END OF PROJECT REPORT

Programme/Project number: 08-02-05-1081 EA 001

Programme Title:

Project Title: ENVIRONMENTAL EDUCATION AND COMMUNICATION WITH STUDENTS AS CATALYSTS IN THE INTERGENERATIONAL INFLUENCE

Programme Leader:

Project Leader: ASSOC PROF DR NIK NORULAINI NIK AB RAHMAN

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APPENDIX 1

Bil	Faedah yang dinyatakan oleh responden.....
1	Menambah ilmu pengetahuan dan menanam sifat cintakan alam sekitar
2	Kesedaran dalam diri tentang alam sekitar
3	Meluaskan pengetahuan tentang isu alam sekitar
4	Mengetahui lebih banyak istilah yang jarang dipelajari di sekolah
5	Mengetahui kepentingan alam sekitar dengan lebih mendalam
6	Mempelajari sesuatu yang baru
7	Dapat berdikari
8	Memberi semangat untuk memelihara alam sekitar
9	Mendapat pengalaman dan pengetahuan tentang alam sekitar
10	Mengenali alam sekitar dengan lebih jelas
11	Mengetahui akibat daripada pencemaran buatan manusia
12	Mengetahui kepentingan hutan kepada kita
13	Mensyukuri pemberian nikmat alam sekitar, mendapat ilmu yang bermanfaat dan kesedaran alam sekitar
14	Dapat mengenali alam hutan, tahu kepentingan untuk alam dan menjaganya supaya tidak tercemar
15	Lebih tahu tentang alam sekitar dan memberikan kesedaran
16	Mendapat maklumat bahawa ada masyarakat yang bergantung terus kepada alam sekitar untuk hidup

APPENDIX 2

50% responden yang menyertai kem ini menyatakan mereka mendapat dorongan daripada diri sendiri dan selebihnya daripada kawan – kawan, ibu bapa/ keluarga dan guru – guru untuk menyertai program – program dan aktiviti – aktiviti yang berunsurkan pendidikan alam sekitar (Jadual 11) Sebanyak 95.66% responden menyatakan minat mereka untuk menyertai program – program dan aktiviti – aktiviti yang akan dianjurkan dibawah projek penyelidikan ini seperti mana yang dinyatakan didalam Jadual 12.

Jadual 1: Pendorong Responden Untuk Menyertai Program Alam Sekitar

Pendorong	Kedudukan	Jumlah	Peratus (%)
Din Sendiri	1	23	50.00
IbuBapa/Keluarga	3	16	34.78
Kawan	2	22	47 83
Guru	4	7	15.22

Jadual 2: Responden Yang Berminat Untuk Menyertai Program Akan Datang

Jawapan	Ya	Tidak	Tiada Jawapan
Jumlah	44	1	1
Peratus (%)	95.66	2.17	2.17

Analisa Keputusan Soal Selidik Bahagian C

Soalan soal selidik Bahagian C memfokus kepada pengetahuan responden dan kefahaman mereka berkenaan dengan Pendidikan Alam Sekitar,istilah Alam Sekitar yang memerlukan responden memberi pendapat dan jawapan mengikut kefahaman masing – masing.

Jadual 3 yang berikut menyatakan tentang kefahaman responden berkenaan dengan Pendidikan Alam Sekitar yang mana data yang diperolehi adalah berdasarkan variasi jawapan yang diterima daripada responden. Daripada Jadual 4 pula menunjukkan 78.26% responden menyatakan bahawa matapelajaran pendidikan alam sekitar perlu diwujudkan di sekolah sebagai salah satu daripada subjek Kurikulum Bersepadu Sekolah Menengah (KBSM) dengan memberikan sebab yang tertentu mengapa ia perlu diwujudkan sebagai mana didalam Jadual 5.

Jadual 3: Kefahaman Responden Tentang Pendidikan Alam Sekitar

Bil	Pendidikan Alam Sekitar ialah.....
1	Pelajaran yang mengajar kepentingan kepentingan alam sekitar kepada manusia
2	Ilmu yang memberi kefahaman mengenai hidupan di bumi
3	Mementingkan pemuliharaan alam sekitar dari ancaman dan pencemaran
4	Hubungkait antara alam sekiling dengan kehidupan manusia dan mengajar untuk menjaga sesuatu yang asli dan semulajadi
5	Cara menjaga alam sekitar supaya kekal dalam keadaan harmoni
6	Cara mengatasi pencemaran dan sebab berlaku pencemaran
7	Menitik beratkan kehidupan flora dan fauna
8	Pelajaran tentang memulihara dan memelihara alam sekitar
9	Sistem pembelajaran yang menerangkan aspek alam sekitar dan ekologi
10	Cara menjaga alam sekitar supaya tidak tercemar
11	Pendidikan yang menghargai dan mencintai alam ciptaan Allah

