THE 5TH
ENVIRONMENTAL TECHNOLOGY AND MANAGEMENT CONFERENCE
NOVEMBER 23RD - 24TH 2015
BANDUNG, INDONESIA

EDITOR IN CHIEF
Prof. Dr. Ir. Enri Damanhuri

PROCEEDINGS BOOK

FACULTY OF CIVIL AND
ENVIRONMENTAL ENGINEERING
INSTITUT TEKNOLOGI BANDUNG

ISBN 978-979-98278-5-2

CONTENTS

ORAL PRESENTATION

APPROPRIATE AND ADVANCED ENVIRONMENTAL TECHNOLOGY

SITI AINUN M. RANGGA SURURI KASIH SAKINAH	Leachate Treatment Using Conventional Ozonation Process And Advanced Oxidation Process At Old Cell Of Landfill In Indonesia	OP/AE/003
ADILLA MUTIA FATIMAH BARTI SETIANI MUNTALIF	Cultivation Of *Chlorella Vulgaris* As Biofuel Potential In Wastewater For The Removal Of Cod, TKN, And Total Phosphate	OP/AE/004
PUTRI NUR ANNISA RUFAIDAH WELLY HERUMURTI	The Effect Of Organic Loading Rate On Anaerobic Baffled Reactor-Anaerobic Filter In Increasing Efficiency Of Domestic Wastewater	OP/AE/005
ALJUMRIANA WELLY HERUMURTI	Effect Of Aerobic-Anoxic Duration In SBR And MBBR For Leachate Treatment	OP/AE/006
DIMAS BRILLIANT SUNARNO ALI MASDUQI ATIEK MOESRIATI	Influence Of Inlet Flow Velocity And Amount Of Inlet On Hydrocyclone To Reduce Total Suspended Solid	OP/AE/008
ANDY MIZWAR GINA LOVA SARI SRI RACHMANIA JULIASTUTI YULINAH TRIHADININGRUM	Bioremediation of Polycyclic Aromatic Hydrocarbons in Coal Contaminated Soils Using In-Vessel Composting Method	OP/AE/010
ROSETYATI RETNO UTAMI GERTJAN GEERLING A.M.J. RAGAS LUFIANDI DWINA ROOSMINI	Evaluation Of Passive Sampling Method For Organic Contaminant Monitoring In Upper Citarum River West Java Indonesia	PP/AE/012
YOKE PEAN THYE	Survey On The Implementation Of Tools	OP/AE/015

Proceedings

The 5th Environmental Technology and Management Conference

Green Technology towards Sustainable Environment

23 - 24 November 2015, Bandung, Indonesia

Editor in Chief

Prof. Dr. Ir. Enri Damanhuri

Published by

Faculty of Civil and Enviromental Engineering

Institut Teknologi Bandung – Indonesia

ISBN 978-979-98278-5-2

Proceedings

The 5th Environmental Technology and Management Conference

Green Technology towards Sustainable Environment

ISBN: 978-979-98278-5-2

Cover Design:

Sandy Indriana

Publisher:

Faculty of Civil and Environmental Engineering
Institut Teknologi Bandung
Jl. Ganesha 10 Bandung 40132
Telp. 022 2504952
Fax. 022 2516586
Email: kantor@ftsl.itb.ac.id
Website: www.ftsl.itb.ac.id

PREFACE

Green Technology that provides the basic needs of society in sustainable environment is essential for the survival, health and well-being of a society in developing countries. The engineers, scientists, policy makers, academics, environmental consultants, environmental contractors, industrial practitioners, businessmen, politicians, NGOs are at the epicenter in seeking means to enhance human life through modernization of technology and infrastructure. The current rate of urbanization, industrialization and environment mismanagement rise environmental issues. The problems are further aggravated with environmental degradation such as soil erosion, depletion of water resources, climate changes, and others. In order to seek answers for these multifaceted challenges, proper planning, implementation and verification exercises are required, via an integrated, multidisciplinary and holistic approach especially in the area of green infrastructure and green cities, development of eco-industry, environmental health and risk assessment, air quality, advanced technology, natural resources and mitigation of climate change. This international conference shall become a momentum for development of sustainable environment through green technology.

