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Proceeding

The 2nd International Conference of
the Indonesian Chemical Society 2013

IC  CS 2013

Research in Chemistry for Better Quality of Environmental

Universitas Islam Indonesia, Yogyakarta, Indonesia
October, 22 - 23th 2013

Abdul Kahar Muzakkir, Conference Hall
Universitas Islam Indonesia (UII), Yogyakarta.
Kampus Terpadu, Jl. Kaliurang KM 14,5 Sleman, Yogyakarta.

Proceeding

The 2nd International Conference of the Indonesian Chemical Society 2013
October, 22-23th 2013

Preface

The international conference is an annual conference of the Indonesian Chemical Society (Himpunan Kimia Indonesia, HKI). In the year 2013, the mandate of the organizing committee was given to the HKI Yogyakarta branch and also supported by Department of Chemistry of Universitas Negeri Yogyakarta (UNY), Department of Chemistry of Universitas Gadjah Mada (UGM), Department of Chemistry of Universitas Islam Negeri Sunan Kalijaga (UIN Suka), National Nuclear Energy Agency (BATAN Yogyakarta), and Volcano Investigation and Technological Development Center (BPPTK Yogyakarta). For the year 2013, ICICS 2013 is hosted by Department of Chemistry, Faculty of Mathematics and Natural Sciences, Islamic University of Indonesia, Yogyakarta from October 22 – 23, 2013. This conference was also prepared to celebrate 70th anniversary of Universitas Islam Indonesia.

The Scientific Programme of ICICS2013 comprises the following:

- | | | |
|---|----|--------|
| 1. Invited Speaker | 11 | papers |
| 2. A total 256 paper for parallels sessions | | |
| a. Organic Chemistry | 32 | papers |
| b. Inorganic Chemistry | 43 | papers |
| c. Physical Chemistry | 37 | papers |
| d. Analytical Chemistry | 68 | papers |
| e. Education Chemistry | 23 | papers |
| f. Biochemistry | 43 | papers |

The breakdown of the presentation is as follows:

Session	Oral	Poster	Total
Invited Speaker	11	0	11
Organic Chemistry	25	7	32
Inorganic Chemistry	38	5	43
Physical Chemistry	31	6	37
Analytical Chemistry	61	7	68
Education Chemistry	22	1	23
Biochemistry	34	8	43
Total	222	34	256

Yogyakarta, 25th November 2013

ICICS 2013

Editors

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The 2nd International Conference of the Indonesian Chemical Society 2013
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Welcoming Address by The Organizing Committee



Assalamu'alaikum Wr. Wb.

Honorable Rector of Universitas Islam Indonesia
The distinguished invited speakers, and
All participants of the ICICS 2013

Welcome you at the 2nd International Conference of the Indonesia Chemical Society 2013 (ICICS 2013) this morning here at the Auditorium Kahar Muzakkir Universitas Islam Indonesia, Yogyakarta. The international conference is an annual conference of the Indonesian Chemical Society (Himpunan Kimia Indonesia, HKI). In the year 2013, the mandate of the organizing committee was given to the HKI Yogyakarta branch and also supported by Department of Chemistry of Universitas Negeri Yogyakarta (UNY), Department of Chemistry of Universitas Gadjah Mada (UGM), Department of Chemistry of Universitas Islam Negeri Sunan Kalijaga (UIN Suka), National Nuclear Energy Agency (BATAN Yogyakarta), and Balai Penyelidikan dan Pengembangan Kegunungpian (BPPTK Yogyakarta). For the year 2013, the honor of hosting ICICS 2013 has been given to the Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Islam Indonesia, Yogyakarta. This conference was also prepared to celebrate 70th anniversary of Universitas Islam Indonesia.

The conference comprises both oral and poster presentation in English and Indonesian with optional post conference publication of full papers in English in the *Procedia Chemistry* (Elsevier, ISSN: 1876-6196) and *Proceeding Conference for Indonesian language*. There are 211 papers presented orally and 34 papers presented by poster covering wide-variety subjects of chemistry. We invited 6 Indonesian invited speakers, 2 Japan invited speakers, 1 Australian invited speakers, 1 Saudi Arabia invited speakers, and 1 Malaysian Invited speakers.

We hope you will enjoy a pleasant and valuable seminar at Universitas Islam Indonesia

Wassalamu'alaikum Wr. Wb.

Riyanto, Ph.D.



