INTERNATIONAL JOURNAL OF RESEARCHES IN BIOSCIENCES, AGRICULTURE & TECHNOLOGY
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www.vmsindia.org

ZEOLITICAL CHEMISTRY: A REVIEW

S. S. Deo, F. Inam, S. Ansari and R. D. Utane
Organo-Analytical Lab, Dept. of Chemistry, Govt. Institute of Science, Nagpur (M.S.), India-440001
rdutane@hotmail.com

Abstract:
The purpose of this paper is to review the recent study in structure, nomenclature and synthetic methods of zeolite. The report shows how to obtain synthetic methods of zeolite, their properties and broad application not only in refineries in catalysts, in modern zeolitical Materials.. The effect of green method during ageing and curing step is prior to conventional method was also investigated and it was found to reduce the synthesis time of pure zeolite.

Keywords: Nomenclature, Refineries in Catalyst, Green Method, Zeolitical Material.

1. Introduction

Zeolites are crystalline, micro porous, meso porous, hydrated, aluminosilicate of alkali and alkaline earth metals. They are built from an infinitely extending three dimensional network of [SiO4]4- and [AlO4]5- tetra hydra which are link to each other by sharing of one oxygen atom the negative charge on the lattice is neutralize by positive charge of cation located within the materials pores.

Zeolites are cheap and effective materials for developing countries to solve their environmental and organic synthetic application problems. Some possibilities of catalytic and non catalytic utilization of zeolite are introduced. Zeolite are very important materials with very broad application not only in refineries as catalysts in adsorption and separation processes, but also in agriculture, new building materials and environmental engineering. Zeolite is application in modern areas like microelectronics and molecular device manufacturing to medical diagnosis.

1.1History:

The zeolite mineral was discovered in 1756 by Swedish chemist and mineralogist Axel Fredicka Cronstedt. They were named "Zeolite" from the greek word meaning boiling stones, i.e. ability to fizz when heated up to 200^{0}C. the enormous development in the information of structure, synthesis, modification, characterization and very broad usage of exceptionally characteristics of zeolite and zeolite like materials was reached in the period of about 250 years. 60 years ago zeolite were only considered as mineral found in volcanic rocks. Providentially and uses of zeolite started in 1960s.

1.2 Structure of zeolite

1.2.1Empirical formula:

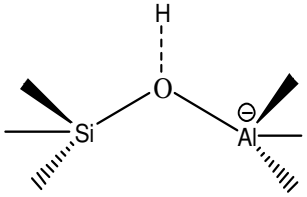
The empirical formulaof zeolite is $M_XD_Y[Al_{X+2Y}Si_{n-(X+2Y)}O_{2n}]mH_2O$ where M is alkali metals, D is alkaline earth metals, x is monovalent cations, n is valence of cation and m is number of water molecules in the zeolite empirical formula.

1.2.2Structural formula

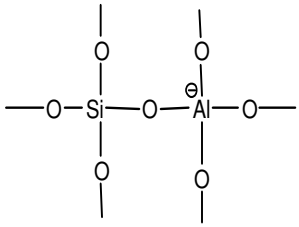
The general structural formula is based on crystallographic unit cell

1.2.3Framework structure of zeolite

Chemical structure of zeolite in planarity the primary building units (PBUs) for zeolite is in tetrahedron and the geometric arrangement of tetrahedron are secondary building units (SBUs) the identical geometry was developed by repeating of SBUs. Zeolites are composed of pores and corner sharing aluminosilicate (AlO4 and SiO4) tetrahedrons, joined into3-dimentional frameworks.



(a)



(b)

(c)

Figure:1 a) chemical structure of Zeolite b) Primary Building unit (PBUs) of Zeolite structure c) Secondary Building unit (SBUs) of Zeolite Structure.

1.3Nomenclature:

The nomenclature has common usage for systematic classification scheme for zeolite. These micro porous and meso porous materials create networks of regular pores such as windows, cages, cavities, channels and effective channel width.

1.3.1Windows:

The n-rings defining the face of polyhedron pore are called windows.

1.3.2Cages:

A polyhedral pore whose windows are too narrow to be penetrated by guest species larger than H_2O called cage.

For example: sodalite cage

1.3.3Cavities:

A polyhedral pore, which has least one face defined by a ring enough to be penetrated by guest species, but which is not infinitely extended is called cavity.

1.3.4Channels:

A pore i.e. infinitely extended in one dimension and is large enough to allow guest species to diffuse along its length is called channel.

1.3.5Effective channel width:

\The effective width of a channel is a fundamental characteristic of a micro porous and meso porous material that describes the accessibility of the pore system to guest species.

