

## PROBLEMS REGARDING THE OPERATION OF CONTROLLED LANDFILL IN TANJUNGPINANG

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### ABSTRAK

Tempat Pembuangan Akhir (TPA) Terkendali yang berada diantara open dumping dan sanitary landfill merupakan salah satu strategi untuk mengelola sampah yang dihasilkan. Satu-satunya TPA di Tanjungpinang, Indonesia, dikenal sebagai TPA Ganet. TPA ini sekarang mengalami masalah operasi disamping masalah lingkungan lainnya. Penelitian ini bertujuan untuk menganalisis cara pengoperasian TPA terkendali, fungsi TPA terkendali, dan permasalahan yang terkait dengan pengoperasian TPA. Studi kasus dilakukan di TPA Ganet di Tanjungpinang, Indonesia sebagai TPA terkontrol. Penelitian ini menggunakan pendekatan kualitatif dan wawancara semi terstruktur. Empat responden dari Kantor TPA Ganet, Dinas Perumahan dan Permukiman Rakyat Kepulauan Riau ikut dalam pendataan tersebut. Hasil study menunjukkan bahwa masalah paling signifikan saat ini di TPA Ganet adalah kurangnya alat berat, tenaga kerja, lahan dimasa akan datang, dan infrastruktur yang mengarah ke lokasi pembongkaran. Oleh karena itu, pembahasan mengenai tantangan yang dihadapi dalam pengoperasian TPA terkendali, kelebihan dan kekurangan dari penggunaan TPA terkendali dibandingkan sanitary landfill, dan inovasi dan perbaikan TPA terkendali diharapkan dapat diberikan di masa mendatang.

Kata kunci : TPA, TPA terkendali, Pengoperasian TPA, teknologi

### ABSTRACT

*A controlled landfill, which sits between open dumping and sanitary landfills, is one of the strategies to manage the waste produced. The single landfill in Tanjungpinang, Indonesia, is called Ganet Landfill. This landfill is now experiencing operating issues in addition to other environmental issues. This research is supposed to analyse the way of the controlled landfill operation, the function of controlled landfill and the problems regarding to the operation of the landfill. The case study was held at Ganet landfill in Tanjungpinang, Indonesia as a controlled landfill. This study used a qualitative approach and semi-structured interviewing tool. Four respondents from Ganet Landfill Office, the Department of Public Housing, and the People Settlement Riau Archipelago participated in the data gathering. Findings indicated that the most significant present issue at Ganet landfill is a shortage of heavy machinery, labor, future land, and infrastructure leading to unloading sites. Therefore, the discussion on the challenges faces in operating the controlled landfill, the advantages and disadvantages of using controlled landfill compared to sanitary landfills, and determination of the innovation and improvements on controlled landfill are expected to be given in the future.*

*Keyword : Controlled landfill, landfill operation, technology*

### 1. INTRODUCTION

Waste became a complex issue that all countries, both developing and developed, had to deal with. In developing countries which lack of

sufficient infrastructure and available land mass giving the issues on solid waste management [1]. Every city needs solid waste management for civilization, and it is the most the crucial function that connects to other municipal operations[2].

Therefore, the government that offers public services should provide it. One method of managing solid waste is to dispose of it in a landfill, where the garbage is contained and any waste that may have an adverse effect on environment, such as polluting the water or the air, is separated[3].

There were several types of landfills such as sanitary landfills, industrial landfills, construction and demolition waste landfills, controlled landfill, etc [4]. Controlled landfill was a method by collectors of waste of all types in a specified area and typically was controlled by the government of the city or the state [21]. Controlled landfill was introduced in 1990s as improvement waste management from open dumping but not as good as sanitary landfill [3]. Besides, it designed, constructed and operated in a manner that the contained solid waste would decrease the cause of potential hazard to public and health or the environment from open dumping method.

In certain areas, controlled landfill was often found and as they were operated by the government, some waste sites had certain features of the sites, such as utilization tenure, simple record keeping, waste coverage, etc [21]. There were still several potential environmental problems associated with the landfilling of waste, which were often long-term and included possible contamination of the groundwater and surface water bodies, the uncontrolled migration of the landfill gas and the generation of odor, noise and visual nuisance[5]. Here, the study was focused on controlled landfill which was operated in Tanjungpinang, Indonesia.