Opening Speech from the Rector of Universitas Islam Indonesia



Assalamu'alaikum Wr. Wb
The distinguished invited speakers, and
All participants of the ICICS 2013

Firstly, I would like to express my great appreciation to the Department of Chemistry UII as one of the organizers of the program The 2nd International Conference of the Indonesian Chemical Society 2013 (ICICS 2013) with the theme "Research in Chemistry for Better Quality of Environmental". I am proud that this interesting event is being organized and held in Yogyakarta.

As the biggest and the oldest private university in Yogyakarta, University Islam Indonesia is committed to the excellence in research and teaching. Recently, we are preparing UII as one of the world class universities.

Knowing that committee has selected outstanding speakers from various prestigious institutions. I believe that all of the participants will enjoy the discussion of issue covered by the topic of this seminar. Scientist have shown that the environment's condition is increasingly critical, and human industrial activities are largely to blame. In fact that environmental damage is a crisis we caused together, therefore, a responsibility we all share together. We are deeply concerned with the issues and opportunities in the internationalization of sciences for better life, sciences have to make better quality of environmental.

Finally, I would once again like to thank the organizer for organizing this event, and to thank all the participants attending this ICICS 2013 event as well as delivering their scientific presentations. I do really hope that you can enjoy this seminar and have excellent stay in Yogyakarta.

Wassalamu'alaikum Wr. Wb

Prof. Dr. Edy Suandi Hamid, M.Ec.
Rector of Universitas Islam Indonesia

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Remarks by the Chairman of the Indonesian Chemical Society (Himpunan Kimia Indonesia, HKI)



Indonesian Chemical Society (Himpunan Kimia Indonesia, HKI) is an independent, nonprofit organization founded in February 1962 to facilitate communication among Indonesian chemists and other professionals from chemistry related fields, and to promote the advancement of science, education, and application of chemistry to support the better life of mankind. HKI organize activities to enhance communication and collaboration among chemists in various institutions in Indonesia, to disseminate new knowledge and research results in chemistry and related fields, to improve the knowledge and

skills of chemists working in schools, universities, industries, research institutes, and other sectors, to nurture a scientific temper on school children to ensure strong capabilities of future chemists that are needed for humankind, and other activities that support its missions. HKI holds various academic conferences, publishes several journals, supports the development of scientific information systems in Indonesian; organize training for chemists in various sectors, etc.

The 2013 International Conference of the Indonesian Chemical Society will be the 2nd event in the ICICS conference series, started in 2012, that brings together individuals involved in chemistry-related fields (chemistry, pharmacy, environmental science, chemical engineering, molecular biology, material science, education chemistry, etc.) or institution in chemistry-related sectors. The First International Conference of the Indonesian Chemical Society 2012 is organized by East Java Branch of HKI in collaboration with chemistry departments at several universities in East Java: ITS, UB, UIN Maliki, UM, UMC, Unair, Unej, and Unesa.

ICICS 2013 will be organized by the Indonesian Chemical Society Yogyakarta branch. The international conference was supported by the Indonesian Chemical Society (Himpunan Kimia Indonesia, HKI), Department of Chemistry of Universitas Negeri Yogyakarta (UNY), Department of Chemistry of Universitas Gadjah Mada (UGM) and Department of Chemistry of Universitas Islam Negeri Sunan Kalijaga (UIN Sunan Kalijaga). For the year 2013, the honor of hosting ICICS-2013 has been given to the Department of Chemistry, Faculty of Mathematics and Natural Sciences, Universitas Islam Indonesia (UII), Yogyakarta, Indonesia.

Congratulations to the ICICS 2013 committee for this conference.

Dr. Muhamad Abdulkadir Martoprawiro
Chairman of the Indonesian Chemical Society

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3. Rector of Islamic University of Indonesia
4. Rector of Gadjah Mada University
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Synthesis of A Chelating Resin Chitosan-1,5-Diphenyl Carbazide and Characterization of Retention Toward Cr(VI) Ions

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Abstract

Synthesis of the derivative chelating resin of chitosan-1,5-diphenyl carbazide (DPC), and characterization of retention for Cr(VI) ions has been carried out. Synthesis chitosan-DPC resin can be done by coupling reacts between diazonium ion from diazotation chitosan with DPC at temperature 1-3°C during 1 hour, the product of 70% yield was obtained. The optimal conditions to modified of chitosan-1,5-diphenylcarbazine microcapsules resin were 0.1 M CaCl₂ and 1% Na-alginate. Ca-alginate-chitosan-1,5-diphenylcarbazine microcapsule resin before and after interacted with Cr(VI) has characterization by using FT-IR spectroscopic, shows the spesific functional groups of the resin. Retention characteristic of resin was investigated for Cr(VI) ions. The optimal conditions for the analytical performance of resin with retention at pH 1, minimum contact time was 30 minutes, retention capacity was 1.7350 mg Cr(VI)/g microcapsule resin.

