MONOPEROXYCARBONATES

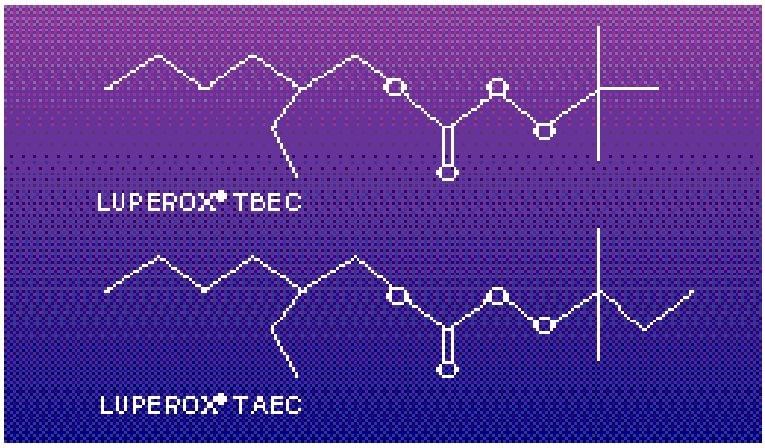
Better Performance In Suspension Polystyrene

ARKEMA

MONOPEROXYCARBONATES

Monoperoxycarbonates are t-Butyl Perbenzoate Replacements For:

- **Zero Benzene**
- **Faster Reactions**
- **Lower Reaction Temperatures**
- **Lower Residuals**



FINISHING CATALYSTS FOR EPS

Reducing residual styrene consumes valuable time and energy. The proper choice of peroxide dramatically decreases reaction time, residual styrene, energy costs and the amount of peroxide needed.

A typical EPS polymerization uses both benzoyl peroxide (BPO) and t-butyl perbenzoate (TBPB). The BPO initiates the majority of the polymerization during a low temperature stage while the TBPB is inactive until the last stage of the reaction when the temperature is increased. The purpose of the TBPB is to finish the reaction by reducing residual styrene to acceptable levels. For this reason, TBPB is referred to as a finishing catalyst.

We started investigating finishing catalysts to address industry concerns that benzene forms from TBPB decomposition. It was quickly determined that other performance benefits could be found by proper choice of the finishing catalyst.

THE OBJECTIVE WAS A PEROXIDE THAT:

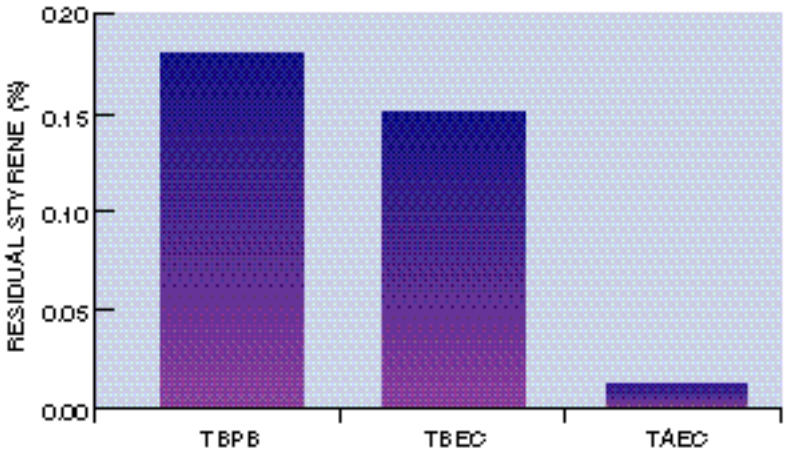
- Reduces residual styrene
- Improves reaction rates
- Lowers energy costs
- Avoids paths to benzene
- Requires no solvent dilution for safe handling

TBEC and TAEC accomplished all of these.

TAEC FOR BEST RESULTS

Luperox® TBEC is quite effective at lowering residual styrene levels, but Luperox TAEC is far superior.

Shown here are three polymerizations using 0.25% Benzoyl Peroxide and 700 ppm of TBPB or an equivalent molar amount of TBEC or TAEC. The reactions were carried out in test tubes for 4 hours at 90°C followed by 2 hours at 120°C

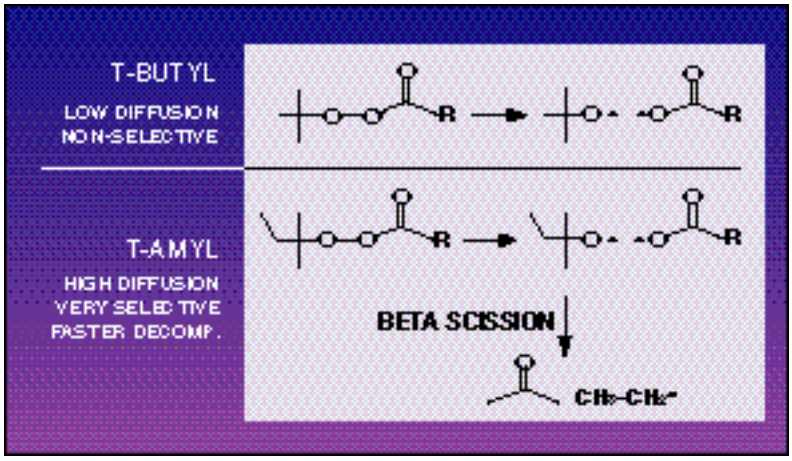


ATOFINA'S T-AMYL TECHNOLOGY

The difference in structure between TBEC and TAEC is slight, yet the difference in performance is tremendous. TAEC belongs to a class of peroxides called t-amyls and TBEC belongs to a class called t-butyls. The t-amyls have some important advantages over the t-butyls resulting from their decomposition mechanism.