12	Pendidikan yang berasaskan kesedaran untuk memelihara alam sekitar
13	Pendidikan yang mengajar tentang kebersihan alam sekitar
14	Perkara yang mencemarkan alam, cara mengatasi dan kesan yang berlaku terhadap pencemaran
15	Cara menyayangi dan menghargai alam sekitar
16	Merangkumi pelbagai aspek tentang alam sekitar
17	Maklumat kemusnahan alam

Jadual 4: Data Responden yang bersetuju diwujudkan matapelajaran Pendidikan Alam Sekitar Di sekolah

Jawapan	Perlu	Tidak Perlu
Jumlah	36	10
Peratus (%)	78.26	21.74

Jadual 5: Sebab perlu dan tidak perlu diwujudkan mata pelajaran Pendidikan Alam Sekitar di sekolah

	Perlu, mengapa.....
1	Untuk memupuk semangat cintakan alam sekitar
2	Mendedahlkan kepentingan alam sekitar kepada kita yang saling memerlukan di antara satu sama lain
3	Tiada pelajaran yang memfokuskan kepada pendidikan alam sekitar
4	Meningkatkan kesedaran alam sekitar
5	Memastikan golongan pewaris mengetahui lebih lanjut mengapa alam sekitar perlu dipelihara
6	Mengajar remaja untuk memelihara dan memulihara alam sekitar walau di mana berada
7	Asas pengetahuan am
8	Memberi pendedahan awal maklumat alam sekitar
9	'merebung buluh, biar dari rebungnya'
10	Menyemai perasaan untuk memelihara dan memulihara alam sekitar
11	Dapat mengetahu status alam sekitar
12	Supaya pelajar dapat memupuk sikap bertanggungjawab untuk memelihara alam sekitar daripada tercemar
13	Generasi muda kurang diberi pendedahan
14	Kerana pencemaran alam sekitar semakin kritikal
15	Kurang nilai – nilai murni di kalangan pelajar
16	Untuk mengawal pencemaran dalam sekolah
	Tidak perlu, mengapa.....
1	Memerlukan masa yang lebih
2	Pelajar mempunyai banyak subjek yang perlu diikuti di sekolah
3	Isu alam sekitar terdapat didalam setiap subjek di sekolah
4	Tidak menraik dan boleh dipelajari daripada risalah – risalah dan media massa
5	Boleh belajar sendiri
6	Sudah diketahui masyarakat dan hanya pengetahuan am
7	Tanggungjawab ibu bapa, mendidik anak kerana ia adalah untuk semua orang.

Sekiranya mata pelajaran Pendidikan Alam Sekitar diaplikasikan di sekolah, sebanyak 73.91% responden menyatakan, konsep pengajaran yang diperlukan adalah teori dan praktikal manakala 13.04% hanya berminat dengan pembelajaran

secara praktikal sahaja dan selebihnya teori sahaja dan tiada sebarang jawapan diberikan (Jadual 6).

Jadual 6: Konsep Pembelajaran Pendidikan Alam Sekitar Pilihan Responden

Konsep	Jumlah	Peratus (%)	Kedudukan
Teori Sahaja	4	8.70	3
Praktikal Sahaja	6	13.04	2
Teori Dan Praktikal	34	73.91	1
Tiada Jawapan	2	4.35	4

Responden juga memberikan pelbagai definisi bagi istilah Alam Sekitar mengikut kefahaman masing – masing seperti di bawah..

Jadual 7: Definisi Alam Sekitar Mengikut Kefahaman Responden

Bil	Definisi Alam Sekitar ialah ..... .
1	Benda hidup dan benda bukan hidup dalam alam ini
2	Semua kahidupan di bumi
3	Alam sekeliling kita
4	Interaksi di antara sesuatu organisma dalam mewujudkan keseimbangan alam
5	Alam semulajadi yang di anugerahkan Allah kepada semua makhluk
6	Manusia dan alam sekitar yang saling melengkapi antara satu sama lain
7	Alam sekitar adalah alam sekitar
8	Yang mempunyai unsur biotik dan abiotik

Berdasarkan analisa soal selidik yang dibuat , didapati sebanyak 56.52% responden menyatakan bahawa guru – guru sekolah mereka tidak pernah mengadakan program – program yang bertemakan alam sekitar di sekolah. Ini menunjukkan kebanyakan peserta kem, kurang di beri pendedahan tentang alam sekitar di sekolah dan menunjukkan bahawa pendidikan alam sekitar kurang di beri perhatian oleh pihak sekolah. Jadual 8 memperincikan hasilan analisa tersebut.Manakala Jadual 9 pula, memberikan contoh program yang pernah diadakan disekolah yang pernah di sertai oleh 43.48% responden.

