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The Effectiveness of Bentonite in Reducing Gas Content in the Isolation Oil Power Transformer Isolation

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Abstract

Bentonite is a mining product that can be activated and used as drilling mud and oil absorber. This study uses a transformer oil isolation oil sample where the sample has a gas content that varies according to the age and condition of the transformer. The analysis of this study was carried out with several different treatments to several samples for further analysis using Gas Chromatograph with the Total Combustible Gas (TCG) Method. Variables used included stirred and unmatched samples and various immersion times, namely immersion for 12 hours, 24 hours, 48 hours and 72 hours. The best absorption results were obtained when the samples were soaked in bentonite for 72 hours with an absorption effectiveness of 96.7% in the stirred sample and 94.02% in the sample which was not stirred.

Keywords*: Bentonite, Transformer Oil, Gas Chromatography*

1. INTRODUCTION

In the utility unit there is a power plant unit that functions to meet the electricity needs of the plant both for tools or other needs. That is why electricity generation has a very important role. At the power plant there are various interconnected equipment so that electricity can be produced and flowed to the factory. The equipment includes Generators and Transformers, where Generators function as power plants and Transformers as voltage regulators. Each tool in the factory has different electricity requirements, so the transformer plays an important role in regulating the current and voltage from the generator to the tool for each device in the factory.

Transformer

Transformer is electrical equipment that is vital in the generation of electrical energy, for that reliability must be maintained so that the process of channeling electrical energy runs smoothly. To maintain the reliability of the transformer, a test is needed to determine the state of the transformer insulation oil, one of which is to analyze the DGA (Dissolved gas Analysis) test, which is to analyze the gas content of the transformer insulation oil using Gas Chromatograph. The content of dissolved gas that is too much in the transformer insulation oil can result in reduced reliability of the transformer and hinder the operation of the plant.

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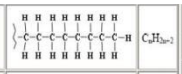
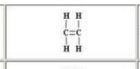
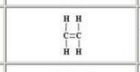
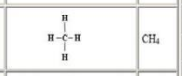
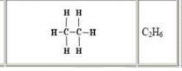
Table 1. Composition of gas content in transformer insulation oil

Mineral Oil		C_nH_{2n+2}	Ethylene		C_2H_4
Hydrogen		H_2	Acetylene		C_2H_2
Methane		CH_4	Carbon Dioxide		CO_2
			Carbon Monoxide		CO
Ethane		C_2H_6	Oxygen		O_2
			Nitrogen		N_2

Bentonite

Bentonite is a clay consisting mostly of minerals. Shaped in special flakes such as broken glass, light yellow to gray, if it is rotted yellowish brown, it can absorb water and expand. The chemical properties of bentonite can be divided into two, namely Sodium (Na) and Calcium (Ca). The main use of Na-Bentonite is for drilling, while Ca-Bentonite is useful as an absorber in oil.

Table 2. Chemical Composition of Bentonite

Komposisi Kimia	Na-Bentonite (%)	Ca-Bentonite (%)
SiO_2	61,3-61,4	62,12
Al_2O_3	19,8	17,33
Fe_2O_3	3,9	5,30
CaO	0,6	3,68
MgO	1,3	3,3
Na_2O	2,2	0,5
K_2O	0,4	0,55
H_2O	7,2	7,22

(Puslitbang Tekmira, 2005)

2. RESEARCH METHODOLOGY

The research on "Effectiveness of Bentonite in reducing Gas content in Transformer Oil Isolation power plants" will be conducted at the Transformer Oil Laboratory of PT. PLN (Persero). The research variables were immersion & stirring time on transformer oil samples mixed with bentonite.

Tools and tool materials

The tools used in this study include: Gas Chromatograph GC-2014 series, Erlenmeyer, Beaker Glass, Filter Paper, Analytical Balance Sheet, 20ml Vial, 50ml Syringe, Aluminum Foil, Magnetic Stirrer.

Materials

a. Transformer Oil
b. Bentonite

Research procedure

Determination of absorption of gas content

a. 50 ml transformer oil is put into 9 different Erlenmeyers.
b. Take 1 Erlenmeyer which contains Isolation Oil without a mixture of Bentonite as an initial comparison
c. Mix the Bentonite on the other 8 Erlenmeyers by 20gr (Mixed Sample)
d. Do stirring using a magnetic stirrer for 1 hour on 1 Erlenmeyer which only contains Isolation Oil and 4 Erlenmeyers that already contain a mixture of Isolation Oil and Bentonite.