The t-amyls give radicals which:

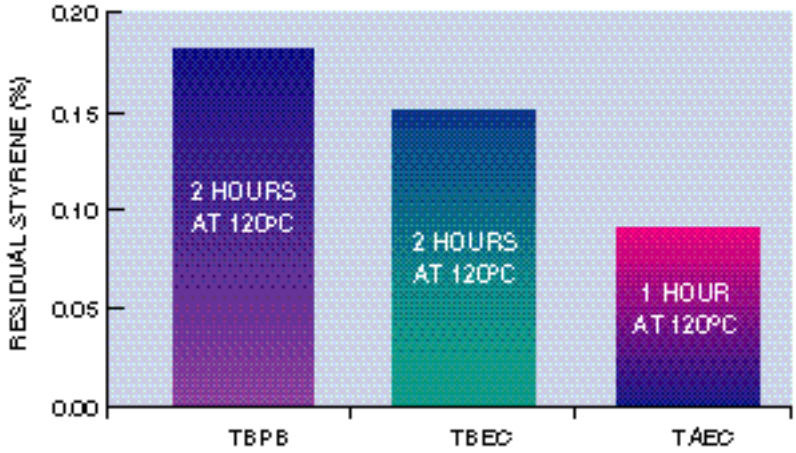
1. Diffuse better in the high conversion matrix of an EPS particle.
2. Are lower energy and therefore more selective to adding a styrene monomer.
3. Escape from the decomposition cage more effectively.
4. Have slightly faster decomposition rates.

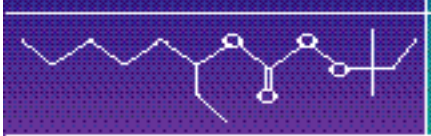


TAEC REDUCES REACTION TIME

TAEC can obtain the same residual styrene levels as TBPB in half the time.

Shown here are three polymerizations using 0.25% Benzoyl Peroxide and 700 ppm of TBPB or an equivalent molar amount of TBEC or TAEC. The reactions were carried out in test tubes for 4 hours at 90°C followed by 2 hours at 120°C for the TBEC and TBPB and only 1 hour for TAEC.



FINISHING TEMP.	RESIDUAL STYRENE (ppm) 110C	115C	120C
	—	660	—
	100	75	10
	635	—	290

TAEC WORKS AT 110°C – SAVES ENERGY

TAEC works better at 110°C than TBPB at 120°C. Thus, energy costs for heating the reactor can be saved. Also shown here is a structure similar to TBPB that would not be expected to form benzene on decomposition. Its performance is inferior to TAEC.

Shown here are the results of 2000 ppm BPO, 800 ppm TAEC, 280 min at 90°C, 20 min ramp and 3 hours at the indicated temperature.

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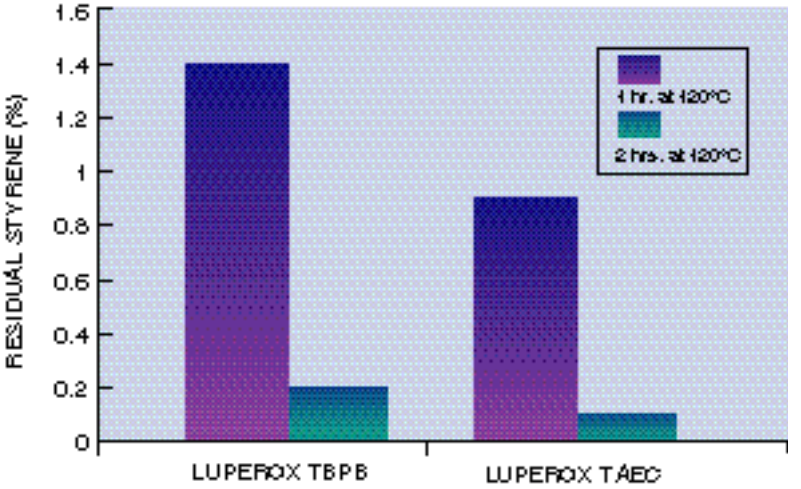
TAEC REQUIRES LESS PEROXIDE

Using only half the molar amount of peroxide, TAEC still outperforms TBPB.



Shown here is styrene polymerized with 0.25% Benzoyl Peroxide and 700 ppm TBPB or 470 ppm TAEC. Polymerizations occurred in test tubes at 90°C for 4 hours and then at 120°C for 1-2 hours.

ULTRA LOW RESIDUAL STYRENE

Residual styrene levels of less than 10 ppm were obtained using 2000 ppm BPO, 800 ppm TAEC, 280 min at 90°C, 20 min ramp from 90-120°C, and 3 hours at 120°C in test tubes.

SUMMARY

Because of the potential for benzene formation from the decomposition of t-butyl perbenzoate, the industry is looking for alternatives. Not only are there alternatives to TBPB but they outperform TBPB in many critical areas. For instance, TAEC reduces cycle time, lowers residual styrene, and decreases energy costs.

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