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Recent aspects of Polypropylene and Polyethylene stabilization

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Stability can be enhanced using an alternative approach developed by SONGWON for demanding applications such as food packaging applications.

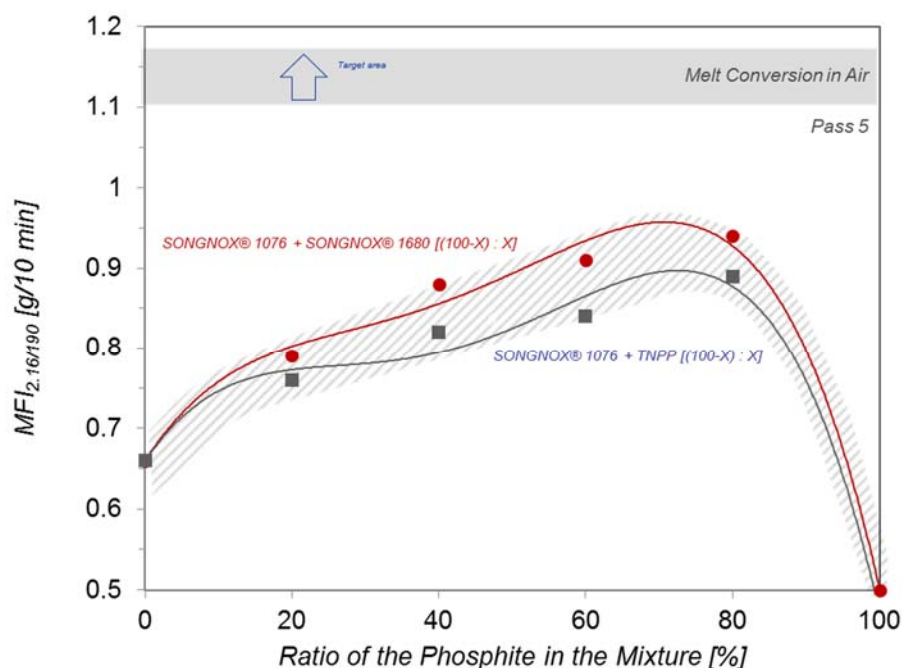
Polypropylene (PP) and polyethylene (PE) need to be stabilized during compounding, processing, storage, and service life due to their inherently limited resistance to auto-oxidation. The chemicals added for this purpose are known as stabilizers and antioxidants. The stabilization of these substrates during compounding and conversion is complex, because the following performance criteria need to be fulfilled:

- Good protection of molecular weight during melt conversion
- Low initial color
- Low color development during melt conversion
- Low gas fading
- Reasonable improvement of thermal stability
- Easily adjustable long term thermal stability (LTTS)

Polyethylene

General purpose processing of linear low density polyethylene (LLDPE) film

The stabilization method for PP using a combination of hindered phenol, such as SONGNOX® 1010 or SONGNOX® 1076 antioxidant, and monophosphites such as SONGNOX® 1680 antioxidant or tris-nonylphenylphosphite (TNPP) provides acceptable protection of the molecular architecture during melt conversion of general purpose grades, i.e., blown film, offering good compatibility and achieving an excellent balance between price and performance. Moderate LTTS is required of the hindered phenol due to lower test temperatures and this solution is suitable for non-durable applications such as packaging film.



New requirements

However, higher standards as regards molecular weight protection and discoloration during melt conversion as well as more stringent regulatory requirements limit the suitability of this basic processing concept for some PE applications.

Manufacturers looking to replace TNPP in LLDPE film have two options: they can either select an alternative liquid phosphite or go for a solid one such as SONGNOX® 1680 antioxidant, which is suitable for general purpose blown film and the best choice in terms of cost versus performance.

