

# DEVELOPMENT OF A SPECIAL ZONE FOR NONORGANIC SOLID WASTE IN FINAL DISPOSAL IN MANGGAR, BALIKPAPAN, EAST KALIMANTAN, INDONESIA

## Article history

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## Abstract

Various problems in solid waste management are covered, among others concerning nonorganic solid waste deposited in Final Disposal. The generation volume amounting to 330,01 tons/day. The solid waste disposal consists of 66% organic and 34% nonorganic. To develop Final Disposal Manggar, Balikpapan, East Kalimantan, one special zone is planned to accommodate nonorganic solid waste. The landfill method for sanitary landfill is covering total area of 25 ha of Final Disposal. The feasibility calculation of the Final Disposal based on Le Grand Method. The original design for three landfill zones in Final Disposal Manggar was specified only for nonorganic waste, however, the plan will be made in 2 alternatives i.e. alternative 1 with separate system and alternative 2 with combined organic and nonorganic waste processing. Based on the calculation of the area totalling 17261,2 m<sup>2</sup>, the productivity period of zone 3 (three) in alternative 1 is 2 years and 5 months. As for alternative 2 the generate combined waste, except waste from market place with a density of 290 kg/m<sup>3</sup> for 2014, which make the solid waste generation 438 m<sup>3</sup>/day, the productivity period of the combined system is 385 days.

Key words : Sanitary landfill, nonorganic, final disposal, solid waste, organic

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## 1.0 INTRODUCTION

The existence of waste, especially the non-decomposable inorganic waste, should not be considered simple. The population increase and the lifestyle mostly influence the volume of city waste. Waste management in Final Processing Manggar, Balikpapan, is based on *Sanitary Landfill* system provided with gas control, *leachate* channel and *leachate* management installation. *Sanitary Landfill* waste system management is specified in Law of the Republic of Indonesia No. 18 year 2008 where, according to the plan, 1 (one) zone is specifically provided for inorganic waste. The plan is to expand Final Processing Manggar in Balikpapan with a zone to accommodate the evaluation of zone 2 and specifically to accommodate inorganic waste [1-5].

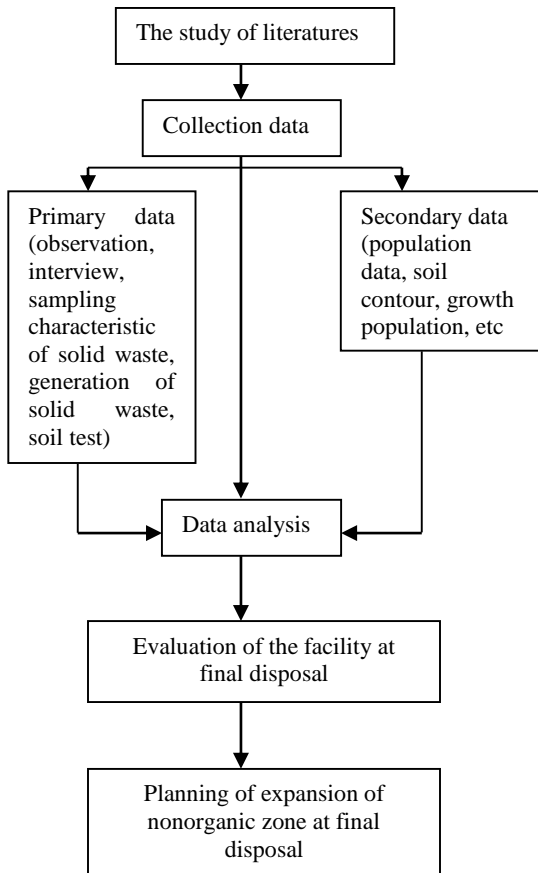
The population increase in the city of Balikpapan is average 1,44%/annually. This population increase

influence the waste volume which in 2006 was 220,06 tons/day and in 2007 was 287,96 ton/day. However the people's awareness on the negative effect of waste stimulates the recycling of waste. It reduced the waste volume in 2008 amounting to 114,569,19 tons/annually or 313,89 tons/day. And the generation in 2009 was reduced to 114,267,40 tons/annually or 313,05 tons/day (0,26%).

