

Hydroquinone and hydroquinone derivatives

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Inhibitor mechanism

Polymerization is initiated by free radicals. The function of an inhibitor is to tie up these free radicals by reacting with them to form stable compounds. Hydroquinone and certain derivatives form these stable compounds in the presence of oxygen. The free radical reacts with oxygen to form a peroxy-free radical. Hydroquinone reacts with this peroxy-free radical to form a free radical complex. The complex then reacts with another peroxy-free radical to form stable compounds.

Eastman Chemical Company offers a series of hydroquinone and derivatives that are practical storage and in-process inhibitors when used by themselves or in combinations. Inhibitor(s) selection should be based on evaluations in your specific system or application. The purpose of this publication is to help you select the most likely candidates and remind you that this family of compounds can be used for purposes other than stopping undesirable reactions.

Hydroquinone (HQ)

HQ is a good general-purpose inhibitor, stabilizer, antioxidant, and intermediate. It is offered in photographic and USP grades. One of the major uses for hydroquinone is an intermediate to make other inhibitors, stabilizers, antioxidants, agricultural chemicals, and dyes.

Mono-tertiary-butylhydroquinone (MTBHQ)

MTBHQ is an effective storage inhibitor for unsaturated polyesters and a highly effective antioxidant for nonfood fats and oils and unstable organic solvents. It is also useful as a cook stabilizer for highly reactive unsaturated polyesters.

2,5-Di-tertiary-butylhydroquinone (DTBHQ)

DTBHQ is an effective inhibitor, antioxidant, and stabilizer. It is useful as an antioxidant for rubber articles and as a stabilizer against odor and color development in various compositions. It is also used in combination with other inhibitors as a storage inhibitor for unsaturated polyesters. In addition, DTBHQ is used as a stopping agent in rubber emulsions and an antiskinning agent in paints.

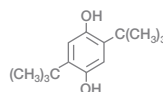
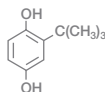
Toluhydroquinone (THQ)

THQ is an inhibitor, antioxidant, and intermediate. As an inhibitor, it is an extremely effective cook stabilizer for highly reactive unsaturated polyesters. It is useful as an antioxidant for oleates, linseed oil, and other nonfood fats and oils. As an intermediate, THQ enters into reactions that are similar to, yet somewhat different from, those of HQ because the methyl group provides some shielding effect.

Applications

| | HQ | MTBHQ | DTBHQ | THQ |
|---|----|-------|-------|-----|
| Antioxidants | | | | |
| for nonfood fats and oils | • | • | | • |
| Inhibitors | | | | |
| for vinyl monomers | • | • | • | |
| for acrylic monomers | • | | | |
| for unsaturated polyesters | • | • | • | • |
| against peroxides in certain solvents | • | • | | |
| Intermediates | | | | |
| for antioxidants and antiozonants | • | | • | |
| for agricultural chemicals | • | | | |
| for dyes | • | | | |
| Stabilizers | | | | |
| against skinning in paints | • | | | |
| against color in emulsion polymerizations | | | • | |
| against color in detergents | | | | |
| against color in polyether polyols | | | | |
| against UV in certain compounds | | • | • | |
| Depigmenting agents | | | | |
| for cosmetic creams | • | | | |
| Stopping agents | | | | |
| for polymerization reactions | | | • | • |
| Catalysts | | | | |
| for oxidation of mercaptans | | | | • |

Typical properties^a



| | HQ ^b | MTBHQ | DTBHQ | THQ |
|---------------------------------|--|--|--|--|
| Empirical formula | C ₆ H ₆ O ₂ | C ₁₀ H ₁₄ O ₂ | C ₁₄ H ₂₂ O ₂ | C ₇ H ₈ O ₂ |
| Molecular weight | 110.11 | 166.21 | 222.31 | 124.13 |
| Physical form | crystals | crystals | crystals | crystals |
| Color | white to off-white | white to tan | white to tan | white to off-white |
| Specific gravity | 1.328 | 1.109 | 1.084 | 1.336 |
| Bulk density, g/mL | 0.66 | 0.22 | 0.61 | 0.60 |
| Assay, wt % | 99.0 min | 98.0 min | 99.0 min | 99.0 min |
| Ash, wt % | 0.004 | — | — | 0.006 |
| Water, wt % | 0.36 | 0.13 | 0.06 | — |
| Melting point, °C (°F) | 171 (340) | 125 (257) | 216 (421) | 126 (259) |
| Boiling point, °C (°F) | 286 (547) | 300 (572) | 313 (595) | 285 (545) |
| Flash point, °C (°F) | 177 (351) | 171 (340) | 216 (421) | 172 (342) |
| Fire point, °C (°F) | 191 (376) | 174 (345) | 216 (421) | 177 (351) |
| Autoignition temp., °C (°F) | 494 (921) | 457 (855) | 421 (790) | 455 (851) |
| Angle of repose | 33 | 58 | 34 | 48 |
| Solubility at 25°C, g/100 g, in | | | | |
| Water | 7 | insoluble | insoluble | 8 |
| Acetone | 20 | 112 | 39 | 98 |
| Ethyl acetate | 22 | 575 | 48 | 38 |
| Ethyl alcohol | 57 | 605 | 35 | 35 |
| Benzene | insoluble | insoluble | 2 | 0.2 |

^aReported for information only. Eastman makes no representation that material in any particular shipment will conform to the values listed.

^bTypical property bulletins are available for all grades of hydroquinone and derivatives.

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