Crosslinking of EVA rubber with peroxides

Application guide

Nouryon

Properties of EVA rubber

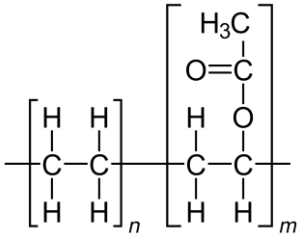
EVA is a rubber with excellent:

- Flexibility, even at low temperatures
- Resilience
- Crack resistant
- Tough at low and moderate temperatures
- Processability by conventional thermoplastic or rubber processing techniques
- High transparency (solar)

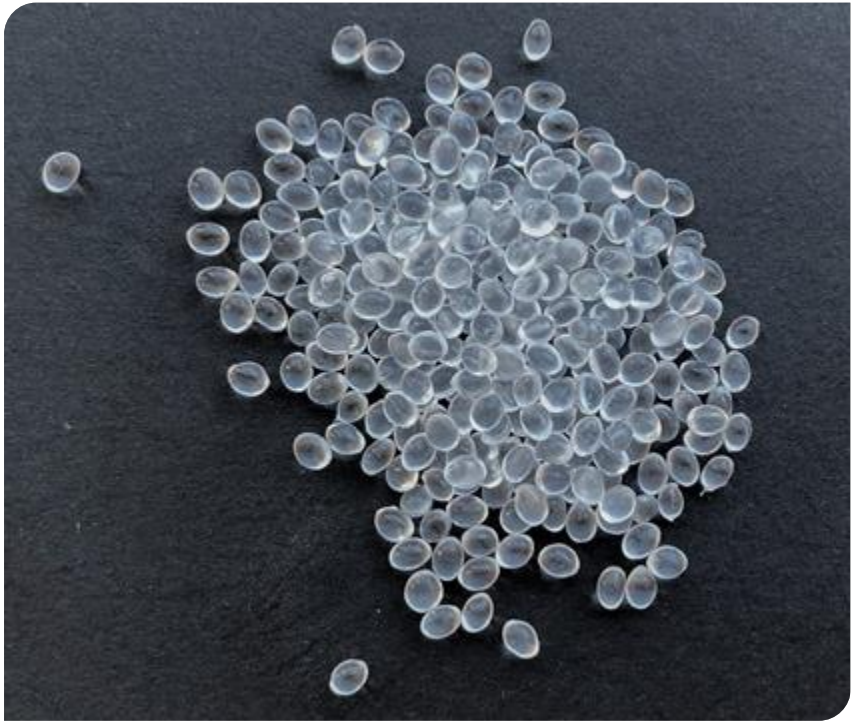
With usage in:

- Footwear
- Automotive
- Construction
- Packaging
- Solar (Trigonox 117)

What is EVA rubber?



EVA (ethylene vinyl acetate rubber) has a saturated backbone. The amount of vinyl acetate varies. Low vinyl acetate is typically up to 4% (thermoplast), medium between 4 – 30% and high >30% (EVM, elastomer). Free acetate content can result in the presence of an acetic smell.



Peroxides used for EVA

Product	Typical application	Physical form	Recommended minimum cure temperature (°C)	Dosing (phr)
Trigonox 117 (Solar grade)	Solar encapsulant	Liquid	150	0.8 – 1.2
Perkadox BC-40	Cable & footwear	Powder, granule or polymer bound	170	2.4 – 4.7
Perkadox 14-40	Cable & footwear (non smell)	Powder, granule or polymer bound	175	1.5 – 3.0
Trigonox 101-45	Cable & footwear (non smell / non blooming), articles coming in contact with food or drinking water	Powder, granule or polymer bound	175	1.4 – 2.9
Alternatively, below peroxides can be used as kicker for a fast onset of cure, in combination with the peroxide types above.				
Trigonox 17-40	Injection molding articles	Powder, granule or EPR bound	160	2.9 – 5.8
Trigonox 29-40	Dual cure with Perkadox 14, Injection molding articles	Powder, granule or EPR bound	145	2.6 – 5.3

The carrier system can be based on calcium carbonate, silica and/or clay.
Pure peroxides could be used again (soaking), for safety and ease of handling formulated product is recommended.

Remarks per peroxide

Perkadox BC
Excellent price-performance ratio! Acetophenone is formed after decomposition, which has a typical smell.

Perkadox 14
Increasing popularity for footwear to reduce smell. Can form decomposition products showing potential to migrate to the surface (bloom). This depends on concentration and polymer polarity.

Trigonox 101
Aromatic free crosslinking peroxide! Low molecular weight decomposition products, which are relatively easy to remove by post-cure.

Trigonox 117S
Used in solar cells as crosslinker for encapsulant layer.

Points of attention for peroxide crosslinking

- Sensivity to oxygen under curing conditions
- Certain components of the rubber compound such as
  - Fillers
  - Extender oils
  - Antioxidants
  - Resins

  must be selected with care because they may, under certain conditions, consume free radicals
- Scorch and cure time are less flexible, since they are determined mainly by the temperature
- During cure, some peroxides may lead to distinct odors
- Post cure may be necessary
- Cured EVA has limited upper temperature (polymer backbone is less thermally stable as compared to EPDM or PE)

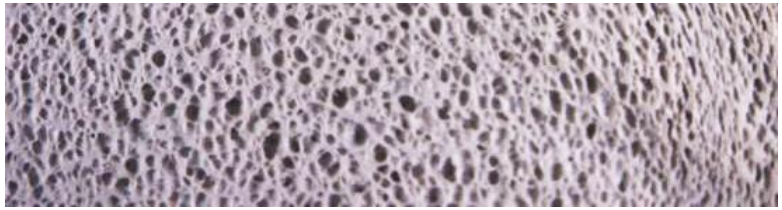
Concluding remarks

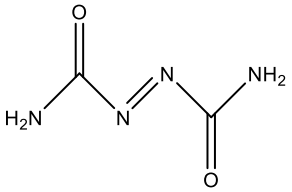
- A broad range of organic peroxides is available for the crosslinking of EVA rubber.
- Peroxide formulations are recommended for safety, and to facilitate handling, mixing, and processing.
- For fast dispersion, polymer bound formulations are highly recommended!
- The application of coagents can improve several properties
  - TAC for improved abrasion resistance in footwear

Tips & tricks

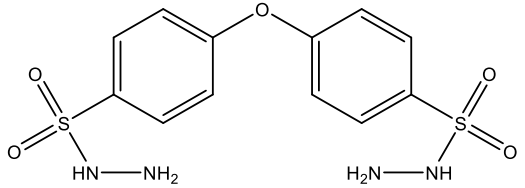
Expanded EVA

Expanded EVA is used for many applications, for example footwear. The expansion can be obtained by the addition of blowing agents (for example ADC or OBSH) to the compound at the mixing stage. The timing during cure is very important, crosslinking should be in line with the blowing agent. Too fast crosslinking will prevent the expansion to form, too slow crosslinking will result in an open cell structure.





ADC
Azodicarbonamide



OBSH
p',p-oxybis benzene sulfonyl hydrazide