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Adsorption of Carbon Monoxide (CO) in ZSM-5 Membrane on Smoking Area

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Abstract

This research aims to know the ability of ZSM-5 adsorbed on the cigarette smoke so that it can reduce the levels of CO in the smoking area. Zeolite membranes formed from steel AlSi316 gauze covered with ZSM-5 prekusor with size of 5 cm, 4 cm, 3 cm, 2 cm and 1 cm are kept at a temperature of 900C for 4 days then characterized using x-ray diffraction (XRD), FTR and SEM, with absorbance test place the gauze into the enclosed space volume 18.000 cm^3containing CO from cigarette smoke.The research was recently reached the stage of inorganic and organic substances leaching and oxidized in electrochemistry in H2SO4 to 20%

We use the result of the previous research by title Adsorption test of Carbon monoxide using Lampung and Malang natural zeolite, by Aditya Zulfa. In that research, Malang and Lampung natural zeolite are being tested its adsorption capacity of CO in pressure condition 0 to 178 psia with 25 psi interval and using variation of adsorbent size and adsorbtion temperature. Both of those zeolites are being compared its adsorbtion capacity, before and after the activation process.The result of Lampung natural zeolite which has the highest adsorption capacity CO, 0,5866 mmol/g at 175 psia. So, it can be found the best specification of an adsorbent which has the highest adsorption capacity of CO between two of natural zeolite.

Keywords: Adsorption, Carbon Monoxide (CO), ZSM-5 Membrane, Smoking Area

1. INTRODUCTION

Based on the latest data from The Tobacco Atlas 2015 Indonesia ranked first by number of male smokers in the world. The data show, as many as 66 percent of men smoked in Indonesia (Kompas, 2016). Global data Adults Tobacco's Suervey (GATS) 2011 shows the prevalence of smokers in Indonesia of 34.8%, and as much as 67% of men in Indonesia are smokers (Health, 2016). So the number of smokers in Indonesia need to gain serious attention.

Cigarette smoke contains about 400 ppm of carbon monoxide (CO) so a source CO of pollution for active and passive smokers. CO gas has a bad impact on health because CO gas can shift the oxygen bound to the hemoglobin and bind the Hb to Hb-CO. According to Ganong (2008), CO gas is a colorless and odorless gas, which is produced by the combustion process are not perfect from materials containing carbon or combustion under high pressure and temperature as they are happening inside the engine.

The characteristic of its CO of body affinity is 250 to 300 times stronger than the O2 affinity. . CO will form the carboxy bond of hemoglobin, thus inhibiting the distribution of O2 to the body tissues. Organ that is very sensitive to CO poisoning is the organ with the most O2 needs of the heart (Anggraeni, 2009). Therefore it is necessary to decrease CO gas content from cigarette smoke in the smoking room (smoking area).

The reduction of CO gas may use activated charcoal, natural zeolite or synthetic zeolite such as ZSM-5 zeolite membrane, which is a membrane consisting of a buffer in the form of stainless steel gauze coated by ZSM-5 zeolite Zeolite ZSM-5 is a hydrogenated aluminosilicate compound having a three-dimensional structure structure constructed by a tetrahedral arrangement of TO4 (T = Si / Al), microporous, and crystalline solids with the principal content of silica, and Na AlO2 and binding a certain amount of water molecules in its core. The crystal compound with this three-dimensional structure has regular interconnected cavities, forming channels in all directions, so as to absorb CO gas better (Adriany, 2011)

2. Methods

2.1 Participants

The participants are collage students, chemical person.

2.2 Instrument

The equipment used is a set of tools which are: glass beaker, , stirrer, volume pipette, measuring cup, 50 ml Polypropylene container, Voltmeter, Waterbath, thermometer, pH meters, Analytical balance, buechner funnel, oven, Shaken/Stirer, ovens, CO. m, FTIR, Scanning Electron Microscopy (SEM) – EDS, JEOL x-ray Difractometer (XRD) Philips PW 1710.

The materials used are cigarette, AlSi 316 stainless steel gauze size 180 Platinum gauze, mesh, HCl, H2SO4, Tetrapropilamonium Bromide (TPA-Br) artificial Merck, H2O non mineral, artificial NaAlO2 Sigma Aldrich, NaOH brand Merck and Ludox HS -40 made by Aldrich-Chemistry

2.3 Procedures (or research design)

Zeolite ZSM-5 membrane synthesis begins with:

2.3.1 Steel Gauze Treatment

Prepared 15 pieces of 1 cm^2 steel gauze soaked in 15% NaOH for 20 minutes (to remove oil / organic substance), then soaked in 15% HCl solution for 20 minutes (for removal of inorganic substances), then washed with distilled water in ultrasonic for 20 minute. Further electrochemically oxidized in 20% H2SO4 with a constant voltage of 3-5V and a current of 1.0 Amperes, then dried at 110ºC, for 1 hour (Gao et al., 2011). Repeated procedure for steel gauze volume 4 cm^2, 9 cm^2, 16 cm^2 and 25 cm^2.

