



Waste Engineering
and Management

Proceeding

SIBE-2009

The 1st International Conference
on Sustainable Infrastructure
and Built Environment
in Developing Countries

SABUGA ITB, Bandung - Indonesia
2nd - 3rd November 2009

Published by
Faculty of Civil and Environmental Engineering
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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 (SIBE) 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
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- **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

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Hazardous Waste Generation and Composition of Private Dental Practices (Case Study Bandung City)

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Abstract

A sector which is need to be particularly considered is the infectious and toxic waste resulting from the health care facilities. Health care services and facilities have to observe the relevance between their activities and their environmental especially if the activities are related to infectious or communicable diseases which might be caused by the patients disease. Many health care services and facilities as in the private clinical practice in Indonesia, the waste managements are still in common way of handling domestic waste. Since some of these wastes are hazardous in nature, this practice can create potential risks to human health and to the environment. Dental health care facility is one of the medical waste sources. Even though dental health care facilities especially private dental health care facilities generate relatively small quantity of solid waste compared to the other facilities, a significant number of wastes will be accumulated and occurred by multiplying with the amount of private dental health care facilities. Based on the results from 80 general private dental practices selected, the production rate of dental solid waste was 142,77 g/practice/day. Dental solid waste was classified in three main categories : (1) Infectious and potentially infectious waste, accounting for 80,45 % by weight. (2) Non-infectious waste, accounting for 14,25 % by weight. (3) Refuse waste, accounting for 5,3 % by weight. The average density general private dental waste is 83,076 kg/m³. Thus, dentistry waste management may not be neglected as a sector with the same priority as well as other medical sources which need to be well organized in avoiding the communicable disease and the hazardous effect subsequently.

Keywords: hazardous waste, private dental health care, waste generation, waste composition.

1. Introduction

Hazardous and toxic waste management is a current “warm” issue in Indonesia. Many regulations have been assembled to control all the hazardous and toxic waste handling system. Based on Indonesia’s government rules, PP RI No. 18/1999, hazardous and toxic waste are defined as residue of any activity which contain hazardous and/or toxic substances in such concentration might contaminate/damage directly or indirectly the environment, human health, sustaining life of human and other creations. Hazardous waste management attracts the government and environmental expert interest, even though until nowadays still limited on concentrates of industrial sources, in other word the other sources of hazardous waste seem to be still neglected.

A sector which is need to be particularly considered is the infectious and toxic waste resulting from the health care facilities. The health care facilities also result the hazardous and toxic waste which depend on their capacity and also their various activities. Regarding to the motto of Indonesian Ministry of Health: “Healthy Indonesia by 2010”, preventive acts and efforts are the first priority in public health care which consequently need to be implemented by the health care facilities. Health care services and facilities have to observe the relevance between their activities and their environmental especially if the activities are related to

infectious or communicable diseases which might be caused by the patient's disease. In such a sensitive and rapid transfer of disease as in viral infection, the general precautions need to be put as the first and urgent priority. They have to do the infection control, including treatment of their waste to prevent the human to human infections risk, and also environmental risks.

As a matter of fact, there are still several problems in hazardous and toxic waste management especially in medical waste handling in Indonesia. Many health care facilities have already applied the incineration technology or another technology to treat their waste, as might be found in big health care capacity/hospital or another health care centre. In another health care services and facilities as in the private clinical practice in Indonesia, the waste managements are still in common way of handling domestic waste. They dump their medical waste into household disposal sites and landfills without any recycling and separation process. Since some of these wastes are hazardous in nature, this practice can create a potential risk to human health and to the environment.

Dental health care facility is one of the medical waste sources. Their activities engage various kinds of chemical substances, and also the materials which might be contaminated with human's blood, saliva, suppuration, etc. These materials are also part of medical waste. Even though dental health care facilities especially private dental health care facilities generate relatively small quantity of solid waste compared to the other facilities, a significant number of wastes will be accumulated and occurred by multiplying with the amount of private dental health care facilities. Thus, dentistry waste management may not be neglected as a sector with the same priority as well as other medical sources which need to be well organized in avoiding the communicable disease and the hazardous effect subsequently.

Less working through medical waste especially dental waste and also less monitoring in Indonesia cause an uncontrolled situation generally.

