THE INFLUENCE OF ACTIVATED ZEOLITE ON THE DECREASING OF NH_3 CONCENTRATION IN FISH POND WATER

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ABSTRACT

A research on the utilization of zeolite from Tadisi Village, Sumarorang, Polmas, West Sulawesi had been carried out. The objective of this research is to identify the influence of activated zeolite both physically and chemically on the decreasing of NH_3 concentration in fish pond water.

The physical activation in this research was done by heating of zeolite samples at the temperature of 100, 200 and 300°C , while the chemical activation was carried out by using reagent of NaOH with the concentration of 2 N. The particle size of the zeolite used in this research was – 4 + 10 mesh and the weight of activated zeolite samples put into the fish pond water samples were 1; 5; and 10 grams with contact time of 0, 1, and 5 days, respectively.

The optimal result of this research indicated that by the addition of 5 grams of the activated zeolite (which had been activated at the temperature of 300°C with contact time for one day), the NH_3 concentration of fish pond water samples decreased as much as 54.97 %. The addition 10 grams of the activated zeolite (which had been activated by NaOH with concentration of 2 N with contact time for five days showed the optimum result by decreasing of the NH_3 concentration in fish pond water samples as much as 45.01 %.

Keywords : Zeolite, ammonia, activation temperature, fish pond water

1. INTRODUCTION

The industrial mineral deposit in Indonesia has a great potency and widely spread through out Indonesian islands. One of such industrial mineral is zeolite which is occurred in Tadisi village, Sumarorang, Polmas, West Sulawesi. This zeolite has not been utilized optimally yet.

To increase the utilization of zeolite, a research was carried out to identify the influence of the type of zeolite activation both physically and chemically to the decreasing of NH_3 concentration in fish pond water.

The research activities consisted of field work and laboratory research. The purpose of field work was to characterize the zeolite by sampling. The zeolite samples were then analysed by chemical and XRD analysis as well as ion exchange capacity The laboratory a research was carried out to identify the influence of activated zeolite both physi-

cally and chemically on the decreasing of NH_3 concentration in fish pond water samples. Physical activation was carried out by heating the zeolite samples at temperature of 100, 200 and 300°C while the chemical activation was carried out by NaOH with the concentration of 2 N and the particle size of zeolite sample used in this experiment was – 4 + 10 mesh. The activated zeolite samples were then put into the fish pond water samples by contact time of 0; 1 and 5 days with the weight of activated zeolite samples were 1; 5; and 10 grams respectively. The results of this research were analysed and evaluated for identifying the influence of this activation both physically and chemically on the decreasing of NH_3 concentration in fish pond water sample.

2. METHODOLOGY

The research methodology consisted of collecting secondary data from previous research or literature study; also field work sampling of zeolite and fish pond water. Zeolite characterization was carried out by chemical and XRD analysis and ion exchanges capacity as well as the experimental work in laboratory.

2.1. Sampling

The sampling activities consisted of sampling of the zeolite in Tadisi village, Sumarorang, Polmas, West Sulawesi and sampling of water and mud in fish pond in Maros, South Sulawesi. Zeolite sampling was taken at the out crop or in the slop of the hill using channel sampling method. Water sampling in the pond fish was carried out at the surface of pond fish button. All of these samples were sent and analysed in laboratory for identifying their characteristics.

2.2. Characterization

To identify the characteristic of the zeolite, characterization had been carried out by using chemical, mineral analysis and ion exchange capacity.

The chemical analysis was carried out by using AAS (Atomic Absorption Spectrophotometer). The objective of chemical analysis is to determine the chemical composition of the zeolite comprising of: SiO_2, Al_2O_3, Fe_2O_3, CaO, K_2O, MgO, TiO_2, Na_2O and LOI. To identify the mineral composition of zeolite, mineral analysis had been conducted using XRD (X-Ray Diffraction). The determination of ion exchange capacity was carried out with activation for 1, 2 and 3 hours by using particle size of – 4 + 10 mesh, methilen bleu of 0.01 N, sample weight of 0.50 grams and titration volume of 32 ml.

2.3. Experimental Works

The experimental activities consisted of preparation, activation of zeolite, and the utilization of activated zeolite for fish pond water treatment and analysing NH_3 concentration in fish pond water sample (Figure 1).