Jadual 8: Perlaksanaan Program Alam Sekitar Oleh Guru – Guru Di Sekolah

Jawapan	Ya	Tidak
Jumlah	20	26
PERATUS (%)	43.48	56.52

Jadual 9: Contoh Program Alam Sekitar Yang Pernah Di sertai Oleh Responden di Sekolah

Bil	Contoh Program Alam Sekitar Di Sekolah
1	Mencari dan mengumpul barang- barang untuk di tebus guna
2	Ceramah, forum dan kempen kitar semula
3	Bergotong royong membersihkan sungai
4	Dalam Pendidikan Jasmani
5	Kempen Kitar Semula dan projek Sains
6	Menyusuri sungai Air Itam untuk ambil iktibar dari pencemaran yang berlaku

Analisa Keputusan Soal Selidik Bahagian D

Soalan Soal Selidik Bahagian D menumpukan kepada analisa terhadap Modul Kem Pendidikan Alam Sekitar yang digunakan didalam aktiviti kem serta hasil yang diperolehi oleh responden dengan mengikuti kem tersebut dari sudut kesedaran, perubahan sikap, perolehan ilmu dan kefahaman responden berhubung dengan alam sekitar.Keputusan analisa adalah seperti didalam Jadual 10.

Jadual 10: Analisa Data Soal Selidik Bahagian D

SS: Sangat Setuju S: Setuju TP:Tidak Pasti TS:Tidak Setuju
STS:Sangat Tidak Setuju TJ:Tiada Jawapan

BIL	SOALAN	KEPUTUSAN (%)					
		SS	S	TP	TS	STS	TJ
1	Anda berpuas hati dengan modul yang digunakan dalam kem ini?	19.57	69.57	4.35	-	-	6.52
2	Modul yang digunakan sangat menarik minat anda?	19.57	67.39	6.52	2.17	-	4.35
3	Pada pandangan anda modul Slot 1 sangat menarik/sesuai?	13.04	69.57	8.70	6.52	-	2.17
4	Pada pandangan anda modul Slot 2 sangat menarik/sesuai?	23.91	63.04	4.35	6.52	-	2.17
5	Pada pandangan anda modul Slot 3 sangat menarik/sesuai?	15.22	71.74	2.17	6.52	-	4.35
6	Pada pandangan anda modul Slot 4 sangat menarik/sesuai?	15.22	67.39	6.52	2.17	-	8.70
7	Pada pandangan anda modul Slot 5 sangat menarik/sesuai?	23.91	60.87	6.52	4.35	-	4.35
8	Pada pandangan anda modul Slot 6 sangat menarik/sesuai?	15.22	65.22	8.70	6.52	-	4.35
9	Pada pandangan anda modul Slot 7 sangat menarik/sesuai?	10.87	63.04	10.87	4.35	-	10.87
10	Pada pandangan anda modul Slot 8 sangat menarik/sesuai?	8.70	69.57	6.52	4.35	-	10.87
11	Pada pandangan anda modul Slot 9 sangat menarik/sesuai?	15.22	65.22	6.52	2.17	-	10.87
12	Pada pandangan anda modul Slot 10 sangat menarik/sesuai?	23.91	54.35	10.87	2.17	-	8.70
13	Selepas mengikuti setiap Slot, adakah anda lebih memahami status alam sekitar di Malaysia?	39.13	50.00	8.70	2.17	-	-
14	Adakah anda akan menghebahkan apa yang anda perolehi daripada kem ini	19.57	60.87	19.57	-	-	-

