PROCEEDINGS OF

18th REGIONAL SYMPOSIUM on CHEMICAL ENGINEERING

(RSCE2011)

Innovation and Sustainability for a Rapidly Changing World

27TH - 28TH OCTOBER 2011, HO CHI MINH CITY, VIETNAM

ORGANIZED BY HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY

SCOPES

- Food Science and Technology
- Biological Technology
- Catalyst and Reaction Engineering
- Renewable Energy Technology
- Environmental and Safely Technology
- Fundamental of Chemical Engineering and Applied Chemistry
- Industrial Chemical Engineering
- Material Science and Technology
- Process and Control Engineering
- Polymer and Petrochemical Technology
- Separation and Purification Technology

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CONFERENCE PROGRAM

Day 1, October 27th, 2011

	Registration
	Opening Ceremonies
08:30-08:55	**Introduction of Participants & Overview of the Conference** ***Dr. Huynh Kim Lam***
08:55-09:15	**Opening Remarks & Messages** *Representative of Rector Board of Hochiminh city University of Technology*
09:15-09:35	**Messages** ***Sponsors***
09:35-10:05	**Photo Session and Coffee Break**
10:05-10:35	**Plenary Lecture S1**
10:35-11:05	**Plenary Lecture S2**
11:05-11:30	**Poster Section**
11:30-13:00	**Lunch Break**
13:00-14:40	**Presentation at four parallel sections** **Section A1:** Catalyst and Reaction Engineering **Section B1:** Renewable Energy Technology **Section C1:** Biological Technology **Section D1:** Food Science and Technology
14:40-15:00	**Coffee Break**
15:00-17:00	**Presentation at four parallel sections (cont.)**
18:30-21:00	**Welcome dinner**

Day 2, October 28th, 2011

08:00-10:00	**Presentation at four parallel sections** **Section A2:** Environmental and Safely Technology **Section B2:** Fundamental of Chemical Engineering and Applied Chemistry **Section C2:** Industrial Chemical Engineering **Section D2:** Material Science and Technology
09:40-10:00	**Coffee Break**
10:00-11:40	**Presentation at four parallel sections (cont.)**
11:40-12:00	**Lunch Break**

Ceramic Membrane from Natural Clay and Fly Ash for Advance Treatment of Urea Fertilizer Industry Secondary Effluent

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ABSTRACT

The purpose of this research is to study the performance a porous tubular membrane which is fabricated from clay and fly ash in certain composition as a part of industrial wastewater treatment installation. The membranes were applied to treat secondary effluent from biological pond outlet that generated by urea fertilizer industry. Parameter examined were pH, Total Suspended Solid (TSS), Electric Conductivity (EC), and metal ions concentration. Fouling reduction method applied was three stage filtration as pretreatment before the feed enter the membrane. The performance in term of flux and rejection were determined and compared for different composition of membranes. The quality of permeate analyzed were TSS, pH, EC and met the Indonesian National Standard (SNI) of effluent water quality. Results showed that the membranes can reduce TSS, EC, and pH level of the wastewater. Scanning Electron Microscopy (SEM) photographs indicated that membranes surface was homogeneous and did not present any macro defect.

Keyword : ceramic membrane, fly ash, secondary effluent

1. INTRODUCTION

Membrane separation system has long been applied in water treatment, either for drinking water or water for industrial purposes. Most membranes are made of polymer, or mixture of solid materials such as ceramics. Problems often encountered in the use of ceramic membranes for wastewater treatment is the mechanical properties of the filter tends to become brittle and fracture easily . Additive substances that can reduce the brittle nature, high temperature resistance, good chemical stability, and anti- microbial.
In this study, output of urea fertilizer industrial wastewater treatment in the form of liquid waste that has been processed and ready to be discarded have advanced processing system using filtration with ceramic membrane made of clay, iron powder and fly- ash to reduce wastewater pollution to certain level that relatively safe in the environment. In addition, the final product filtration process can be reused as cooling water or boiler feed water after further purification processes.