2.3.1 Zeolite Sample Preparation

The zeolite sample used for conducting the research was prepared by crushing zeolite up to 3 cm of particle size, followed by grinding and sizing of zeolite to obtain the particle size of – 4 + 10 mesh.

2.3.2 Zeolite Activation

The particle size used in this activation was – 4 + 10 mesh. There are two methods of activation of the zeolite that had been conducted namely physical and chemical activation.

Chemical activation was done by stirring the mixture of zeolite and NaOH solution at concentration of 2 N, and keep the mixture for 6 hours. This mixture was then filtered for separating activated zeolite and NaOH solution followed by washing activated zeolite with water. Physical activation was carried out by heating the zeolite at the activation temperature of 100, 200, and 300°C. The heating rate temperature was 10^o/minute. The temperature was kept for 6 hours after reaching the activation temperature of 100, 200 and 300°C.

2.2.3 Experimental Procedures

The experimental was conducted in several step as follows :

The water and mud of fish pond water sample were put in the calibrated beaker (volume one litre) and its NH_3 concentration was analysed. The activated zeolite of 1, 5 and 10 gram (which had been activated at the temperature of 100, 200 and 300°C) were put into the calibrated beakers (volume one litre) kept the mixture for 5 days and then its NH_3

concentration was analysed. With the same methods, the activated zeolite of 1, 5, and 10 gram (which had been activated with NaOH solution of 2N) were put into the other calibrated beaker (volume one litre), kept the mixture for 5 days and then its NH_3 concentration was analysed.