	kepada keluarga, rakan – rakan, guru dan masyarakat?						
15	Adakah ilmu pengetahuan anda tentang alam sekitar lebih meningkat setelah mengikuti kem ini?	26.09	45.65	17.39	10.87	-	-
16	Adakah kesedaran anda tentang alam sekitar lebih meningkat berbanding sebelum mengikuti kem ini?	36.96	50 00	6.52	4.35	-	2.17
17	Adakah anda akan bertindak untuk melindungi alam sekitar sekiranya terdapat sebarang kemusnahan alam sekitar yang berlaku di persekitaran anda?	17.39	78.26	4.35	-	-	-
18	Adakah anda akan berubah sikap kepada seorang yang lebih peka kepada isu alam sekitar selepas mengikuti kem ini?	32.61	54.35	13.04	-	-	-
19	Adakah anda banyak memperolehi kemahiran yang berguna semasa mengikuti kem ini?	26.09	65.22	4.35	2.17	2.17	-
20	Setujukah anda, jika anda dikatakan seorang yang 'buta alam sekitar' sebelum mengikuti kem ini?	8.70	17.39	19.57	30.43	23.91	-
21	Setujukah anda jika anda dikatakan telah memperolehi banyak pengetahuan dan kemahiran alam sekitar yang berguna setelah mengikuti kem ini?	32.61	54.35	8.70	4.35	-	-
22	Adakah sebelum ini, anda adalah seorang yang tidak peka kepada isu alam sekitar?	13.04	19.57	32.61	26.09	4.35	4.35
23	Pada pandangan anda, alam sekitar di Malaysia berada di tahap kritikal?	26.09	50.00	15.22	2.17	-	6.52
24	Pada Pendapat anda wajarkah kem alam sekitar seperti ini diadakan?	63.04	34.78	2.17	-	-	-
25	Adakah fasilitator yang bertugas, sangat berkalibar dan banyak membantu anda?	45.65	43.48	8.70	2.17	-	-

Daripada keseluruhan data yang telah dianalisa didalam Jadual 10 didapati responden sangat berpuas hati dengan modul kem yang digunakan. Responden juga berpendapat modul yang digunakan sangat menarik minat mereka dan dan konsep pengajaran dan pembelajaran yang mereka terima daripada setiap slot dapat diikuti dengan baik.

Responden juga telah menunjukkan peningkatan pengetahuan yang positif tentang isu alam sekitar di Malaysia. Selain itu mereka juga dapat memupuk sikap, rasa kesedaran, melahirkan kemahiran untuk bertindak dalam menangani isu alam sekitar dengan menyampaikan pengetahuan yang mereka perolehi daripada kem ini. Responden juga berpendapat bahawa kem alam sekitar seperti ini wajar diadakan bagi memberi kesedaran secara berterusan kepada masyarakat khususnya golongan remaja untuk menyemai rasa bertanggungjawab dalam memelihara dan maulihara alam sekitar. Responden juga sangat bersetuju bahawa fasilitator yang bertugas sangat berkalibar dan banyak membantu mereka dalam usaha memberikan pendidikan alam sekitar yang berkesan kepada mereka.

Analisa Keputusan Soal Selidik Bahagian E

Didalam Bahagian E Soal Selidik ini, responden diminta untuk membuat pilihan jawapan yang telah disediakan yang berkaitan dengan isu alam sekitar. Ini adalah untuk mengenalpasti sejauh mana kesedaran responden berhubung dengan isu alam sekitar yang berlaku di persekitaran mereka.

Jadual 21 berikut menunjukkan peratusan isu alam sekitar yang paling kritikal di Malaysia . Berdasarkan data yang diperolehi, responden meletakkan isu pencemaran air berada pada kedudukan paling krirkal dengan peratusan 95.65% di ikuti oleh pencemaran udara 84.78% dan selebihnya sebagaimana yang dinyatakan didalam jadual.

Jadual 21: Analisa Isu Alam Sekitar Paling Kritikal

Bil	Isu Alam Sekitar	Jumlah	Peratus(%)	Kedudukan
1	Pencemaran Udara	39	84.78	2
2	Pencemaran Air	44	95.65	1
3	Pencemaran Bunyi	18	39.13	6
4	Pencemaran Terma	4	8.70	10
5	Penipisan Lapisan Ozon	30	65.22	4
6	Sisa Pepejal	8	17.39	8
7	Penebangan/ Kemusnahan Hutan	36	78.26	3
8	Kesan Rumah Hijau	14	30.43	7
9	Urbanisasi	7	15.22	9
10	Sisa Kimia Industri	30	65.22	4

Jadual 12 berikut menunjukkan peratusan sumber maklumat alam sekitar yang diperolehi oleh responden. Berdasarkan kepada keputusan yang diperolehi didapati media massa dan media elektronik memainkan peranan yang sangat penting dalam menyebarkan maklumat alam sekitar kepada masyarakat yang mana perolehan maklumat daripada surat khabar berada pada kedudukan teratas diikuti oleh televisyen.

