



ICICS 2015

**THE 4th INTERNATIONAL CONFERENCE OF
THE INDONESIAN CHEMICAL SOCIETY**

29 - 30 SEPTEMBER 2015

MEDAN - INDONESIA

THEME : ENHANCEMENT INNOVATIVE CHEMISTRY RESEARCH

PROGRAMME AND ABSTRACT



Universitas
Sumatera
Utara



Universitas
Medan



Pemerintah
Propinsi



Himpunan



ICICS 2015

CHAIRMAN

Dear Colleagues,
Welcome aboard!

The ICICS 2015 has been organized to provide a platform for the academicians and researchers to assemble and share the recent knowledge as well as to discuss the initiations required for the growing field of Analytical Sciences. Response to this conference is overwhelming. The conference will have total of 163 papers comprising two plenary, 4 keynote, 36 orals and 61 posters.

Many thanks to Rector Universiti Sumatera Utara, Rector Univeristi Negeri Medan and Himpunan Kimia Indonesia (HKI) for organized this wonderful event. On behalf of the organizing committee, I thank our Patron, Gabernor Sumatera Utara. I am also thankful to co-organizer of this conference, Dr. Muhammad A. Martoprawiro from Himpunan Kimia Indonesia, and other colleagues for their invaluable support. Also, many thanks for them who supported enthusiastically by giving advertisements in the conference digest.

My team, the organizing committee of the ICICS 2015, has been working relentlessly towards the conference call to the registration desk to make the ICICS 2015 a memorable event. They were passionate and those services are beyond comparison. I acknowledge them with deep sense of gratitude and love. I wish you a fruitful stay at ICICS 2015! Once again, I thank you, on the behalf of the organizing committee for your participation and support.

Best Regards,
Organizing Committee

Prof. Dr. Harry Agusnar
Chairman

RECTOR OF SUMATERA UTARA UNIVERSITY

Inna Lillahi Warahmatullahi Wabarakatuh.

Very Good Morning Ladies and Gentlemen.

First of all I would like to welcome to our Distinguished Guests and Keynote Speakers, as well as Presenters and Participants of The 4th International Conference of Indonesia Chemical Society (ICICS) 2015 which is jointly organized by : Departemen of Chemistry UNM with UNIMED and The Indonesian Chemical Society North Sumatera, held in Tiara Convention Centre, Medan, Indonesia. On behalf of The Organizing Committee and Civitas Scientifica of The University of Sumatera Utara, I would like to welcome you all to Medan and North Sumatera Province. Especially to our guests and Speakers coming from Japan, Korea, USA, Thailand and Malaysia and other Countries and Provinces in Indonesia, we do hope that you enjoy your stay during the Scientific Session in The ICICS.

We are honoured to have you all here and would like to thank you to your interest and participation in the ICICS to discuss our main issue we are facing today, especially in North Sumatera Province, regarding "Enhancement Innovation Research".

This issue is directly related into the development of our economy and enterprises which have been susceptible to global crisis, due to their commodity-oriented products. Various agricultural and plantation products. Various agricultural and plantation products, especially in Sumatera Island and Indonesia in general, such as : palm oil, natural rubber, wood, coconut, and other natural resources have not been processed to end products and only been marketed as commodities. Whereas several synthetic consumer products, including : pharmaceuticals, as well as polymeric and other engineering materials have to be imported to meet domestic demands. Processing of the renewable natural resources requires chemistry as well as polymer material expertise to increase value-added of the products, which in turn decreasing susceptibility of our economy against the global crisis.

In this occasion we would like to thank to Keynote Speakers and Lecturers : especially The Governor of North Sumatera for your invaluable contributions and recommendations in this seminar. We also thank to all presenters and participants for your valuable discussions.

Secondly, I would like to congratulate The Organisers of The Indonesian Chemical Society (ICS) will gather all professionals and practitioners in the field of chemistry to contribute to the developments of North Sumatera Province and other countries in general.

Inna Lillahi Warahmatullahi Wabarakatuh.

23 September 2015

Dr. H. D.

