



Waste Engineering  
and Management

Proceeding

SIBE-2009

The 1<sup>st</sup> International Conference  
on Sustainable Infrastructure  
and Built Environment  
in Developing Countries

SABUGA ITB, Bandung - Indonesia  
2<sup>nd</sup> - 3<sup>rd</sup> November 2009

Published by  
Faculty of Civil and Environmental Engineering  
Institut Teknologi Bandung - Indonesia



AUN/SEED-Net



# Proceeding

Waste Engineering and Management

## SIB€-2009

The 1<sup>st</sup> International Conference  
on Sustainable Infrastructure  
and Built Environment  
in Developing Countries

SABUGA ITB, Bandung - Indonesia  
2<sup>nd</sup> - 3<sup>rd</sup> November 2009

Published by  
Faculty of Civil and Environmental Engineering  
Institut Teknologi Bandung - Indonesia



AUN/SEED-Net



*SIBE 2009 published eight (8) volumes of proceeding as following :*

*Volume A : Structure and Material*

*Volume B : Transportation System and Engineering*

*Volume C : Water Engineering and Management*

*Volume D : Waste Engineering and Management*

*Volume E : Ocean Engineering*

*Volume F : Construction Management*

*Volume G : Geotechnical Engineering*

*Volume H : Environmental Protection and Management*



## PREFACE

The 1st International Conference on Sustainable Infrastructure and Built Environment in Developing Countries (SIBEE) 2009 is aimed to provide a forum to discuss and disseminate recent advance in scientific research, technology, and management approach to obtain better environment quality.

Infrastructure that provides the basic need of a society and sustainable infrastructure system are essential for the survival, health and well-being of a society. In developing countries, civil and environmental engineers are at the epicenter in seeking means to enhance the quality of human life through modernization of infrastructure as evidenced by provision of shelters, water, and transport, amongst others. The current rate of urbanization and industrialization raises a number of environmental issues, often resulting in environmental mismanagement, especially in developing countries. The problems are further aggravated by environmental degradation such as soil erosion, depletion of water resources, etc. In order to meet these multifaceted challenges, proper planning followed by implementation and verification must be exercised, via an integrated, multi disciplinary and holistic approach.

The conference will provide an opportunity for professionals and researchers to learn, share and exchange about the latest development and research in civil and environmental engineering. The scope of the conference covers all aspect of civil and environmental engineering practices.

Participants of the conference include researchers, academic staffs, students, industries, public and local governments. The keynote presentations during the conference are as follows:

Keynote speakers:

- **Indonesian Government Representative**  
*Minister of Public Works, Indonesia*
- **Dr. Puti Farida Marzuki**  
*Dean of the Faculty of Civil and Environmental Engineering, Institut Teknologi Bandung, Indonesia*
- **Dr. Tony Liu**  
*National Taiwan University, Taiwan*
- **Prof. Shunji Kanie**  
*Hokkaido University, Japan*
- **Prof. Syunsuke Ikeda**  
*Tokyo Institute of Technology (AUN/SEED-Net), Japan.*

Invited speakers:

- **Dr. Setiawan Wangsaatmaja**  
*Environmental Protection Agency of West Java Province, Indonesia*
- **Dr. Edwan Kardena**  
*Faculty of Civil and Environmental Engineering, Institut Teknologi Bandung, Indonesia*
- **Prof. Harianto Rahardjo, Ph.D.**  
*School of Civil and Environmental Engineering, Nanyang Technological University, Singapore*
- **Prof. Ikuo Towhata**  
*School of Engineering, University of Tokyo, Japan*
- **Prof. Dr. Seiichi Kagaya**  
*School of Engineering, Hokkaido University, Japan*
- **Prof. Jun Sasaki**  
*School of Engineering, Yokohama National University, Japan*
- **Prof. Carl Martin Larsen**  
*Norwegian University of Science and Technology, Norway*

- **Dr. George W. Annandale, D.Eng., P.E.**  
*Golder Associates Inc., USA*
- **David Woodward, D.Phil.**  
*University of Ulster, United Kingdom*
- **Dr. Delia Dimitriu**  
*Centre for Air Transport and the Environment (CATE), Manchester Metropolitan University, United Kingdom*
- **Prof. Tsunemi Watanabe**  
*Department of Infrastructure Engineering, Kochi University of Technology, Japan*
- **Prof. Shyh-Jiann Hwang**  
*Department of Civil Engineering, National Taiwan University, Taiwan*
- **Prof. Kuo-Chun Chang**  
*Department of Civil Engineering, National Taiwan University, Taiwan*
- **Prof. Suprihanto Notodarmojo**  
*Faculty of Civil and Environmental Engineering, Institut Teknologi Bandung, Indonesia*
- **Masyhur Irsyam, Ph.D**  
*Faculty of Civil and Environmental Engineering, Institut Teknologi Bandung, Indonesia*
- **Prof. Nakasaki Kiyohiko**  
*Tokyo Institute of Technology, Japan.*