## 2. LITERATURE REVIEW

Controlled landfill had different construction and operation with the waste compared to open dumping and sanitary landfill. By observation on operation of controlled landfill, it will give an idea and information on how it works. Mostly controlled landfill had a plan for mitigating any burden or impact on environment due to landfill activities[3]. Controlled landfill was a landfill site which gave appropriate level of compaction, waste covering, and leachate shelter and treatment but still an unacceptable operation, as it did not comply with the fundamental landfill principles of waste compaction and covering [6]. It is the

method with dropping the waste at the landfill then it was compacted and covered with soil which at least every seven days and this method had a better side which effect on environment would be lower, the land could be reused, and quite good environmental aesthetics[7].

### 2.1 The Use of Landfills

Landfills in the modern period were efficient places to store waste. To ensure compliance with federal legislation, landfills were located, planned, maintained, and monitored [22]. The goal of a landfill was to isolate waste from its surroundings in order to reduce air and water pollution [23]. In addition, the landfill was utilized for land development, environmental preservation, and storage [8]. The significance of land development was particularly relevant to the Indonesian landfill. However, landfills were a typical final disposal location for waste and byproducts of other treatment methods[9].

Each controlled waste site must be maintained in a usable state for the duration of the intended lifetime of site. Leachate, biogas, and heat would be produced by biological and physical-chemical processing after the primary components of waste and water were introduced to a regulated waste disposal of municipal solid waste[10]. Buildings to store waste were required because waste creation is a direct result of urban life. It was made to monitor and avoid any potentially harmful materials in a waste containment system. The performance criteria of system called for a sufficient structure that covers every aspect of strategy, architecture and delivery. Accurate testing was also required to make sure that the operations ran without a problem and according to the specified specifications[10].

### 2.2 Categorization of Controlled Landfill

Municipal solid waste, industrial waste and hazardous materia waste were the three current standard kinds of landfills [24]. Every type of waste recognised the consequences on the environment and used a variety of measures to do so. Green garbage, a landfill type that was still developing, allowed for the controlled disposal of organic elements [24]. It did add, though, that after it learnt about various sorts of landfills, it began to

comprehend why there were limitations on what could be thrown in with curbside waste or why some dumpsters could only accept particular items. The types of landfills are listed in Table 1.

**Table 1.** Varieties of Landfill [24]

Varieties of Landfill	Waste Collected
Municipal Solid Waste Landfill	Residential waste, commercial solid waste, hotel wastes, school wastes [11]
Industrial Waste Landfill	Industrial waste, construction debris disposal, rocks or soil, glass, clay, etc (EPA, 2016)
Hazardous Waste Landfill	Hazardous waste such as flammable liquids, radioactive substance, corrosive substances [12]
Green Waste Landfill	Organic materials such as fruits, vegetables, tree branches, flowers and grass trimming (EPA,2016)

There was also another waste-dumping categorization technique, which is shown in Table 2. Following the Indonesian government's adoption of the Waste Act 18/2008, the dump sites under investigation used "controlled dump site" as opposed to "engineered dumping site"[13]. The main reasons for the failures were insufficient waste management, high administrative expenditures, and scavengers activity at the disposal site [14]. The three main criteria that determined whether a facility performed successfully were first the level of waste management regarding the intake and handling of waste at the site, second the level of control regarding the treatment of waste, the method of disposal at each site, and potential pollution, and third the level of inspection and verification of environmental controls [13].

**Table 2.** Classification of Landfilling Systems Based on Practice and Operational Factors [13], [14]

Classification	Levels
Open Dumpsite	0
Controlled tripping	1
Sanitary landfill with a bund and daily cover	2
Sanitary landfill with leachate recirculation	3
Sanitary landfill with leachate treatment	4

### 2.3 Controlled Landfill Operation

Although landfills were a crucial part of waste management, they may seriously harm the ecosystem. Therefore, a proper design and operation were required. An overview of the landfill concepts was given after a broad description of the landfill operation, with a focus on landfills for municipal solid waste [15]. Municipal solid waste was often disposed of in controlled landfills, which were sometimes referred to as reactors because they allow for the production of heat, leachate, and other materials through biological and physicochemical processes once the basic components have been added [10]. The controlled landfill approach involved storing waste in a landfill, compacting it, and then covering it with dirt at least once every week [7].

