

ROMBEST® masterbatches

UV-STABILIZER MASTERBATCHES

TECHNICAL INFORMATION

All plastic products exposed to heat, light and oxygen, are subjected to degradation, i.e. loss of their useful mechanical and physical properties. The degradation process can be retarded and the useful life of plastic products prolonged, by the addition of stabilizers in the polymer mass.

The most important reason causing degradation of plastics is the UV-radiation of the sun. The energy carried by this radiation initiates or accelerates chain chemical reactions in the polymer's molecules, causing chain-scission and/or cross-linking. As a result, the plastic product is losing its properties and becomes brittle.

ROMCOLOR 2000 has developed a complete range of UV masterbatches, with selected heat and light stabilizers, for virtually every polyolefin application.

Major advantages of ROMBEST UV masterbatches are:

- The careful selection and balanced formulation of different additives.
- The excellent dispersion of the additives in the base resin.
- Easy processing without affecting the mechanical properties of the end products.

GENERAL INFORMATION

There are three main classes of UV-stabilizers:

1) HALS (Hindered Amine Light Stabilizers): this is the most modern class of UV-stabilizers. They mainly act by "free radical scavenging", i.e. by interrupting the propagation of chain reactions that cause degradation of the polymer, thus retarding the ageing process.

There are three main kinds of HALS used in polyolefin applications:

- a) Low molecular weight HALS (such as HALS I)
- b) High Molecular Weight HALS (such as HALS II & HALS III).
- c) NOR HALS.

High Molecular Weight HALS are more compatible with polymers, have lower volatility and tendency to migrate, better extraction resistance and better contribution to heat stability.

HALS has shown an outstanding efficiency in most applications. In the presence, however, of sulfur or halogen containing organic compounds (pesticides, flame retardants, pigments etc.), they risk to have their efficiency considerably reduced due to chemical interactions with these substances, leading to early failure.

NOR HALS is a new type of HALS with improved resistance to chemicals. It can offer effective protection to plastic products in contact with sulfur, halogens or other acidic substances, as in the case of greenhouses where sulfur is used for crop protection and stadium-seats with flame-retardants.

2) UV-Absorbers (benzophenones & benzotriazoles): these products mainly act by absorbing the UV-radiation and dissipating it into thermal energy, thus preventing its absorption by the polymer. UV-Absorbers are more effective in thick/unpigmented products, especially in combination with a HALS or Ni-quencher.

UV-Absorbers are not recommended for thin products (below 100 mic.) as they tend to migrate and are lost from the polymer mass within a relatively short period. Also, according to the Beer's Law, a certain "depth" inside the material is necessary for sufficient UV-absorption. It should be noted that UV-Absorbers are not so effective in pigmented products, as most pigments reflect or absorb themselves the UV-radiation. They can be useful however in some cases for protecting certain pigments from fading.

3) Ni-Quenchers: they are Ni organic complexes that act mainly by deactivating excited polymer states and dissipating the energy in harmless forms. Ni-quenchers impart a greenish shade to the products they stabilize, which is undesirable for pigmented articles.

Ni-Quenchers have proven to be efficient UV-stabilizers for LDPE greenhouse films, their main advantage being that they are not affected by sulfur.

APPLICATIONS

Recommendations for selection and use of ROMBEST UV masterbatches are given for a number of polyolefin applications in the following tables, with indicative addition rates that should be considered a general guideline only.

Exact addition level for each product depends on its characteristics (resin, color, thickness, other additives used etc.), the geographical area, the conditions of use and the desired lifetime.

This document presents the standard range of ROMBEST UV masterbatches. Modified versions or tailor-made products can be produced upon request, e.g. with another base resin or containing different combinations and/or amounts of UV-stabilizers, antioxidants, processing stabilizers and other additives such as anti-fogging, IR & anti-static compounds.

1) UV-STABILIZATION OF GREENHOUSE FILMS

ROMCOLOR 2000 specializes in UV-stabilization of agricultural films. The company has its own experimental greenhouses, specially designed for testing new formulations of UV-stabilizers, and can provide useful advice for this particularly demanding application.