2.3.2 Synthesis of ZSM-5 zeolite precursor solution

Mixed amounts of 0.1315 g NaAlO2 and 1.3302 g NaOH 50% w / v in container 1. Dissolved 1.4705 g TPA-Br in water 22.0910 g into container 2, and stirred for 5 minutes, then put into In container 1, and added 24.9575 g Ludox HS 40% so that the semi-gel and shaken then formed homogenous gel. Stirer at 900 rpm for 6 hours (Pratama, 2012; Mukaromah, et al., 2014).

2.3.3 Coating of ZSM-5 zeolite precursor solution on AlSi 316 steel gauze

ZSM-5 zeolite precursor solution was coated on stainless steel gauze already treated in procedure number 1. Furthermore the steel gauze was inserted in a polypropylene plastic container and heated to 90 ° C in the oven for 4 days, thus forming a zeolite membrane ZSM-5 . The ZSM-5 membrane was washed with distilled water and heated at 60 ° C for 3 hours, then fed into a furnace with a temperature of 550 ° C for 6 hours (Mukaromah et al., 2014). Furthermore, the obtained zeolite membrane was characterized by X-ray diffraction (XRD), FTIR and SEM.

2.3.4 Decrease of CO gas with ZSM-5 zeolite membrane

The test covered spaces prepared with 18,000 cm3 volume, then a cigarette inserted into the test room and dinyalakanselama in 5 minutes. The resulting CO Gas concentration is measured with meters and recorded as the concentration of CO is beginning. Then put the membrane ZSM-5 with 1cm2 into the space test for 10 minutes. Measured concentrations of gas CO late after receiving treatment by membrane adsorbsi ZSM-5. The procedure is repeated 3 times, and repeated also for time variation of 20, 30, 40, and 50 minutes. The procedure is repeated for the steel gauze size 4 cm^2, 9 cm^2, 16 cm^2 and 25 cm^2.

3. Result

The amount of CO gas adsorbed on activated and unactivated zeolite from the test results was presented in the form of Gibbs adsorption mol. The data retrieval process at each increase in adsorption pressure is performed after 15 minutes where the pressure does not change significantly indicating that the adsorption equilibrium has been achieved.

At the highest pressure of adsorption which is about 175 psia, the activated zeolite is able to adsorb the CO gas of 0,5866 mmol/g zeolite unabsorbed zeolite only by 0,2537 mmol/g zeolite. Lower ability of unactivated zeolites can be caused because the zeolite is not yet pure, there are still impurities that cover the surface or pore of zeolite. Not activated zeolite pore size that is still small enough that where 33.93 Ă is composed of many layers as well as pore space which does not give much for co molecules for trapped and interact with atoms of zeolite ability so adsorbsinya be small

Various sizes of zeolites used as adsorbents ie 37-50 microns, 100 microns and 300 microns to absorb CO can produce the highest concentration of CO adsorbed that is on the smallest zeolite particle size of 37-50 microns and the smallest teradsorb CO concentration that is on the size The largest particle is 300 microns.

Temperature variations used when adsorption is 25ºC, 35ºC and 50ºC as the operating conditions of CO absorption can produce the largest CO adsorbed consentration that is at the smallest temperature of 25ºC and the smallest adsorbed CO concentration is at the largest operating temperature is 50ºC.

4. Discussion

The amount of CO which adsorbs continues to grow with the increase in pressure adsorption. The higher the pressure in the gas phase of the space the more CO molecules diffuse to the surface and the approaching entry into porous zeolite to interact with the atoms that the number of moles of CO adsorbs are getting bigger. Curve adsorbtion isothermal both zeolite has a tendency to still continue to rise by raising the pressure above 200 psia. Therefore, on a comparison of natural zeolite, activated this may imply that the activation process is very influential on the internal surface area of the particle zeolite are getting bigger and the comparison of Si/Al are also getting larger.

5. Conclusions

1. Based on the experimental process of adsorption that uses a variation of the size of natural zeolites, activated with the smallest size lampung i.e. 37-50 microns have a capacity of largest adsorption i.e. amounting to 0.727 mmol CO/g of zeolite. This is demonstrating that the more particle small size, then the greater the capacity of the adsorbance
2. Based on experimental process of adsorbs using temperature variation, the adsorption process with low temperature (room temperature) has the largest adsorption capacity of 0.727 mmol CO / g zeolite. This indicates that the higher the adsorption operating temperature, the smaller capacity adsorbed
   For the theoretical review paper, use a suitable format based on the full paper's contains.

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