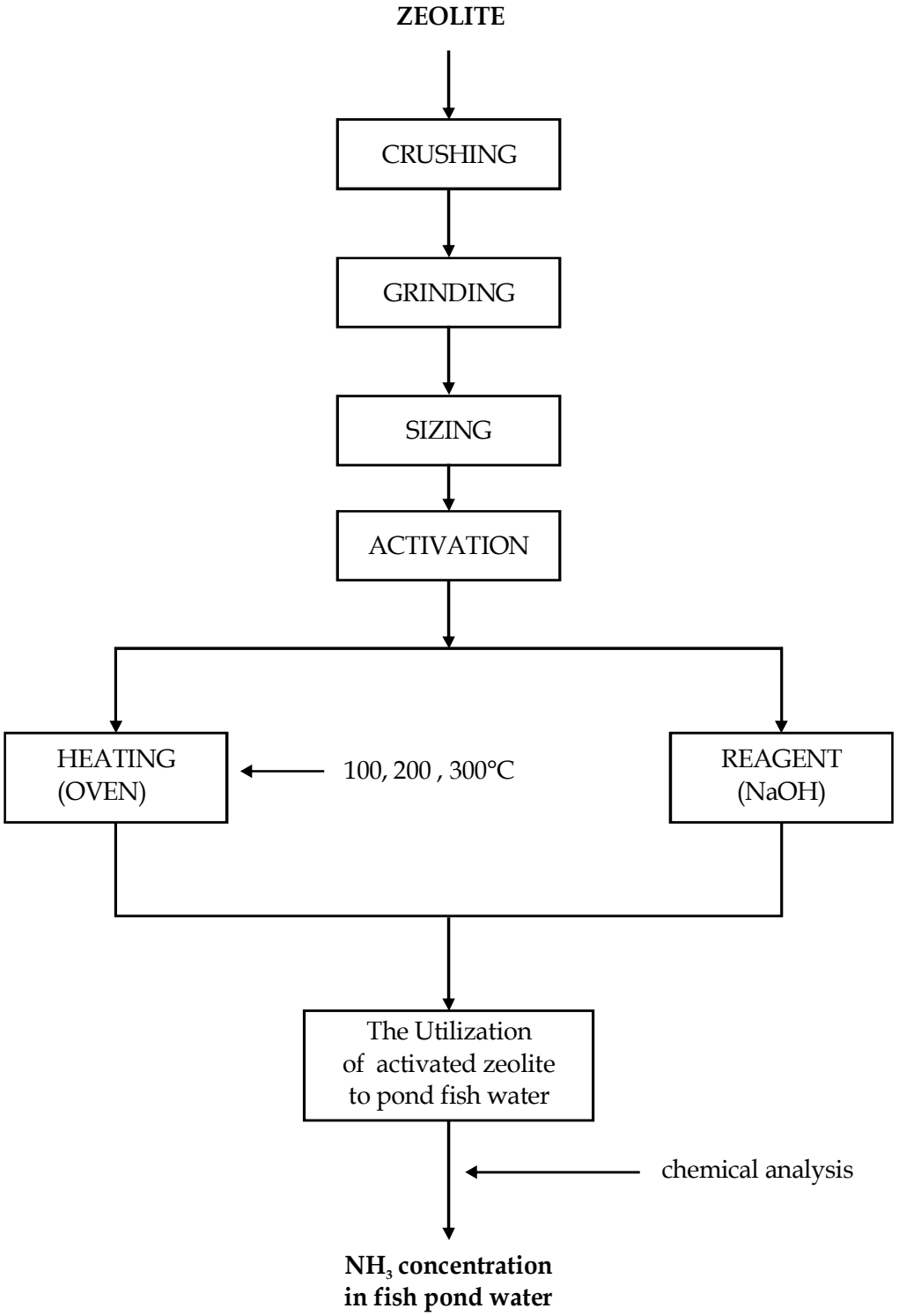

Figure 1. Flow chart of the experimental work

3. RESULTS AND DISCUSSION

3. 1. Zeolite Characterization

The analysis result of chemical composition of the zeolite is shown in Table 1.

Table 1. Chemical composition of zeolite

No	Oxides component	Weight (%)
1	SiO_2	66.30
2	Al_2O_3	14.95
3	Fe_2O_3	1.14
4	TiO_2	0.15
5	CaO	1.89
6	MgO	1.24
7	K_2O	5.03
8	Na_2O	0.45
9	LOI	7.62

Based on the chemical analysis of the zeolite sample (Table 1) with a high content of LOI (7.62 %) indicated that this material contain zeolite mineral (Handhoyo et al, 1993), because zeolite has a void structure which is filled with ions and water molecules that move freely. This void structure has a great possibility to have a high absorption ability. The zeolite absorption capacity depend on the channel diameter and the specific surface area of the zeolite .Theoretically, the material will be absorbed by the zeolite when the channel diameter of material is less than the channel diameter of zeolite (Lenny and Sofiyah, 1995). The higher the channel diameter of zeolite, the higher of the absorption capacity of zeolite (Gani, et al, 1998).

According to the previous data (Dinas Pertambangan TK I, 1998) the result of XRD analysis indicated that this zeolite is dominated by clinoptilolite. This condition is supported by the high content of K_2O (5.03 %) which is indicated in Table 1. Based on the pore structure, the clinoptilolite is silicate alumina which has the channel diameter of 3.5 A and can absorb materials such as H_2O, CO_2, oxygen, nitrogen etc (Mumpton, 1981).

Based on the determination of ion exchange capacity (IEC) of zeolite (Table 2) indicated that IEC had an optimal result of 120.5 meq/100 gr with activation time of 3 hours and the addition of methilen blue of 60.5. The activation of clipnotilolite type of zeolite for less than five hours will not destroy the crystal structure of zeolite (Lenny and Sofiyah, 1995).

Table 2. Ion exchange capacity of zeolite

No	Activation time (minutes)	Methilen blue (ml)	Ion exchange capacity (meq/100 grams)
1	60	37.0	74.0
2	120	49.1	98.2
3	180	60.5	120.5

3.2 The Influence of Activated Zeolite

The results of NH_3 concentration of fish pond water before and after the addition of activated zeolite with NaOH activation is shown in Figure 2.