Health care waste is an extremely hazardous category as it poses health and environmental hazards due to one or more of the following characteristics: (Damanhuri, 1994)

- General waste
- Pathological waste
- Radioactive waste
- Infectious waste
- Sharps instruments
- Pharmaceuticals waste
- Citotoxic waste
- Pressure container

By the various kinds, medical waste is believed as the main source of infection diseases for the human, for short and long periods (Indriani, 2007). There are some effects by the medical waste exposure to human, such as minor infection, intermediate, major, until mortality effect, depends on the exposure doses and also the exposure period.

Dental health care unit in hospital/ clinics/ private provide the healthcare services including prevention, treatment, diagnoses, treatment planning, cases treatment, disease treatment, mouth cavity deviation treatment, and the other structure which is connected to those areas (Wikipedia, 2007). Dental health care service divided into two major classifications, general dental health care service and dental specialist health care service.

Dentistry involves a variety of materials that are infectious and that partially resemble some medical materials due to their use in patients' therapy and their contact to biological fluids (blood, saliva), but dentistry also involves certain materials that are not used in general medicine. Among them, some are extremely toxic, as they consist of heavy metals and chemical combinations, introducing a great health hazard to citizens and dentistry personnel, as well as broader environmental impacts. (Hilltz, 2007)

The classifications of dental healthcare waste that have potential risk to the environment and need special management are: (Divaris et al, 2003)

- Dental amalgam
- Liquid waste
- Sharp and contaminated instrument
- Pathological waste
- Desinfectan, and other chemical substances

2. Methodology

2.1. Literary review

Literary review is the initial step to obtain general information connected with the research. The literary review includes kind of hazardous waste and medical waste, waste management technology, dentistry activity.

2.2. Preface survey

The purposes of preface survey are observing the existing condition of dental health care waste management, and also give many considerations for selecting the sampling area/ locations.

2.3. Private Dental Practice Selection

This study take place at Bandung City, West Java Province, Indonesia. By the private dental practice license by the local Health Care Department in Bandung City, there are 794 general dental health care and 128 dental specialist health care. The specified data is shown in **Figure 1**. Until March 2008, as shown on Figure 1 there are 922 (accumulated) private dental health care units scattered in 117 sub-districts (kelurahan) of Bandung City. The number of private dental health care is increasing in every year. The large amount of dental health care and its development have to be considered as potential risk by the producing of the large amount of hazardous and toxic waste.

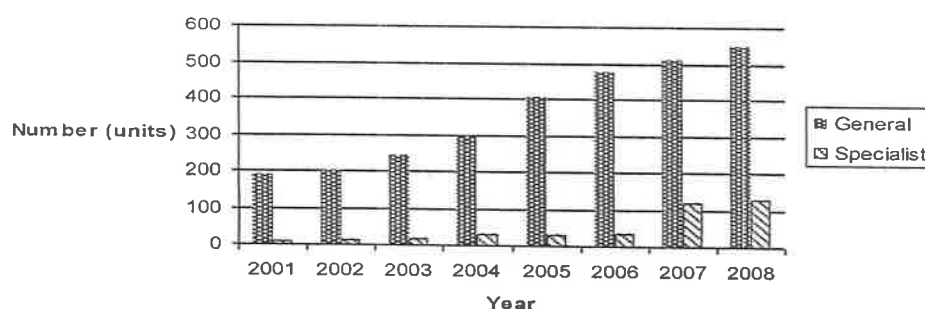


Figure 1 Licensed Dental Health Care in Bandung City

In order to examine the composition of solid wastes and to investigate the solid waste management practices in Bandung city, the solid waste was sampled from 80 private dental practices, which is scattered in 19 sub-district (kelurahan). The sample size constituted 10% of the overall general private dental practices licensed. This sample can be considered as representative and may lead to reasonably safe conclusions for the entire Bandung City due to the following reasons:

- Based on SNI M 36-1991-03 on determining the size sample, 80 samples of 794 objects population counted as big sample.
- General private dental practice's activity engage the homogenous procedures. Thus, most of these sample produce the resemble type of waste, but still in different composition.
- Various acceptances of the doctor/ paramedic due to this research.
- Efficient & effectiveness considerations.

The specific amount of the sample on each sub-district is shown in **Table 1**.

2.4. Data collecting

- Primary Data :

- Observation
- Interview and discussion
- Identify & examine dental health care waste, sources.

In order to examine the composition of dental health care waste, there are two kinds of sampling methods which is appropriated with existing situation and condition. In several dental health cares, the solid waste was sampled for eight days. In another dental health care, the solid waste was sampled by two or three days in a week. The sampling periods was on March-July 2008. Solid waste sampling includes the physical examinations of the waste such as solid waste density and composition (in site the sampling locations/areas). There, the waste was manually separated in 15 sub-fractions and each sub-fraction is weighed. The 15 sub-fractions is determined through the literary study and preface survey.

