Removal of Water Hardness by Zeolite Process

ADITYA JADHAV[1], ROHIT CHALAK[2], VIJAY GHOLAP[3], VISHWAJEET IGE[4], ARPAN DESHMUKH[5]

[1, 2, 3, 4] *Student, Department of Civil Engineering, G H Raisoni College of Engineering and Management, Wagholi, Pune*

[5] *Assistant Professor, Department of Civil Engineering, G H Raisoni College of Engineering and Management, Wagholi, Pune*

Abstract— The use of low-cost materials in zeolite synthesis becomes an area of important interest in water softening. This research is aimed to utilize kaolin for zeolite synthesis with hydrothermal method. Mechanical, thermal chemical treatments of raw kaolin were used for zeolite synthesis. Fourier Transform Infrared Spectrometry (FTIR), AAS, XRD, surface area (BET), differential scanning calorimetry and TGA were used to characterize kaolin and zeolite and UV–VIS/spectrometer were used for adsorption capacity of ion exchange Effect of contact time, pH solution and temperature of the solution were studied for batch experiments.

I. INTRODUCTION

Zeolite is microporous mineral which is used as catalyst in many industrial purposes such as water purification and air purification The zeolite are hydrated alumina silicates and general composition $Al_xSi_yO_2$ (x+y) (without water molecules) Zeolite are two types natural and synthetic or artificial. The natural that is used of water softening in gluconates or green sand .Permutt is synthetic and it's chemical formula is Na_2O, Al_2O_3, $nSiO_2$, xH_2O. These are used as ion exchange and our movalin water softener. Permutt are more porous, glassy, and have higher softening capacity than green sand Nowadays, the increasing interest in zeolite synthesis from low-cost materials has promoted the development of various studies on their conversion into zeolitic materials, giving rise to an extensive advantage particularly with regards to high quality drinking water and removal of pollutants from industrial, agricultural and municipal wastewaters (Kesraoui-Ouki et al. 1994).Kaolin possesses the Si-O or Al-O octahedral and tetrahedral sheets which are in active to modification overactivation This means that it is difficult to directly synthesize Zeolites and the kaolin must be pre-activated to change this inert structure (Shukur 2015).

II. METHODOLOGY

Kaolin was used for synthesized zeolite as source of silicon and aluminum for metal adsorption. 98% concentrated sulfuric acid was used to split it into its silica and alumina components Anhydrous sodium hydroxide pellets (NaOH) were used as the activating agent. An electric furnace was used for calcinating natural kaolin at 750 °C for 3 hours. A digital balance (Sartorius with 0.01 mg sensitivity) was used for weighing of raw materials and chemicals. A sieve was used to determine the particle size of kaolinite clay powder. A jaw crusher (BB51) was used for crushing kaoliniteclayto,0.075mm and an oven dryer (PH- 030A) was used to dry samples at a temperature of 105 °C for 24hrs

III. INSTRUMENTATION

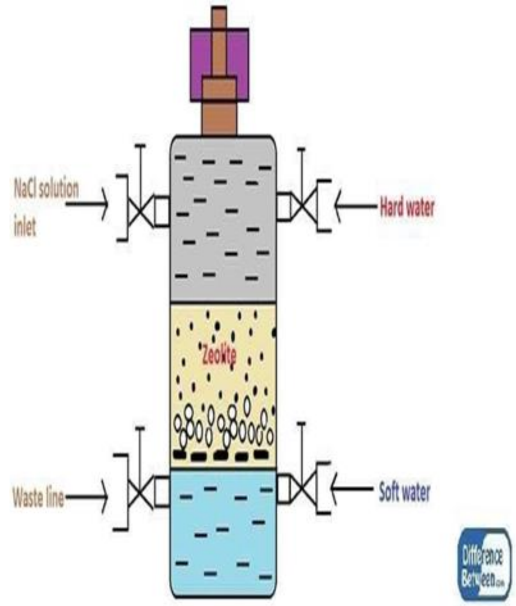
An electric furnace was used for calcination of the raw kaolin at 750 °C for 3 hours. A BrunauerEmmett- Teller (BET) machine was used to analyze surface area and pore size. X-ray diffraction (XRD) 700 SHIMADZU Technology was used to crystalize and purify the zeolite A JASCO MODEL 4100 Fourier Transformed Infrared Radiation (FTIR) Spectrometer was used to measure the absorption of IR radiation by zeolite as the atoms vibrate about their bond. Atomic absorption spectrometry (AAS) was used for elemental composition analysis. A UV/Vis spectrometer was used for determination of the adsorption/capacity of ion exchange with hardness causing metal. A differential scanning calorie meter (DSC) - 8000 and ATAT2012 Thermogravimeter analyzer was used for thermal analysis of synthesized zeolite and kaolin.

IV. PROCESS OF ZEOLITE

In the water softening process, we pass the hard water through a bed of zeolite (inside a cylinder) at a specified rate. Then the cations that cause the water-hardening will retain on the zeolite bed because these cations exchange with the sodium cations of zeolite. Therefore, the water coming out of this cylinder contains sodium cations rather than calcium and magnesium cations.

When all sodium ions are replaced by calcium and magnesium ions, the zeolite becomes inactive. Then the zeolite needs to be regenerated. Brine solutions are passing through the bed of inactivated zeolite. The following reactions are taken place and form Na_2Ze.After some time, the zeolite bed gets exhausted. Then we have to stop the water flow and treat the bed with concentrated brine solution (10%) in order to regenerate the zeolite. When we treat the bed with a brine solution, it washes

Away all the calcium and magnesium ions by exchanging them with sodium ions in a brine solution Therefore, this treatment regenerates the zeolite.



V. RESULT

This chapter deals with the result obtained during the completion of test. The study was depending upon the water hardness removal in waste water Result obtained during the research and complete the practical process work are presented by following table. The study water hardness is important for avoiding health problem. The problem is coming out mainly in rainy season. So, this problem avoids we need to check water hardness.

We exactly use the zeolite is 5 ml or 5 grams and 4 bottles of water use in tank which means the 4 liters of water this case we understood the hardness of water before testing is 110ppm and after completion of test water hardness is 89ppm

VI. CONCLUSION

The results of the present investigation show that natural kaolin is an abundant and low-cost material that can be synthesized for the removal of metals such as calcium and magnesium from water. Synthetic zeolite contains a high percentage SiO2, which makes it a useful material for hardness removal. The removal efficiency is influenced by the pH of the adsorbent. The best adsorption capacity for Caþ2 and Mgþ2 ions is achieved at pH 6.5. Equilibrium time after stirring is reached in 150 minutes for synthetic zeolite. The effect of solution temperature influences the adsorption/ion exchange process Low temperatures favor the removal of hardness. The removal rate of calcium.

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