Keywords : Chitosan, alginate, Chelating resin, Diphenyl carbazide, Cr(VI).

Introduction

Chromium occurs in nature at very low concentrations predominantly in two oxidation states, which differ significantly in their toxicity. While Cr(VI) is toxic and carcinogenic upon inhalation, Cr(III) is known to be an essential nutrient for humans supplied also in pharmaceutical products as a dietary supplement. Increasing production of Cr(VI), due to oxidation of Cr(III) in industrial plants or from its spontaneous oxidation in soils, may pose pollution problems to drinking and surface waters. (Paleologos et al., 2001). In recent years, the determination of chromium especially Cr(VI) is become very important in environmental samples. One technique of determining Cr(VI) developed in recent years is preconcentration technique based chelating resin, using a spectrophotometer detector.

Chelating resin basically is consisted of two components that are functional of chelating group and polymer matrix as supported. Nature of from both this components will determine usage and performance from a chelating resin. The selectivity will be determined by type chelating group, while capacities, mechanic strength and the chemistry resistance determined by supporter polymer type who applied (Saitoh, et al. 2007; Trochimczuk et al., 2004). This means that a chelating resin with certain characteristic can be synthesis by considering both the compiler components.

The strategy determines in preconcentration to apply chelating resin is how to incorporate chelating reactant into polymer supporter material (Bilba et al., 1998). Way of simple is through impregnation technique, but chelating resin yielded generally gives unfavourable performance because chelating group which only tied in physical to earn easily escapes again at the time of its use (Amran and Heimburger, 1996; Alexandratos and Smith, 2004). To solving problems explained above, hence chelating group shall tie chemically through covalent bond at polymer applied as supporter material (Prasada et al., 2004). The existing finite, chelating resin this type has not many checked more than anything else is commercial and still be classified as fine-chemicals.

Chitosan can be synthesized with deacetylation reaction by removal acetyl group (COCH_3) from chitin using alkali solution (Dutta et al, 2004). Pure chitosan is generally used as an absorbent for heavy metals in flakes and powder form. Adsorption ability of chitosan against heavy metals is strongly influenced by physical-chemical properties of chitosan. Chitosan which not cross-linked have an adsorption capacity is greater than the cross-linked chitosan, but the cross-linked chitosan have the physical endurance to acid better than not cross-linked chitosan (Wan Ngah, 2002). In recent years, the synthesis of chitosan have been carried out and modification of chitosan with the addition of side groups with the aim to analytical using such chelating resin against heavy metals contained in natural samples in trace concentrations (Katarina et al., 2005).

Based on above description this research has been synthesized chelating resin chitosan modified with the addition of 1,5-diphenyl carbazide (DPC) compound and modified into form of microcapsules in alginate salt which expected to be used as a microcapsule resin for retention of Cr(VI) ion. Chitosan obtained from chitin by deacetylation reaction from windu shrimp's (*Penaeus monodon*) shells with 60 % sodium hydroxide, and then DPC group is added as a chelating group to increase the retention capacity of the Cr(VI) ions.

Experimental

Instrumentation. A set of reflux system, three-neck flask, blender, sieve size of 100 mesh, filter paper, analytical balance, porcelain bowls, glass funnel, the volume pipettes, stopwatch, oven, hot plate with stirrer, Spectronic 20 D+, Spectrophotometer FT-IR (Fourier Transform - Infra Red) Prestige 21-D., was used for all measurements.

Reagents. All reagents were of analytical-reagent grade; sodium hydroxide, hydrochloric acid, sulfuric acid, nitrate acid, calcium chloride, acetic acid, ethanol, acetone, sodium nitrite, sodium alginate, 1,5-diphenyl carbazide, potassium bichromate, glacial acetic acid and aquabidest.

