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1. Introduction

Ceramic material is a non-metallic material which is formed by a heating process. Now ceramics are widely used as electronic components, kitchen utensils, building materials and as a means of filtering water, for example ceramic membranes [3].

Membrane ceramic is a material that is categorized as an inorganic membrane. Ceramic membrane has an advantage over other membranes because they are resistant to heat, acids and alkalis. The raw materials for making ceramics are bentonite, silica, clay, quartz and alumina, while the pore-forming materials other than inorganic materials such as carbon and calcium carbonate, are also organic materials such as rice flour, activated carbon, potatoes and corn [6].

Kaolin, clay, feldspar and quartz and bentonite. Natural bentonite is a hydrated silicate alumina with the main element consisting of alkaline and alkaline earth cations from the compounds it contains. Bentonite means clay which contains hydrate compounds of alumino silicates with the main elements of alkaline soil and has ion exchange properties and high absorption ability [2]. In addition, one of the materials that can be used is the volcanic ash of Mount Sinabung. Volcanic ash is magma

fragments and consists of minerals, volcanic glass and also contains materials high in silica and aluminum [7]. The content of volcanic ash was taken from Mt. The eruption of Mount Sinabung from the Berastepu Kec Village area. Simpang Empat Kab. All type volcanic eruptions are capable of causing dangerous and destructive phenomena [8]. However, volcanic ash in Karo and is used as a raw material in the manufacture of paving block [10] or ceramic membranes because volcanic ash compounds contain SiO2 (78.3%), Fe2O3 (2.91%), Al2O3 (4.56%), MgO (1.07) compounds. %), CaO (4.84%), Na2O (0.46%) [4].

Research that has been done using volcanic ash material, namely porous ceramics for motor vehicle exhaust gas filters and catalytic converters. This research tries to utilize the volcanic ash material of Mount Sinabung for ceramic membranes with carbon active [9] [11].

2. Methods

In this study, the manufacture of ceramic membranes using bentonite, Sinabung volcanic ash and activated carbon using conventional techniques with variations in the composition of bentonite, Sinabung volcanic ash and activated carbon are presented in Table 1.

Table 1. Comparison of Porous Ceramic Material Composition

Bentonite (%wt)	Volcanic Ash (%wt)	Carbon Active (%wt)
80	**0**	**20**
75	**5**	**20**
70	**10**	**20**
65	**15**	**20**
60	**20**	**20**

The three ingredients are mixed evenly and then printed using a pellet mold. After the ceramic membrane samples were printed in the form of pellets, then each sample was burned with a temperature treatment of 800°C, 900°C and 1000°C and for 3 hours.

After the ceramic membrane sample in the form of a pellet was sintered, then each sample was characterized for its mechanical properties, namely the compressive test and hardness test using the UTM and Hardness Testing equipment available at the PTKI Medan Material Test Laboratory.

3. Results and Discussion

3.1 Compressive strength

The compressive strength value of ceramic membrane shows that there is an effect of sintering temperature on the compressive strength of ceramic membranes made of bentonite, volcanic ash and activated carbon as shown in Table 2.

Table 2. Compressive Strength Ceramic Membran

Bentonite: Volcanic Ash: Carbon Active	**Compressive strength (MPa)**		
	800° C	**900° C**	**1000° C**
80:00:20	2.6	2.96	3.02
75:5:20	2.8	3.03	3.25
70:10:20	3.2	4.5	5.41
65:15:20	4.3	4.7	6.66
60:20:20	4.5	4.75	5.19

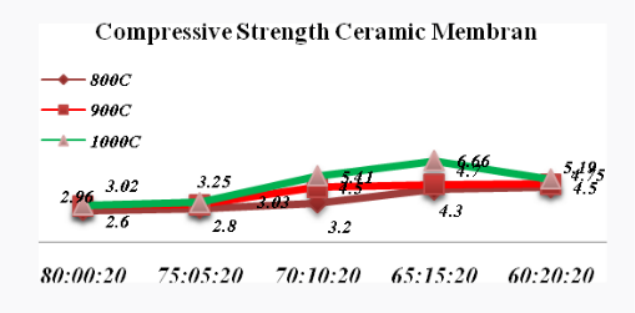

Figure 1. Graph of Compressive Strength with composition of Bentonite,Volcanic Ash and Carbon Active

The results showed that the optimum composition of bentonite, Sinabung volcanic ash and activated carbon at the composition of 65: 15: 20 with a temperature treatment of 1000°C had the highest compressive strength value of 6.6 MPa. Almost all variations mix, there is a relationship directly proportional to the sintering temperature and the compressive strength of the ceramic. The greater the sintering temperature, the more large compressive strength of the ceramic membrane generated.

3.2 Hardness

The hardness value of ceramic membrane shows that there is an effect of sintering temperature on the hardness of ceramic membranes made of bentonite, volcanic ash and activated carbon as shown in Table 3.