The 5th Environmental Technology and Management Conference (ETMC) was held on 23-24th November 2015, at *Sasana Budaya Ganesha, Institut Teknologi Bandung* (ITB). The ITB is located in Bandung, West Java. Bandung is the center of Sundanese culture and volcanoes surrounds city which make Bandung to be a delightful place to host this conference. More than 300 scientific participants (researcher, students, government officers and industries) had many fruitful discussions and exchange ideas that contribute to the success of the conference. Participants of the conference are coming from US, Australia, Nederland, Japan, Malaysia, Singapore and Indonesia, made the conference truly worthwhile globally. There are 4 speakers in plenary sessions covering different areas, and all the keynote speakers are well known and competent speakers; They are Ir. Mochamad Basoeki Hadimoeljono, M.Sc., Ph.D (Ministry of Public Works and Housing, Republic of Indonesia), Prof. Dr. AJM Smits (Director of Institute for Science, Innovation & Society, Radboud University Nijmegen), Albert Simanjuntak (President Director of Chevron Pacific Indonesia) and Ir. Edwan Kardena, PhD (Environmental Engineering, Institut Teknologi Bandung). There were also 5 parallel sessions with eight invited speakers : Prof. Satoshi Okabe; Prof. Ir. Mindriany Syafila, MS; Prof. Ir. Iwan Kridasantausa Hadihardaja, MSc, PhD; Prof. Dr. Takeshi Fujiwara; Rene van Berkel, PhD; Prof. dr. A.M.J. Ragas; Dr. Budi Haryanto, SKM, MKM, MSc; Dr. rer.nat Armi Susandi,MT.

This volume of proceedings from the conference provides an opportunity for readers to engage with a selection of refereed papers that were presented during the conference. These proceedings divided into 6 sections of 110 abstracts as oral presentation and 23 abstracts as poster session with such topics as follows: Air Quality & Climate Change, Green Cities & Infrastructures, Eco-Industries, Appropriate & Advanced Environmental Technology, Natural Resource Management, and Environmental Health and Risk Assessment. Selected papers will be republished in the special issues of Journal of Technological and Engineering Sciences.

Generous support for the conference was provided by Chevron Pacific Indonesia, JICA, BNI, Vale, Sari Husada, Indocement, Holcim, Sabuga and Faculty of Civil and Environmental Engineering, ITB. The funds were sizeable, timely, and greatly appreciated, and allowed us to support a significant number of young scientists (students) and delegates from developing countries.

Finally, the 5th ETMC was a very successful conference. The plenary lectures, parallels session and special reports bridged the gap between the different fields of green technology, making it possible for non-experts in a given area to gain insight into new areas. Also, included among the speakers were several young scientists and students, who brought new perspectives to their fields. Given the rapid advancement of science in all areas that covered by ETMC, we expect that this ETMC was as stimulating as the previous one, as indicated by the papers contributions presented in this proceeding volume.

Bandung, 24 November 2015

Ir Agus Jatnika Effendi, PhD

LIST OF COMMITTEE

STERRING COMMITTEE

Chairman : Prof. Dr. Ir. Mindriany Syafila, MS

1. Prof. Dr. Ir. Wisjnuprapto
2. Prof. Dr. Ir. Enri Damanhuri
3. Prof Ir Suprihanto N, Ph.D
4. Prof. Dr. Ing. Ir. Prayatni Soewondo, MS
5. Prof. Dr. Ir. Arwin Sabar, MS
6. Prof. Dr. Ir Tjandra Setiadi, M.Sc
7. Dr. Ir. Dwina Roosmini, MS
8. Dr. Ir. Edwan Kardena
9. Ir. R. Driejana, MSCE, Ph.D
10. Dr. Herto Dwi Ariesyadi,ST,MT
11. Dr. Rofiq Iqbal, ST,MSc

ORGANIZING COMMITTEE

Chairman : Ir.Agus Jatnika Effendi, PhD

Secretary : Emenda Sembiring, ST,MT, MEngSc, PhD

Treasurer : Dr. Ing Marisa Handajani, ST,MT

Sponsorship coordinator : Ir. Puji Lestari, PhD

Ir. Edwan Kardena, PhD

Dr. Sukandar, SSi,MT

Dr. Asep Sofyan, ST, MT

Publication : Dr Mont Kania Dewi ST, MT

Ir. Indah Rahmatiah, MSc, PhD (proceeding)

Haryo Satriyo Tomo, ST, MT (internet media)