There are three classes of UV-masterbatches proposed for this application:

(a) Based on Ni-Quencher and UV-Absorber

UV 21 & UV 17 are suitable for 1-5 season films (depending on area and addition rate), while UV 16 is mainly recommended for 1-2 season films. The carrier resin of UV 21 is LDPE with MFI 0.3, resulting to higher mechanical properties of the film and better bubble stability, especially if a high addition rate of masterbatch is required. Films stabilized with above products have a yellow/greenish shade and are resistant to interactions with sulfur and sulfur containing pesticides.

(b) Based on HALS and UV-Absorbers

UV 241, UV 18H & UV 17H are recommended for lifetimes of 1-5 seasons, provided there is no excessive use of pesticides or sulfur, as these products interact with HALS and can limit dramatically their efficiency.

UV 241 & UV 17H are colorless while UV 18H contains a yellow/green pigment to imitate the shade of films stabilized with Ni-quencher.

UV111 contains a combination of a new generation HALS with UV absorber, offering improved resistance against normal use of pesticides.

(c) Based on HALS and Co-Stabilizers

These products have been developed with the purpose of improving the resistance of HALS to pesticides.

HALS is reactive alkaline molecules - this is why they are deactivated by acidic pesticides and their residues. By introducing in the film compounds with higher alkalinity which react with the pesticides and neutralize them, the damage to HALS is reduced and the life of the film is prolonged. These compounds are called Co-Stabilizers. It should be noted that Co-stabilizers improve the resistance of the film against normal use of pesticides but do not offer adequate protection in case of use of sulfur or excessive application of pesticides.

UV 34, UV 495 & UV 37 are mostly recommended for 2-5 season films with a thickness of 120-200 mic. while UV 35 is more suitable for 1-2 season films with a thickness of 80-120 mic. as well as for mulching and low-tunnel films.

UV 37 contains a yellow/green pigment to imitate the shade of films stabilized with Ni-Quencher; however, a colorless version is also available upon demand.

(d) Based on NOR HALS and UV-Absorbers

UV 1211 is a **new development**, containing NOR HALS combined with a UV-absorber and other special additives. It has been designed for use in greenhouses where sulfur and/or excessive pesticides are applied for pest control. UV 1211 is designed for diffusing films while a version for clear films, UV 1215, is also available.

2) UV-STABILIZATION OF THICK UNPIGMENTED PE FILMS

For the UV-stabilization of pallet covers, heavy duty bags etc., with thickness above 120 mic. and life-expectancy of 9-18 months, it is recommended to use masterbatches based on HALS or HALS + UV-Absorber, such as UV 10H, UV 14H, UV 15H, UV 17H, UV 18H, UV 20H, UV 22H & UV 26H. For applications involving sealing, it is advisable to use masterbatches containing HALS II or the HALS III + HALS II combination. UV 18H imparts to the film a yellowish/greenish shade.

3) UV-STABILIZATION OF THIN AND PIGMENTED PE FILMS & TAPES

For the UV-stabilization of polyethylene films for packaging or agricultural uses, transparent or pigmented with thickness below 100 mic., as well as of pigmented films above 100 mic. (e.g. silage films and nursery films) and PE tapes it is advisable to use HALS based masterbatches, such as UV 10H, UV 14H, UV 15H, UV 20H, UV 22H & UV 26H.

UV 10H, UV 14H, UV 22H & UV 26H should be preferred in applications involving heat-sealing. In such applications, UV 15H & UV 20H should be used after trials.

For agricultural applications involving extensive contact with pesticides (e.g. mulching films) it is recommended to use either UV 35 (at an addition of 1,5-6 %) or, preferably, UV 1510 (at 1-6%). UV 1510 contains NOR HALS and offers maximum safety when there is excessive use of pesticides or sulfur. For colored films where the pigments used contain metals (e.g. yellow, brown or silver) it is recommended to increase the addition of UV-masterbatch relative to the amount used in unpigmented films of the same type and thickness.

4) UV-STABILIZATION OF THICK POLYETHYLENE PRODUCTS

For thick PE articles the preferred choices are UV 15H (pigmented articles) and UV 17H (unpigmented articles). UV 10H, UV 14H, UV 20H, UV 22H & UV 26H can also be used.

5) UV-STABILIZATION OF PP TAPES

The most efficient UV masterbatches for PP tapes are those containing HALS I, i.e. UV PP913H, UV PP915H, UV PP921H & UV PP941H. HALS II based UV PP926H and synergistic combinations of HALS I + HALS III, such as UV PP911H, UV PP912H & UV PP919H, offer additional protection from thermal degradation, especially in black or dark coloured items exposed to sunlight.