Table 3. Hardness Ceramic Membran

Bentonite: Volcanic Ash: Carbon Active	Hardness (MPa)		
	800° C	**900° C**	**1000° C**
80:00:20	93.320	108.220	117.112
75:5:20	106.540	117.340	149.859
70:10:20	118.430	130.671	153.428
65:15:20	175.121	182.422	187.639
60:20:20	132.826	102.212	142.826

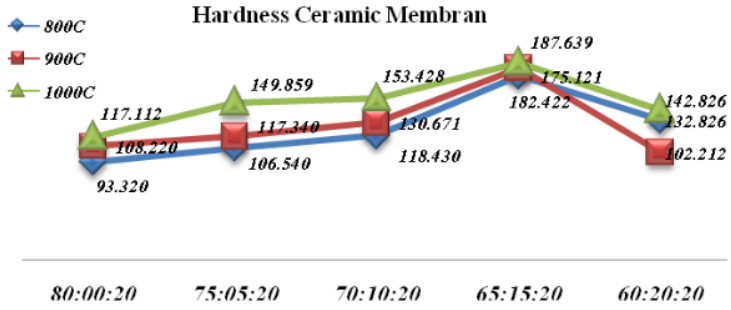

Figure 2. Graph of Hardness with composition of Bentonite,Volcanic Ash and Carbon Active

The results showed that the optimum composition of bentonite, Sinabung volcanic ash and activated carbon at the composition of 65: 15: 20 with a temperature treatment of 1000oC had the

highest hardness of 187.639MPa. This shows that the greater the addition of volcanic ash to the composition of the ceramic membrane, the higher hardness values of the ceramic membrane. Likewise with the sintering temperature, the more the value of the ceramic membrane combustion temperature, the higher the value of mechanical strength, namely compressive strength and hardness [1].

4. Conclusions

This research presents the effect of variations in the composition of bentonite, volcanic ash from Mount Sinabung and activated carbon on the mechanical properties of membranes. This study also affects the effect of ceramic membrane sintering temperature on the mechanical properties of ceramic membranes. Based on the results of the research, the increase in compressive strength and hardness values was caused by the addition of volcanic ash to the composition (60:15:20) and an increase in temperature at sintering1000oC had an optimum compressive strength value of 6.6 MPa and hardness of 187.639MPa.

References

[1] A.(Ed.). Lakshmanan, *Sintering of ceramics: new emerging techniques* (BoD–Books on Demand, 2012).

[2] Bachtiar, Iyas Muzalif, Sudarsono Sudarsono, and Abd Kadir. "Pengaruh Fraksi Volume Pasir Terhadap Kekuatan Bending, Densitas Dan Porositas Keramik Berbahan Dasar Tanah Liat." *ENTHALPY* 4.3, 2019.

[3] Haryanti, Ninis Hadi, and Tetti Novalina Manik. "PENGARUH SUHU SINTERING TERHADAP SIFAT MEKANIK KERAMIK BERBAHAN LEMPUNG DAN ABU SEKAM PADI." *Jurnal Fisika Flux: Jurnal Ilmiah Fisika FMIPA Universitas Lambung Mangkurat* 13, no. 1 pp: 1-10, 2016.

[4] Hasanah, Moraida, et al. "Effect of the mass and volume shrinkage of porous ceramics on Sinabung volcanic ash." *AIP Conference Proceedings*. Vol. 2221. No. 1. AIP Publishing LLC, 2020.

[5] Hasanah, M., & Fynnisa, Z. (2019, December). ANALISIS SIFAT EMISI GAS CO, HC, CO2 DAN O2 PADA MEMBRAN KERAMIK BERBASIS BENTONIT DAN DEBU VULKANIK GUNUNG SINABUNG. In *Seminar Nasional Multi Disiplin Ilmu Universitas Asahan*.

[6] Manohar, 2012. Development and Characterization of Ceramic Membrane, International Journal of Modern Engineering Research (IJMER). 2: 1492-1506.

[7] M. F. Serra, M. S. Conconi, G. Suarez, E. F. Aglietti, and N. M. Rendtorff, Ceram. Int. 41, 6169–6177, 2015.

[8] Nurwihastuti, Dwi Wahyuni, et al. "Volcanic hazard analysis of sinabung volcano eruption in karo north sumatra indonesia." *Journal of Physics: Conference Series*. Vol. 1175. No. 1. IOP Publishing, 2019.

[9] Saktisahdan, Tengku Jukdin, Moraida Hasanah, and Supriono Siregar. "PENGARUH KOMPOSISI TERHADAP SIFAT MEKANIK KERAMIK BERPORI MENGGUNAKAN DEBU VULKANIK GUNUNG SINABUNG."

[10] Sembiring, I. S., and I. P. Hastuty. "Sianbung Volcanic Ash utilization As The Additive for Papving Block Quality A and B." *IOP conf. Materials Science and Engeeneering*, 2017.

[11] Sinuhaji, P., Sembiring, T., & Handoko, F. Using Alumina and Volcanic Ash in Producing Catalytic Converter Ceramics. *Int. J. Appl. Eng. Res*, *12*, 343-347, 2017.

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