Synthesis of Chitosan -1,5-diphenylcarbazide Resin

2 g of chitosan added to 100 mL 1M HCl alternating with addition of 75 mL 1 M NaNO₂ until resin was azotated in the presence of iodine paper color change, by keeping the temperature between 1-3 °C. Then add dropwise 100 mL of 10% 1,5-diphenylcarbazide and stirred for 1 h with temperature between 1-3 °C and left for 24 h in the refrigerator. The mixture was then filtered and rinsed with distilled water until neutral pH and dried in oven at 60 °C (Panggabean et al., 2009)

Production of Ca-Alginate-Chitosan-1,5- diphenylcarbazide Microcapsules Resin

25 mL CaCl₂ solution prepared with various concentration of 0.1 - 1 M into each 100 mL glass beaker, then added 0.025 g Chitosan -1,5-diphenylcarbazide resin synthesis and stir until homogeneous with magnetic stirrer. 1% Na-alginate was added dropwise with a burette while stirring with a magnetic stirrer on to form of Ca-alginate-chitosan-1,5-diphenylcarbazide microcapsules, adjust the flow rate in the buret and the rotational speed of the magnetic stirrer and Ca-alginate-chitosan-1,5-diphenylcarbazide microencapsulated granules dried at room temperature for ± 24 hours. For the same steps, varied concentrations of Na-alginate 0.5 and 0.75% at the optimum concentration of CaCl₂ solution. Subsequently the dried resin microcapsules can be determined retention of the ion Cr(VI) (Panggabean et al., 2012).

Characterization of Ca-Alginate-Chitosan-1,5- diphenylcarbazide Microcapsules Resin

Microcapsule of resin before and after interacted with Cr(VI) has characterization by using FT-IR spectroscopic. The retention capabilities of chelating resin synthesis will be evaluated through a batch method are determining the optimum pH, minimum contact time, and retention of capacity. 0.05 g of Ca-alginate-chitosan-1,5-diphenylcarbazide microcapsule resin added 10 mL of standard metal ion Cr(VI) 1 mg/L, stirred and allowed 30 minutes, filtered. The amount of metal ions retented will be calculated by measuring the amount of residual determined by visible spectrophotometry at $\lambda = 540$ nm. The data obtained can describe the character retention of the chelating resin synthesized.

Results and Discussion

Synthesis of Chitosan-1,5-diphenylcarbazine Resin

Synthesis of chitosan-1,5-diphenylcarbazine resin is done through the diazotation reaction. Diazotation is a way to change the amine group into a diazo group using concentrated acid solution (Panggabean, et al, 2009). In this process chitosan reacted with HCl 1 M and NaNO₂ 1 M alternately at 1-3 °C until the resin azotated. Reaction temperature is maintained at below 3 °C because the reaction is highly exothermic. Hydrochloric acid is a strong acid which serves as a catalyst and forming chitosan chloride salt. NaNO₂ serves as forming nitrosonium ion together with HCl (Sykes, 1989) to produce diazonium salt. The mixture then reacted with 1,5- diphenyl carbazine 5 % dropwise and stirred for ± 1 hours at 1-3 °C. Diazonium salt is stable at low temperature (0-4 °C) and sensitive to light and can easily be damaged at ultraviolet wavelength and visible light (Panggabean, et al, 2009). Diazonium salt has coupling reaction with 1,5- diphenylcarbazine to produce chitosan- 1,5- diphenyl carbazine compound (**Figure 1**). The obtained Chitosan-1,5- diphenylcarbazine resin after diazotation is reddish brown with a yield of 39.43%.

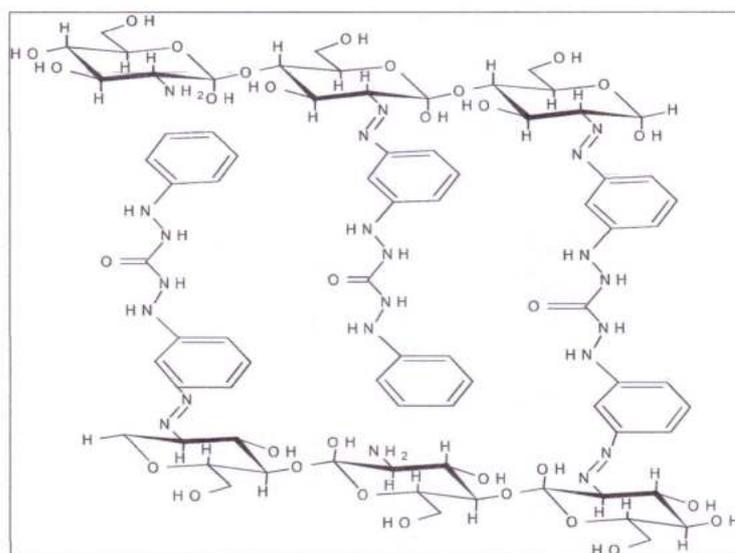


Figure 1. Structure of Chitosan-1,5-Diphenylcarbazine

Production of Ca-Alginate-Chitosan-1,5- Diphenylcarbazine Microcapsule Resin

The production of Ca-alginate-chitosan-1,5- diphenylcarbazine microcapsules conducted by reacting the Na-alginate solution with chitosan resin-1,5-DPC in CaCl₂

