Chapter 4
Production of Ethylene and its Commercial Importance in the Global Market

Ahmad Alshammari
King Abdulaziz City for Science and Technology, Saudi Arabia

Abdulaziz Bagabas
King Abdulaziz City for Science and Technology, Saudi Arabia

Venkata Narayana Kalevaru
Leibniz Institute for Catalysis, Germany

Andreas Martin
Leibniz Institute for Catalysis, Germany

ABSTRACT

Ethylene is the largest of the olefin markets and is also one of the most important petrochemically derived monomers that are used as a feedstock for the production of various commercially useful chemical products (e.g. polyethylene, polymers, fibers etc.). The primary objective of this chapter is to provide a comprehensive overview about olefins particularly ethylene production technologies and its commercial significance in the world market. The content of this chapter is presented as follows: a general overview about olefins production is given. This is followed by introducing the reader to ethylene including its properties importance/applications. The next section describes the production technologies of ethylene and some of its selected derivatives, followed by an overview of the technology, market, costs, capacity, global demand and supply of ethylene technology. Finally, main points and outlook of this highly industrially important commodity chemical are summarized.

OLEFIN PRODUCTION

General Introduction (Solomons, 1996)

Olefins or alkenes are hydrocarbons structurally distinguished by their carbon-carbon double bond. They are generally represented by the molecular structure shown in Box 1.

Ethene or ethylene is the simplest olefin because both of its double bond carbon atoms are not substituted (i.e. they are only attached to hydrogen atoms). Propene or propylene is a gaseous mono-substituted olefin where a methyl group ($-CH_3$) is attached to one of the double bond carbon atoms, thereby extend-

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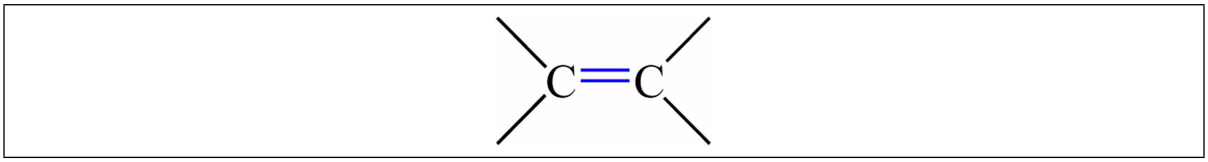
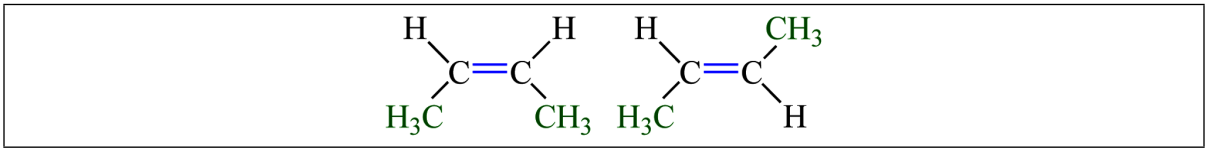
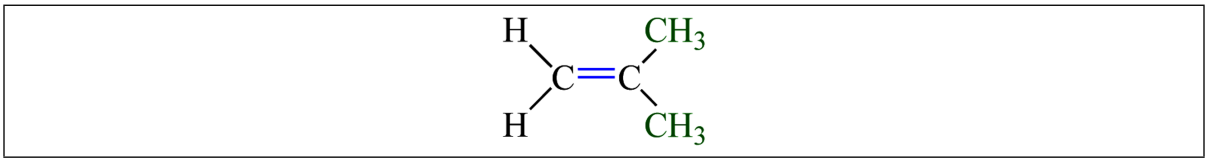
Box 1. General molecular structure of olefins



Box 2. Molecular structure of cis- and trans-2-butene



Box 3. Molecular structure of 2-methylpropene



ing the hydrocarbon chain by one carbon atom. Disubstitution of both of the double bond carbon atoms leads to the emergence of two diastereomers: *cis* when both of the substituent groups are on the same side and *trans* when they are on opposite sides. Box 2 shows an example of the diastereomers *(cis* and *trans*) of 2-butene.

However, diastereomerism disappears when both of the substituent groups are attached to one carbon atom of the double bond, as in the case of isobutene or 2-methylpropene (Box 3).

For trisubstituted and tetrasubstituted alkenes, alkene stereochemistry cannot be described anymore in terms of *cis* and *trans*; it is conveniently described by the Cahn-Ingold-Prelog convention, known as the (*E*)–(*Z*) system, on the basis of group priority. Both E and Z symbols come from German Language, i.e. the E comes from a German word “entgegen”, which means opposite, and also the symbol Z comes from a German word “zusammen”, which means together. Alkene stereochemistry is designated (*E*) when groups of higher priority are on opposite sides of the carbon atoms of the double bond. On the other hand, alkene stereochemistry is designated (*Z*) when groups of higher priority are on the same side of the carbon atoms of the double bond. Box 4 shows an example of the two diastereomers (*E*) and (*Z*) of 1-bromo-1-chloro-1-pentene.

Box 4. Molecular structure of (E)- and (Z)-1-bromo-1-chloro-1-pentene