- Secondary Data :

- General information about dental health care regulatory, hazardous waste management regulatory, and another official data from the interrelated department/ public services.

Table 1 Sampling Locations

No	Sub-District (Kelurahan)	Total Private Dental Practice (PDP)	30% PDP	Sample
1	Citarum	92	27.6	18
2	LebakGede	42	12.6	20
3	Antapani	21	6.3	6
4	Gegerkalong	20	6	5
5	Cihapit	19	5.7	6
6	Cikutra	12	3.6	3
7	Cisaranten	17	5.1	5
8	Sukamiskin	7	2.1	3
9	Cicaheum	1	0.3	2
10	KebonKangkung	7	2.1	2
11	Dago	7	2.1	2
12	Padasuka	6	1.8	1
13	Lingkarselatan	5	1.5	1
14	Ujung berung	5	1.5	1
15	Cibadak	5	1.5	1
16	Cigadung	5	1.5	1
17	Cipaganti	2	0.6	1
18	Kacapiring	2	0.6	1
19	Hegarmanah	7	2.1	1
		Total		80

2.5. Data Analysis and Discussion

From the analysis of data and evaluation, a conclusion can be derived together with recommendations from the conclusion of the research conclusion on hazardous waste handling of private dental practices.

3. Results and Analysis

Observing the procedures regarding dental waste generation and management that take place within private dental practices, researcher presumed the lack of environmental educations of dentists. The performed survey in private dental practices pointed out the

problems related to dental waste management in Bandung City. Since the dental waste is treated as simply a regular domestic waste, without considering the different qualitative characteristics of the materials. Thereupon, huge amounts of dental waste were found to be disposed daily without any treatment or appropriate handling. During the research, some dentists treated this issue with a confusion and interest to look forward the solutions, but other part of dentist treated this issue with skepticism. Nonetheless, dentist who is engaged with this research found to be environmentally aware, and hopefully that they will also implement the safe disposal of their waste based on the right methods.

During the manual separation of dental waste, the following components were identified and weighed:

1. Paper, originating from various kind of activities
2. Plastic, originating from plastic glasses and packaging of dental products
3. Plastic coated paper/ mixed paper-plastic
4. Mask
5. Rubber/ latex gloves used by dentists and/or nurse in dental practice
6. Syringe
7. Glass
8. Medicine tube
9. Dentures and alginate
10. Extracted Teeth
11. Sharps tools : needles, surgical blades
12. Amalgam from old fillings or excess amalgam from the filling
13. Blood contaminated cotton and tissues
14. Saliva ejector, containing metal coated with plastic
15. Refuse, other type waste.

Based on the above components, the classification of dental solid waste presented in Figure 2, was proposed.