Various studies conducted several researchers previously showed that the secondary waste from industry has good prospects as a source of water in the future. Secondary waste that has been proven to be processed can be used as a non-potable water such as to feed cooling tower systems. (Wijesinghe et al. 1996). The combination of MF, UF and RO can also produce high quality water that can be used in the electronics industry (Qin, et al. 2005).
Studies that have been made using ceramic membranes (Nasir, S et al 2010) showed that the ceramic membrane made with a certain ratio of clay and coal ash were quite effective in reducing TDS, heavy

metals and ammonia from fertilizer industry wastewater urea. One disadvantage encountered is the nature of the membranes are fragile and easily broken (brittle). The same thing with a ceramic membrane made of a mixture of clay, zeolite, silica, and manganese in water treatment wetlands as a source of clean water (Iqbal, M et al 2010).

2. METHOD

2.1. Material and Equipment

Observation of the industrial wastewater quality from urea fertilizer at a certain period and during plant operations running normally conducted, focused on the secondary effluent from Biological Pond Outlet as waste final disposal to river.
The main tools and materials used in are this research are ceramic filters, flow meter, plastic hose, pressure gauge, PVC pipes and pumps, pH meter, TDS meters, measuring cups, Erlenmeyer glass, AAS, test tubes, filter paper, oven, electric scales, liquid waste results industrial processing of urea, a solution of H_2SO_4-$AgSO_4$, $K_2Cr_2O_7$ - $HgSO_4$ and iron powder filings.

2.2. Ceramic Membrane Fabrication Process

Ceramic filters used in this study is made of a mixture of clay, fly-ash and iron powder with the composition : 80%:20%:0%, 79%:20%:1%, 77.5%:20% : 2.5%, and 75%:20%: 5%, 75%:25%:0%, 74%:25%:1%, 72.5%:25%:2.5%, 67.5%:25%:7.5%, and 80%:10%:10%. Particle size of iron powder and fly ash are 250 μm. Clay, fly-ash and iron powder mixed with a ratio of the above composition, added water and mix evenly. The mixture is printed with a plaster mold is then removed from the mold, dried at room temperature for 7 days and burned at a temperature of 900-1000 ° C for 12 hours. Membrane dimensional : inside diameter = 4 cm, outside diameter = 5 cm, thickness = 1 cm, and height = 25 cm.

2.3. SEM analysis

The figure below is a SEM photograph of ceramic membrane sample before being used for the processing of secondary effluent urea fertilizer industry. Pore size 1 μm, making this ceramic membrane classified as microfiltration membranes which could separate materials with diameters > 1 μm - 10 μm, and indicated that membranes surface was homogeneous and did not present any macro defect.

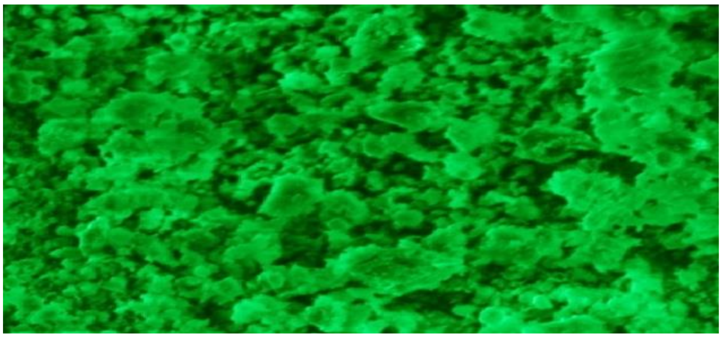


Figure 1. SEM Photograph of Fabricated Ceramic Membrane Sample

2.4. Schematic of equipment and process systems

Urea fertilizer industry wastewater are storaged in 250-liter tank, for jetting the process used centrifugal pumps.. This installation consists of four housings, respectively, contain silica sand, zeolite, activated carbon, and the last ceramic filter. Liquid waste from the biological pond outlet drained from the tank through a PVC pipe with the help of successive passing a pump housing that contains silica sand, zeolite, and activated carbon before heading to the ceramic membrane. Liquid waste that flows into the ceramic membrane will seep through the pores of the wall. Operating conditions for each membrane : inlet flow rate varied between 7.5 liters / minute and 10 liters / minute with time of operation 15, 30, 45 and 60 minutes.