solution. The formation of the microcapsules characterized by changes in the morphology of the original Na-alginate solution into Ca-Alginate-Chitosan-1,5-Diphenylcarbazine microcapsule shaped gel sphere then Ca-Alginate-Chitosan-1,5-Diphenylcarbazine microcapsule dried at room temperature. The concentration of CaCl_2 and Na-alginate solution be varied to obtain the microcapsules resin able to maximum retention of Cr(VI) ion.

On the variation of the concentration of CaCl_2 solution with a solution of 1% Na-alginate, the % retention of ions Cr(VI) are the most significant at concentrations of 0.1 M CaCl_2 solution is 84.60%, whereas the concentration of CaCl_2 solution 0.5 M and 1 M, % retention of the metal ions Cr(VI) is very small at just under 20% (**Figure 2**). This is because the form of the microcapsules at a concentration of 0.5 and 1 M CaCl_2 solution denser and less porous which in this case acts as a matrix Ca metal in metal uptake.

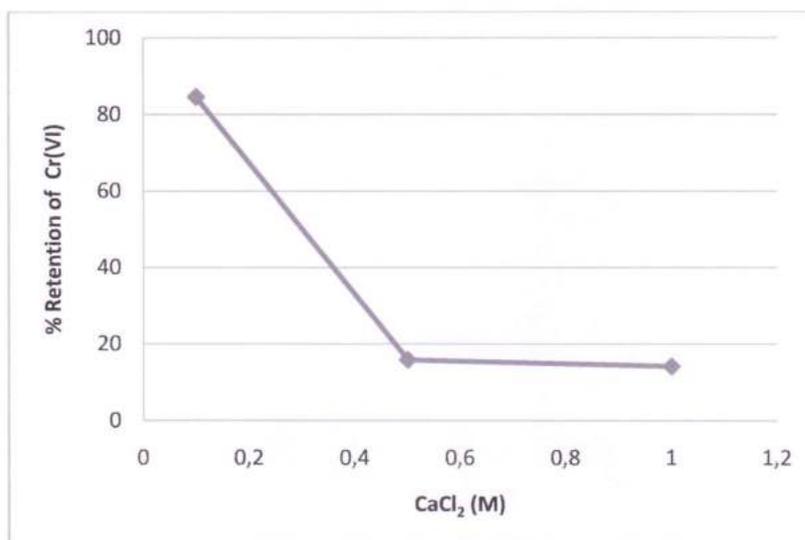


Figure 2. Effect of CaCl_2 concentration on making Ca-alginate-chitosan-1,5-diphenylcarbazine microcapsules

From the optimum concentration of CaCl_2 , subsequently varied Na-alginate concentration of 0.5 and 0.75% respectively at remains 0.1 M CaCl_2 , and measured the retention of the ions Cr(VI). Variations in the concentration of Na-alginate obtained results are best retention occurred in 0.75% Na-alginate with retention of 96.90% (**Figure 3**). However, because of the texture of the mixture is less well rounded in form microcapsules so feared ineffective in its application for preconcentration stage in minicolumn, then

subsequently used for the manufacture of microcapsules composition of 1% Na-alginate which also has a high retention% was 90.20%.