Jadual 12: Sumber Perolehan Maklumat Alam Sekitar Responden

Bil	Sumber Maklumat	Jumlah	Peratus (%)	Kedudukan
1	Surat Khabar	39	84.78	1
2	Majalah	16	34.78	8
3	Radio	9	19.57	7
4	Televisyen	36	78.26	2
5	Buku	21	45.65	5
6	Sekolah	23	50.00	4
7	Guru	25	54.35	3
8	Kawan	12	26.09	7
9	Masjid	2	4.35	10
10	Lain- lain, nyatakan	3	6.52	9

Jadual 13 pula merupakan data perolehan berhubung dengan kefahaman responden tentang isu alam sekitar semasa yang berlaku di persekitaran mereka. Berdasarkan maklumat tersebut di dapati kebanyakan responden lebih memahami isu – isu alam sekitar yang berkaitan dengan pencemaran udara, air, kemusnahan hutan dan lain- lain. Walaubagaimanapun masih ada dikalangan responden tidak memahami, tidak tahu, tidak pasti dan tidak memberikan apa - apa jawapan kepada soalan yang diutarakan.

Jadual 13: Tahap Kefahaman Responden Tentang Isu Alam Sekitar

SF: Sangat Faham F:Faham TF:Tidak Faham

TT:Tidak Tahu TP:Tidak Pasti TJ:Tiada Jawapan

Bil	Isu Alam Sekitar	Keputusan (%)					
		SF	F	TF	TT	TP	TJ
1	Pencemaran Udara	19.57	80.43	-	-	-	-
2	Pencemaran Air	21.74	78.26	-	-	-	-
3	Pencemaran Bunyi	17.39	65.22	4.35	2.17	10.87	-
4	Pencemaran Terma	2.17	26.09	39.13	10.87	19.57	2.17
5	Penipisan Lapisan Ozon	13.04	63.04	13.04	-	10.87	-
6	Sisa Pepejal	8.70	60.87	8.70	4.38	17.39	-
7	Penebangan/ Kemusnahan Hutan	26.09	65.22	2.17	2.17	2.17	2.17
8	Kesan Rumah Hijau	8.70	52.17	10.87	-	26 09	2.17
9	Urbanisasi	2.17	39.13	19.57	15.22	13.04	10.87
10	Sisa Kimia Industri	6.52	13.04	4.35	4.35	4.35	-

PROGRAM & ABSTRACTS

10th THE APCChE CONGRESS

The Asian Pacific Confederation of Chemical Engineering

October 17(Sun.)-21(Thu.), 2004 Kitakyushu, Japan

EArth Sustainable Technologies (EAST)

Chemical Engineers' Challenge

The Society of Chemical Engineers, Japan
The Asian Pacific Confederation of Chemical Engineering
http://www.scej.org/apcche2004/

With the cooperation of the city of Kitakyushu
With the assistance of Kitakyushu Convention Bureau

Mixed-Industrial Effluent Treatment by Physico-Chemical and Biological Process

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Two chemical and biological approaches were studied on the mixed-industrial effluent running through the closed drainage system (CDS) within an industrial zone and the study was run separately The mixed-industrial effluent comprised effluents from various industries that have been treated at their own treatment plant system and should have met the regulated limits before discharging into the CDS But in this case it happened adversely The aim of this study was to compare the ability of both approaches in treating the mixed-effluent based on the COD removal The biological study was carried out at 0 5 mg/L dissolved oxygen (DO) concentrations in bench scale activated sludge with the addition of granular activated carbon (GAC), at 4 hours hydraulic retention time (HRT) using inorganic coagulant, Alum and poly-aluminum chloride (PACl) each in combination with three different types of powdered activated carbon (PAC) used in the physico-chemical treatment The experiments were operated at inherent pH of the mixed-industrial effluent The results for physico-chemical treatment shows that if the pH of the mixed industrial effluent remains unaltered, a higher dosage of both alum and polyaluminium chloride (PACl) are needed to reduce COD value by 17 5% and 30 2% for PAC type A, 31 5% and 67 4% for PAC type B, 36 1% and 70% for PAC type C respectively The results obtained under suspended-fixed growth system illustrate about 72% of the COD been removed

M-09

Degradation of Formic Acid by Photocatalytic Reaction Combined with Fenton Reaction on a Nafion Membrane Adsorbing Iron Ions