Rector of The University of Sumatera Utara

**ICICS 2015
PROGRAMME SEMINAR
29 – 30 September 2015**

MONDAY, 28th September 2015

Pre-registration
Lobby, Hotel Tiara, Medan, Indonesia

TUESDAY, 29th September 2015

REGISTRATION
Ground floor, Tiara Convention Centre (TCC), Medan, Indonesia

OPENING CEREMONY
1st floor, Balai Raya, TCC

COFFE BREAK
(1st floor, Balai Raya, TCC)

10:00 – 12:00 SEMINAR PLENARY

**Room
Moderator**

**: Balai Raya, PCC
: Prof. Dr. Harlem Marpaung**

08:00-10:00	KP-1	Prof. Dr. Tomatshu Takahashi (<i>Catalysis Research Center, Hokkaido University Okayama- Japan</i>)	Three Decades of Optical Chemical Sensors Research: Malaysia Experience & The Way Forwards
10:00-12:00	KP-3	Prof. Dr. Taifo Mahmud (<i>Department of Pharmaceutical Sciences, Oregon State University, USA</i>)	Research at the Interface of Chemistry, Biology, and Medicine: A Collaborative Journey
12:00-13:00	KP-4	Prof. Dr. Zuriati Zakaria (<i>Universiti Teknologi Malaysia</i>)	Assessment of Toxic Elements in Surface Sediment from Linggi River, Malaysia
13:00-14:00	KP-2	Prof. Dr. Duen Ren-Hou (<i>Taiwan</i>)	

12:00 – 13:00 Lunch (Balai Raya), Sholat and Rest

13:10 – 15:30 The First Session

Sesion 1 : Material Chemistry, Catalysis, and Processes (A)

Room : Balai Raifa

Hari/Tgl : Selasa/29 September 2015

1A-1	<i>Rudy Tahan Mangapul Situmeang, Raden Supryanto, Lolita Albert Kahar, Liza Apriliya Sukartiningsih</i>	Characteristics of LaCrO_3 Nano Particles prepared using Pectin as emulsifying agent <i>Rudy Tahan Mangapul Situmeang, Raden</i>
1A-2	<i>Yulia Eka Putri, Diana Vanda Wellia, Alviionita Alvionita</i>	Morphology-controlled synthesis of SrTiO_3 nanocube via solvothermal method
1A-3	<i>Safni S Safni, Diana Vanda Wellia, Puti Sri Komala, Reza Putri Audina</i>	Degradation of Textile Dye (Yellow-Gcn) by Photolysis with UV Light and Solar Irradiation Using C-N-Codoped TiO_2 Catalyst
1A-4	<i>Sri-Wardhani</i>	Hydrogen Peroxides for Improved Dyes Photodegradation Hydrogen Peroxides for Improved Dyes Photodegradation.
1A-5	<i>Atiek Rostika Noviyanti, Dani Gustaman Syarif, Riansyah Amymurdin Riansyah Amymurdin</i>	The Effect Of NaOH and KOH on Preparation of Apatite Lanthanum Silicate using Hydrothermal Method.
1A-6	<i>li Andri, Evy E Ernawati, Iwan Hastiawan, Muhammad Prasha Silitonga</i>	Synthesis and Characterization of Nanocomposite Sulfonated PVDF Membrane.
1A-7	<i>Evy Ernawati, Solihudin Solihudin, Rubianto A A Lubis, Juliandri Juliandri, Diana Rakhmawaty E, Atiek Rostika Noviyanti, Roekmiati Tjokronegoro</i>	Cellulose Isolation from Rice Husk using Alkaline Peroxide
COFFE BREAK		
1A-8	<i>Diana Rakhmawaty Eddy, muhammad rofik usman, atiek rostika noviyanti Diana Rakhmawaty Eddy, muhammad rofik usman, atiek rostika noviyanti</i>	The Role of Base Solvent Variant to Structure And Crystal Size Titanium Dioxide (TiO_2) by Hydrothermal Method

IC-11	<i>Zul Alfian, Harlem Marpaung, Muhammad Taufik</i>	Analysis Of Methamphetamine In Users Hair By Gas Chromatography-Mass Spectroscopy (Gc-Ms)
ID-1	<i>Jaslin Ikhsan, Siti Sulastri, Erfan Priyambodo</i>	Adsorption Isotherm of Phosphate Ions onto Silica and Amino-Modified Silica from Lapindo Mud
ID-2	<i>Rikson Asman Siburian</i>	Sintesis Grafena Dan Kinerja Grafena Sebagai Material Pendukung Energi Terbarukan
ID-3	<i>Suherman, dan Sitti Rahmawati</i>	Pemulihan dan Peningkatan Produksi Buah Kakao