Ir. James Nobelia I, MT

Logistic coordinator : Dr. Ahmad Soleh, ST, MT

Dr. Helmy, ST,MT

Drs Daddy Surachman, MS

Ir. Hardjono

Drs. Moh. Irsyad, M.Si

Program Coordinator : Suharyanto, ST,MSc, PhD

Ir Yuniati, MSc, PhD

Dr. Opy K, ST., MT

Dr. Ir. Tri Padmi D

Welcome Dinner coordinator : Dr. Katharina Oginawati

Exhibition/Poster coordinator : Dr. I.M.Wahyu W, ST,MT

Dr. Mochammad Chaerul, ST, MT

SCIENTIFIC COMMITTEE

Chairman : Prof. Dr. Ir. Enri Damanhuri

Secretary : Prof. Dr. Ing. Ir. Prayatni Soewondo, MS

1. Prof. Dr. Ir. Arwin Sabar, MS
2. Prof. Ir. Suprihanto N, Ph.D
3. Prof. Dr. Ir. Mindriany Syafila, MS
4. Dr. Ir. Tri Padmi Damanhuri
5. Dr. Ir. Tresna Dermawan Kunaefi
6. Dr. Ir. Benno R, MT
7. Ir. Pudji Lestari, Ph.D
8. Dr. Ir. Priana Sudjono, MS, Dipl.Eng
9. Ir. Idris Maxdoni Kamil, M.Sc, Ph.D
10. Dra. Barti Setiani Muntalif, Ph.D
11. Dr. Ir. Indah Rahmatiah SS, MSc
12. Ir Arief Sudrajat, MSc,PhD

Proceedings

The 5th Environmental Technology and Management Conference

Green Technology towards Sustainable Environment

23 - 24 November 2015, Bandung, Indonesia

Editor in Chief

Prof. Dr. Ir. Enri Damanhuri

Published by

Faculty of Civil and Enviromental Engineering

Institut Teknologi Bandung – Indonesia

ISBN 978-979-98278-5-2

LEACHATE TREATMENT USING CONVENTIONAL OZONATION PROCESS AND ADVANCED OXIDATION PROCESS AT OLD CELL OF LANDFILL IN INDONESIA

S Ainun, MR Sururi - 2015 - eprints.itenas.ac.id

BOD7COD Leachate from the old7completed landfill is very low so that chemical oxidation proce. ss can he used to treat it. This research was using ozone (Os) and O s/UV process to treat leachate from old landfill. The aim of this re. search is to compare and contrast the efficiency of hoth pmcesses hy a semi hatch contactor worth continuous ozone gas supply as many as 3 L7minutes to the contactor filled worth 1 L leachate samples. O z7UV processes show better performance than O z alone. O z7UV can remove iurkidiy as many as …

☆ Simpan 99 Kutip Artikel terkait »

Menampilkan hasil terbaik untuk penelusuran ini. Lihat semua hasil

The 5th Environmental Technology and Management Conference "Green Technology towards Sustainable Environment" November 23 - 24, 2015, Bandung, Indonesia.

ISBN: 978-979-98278-5-2

LEACHATE TREATMENT USING CONVENTIONAL OZONATION PROCESS AND ADVANCED OXIDATION PROCESS AT OLD CELL OF LANDFILL IN INDONESIA

Siti Ainun[a,*,†], *Email: siti_ainun@yahoo.com*

M. Rangga Sururi[b], *Email: rangsoer@yahoo.com*

Kasih Sakinah [c], *Email: kasihsakinahirawan@yahoo.com*

[a] *Environmental Engineering Department, Institut Teknologi Nasional, Bandung, Indonesia*

[b] *Environmental Engineering Department, Institut Teknologi Nasional, Bandung, Indonesia*

[c] *Environmental Engineering Department, Institut Teknologi Nasional, Bandung, Indonesia*

** Presenter; † Corresponding author.*

Abstract: *BOD/COD Leachate from the old/completed landfill is very low so that chemical oxidation process can be used to treat it. This research was using ozone (O_3) and O_3/UV process to treat leachate from old landfill. The aim of this research is to compare and contrast the efficiency of both processes by a semi batch contactor with continuous ozone gas supply as many as 3 L/minutes to the contactor filled with 1 L leachate samples. O_3/UV processes show better performance than O_3 alone. O_3/UV can remove turbidity as many as 80% and O_3 processes only half of that (40%). Conductivity of the sample was decrease until 41% on O_3/UV processes meanwhile on O_3 processes it was only 22%. 66% of Organic aromatic as UV 254 were removed on O3/UV processes in the meantime O3 processes only remove 51%.*

Keywords: *Ozone; Advance Oxidation Process; Efficiency; UV.*

1. Introduction

Landfill is widely used in developing countries, including Indonesia. More than 68% of its waste generation ends up in landfill. The drawback from this technique is that it will produce leachate. Leacheate problems in Indonesia are complex and become one of the national problems due to the inappropriate handling. This condition get worse with an open dumping system which is mostly operated in the landfill (Damanhuri, 2008b). This kind of landfill operating system will increase the generation of leacheate quantity. The quantity of leachate is depending on the rain water which percolated into landfill cell. However, leachate is also resulted from degradation process of organic waste which are dominated the solid waste composition in Indonesia. Leachate will be generated continually even when the landfill had not operated.