According to [10], controlled landfills were defined by internal heat generation caused by aerobic and anaerobic processes. Waste volumes also exchanged heat with ambient soil and eternal air. Consideratons like the methods, the other of landfilling, the control of slopes throughout the landfill, the use of cover soils, etc. were made in the procedure of the waste disposal phase[16]. The whole spectrum of operations involved in landfill include delivering solid waste to deck locations, dispersing it, mixing it, applying an end-use cover, and other disposal processes [16]. In the other words, the controlled activity of the landfill was more than open dumping but different from the sanitary landfill. The removal of waste from household, industrial, municipal, and educational sources mared the beginning of controlled landfilling. The waste was then transported to the landfill, where it was organized and compacted.

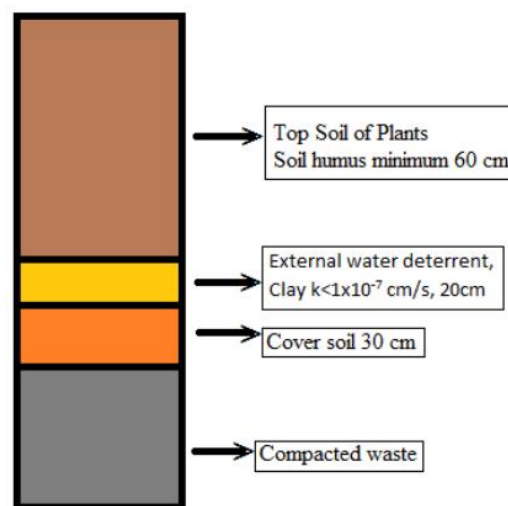
In a regulation issued by the Minister of Public Works, Badan Standarisasi Nasional Indonesia explained that routine action plans for handling waste in the landfill area as well as those related to the operation of other facilities and

infrastructure fell under the scope of landfill operations and maintenance. Before beginning waste management operations, construction and ongoing installation activities of landfill basecoat systems, leachate collection systems, and gas capture systems, and gas capture systems may be taken into consideration and provided in accordance with standards[17].

After being recorded, waste that would be treated by hoarding or landfilling would be brought to a determined landfill location. Waste throwing was not permitted elsewhere save the areas marked by the field supervisor [25]. Additionally, they claimed that the position of the unloading point needs to be properly planned and communicated to truck drivers in order for them to dump at the proper area so that the subsequent process might be completed successfully. Trucould readily access the unloading sites since they were typically situated along the work road and on the perimeter of the operating cell. Following the completion of their tasks, the leveling and compaction of waste was done while taking into account how effectively heavy equipment operated. In order to create conditions for effective land use and stable landfill surface, waste was leveled and compacted. The leveling and compaction of waste must be done up to a height of 1.5 meters with a slope of roughly 30-45 percent, according to [25]. To get the pile as compact as possible, the dozer compacted it up to five times during grinding. Five trucks could be unloaded concurrently in each zone that was 25 to 30 meters wide, with a working face width of roughly 5 meters for each truck. In the meantime, landfilling took place during the rain season incells close to active and functional highways. Waste could be dumped directly from the road, but leveling and compacting the waste required heavy machinery.

A layer of regular (daily or intermediate) cover, a layer of clay with a thickness of 20 centimeters and maximum permeability of  $1 \times 10^7$  cm/s, and lastly topsoil with a minimum thickness of 60 centimeters made up the final cover in the controlled landfill [25]. They said that the waste was covered with soil, and that the process of compaction was carried out in stages, cell by cell, allowing it to continue by building the next layer above the previous one once the first layer of cells was finished. When the cover soild was not being

used, it should not be eroded by rain, periodic maintenance, or past heavy equipment operations. Fig 1. Below show the cover soil layers of controlled landfill.



**Cover soil for Controlled Landfill**

**Figure 1.** The layer of cover soil applied on controlled landfill [25]

### 3. RESEARCH METHOD

This study focused on the functioning of Ganet Landfill as a controlled landfill in order to achieve the research goals. For the purpose of this study, an interviewing approach was selected.