: Essential Oils, Drugs and Narcotic (E)
: Agricultural Chemistry and Food Chemistry (F)
: Theoretical and Computational Chemistry (G)
: Balai Duta
: Selasa/29 September 2015

1E-1	<i>Adil Ginting</i>	Constituents of leaf essential oil of <i>Pluchea indica</i> (L.) Less. from Indonesia
1E-2	<i>Noor Fitri</i>	Patchouli essential Oil Extraction using light fermentation - Water Bubble distillation
1E-3	<i>Edi Priyo Utomo</i>	Dehydration of patchouli alcohol and PCA approach to determine product isomers.
1E-4	<i>Heri Septya Kusuma, Mahfud Mahfud</i>	Response Surface Methodology for Optimization Studies of Microwave-assisted Extraction of Sandalwood Oil.
1E-5	<i>Warsito warsito, Edi Priyo Utomo, Siti Mariah Ulfa</i>	Effect of hydration and oxidation reactions of the chemical composition of Kaffir lime oil.
1F-1	<i>Titania Tjandrawati Nugroho, Hilwan Yuda Teruna, Riryng Novianti, Dinda Yulia Octaviani, Nikmatul Maul</i>	HPLC Evidence of possible transglycosylation by Cellulose assisted extraction of plant polar compounds in in 40% Ethanol.
1F-2	<i>Adam Wiryawan</i>	The Role of Chemical Sciences to 1F-3The Critical point in the halal Certi1F-4fication of foods product, Beverage, Medicine and Cosmetics
1F-3	<i>Eliza Bachtiar, Herlina Herlina, Ines Sugiri Sugiri.</i>	Preparation and Characterization Edible Film from <i>Dioscorea</i> Starch Incorporated with Liquid Smoke and It's Antibacterial and Antioxidant Properties.

COFFEE BREAK

WENESDAY 30th September 2015**08:00 – 10:00 Plenary Session**

Session : Plenary
Room : Balai Raya
Moderator : Prof. Dr. Ramlan Silaban
Hari/Tgl : Rabu/30 September 2015

IS-1	Prof. Duangjai Nacapricha (Faculty of Science, Mahidol University, Thailand)	Some Innovation Products from Analytical Chemistry Research
IS-2	Prof. Bohari Mohd Yamin (Universiti Kebangsaan Malaysia)	Complexation of Protonated Curtis Salts with Nickel and Chromium
IS-3	Prof. Basuki Wirjosentono (University of Sumatera Utara)	Modification of Cyclic Natural Rubber (CNR: <i>Resiprene-35</i>) using Maleic Anhydride and Synthesis of Its Low Molecular Weight

10:00 – 10:30 Coffee Break (Lobby Balai Raya)**10:30 – 12:30 The Third Session**

Session 2 : Material Chemistry, Catalysis, and Processes (A)
Room : Biomaterial (I)
Hari/Tgl : Balai Raya
Rabu / 30 September 2015

2A-16	Mita Rilyanti, Yuli Ambarwati, Muhammad Yusuf	Preparation of Zeolites without Impurities using Bagasse Ash as The Aluminosilicate Source Materials
2A-17	Diana Vanda Wellia, Rommy Dwipa, Rahmi Saridewi, Safni	Green Preparation of C-N-Codoped TiO ₂ Powder and Its Application for Fabric Industry's Dye Degradation
2A-18	Swatika Juhana, Agus Taufiq, Cheppy Asnadi	Synthesis of Silica Gel Based Corncob of Gunung Kidul and Characterization and Test The Water Absorption Capability.
2A-19	Rikson Asman Siburian.	Effect of N-Doped Graphene for Properties Of Pt/N-Doped Graphene Catalyst

		<i>Gandasasmita, Muhammad Bachri Amran</i>	alginate glutaraldehyde
	II-1	<i>Seri Maulina, Iloan Pandang H Manalu, Yos Pauer Ambarita</i>	Comparison Utilization with Frond to Produce Oxidation using Alkali Fusion Oxidation Method
	II-2	<i>Tri Sutanti Budikania, Candra Irawan, Kartini Afriani, Nelson Saksono.</i>	Degradation of Linear Alkylbenzenesulfonate (LAS) by Using Cold Glow Discharge Electrolysis (CGDE) with NaOH Electrolyte Solution
	II-3	<i>Indra - Mawardi</i>	Effect of Injection Temperature on Defect Plastic Products
	II-4	<i>Dwi Rasy Mujiyanti¹, Utami Irawati¹, Nur Mauliddiyah Akhir</i>	Study Of Silica Gel And Merkapto-Silica Hybrid Desorption for Co(II) Ion