The objectives of this conference are:

1. To provide a platform for exchange of ideas, information and experiences among academics, researchers, consultants, engineers, manufacturers and post graduate scholars in civil and environmental engineering.
2. To discuss and evaluate the latest approaches, innovative technologies, policies and new directions in infrastructure development, pollution prevention and eco-friendly technologies adapted to developing countries.
3. To promote cooperation and networking amongst practitioners and researchers involved in addressing infrastructure and built environment issues.

The oral and poster presentations are subdivided into 8 major sections, as following:

- A. Structure and material
- B. Transportation system and engineering
- C. Water engineering and management
- D. Waste engineering and management
- E. Ocean engineering
- F. Construction management
- G. Geotechnical engineering
- H. Environmental protection and management.

There are 174 contributors in oral presentation and 36 contributors for poster presentation.

Finally, the Organizing Committee wishes that this conference is able to provide beneficial scientific information to the participants and other concerned readers.

Bandung, November 2009  
Organizing Committee



## LIST OF COMMITTEE

### STEERING COMMITTEE

- Chair : Dr. Puti F. Marzuki  
(Dean of FCEE ITB, Indonesia)
- Co-Chair : Prof. Indratno Soekarno      Prof. Takashi Mikami  
                  Prof. K.C Chang                    Dr. Iswandi Imran  
                  Prof. Bambang Sugeng                Dr. Masyhur Irsyam  
                  Dr. Biarno W. Soemardi                Prof. Suprihanto Notodarmodjo  
                  Prof. Arwin Sabar                        Prof. Enri Damanhuri  
                  Dr. Ricky L. Tawekal

### ORGANIZING COMMITTEE

- Chair : Prof. Dr. Ir. Enri Damanhuri
- Co-Chair : Ir. Muhamad Abduh, MT, Ph.D.
- General Secretary : Dr. Kania Dewi, ST, MT.
- Dr. Hendra Achiari, ST, MT.      I Made Wahyu Widyarsana, ST, MT.  
Ir. Rildova, MT, Ph.D.                Dhemi Harlan, ST, MT, MSc., Ph.D.  
Dr. Russ Bona Frazila, ST, MT.      Dr. Mochammad Chaerul  
Ir. Erza Rismantojo, Ph.D.            Dr. Ir. Dwina Roosmini, MS.  
Ir. Ima Fatima, M.Eng.                Dr. Herto Dwi Ariesyady, ST, MT.  
Dr. Ir. Tri Padi                         Dr. Nita Yuanita, ST, MT.  
Dr. Sukandar, S.Si, MT.                Qomarudin Helmy, ST, MT.  
Dr. Endra Susila, ST, MT                Hasbullah Nawir, ST, MT, Ph.D.  
Suphia Rahmawati, ST, MT.            Dr. Ir. Sony Sulaksono, MT.  
Ivindra Pane, ST, MSE, Ph.D.            Ms. Rahima Hanifa  
Ms. Iin Varida                            Ms. Neneng Eliana  
Mr. Ibet Setiawan                        Mr. Bobby Tri Andono  
Mr. Rahmat Danu Andika

### SCIENTIFIC COMMITTEE

- Chair : Dr. Krishna S. Pribadi
- Co-Chair : Dr. Saptahari Soegiri      Prof. Shyh-Jiann Hwang  
                  Prof. Naoyuki Funamizu                Prof. Hang Tush  
                  Prof. Rizal Z. Tamin                    Prof. Ofyar Z. Tamin  
                  Prof. Amrinsyah Nasution            Prof. Adang Surahman  
                  Prof. Wisjnu Prapto                    Prof. Juli Soemirat  
                  Dr. Wayan Sengara                    Dr. R. Driejana  
                  Dr. Syahril B. Kusuma