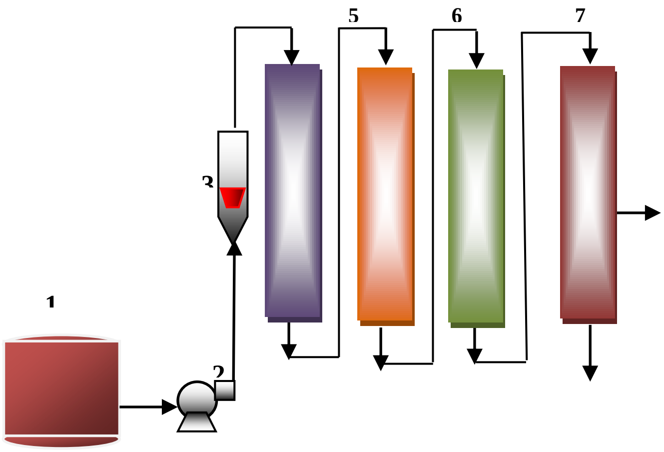


Figure 2. Series of Research Equipment
(*1. Tank, 2. Pump 3. Feed Flowmeter 4. Silica 5. Zeolit, 6. Activated Karbon , 7. Ceramic Membrane)*

3. RESULT

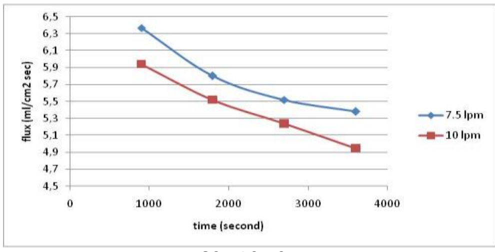
3.1. Analysis of the initial sample of urea fertilizer industry wastewater

The wastewater discharge that has undergone processing into the outlet is between 458-460 m3/hr. This means the ratio (pollution load) between the amount of wastewater discharged and the amount of urea production (tons) is between 1.71 to 1.92. The results of preliminary analysis of the effluent is shown in Table 1.

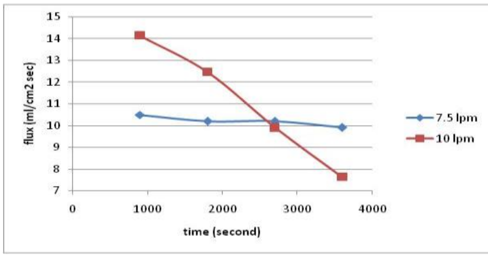
Tabel 1. Content of Initial Waste

No	Parameter	Nilai
1	pH	9.84
2	TSS	54 mg/l
4	Conductivity	5.08 µS
5	NH3-N	369 mg/l
6	Fe	0.092 mg/l
7	Mn	0.009 mg/l
8	Cr	0.116

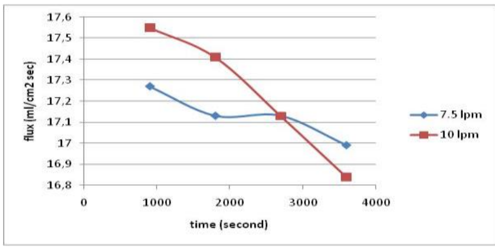
3.2. Relation between Flux and Operating Time