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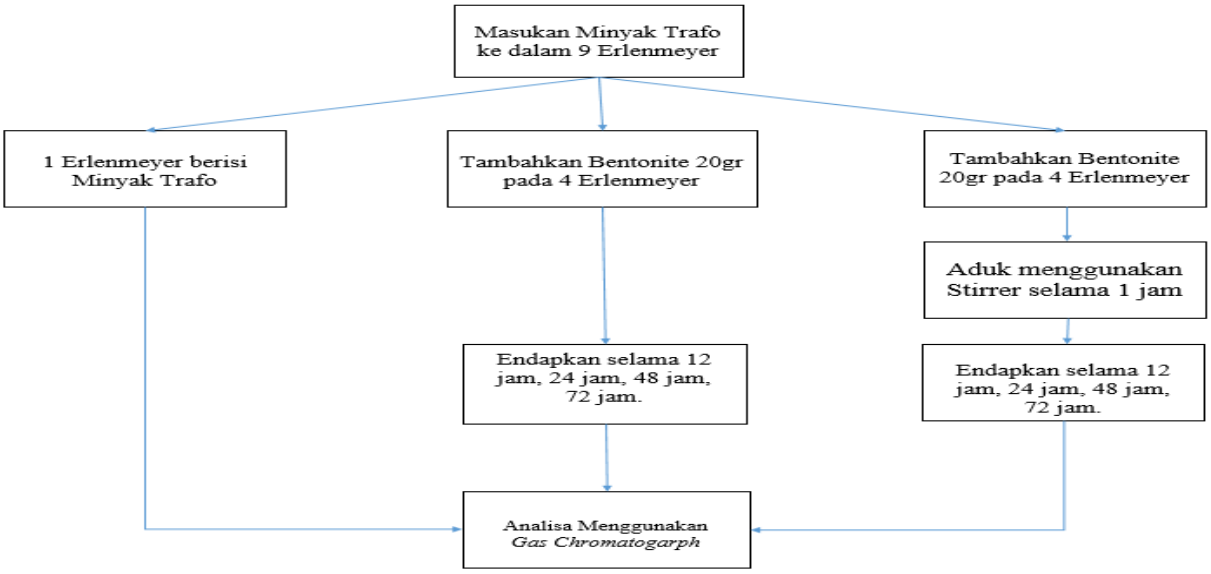
e. Label and do immersion in the mixed sample for 12 hours, 24 hours, 48 hours, and 72 hours and filter using filter paper before testing using GC

Analysis of dissolved gas content

a. Oil that has been mixed with Bentonite is filtered beforehand using filter paper.
b. Take 20ml of filtered insulation oil and put it in vial.
c. Perform hydrocarbon gas testing using GC.
d. Repeat the experiment on samples that have been soaked for 12 hours, 24 hours, 48 hours, and 72 hours**.**

Diagram Block



RESULTS AND DISCUSSION

Table 3 Analysis of Gas Absorption without Stirring

Komponen kimia (ppm)	Sample Awal	Waktu Perendaman			
		12 jam	24 jam	48 jam	72 jam
Hidrogen (H2)	0	0	0	0	36.532
Karbon Monoksida (CO)	839.914	791.844	644.537	113.994	7.527
Metana (CH4)	8.260	7.525	6.759	66.447	1.185
Etana (C2H4)	0	0	0	28.485	0.392
Etilen (C2H6)	0	0	0	216.779	5.117
Asetilen (C2H2)	0	0	0	0	0
Total Combustible Gas	848.174	799.369	651.296	425.705	50.757

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Table 4 Analysis of Gas Absorption with Stirring

Komponen kimia (ppm)	Sample Awal	Waktu Perendaman			
		12 jam	24 jam	48 jam	72 jam
Hidrogen (H2)	0	43.402	131.221	0	0
Karbon Monoksida (CO)	839.914	203.035	347.395	321.956	24.459
Metana (CH4)	8.260	178.752	25.264	3.236	0.939
Etana (C2H4)	0	232.747	6.944	0	0
Etilen (C2H6)	0	58.888	29.435	0	2.611
Asetilen (C2H2)	0	0	0	0	0
Total Combustible Gas	848.174	716.824	540.259	325.192	28.009

The absorption of the gas content using bentonite with different intensity of immersion time and different treatment is stirred and not stirred, the sample before it is put into GC is filtered first using filter paper and then taken as much as 20ml and put into a vial / sample container. Furthermore, the difference in the gas absorbed by bentonite can be seen in the results of analysis using GC.