The reduction of waste volume transported to Final Processing Manggar is due to waste reduction program (integrated waste management) which was applied in various places in the city of Balikpapan, in the form of organic as well as inorganic waste.

## 2.0 EXPERIMENTAL

The following stages of research:



## 3.0 RESULTS AND DISCUSSION

The projection is based on Geometric method which has the smallest standard deviation of 3076,964007 hence the value is considered almost the same as the actual. See Figure 1.

Increase in agricultural sector is 6,09%, increase in industrial sector is 1,68% and per capita income is 5,41% (Source: PDRB Kota Balikpapan tahun 2006) with population increase of 1,44%. Based on the above mentioned increases by sector, the waste coefficient is calculated as follows:

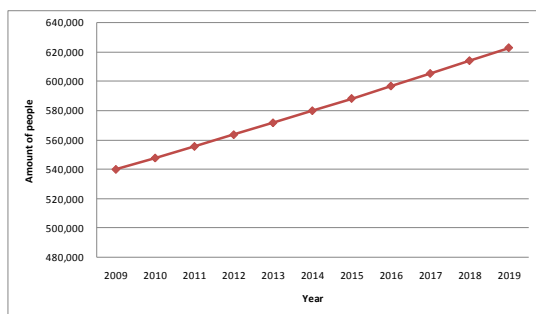


Figure 1 Population projection year 2009-2020  
Source: Calculation In 2010

Equation (1) shows the genertation calculation as follows:

$$Q_n = Q_0(1,010)^n \dots \dots \dots (1)$$

Q<sub>0</sub> represents the volume of genertation collected from the daily observed arrival of the transport vehicles to Final Processing Manggar on year 0 namely year 2009. The volume amounts to 114,267,40 tons in 2009.

The draft for zone 3 (three) landfill in Final Processing Mandar plan specified it only for inorganic waste. However the calculation will be made in two alternatives, i.e. alternative 1 in case of separate system (specifically for inorganic waste) and alternative 2 in case of mixed system.

In alternative 1, the waste composition consist of 66% organic waste and 34% inorganic waste (referring to year 2005 data, the density of organic waste is 290 kg/m<sup>3</sup> and of inorganic waste is 240 kg/m<sup>3</sup>). Alternative 2 calculates the mixed genertation excluding market waste and consisting only of waste from residences, shops and offices having the waste density of 290 kg/m<sup>3</sup>. Calculation of genertation in coming 5 (five) years (i.e. year 2014-2019) is presented in Figure 2.

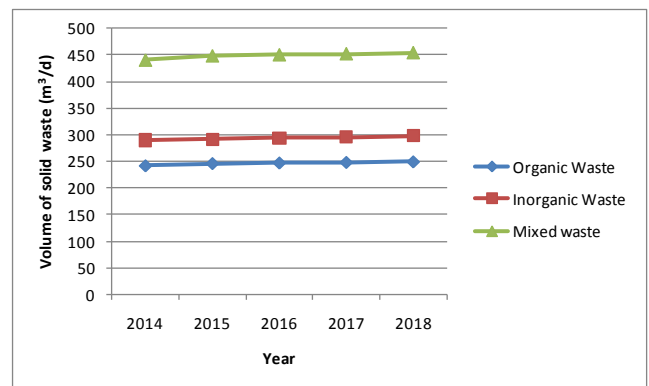


Figure 2 Genertation projection years 2014-2019  
Source: Calculation, 2010

Based on laboratory analyses, the soil type in Final Disposal Balikpapan is alluvial, having average permeability index of 0.0628 cm/second. The National Indonesian Standard T-11-1991-03 states that permeability should not be more than 10<sup>-6</sup> cm/second. Permeability less than 10<sup>-6</sup> cm/second is considered incapable to prevent the leachate to leak through the landfill cell.

Evaluation based on SK SNI T-11-1991-03 showed a score of 529, which mean that Final Processing Manggar has a feasibility value of location of 66,96%, meaning that it is feasible as Final Processing Zone of waste in the city of Balikpapan.

