Coliform Distribution Around The Antang Landfill Soil Makassar City, South Sulawesi

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ABSTRACT

Tamangapa Antang landfill in its operation was conducted by open dumping, which potentially contaminate the surrounding soil. Research has been conducted on the distribution of Coliform bacteria as soil contaminants around Antang Landfill in Makassar City. This research aimed to determine to what extent the distribution of Coliform bacteria contaminate the soil around Antang Landfill. The sampling was divided into 4 Lines, 2 Lines were in the direction of the groundwater flow (Line A and Line C) and 2 Lines were perpendicular to the groundwater flow (Line B and Line D), at the depth of 0 to 10 cm, 10 to 20 cm and 20 to 30 cm. Samples were analyzed using Nutrient Agar and Biochemical Test method. The results show that Coliform Bacteria have spread vertically on Topsoil. The highest abundance population of Coliform bacteria was detected in Line B (240 cfu/gr) at 10 to 20 cm depth, Line D (210 cfu/gr) at 0 to 10 cm depth, Line A (110 cfu/gr) at 10 to 20 cm depth and Line B (23 cfu/gr) at 0 to 10 cm depth. The abundance of Coliform bacteria in the soil is very potential to contaminate the bio-soil environment, plants, damage the soil surface and structure around the Antang Landfill.

Keywords: Antang Landfill, Open Dumping, Topsoil, Coliform bacteria, Makassar.

1. INTRODUCTION

Landfill for Makassar City community is an important requirement to create environmental comfort in big city. Even if it is only one day the garbage in Makassar City is not transferred to the landfill, the city will be full of garbage which will be very disturbing the public convenience. Garbage production in Makassar City is constantly increasing drastically [1]. Piles of garbage in landfill are medium for breeding of pathogenic and non-pathogenic microbes [2]. Tamangapa Antang landfill is the center of landfill of all Makassar City areas. Since the opening of Tamangapa Antang landfill, it is estimated that 1.240.000 tons of organic waste have been disposed [3]. In its operation, Open Dumping method was used which potentially contaminate the soil.

The location of Tamangapa Antang landfill in Bangkala Sub-District, Manggala Makassar District, South Sulawesi province, has been used since 1995 until today with an

area of 18.8 Hectare. In addition, Tamangapa landfill which was originally designed for 10 years need, but in fact the landfill is still in use until today, meaning that the landfill is now 21 years old, unable to accommodate the garbage volume anymore which reaching to 800 tons or about 4,000 cubic per day. Based on the records of Department of Hygiene and Environment, Makassar with a total population of approximately 1.3 million people is producing about 3.800 m3 or equal to 300 Tons urban garbage daily, whereas the maximum capacity of Tamangapa landfill is only about 2.800 m3 of urban garbage daily. Additional landfill is needed for the disposal of 1000 m3 of garbage. About 87% of garbage in Makassar is organic waste and about 13% is inorganic waste, such as plastic and paper.

Impacts that can be caused by Tamangapa Antang garbage landfill is primarily on shallow groundwater quality. According to Arifin, et al., 2014, the direction of groundwater flow that carries leachate at Antang landfill is in the same direction with the slope of rock layers, which is northwest – southeast. Contamination to shallow groundwater caused by liquid waste permeation from garbage landfill may also contaminate the surrounding community wells. This contamination has been felt by residents around the landfill, especially those who used free groundwater as a source of drinking water. Leachate movement has spread to the northwest – southeast, contamination around (300 to 450) meters from Tamangapa garbage landfill which following the direction of groundwater flow [4].

Coliform as soil contaminants around landfill has been conducted a lot, but in Indonesia, especially in Makassar City, South Sulawesi is still lacking. Contaminations in landfill area are not only in water, but also in the soil. One of the detected contaminants in the soil is Coliform. Some previous studies focused solely in leachate contamination and air contamination. The purpose of this study was to determine the extent to which the distribution of Coliform bacteria can contaminate the soil around Antang landfill. This study was focused on the distribution of Coliform bacteria as soil contaminants around Antang landfill at 0 to10 cm, 10 to 20 cm and 20 to 30 cm depth.

2. METHODS

The study area is administratively locatet in Bangkala District, Manggala Sub-District, Makassar city, South Sulawesi Province. Geographically located at coordinate points of 119o, 29', 10" to 119o, 29',40" East Longitude and 5o, 10',20" to 5o, 10', 40" South Latitude. The study area was shown in Fig 1.