Leachate contains organic material which either biodegradable or non-biodegradable. It is also containing significant amount of ammonia and heavy metals. According to toxicological test, leachate had a harmful effect to man health (Renou, et al, 2008). Leachate characteristic is affected by the age of landfill cell. Most of the biodegradables organics is found on leachate from the young cell (below 10 years), meanwhile leachate from old cell generally contain non-biodegradable organic (Renou, 2008).

The efficiency of leachate treatment depends on its characteristic. It means that the quality and quantity of leachate must be determined before we treat the leachate which is affected by: rainfall intensities; runoff; daily cover permeability; compaction technique; and its composition (Renou, 2008).Stabilization pond are commonly used in Indonesia as a leacheate treatment technique (Damanhuri, 2008b). It has a long detention time as its weakness which required an extensive land that mainly difficult to found in urban areas. Furthermore, leachate is waste that is difficult to directly biologically treated (Cortez etal, 2010).

Advanced oxidation technique is a technique that can be used to reduce color, organic matter content, as well as to change the leachate to be more easily degraded (Renou, 2008). Ozone is interesting to be used because it has high oxidation power. In water, ozone will decompose to $OH^{\cdot}$, the strongest oxidant in the water (Von Gunten, 2003).The process of ozonation and advanced oxidation process by accelerating the decomposition of ozone into OH radicals is one of the efforts that can be considered to be effective for leachate treatment.

This research used leachate samples from old cell landfill. The sample was taken from Leuwigajah landfill which operated during 1987-2005. The landfill designed was sanitary landfill technique, but the fact showed that it was operated by the open dumping system. Oxidation technique by using conventional ozone (O_3) and Advance Oxidation Process (AOP) were used to treat leachate. One of AOP technique is O_3/UV. UV can decompose ozone to produce hydroxyl radicals more rapidly. Ozone conventional process and O_3/UV can reduce COD and improve the quality of leachate until it is ready to be degraded by biological process (Tizaoui et al,2007).

2. Materials and Methods

Samples were taken as a grab sampling from the leachate collection points which become an effluent channel. It flows through water bodies without any treatment. Leachate characteristic will have an impact on the stability of the ozone in the water, which is highly dependent on its characteristics especially pH, type and organic matter content and alkalinity of water (Hoigne, 1983). The measurement of leachate characteristic was taken on parameter of BOD, COD, pH, Electrical conductivity, turbidity, temperature, alkalinity and UV $_{254}$.The methodology being used for each parameter refers to the SNI and the Standard Methods for the Examination Water and Wastewater 21th edition.

The study was conducted in a semi batch with continuous ozone gas supply to the contactor filled with leachate samples. The equipment used in this study was oxygen tube, flow meter, ozone generator and ozone contactor which can be seen at Fig.1. The flow of oxygen to the ozone generator is measured by the flow meter with flow rate at 3 L/min. Ozone generator used were OZF - 1G , POWER 200 W , 220 V, which will change the O_2 into O_3. Ozone which generated from the ozone generator is supplied to the ozone contactor which had previously been filled with 1 L of leachate sample. For a presence of homogeneous ozone through the leachate sample, ozone gas is supplied by using a filter disc.

