Product Data Sheet

Trigonox® 21S

Product description

tert-Butyl peroxy-2-ethylhexanoate

CH₃(CH₂)₃CH(COOCH₃)CH(COOCH₃)CH₃

Molecular weight: 216.3
Active oxygen content peroxide: 7.40%
CAS No.: 3006-82-4
EINECS/ELINCS No.: 221-110-7
TSCA status: listed on inventory

Specifications

Appearance: Clear liquid
Color: 20 Pt-Co max.
Assay: 95.0% min.
Active Oxygen: 7.0% min.
Hydroperoxides as TBHP: 0.3% max.
Inorganic + organic hydrolysable chloride: 100 mg/kg max.

Characteristics

Density, 20°C: 0.900 g/cm³
Viscosity, 20°C: 4.3 mPa.s

Storage

Due to the relatively unstable nature of organic peroxides a loss of quality can be detected over a period of time. To minimize the loss of quality, AkzoNobel recommends a maximum storage temperature (Tₛ max.) for each organic peroxide product.

For Trigonox 21S

Tₛ max. = 20°C and
Tₛ min. = -30°C to prevent crystallization

When stored according to these recommended storage conditions, Trigonox 21S will remain within the AkzoNobel specifications for a period of at least 3 months after delivery.

Thermal stability

Organic peroxides are thermally unstable substances, which may undergo self-accelerating decomposition. The lowest temperature at which self-accelerating decomposition of a substance in the original packaging may occur is the Self-Accelerating Decomposition Temperature (SADT). The SADT is determined on the basis of the Heat Accumulation Storage Test.
For \textit{Trigonox} 21S

\begin{center}
\begin{tabular}{ll}
SADT & : 35°C \[ \text{Emergency temperature (T}_{\text{em}}) \] : 25°C \\
Control temperature (T_c) & : 20°C \\
\end{tabular}
\end{center}


\textbf{Major decomposition products}

Carbon dioxide, tert-Butanol, Heptane, 3-tert-Butoxyheptane

\textbf{Packaging and transport}

In North America \textit{Trigonox} 21S is packed in non-returnable, vented, five gallon polyethylene containers of 35 lb net weight.

In other regions the standard packaging is a 30-liter HDPE can (Nourytainer®), vented, for 25 kg peroxide content.

Both packaging and transport meet the international regulations. For the availability of other packed quantities consult your AkzoNobel representative.

\textit{Trigonox} 21S is classified as Organic peroxide type C; liquid, temperature controlled, Division 5.2; UN 3113

\textbf{Safety and handling}

Keep containers tightly closed. Store and handle \textit{Trigonox} 21S in a dry well-ventilated place away from sources of heat or ignition and direct sunlight. Never weigh out in the storage room.

Avoid contact with reducing agents (e.g. amines), acids, alkalis and heavy metal compounds (e.g. accelerators, driers and metal soaps).

Please refer to the Material Safety Data Sheet (MSDS) for further information on the safe storage, use and handling of \textit{Trigonox} 21S. This information should be thoroughly reviewed prior to acceptance of this product.

The MSDS is available at polymerchemistry.akzonobel.com

\textbf{Applications}

\textit{Trigonox} 21S, tert-butyl peroxy-2-ethylhexanoate, is a perester which is used for the curing of unsaturated polyester resin at elevated and high temperatures.

\textit{Trigonox} 21S is preferred for the curing of UP resin based Hot Press Moulding formulation (such as SMC and BMC) in the temperature range of 120 - 160°C. As \textit{Trigonox} 21S is a high reactive peroxide, it is very suitable as a kicker in formulations for pultrusion and SMC/BMC.

In combination with a cobalt accelerator, \textit{Trigonox} 21S is also applicable for the cure of UP resins in the temperature range of 60°C and higher. Application area can be air drying lacquers, diplacquers, wall panels, filament winding, etc.

\textit{Trigonox} 21S has normally a much shorter pot life in the pure resin than \textit{Trigonox} C, tert-butyl peroxybenzoate.
Dosage

Depending on working conditions, the following dosage levels are recommended:

- Trigonox 21S: 1 - 2 phr
- Accelerator NL-49-P: 0.5 - 3 phr

Cure Characteristics in pure UP resin

In a high reactive standard orthophthalic UP resin the following application characteristics were determined:

Activation temperature

<table>
<thead>
<tr>
<th>Compound</th>
<th>Temperature</th>
<th>Pot life</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 phr Trigonox 21S</td>
<td>60°C</td>
<td>22 days</td>
</tr>
<tr>
<td>1 phr Trigonox 21S + 1 phr Acc. NL-49P</td>
<td>50°C</td>
<td>5 days</td>
</tr>
</tbody>
</table>

Pot life at 20°C

<table>
<thead>
<tr>
<th>Compound</th>
<th>Pot life</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 phr Trigonox 21S</td>
<td>22 days</td>
</tr>
<tr>
<td>1 phr Trigonox C</td>
<td>56 days</td>
</tr>
<tr>
<td>1 phr Trigonox 21S + 1 phr Acc. NL-49P</td>
<td>5 days</td>
</tr>
<tr>
<td>1 phr Trigonox C + 1 phr Acc. NL-49P</td>
<td>17 days</td>
</tr>
</tbody>
</table>

For the application at elevated temperatures the following reactivity data give an idea of the performance:

Time-Temperature curves at 70°C and 90°C

<table>
<thead>
<tr>
<th>Compound</th>
<th>Cure Gel Time to Peak exotherm</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 phr Trigonox 21S</td>
<td>70°C 9 min. 16 min. 233 °C</td>
</tr>
<tr>
<td>1 phr Trigonox 21S + 1 phr Acc. NL-49P</td>
<td>70°C 3 min. 5 min. 214 °C</td>
</tr>
<tr>
<td>1 phr Trigonox 21S</td>
<td>90°C 1 min. 6 min. 258 °C</td>
</tr>
<tr>
<td>1 phr Trigonox 21S + 1 phr Acc. NL-49P</td>
<td>90°C 0.3 min. 1.5 min. 240 °C</td>
</tr>
</tbody>
</table>

Cure Characteristics in Hot Press Moulding

In a standard Hot Press Moulding (HPM) compound based on a high reactive orthophthalic polyester resin with calcium carbonate as filler and magnesium oxide as thickening agent, the following application characteristics were determined:

Shelf life at 30°C

<table>
<thead>
<tr>
<th>Compound</th>
<th>Shelf life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Not pigmented + 5 phr iron oxide black</td>
<td>14 days</td>
</tr>
<tr>
<td>1 phr Trigonox 21S</td>
<td>17 days</td>
</tr>
<tr>
<td>1 phr Trigonox C</td>
<td>17 days</td>
</tr>
</tbody>
</table>

Platengel time

<table>
<thead>
<tr>
<th>Compound</th>
<th>Mould temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>120°C</td>
<td>13 s</td>
</tr>
<tr>
<td>140°C</td>
<td>85 s</td>
</tr>
</tbody>
</table>

*p = parts per hundred resin
Minimum Moulding time

Measured in a 4 mm cup shaped moulding at 140°C.

1 phr **Trigonox 21S** 15 s
1 phr **Trigonox C** 60 s

For more information about the performance of the peroxide in the HPM application, reference can be made to the technical bulletin ‘Initiators for UP Resin moulding compounds’.

*Trigonox and Nourytainer are registered trademarks of Akzo Nobel Chemicals B.V. or affiliates in one or more territories.*