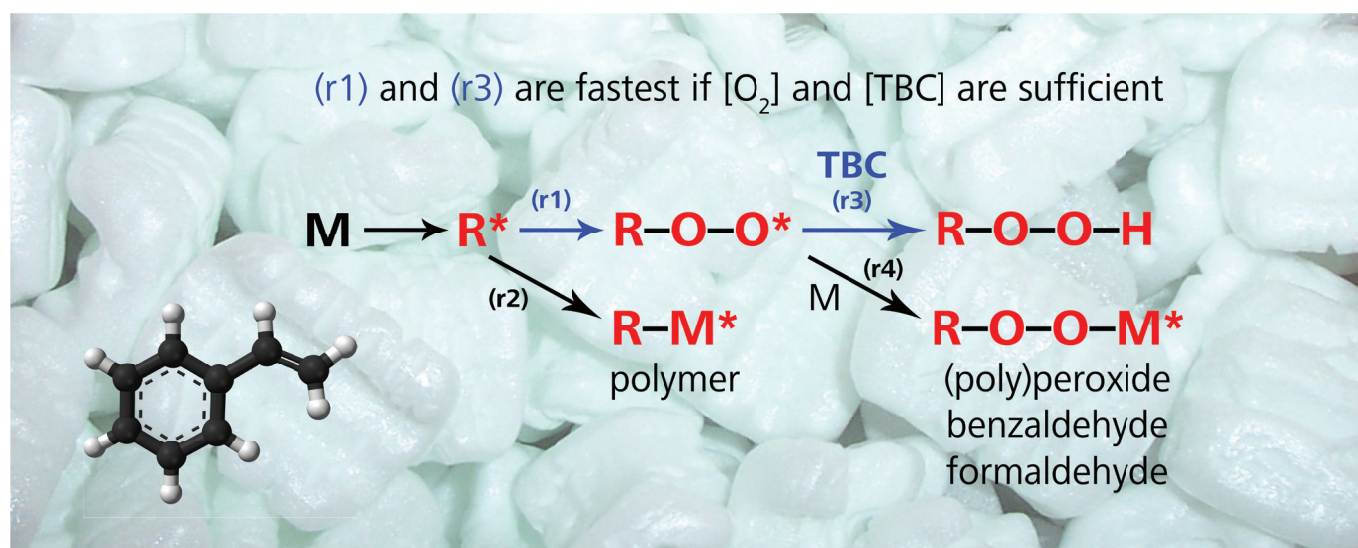


Inhibiting Polymerization: Monitoring the Concentration of TBC in Styrene According to ASTM D4590

More than 27 million tons of styrene monomer ($C_6H_5CH=CH_2$) are produced worldwide each year. The stabilizer 4-tert-butylcatechol (TBC) plays a crucial role in preventing premature polymerization during storage and transport of styrene, butadiene, vinyl acetate, and other reactive monomers. When these monomers (**M**) are exposed to either light or heat, they form radicals (**R***) which can react with either oxygen (causing peroxide radicals) or with other monomers, creating polymer chains. This polymerization reaction itself is exothermic, and if not contained, can lead to runaway polymerization in the tank with serious consequences.

TBC is a free radical inhibitor which requires oxygen to prevent the monomers from polymerizing. A minimum concentration of O_2 is required in solution (10–15 mg/L) as well as in the headspace because of the monomer vapors present there. The O_2 addition is necessary to take advantage of different reaction kinetics – peroxide radical formation (**r1**) occurs much faster than styrene polymer formation (**r2**). In the presence of the correct amount of TBC, these peroxide radicals are scavenged (**r3**). Otherwise, the peroxide radicals react with styrene monomers to form peroxide chains (polyperoxides, **r4**) until the oxygen is completely depleted. These contaminations can cause a hazard during purification processes (distillation) due to the instability of peroxides at increased temperatures. In order not to compromise the product quality, the TBC concentration in styrene has to be maintained above 10–15 mg/L TBC. To control TBC depletion, close monitoring of its concentration is required. A Process Analyzer from Metrohm Applikon configured for photometric analyses accomplishes this at the inlet of the styrene storage tank, ensuring optimal storage conditions.



Mechanism for the inhibition of polymer formation in styrene monomer with the addition of TBC and O_2 .

Application: The method used is based on ASTM D 4590-13 for the colorimetric analysis of 4-tert-butylcatechol (TBC) in styrene. The results are calculated based on a photometric determination at 490 nm.

Typical Range: 0–50 mg/L 4-tert-butylcatechol (TBC)

Remarks: In a hazardous environment, the process analyzers have to be Ex proof like the ADI 2045TI Ex proof Analyzer.