: **Chemical Education (M)**
 : **Balai Citra I**
 : **Rabu / 30 September 2015**

		<i>Ramlan silaban</i>	Preparing An Innovative Chemistry Teaching Module Of Electrolyte And Non Electrolyte Solution Material Integrated Character Education
	III-1	<i>Jaslin Ikhsan, Septi Riyanningsih, Sulistiowati Sufiardi</i>	Analytical Chemistry at SMK - SMAK Bogor through Scientific Approach and Assisted by ICT-based Media
	III-2	<i>Agus Abhi Purwoko</i>	Pengaruh Pendekatan Brain Based Learning Terhadap Hasil Belajar Kimia Di Sma
	III-3	<i>Bajoka Nainggolan, Ruth Dharmayana Sinaga</i>	Applying Of Model Of Quantum Teaching Learning With Media Map Conception To Increase Result Of Learning And Character Cooperation Student At Fundamental Discussion Atomic Structure In Sma
	III-4	<i>Ratu Evina Dibyantini</i>	Comparison Of Students' Learning Outcomes Which Taught By Using Problem - Based Learning Model And Cooperative Type Of Think - Pair - Share By Using Macromedia Flash

ICCCS 2015

CERTIFICATE OF ATTENDANCE



This is to certify that
JASLIN IRHSAN
AS
PRESENTER
at
The 4th International Conference Indonesian Chemical Society
29 - 30 September 2015
Medan, Indonesia

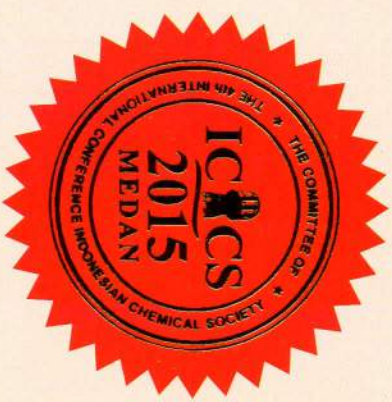
Indonesian Chemical Society
President

Muhammad A. Martoprawiro



Organizing Committee
Chairman

Prof. Dr. Harry Agusnar, M.Sc



Adsorption Isotherm of Phosphate Ions onto Silica and Amino-modified Silica from Lapindo Mud

Jaslin Ikhsan^{1,2}, Siti Sulastr¹, Erfan Priyambodo¹

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Yogyakarta State University, Jl. Colombo No. 1 Yogyakarta

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Abstract

The study of phosphate adsorption isotherm was carried out to propose the adsorption process. The propose was based on best fit of experimental data to isotherm equation model, and proton stoichiometry (χ), e.i. the number of protons taken or released by the adsorption process. The isotherm model might show site density of sorbent (N_m) and equilibrium constant for the adsorption process (K). The experimental data were collected by varying concentration of the phosphate ions at a constant pH 7.0 and room temperature on equilibrium time of 1 hour contact to the surfaces of sorbent of silica or amino-modified silica (AMS) from Lapindo mud. Data of proton stoichiometry were collected by noting very carefully the amount of added H^+ or OH^- ions to maintain the pH 7.0 during the contact time of each phosphate concentration studied. Experimental data fitted very well to the Langmuir isotherm equation, indicating the formation of monolayer coverage on available surface sites of both silica and AMS whose N_m of silica was about the same as that of AMS, e.i. 8.197×10^{-5} and $8.350 \times 10^{-5} \text{ M g}^{-1}$, respectively, but the values of K of the adsorption onto silica was about a half of that onto AMS, e.i. 1056.277 and 2023.657 L g^{-1} , respectively. Very few values of χ indicated that adsorption process did not involve proton. From the model, the study suggest that adsorption processes on both silica and AMS were through hydrogen coordination bond.

Keywords: Phosphate adsorption; amino-modified silica; adsorption process; hydrogen coordination bond.