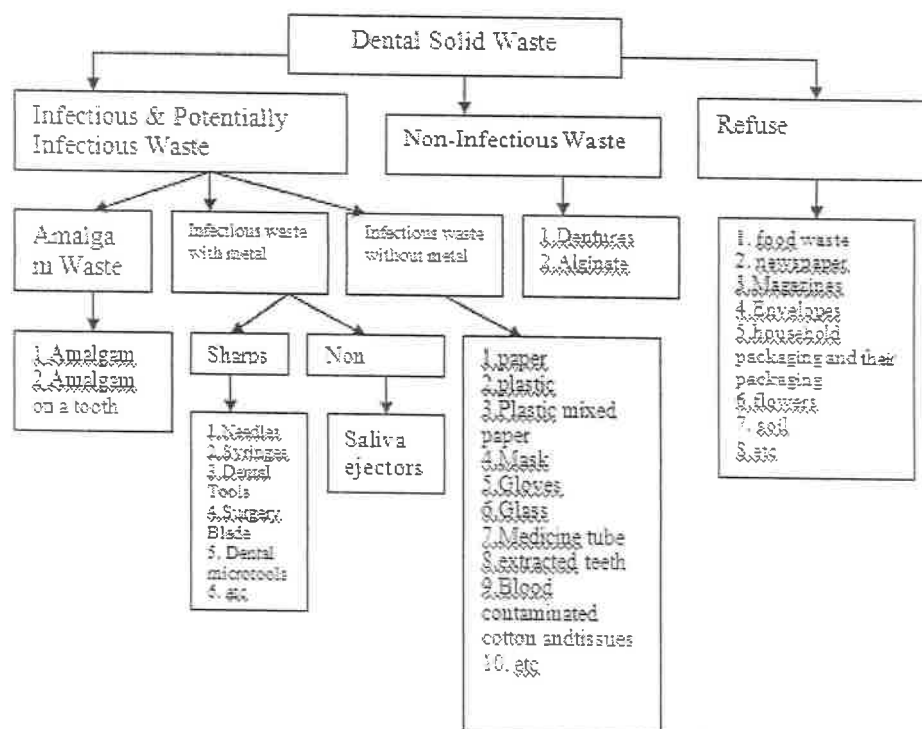


Figure 2 Classification of Dental Solid Waste

It is very difficult for private dental practice to maintain detailed medical records of their patients. Thus, any patient could be a potential infectious disease carrier. Therefore, it was not possible to distinguish infectious from non-infectious waste based on the basis of the patient being treated. Since, no microbiological characterization was conducted in this work, the category of infectious waste includes the infectious and potentially infectious materials. These waste components have come in contact with blood and other potentially infectious fluid of the mouth. For example, the first three components had obvious stains of blood, pus, exudates fluids, or amalgam. Saliva ejectors contained amalgam and exudates fluid. Dentures and alginates are classified as non infectious waste, even they may become infectious of their contact with mouth fluid, but in this research they become hazardous due to their chemical toxicity.

Based on the results from 80 general private dental practices selected, the production rate of dental solid waste was 142,77 g/practice/day. Dental solid waste was classified in three main categories :(1) Infectious and potentially infectious waste, accounting for 80,45 % by weight. (2) Non-infectious waste, accounting for 14,25 % by weight. (3) Refuse waste, accounting for 5,3 % by weight. The result is presented in **Table 2**. The average density general private dental waste is 83,076 kg/m³, this information shown in **Figure 3**.

Table 2 General Private Dental Waste Production

Sub-District (Kelurahan)	Weight (gram/day)	Infectious (gram/day)	Non Infectious (Gram/day)	Refuse (gram/day)
Gegerkalong	95.91	90.37	2.52	3.01
Cihapit	75.47	55.24	18.33	1.90
Cicaheum	91.21	69.65	14.30	7.26
Cigadung	77.95	54.68	15.67	7.60
Lingkar Selatan	143.42	102.84	34.10	6.48
Cibadak	48.28	48.28	0	0
Cikutra	143.96	99.96	40.47	3.53
Ujungberung	88.60	85.61	0.00	2.97
Cipaganti	120.81	111.86	0.00	8.95
Sukamiskin	117.41	84.28	24.80	8.33
Kebonkangkung	153.69	112.68	34.96	6.05
Dago	92.84	77.65	12.76	2.43
Padasuka	161.61	109.90	46.37	5.34
Kacapiring	122.41	96.46	25	0.96
Cisaranten	100.31	88.04	9.93	2.33
Hegarmanah	172.75	144.40	21.75	6.60
Antapani	162.41	117.32	31.30	14.47
Citarum	398.09	341.56	28.99	27.87
Lebak.Gede	345.55	291.55	25.53	28.37
Maximum Value	398.09	341.56	46.37	28.37
Average	142.77	114.86	20.36	7.60
Minimum Value	48.28	48,28	0	0
Average Percentage (by Weight)		80.45	14.25	5.30