#### 3.1 Interview Instrument

Semi-structured interviews with staff members, employees, and others who have been involved in Ganet Landfill Operations served as the study methodology. Four respondents were interviewed between November and December 2020 for this study, three of them were from the Ganet Landfill office and one from The Public Housing Office for the Cleanlines and Gardening area of the Province of Kepulauan Riau Indonesia. This research was focused on current problems regarding to the operation of landfill in Ganet Landfill Tanjungpinang, Indonesia.

There were three parts of questions that would be used in interview which were involved Part A, B, and C. Part A consisted of questions related to information about the background of the

respondent. Part B consisted of basic information about landfill. While part C consisted of questions related to current problems regarding to the operation of landfill. Table 5 shows the elements of interview questions.

**Table 5.** Element of Interview questions

Part	Element	Potential Answer
A	Background of respondents	Background of respondent
B	Basic information about the landfill	General information about landfill
C	Current problems regarding to the operation of landfill	RC1, RC2, RC3, RC4

\*R=Answer, C=Question Part, Number=Number of each respondents

In this study, obtained data were methodically evaluated and ordered to be appropriately characterized using content analysis. Following the completion of the data analysis process, recommendations for enhancing the functioning of controlled landfill in Tanjungpinang were made.

### 3.2 Controlled Landfill in Tanjungpinang

Tanjungpinang, Indonesia region is home to the Ganet Landfill. With coordinates N 0°93.854', E 104°53.332', the landfill was situated in Tanjungpinang, Kepulauan Riau Indonesia, close to the Ganet region. Nearby the Raja Haji Fisabilillah International Airport, the landfill had been in operation for around twenty years and covered a land area of fourteen hectares. Each day, this landfill was anticipated to receive ninety tonnes of its maximum daily capacity.

## 4. RESULT AND DISCUSSION

The results and analysis of data gained from Tanjungpinang Landfill in Riau Archipelago, Indonesia.

### 4.1 Background of Respondent

The Department of Public Housing Service for Tanjungpinang City Residential Sector, Cleanliness and Gardening is in charge of the Ganet Landfill office, where some of the interviewees were recruited. Department of Housing and People Settlements Riau Archipelago provided one of the respondents. For the purpose of this research goal, each of them respondents gave information. The information of respondents is shown in Table 6 below.

**Table 6.** Respondent Background

Respondent	Company Name	Position
R1	Ganet Landfill Office	Heavy Equipment Operation Supervisor
R2	Ganet Landfill Office	Staff of Leachate Monitoring, Fecal Sludge Treatment Plant, and Methane Gas
R3	Ganet Landfill Office	Head of The Waste Management Department
R4	Department of Housing and People's Settlements Riau Archipelago	Staff of Environmental Sanitation and Sanitation

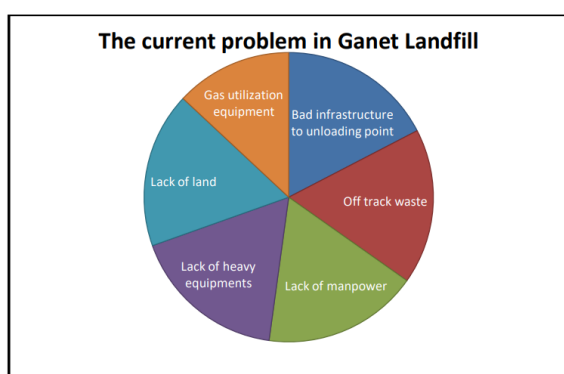
### 4.2 The Present Problem with Ganet Landfill as Controlled Landfill

Ganet Landfill was the only landfill built in Tanjungpinang, Riau Archipelago, Indonesia, located in the Ganet district. The research was undertaken to explain the issues of why controlled landfill was still used. There were multiple issues expressed by the interviewees about the activity of controlled landfills in the interviews conducted from November to December.

All respondents were informed that many individuals understood what a landfill and sanitary landfill were. From 2012 to 2018, the Ganet Landfill in Tanjungpinang, Kepulauan Riau, Indonesia, was managed as a sanitary landfill by personnel who were accustomed to doing so. The landfill was converted to controlled landfill in

2018. Fig 2 shown the problems prosed by all respondents.

During the interview, there were issues with the road accaesa to the place of unloading and poor infrastructure. Respondentd said, the unloading spot had to be moved because the road was so muddy during the storm. There was no concrete or asphalt in the lane. Because the path solely made use of the natural area terrain, truckers and other heavy vehicles could not pass through it.



