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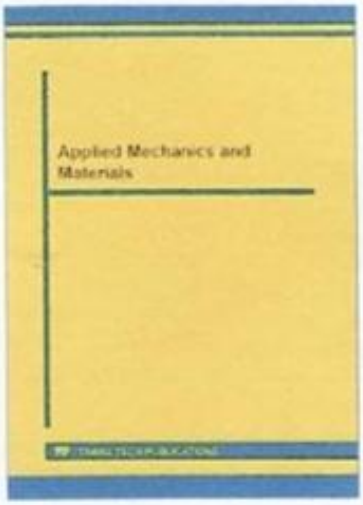

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Manufacture of Water Vapour Filter Based on Natural Pahae Zeolite Used for Hydrogen Fueled Motor Cycle

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Keywords: Pahae zeolite, activation, absorption, water vapour, filtration.

Abstract. Province of North Sumatera has been well known as a territory having multi kind of industrial minerals which have not been used and maintained properly and optimally. One of which is a natural Pahae zeolite derived from Tarutung, Tapanuli Utara-Indonesia. The objective of this research is to exploit Pahae zeolite to absorb water molecules flowing into the combustion chamber of a hydrogen fueled motorcycle. The generation of water molecules was as a result of water splitting process in water to hydrogen converter of the motorcycle. The grain size of Pahae zeolite was lessened up to 60 and 200 meshes which were then chemically activated by soaking with 30% KOH solution and calcination at a temperature of 300°C for 2 hours. The test results conducted on the intake pipe of combustion chamber showed that the particle size of 200 meshes had more absorption than that of 60 meshes. It was also found that type of Pahae zeolite had better absorption compared with Cikalong zeolite.

Introduction

The fossil energy crisis is still to be a main issue in this world until now. An innovation of developing hydrogen fueled motorcycle has been doing in Laboratory of Terpadu Fisika, University of Sumatera Utara-Indonesia as an effort to overcome the problem since 2009. The motorcycle is equipped with electronic water to hydrogen converter to generate hydrogen gas flowed into a combustion chamber. Even thought, the motorcycle made a success of travelling without utilizing gasoline, but incomplete combustion occurred occasionally as the road test. This was caused by the hydrogen gas flow to combustion chamber brought with the water molecules from the converter. Therefore, the filtering of water molecules in hydrogen gas pipeline of the motorcycle becomes very necessary.

In this work, zeolite derived from Pahae has been exploited as a raw material for manufacturing water molecule filter placed in hydrogen gas pipeline of our hydrogen fueled motorcycle. Zeolite which is an inorganic polymer was chosen because it is composed of repeating units in the form of SiO and AlO_4 tetrahedra. Tetrahedral bonds form by sharing one oxygen atom by two tetrahedra, so that each tetrahedron bind four other tetrahedra [1]. Polymers that form a three-dimensional tetrahedral network in the form of crystals have pore channels and cavities that can be filled with water molecules. The existence of polar and non-polar nature of the zeolite surface makes it containing a lot of exchangable cations where the cations bind water molecules strongly [2]. However, on the other hand the composition of the natural zeolite still contains many impurities, so it is necessary to improve the activation process of adsorption [3]. The adsorption characteristics of any zeolite are dependent upon the detailed chemical/structural make up of the adsorbent. The Si/Al ratio and the cation type, number and location are particularly influential in adsorption [4].

Methodology

The choice of the proper zeolite and the best operating adsorptive conditions can be refined by the helpful tool of molecular simulation techniques [5-7]. Natural zeolite used in this work was derived from Pahae, Tarutung, Tapanuli Utara-Indonesia. Pahae zeolite in lump form was shattered in a Fritsch Mortar Grinder Pulverisette 2 and then, it was sifted to obtain zeolite powder with the size of 60 and 200 meshes. The powder was activated by stirring it up in 30% KOH solution for 3 hours using a magnetic stirrer and followed by heating it at 300°C for 2 hours in an oven.

The water absorptive capability test was done by soaking zeolite in water for 24 hours, while its air absorptive capability was tested by keeping it in air for 24 hours. Hereafter, the water contained by zeolite powder was squeezed with a filter and then the wet zeolite powder was dried in open air for 3 hours. For the application as a filter of water molecules, the dried zeolite powder was encased in a waterproof paper and placed in water to hydrogen converter KIT equipped with a hydrogen sensor as shown in Figure 1. The test result of Pahae zeolite was compared to that of Cikalong zeolite derived from Java.