## CONTENT

<b>PREFACE</b>	<b>i</b>
<b>LIST OF COMMITTEE</b>	<b>iii</b>
 <b>PLENARY LECTURE</b>	
<i>Djoko Kirmanto</i>	
<b>Keynote Speech from the Minister of Public Works Republic of Indonesia</b>	<b>1</b>
<i>Puti Farida Marzuki</i>	
<b>Toward Sustainable Infrastructure and Built Environment: Striving for Relevance in Civil and Environmental Engineering Education and Research</b>	<b>5</b>
<i>Shunji Kanie</i>	
<b>Sustainable Development in Vulnerable Environments: For Construction and Engineering in Permafrost Regions</b>	<b>16</b>
<i>Syunsuke Ikeda</i>	
<b>Transport Processes of Sediment /Nutrients in Watershed and Application to Asian and Pacific Countries</b>	<b>25</b>
<i>Tony C. Liu, Jenn-Chuan Chern, and Kuo-Chun Chang</i>	
<b>Concrete Technology for Sustainable Infrastructure</b>	<b>35</b>
 <b>SPECIAL LECTURE</b>	
 <b>ORAL SESSION PAPERS</b>	
<i>Abdullah Al-Mamun, Maan Fahmi R. Al-Khatib, Aishah Jamaluddin Ahmad, Mohammed A. Al Sa'adi, Md. Zahangir Alam, Suleyman Aremu Muyibi, Faris Ismail, Azni Idris</i>	
<b>Adsorption of Chromium from Water by Carbon Nanotubes Grown on Powdered Activated Carbon</b>	<b>42</b>
<i>Amitava Bandopadhyay</i>	
<b>Recent Innovations in Managing and Utilization of Solid Wastes from Steel Sector</b>	<b>49</b>
<i>Bui Xuan Thanh, Chettiyapan Visvanathan</i>	
<b>Performance of Aerobic Granules Coupling With Membrane Bioreactor</b>	<b>55</b>
<i>Dimu Jawad, Mirielle Manoukian</i>	
<b>Developing LCCA Model for Solid Waste Management Facility: What is Important?</b>	<b>62</b>
<i>Effendi, A.J., Q. Helmy., P.S. Hoesni, T. Tedjakusuma</i>	
<b>The Application of Bioemulsifier Produced by Azotobacter vinelandii in Bioremediation Oil-Contaminated Soil</b>	<b>69</b>
<i>Fadjari Lucia Nugroho, Setiati, Roby</i>	
<b>Biosorption of Remazol Golden Yellow 6 Dye by Mixed Culture of Live Fungi</b>	<b>75</b>
<i>Florinda Bacani, Gonzalo Chua Jr., Elvin Dexter Lee, Cedrik Nigel Perfecto</i>	
<b>Test and Monitoring of Lead Accumulation Using Hydrophyte Hibiscus Cannabinus L.Plant as Metal Accumulators for Potential Phytoremediation</b>	<b>82</b>



<i>Herto Dwi Ariesyady, Tsukasa Ito, Badariah Yosiyana, Marisa Handajani</i>	
<b>The Propionate-Oxidizing Bacteria (POB) Diversity of Anaerobic Digesters in Tropical Environment as Revealed by 16S rDNA Gene Cloning Analysis</b>	<b>87</b>
<i>I.M. Wahyu W., E. Damanhuri, Tri Padmi, Kuntjoro A. Sidarto</i>	
<b>Study of Computer E-Product Ownership on Household Level in The City of Bandung</b>	<b>95</b>
<i>Kania Dewi</i>	
<b>Oxides of Nitrogen (NOx) Abatement by Photocatalytic Activity Using Titanium Dioxide (TiO<sub>2</sub>)</b>	<b>102</b>
<i>Liza Ferina, Shaliza Ibrahim, M. Suffian M. Annuar</i>	
<b>Optimization of Aqueous Remazol Brilliant Blue R (RBBR) Decolorization by <i>Trametes</i> sp. Pellets in Fluidized Bed Reactor (FBR)</b>	<b>108</b>
<i>Maria Antonia N. Tanchuling, Harold M. Aquino, Dennis C. Ong, Augustus C. Resurreccion</i>	
<b>Removal of Zinc and Lead Ions from Aqueous Solution Using Coco-Peat as Sorbent Material</b>	<b>114</b>
<i>Mochammad Chaerul, Adi Susangka</i>	
<b>Multicriteria Analysis for Selecting Municipal Solid Waste Composting Technology</b>	<b>120</b>
<i>Nadia Paramita, Prayaini Soewondo</i>	
<b>Strategy for Sustainable Domestic Wastewater Onsite Facility Improvement in Slum Area through PNPM Mandiri (Case study: Sadang Serang Area-Bandung, West Java)</b>	<b>125</b>
<i>Nguyen Thi Van, Dr. Maria Lourdes Dalida, Prof.Dr. Shiro Yoshikawa, Prof. Dr. Huynh Trung Hai</i>	
<b>Adsorption of Metallic Ions onto Chitosan coated bentonite: Equilibrium and Kinetic</b>	<b>131</b>
<i>Norzila Othman, Noor Hana Hussain, Ahmad Tarmizi Abd Karim, Suhaimi Abdul-Talib</i>	
<b>Isolation and Optimization of Napthalene Degradative Bacteria</b>	<b>140</b>
<i>Nur Atiqah Ismail, Shaliza Ibrahim, Mohamad Suffian Mohamad Annuar</i>	
<b>Effect of Selected Physical and Chemical Parameters on Crystal Violet Decolorization by Immobilized Laccase</b>	<b>145</b>
<i>Patiparn Punyapalakul, Sumeth Junsuthonpoj</i>	
<b>Selective Adsorption of Heavy Metals and Ionic Dyes on Silica Coated Superparamagnetic Particles</b>	<b>152</b>
<i>Phetyasone Kaypanya, Augustus C. Resurreccion, Ma. Antonia N. Tanchuling, Ken Kawamoto, Toshiko Komatsu, Jiro Takemura, Per Moldrup</i>	
<b>Linking Methane Emission Rate to Gas Transport Parameters of Final Soil Cover at Payatas Controlled Dump Site in the Philippines</b>	<b>158</b>
<i>Prihandrijanti, M., Malisie, A. Firdayati, M., Oterpohl, R.</i>	
<b>Ecological Sanitation, an alternative for a Sustainable Domestic Wastewater Management System in Indonesia</b>	<b>165</b>
<i>Puji Lestari, Yandhinur D Mauliadi</i>	
<b>Application of PMF Model for Sources Apportionment of Aerosol Fine and Coarse Particles during Dry and Wet Seasons in Rural Area, Bandung, Indonesia</b>	<b>172</b>