1. Introduction

Phosphate ion is one of micro nutrients that are needed by plants. A lot amount of phosphate ions are used by farmers without stoichiometric calculation. As a result, phosphate excess in significant amount is wasted to flow to river or lake without careful control. Therefore, environmental problems may arise. For instance, many worthless plants thrive in rivers and waterways leading to imbalance of water ecosystems. Therefore, transport of phosphate ions in water is crucial to be investigated and controlled.

Adsorption was commonly used as a process to remove or to decrease the concentration of chemical wastes in the environment. Adsorption was also used to understand the process of transport of molecules or ions in water. By varying the concentration of sorbate in the adsorption experiment, which is known as adsorption isotherm, adsorption process may be predicted. Bono *et al.* (2014) proposed that pores of the sorbent were essential on binding of acetone and propanol from a non-azeotropic mixture. It was indicated by higher adsorption fraction of sorbate onto activated carbon than onto silicate, due to their different porosity. The adsorption was described by the formation of monolayer type adsorption. Based on fitting to adsorption data by Langmuir equation, Ikhsan *et al.* (1999) argued that metal ions were bound by clay mineral kaolinite through non-specific electrostatic interactions, with adsorption occurred by ion exchange.

Proton stoichiometry as the measurement of the number of H^+ ions taken up or released in the adsorption process when the concentration of sorbates was varied, but the pH and temperature were kept constant, reinforced the propose of adsorption mechanisms. Ikhsan *et al.* (1999) reported that small values of proton stoichiometry for the transition metal adsorption by kaolinite at low pH values were consistent with the proposed mechanisms of ion exchange reaction, while at higher pH, the

proton stoichiometry values were higher which indicated that surface sites of kaolinite involves the expulsion more proton because of inner-sphere coordination to the sites.

Silica contains hydroxyl groups ($-OH$) which is variable-charged. After it was modified with amine, the active sites were amine groups ($-NH_2$). Adsorption isotherm experiments of phosphate ions by both sorbents were modelled by Langmuir or Freundlich Isotherm equation to understand the style of adsorption, site density of sorbent (N_m) and equilibrium constant for the adsorption process (K).

2. Methods and Experimental Details

The sorbent of silica was separated from Lapindo mud, and AMS was amine-modified of the silica from Lapindo mud. Both silica and AMS were adsorbents used in this study.

Adsorption isotherm was conducted to find out the effect of phosphate concentration. The sorbent of silica or AMS was dissolved into 150 mL 0.01 M of KH_2SO_4 whose pH was adjusted to be 5 and kept constant by adding KOH or HNO_3 . The suspension was let equilibrate for 2 h, and 10 mL sample was taken. The concentration of KH_2SO_4 was increased by adding the stock solution of KH_2SO_4 in steps of increments until the total concentrations added were 0.015 M. On each step of addition of stock solution which reached equilibrium time of 2 h, a sample was taken. The concentration of KOH or HNO_3 added for maintaining the pH was recorded carefully. All samples were centrifuged and their filtrates were analysed for free concentration of KH_2SO_4 using UV-Vis Shimadzu 2450.

Data of adsorption isotherm were analysed by Langmuir or Freundlich isotherm equation to calculate N_m and K .

3. Results and Discussion

The sorbents that were used in this research were (a) silica that were separated from Lapindo mud, and (b) silica from the mud that was modified by amino (AMS). Both sorbents were prepared and being reported in a separate publication.

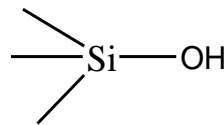


Figure 1a. The structure of silica sorbent

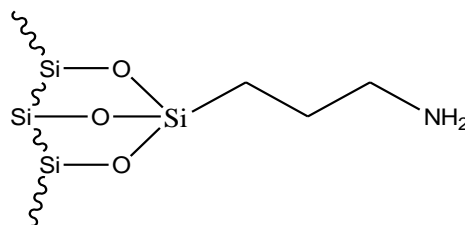


Figure 1b. The structure of AMS sorbent

Adsorption isotherms of phosphate by each adsorbent were measured at pH 5.0. The pH of suspension of sorbent was adjusted into pH 5.0, and so was the pH of phosphate stock solution. Keeping the pH of system be constant was to note the concentration of acid/base that were added in the experiments. The consumption of acid/base in the adsorption was used to estimate the amount of proton that was needed or released when the adsorption take placed, that was called proton stoichiometry, χ (Table 1). Similar method was done by Ikhsan *et al.* (1999; 2004a, 2004b) to determine the number of proton that was taken up or released in the adsorption of transition metal ions and aspartic acid by kaolinite.