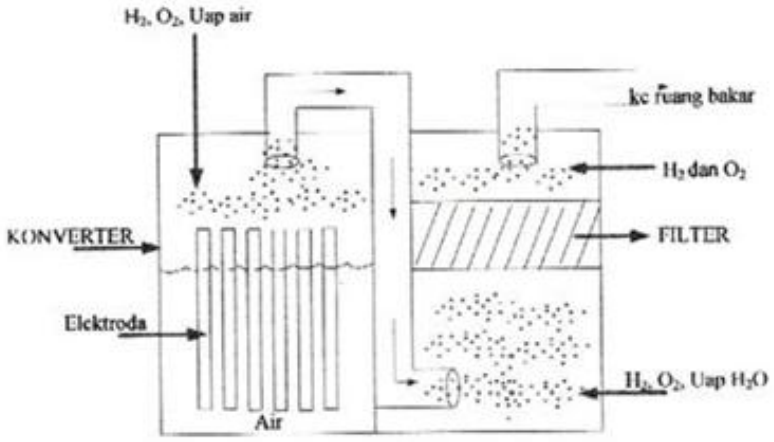
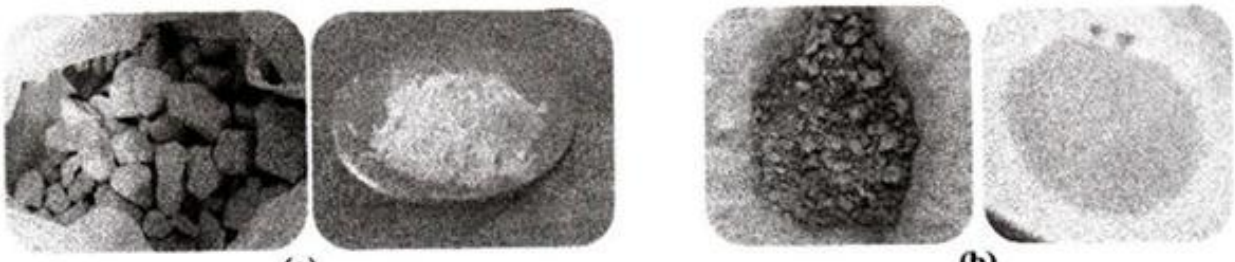


Fig. 1. Schematic of water to hydrogen converter

Results and Discussion

The activation results of Pahae and Cikalong zeolite powders are shown in Figure 2. It seems that Pahae zeolite powder has grayish-white color and very tenderness, while Cikalong zeolite has bluish green color and very hardness.



(a) (b)

Fig. 2. Zeolite powders of (a) Pahae and (b) Cikalong, before and after activation process.

Test results in Tabel 1 show that the grain size influenced water and air absorptions of Pahae and Cikalong zeolite powders where the smaller the grain size of the zeolite absorption will be ever greater. This was evidenced by 200 mesh Pahae zeolite powder which has had absorptive capability for water and air greater than 60 meshes and the same thing happens in the zeolite Cikalong. And what is more, the comparison of absorptive capability between Pahae and Cikalong zeolite powders shows that Pahae zeolite powder has higher absorption.

Table 1. Results of absorptive capability of zeolite powders.

Zeolite	Absorptive Capability	
	Water (%)	Air (%)
Pahae Zeolite (200 meshes)	62,61	11,89
Pahae Zeolite (60 meshes)	48,45	7,83
Cikalong Zeolite (200 meshes)	51,10	5,21
Cikalong Zeolite (60 meshes)	42,69	2,91

The ion-exchange process is reversible, allowing for adsorption of ions and molecules, making zeolites useful as filters [8]. Absorptive capability of zeolite filters to water molecules can be represented by hydrogen sensor readings. When amount of water molecules falling onto sensor surface much more as the sensor is sensing the presence of hydrogen gas on its surface will retard the increase in output voltage. It means that the increase in output voltage of sensor is directly proportional with the improvement of absorptive capability of zeolite filters.

The graphs in Figure 3 show hydrogen sensor readings in the output voltage. The readings display that the use of 200 meshes Pahae zeolite filter in KIT as hydrogen gas generation was going on higher than 60 meshes. The output voltage of sensor is 3.569 volts for 200 mesh Pahae zeolite filter after it was exposed to water molecules brought with hydrogen for 22 minutes. Whereas, for 60 meshes is 3.275 V at the same duration as shown in Figure 3, meaning that the grain size influences the absorptive capacity of a filter based on Pahae zeolite.