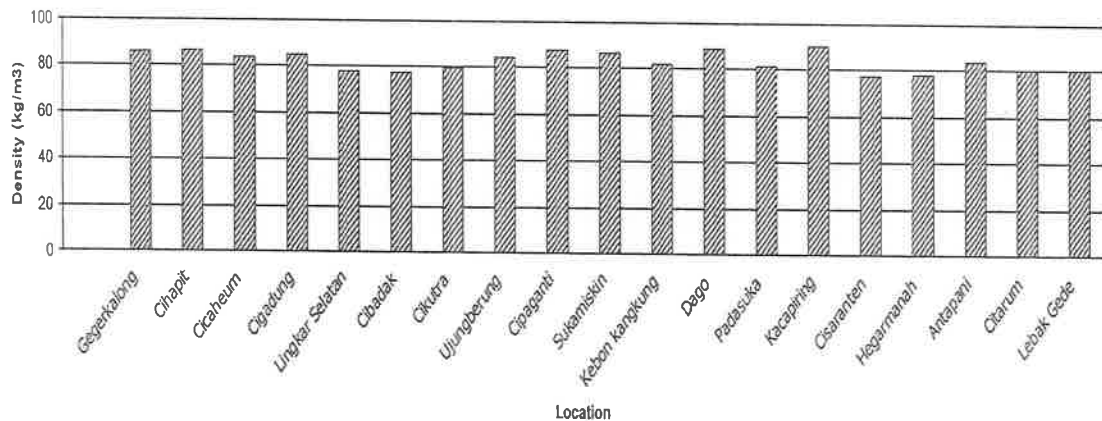


Figure 3 General Private Dental Waste Density

3.1. Infectious Waste

The category of infectious waste includes components containing metal, components without metal, and amalgam waste. The total amount of each component is shown in **Figure 4**. Amalgam is an infectious or a potentially infectious waste containing 49% mercury (EllyKizlary, et all, 2004). Although it does contain metal, it is classified separately here, because mercury is a major environmental contaminant. The production rate of the infectious waste was 114.86 g/practice/day. A more detailed classification is presented in **Table 3**.

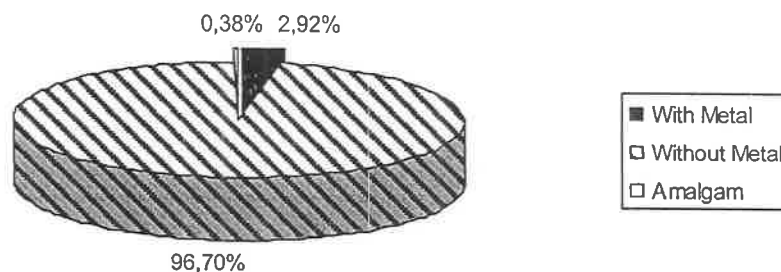


Figure 4 Classification of infectious waste on general private dental practice

Syringes are listed as infectious and potentially infectious with metal since it's considered within sharps metal on the components. Most of the plastic syringes had the needles on and the protective covers were on them. However, some syringes had exposed needles, with a potential to injure the garbage collecting people. In accordance with Indonesia Waste Regulations, many hospital and/or clinics has the practice of collecting the needles in special closed containers and placing into garbage can in that form. However it seems that this rule is not always being followed by the private dental practice.

Instruments that contain blood in significant amounts are considered infectious, thereforeregulated under the medical waste laws as a class of waste that needs to be handled separately. However, disposable items that come into contact with blood, saliva, and other mouth liquid (like gloves, tissues, cotton, etc.) and are only stained but not saturated with those liquid sometimes are not considered biomedical (infectious) wastes. Only if the item is saturated with those liquid it is considered as infectious waste. Even though contain a little infectious potential, these waste still have to be noticed. These infectious wastes then have to be collected and handled separately. Since this fact is not very explicit any medical waste regulations, the private dental practice may have slightly different interpretations. As **Table 3** shows, quite a high amount of cotton and tissues (34.24% of total infectious waste) were encountered especially in wastes from some private dental practices. Some of these contained a significant quantity of blood, saliva, mouth liquid, although none were saturated.

Table 3 Classification of infectious waste and potentially infectious dental solid waste

Waste Category	Production Rate (g/dental practice/day)	%Weight
Infectious and Potentially infectious waste without metal		
Paper	12.67	11.03
Plastic	8.30	7.23
Mixed Paper-Plastic	5.47	4.76
Masks	8.18	7.12
Rubber/Latex Gloves	22.28	19.40
Glass	2.61	2.27
Medicine Tube	7.00	6.41
Teeth	1.76	1.53
Cotton & Tissue	39.32	34.24
Saliva ejector	3.48	3.03
Infectious and Potentially infectious waste with metal		
Syringe	1.90	1.65
Sharp	1.46	1.02
Amalgam Contaminated	0.43	0.30
Total	114.86	100

3.2. Non-infectious Waste

The production rate of the non-infectious waste was 20.36 gram/day/practice, and its included dentures and alginate.

4. Conclusion

After the research period, some conclusions about composition and production rate of general private dental practice waste are:

1. The production rate of general private dental practice solid waste in Bandung City was 142.77 g/practice/day.
2. Dental solid waste was classified in three main categories :(1) Infectious and potentially infectious waste, accounting for 80.45 % by weight. (2) Non-infectious waste, accounting for 14.25 % by weight. (3) Refuse waste, accounting for 5.3 % by weight.

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