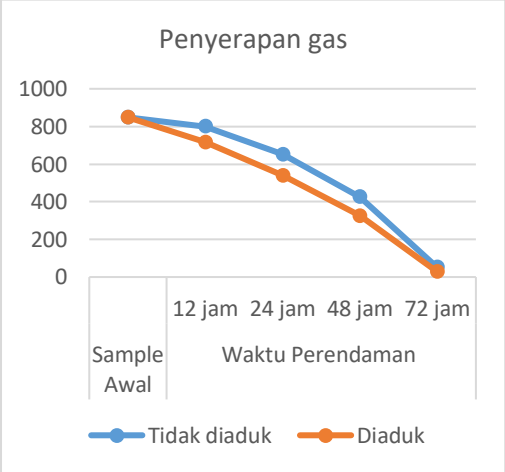

Figure 1. Graph of hydrocarbon gas absorption.

Can be seen the difference in gas content contained in the graph that the longer immersion transformer oil with bentonite, the Bentonite works better and the stirring carried out before soaking in a certain time can reduce the gas content than the transformer oil sample that is not stirred. The most efficient absorption is a sample that has been immersed for 72 hours with a total dissolved gas composition of 50,757 ppm without stirring and 28,009 ppm with stirring.

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1. Immersion for 12 hours

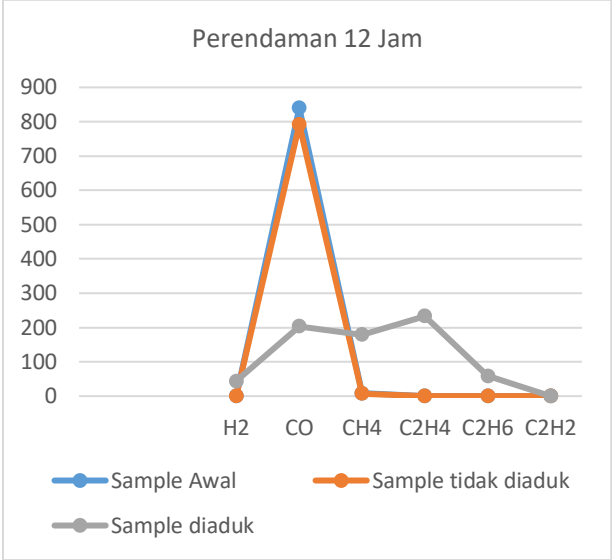

Figure 2. Graph of gas absorption after soaking for 12 hours.

It can be seen in the picture that there is a difference in the gas absorbed by bentonite to work more efficiently on the sample that is not stirred than the sample that is stirred but, the CO content in the sample that is not stirred is higher than the sample that is stirred.

2. Immersion for 24 hours

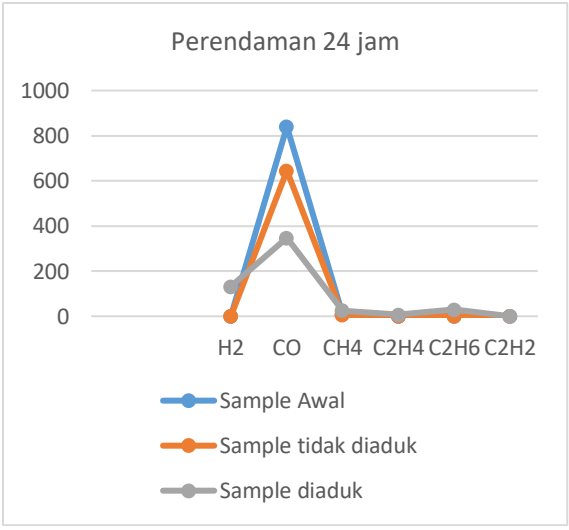

Figure 3. Graph of gas absorption after being soaked for 24 hours.

The difference in gas absorbed after soaking for 24 hours is different in the Carbon Monoxide (CO) section where the difference has a value of up to 100ppm.

3. Immersion for 48 hours

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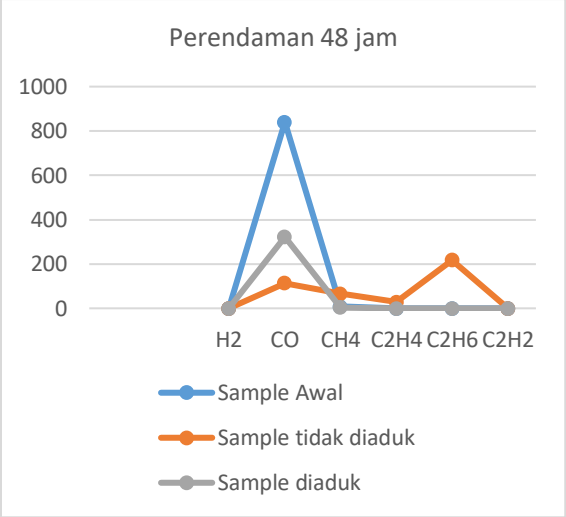

Figure 4. Graph of absorption of gas after soaking for 48 hours.