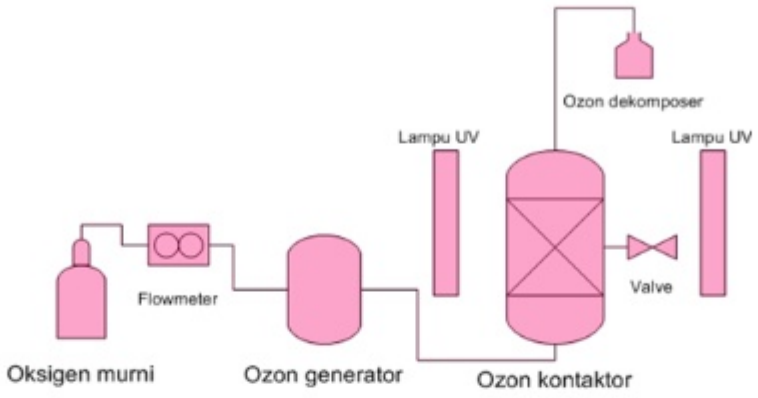

Figure 1.Experimental Set Up

Total contact time in every variation was 60 minutes. Every 10 minutes, sample was taken to be measured to observe the dynamic changes of every parameter such as ozone residual concentration, pH, and alkalinity. The concentration of residual ozone and the presence of OH radicals in the solution will affect the effectiveness of the process of oxidation. Meanwhile to identify the effect of the ozonization process the parameter that measured were turbidity, conductivity, aromatic organic, and COD. It is also essential to identify the removal critical point of each parameter.

3. Results and Discussion

3.1 Leacheate Characteristic

The pH of the leachate sample was on neutral range, and the temperature was on room temperature. pH will affect the rate of ozone decomposition. The more alkaline pH, the decomposition process will be faster than in acidic pH. The sample contain carbonate between 90 and 102 mg/L, and bicarbonate between 205-234.2 mg/L. In the conventional ozonation process, carbonate and bicarbonate is an inhibitor chain reaction (von Gunten, 2003), as well as the waste treatment process (Fernando, 2005).The organic aromatic of the sample was measured by UV $_{254}$, and it was 1.0434 Abs. It is a parameter which informs the quantity of aromatic organic matter and unsaturated compounds in water (Beltrand, JFernando, 1995). Organic materials such as lignin, humus and aromatic compounds, in general, can be absorbed by UV radiation (APHA, 1999). COD of the sample were 280.9-282.3 mg/L and the BOD was only 11.3-14.46 mg/L. The ratios of BOD/COD were only 0.04-0.05 which indicated that biological process will not effective to be used. Furthermore, this small ratio was due to degradation of biodegradable organic which mostly happened in old cell landfill (Renou, 2008).

3.2 Ozone Residual Concentration

The comparison of ozone residual concentration of conventional O3 and AOP O_3/UV is shown at Figure 2.

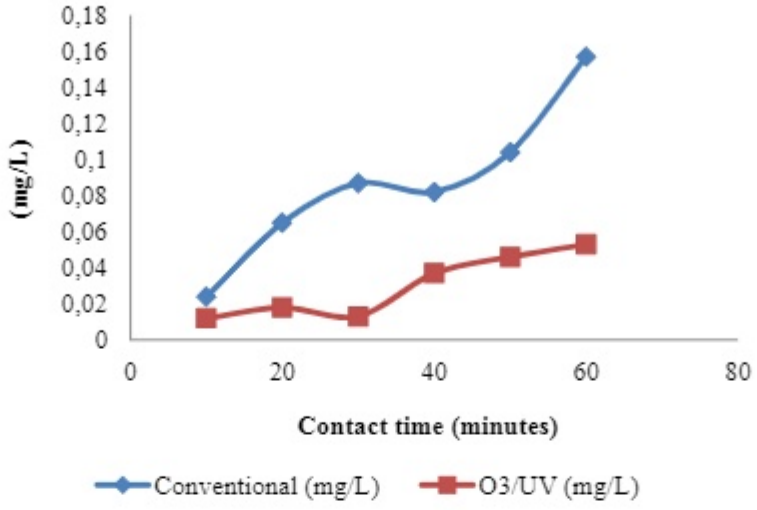

Figure 2. Comparison of Residual Ozone Concentration

Table 1 informs that the concentrations of residual ozone on O_3 process are higher than on O_3/UV process. In solution, ozone can react with various compounds dissolved in water in two ways, which are direct reaction and indirect reaction. Both of these reactions are an oxidation reaction. Immediate reactions are reaction which conducted by ozone, whereas indirect reaction is the reaction which is done by the decomposition products (Chen, 2008). Decomposition of ozone is the first step of the reaction mechanism performed in indirect reaction. The lower concentration of residual of ozone at O_3/UV process indicating the OH · on this process is higher compare to O_3 process. UV light can decompose ozone more quickly and it can result free radical in significant amount for oxidation process (Chen, 2008). Topudrutiet. al., 1993 in Savant, 2003 informed that the reaction of ozone with UV results in the formation of hydrogen peroxide which then reacts with UV light to form hydroxyl radicals. The presence of hydrogen peroxide will accelerate the form of form hydroxyl radicals by the reaction as follow (Kurniawan et al, 2006):