Where due to very low thickness and/or requirements for very long lifetime it is necessary to use high amounts of UV-stabilizers (active ingredients exceeding 0,3-0,4%), the combination of HALS I + HALS III ensures better results than HALS I alone.

Where food approval is necessary, HALS II, HALS III or combinations of HALS III + HALS II are used (UV PP909H, UV PP910H, UV PP916H, UV PP920H, UV PP922H, UV PP926H), but addition rates should be higher than those of HALS I for the same life expectancy.

HALS II & HALS III have the additional advantages of better contribution to thermal stability and, most importantly, lower water carry-over, i.e. better processability.

6) UV-STABILIZATION OF THICK POLYPROPYLENE PRODUCTS

UV masterbatches based on HALS I, such as UV PP913H, UV PP915H & UV PP921H are the preferred choice for thick PP products.

For black or dark items where improved thermal protection is necessary as well as in cases requiring very long lifetime and therefore very high amounts of HALS, combinations of HALS I + HALS III (UV PP911H, UV PP912H, UV PP919H) offer better results.

For items requiring food approval, HALS III or combinations of HALS III + HALS II are used (UV PP909H, UV PP910H, UV PP916H, UV PP920H, UV PP922H), at addition rates higher than those of HALS I for obtaining the same lifetime..

7) UV-STABILIZATION OF POLYPROPYLENE FIBERS

Because of the high surface area to volume ratio in fibers, it is critical to employ stabilizers with low volatility and high extraction resistance. These criteria are met by high molecular weight HALS III as well as by combinations of HALS III + HALS II, which at the same time contribute to the thermal stability during end-use (e.g. rear-shelves, trunk liners in cars).

The most suitable masterbatches for this application are UV PP916H, UV PP920H & UV PP922H. UV PP957H & UV PP958H – due to their very high content of active ingredients – can be used at very low addition rates and ensure the minimum adverse effect on mechanical properties of the fiber. Correct use of UV PP957H & UV PP958H, however, requires very accurate feeding by gravimetric systems as well as perfect homogenization during extrusion of the fibers.

8) UV-STABILIZATION OF PS & ABS PRODUCTS

UV PS724H is specially designed for PS & ABS products. As an indication for trials, an addition rate of 3,5 % for PS and 5 % for ABS is necessary for a 2 mm pigmented product to obtain a lifetime of 5 years in Mediterranean climate.

9) UV-STABILIZATION OF PET PRODUCTS

UV PT2320 (medium filter) and UVPT2310 (high filter) are specially designed for PET bottles and containers, in order to protect the content from UV degradation (i.e. change of color, nutritional value, taste e.t.c).

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ROMBEST ® UV MASTERBATCHES FOR PE

ROMBEST	CARRIER RESIN	UV-STABILIZERS	UV-STABILIZERS RATIO	ANTIOXIDANTS	PROCESSING STABILIZER	TOTAL ACTIVE INGREDIENTS %	SHADE	GREENHOUSE FILMS	THICK UNPIGMENTED FILMS	THIN - PIGMENTED FILMS & TAPES	THICK PRODUCTS	FOOD APPROVAL
UV 15	PE	UVA		◆	◆	15			2-4%		2-4%	<3,5%
UV 16	PE	Ni-Q + UVA	1 :1	◆	◆	16	Y	2-6%				
UV 17	PE	Ni-Q + UVA	2 :1	◆	◆	16	Y	2-13%				
UV 21	PE	Ni-Q + UVA	2 :1	◆	◆	21	Y	1,5-10%				
UV 10H	PE	HALS III + HALS II	1 :1		◆	10,5			1,5-4%	1,5-6%	1,5-3%	◆
UV 14H	PE	HALS III + HALS II	1 :1		◆	15,5			1-3%	1-4%	1-2%	◆
UV 15H	PE	HALS III			◆	15,5			1-3%	1-4%	1-2%	◆
UV 17H	PE	HALS III + UVA	2 :1		◆	15,5		2-13%	1,5-3,5%			<10%
UV 18H	PE	HALS III + UVA	2 :1		◆	15,5	Y	2-13%	1,5-3,5%			<10%
UV 20H	PE	HALS III			◆	20,5			0,75-2%	0,75-3%	0,75-2%	◆
UV 22H	PE	HALS III + HALS II	1 :1		◆	20,5			0,75-2%	0,75-3%	0,75-2%	◆
UV 26H	PE	HALS III			◆	20,5			0,75-2%	0,75-3%	0,75-2%	
UV 241	PE	HALS III + UVA	2 :1		◆	20		1,5-10%				
UV 34	PE	HALS III + UVA + CS			◆	21,5		1,5-10%				
UV 35	PE	HALS III + CS			◆	25,5		1,5-6%		1-6%		◆
UV 37	PE	HALS III + UVA + CS			◆	20,5	Y	2-9%				
UV 111	PE	HALS IV+HALS II + UVA			◆	22,5		1,5-10%				
UV 495	PE	Tinuvin 494 + UVA			◆	25,5		1,5-10%				
UV 1211	PE	NOR HALS + UVA			◆	33		1,5-10%				
UV 1215	PE	NOR HALS + UVA			◆	22		1,5-10%				
UV 1510	PE	NOR HALS			◆	15,5		1-6%		1-6%		