<i>Putri Sri Komala, Agus Jatnika Effendi, IG. Wenten, Wisnuprpto</i>	
<b>Flux Continuity in Membrane bioreactor for Azo Dye Biodegradation</b>	178
<i>Putri Andini Budiman, Sukandar</i>	
<b>Composting Process of Sludge From Dairy Industry's Waste Water Treatment Plant</b>	184
<i>Ratna Permatasari, Tri Padmi Damanhuri</i>	
<b>Greenhouse Gas Emission Study From Pet Recycling Process of Bottled Drinking Water</b>	196
<i>Setiadi T, Rachma R.M, Reinaldo V, Muhyinsyah A</i>	
<b>Electricity Generation from Tapioca Wastewater Using Microbial Fuel Cell (MFC)</b>	202
<i>Siti Ainun, Yulianti Pratama, Elvin Malino</i>	
✓ <b>Study of Domestic Packaging Waste Generation Case Study: Kelurahan Cigadung, Bandung, West Java</b>	208
<i>Siti Suhana Sulaiman, Shaliza Ibrahim, M. Suffian M. Annuar</i>	
<b>Dye Decolorization by Pellets of <i>Pycnoporus sanguineus</i> using Stirred Tank Reactor</b>	215
<i>Theingi Soe, Ma, Antonia N. Tanchuling, Augustus C. Resurreccion, Ken Kawamoto, Toshiko Komatsu, Jiro Takemura, Per Moldrup</i>	
<b>Methane Concentration and Methane Emission Rate Measurements on the Final Landfill Cover at the Payatas Controlled Dumpsite: Correlation of Methane Concentration to Field Water Content and Ground Temperature</b>	222
<i>Thuy Vu Kiem, Manh Vu Van, Maria Lourdes P. Dalida</i>	
<b>Recovery Of Chromate from Chrome Electroplating Waste Water by Anion Exchange Resin Method</b>	228
<i>Vu Minh Trang, Analiza P. Rollon</i>	
<b>Removal of reactive azo dye in a Sequencing Batch Reactors: Effects of Total Cycle Time and Anaerobic:Aerobic Retention Time Ratio</b>	238
<b>POSTER SESSION PAPERS</b>	
<i>Adyati P. Yudison, Driejana, M. Irsyad</i>	
<b>Correlation of SO<sub>2</sub> Emission from Open Burning With Solid Waste and Burning Characteristic</b>	244
<i>Christy Yohana Wulandari, Sukandar</i>	
<b>Hazardous Waste Generation and Composition of Private Dental Practices (Case Study Bandung City)</b>	250
<i>Eka Wardhani, Etih Hartati, Lutfia Fitri Yusuf</i>	
<b>Identification of Clean Production Opportunities at Textile Industry of "PT X" in Indonesia</b>	258
<i>Emenda Sembiring, Vilas Nitivattananon</i>	
<b>Model Formulation for a Preliminary Decision-Making Tool for a Regional Solid Waste Management in Developing Countries</b>	264
<i>Kania Dewi, Ivan Yosafat Siahaan</i>	
<b>Optimization of Carbon Dioxide Abatement in Carbonation Reactor Utilizing Solid Waste of Carbide Welding Process</b>	270
<i>Nadia, R., Mohd. Bakri, I., Khairul Nadiah, I.</i>	
<b>Transport and Trade of Electronic Waste in Malaysia: Aspects and Issues</b>	276

