

REMOVAL OF SEAWATER HARDNESS CONTAIN Ca^{2+} ION USING NATURAL ZEOLITE AS ADSORPTION

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Abstract

Indonesia was an archipelago country in which 2 / 3 was surrounded by the ocean. Sea water contains many minerals that was useful and there was also elements that harm human beings one of which is Ca^{2+} ions that cause water hardness. Ions can be removed by using natural zeolite as adsorption. This research was expected to utilize zeolite as an absorber to absorb Ca^{2+} ions contained in seawater causes of hardness so that it can be used and processed further and can be applied on an industrial scale. The method used in this research was batch research. Before the zeolite was used for adsorbent, zeolite first activated using NaOH 1N. Zeolite already active is mixed with seawater and then stirred. The conditions used in this research are the conditions specified amount of sea water, the weight of zeolite and stirring speed. While working conditions are the zeolite particle size and stirring time. Based on the results of research conducted, the best conditions obtained on the zeolite particle size of 100 meshes with 75 minutes of stirring time, producing levels of calcium (Ca^{2+}) of 909.25 mg / liter.

Key words: hardness, sea water, zeolite, adsorption

1. INTRODUCTION

Water is an important element in life. Almost all life on earth is not apart from any element of this water. The main source of water that supports life on this earth is the sea, and all water will eventually return to the sea that acts as a reservoir or container. Water can experience the hydrological cycle. While undergoing the hydrologic cycle of water is always absorbs the substances that cause the water was no longer pure.

These substances are absorbed by natural water can be classified as dissolved solids, dissolved gases and suspended solids. In general type of impurities contained in water depends on the type of material that comes. Mineral materials that can be contained in the water because of its contact with the rocks consist mainly of: calcium carbonate (CaCO_3), magnesium carbonate (MgCO_3), calcium sulfate (CaSO_4), magnesium sulfate (MgSO_4), and so forth.

Zeolite has a cavity that can be filled by a variety of materials in accordance with the desired, and zeolite crystals also have a porous structure and large surface area. With these capabilities, the zeolite can be utilized in various purposes i.e. as adsorbent.

Adsorption activity is usually influenced by the size and amount of adsorbent used, the more surface area means smaller size and number of more and more the faster the process of adsorption equilibrium is

reached. In previous researchers who use flow column method with variation of height of the bed of zeolite 5, 10, and 15 cm with zeolite size 20-30 meshes. Zeolite was found most effective is the height of the bed 15 cm can reduce as much as 200 ppm. And zeolite with a size 20-30 mesh with a weight of 60 grams has a great ability to absorb Ca^{2+} ions. (Astatina, Syariufidin, 2004)

Zeolite as an adsorbent is able to remove ions Ca^{2+} (calcium), which became a cause of water hardness that can be used for water purification and can be applied in daily life as clean water that is free of Ca^{2+} ions. Seawater is used because seawater contains a lot of Ca^{2+} ions cause water hardness.

2. BASIC THEORY.

Seawater

Sea is a vast collection of salt water and is associated with the ocean. Water in sea is a mixture of 96.5% pure water and 3.5% other materials such as salts, dissolved gases, organic materials and particles not dissolved. The main physical property of sea water is determined by the 96.5% pure water. Rock weathering process continues due to rains that occurred and was carried into the oceans, causing sea water more salty. Seawater is water that has dissolved therein a variety of solids and gases. In 1000 g will contain \pm

35 g soluble compounds that are collectively and salt. In other words 96.5% of seawater is in the form of pure water and 3.5% of the solute. Solute includes salts of inorganic solids, the largest fraction of dissolved material consisting of solid inorganic materials. These ions are Chlorine, Sodium, Sulfate, Magnesium, Calcium, and Potassium. Four subsequent ions are Bicarbonate, Bromide, As, Borate, and Strontium. (Nybakken, J.W, 1992)

Results of content analysis of seawater samples are Calcium (Ca): 1273 mg / L

In general, water with hardness less than 50 mg / l = 50 ppm (as CaCO₃) is corrosive. Instead of water with hardness higher than 80 mg / l will require a lot of soap when used for washing. Therefore, hardness of the water is considered good if the hardness value is between (50-80) mg/l).

The softening of hard water aimed at improving water quality, in order to be consumed by the public. In addition, water hardness will remove the active power of soap, the crust formed on the cooking appliance, a blockage in the plumbing and making vegetables become hard.

Zeolite

Zeolite is usually found in a state mixed with other minerals such as sodalite, feldspar and leusite. Zeolite in the nature often found in the holes of lava rocks, and sedimentary rocks, especially in fine-grained pyroclastic sediments (tuff). (Haryanto, 1987).

Main Content of Natural Zeolite:

SiO ₂ = 62.75 %	Al ₂ O ₃ = 12.71 %
K ₂ O = 1.28 %	CaO = 3.39 %
Na ₂ O = 1.29 %	MnO = 5.58 %
Fe ₂ O ₃ = 2.01 %	MgO = 0.85%

(Prayitna, 1988)

Zeolite have a cavity filled by a variety of materials as desired, and in this empty room can act as catalysts for a reaction. (Kirk, Othmer, 1981)

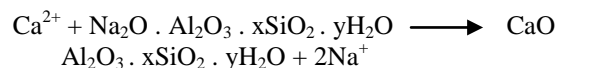
With these capabilities, the zeolite can be utilized in various purposes namely absorption (separation / purification), ion exchange, and a catalyst. The factors that influence the adsorbtion process, namely:

1. The size of Adsorbent particle
2. Temperature
3. Time

The mechanism of Zeolite Reaction

Absorption mechanism that may occur in the zeolite is a physical absorption and chemical absorption. The effectiveness of these mechanisms depends on the absorbed species, ion exchange capacity of zeolite, the acidity of the surface, and the moisture content of zeolite adsorbent.