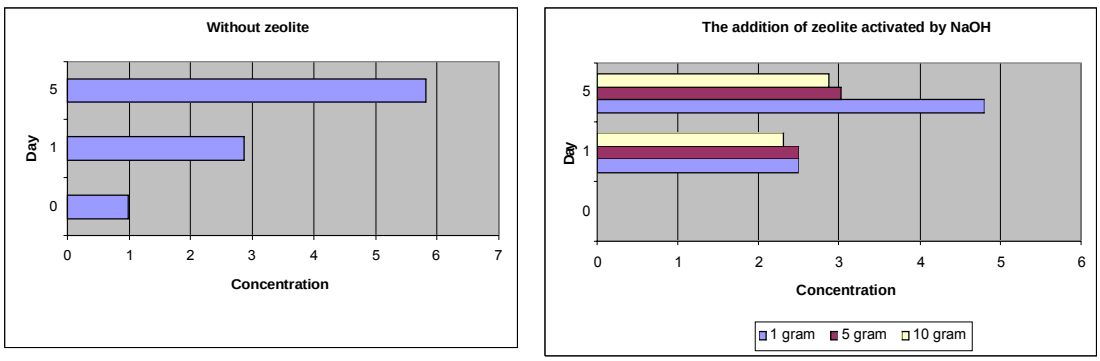

Figure 2. NH_3 concentration of fish pond water before and after the addition of zeolite activated by NaOH

The result of the experiment (Figure 2) shows that NH_3 concentration in fish pond water sample decreased after the addition of the zeolite activated by NaOH either one or five days.This condition was effected by dissolving of some materials/minerals contained in the zeolite void structure, therefore the absorption of zeolite will increase. Besides, by the addition of more zeolite, into fish pond water sample, its NH_3 concentration will decrease due to the increasing absorption capacity as well as the void structure of zeolite

The results of NH_3 concentration of fish pond water samples before and after the addition of activated zeolite with the actvation temperature of 100, 200 and 300° can be seen in Figure 3, 4 and 5 respectively.

Based on the experimental data (Figure 3, 4 and 5), the NH_3 concentration in fish pond water samples before and after addition of activated zeolite with the activation temperature of 100, 200, and 300°C indicated that the higher the activation temperature, the higher the decreasing NH_3 concentration in fish pond water samples. This condition was effected by the decreasing of H_2O^+ or H_2O^- in the zeolite void structure. The higher of activation temperature, the less of water content in the zeolite void structure, consequently the higher absorption capacity of zeolite.

From this research, the optimum result indicated that by the addition of activated zeolite which was activated at the temperature of 300°C and with

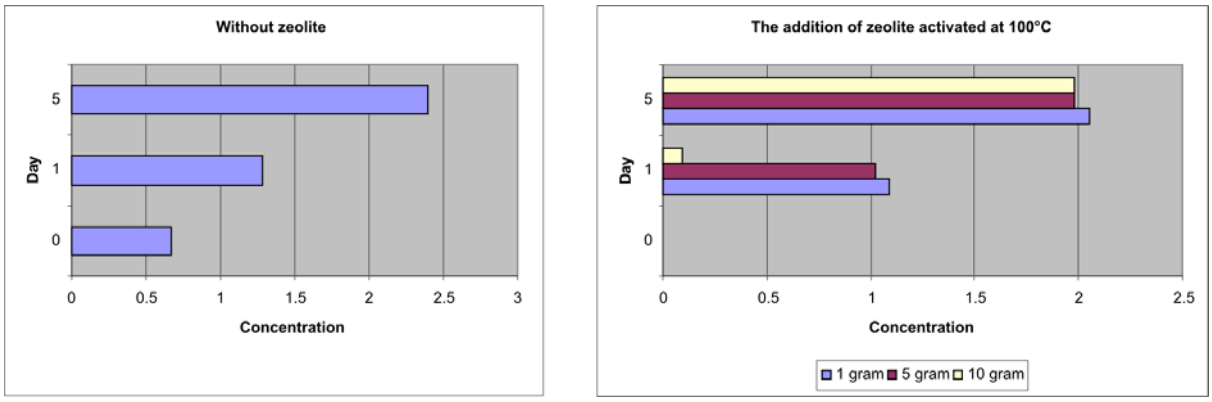

Figure 3. NH_3 concentration of fish pond water before and after the addition of zeolite activated at 100°C