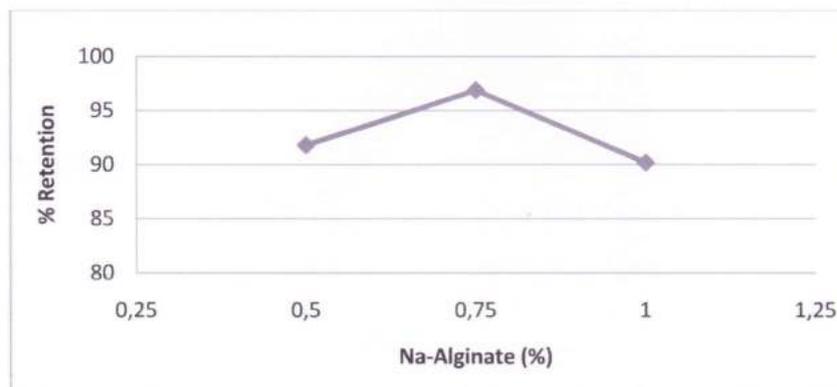


Figure 3. Effect of Na-Alginate Concentration on the Preparation of Ca-alginate-chitosan-1,5-diphenylcarbazine

Analysis of Ca-Alginate-Chitosan-1,5-Diphenylcarbazine microcapsule

Ca-Alginate-Chitosan-1,5-Diphenylcarbazine microcapsule were analyzed by FTIR spectroscopy. Spectrum analysis of Ca-Alginate-Chitosan-1,5-Diphenylcarbazine microcapsule before interacted with Cr(VI) compared to the spectrum of Ca-Alginate-Chitosan-1,5-Diphenylcarbazine microcapsule that after interacted with Cr(VI) can be seen in **Figure 4** and **5**.

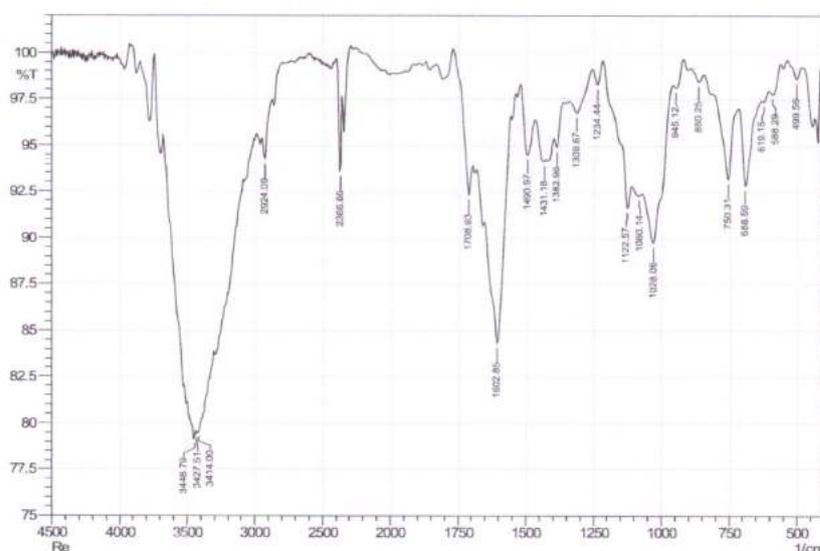


Figure 4. FTIR spectrum of Ca-Alginate-Chitosan-1,5-Diphenylcarbazine microcapsule

FTIR spectrum in **Figure 4** shows a broad absorption peaks at wave number 3446.79; 3427.51 and 3414.00 cm^{-1} indicate typical absorption peak of O-H stretching vibration. Absorption peaks at wave number 2924.09 cm^{-1} is the CH stretching vibration of alkanes. Absorption peaks at wave number 1708.93 cm^{-1} indicate typical absorption of stretching vibrations of carbonyl group (C=O) where is possibility of amide groups at 1.5 DPC and carboxylic acid salt of alginic. Absorption peaks at 1062.85 and 1490.97 cm^{-1} is typical of the stretching vibration peak symmetry and asymmetry -N=N- groups that is likely to come from diazo bond between chitosan and 1.5-diphenylcarbazine or 1.5-difenilkarbazone. Absorption peaks at wave number 1028.06; 1080.14 and 1122.57 cm^{-1} showed C-O stretching vibration from the compound chitosan and alginate. Absorption peaks at wave number 750.31 cm^{-1} , is typical absorption of stretching vibration of N-O (Silverstein, et al, 1986).