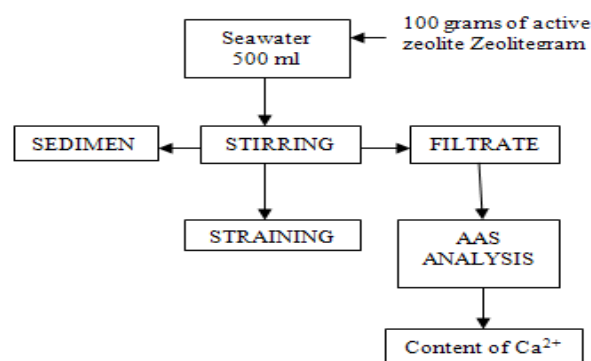
Exchange occurs between the zeolite with NaOH as follows:



3. RESEARCH METHODOLOGY

Zeolite preparation procedures

Natural zeolite to be used grinded and then sifted according to the size specified. Weigh 100 grams of zeolite then wash it using distilled water, insert the zeolite into NaCl 1N solution with a ratio of 1 gram of zeolite in 10 ml solution stirred for 24 hours. After stirring and then filtered and washed with distilled water to neutral (pH of secondhand washed water measured with pH paper). Strain again to be able to separate the filtrate to residue. Dry the residue in an oven at temperatures of 110-120⁰C for 3 hours and the filtrate discarded.

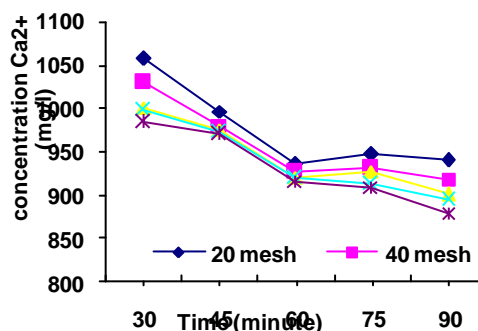


Research flow chart

4.

RESULT AND DISCUSSION

From the results of research on ion Ca²⁺ in



seawater by using AAS method is obtained data below.

Figure 1. The relationship between Ca²⁺ ion concentration with stirring time

From Figure 1 shows that the adsorption of zeolite for the Ca^{2+} is very depend on processing time, where the longer time the process result the absorption of Ca^{2+} metal will be greater and this is because the process of absorption of the Ca^{2+} metal is the physical processes that are running slowly (takes time), the longer absorption time mean of the absorbed metals will be greater or metal left in the seawater will be smaller but at a certain time a decrease in Ca^{2+} ion concentration of this is due to the weakening of zeolite active power. The best condition was obtained at 75 minutes of stirring time with zeolite size of 100 meshes with Ca^{2+} ion concentration of 909.25 mg / l.

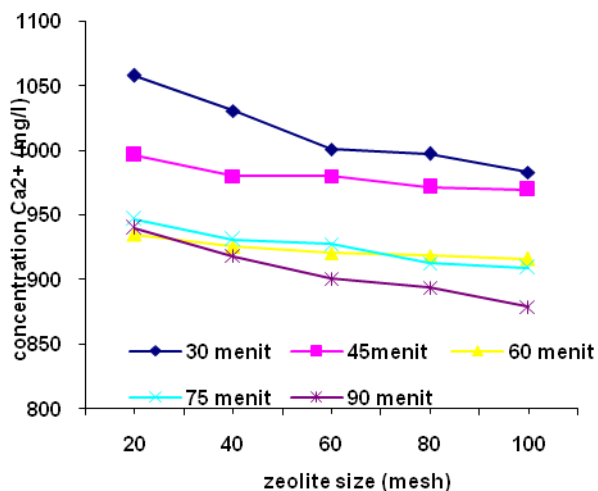


Figure 2. The relationship between Ca^{2+} ion concentrations with particle size of zeolite

From Figure 2 shows that the adsorption of zeolite for the Ca^{2+} metal depend on the particle size of zeolite. Where the particle size of zeolite is smaller, the active power of zeolite has greater absorb Ca^{2+} metal in seawater so that less and less. In the zeolite particle size of 20 meshes, the Ca^{2+} concentration and decreased only slightly and this is because the small surface area of zeolite, while for the zeolite particle size 100 meshes zeolite the higher absorption due to the large surface area. The best condition was obtained at 75 minutes of stirring time with zeolite size of 100 meshes with Ca^{2+} ion concentration of 909.25 mg / l.

5. CONCLUSION

Based on research that has been done, it can be concluded:

1. The bigger the surface area of zeolite particle the greater the adsorption capacity of Ca^{2+} metal.
2. The longer the stirring time, the greater absorption of Ca^{2+} ions occurs so that the

higher the absorbed until it reaches its saturation point is at 75 minutes.

3. The relatively good conditions of adsorption for Ca^{2+} ions occurs on the zeolite particle size of 100 meshes with a weight of 100 grams of zeolite, the stirring speed of 200 rpm and stirring time for 75 minutes the final Ca^{2+} concentration of 909.25 mg / l.
4. Zeolite can be used as an adsorbent to reduce the metal content of Ca^{2+} in seawater but it has not been able to meet the standardization of quality standards as clean water for hardness as CaCO_3 with a concentration of 500 mg / l.

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