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UV irradiated titanium oxide can degrade various kinds of organic compounds by hydroxyl radicals (HO) that are produced during the reaction We recently found that in this reaction, H_2O_2 is formed at a concentration level of ppm (parts per million) from water and the initial rate of formation of H_2O_2 is proportional to the initial rates of degradation of HCOOH and HCHO On the other hand, Fenton reaction also utilizes HO to degrade organic compounds In this reaction, however, H_2O_2 must be added to the reaction mixture to produce HO To overcome this disadvantage, this work investigates a new process consisting of the photocatalytic reaction on UV-irradiated titanium oxide and the Fenton reaction on a Nafion membrane adsorbing ferrous ions, in which the Fenton reaction proceeds by utilizing the H_2O_2 formed in the photocatalytic reaction The experimental result using HCOOH as a reactant clearly showed that the Fenton reaction occurs without addition of H_2O_2 and adjustment of a pH value and the combined process results in an increase in the rate of degradation of HCOOH Also, it was confirmed that the Nafion membrane after repeated seven batch runs can quickly be regenerated with L(+)-ascorbic acid and then used repeatedly

1M-10

Kinetics for Biodegradation of Toxic Organic Chemicals in Wastewaters by Utilizing Waste Activated Sludge in a Slurry Bioreactor

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Toxic organic chemicals, volatile organic compounds, (VOCs) and pesticides, in wastewaters were biologically degraded by utilizing waste activated sludge in a gas-liquid-solid three-phase slurry bioreactor The biodegradation kinetics of toxic organic chemicals was examined in batch experiments at varying initial toxic organic chemical concentrations, waste activated sludge concentrations and aeration rates The bioreactor constructed from plexiglass had an internal diameter of 75 mm and a working volume of 2 L As an activated sludge, waste activated sludge obtained from Kawagoe City Wastewater Treatment Plant located in Saitama, Japan was used It was found that the biodegradation rates of toxic organic chemicals were approximately described by first order kinetics However, in the case of the VOC used in this study, o-cresol, the shape of the curves for specific biodegradation rates of was typical for the substrate inhibition kinetics Therefore, the kinetic parameters of aerobic o-cresol biodegradation were estimated using Haldane's substrate inhibition equation The oxygen consumption during the biodegradation process was also examined The oxygen consumption rate was adequately described by the Haldane type model The biodegradation of toxic organic chemicals by waste activated sludge and the change of dissolved oxygen concentration in the slurry bioreactor were successfully simulated

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EFFECT OF MEDIA, SEEDING AND SUBSTRATE ON THERMOPHILIC ANAEROBIC DIGESTIBILITY OF PALM OIL MILL EFFLUENT (POME)

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ABSTRACT

A laboratory study was carried out at thermophilic temperature (55°C) to assess and compare the effect of two types of media, seeding and substrate on the anaerobic digestibility of POME Oil Palm kernel shell and oil palm empty fruit fiber were used as a media for the anaerobic fixed-bed digester The two seeding types used were digested POME and commercialized bacteria (FM A and FM B) Volatile fatty acid (VFA) synthetic wastewater and solubilized POME were used as a substrate and were introduced to the studied digester There were nine anaerobic digester constructed, eight fixed-bed typed and one control Four reactors synthetic wastewater (VFA), four reactors solubilized POME and one reactor of raw POME as a control Each digester was filled up with a combination of oil palm kernel shell + commercialized bacteria, oil palm kernel shell + digested POME, oil palm empty fruit fiber + commercialized bacteria, oil palm empty fruit fiber + digested POME Chemical oxygen demand (COD) reduction and microbial growth were monitored to evaluate the effect of media, seeding and substrates type on the system performance The COD removal was up to 60 % from the initial COD concentration of 9 3 g/L that was achieved from the digested POME digester with palm shell kernel as a media and fed with solubilized POME

Keywords POME, anaerobic digestion thermophilic, COD, media

INTRODUCTION

Malaysia is the world largest producer and exporter of palm oil. The number of oil palm mill has increased significantly over recent years POME is considered as one of the most polluting agro-industrial residues due to its high organic load. The three main sources of POME are sterilizer condensate, hydrocyclone waste and clarifier sludge The mixed POME is characterized by low pH (average 4 0), high chemical oxygen demand COD (average 50 g/L) and high suspended solid SS (10-25 g/L) For a well-controlled conventional oil palm mill, about 0 9 m^3, 0 1 m^3 and 1 5 m^3 of sterilizer condensate, clarifier sludge and hydrocyclone waste are generated for each tonne of crude palm oil produced (Borja et al 1996)

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SPECIATION OF HEAVY METALS IN CLOSED DRAINAGE SYSTEM OF PRAI INDUSTRIAL ZONE PHASE 1 AND 2, MALAYSIA