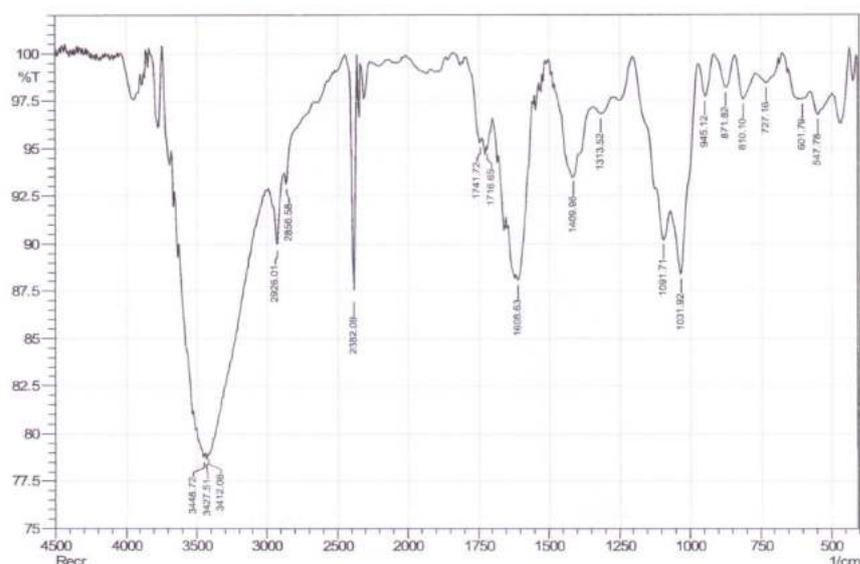


Figure 5. FTIR spectrum of Ca-Alginate-Chitosan-1,5-Diphenylcarbazine microcapsule + Cr(VI)

FTIR spectrum Ca-Alginate-Chitosan-1,5-Diphenylcarbazine microcapsule has interacted with Cr(VI) (**Figure 5**), shows that most of the wave number has changed absorption intensity. It can be seen at 1741.72 and 1716.65 cm^{-1} absorption peaks showed reduced uptake in group C=O and C-O followed by increased uptake in the wave number 1031.92 cm^{-1} . This is expected because there has been a change in the structure of 1.5-diphenylcarbazine to 1.5-diphenylcarbazine binds to Cr(VI). Intensity decrease also occurred in the -N=N- stretching vibration in wave numbers 1608.63 cm^{-1} and also the NH- bending

vibration at wavenumber 727.16 cm^{-1} , this may occur due to the interaction between the 1,5-diphenylcarbazone complexing with Cr(VI).

Determination of Characteristic Retention of Microcapsules Resin

In the process of Cr(VI) ion retention by Ca-Alginate-Chitosan-1,5-Diphenylcarbazide microcapsule resin was carried out by batch method. That is by soaking the resin into Cr(VI) standard solution. The ability of Ca-Alginate-Chitosan-1,5-Diphenylcarbazide microcapsule resin in the retention of the metals Cr(VI) is obtained as a characteristic of the resin, which includes: optimum pH, minimum contact time, and retention capacity.

Determination of optimum pH

Determination of optimum pH microcapsules resin using a batch method or immersion is done by measurements the concentration of Cr(VI) with varying pH standard solution. 0.05 g microcapsules resin soaked for 30 min in 10 ml of 1 mg/L Cr(VI) standard solution so that can be determined the optimum pH Cr(VI) retained well.

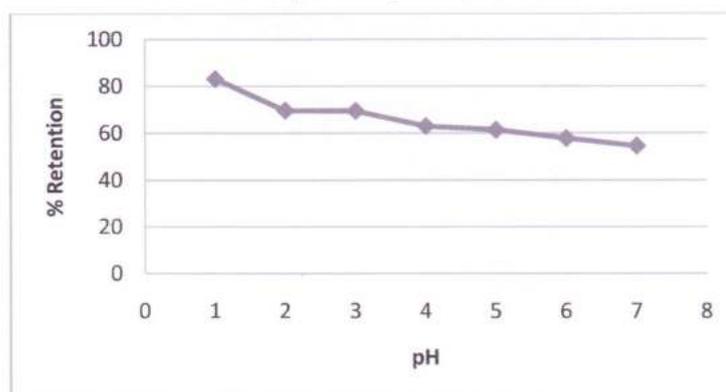


Figure 6. Determination of pH optimum

Figure 6. shows the microcapsule resin at pH 1, absorption has most favorable to the Cr(VI) ion is more than 80%. This is due to the pH stability of the complex formation occurs between DPC ligand with Cr(VI) ions which causes the metal ions can be maximum retained.

Determination of the minimum contact time

Determination of minimum contact time aims to find out how long it will need microcapsules resin in the retention of Cr(VI) ions well. At this stage of the research was done by 0.05 g of microcapsules resin into 10 ml of 1 mg/L Cr(VI) standard solution at the optimum pH 1 by varying the contact time from 1 - 120 min.