HALS II, HALS III, HALS IV : High Molecular Weight HALS

Ni-Q : Ni-Quencher

UVA : UV-Absorber

CS : co-stabilizers

Tinuvin 494 : HALS & costabilizers blend (product of Ciba S.C.)

Y : greenish/yellowish

ROMBEST® UV MASTERBATCHES FOR PP, PS & ABS

ROMBEST	CARRIER RESIN	UV-STABILIZERS	UV-STABILIZERS RATIO	TOTAL ACTIVE INGREDIENTS %	PROCESSING STABILIZER	PP FILMS & TAPES	PP / PS / ABS THICK ARTICLES PET CONTAINERS	PP FIBERS	FOOD APPROVAL
UV PP909H	PPH	HALS III		10,5	◆	3-6%	1,5-5%	3-6%	◆
UV PP910H	PPH	HALS III + HALS II	1:1	10,5	◆	3-6%	1,5-5%	3-6%	◆
UV PP911H	PPH	HALS I + HALS III	3:1	10,5	◆	2-4%	1-3%		
UV PP912H	PPH	HALS I + HALS III	1:1	10,5	◆	2,5-5%	1,5-4%		
UV PP913H	PPH	HALS I		10		2-4%	1-3%		
UV PP915H	PPH	HALS I		15		1,5-3%	0,7-2%		
UV PP916H	PPH	HALS III		15,5	◆	2-4%	1-3,5%	2-4%	◆
UV PP917H	PPH	HALS III + HALS II	1:1	15,5	◆	2-4%	1-3,5%	2-4%	◆
UV PP919H	PPH	HALS I + HALS III	1:1	20,5	◆	1,5-2,5%	0,75-2%		
UV PP920H	PPH	HALS III		20,5	◆	1,5-3%	0,8-2,5%	1,5-3%	◆
UV PP921H	PPH	HALS I		20		1-2%	0,5-1,5%		
UV PP941H	PPH	HALS I		40		0.5-1%			
UV PP922H	PPH	HALS III + HALS II	1:1	20,5	◆	1,5-3%	0,8-2,5%	1,5-3%	◆
UV PP926H	PPH	HALS II		20,5	◆	1,5-3%	0,8-2,5%	1,5-3%	◆
UV PP957H	PPH	HALS III		50,5	◆	0,6-1,2%		0,6-1,2%	◆
UV PP958H	PPH	HALS III + HALS II	1:1	50,5	◆	0,6-1,2%		0,6-1,2%	◆
UV PT2310	PET	Special UV absorber 1		10			1-2 %		◆
UV PT2320	PET	Special UV absorber 2		20			2-4 %		◆
UV PS724H	PS-GP	HALS I + HALS III + UVP	1:1:2	20			3-5 %		

HALS I : LowMolecular Weight HALS

HALS II : High Molecular Weight HALS

HALS III : High Molecular Weight HALS

UVP : UV-Absorber special for PS & ABS

Suggested addition rates are general guidelines only. The appropriate addition for any application depends on the product, the area of exposure, the conditions of use, the required life-time, the presence in the product or the environment of pigments, additives or other chemicals and on other application specific parameters.