**Figure 2.** Problems in Ganet Landfill

The location of offtrack waste was also one of the problems that arose during waste processing. This was accomplished by the local populations, who dumped waste along a non-predetermined road, like in front of an unwarranted house. This made waste collection worker need to put in more effort to surpass the set quotas. However, respondents 1, 2, 3, and 4 stated that a lack of labor was another issue. There were reportedly only twenty-six employees at the Ganet Landfill. As the landfill was fourteen hectares wide, the lack of manpower forced the landfill operation to run slower.

Due to the limited numbr of heavy machinery-two bulldozer, one excavator, and one loader-the functioning of the landfill was limited. The challenge in handling the waste at the landfill site was caused by the need to operate around ninety tons of waste every day with the available equipment. Heavy machinery was employed to crush, arrange, and cover the rubbish with soil. Those heavy equipments were crucial to the daily landfill operations.

Afterwards, there was currently enough room for the waste on the landfill to be accommodated. Only two hectares remained, though, and they were not used for anything. Out of the fourteen

hectares of landfill, eight hectares were used for landfilling, while four hectares were used for building, garages, and other services. According to the responders, there may not be enough land in the future to accommodate the waste produced. In the future, the landfill would need to expand. The two remaining hectares would be worse if the landfill was left as is.

Another problem mentioned by respondents included the machinery used to handle the gas produced by the waste pile. Diesel and gasoline that have been transformed into petrol from methane gas that was produced from waste. When the processing techniques were inspected, the problem occurred. Ganet Landfill only had one flaring device and station for these gases. Until the machine returned to normal after the machinery was damaged, the process of changing the gas was not carried out effectively. It was a shame that it was not possible to process the gas optimally.

From the prior statement, it was clear that poor infrastructure was another issue with the landfill. The difficulty, according to [26], Environment and Foresty Ministry waste management, was caused by commitment of each government regional to control its waste more than the availability of facilities. Additionally, a previous study revealed that one issue was that the government disregarded agreements regarding truck uniformity, the trach or route of the truck, and the operating hours of the truck [18]. It is continued by saying that the number of fleets delivering waste to landfills did not keep up with the increase in waste that happened.

In addition, earlier research reported that a manpower shortage was one of the problem with operatuing landfills [19]. According that, the landfill had a good office, was well-managed, and had heavy equipment, but it needed to increase its staff numbers in order to run smoothly. Additionally, a different study found that human resources of organization or companies itself were crucial for landfill [20]. At different levels, at different times, and for different reasons, such as requirements from public policy and predetermined strategic planning or management, there may be a need for human resources development.

An earlier study that indicated that this was a problem that commonly occurred in the city also supported the lack of land suitable for use as a

landfill [27]. It Claimed that there was always a problem with land availability, particularly when constructing infrastructure facilities and infrastructure that supported public services like landfills. It was reported that there were several issues with the quality of landfill due to a lack of heavy equipment, such as the issue of roads that were still muddy and unsuitable, especially when the weather was frequently rainy, even if maintenance was done [28]. It was also stated that the inability of landfill to treat waste effectively was hampered by the lack of heavy equipment needed to crush waste mounds.

## 5. CONCLUSION AND RECOMMENDATION

It is concluded that Ganet Landfill nevertheless had many problems and difficulties while being a controlled landfill. While still lacking in terms of technological advancements. From study, the most significant current problem at Ganet Landfill was a lack of workers, heavy equipment, futue-useful land, unloading point infrastructure, waste that was not placed in its path, and gas processing equipment.

It is recommended in the future; this research can be further discussed in challenges faces in operating the controlled landfill. Beside could determined the innovation or improvements that were expected to be given to controlled landfill. Also explore the advantages and disadvantages of using controlled landfills compared to sanitary landfills.

Additionally, it became clear why this particular form of landfill was still in use by studying about controlled landfills and why it was not changed into another type of landfill. Ideas for the expansion of waste operations and processing in Tanjungpinang were also given. In order to improve it as landfill in the future.

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