Table 1 showed that very few proton involved in the adsorption of phosphate by both sorbents, either silica or AMS. The very small amount proton was released on the adsorption of phosphate onto silica, but it was taken up on that onto AMS. The ratio of the number of mole between proton involved and phosphate adsorbed was 0.00378 to 1 on the adsorption of phosphate onto silica, and 0.00421 to 1 on that onto AMS. These data indicated that the reaction mechanism on the adsorption of phosphate onto silica or AMS did not involve proton.

Table 1. Proton Stoichiometry for Phosphate Adsorption onto Silica or AMS

Sorbent	Proton stoichiometry, χ (number of mole of protons taken up per mole phosphate adsorbed)		
	Exp 1	Exp 2	Average
Silica	-0.00400	-0.00357	-0.00378
AMS	0.00280	0.0563	0.00421

Adsorption isotherm was conducted by varying the concentration of phosphate, and measured its free concentration after the adsorption. Figure 1 showed that the percentage of phosphate adsorbed by both sorbents were about the same. At initial low concentration of phosphate, all phosphate ions were taken up by sorbents, but as the concentration of phosphate was raised, the percentage of phosphate ions that were adsorbed by the adsorbents became smaller (Figure 2). It was due to the availability of surface. When the surface or active sites of adsorbents are still available, most free phosphate ions were bound by the surface, but after the loading capacity of the surface decreased due to the adsorbate occupation, the ability of surface to attract the phosphate ions also decreased. The maximum number of the loading was calculated from modelling using isotherm equations of Langmuir or Freundlich.

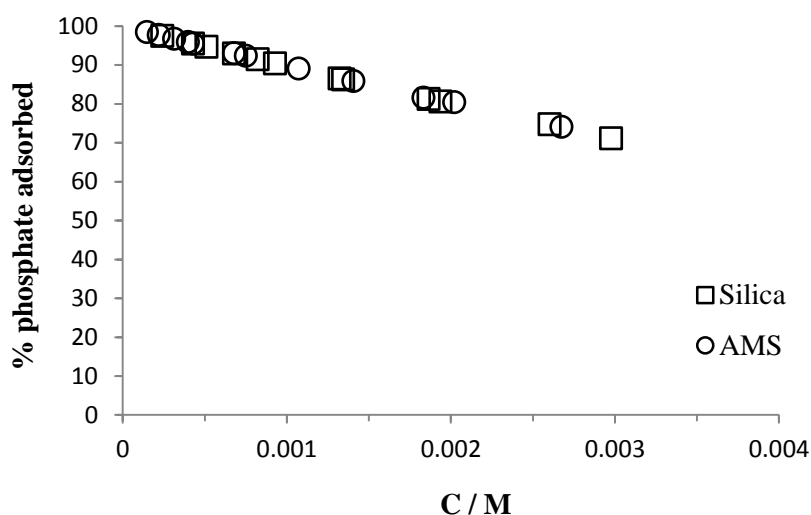


Figure 2. Effect of equilibrium concentration of phosphate ions to its adsorption onto (\square) silica and (\circ) AMS at pH 7.

The calculation showed that the adsorption process followed the model of Langmuir. The Langmuir model was calculated by the equation.

$$\frac{C}{N} = \frac{1}{KN_m} + \frac{C}{N_m}$$

Where C is equilibrium concentration (M), N is the number of phosphate ions adsorbed ($M\ g^{-1}$), K Langmuir constant ($L\ g^{-1}$), and N_m is the maximum amount of phosphate ions adsorbed ($M\ g^{-1}$).

Figure 3 Showed the fit calculated from the Langmuir model which fitted well to isotherm data as indicated by determinant coefficient, R^2 given in the Table 2. On the other hand, the calculation using the Freundlich equation did not fit well to the data as indicated small values of R^2 . It means that the adsorption occurred following the assumption of Langmuir. Yue *et al.* (2010) reported that phosphate adsorption on modified Giant Reed occurred by forming one monolayer surface complex based on the modelling of isotherm data using Langmuir equation.