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ABSTRACT

In this study, Closed Drainage System (CDS) and pump houses of Prai Industrial Zone 1 and 2 (PIZ) are studied to determine their environmental pollution levels and to preliminary assess the release possibility of the toxic elements within each fractions The samples were collected from 19 selected sites along the CDS and at the pump house Five sequential extraction procedures of the speciation of trace elements were used to partition the sediments into exchangeable bond to carbonates bond to oxides Fe-Mn bond to organic matter and bond to residue The heavy metals contents in the sample solution were analysed by flame atomic absorption spectrophotometry (AAS) The results show that the concentrations of Pb in exchangeable, bond to carbonates, oxides Fe-Mn, organic matter and residue fraction are in the range between 0 761 – 1 581mg/L, 0 676 – 1 811mg/L, 0 363 – 2 561 mg/L, 0 121 – 1 823 mg/L, and 0 189 – 2 010 mg/L respectively meanwhile the concentration of Cu in the various fractions were in the range between 0 004 – 1 106 mg/L, 0 016 – 0 421 mg/L, 0 051 – 1 462 mg/L, 0 05 – 0 814 mg/L and 0 015 – 0 130 mg/L correspondingly The concentration of Zn in exchangeable bound to carbonate, oxides Fe-Mn, organic matter and residue in ranges between 0 326 – 1 986 mg/L, 0 494 – 5 088 mg/L 1 035 – 4 986 mg/L, 0 30 – 0 924 mg/L and 0 049 – 0 248 mg/L respectively The concentration of Cd in exchangeable, bound to carbonate, oxides Fe-Mn organic matter and residue were ranged between 0 17 – 0 256 mg/L, 0 17 – 0 325 mg/L, 0 104 – 0 298 mg/L 0 268 – 0 967 mg/L and 0 25 – 0 574 mg/L respectively Results from the metal speciation in sediment samples will be discussed

Key words Trace metal, speciation sediment, sequential extraction, industrial zone, toxicity, bioaccumulation

INTRODUCTION

Awareness on toxicity of heavy metals upon their chemical forms has led to an increasing interest in the qualitative and quantitative determination of specific metal species The Prai Industrial Zone (PIZ) (Figure 1) is situated in the northern state of Penang, Malaysia and was developed during the early 1970s PIZ accommodate almost 200 premises of light and

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MIXED-INDUSTRIAL WASTEWATER TREATMENT VIA BENCH-SCALE ACTIVATED SLUDGE-GRANULAR ACTIVATED CARBON REACTOR

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ABSTRACT

Studies of a reactor system to treat the concoction of mixed-industrial wastewater using a combination of biological treatment with granular activated carbon (GAC)have been carried out The purpose of the study was to examine the efficiency removal of the biochemical oxygen demand (BOD_5), chemical oxygen demand (COD), suspended solids (SS), nitrate (NO_3) and nitrate nitrogen (NO_3-N) at 0 5 mg/L and 5 0 mg/L dissolved oxygen (DO) concentration in bench scale activated sludge (BSAS) suspended growth and BSAS suspended-fixed growth system (GAC added) at 4 hour hydraulic retention time (HRT) The results obtained under BSAS suspended growth depicted that at 0 5 mg/L DO about 80%, 78% and 67% of SS, BOD_5 and COD removed respectively Both NO_3-N and NO_3 attained approximately 60% reduction At higher DO level, 5 0 mg/L, BOD_5, COD, NO_3-N and NO_3 attained better percent removal, 79 6%, 74 3%, 67 3% and 62 4% respectively while only 76 5% SS was reduced Under BSAS suspended-fixed growth system the results illustrate that at 0 5 mg/L DO, BOD_5 achieved 92 6% reduction followed by 81 2% SS, 72% COD, 62 4% NO_3-N and 61 8% NO_3

When the DO level was increased to 5 0 mg/L, all the parameters tested attained higher percentage removal compared to 0 5 mg/L DO concentration accept for BOD_5 The results indicated that the suspended-fixed growth system works better than suspended growth system in treating the mixed-industrial wastewater

INTRODUCTION

A closed drainage system (CDS) serves a major industrial zone in Penang where heavy industries such as chemical process, petrochemical and heavy metal industries are located The CDS serves dual role both in flood mitigation in the industrial area as well as an immediate receiving water body of all the industrial treated effluent prior to its release into the sea Initial site surveillance and wastewater analysis revealed the alarming state of the water in the CDS The condition has a trailing effect of exacerbating the mudflat regions lining the adjacent coastal zones with toxic contaminants It is apparent that the flow through the CDS is still highly polluted and requires further treatment prior to release to the sea

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EFFECTS OF VARIOUS Zn(II) SUBSTRATE AND BIOMASS CONCENTRATIONS ON OXYGEN UPTAKE RATE