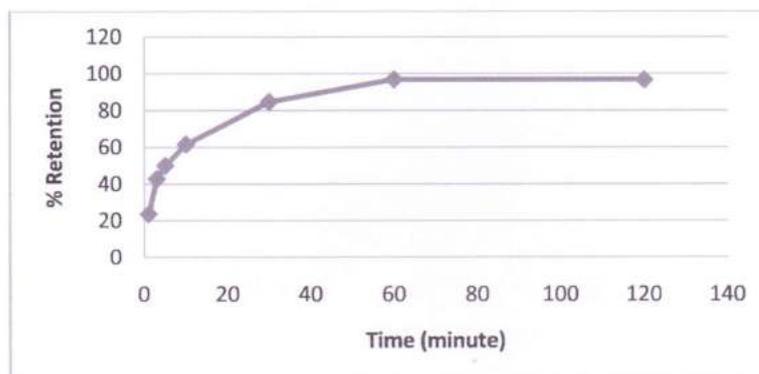


Figure 7. Determination of optimum contact time on the retention Cr(VI)

Figure 7. known that level of absorption of Cr(VI) is very fast at the beginning of the absorption process. This is caused by rapid diffusion and molecules absorption into contact to the external surface of resin. After the retention process is very fast. Cr(VI) retention rate gradually declined during the interval of time and reached equilibrium values. Where is this process due to the diffusion speed of Cr(VI) in the matrix of resin particles (Gong, 2010). From the calculation results showed minimum contact time required microcapsules resin to retent metal ions Cr(VI) is 30 minutes, where more than 80% of Cr(VI) ions has retented by resin and in the next minutes, the retention of Cr(VI) ions obtained is not much different.

Determination of the retention capacity

Retention capacity is a parameter that indicates the ability of Ca-Alginate-Chitosan-1,5-Diphenylcarbazine microcapsule resin to retent Cr(VI) ions. Determination of retention capacity is done by batch method, which is made of resin soaking 0.05 g of Ca-Alginate-Chitosan-1,5-Diphenylcarbazine microcapsule resin into 10 ml of Cr(VI) standard solution with pH 1 with various concentrations of Cr(VI) ions 1-15 mg/L, so it can be determined the ability of Ca-Alginate-Chitosan-1,5-Diphenylcarbazine microcapsule resin to retent Cr(VI) ions.

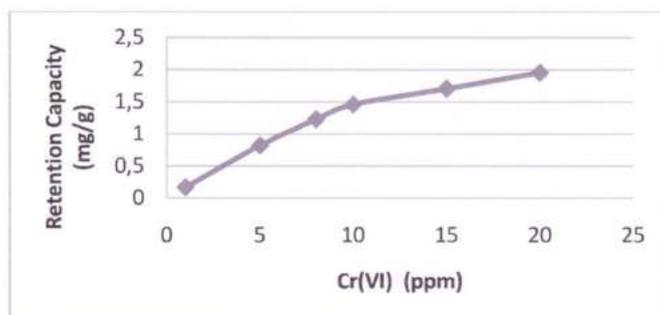


Figure 8. Determination Retention Capacity of microcapsule resin

Figure 8, relationships equation between Cr(VI) concentrations with many Cr(VI) ions retained by resin. By extrapolation method obtained two curves crossover point represents the value of the capacity retention of microcapsule resin. Where the two lines of equation $y = 0.117x + 0.113$ and $y = -0.110x + 3.260$ and the intersection between the two lines is the optimum retention capacity of Ca-Alginate-Chitosan-1,5-Diphenylcarbazide microcapsule resin was 1.7350 mg Cr(VI)/g resin. Where the results indicated that for every 1 g of resin microcapsule may retain 1.7350 mg Cr(VI).

Conclusion

Chitosan-1,5- Diphenylcarbazide resin compound can be synthesized and modified to become Ca-alginate-chitosan-1,5- Diphenylcarbazide microcapsule resin by reaction between Na-alginate solution with chitosan-1,5- Diphenylcarbazide resin in CaCl₂ solution. The optimal conditions were obtained by 0,1 M CaCl₂ and 1% Na-alginate. Characterization of Ca-alginate-chitosan-1,5-diphenylcarbazide microcapsule resin for Cr(VI) ion was indicated that optimal Cr(VI) ion retention at pH 1, minimum contact time 30 and retention capacity was 1.7350 mg Cr(VI)/gr microcapsule resin.

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