



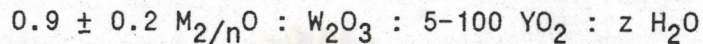
CHAPTER I

INTRODUCTION

Crystalline zeolites are complex materials chemically and structurally, because of the complexity, Smith [1] proposed the loose definition : " a zeolite is an aluminosilicate with a framework structure enclosing cavities occupied by large ions and water molecules both of which have considerable freedom of movement, permitting ion-exchange and reversible dehydration." The framework structure consists of corner-linked tetrahedra in which small atoms (collectively denoted T atoms) lie at the centers of tetrahedra and oxygen atoms lies at the centers. The T sites of all natural zeolites are dominated by Al and Si atoms, but chemically related atoms such as Ga, Ge, and P can be incorporated into synthetic zeolites. The large ions in the cavities of natural zeolites are mono- or divalent, the principle species (Na, Ca, K, Mg, and Ba) reflect the geochemical abundance and the competition with other minerals during geochemical differentiation. The ideal formular of zeolites is $M_p D_q [Al_{p+2q} Si_r O_{2p+4q+2r}] \cdot n H_2 O$: the infinite corner-sharing of tetrahedra requires that there are twice as many framework oxygens as T atoms, while charge balance requires that the number of trivalent Al ions equals the sum of p (monovalent) ions and twice q (divalent) ions. Zeolites can also be considered in terms of the densities of bonds Si-O-T (T=Al or Si) in the x, y, and z directions. Certain network anions have bond densities comparable in all directions ; others have bond densities greater in two directions than in the third ; and others have these densities greater in one direction than in the remaining two [2]. For pentasil zeolites, network anions have bond

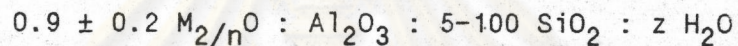
densities in all directions and have relatively continuous channels. The pentasil zeolites are consisted of ZSM-5, ZSM-11, Silicalite I, and Silicalite II.

A family of ZSM-5 compositions can be identified in terms of mole ratios of oxides, as follows:



wherein M is a cation, n is the valence of said cation, W is selected from the group consisting aluminum and gallium, Y is selected from the group consisting of silicon and germanium, and z is from 0 to 40.

In the preferred synthesized form, the zeolite has a formula in terms of mole ratios of oxides, as follows :



and M is selected from a group consisting of a mixture of alkali metal cations, and tetraalkylammonium cations, the alkyl group of which preferably contain 2-5 carbon atoms. Crystals of synthetic zeolite ZSM-5 are shown in fig.1.1.

Among the industrial used catalysts, zeolites are one of the most useful catalyst. Zeolites, both natural and synthetic, have been demonstrated in the past to have catalytic capabilities for various types of hydrocarbon conversion. Zeolite applications are summarized as follows [3] : adsorption, ion-exchange, hydrogenation and dehydrogenation, shape-selective reforming, methanol to gasoline conversion, hydrocarbon conversion ; alkylation ; cracking ; hydrocracking ; isomerization, etc. For ZSM-5 zeolites, they are useful in cracking and hydrocracking, not only that, they are outstanding useful in other petroleum refining processes indicating again the unique catalytic characteristics of this family of zeolites. The later process include isomerization of n-paraffins and naphthenes, polymerization of compounds containing an olefinic or acetylenic carbon to carbon linkage such as isobutylene and

butene-1, reforming, alkylation, isomerization of polyalkyl substituted aromatics, e.g., ortho xylene and disproportionation of aromatics such as toluene to provide a mixture of benzenes, xylenes, and higher methylbenzenes. The ZSM-5 catalysts have exceptional high selectivity and under conditions of hydrocarbon conversion provide a high percentage of desired products relative to total products compared with known zeolitic hydrocarbon conversion catalysts. In addition to the thermal stability of this family of zeolites under these conditions, they provide conversion of the cracked oil to materials having low molecular weights and boiling points which are of greater economic value [4].

Because of the importance as mentioned above, therefore, the purposes of this study were :

1. to synthesize pentasil zeolite catalyst,
2. to study the effects of chemical compositions of crystal, initial pressures, pH of mixing solutions, temperatures and times in crystal synthesis, and temperatures and times in calcination process on structure and size of pentasil zeolite catalyst,
3. to study the optimum conditions effecting the structure of catalyst synthesis .

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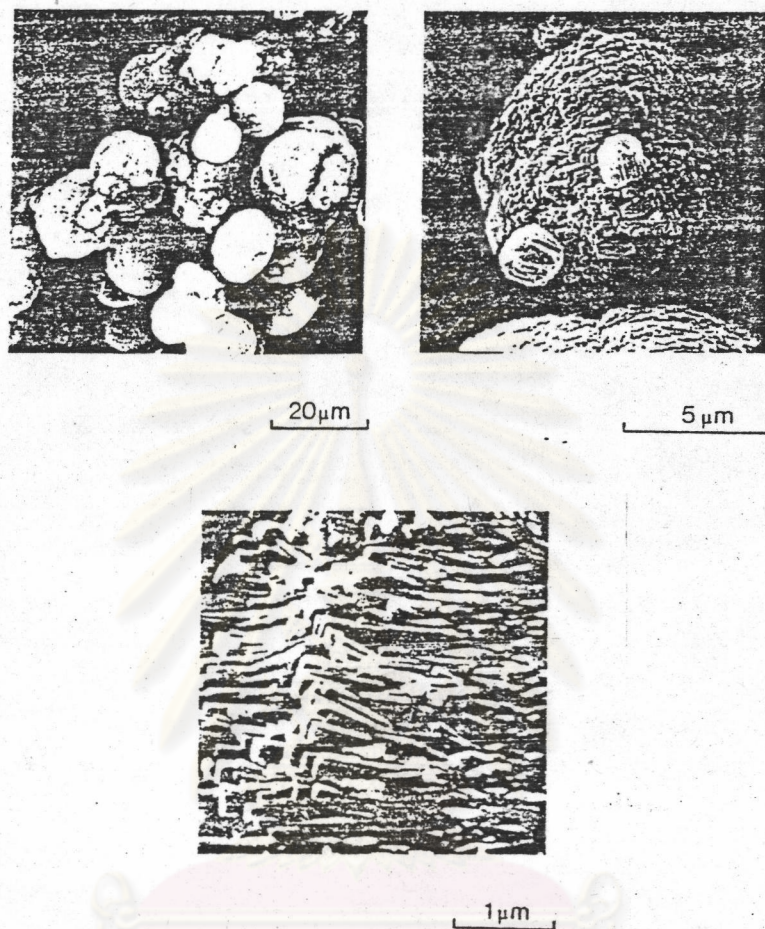


Figure 1.1 SEM micrographs showing the polycrystalline aggregate-type morphology obtained for (Na)ZSM-5.

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