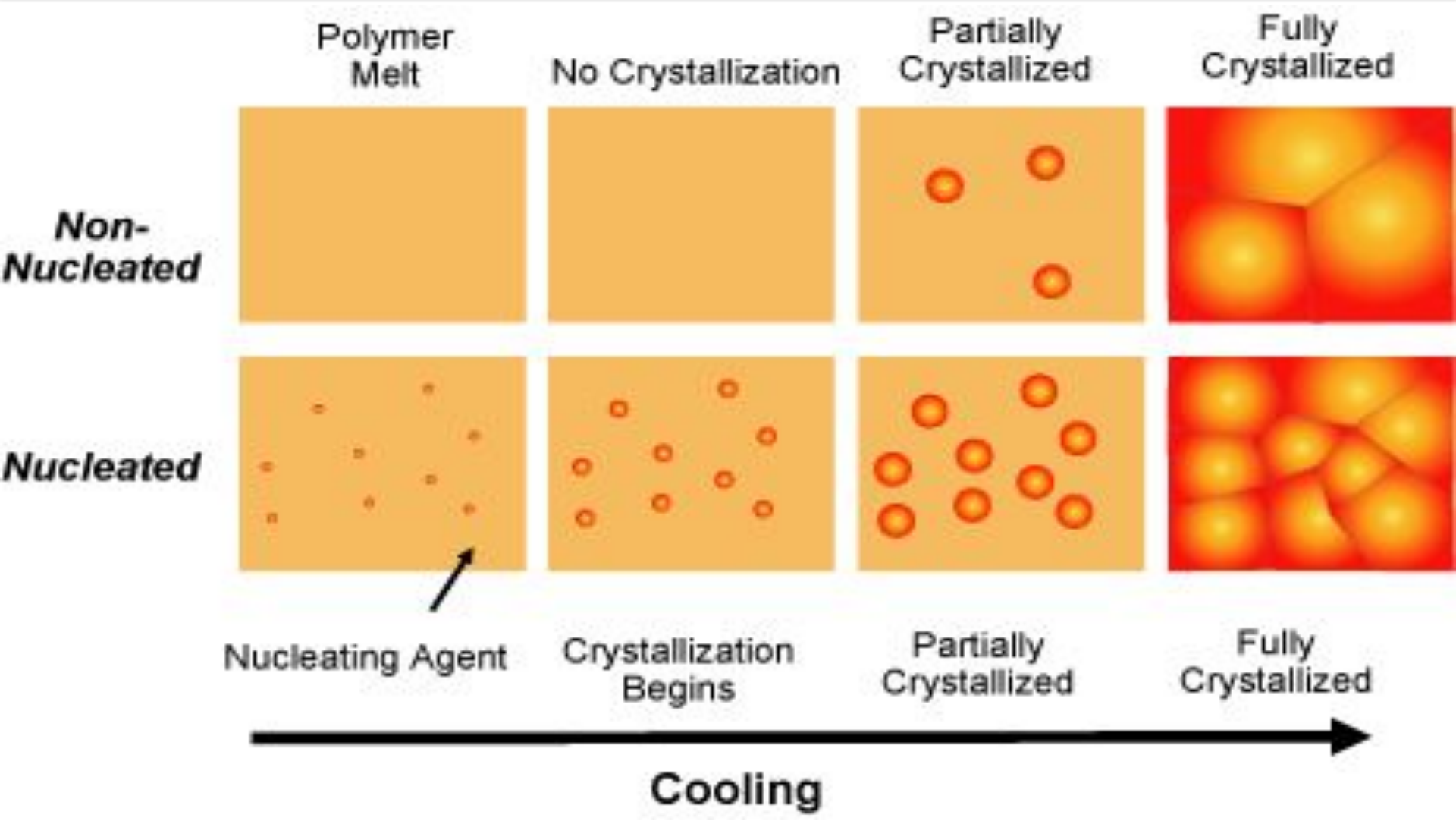


Illustration of the heterogeneous nucleation process versus a non-nucleated resin for comparison