*Nazainulshila R., Zulbahri R.H*

**The Socio Economic Effect on Municipal Solid Waste Generation  
and Composition: A Case Study in Kuala Terengganu, Besut And Kemaman** 280

*Siti Ainun, Harrie van Bommel*

**Study of the Criteria Assessment In The Implementation of Packaging Waste  
Management System Related to Integrated Product Policy and Extended  
Producer Responsibility** 286

**LIST OF PRESENTER**

**INDEX OF AUTHOR**

**ACKNOWLEDGMENT**



## **Study of Domestic Packaging Waste Generation Case Study: Kelurahan Cigadung, Bandung, West Java**

**Siti Ainun<sup>1,\*</sup>, Yulianti Pratama<sup>1</sup>, Elvin Malino<sup>1</sup>**

<sup>1</sup>Environmental Engineering Department, Faculty of Civil and Environmental Engineering,  
Institut Teknologi Nasional, Jalan PKH. Mustopha no.23 Bandung 40124, Indonesia

\*Corresponding author: siti\_ainun@yahoo.com

### **Abstract**

*Changes in consumption patterns and the ways of living have big influence in waste generation. The consumer society manipulates the composition of waste generation and predisposes growth of packaging production. Packaging production gives a big contribution to the waste stream which varies from a wide variety of package materials, form and performances. Therefore, it needs to conduct a research aimed at determining the average percentage of packaging waste generation as compared to domestic waste. The research was conducted in Kelurahan Cigadung which held high household activities. SNI 19-394-1994 was used in according to sampling of the weight, volume and compositions of wastes. The research result shows that the total packaging waste generation of Kelurahan Cigadung is up to 26% or 1100 kg/day the total waste generation. The packaging waste generation of branded products is 18% or 775 kg/day of the total waste generation. The composition of packaging wastes of branded products was plastic 48.47%, can 9.5%, glass 4.2%, paper 2.83%, drugs 1.93%, aluminium foil 0.57% and Styrofoam 0%. This research shows that it is time to encourage the extended producer responsibility system in Indonesia.*

**Keywords:** branded products, domestic waste generation, packaging wastes.

### **1. Introduction**

Based on the report of PD Kebersihan Bandung, there are changes in waste composition generated in Bandung city. It is showed that the generation of non-organic waste has increase up to 0.74% within 2 years. In 2002 Bandung city has generated domestic waste which compose of 63,56% organic waste and 36,44% non-organic waste (plastics, Styrofoam, metals, can) and in 2004 the composition was change into 62.82 % organic waste and 37.18% non organic waste. Most of non organic waste is non biodegradable which can give a negative impact to the environment if not being carefully managed. Non organic waste is difficult to be naturally decomposed, it will give an aesthetic disturbances which leads to uncomfortable environment, it also become a place of disease vectors grow, it can make drainage sewerage clogged which can leads to flood, and all of that can happened especially if it is not being manage in a proper way. Most of non organic composition is consider being used as packaging materials

Changes in consumption patterns and the ways of living have big influence in waste generation. The consumer society manipulates the composition of waste generation and predisposes growth of packaging production. Packaging production gives a big contribution to the waste stream which varies from a wide variety of package materials, form and performances. Packaging is used as a tool for market trading, products delivery and transportation. Benefits of packaging (Helen, 2005) are: (1) product containment and preservation, (2) convenience for transport and distribution, (3) tamper evidence and food safety, (4) product information and identification, (5) marketing and product differentiation



(6) convenience for consumer (7) product life extension. The development of packaging production in fulfilling the needs for sustainable production and consumption system is still growing. The generation of waste has become more complex to be managed; a lot of problems and conflicts arise due to packaging. Environmental impact of the packaging according to Helen, 2005 are: (1) litter and its impacts on wildlife and visual amenity, (2) amount of waste to landfill and the impacts of landfill (e.g. leachate), (3) excessive or inefficient use of materials, (4) reduction in waste due to food preservation (5) toxic wastes from manufacture or end-of-life (6) energy costs (7) lack of secondary markets for new materials. This is one of the considerations why the study of packaging waste is become important.

Based on the previous study of the potency of recyclable plastic waste generation in Bandung city, it has been shown that 34% of plastic waste generation is packaging waste. The sources of waste generation can be classified as domestic and non domestic waste. This study is focusing on the domestic waste which being chosen because it dominates waste generation and because of the complexity of its management. Indonesia, especially the Environmental Ministry has predisposed the new regulation due to solid waste management system in 2008. It is stated that everyone is responsible of their own waste and also it is stated that it is an obligation of the producer to manage the packaging with and or without its product which difficult to be naturally decomposed. This is become the main consideration of the importance of this study being conducted. This study predisposed as the first step to identify the quantity and the composition of packaging waste which being generated in domestic waste which can help to manage its management as a whole and to plan the next step for better solid waste management.