The sample that was not stirred this time had a high absorption if it was done for 48 hours. But Ethylene content increases, this is dangerous because it can affect the transformer if it has Ethylene content in the insulating oil.

4. Immersion for 72 hours

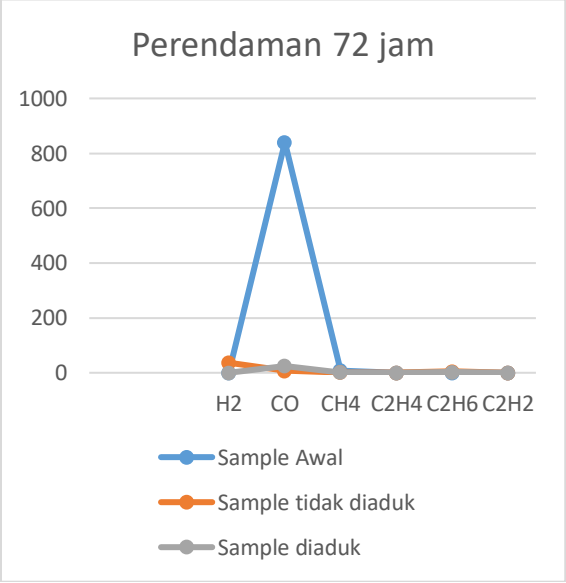

Figure 5. Graph of gas absorption after being immersed for 72 hours.

Samples that are stirred and not stirred after being soaked for 72 hours have very little gas content value, in contrast to the previous immersion which still has an up and down gas content value From the details above, each immersion has a different absorption of the gas content but the absorption gradually decreases as bentonite is soaked in the insulating oil for longer. In this study, bentonie worked optimally at the immersion time for 72 hours where the gas content contained in the sample of the insulating oil could be absorbed as much as 94.02% in the condition without stirring and 96.7% in the condition with stirring.

CONCLUSION

a. Bentonite can absorb gas in the transformer insulation oil and can work almost optimally
b. The effect of the gas that appears on the immersion can be caused by air temperature and humidity or an error factor either from equipment or humans

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c. Effectiveness of Bentonite works on samples with immersion time for 72 hours with an absorption efficiency value of 94.02% in conditions without stirring and 96.7% in conditions with stirring.

REFERENCES

1. Chumaidy Adib, 2014. Analisis Kegagalan Minyak Isolasi Pada Transformator Daya Berbasis Kandungan Gas Terlarut. Jurnal Program Studi Teknik Elektro FTI-ISTN
2. IEEE Power and Energy Society, 2013.
3. IEEE Guide for Diagnostic Field Teesting of Fluid-Filled Power Transformers, Regulators, and Reactors. New York, USA.
4. Loai Nasrat, 2011. Improvement of Used Transformer Oils with Activated Bentonite. Journal Electric Power & Machines Department, South Valley University, Qena, Egypt.
5. Nynas Naphtenis AB, 2004. Transformer Oil Handbook, First Edit. : Sweden
6. PT. PLN Persero. 2014. Buku Pedoman Pemeliharaan Transformator Tenaga : Jakarta
7. Safiddine, L. 2017. Transformer Oil Reclamation by Combining Several Strategies Enhanced by the use of Four Adsorbents. Laboratorie de Genie Chimique, Universite Saad Dahlab Blida, Algeria.
8. Sharin Ab Ghani, 2018. A Review on the Reclamation Technologies for Service-Aged Transformer Insulating Oils. Indonesian Journal of Electrical Engineering and Computer Sciense : Vol. 10, No. 2 May 2018, pp 426~435
9. Toeti, K. 2012. Karakteristik Bentonit Teknis Sebagai Adsorben Indigo Biru. Jurnal Jurusan Kimia FMIPA, Universitas Negeri Surabaya.
10. Windy Utari, 2016. Efektifitas Karbon Aktif Dalam Menurunkan Kadar Bilangan Peroksida Dan Penjernihan Warna Pada Minyak Goreng Bekas. Jurnal Ilmiah Program Sarjana Fakultas Kesehatan Masyarakat, Universitas Sumatera Utara
11. Yustinah, Hartini. 2011. Adsorbsi Minyak Goreng Menggunakan Arang Aktif dan Sabut Kelapa. Jurnal Fakultas Teknik, Teknik Kimia,Universitas Muhammadiyah Jakarta,

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