Soil sample on taken Topsoil at 0 to 10 cm, 10 to 20 cm and 20 to 30 cm depth, by dividing it into 4 Lines, 2 Lines were in the

direction of the groundwater flow, that is Line A and Line C; and 2 Lines were perpendicular to the groundwater flow, that is Line B and Line D. 12 soil samples were analyzed biochemically. Each sample was collected as much as 0.5 kg by using a stainless steel shovel. Subsequently, soil samples were put into a sterile container and labelled containing location, ianalysis. During soil sample collection, soil type, soil color, soil conditions and temperature were recorded [5; 6].

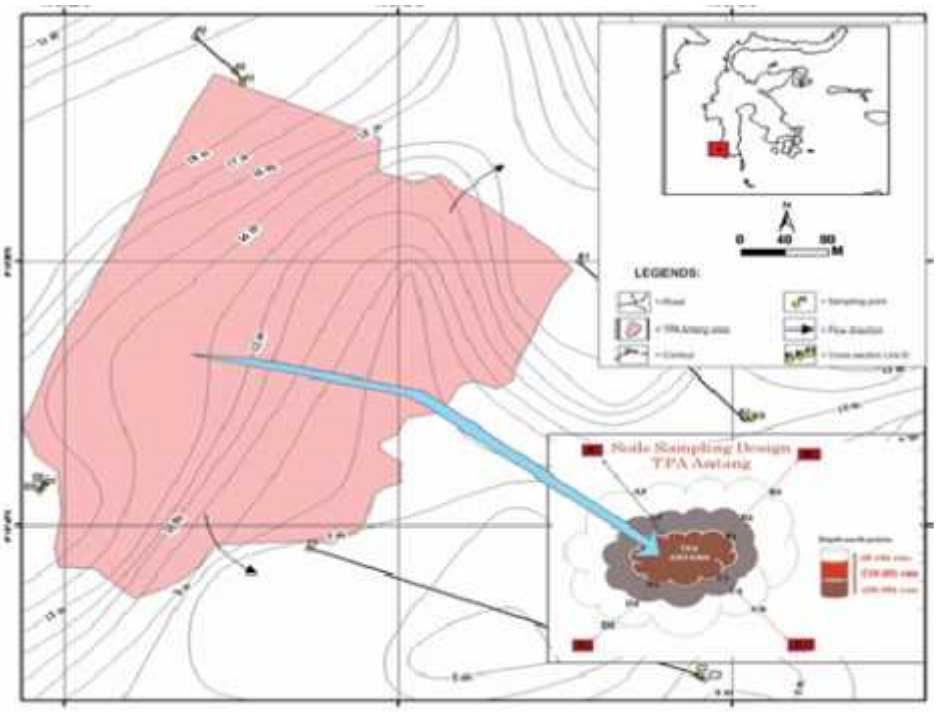

Fig. 1. Map of location and retrieval point Sample

3. RESULTS AND DISCUSSION

A. Results

To count the number of Coliform bacteria population, MacKonkey media was used with reference to Cowan (1974) manual for the identification of medical bacteria [7]. The calculation results of Coliform bacteria population in 0 m point for Line A, Line B, Line C and Line D at 0 to 10 cm, 10 to 20 cm and 20 to 30 cm depth was show in Fig. 2.

It can be seen in fig 2 that the population of Coliform bacteria for Line A, at 0 to10 cm depth is 43 cfu/gr, at 10 to 20 cm depth is increased to 110 cfu/gr and at 20 to 30 cm depth decreased to 23 cfu/gr. This is because 0 to 10 cm and 20 to 30 cm depth contains little soil organic compounds,

insufficient oxygen and nutrients intake to sustain bacterial life, consequently the growth and reproduction of bacteria in the soil will run slowly. While at 10 to 20 cm depth contains a lot of soil organic compounds, n sufficient oxygen intake, abundant nutrients and have relative humidity, therefore the growth and reproduction of bacteria very rapidly will multiply in the soil.

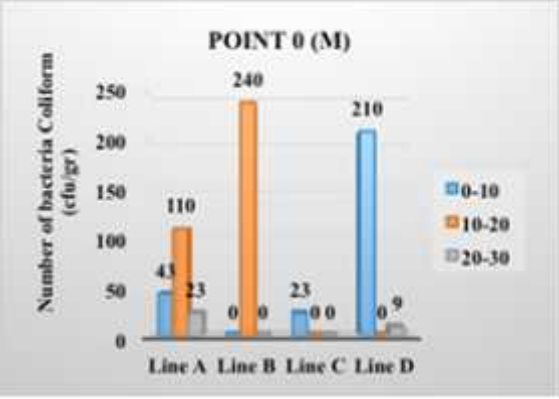

Fig. 2. Calculation results of Coliform bacteria population in 0 m point for Line A, Line B, Line C and Line D at 0 to 10 cm, 10 to 20 cm and 20 to 30 cm depth.