$$2O_3+H_2O_2 \rightarrow 2{\bullet}OH + 3O_2$$

3.3 The Dynamic Changes of pH and Alkalinity

The dynamic changes of pH and alkalinity are measured to evaluate the response of leachate on ozonation process. pH is an important parameter because hydroxide ions initiate decomposition of ozone. Alkalinity measurements will be seen from the dynamics of the content of carbonate and bicarbonate. The increase in pH will initiate the ozone decomposition, otherwise carbonate and bicarbonate will retain it. The result of the research can be seen at Table 1 and Table 2.

Table 1 pH comparison

Time (minute)	Conventional O_3 (mg/L)	AOP O_3/UV (mg/L)
10	8.08	6.89
20	8.68	7.48
30	8.96	7.59
40	8.98	7.65
50	9.07	7.67
60	9.13	7.7

Table 2 Alkalinity comparison

Time (minute)	Conventional O_3		AOP O_3/UV	
	Carbonate (mg/L)	Bicarbonate (mg/L)	Carbonate (mg/L)	Bicarbonate (mg/L)
10	96	219.6	144	683.2
20	78	189.1	96	536.8
30	90	158.6	48	439.2
40	90	128.1	48	292.8
50	84	140.3	48	146.4
60	78	115.9	96	97.6

It shows that the pH of the sample gradually increase at every contact time, meanwhile carbonate and bicarbonate are decreasing. The pH will increase due to ozone decomposition which will produced $OH^{\cdot}$, meanwhile carbonate and bicarbonate were continually used as a reactant so that carbonate radical will be produced and act as terminator of chain reaction production of $OH^{\cdot}$

3.4 The Process Efficiency

The performance of the ozonization process will be shown through the removal efficiency of turbidity, conductivity, organic aromatic and COD which presented in Figure 3, Figure 4, Figure 5 and Figure 6.

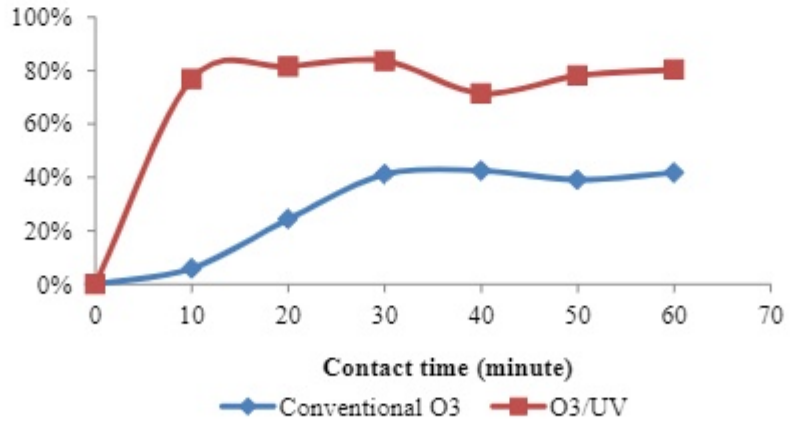

Figure 3. Turbidity Removal Efficiency

Figure 3 show that O_3/UV has a higher efficiency in removing the turbidity. The critical point for O_3/UV is at 30 minutes with 84% removal efficiency, meanwhile in the conventional O_3

can remove 42% turbidity at 40 minutes of contact time. At the end of total contact time, O_3/UV reach 80% removal efficiency with 2.42 NTU and only 42% removal efficiency can be achieved for conventional O_3. In water, ozone decomposes into OH radical which is the strongest oxidizer in water. OH radicals are not selective, while ozone is selective. Therefore, if there is a material resistant to ozone, it will be oxidized by OH radicals (von Gunten, 2003).