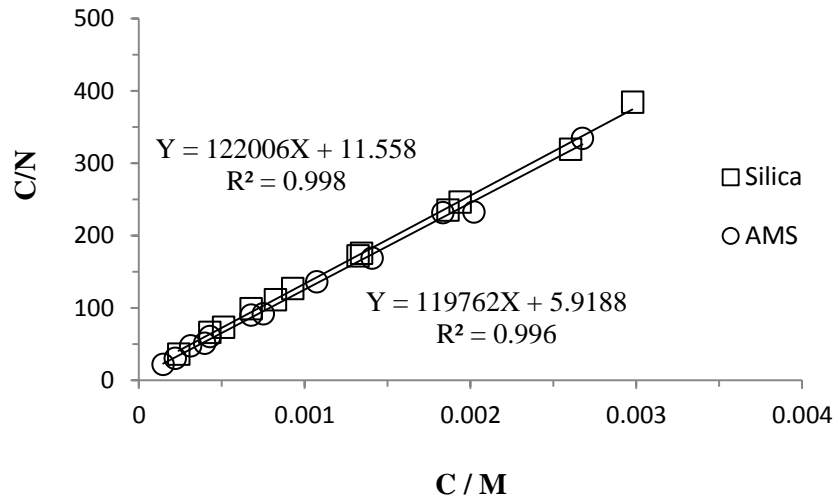


Figure 3. The fit of isotherm data to Langmuir isotherm model

Table 2. The parameters of Langmuir and Freundlich isotherm

Adsorption Model	Silica	AMS
Langmuir		
N_m ($M g^{-1}$)	8.197×10^{-5}	8.350×10^{-5}
K ($L g^{-1}$)	1056.2770	2023.6566
R^2	0,998	0.995
Freundlich		
K ($L g^{-1}$)	1.4028×10^{-5}	1.3614×10^{-5}
$1/n$	0.0930	0.0800
R^2	0.869	0.692

The Langmuir assume (a) the adsorption as the coverage of adsorbents' surfaces that have a specific number of sites and to which the adsorbate molecules can be adsorbed forming only one monomolecular layer on the surface, (b) the adsorption is localized and all sites are identical, and (c) the heat of adsorption is independent of surface coverage (Shaw, 1970). When the surfaces were fully covered in a monolayer form by the adsorbate, the adsorption does not go further. Therefore the maximum amount of adsorbates covering in a monomolecular layer to the surfaces (N_m) can be calculated. The values of N_m indicated the capacity of sorption of the sorbents. From the calculation using regression linear equation depicted in the Figure 3, the capacity of silica or AMS for phosphate ions was 8.197×10^{-5} or $8.350 \times 10^{-5} M g^{-1}$, respectively (Table 2). While the K in Langmuir equation isotherm model is the equilibrium constant for the adsorption-desorption process whose values were given in the Table 1056.2770 and 2023.6566 $L g^{-1}$. The small difference of N_m values of both sorbents indicated that the modification of silica by amine functional groups increased slightly the capacity of surface, but the increase was not significant. But, the equilibrium constant of adsorption-desorption process, K of AMS was higher than that of silica.

Interaction of phosphate ions by sorbent silica or AMS was affected by the nature of the sorbent and the adsorbate. At pH experiment of 7.0, the surface of silica which is usually represented by SOH, with S is Surface and OH is hydroxyl groups, is negatively charged at high pH because of protonation and is positively charged at low pH because of deprotonation, as shown by the reactions 1 and 2 (Sposito 1984, Ioannou *et al.* 2013, Ikhsan *et al.* 2015).





The pH at which the silica surface is neutral in charge is called the point zero charge (PZC). PZC of silica was at below pH 7.0 (Kosmulski, 2009). At pH 7.0 at which the isotherm experiments were conducted, the silica sorbent was most probably negatively charged. Different from silica, AMS has one lone pair electron that is ready for interaction (Figure 4), and so does it at pH 7.0. Similar system has been reported by Parfitt and Atkinson in Ioannou *et al.* (2013). The PZC of goethite-adsorbed phosphate system was at pH 5.0. Goethite is Ferrous hydroxide (FeO-OH), that is similar to the sorbent investigated. Therefore the pH of system in this investigation was above the PZC. The pH system that was higher than PZC made the sorbent tended to be negatively charged.