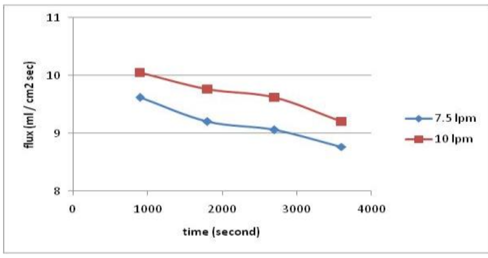
80 : 20 : 0



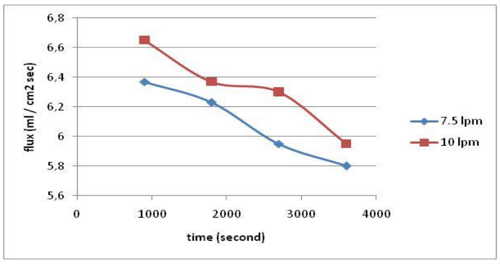
79 : 20 : 1



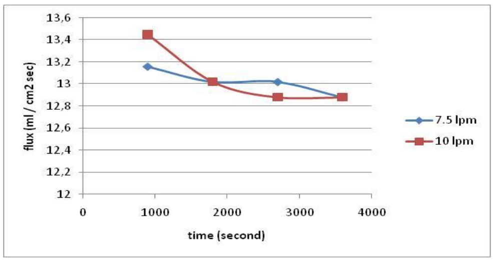
77.5 : 20 : 2.5



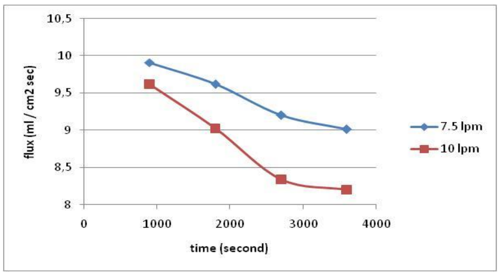
75 : 20 : 5



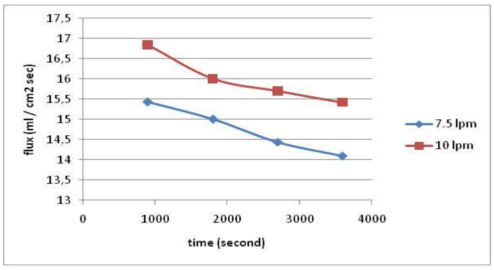
72.5 : 20 :7.5



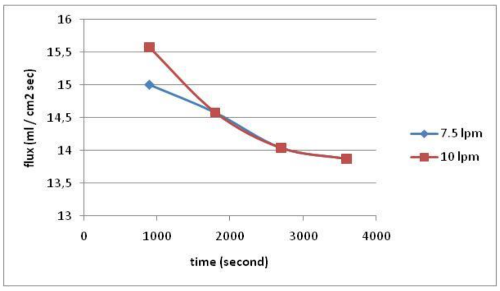
75 : 25 : 0



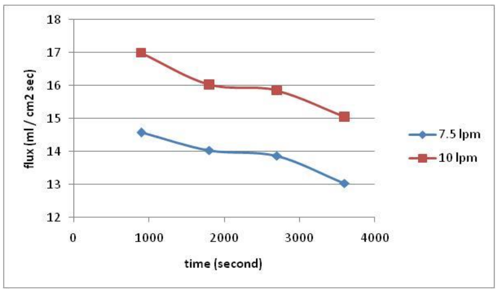
74 : 25 : 1



72.5 : 25 : 2.5



67.5 : 25 : 7.5



80 : 10 : 10

Figure 3. Flux vs time for all membrane composition,

From the observational data on the performance of the membrane flux, all decrease with the operating time. Best membrane performance in terms of flux is achieved by composition of 72.5 %: 20%: 7.5 % of 3114. 10-4 ml/cm2 seconds