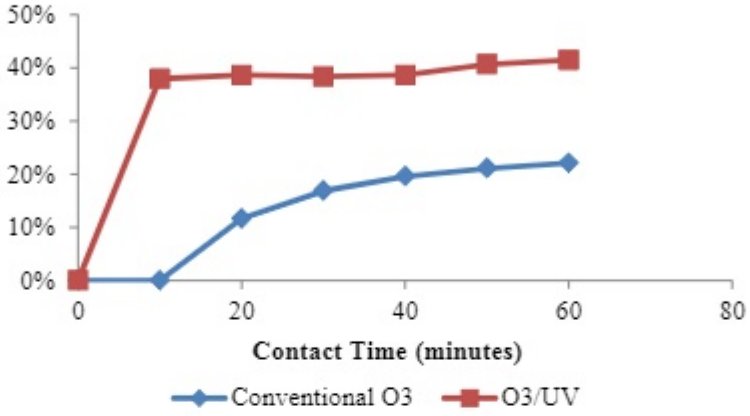

Figure 4. Conductivity Removal Efficiency

The same trend of turbidity is shown with the result of conductivity removal. The high content of electrical conductivity usually indicates the level of contamination in the water. Based on Sehah (2008), leachate is indicated containing many compounds of acids, bases and salts which are dissolved into positive ions and negative ions that increase its conductivity. The conductivity removal efficiency from conventional O_3 (22%) is only reached half from the O_3/UV achievement (44%). After 60 minutes of contact time, the electrical conductivity is around 46,1µmhos/L for conventional $O_3$and 80,5 µmhos/L for O_3/UV.

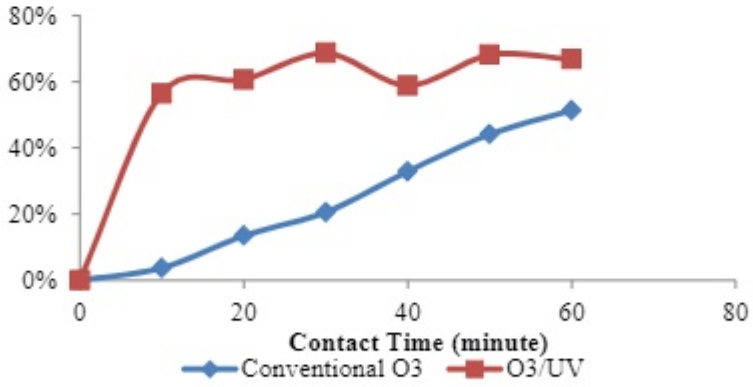

Figure 5. Organic Aromatic (UV_{254}) RemovalEfficiency

Figure 5 provides information that the removal of aromatic organic material is occurs in each process. In the conventional ozonation process, aromatic organic matter content was reduced by51% with 0.508 Abs, while the AOP process (O_3/UV), its efficiency rises to 67% with 0.138 Abs. This result indicates that there is a close relationship between the concentrations of residual ozone removal efficiency of aromatic organic matter. In the AOP process

(O_3/UV), it is known that at 30 minutes of contact time, concentration of residual ozone is at its lowest point, which indicates dominance presence of OH radicals to improve the removal efficiency of aromatics organic matter and other unsaturated compounds. When the aforementioned data is related to the ozone residual concentration data, it indicates that hydroxyl radicals capable of degrading organic aromatic stronger than ozone.
The COD removal efficiency is shown at Figure 6 which gives information that the AOP process (O_3/UV) only able to have an efficiency of 38% with COD concentration is about 267 mg/L , while the conventional ozonization process is reach up to 45% with 153.60 mg/L. The critical point in the conventional ozonation process is at the 60th minute and 30 minute for AOP (O_3/UV).

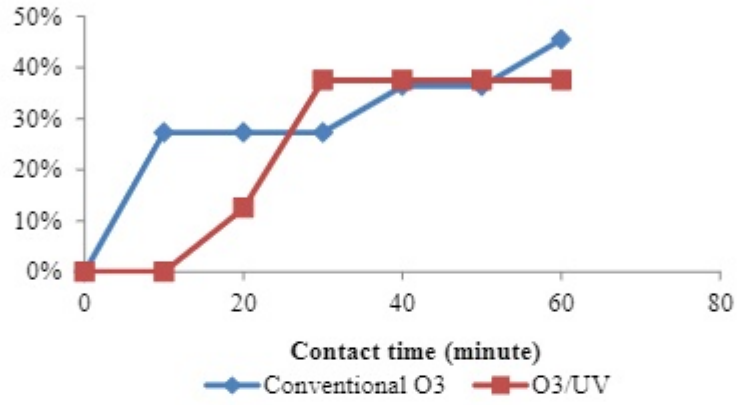

Figure 6. COD RemovalEfficiency

COD reduction indicates that the ozonation process both conventional and AOP are highly dependent on the direct reaction and indirect reactions. Indirect reaction play more dominant role in the provision for organic materials to produce better efficiency. According to Wu (2004) O_3/UV is the most effective of AOP to increase the level of biodegradability of leachate. It is because when we used this process, organic complex will be oxidized to form low molecular organic carbon. UV radiation is not only make the ozone molecule to become OH · but also made organic more easy to be degraded (Li, Zhou, & Hua, 2010). The sample was taken from old cell of landfill, with possibility that organic degradable content are already naturally degraded. Organic degradation can be carried out by microorganisms in the soil where the leachate flows before finally assembled on the drainage channel that looks like a pool (sampling location). The length of natural degradation time which has occurred can cause the leachate contains the compounds which are remain resistant (very difficult degraded) or are toxic.