## 2. Materials and Methods

The location of this study takes place on the Kelurahan Cigadung which being chosen since it can represent high domestic activities and also the heterogeneity of type of housing which represent the source of domestic waste. Literature search is being done to sharpen the scope of this study. A survey and interviews had been conducted to choose the sample of many types of housing, which include permanent, semi permanent and non permanent. Amount of sample is being counted based on the survey data using the Indonesia National Standard of SNI 19-3964-1994 about the methodology of taking and measuring waste generation flow and composition for urban waste generation. The amount of sample can be seen in Table 1 below.

**Table 1** Amount of Sample

No.	Type of Housing	Total (Unit)	SNI Recommendation (unit)	Data Taken (unit)
1	Permanent	2173	13	13
2	Semi Permanent	1800	11	13
3	Non Permanent	998	9	13
	<b>Total</b>	<b>4971</b>	<b>30</b>	<b>36</b>

*Source: SNI 19-3964-1994 and analysis, 2008*

The primary data had been taken by measuring the waste generation by its flow rate, its composition and its density. Sampling is being done in 8 days and measured weight, volume, density and waste composition by its physical component and by packaging component. The materials used for doing the measurement of this sampling are the box sampling (for measuring the weight and volume), scaling, gauge, plastic bags and hand gloves. Secondary data is taken to support the discussion and evaluation such as physically condition of sampling location, socio economic condition of the community, solid waste management in general in the location. Primary data was collected and mathematically analyzed using these equations:



1. Flow rate of waste generation (kg/person/day and litre/person/day)

$$\frac{\text{waste weight (kg)}}{\text{average sum of person in one house (person)}} \quad (1)$$

$$\frac{\text{waste volume (litre)}}{\text{average sum of person in one house (person)}} \quad (2)$$

2. Waste composition and packaging composition by weight

Each kind of waste and each kind of packaging being scaled by its weight by using this equation

$$X = \sum \frac{x_i}{n} \quad (3)$$

X = arithmetic average

x<sub>i</sub> = observation value

n = number of sample

Descriptive discussion would be explained by using all of the data and its analysis. It would discuss due to the total waste generation, total weight of all components, total weight of packaging waste and total weight of labelled / branded packaging waste based on the Indonesia National Standard of SK SNL S - 04 - 1991-03 about the Methodology of Urban Solid Waste Management. The main result would try to get the amount of total weight of packaging waste and branded packaging waste which will be compared to the total waste generation.

### 3. Results

Based on secondary data from Kelurahan Cigadung, the population on July 2008 was 25.011 people with density of 94,57 capita/Ha. The responsibility of the solid waste management in the location is being divided to PD Kebersihan and the community itself. Waste collection, transportation and treatment are being managed institutionally by PD Kebersihan Bandung City. Meanwhile the community is responsible for handling and local collection which being coordinated by the local authority (Rukun Warga). Kelurahan Cigadung use individual handling more than communal handling. They use permanent handling waste which being constructed in front of their house or they just using the regular garbage plastic. They use two different kind of collection system, direct and indirect collection system which being done in two times a week in average. They have two locations of temporary disposal which being transported to Sarimukti landfill. The regulation of the management is being adopted from the city regulation.

The discussion will be explained descriptively by the flow of this diagram in Figure 1.

