Objectives

After completing this section, you should be able to

1. write an equation to describe the industrial preparation of ethylene oxide.
2. list two important industrial uses of ethylene oxide.
3. write an equation to describe the normal laboratory preparation of an epoxide.
4. identify the epoxide produced from the reaction of a given alkene with a peroxyacid.
5. identify the alkene, the reagent, or both, needed to prepare a given epoxide.
6. write an equation to describe the preparation of an epoxide from an alkene via a halohydrin.

Key Terms

Make certain that you can define, and use in context, the key term below.

• epoxide (oxirane)

**Epoxides** (also known as **oxiranes**) are three-membered ring structures in which one of the vertices is an oxygen and the other two are carbons. Edit section

\[
\begin{align*}
&\text{\text{O}} \\
\text{\text{\text{C}} - \text{\text{\text{\text{\text{C}}}}}} \\
&\text{\text{\text{\text{\text{\text{\text{\text{\text{R}}}}}}}}}
\end{align*}
\]

The most important and simplest epoxide is ethylene oxide which is prepared on an industrial scale by catalytic oxidation of ethylene by air.

\[
\text{H}_2\text{C}≡\text{CH}_2 \xrightarrow{\text{O}_2} \text{O} \\
\text{Ag}_2\text{O}, \Delta
\]

Ethylene oxide is used as an important chemical feedstock in the manufacturing of ethylene glycol, which is used as antifreeze, liquid coolant and solvent. In turn, ethylene glycol is used in the production of polyester and polyethylene terephthalate (PET) the raw material for plastic bottles.

Oxacyclopropane synthesis by peroxycarboxylic acid requires an alkene and a peroxycarboxylic acid as well as an appropriate solvent. The peroxycarboxylic acid has the unique property of having an electropositive oxygen atom on the COOH group. The reaction is initiated by the electrophilic oxygen atom reacting with the nucleophilic carbon-carbon double bond. The mechanism involves a concerted reaction with a four-part, circular transition state. The result is that the originally electropositive oxygen atom ends up in the oxacyclopropane ring and the COOH group becomes COH.
Epoxides can also be synthesized by the treatment of a halohydrin with a base. This causes an intramolecular Williamson ether synthesis.

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