4. Conclusions

O_3/UV processes show better result than O_3. O_3/UV can remove turbidity as many as 80% and O_3 processes only half of that (40%). Conductivity of the sample was decrease until 41% on O_3/UV processes meanwhile on O_3 processes it was only 22%. 66% of Organic aromatic as UV $_{254}$ were removed on O_3/UV processes in the meantime O_3 processes only remove 51%. The research shows that critical points to remove all above parameters were between 30-40 minutes. The research result was shows O_3/UV process are appropriate to treat leacheate from old cell especially for organic aromatic content.

Acknowledgement

Acknowledgements addressed to the Director of Research and Community Service Directorate General of Higher Education (DP2M DGHE) of the Ministry of Education and Culture, Fiscal Year 2013, which has funded this research as a Competitive Research Grant.

References

[1] Chedly Tizaoui, Latifa Bouselmi, Loubna Mansouri, Ahmed Ghrabi. (2007) *Landfill leachate treatment with ozone and ozone/hydrogen peroxide systems* Journal of Hazardous Materials 140 316–324

[2] Chen Yi-Hung, Neng-Chou Shang, Da-Cheng Hsieh (2008) *Decomposition od dimethyl phthalate in an aqueous solution by ozonation with high silica zeolite and UV radiation* Journal of Hazardous Materials 157 (2008)260–268

[3] *Enri Damanhuri, Tripadmi Damanhuri, (2008a), Diktat Kuliah Persampahan, Pembangunan air minum dan penyehatan lingkungan di Indonesia Pembelajaran dari berbagai pengalaman. TeknikLingkungan ITB AMPL,Bapenas*

[4] Enri Damanhuri, (2008b),Diktat Kuliah Teknik Pembuangan Akhir Sampah, Teknik Lingkungan ITB

[5] *Fernando, Beltrand J, (1995), Ozone reaction kinetic for water and wastewater system, CRC Press company, Washington DC, pp 11-12.*

[6] Hoigne , Bader., (1983).,*Rate constants of reaction of ozone with organic and inorganic compound in water-I non- dissociating organic compounds,* WaterResearch, 17,173-183.

[7] Jerry J. Wu , Chih-Chao Wu, Hong-Wen Ma, Chia-Chi Chang (2004) *a Short Communication Treatment of landfill leachate by ozone-based advanced oxidation processes* Chemosphere 54 997–1003

[8] *Kurniawan., Tonni, Agustiono., Wai-Hung, Lo., G.Y.S. Chan, (2006), Radical Catalayzed Oxidation Reaction for Degradation of Recalcitrant Compound From Landfill Leacheate, Chemical Engineering Journal, 125, pp. 35-57.*

[9] *Li, W., Zhou, Q., and Hua, T., (2010),Removal of Organic Matter from Landfill Leachate by Advanced Oxidation Processes : A Review, International Journal of Chemical Engineering, 2010,pp 1 – 10*

[10] Renou, S., Givaudan, J. G., Poulain, S., Dirassouyan, F., & Moulin, P. (2008). *Landfill leachate treatment: Review and opportunity*. Journal of hazardous materials, 150(3), 468-493.

[11] Sehah, Cahyanto, Wahyu Tri, (2009),*Pengujian Daya Hantar Listrik Air Tanah Di SekitarTempat Pembuangan Akhir Gunung Tugel Kabupaten Banyumas Menggunakan Prinsip Jembatan Wheatstone*, Jurnal Molekul, 4(1), pp.39-41.

[12] Susana Cortez, PilarTeixeira, Rosário Oliveira*, Manuel Mota. (2011).*Evaluation of Fenton and ozone-based advanced oxidation processes as mature landfill leachate pre-treatments*. Journal of Environmental Management 92 749e755

[13] Von Gunten., Urs, (2003), *Ozonation of Drinking Water: Part I. Oxidation Kinetics and Product Formation*, Water Research, 37, 1443-1467