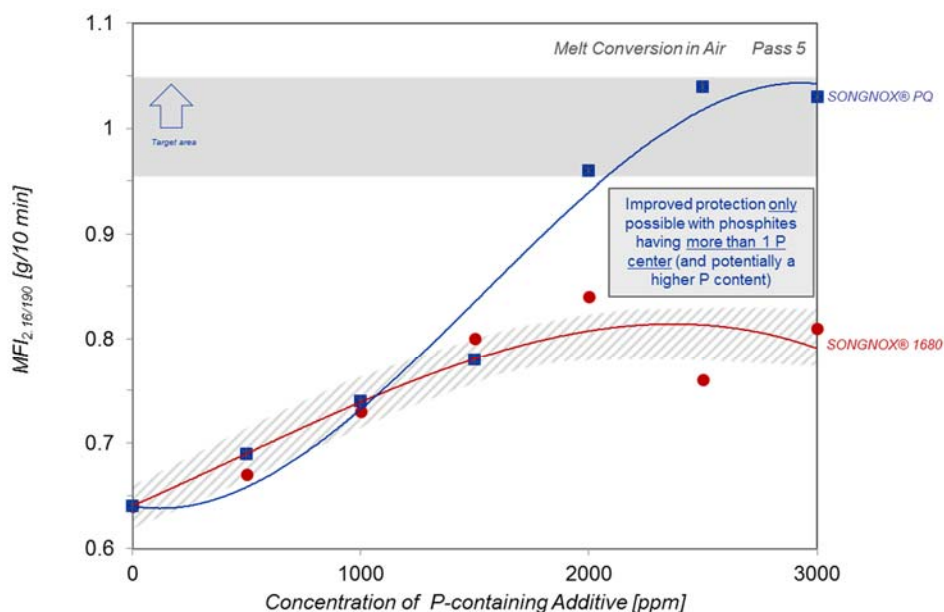
For more demanding applications, including

- mPE (narrow molecular weight distribution)
- Pipes (oxygen deficiency during compounding)
- Rotational molding (long cycles)
- Cast film
- High temperature and shear processing (in general)

the required loading level of SONGNOX® 1680 would exceed the solubility level and cause blooming.

One option is to replace SONGNOX® 1680 with SONGNOX® PQ antioxidant, a higher performance processing stabilizer, because it has better compatibility and solubility in LLDPE.

The other option is to keep the amount of SONGNOX® 1680 below its maximum solubility level in polyethylene and add a high-end radical scavenger.



Polypropylene

General purpose thermal stabilization of PP injection molding grades

In the 1970s CIBA-GEIGY introduced a technology that involved a move from low molecular weight to high molecular weight phenols, i.e., thermal stabilizers. SONGNOX® 1010 antioxidant, which is based on this technology, achieves strong effects even at low concentrations. In addition, this product is suitable for indirect food contact application, since it does not cause organoleptic issues.

Limitations, however, are imposed by potential discoloration in unpigmented substrates, and a visible saturation effect in amounts as low as 2500 ppm, depending on the substrate.

An alternative school of thought

SONGWON developed a different approach and in 2010 introduced a new LTTS Concept involving innovative stabilizer solutions: the stabilizer package SONGXTEND® 2124 enhances LTTS beyond the performance of SONGNOX® 1010 and SONGNOX® DSTDP, and improves LTTS beyond the industry standard, for example on glass fiber reinforced polypropylene (GF-PP).

However, SONGXTEND® 2124 can give rise to organoleptic issues. In the same year, SONGWON introduced a second alternative LTTS Concept: SONGXTEND® 2123 is a sulfur-free formulation that offers a modest extension of the LTTS, causes few organoleptic issues and is low in VOC. It can be used where SONGNOX® 1010 cannot provide adequate LTTS, but it is not suitable for indirect food contact applications.

Conclusions

Traditional stabilizer packages for processing stability and LTTS provide satisfactory performance for general purposes. However, methods based on the alternative school of thought yield significantly better results, including higher durability at the same concentration and fewer secondary effects.