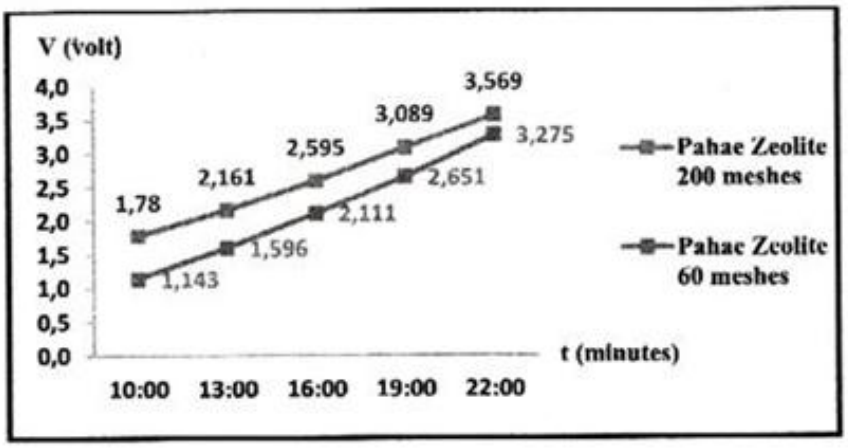


Fig. 3. Output voltages of hydrogen gas sensor as a function of time for Pahae zeolite filter with the grain size of 60 and 200 meshes.

The different result was appointed by Cikalong zeolite filter with the grain size of 60 meshes. The sensor output voltages using 60 meshes Cikalong zeolite filter are higher compared to 200 meshes until the gas expose time of 16 minutes. However, the gas exposure above 16 minutes resulted in no significant increase in output voltage for 60 meshes Cikalong zeolite filter. It is likely that this saturation trend may be caused by its high grain hardness that results in the absorption

space being possessed of 60 meshes Cikalong zeolite filter is very close and in turns, it deliver low capacity to absorb water molecules much more. This is indicated by the output voltages for 60 meshes become lower than 200 meshes above 16 minutes expose. However, by reducing the grain size to 200 meshes, the saturation trend can be removed. This is indicated by the sensor output voltages using 200 meshes Cikalong zeolite filters increase continuously, the same like the trends of 60 and 200 meshes Pahae zeolite filters.

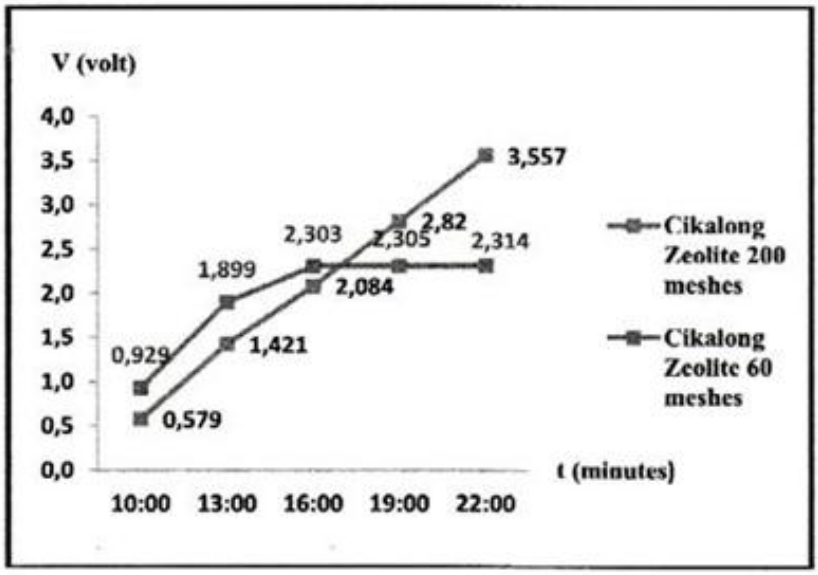


Fig. 4. Output voltages of hydrogen gas sensor as a function of time for Cikalong zeolite filter with the grain size of 60 and 200 meshes.