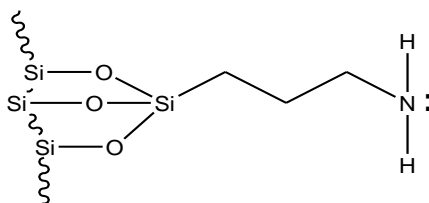


Figure 4. one lone pair electron on each unit of AMS site

On another site, the adsorbate of phosphate ions is mainly in the form of anion (Figure 5). The distribution of phosphate as calculated from the results of experiment conducted by Ikhsan *et al* (2012) as below. At pH 7.0, phosphate is dominantly in one and two-negative charges.

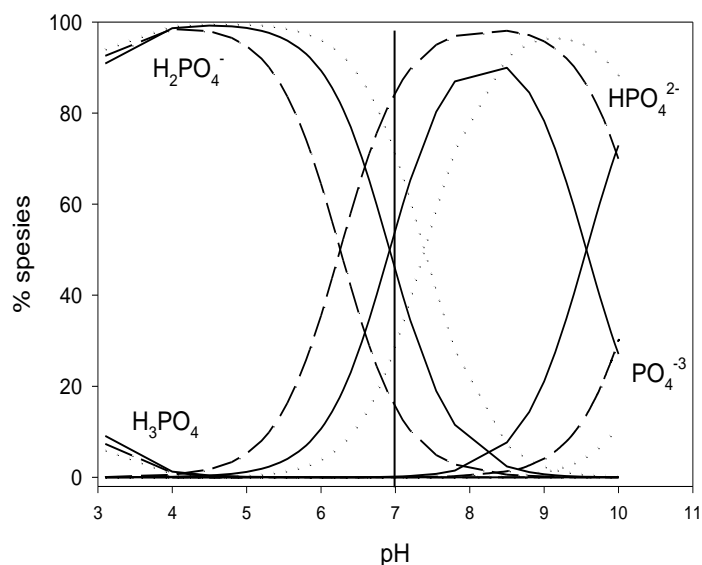


Figure 5. Distribution of phosphate species at various pH values at temperature of (.....) 10 °C, (---) 30 °C and (—) 50 °C.

Based on the existence of the species of silica and AMS sorbents, and phosphate ions, it can be proposed that the interaction between the sorbent of silica and phosphate ions was by hydrogen bonding, as illustrated by Figure 6.

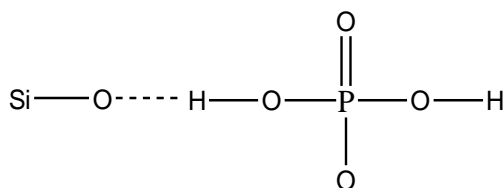


Figure 6. Surface complex formed between SO^- active sites of silica and phosphate ions.

While, the complex formed by surface sites of amine functional groups and the phosphate ions was also by hydrogen bonding as illustrated by Figure 7.

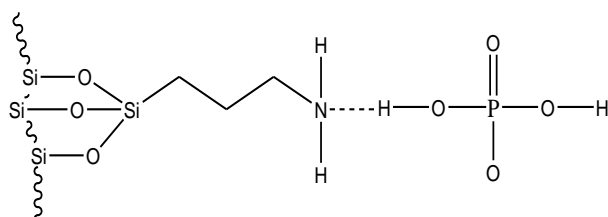


Figure 7. Surface complex formed between amine functional groups of AMS sites and phosphate ions.

Both surface complexes were formed without proton involvement, based on the data of the usage of proton (proton stoichiometry, χ) in the Table 1). Very small number of mole of proton, 0.00378 mole were released when silica bound one mole of phosphate ions. For the AMS surface-phosphate complexes, 0.0421 mole proton were needed when the surface bound one mole phosphate ions.

4. Conclusion

Phosphate ions were adsorbed by either silica or AMS without significant involvement of proton because the interaction were through hydrogen bonding, The surface complex was one monomolecular covering the surface of sorbent following Langmuir model. The capacity, N_m of silica and AMS were 8.197×10^{-5} and $8.350 \times 10^{-5} \text{ M g}^{-1}$, respectively, but the values of K of the adsorption onto silica was about a half of that onto AMS, e.i. 1056.277 and 2023.657 L g^{-1} , respectively.

5. Acknowledgement

The authors express their gratitude to DRM, Ministry of Research and Higher Education of Republic of Indonesia, funding the research with contract No. 38/FUNDAMENTAL/UN.34.21/2015.

6. References

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