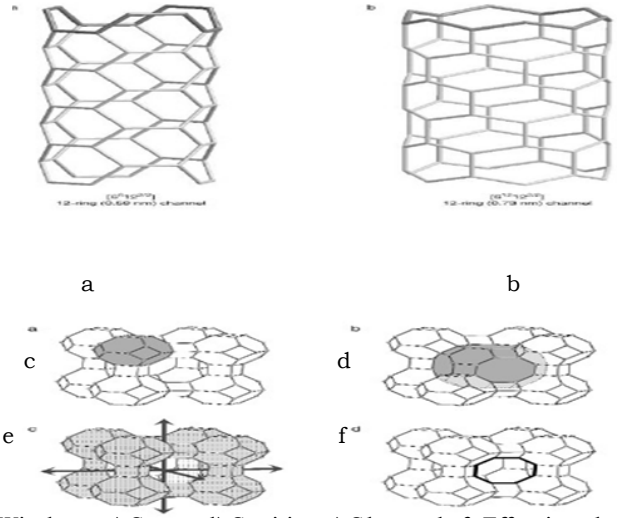


Figure2. a) And b) Windows c) Cages d) Cavities e) Channels f) Effective channel width

2. Materials:

On focusing the synthesis and structural chemistry of zeolite like micro porous, meso porous materials as well as host guest type silicon between (Si) and Aluminum (Al) and their oxides. Hence Zeolite contains combination of oxides of Si and Al. The wide varieties of possible materials are due to the larger number of ways in synthesis of zeolite. In present investigation there are two types of sources such as Silica and Alumina. In current trends various type of raw materials present in industrials waste such as silica source i.e. coal fly ash, rice husk, kaolinite clay, Tunisian sand and alumina source i.e. Al-Dross, aluminum scrap, red mud, etc.

2.1Silica sources:

2.1.1Fly ash: It is waste material produce by various thermal power plants.

2.1.2Rice husk: It is waste material produce by farming and rice mill.

2.2Alumina Source:

2.2.1Al-Dross: This Dump material obtained during electrolysis of alumina by various aluminum refineries.

2.2.2Red mud: this dump material obtained during bayers process by various alumina refineries.

3. Synthetic Methods:

In recent trends commercially synthetic zeolite are more often used than natural zeolite due to their particle size and crystallinity. The materials are characterized by Scanning electron microscopy (SEM), X-Ray Diffraction (XRD), X-Ray Fraction (XRF) and BET Methods.

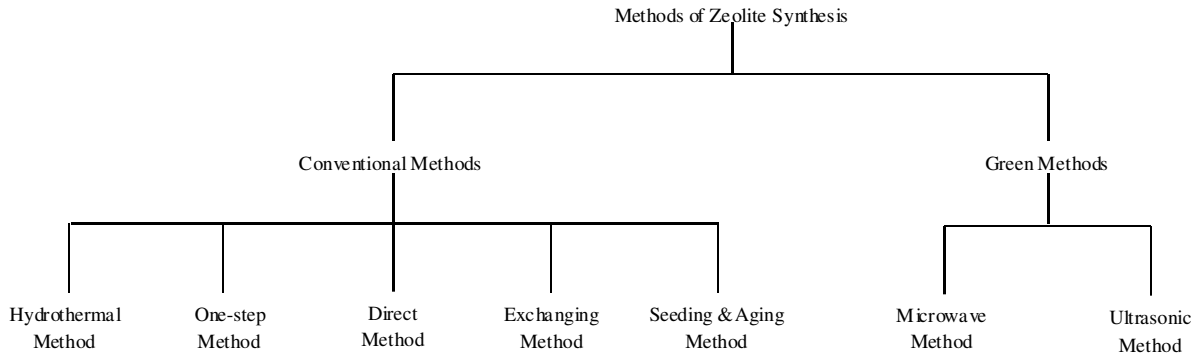


Figure3. Methods of Zeolite Synthesis

3.1Conventional Method:

Conventional zeolite synthesis involves the various methods like hydrothermal, One Step, Direct, Exchanging, Seeding and aging method

3.1.1Hydrothermal method: Zeolite was synthesized at high temperature and pressure using autoclave.

3.1.2One step Method: Materials were fused with sodium hydroxide in muffle furnace.

3.1.3Direct Method: Two raw materials directly mixed with different condition to synthesize **zeolite.

3.1.4Exchanging Method: Sodium type zeolite (Na-Zeolite) mixed with Metal salt i.e. Cu, Fe, and Ni, etc. and stirred at room temperature.

3.1.5Seeding and aging Method: It is use to produce highly pure zeolite with the absence of other impurities.

3.2Green method for Synthesis of zeolite:

In current trends, the main problem in zeolite researcher is the availability and cost of raw materials and conventional synthetic method. In materials specifically in alumina and silica source. Alumina sources are Dross, redmud, etc. by Green method like Microwave and ultrasonic method

3.2.1Microwave method: Microwave irradiation activates the materials and synthesized the zeolite. This method is used to reduce the time as well as increase the yield of zeolite.

3.2.2Ultrasonic method: This method is use to remove curing step (long heating).ultrasonic sound wave irradiate with materials used for synthesis of zeolite.

4. Acknowledgement:

The author Rajdip Utane is gratefully acknowledges the funding support rendered by DST, New Delhi for the INSPIRE fellowship [IF140439]. We thanks to Dr. R.G. Atram, Director Institute of Science, Nagpur for providing the necessary research facility

5. Conclusion:

Green technology enhancing new tool for catalytically chemistry among which can find altered zeolite with new and exceptional properties. An objective for modern works is to prolong the possibilities of the new methods for preparation of zeolites. In searching of modified methods in such way that lowering the cost of the procedures and protecting the environment. The consumption of zeolite as micro porous and meso porous materials is based on their unique pore size and it is characterized by different technique such as SEM, XRD, XRF and BET methods.

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