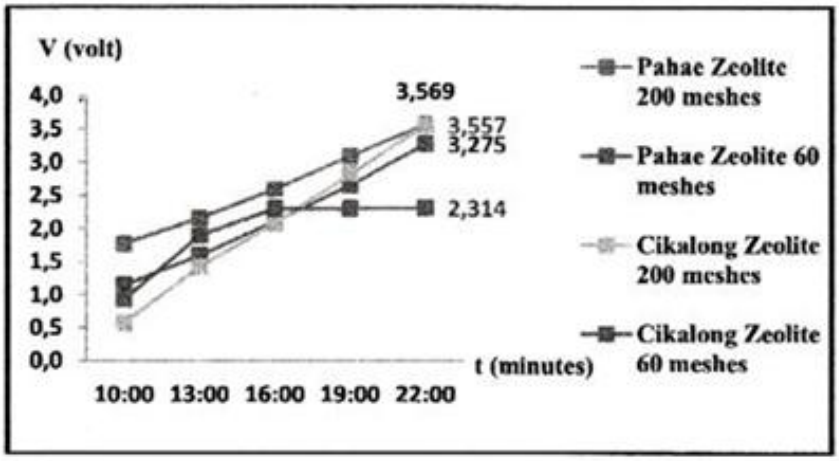


Fig. 5. Comparison of output voltages for the use of 60 and 200 meshes Pahae zeolite filter and 60 and 200 meshes Cikalong zeolite filter.

When all results of output voltage measurement are compared, it can be seen that 200 meshes Pahae zeolite filter has the best absorptive capacity. Although the absorptive capability of 200 meshes Cikalong zeolite filter is lower than 200 meshes Pahae zeolite filter, but after 22 minutes under expose the absorptive capability represented by the output voltage is almost the same. Therefore, it can be concluded that the grain size.

Conclusion

Based on the experimental results, it can be concluded that Pahae zeolite filter with the grain size of 200 meshes has optimum absorption compared the others. And sensor readings show that the use of 200 meshes. Pahae zeolite filter provide highest output voltage than the others. Thus, 200 meshes Pahae zeolite powder has highest absorptive capability for the application as water molecule filter for hydrogen fueled motorcycle

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References

[1] L.B. Sand, F.A. Mumpton (Eds.), Natural Zeolites: Occurrence, Properties, Use, Pergamon Press, Oxford, 1978.

[2] Kahar, A., (2007), Pengaruh Laju Alir Dan Diameter Partikel Zeolit Pada Proses Penjerapan Fenol Terlarut Dalam Limbah Cair Industri Kayu Lapis, *Jurnal Kimia Mulawarman* Vol 4 : 1693-5616.

[3] Setiadi dan Pertiwi, A, (2007), Preparasi dan Karakterisasi Zeolit Alam untuk Konversi Senyawa ABE menjadi Hidrokarbon, *Prosiding Konggres dan Simposium Nasional Kedua MKICS April 2007.*

[4] Mark W. Ackley, Salil U. Rege, Himanshu Saxena, Application Of Natural Zeolites In The Purification And Separation Of Gases, Microporous and Mesoporous Materials 61 (2003) 25–42.

[5] J.-C. Charpentier, The Triplet 'Molecular Processes–Product–Process' engineering: the future of chemical engineering. Chem. Eng. Sci. 57 (2002) 4667–4690.

[6] R. Millini, Application of modeling in zeolite science, Catal. Today 41 (1–3) (1998) 41–51.

[7] P. Cosoli, M. Ferrone, S. Pricl, M. Fermeglia, Grand Canonical Monte-Carlo simulations for VOCs adsorption in non-polar zeolites, Int. J. Environ. Technol. Manage. 7 (1–2) (2007) 228–243.

[8] Scoott M.auerbach, Kathleen A. Carrado, and Prabir K. Dutta, Handbook of Zeolite Science and Technology, Marcel Dekker, Inc, New York, 2003.

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[7] P. Cosoli, M. Ferrone, S. Pricl, M. Fermeglia, Grand Canonical Monte-Carlo simulations for VOCs adsorption in non-polar zeolites, Int. J. Environ. Technol. Manage. 7 (1-2) (2007) 228- 243.
http://dx.doi.org/10.1504/IJETM.2007.013247
[6] R. Millini, Application of modeling in zeolite science, Catal. Today 41 (1-3) (1998) 41-51.
http://dx.doi.org/10.1016/S0920-5861(98)00037-6
[5] J. -C. Charpentier, The Triplet Molecular Processes-Product-Process, engineering: the future of chemical engineering. Chem. Eng. Sci. 57 (2002) 4667-4690.
http://dx.doi.org/10.1016/S0009-2509(02)00287-7
[4] Mark W. Ackley, Salil U. Rege, Himanshu Saxena, Application Of Natural Zeolites In The Purification And Separation Of Gases, Microporous and Mesoporous Materials 61 (2003) 25- 42.
http://dx.doi.org/10.1016/S1387-1811(03)00353-6