Feasibility evaluation applying *Le Grand* method showed a score of 7, which means that it is categorized as extra-ordinary and is eligible of A point. The A point is for those categorized as extra-ordinary and is eligible for final processing zone.

In zone 3 three), the *cut and fill* process will be applied. The process consist of digging 4 m deep and later will

be covered when the vegetation becomes 8 m high from the original surface which totally be 12 m high. It is calculated that alternative 1 is effective for 879 days or 2 years and 5 months and alternative 2 for 385 days. Meanwhile, zone 3 (tree) is planned to operate on *sanitary landfill* method and is specialized for accommodating inorganic waste, i.e. plastic, metal, paper, glass, battery, rubber and solid organic wastes e.g. wood. Organic waste produced by community activity will be processed into compost. Referring to existing condition, zone 3 Final Processing Manggar is a new location that has to be provided with basic layer of *landfill*, each *landfill* having the following dimension:

- 1) The planned area is 17,261 m<sup>2</sup>, consisting of 239 m long and 80 m wide.
- 2) Basic layer:
  - a) *Ground liner*: 500 m high, 239 m long, 80 m wide.
  - b) *Geomembran*: 1,5 mm thick, 251 long, 92 m wide.
- 3) *Geotextile* layer: 1,7 mm thick, 251 m long, 92 m wide.

The plan is to use PVC pipes for the channel to prevent corrosion, and placed it on the base of the *landfill*. Besides, to prevent the channel from being covered by waste, gravel will be placed between the pipes. *Leachate* collecting pipes are planned with 1 – 1,5% slope.

Gas resulted from waste decomposition is used for ventilating pipes where the horizontal part of the pipes are combining leachate pipes and gas pipes i.e. 20 cm diameter for branch pipe, 30 cm diameter for main pipe and 10 cm diameter for vertical pipe. Impermeable layer used in zone 3 (three) is *geomembran* layer with 1,5 mm thickness and *geotextile* layer with 1,7 mm thickness. Barrier zone is +/- 10 Ha around Final Processing Manggar.

The plan is to have two system of selection in zone 3 (three) i.e. selection from the source followed by selection in the transport vehicle by the transporter. Selection is also conducted in Final Processing, where a *drop zone* is available to do selection before it is transferred to the landfill and the pipes composting building.

The drainage channel which has been built along zone 1 (one) and zone 2 (two) is located in planned zone 3. This makes it impossible that in a *landfill* area is also available a drainage channel which may disturb the dredging process. Moreover, water pollution may occur from the *leachate*. Hence, the drainage channel in a landfill area will be transferred to a location with a suitable slope that will make it flow to river Manggar kecil.

## 4.0 CONCLUSION

### 4.1 Conclusion

According to its purpose, the development plan of Final Processing Manggar is concluded as follow:

1. The inorganic generation amounts to 235,51 m<sup>3</sup>/day and mixed (organic and inorganic) wastes amounts to 438,70 m<sup>3</sup>/day.
2. Based on evaluation using SK SNI T-11-1991-03, the Final Processing location feasibility scored 529 or equivalent to 66,96%; and using *Le Grand* method the score is 7 hence it can be stated that the location of Final Processing Manggar fulfill the criteria.
3. The draft of Final Processing zone 3 (three) plan, namely:
  - a. Applying sanitary landfill method;
  - b. Specifically to accommodate inorganic waste.
4. Based on calculation, zone 3 (three) Final Processing Manggar, Balikpapan, covering an area of 17 261,2 m<sup>2</sup>, have the capacity of accommodating waste for 2 (two) years and 5 months in alternative 1, and for 385 days in alternative 2.
5. According to the facility evaluation, to support zone 3 (three), repair and additional facilities are required, a.o.: entrance, working road, impermeable layer, *barrier zone*, drainage facility, *leachate* channel, organic waste processing, manpower.

### 4.2 Recommendation

In the plan of developing zone 3 (three) Final Disposal Manggar. Balikpapan, the recommendations are:

- the city government (the municipality) of Balikpapan should socialize the waste selection program (3R), and
- the city government of Balikpapan should participate in the program, according to Law No.18 year 2008 from the source in order to support the program.

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