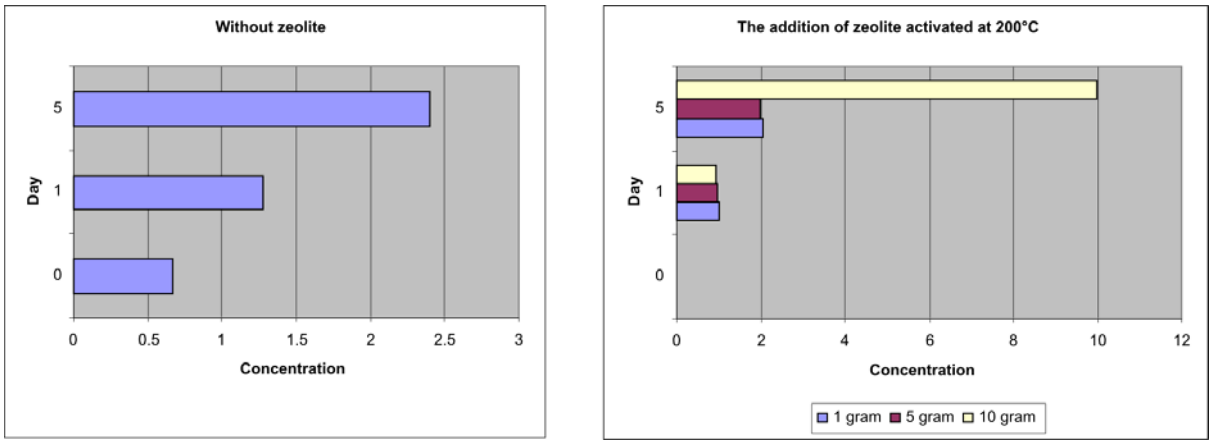

Figure 4. NH_3 concentration of fish pond water before and after the addition of zeolite activated at 200°C

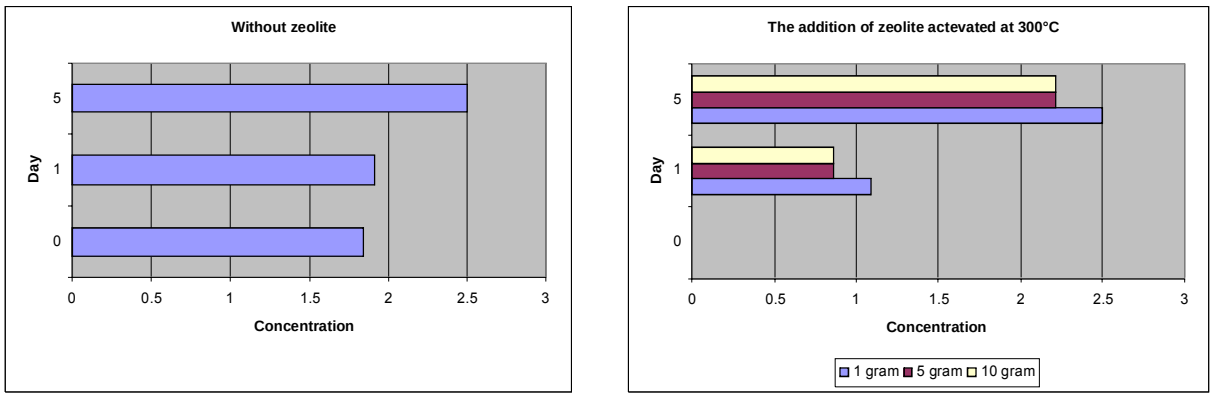

Figure 5. NH_3 concentration of fish pond water before and after the addition of zeolite activated at 300°C

NaOH solution 2 N into fish pond water decreased their NH_3 concentration of 54.97 % and 45.01 % respectively.

4. CONCLUSION

Based on the experimental results, some conclusion can be drawn as follows :

1. Zeolite is identified as clinoptilolite which has a void structure filled by ions and water molecules, can move freely and it had a high absorption ability after activation

2. The most effective ion exchange capacity was shown by the activation of zeolite for three hours.

3. The decreasing of NH_3 concentration in fish pond water samples after the addition of activated zeolite was better than that of without any addition of zeolite.

4. The optimum result of this experiment indicated that by the addition of 5 gr of the activated zeolite (which had been activated at 300°C with contact time for one day) NH_3 concentration in fish pond water samples decreased as much as 54.97 % while the addition of 10 gr of activated zeolite (which had been activated by NaOH with concentration of 2 N and contact time for five days showed the optimum result by the decreasing of NH_3 concentration in fish pond water samples as much as 45.01 %.

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