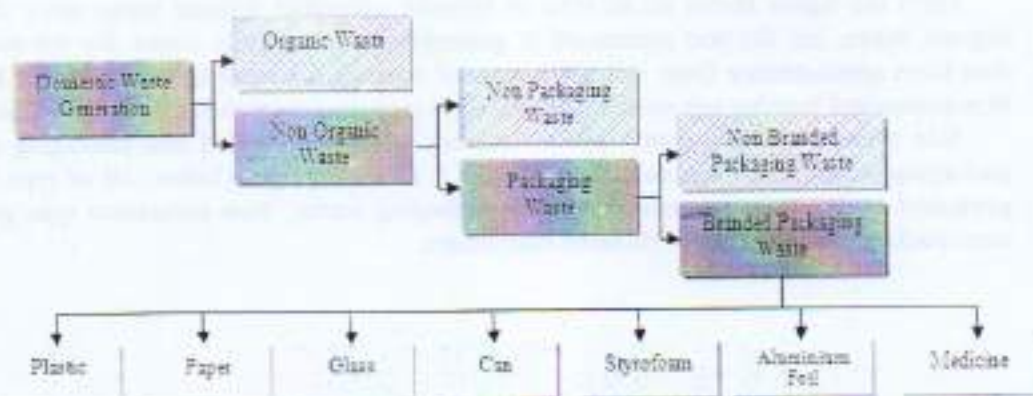


Figure 1 Flow of Discussion

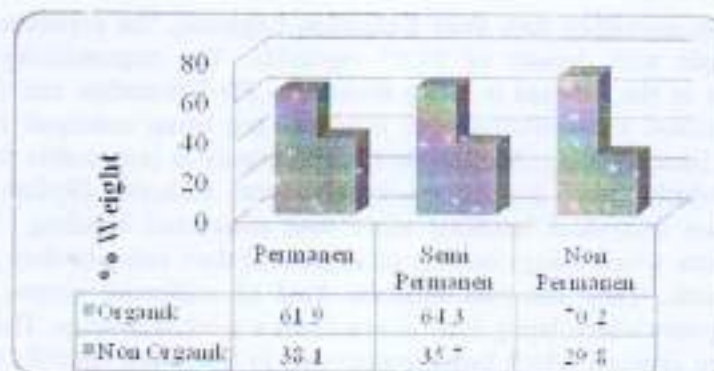
Domestic waste generation in high density population based on type of housing can be seen in Table 2. From data in the table, we can see that there are differences of flow generation rate in every type of housing. Permanent house generate waste up to 0, 26 kg/person/day more than semi permanent with 0, 13 kg/person/day and the less is non permanent house with 0, 12 kg/person/day. This data shows the similarity with the literature which state that one of the factors that influence the generation of waste, one of them is the socio economic factors. In average this high domestic activities has been generating waste with flow rate of 0, 17 kg/person/day or 2, 90 l/person/day.

The composition of waste generated can be classified into organic waste with 65, 47% or 2783, 56 kg/day and organic waste with 34, 53% or 1468, 31 kg/day. Waste composition in every type of housing can be seen in Figure 2.

**Table 2** Waste Generation

Type of Housing	Waste Generation		Waste Density (kg/L)
	kg/person/day	L/person/day	
Permanen	0.26	4.31	0.060
Semi Permanen	0.13	2.31	0.056
Non Permanen	0.12	2.09	0.057
<i>Average</i>	<i>0.17</i>	<i>2.90</i>	<i>2.90</i>
<b>Total Waste Generation (kg/day) (Population : 25011)</b>	<b>4251.87</b>	<b>72531.9</b>	<b>0.059</b>

Source: Analysis, 2009.

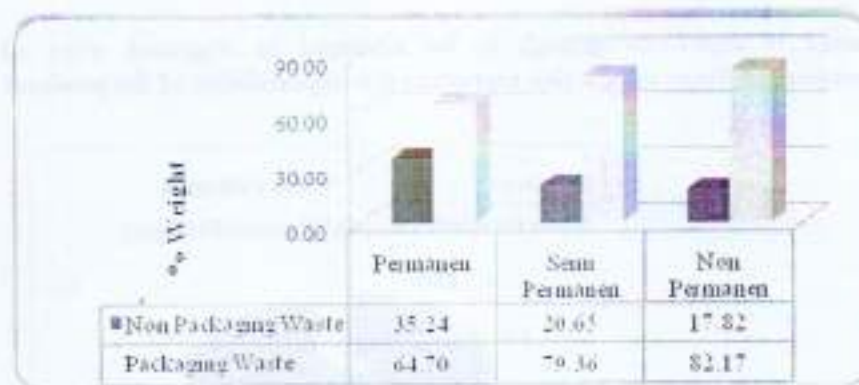


**Figure 2** Waste Composition VS Type of Housing

From the figure above all of type of housing generated organic waste more than non organic waste, but the non permanent is generating more organic waste. By the secondary data from questionnaire there are differences of cooking activities in every type of housing. Non permanent housing use more raw material in preparing food than other type of housing.

Non organic waste in every type of housing is being classified into packaging and non packaging waste which can be seen in Figure 3. From the figure below, all of type housing generated packaging waste more than non packaging waste. Non permanent type generates most packaging waste (82, 17%) more than others.





**Figure 3** Non Organic Waste Composition VS Type of Housing

But if we take a look at the data of packaging waste composition of branded and non branded packaging waste in Figure 4, non permanent type generates the most of non branded packaging waste. Branded packaging waste is being generated most from the permanent type of housing.



**Figure 4** Packaging Waste Composition VS Type of Housing

By the description of those data we can conclude that the generation of packaging waste is related to the socio economic condition. The packaging waste is being generated most from the non permanent type of housing but it is being dominated by the non branded packaging. It means that most of the product they buy is dominated as a function of product delivery and transportation. These phenomena are supported by the data from sampling observation which showed that there are differences of form and size of packaging waste between every type of housing which can be seen in Table 3.