3.3. Rejection of pH, TSS and EC

Tabel 2. Reduction of TSS, EC, and pH

Membrane Clay : fly ash : iron powder	Time (minute)	TSS Initial = 54		E / C Initial = 5.08 µS		pH Initial = 9.84	
		7.5 lpm	10 lpm	7.5 lpm	10 lpm	7.5 lpm	10 lpm
80 : 20 : 0	15	27	24	4,68	4,59	8,98	8,87
	30	19	16	4,60	4,51	8,93	8,79
	45	17	18	4,52	4,46	8,78	8,76
	60	05	07	4,43	4,38	8,75	8,20
79 : 20 : 1	15	52	43	2,71	3,07	8,92	8,89
	30	42	32	2,59	2,91	8,91	8,87
	45	24	23	2,39	2,76	8,87	8,80
	60	15	11	2,23	2,56	8,84	8,76
77.5 : 20 : 2.5	15	42	48	4,40	5,06	8,97	9,05
	30	36	20	4,39	3,75	8,97	8,98
	45	34	28	4,20	3,65	8,95	8,89
	60	13	11	3,60	3,24	8,93	8,87
75 : 20 : 5	15	48	52	3,15	3,45	8,82	8,84
	30	39	43	3,02	3,29	8,88	8,74
	45	23	23	2,85	3,02	8,84	8,70
	60	12	18	2,63	2,89	8,78	8,60
72.5 : 20 : 7.5	15	50	54	4,21	4,27	8,97	8,75
	30	43	48	4,13	4,25	8,88	8,70
	45	35	31	3,94	4,14	8,86	8,63
	60	24	26	3,90	4,12	8,72	8,62
75 : 25 : 0	15	54	54	4,17	4,24	9,10	9,06
	30	54	53	3,63	3,66	9,10	9,05
	45	46	48	3,60	3,64	9,09	9,03
	60	35	39	3,37	3,19	9,08	9,02
74 : 25 : 1	15	54	47	4,48	4,48	9,10	8,90
	30	44	34	4,39	4,28	9,05	8,86
	45	30	29	4,36	4,20	8,95	8,83
	60	26	13	4,23	4,04	8,92	8,81
72.5 : 25 : 2.5	15	54	53	4,11	3,81	9,00	8,91
	30	47	48	3,69	3,76	8,96	8,88
	45	33	37	3,67	3,65	8,91	8,77
	60	22	24	3,49	3,20	8,86	8,74
67.5 : 25 : 7.5	15	51	54	5,03	4,50	8,99	8,95
	30	45	49	4,71	4,05	8,92	8,94
	45	34	43	4,47	4,05	8,91	8,91
	60	25	38	4,44	3,86	8,89	8,88
80 : 10 : 10	15	52	49	4,28	4,33	9,03	9,10
	30	47	41	4,23	4,24	9,07	9,04
	45	35	30	3,97	4,23	9,00	8,98
	60	24	21	3,92	4,15	8,96	8,90

Best TSS decreasing result is obtained on the membrane composition 80: 20: 0 with 60 minutes of operating conditions and 7.5 lpm flow rate, the results is 5 mg / l . There was a decrease of 90.74 % of the initial conditions 54 mg / l. From the pH decline data obtained best results on the membranes composition 80: 20: 0, operating time of 60 minutes and 10 lpm flow rate, ie 8:20, decreased by 1.64.

Before the waste processed waste acidity level is above the 9, classified as alkaline. This situation caused many NH4OH compounds in the effluent before it is processed. The best result of E/C decreasing was obtained on membranes composition 79: 20: 1 with operating conditions of 60 minutes and 7.5 lpm flow rate, the result E / C 2:23 μS. There was a decrease of 56.10 % from the initial conditions μS 5:08

3.4. Analysis of Metal Content

Table 3. Result of Metal Content Reduction

Membrane Composition	Results (mg/l)		
	Fe	Mn	Cr
Initial	0.092	0.009	0.1160
67.5 : 25 : 2.5	0.030	0.005	0.0786
67.5 : 25 : 2.5	0.033	0.006	0.0833
77.5 : 20 : 2.5	0.021	0.008	0.0701
77.5 : 20 : 2.5	0.054	0.008	0.0480

From the analysis of secondary effluent that has been processed with the ceramic membrane with the operating conditions of 10 lpm and 60 minutes to four membrane, ceramic membrane could reduce levels of Fe, Mn, and Cr from the initial conditions of 0092 mg/l, 0009 mg/l, and 0.1160 mg/l respectively.

4. CONCLUSION

Performance of ceramic membranes made from a mixture of clay, coal fly ash and iron powder is effective in producing good quality permeate in lab scale process. It is reflected in decreasing of TSS, EC, pH, metal content in the effluent. Composition, flow rate, and time were found to have an effect on filtration process.

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