



**ETHYLENE DIMERIZATION AND
OLIGOMERIZATION TO BUTENE-1 AND
LINEAR α -OLEFINS**

A Review of Catalytic Systems and Processes

by

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PREFACE

This issue of *Catalysis Today* presents a comprehensive status of the processes and catalysts used for ethylene dimerization and oligomerization to butene-1 and higher linear α -olefins, based on the literature reviewed up to 1991, and covers only those contributions that are remarkable and relevant. The large number of publications and patents in this field reveal the extensive scientific research that has been conducted during the last twenty years and the importance of α -olefins as key intermediates for detergents, plasticizers, polyethylenes, and a variety of other fine chemicals. The main objective of this review is to examine in depth the present state of knowledge of ethylene dimerization and oligomerization, and identify the production technologies, catalysts used, and relevant patents in the field.

Linear α -olefins are represented by the chemical formula $RCH=CH_2$, where R is a normal alkyl group having two to eighteen carbon atoms. These α -olefins are clear, colorless, mobile liquids with the exception of butene-1 which is gas at ambient condition of temperature and pressure. Reactions at the double bond of these olefins with a variety of organic and inorganic compounds lead to a myriad of chemical products. Many of these have found commercial use in the chemical and petrochemical industries. Alpha olefins consumption, that has grown dramatically since 1964, is expected to continue to expand.

The review is divided into two parts – Part 1: ethylene dimerization to butene-1 and Part 2: ethylene oligomerization to α -olefins. The catalytic systems are classified and discussed according to the type of active metal employed in the dimerization or oligomerization reaction. Representative and typical operating conditions and reaction mechanisms of widely accepted scope are elucidated with each catalytic system. Commercial and prospective processes of each technology are discussed and compared. The current industry status of butene-1 and α -olefins production as well as commercial applications of these olefins are discussed and reviewed. The conclusions present the significant results of selected catalytic systems, their effectiveness in the dimerization and oligomerization of ethylene, and the disadvantages in using other catalytic systems with respect to the selectivity of products, catalyst stability and by-products formation.