**Table 3** Branded Packaging Waste Domination

Type of Housing	Domination of Branded Packaging Waste		
	Function	Form	Size
Permanent	Daily needs such as shampoo, soap,	Bottle, Sachet	Big and medium
Semi Permanent	Instant Food eg. Indomie	Plastic Packaging	Food packages
Non Permanent	Retail package	Plastic Packaging	Small

Source : Sampling Observation, 2008

In general, comparing to the total waste generation, the composition of the waste generated in high domestic activities can be seen in Figure 5. The figure above shows that the waste generated is still dominated by organic waste, but the percentage of packaging waste has already up to 26% or  $\pm$  1100 kg/day. Branded packaging waste is up to 18% of the total waste generated with the same as  $\pm$  775 kg/day which can be seen in details in Table 4. This

amount is significant enough to be managed in separated ways of the solid waste management. Especially it also represents the responsibility of the producer of their product.



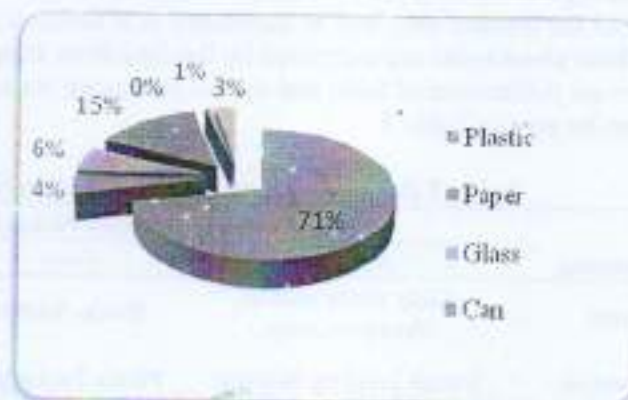
**Figure 5** Waste Composition

The brief view of the composition of the branded packaging waste can be seen in Figure 6 and Table 4. It is being dominated by plastics (31 % or 12.97% (551 kg/day) of total waste generation) and can (15% or 2.66% (113 kg/day) of total waste generation). This data can be used to the producer to start thinking about planning their strategy in marketing their products with more environmental friendly materials.

**Table 4** Composition of Branded Packaging Waste

	Non Branded	Branded Packaging Waste							Total
		Plastic	Paper	Glass	Can	Styrofoam	Aluminium Foil	Medicine	
Waste Generation (kg/day)	112.39	551.57	33.09	48.55	113.18	0.00	5.99	22.28	774.65
Percentage from total waste generation	7.82%	12.97%	0.78%	1.14%	2.66%	0.00%	0.14%	0.52%	18.22%

Source: Analysis, 2009.



**Figure 6** Branded Packaging Waste Composition from Packaging Waste Generation

#### 4. Discussion

There are still some researches to conduct due to this topic to broaden the general view of packaging waste in Indonesia. One of them is a research which is conducted to know the most producers which generate the most packaging waste. This study will encourage all stakeholders to start responsible of their waste and empowered the polluters pay principles and encourage the predisposed the management of extended producer responsibility.



## 5. Conclusion

Total domestic waste generated in high domestic activities is 4251.87 kg/day or 72531.9 l/day and 65% is organic waste. Packaging waste is generated up to 26% or 1100 kg/day and branded packaging waste is generated up to 18% or 775 kg/day. This result shows that it's already a time to encourage the extended producer responsibility in Indonesia.

## 6. References

- Helen, Lewis, 2005, Defining product stewardship and sustainability in the Australian packaging industry, *Environmental Science & Policy* 8, 45–55.
- Departemen Pekerjaan Umum. 1994, Metode Pengambilan dan Pengukuran Contoh Timbulan dan komposisi Sampah Perkotaan. Jakarta : Badan Standarisasi Nasional.
- Aryani, I. 2008. Studi Potensi Daur Ulang Sampah Plastik di Kelurahan Cigugur Tengah. Bandung : Institut Teknologi Nasional.
- Departemen Pekerjaan Umum. 1990. Tata Cara Pengelolaan Teknik Sampah Kota, SK SNI T-13-1990-F. Bandung : Yayasan LPMB
- Calver,Giles.2002.What is Packaging Design. Germany., retrieved in <http://awanisti.multiply.com/journal,2007.html>, 22 September 2008
- Salch, A. 2007. How to Integrated Packaging Waste Management System into Integrated Product Policy Implementation. Germany : Saxion University of Applied Sciences, Deventer
- Susanti,A.: Communication Director of Indonesian Packaging Federation. <http://polycap.blogdetik.com.html>, 22 September 2008
- Tchobanoglous,G. et. Al. 1993. Integrated Solid Waste Management, International Editions. Singapore : McGraw-Hill Book Co.