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ABSTRACT

The effect of Zn(II) (10, 20, 40, 60 mg/L) and substrate (103, 206, 411 mg/L as chemical oxygen demand (COD)) on the oxygen uptake rate in a mixed-industrial effluent with differing biomass concentrations (160, 245, 360 mg/L) were investigated In statistical analyses, a factorial experimental design approach was followed and results were treated by multiple regression techniques A mathematical model was developed to express the maximum oxygen uptake in terms of Zn(II), substrate and biomass concentrations The biomass-to-metal ratio was found to be very significant so that another model that expressed as oxygen uptake in relation to the biomass-to-metal ratio and also to substance concentration was developed Finally, the effect of Zn(II) was demonstrated to depend on both substrate and biomass concentrations This effect was stimulatory at low concentration of Zn(II), however complete inhibition was never observed even at the highest concentration of Zn(II) studied

INTRODUCTION

The toxicity of heavy metals to biological wastewater treatment processes has been studied in numerous works (Dilek and Yetis 1992, Zarnovsky *et al* 1994, Mazierski 1995, Madoni *et al* 1996) Neufeld and Greenfield (1981) reported that 0 5 mg Zn(II)/L were toxic for Nitrosomonas, while Benmoussa *et al* (1986) reported 100% inhibition of nitrifying bacteria in the presence of 3 mg Zn(II)/L Cardinaletti *et al* (1990), observed that the protozoa community of an activated-sludge plant treating wastes containing 0 6-1 2 mg/L of soluble zinc, was not affected neither in density nor species richness

Yetis *et al* (1992), emphasized the importance of the biomass-to-metal ratio in biochemical oxygen demand (BOD_5) experiments However, according to Albek *et al* (1997) a gap still exists in the literature on the combined effects of initial seed biomass and substrate concentration in the context of metal toxicity to oxygen uptake As mentioned by Yoong *et al* (2000) the oxygen uptake rate (OUR), or respiration rate in wastewater treatment plants represents the amount of oxygen per unit volume utilized per unit time by the available microorganisms. The two important biochemical processes of biomass growth and substrate removal are directly linked to the respiration rate The study was focused on Zn(II) because its presence in sediment is higher than copper, lead and cadmium as mentioned by Lim and Hoi (1997) in their study on heavy metal pollution and speciation in

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Pollutant Load in Closed Drainage System at Prai Industrial Zones 1 and 2, Penang

by

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Abstract— A closed drainage system (CDS) serves a major industrial zone in Penang where heavy industries such as chemical process, petrochemical, fertilizer and heavy metal are located The CDS serves dual role both in flood mitigation in the industrial area as well as an immediate receiving water body prior to the release of the effluent into the sea The effluents discharged from the factories into the CDS must be according to the limit set by the Department of Environment Initial site surveillance and wastewater analysis revealed the alarming state of the water in the CDS The condition has a trailing effect of exacerbating the mudflat regions lining the adjacent coastal zones with toxic contaminants To ascertain the status of the wastewater circulating within the CDS, a study was conducted on the pollution load, pollutant characterization and its flow pattern in the CDS serving the PIZ 1 and 2 Parameters such as BOD_5, COD, suspended solids, cadmium, lead, oil and grease and copper exceeded the limits of Standard B at the sampling point of MPSP (Seberang Prai Municipal Council) pumping station The level of cadmium detected was as high as 0 203 mg/l which was 10 times exceeding the regulation, while oil and grease content was also high at 62 93 mg/l, a value 6 times the limit set by the Department of Environment The presence of organic pollutants of fatty acid compounds was determined using GC-MS (Gas chromatography mass spectrophotometer) This group of pollutants may be considered as a background chemical pollutant load of the receiving waters through the effluent discharge point from the individual premises

Keywords: Closed drainage system, pollutant load, fatty acid compound, Environmental Quality Act 1974

Introduction

A closed drainage system (CDS) within the Prai Industrial Zones (PIZ) 1 and 2 serves to receive only treated effluents from various industries within these industrial zones The primary goal for treatment of industrial wastewater by individual industries is to protect the receiving waters from pollution The treated effluents flow through the CDS and eventually to Seberang Prai Municipal Council (MPSP) pumping station before finally being discharged into the Penang Straits Each industry within the zones must treat its wastewater to comply to the Standard B limits set under the Environmental Quality Act (Sewage and Industrial Effluent), Regulations, 1979 (EQA 1974, 199), prior to release into the CDS However, the extent of pollution of the receiving water body, Penang