There is no bacterial growth in Line B at 0 to 10 cm and 20 to 30 cm depth. This is because at that depth does not contain soil organic compounds, no oxygen intake, and does not contain nutrients to sustain bacterial life, consequently the bacterial growth and reproduction cannot multiply in the soil. While at 10 to 20 cm depth contains a lot of soil organic compounds, sufficient oxygen intake, abundant nutrients and have relative humidity, therefore bacterial growth and reproduction in the soil will multiply so fast.

There is no bacterial growth for Line C at 10 to 20 cm and 20 to 30 cm depth. This is because at that depth does not contain soil organic compounds, no oxygen intake, and does not contain nutrients to sustain bacterial life, as a consequence the bacterial growth and reproduction cannot multiply in the soil. While at 0 to 10 cm depth contains a lot of soil organic compounds, sufficient oxygen intake, abundant nutrients and have relative humidity, therefore bacterial growth and reproduction in the soil will multiply very quickly.

For Line D at 0 to 10 cm depth as many as 210 cfu/gr bacteria are found, this is because at 0 to 10 cm depth contains a lot of soil organic compounds, sufficient oxygen intake, abundant nutrients as well as relative humidity, therefore the growth and reproduction of bacteria in the soil will multiply very quickly. At 10 to 20 cm depth, there is no bacterial growth because at that depth does not contain soil organic compounds, no oxygen intake, and does not contain nutrients to sustain bacterial lide, consequently the bacterial growth and reproduction in the soil cannot multiply. While at 20 to 30 cm depth, 9 cfu/gr bacteria are found, this is because at that depth contains very little soil organic compounds, insufficient oxygen intake and nutrients to sustain bacterial life, consequently the growth and reproduction of bacteria in the soil will be slow-moving.

B. Discussion

From the research results, it can be seen that Coliform population in Line A, Line B, Line C and Line D have spread vertically on Topsoil. This is because the sampling point is close to the residents' environments, and is influenced by human activities. The soil around the landfill may be bacteriologically contaminated through permeation from the sewage channels such as septic tank [8; 9].

Distribution of bacteria population such as Coliform is determined by a number of environmental factors such as water content, pH, temperature, light, soil organic compounds as well as nutrients. The average pH in Antang landfill soil is ranging from 4.82 to 6 with average temperature ranging between 25 to 36 oC. At low pH, the availability of nutrients is very high therefore the bacterial activity will increase. Additionally, temperature also plays an important role in regulating the course of metabolic reactions of all living things including bacteria. When the ambient temperature is higher than temperature that can be tolerated by bacteria, it will cause denaturation of protein and other essential components which cause the bacteria to die. Similarly, if the ambient temperature is below the tolerance limit, cytoplasmic membrane will not be in liquid form, which causes the nutrients transportation halted and the cell life process will stop [10; 11]. Antang landfill has relative humidity, therefore it will affect the growth and reproduction of bacteria. Topsoil layer contains high soil organic matter, as well as sufficient soil humidity, thus providing an opportunity for microorganism to decompose complex organic residues into simpler forms, therefore, the amount of microbes a generally higher in the topsoil layer [12]. The abundance of Coliform bacteria vertically around the landfill site indicates the effect of soil humidity and soil wetting. Line A, Line B, Line C and Line D indicate the development of Coliform which is influenced by leachate flow direction. Antang landfill has been operating for 21 years, Antang landfill is Utisol soil (reddish soil that contains clay and acidic). The color occurs due to the metal content especially Fe and Al which are oxidized. Antang landfill is acidic, lack of Nutrients contain of N, P and K very acidic, and lack of organic material [4].

Coliform is a class of intestinal bacteria, which live in the digestive tract of human and animals [7]. Coliform is an indicator of pathogen bacterial contamination, pathogenic bacteria is more resistant to wet and moist soil. Coliform is rod-shaped anaerobic or anaerobic facultative gram-negative bacteria, does not form spores, and can ferment lactose to produce acids and gases at 35 to 37 °C [13].

The higher the contamination level of Coliform bacteria, the higher the risk of other pathogenic bacteria presence that normally live in human and animal feces [14].

4. CONCLUSION

The research results showed that Coliform bacteria population aroung Antang landfill has spread vertically on Topsoil. Isolation and identification were conducted through observation of morphology, physiology, gram staining using Nutrient Agar method and biochemical testing. The highest coliform bacterial population was detected in Line B (240 cfu/gr) at 10 to 20 cm depth, Line D (210 cfu/gr) at 0 to 10 cm depth, Line A (110 cfu/gr) at 10 to 20 cm and Line B (23 cfu/gr) at 0 to 10 cm depth. The abundance of coliform bacteria is strongly influenced by environmental factors such as water content, pH, temperature, light, soil organic matter, humidity, and nutrients to sustain bacterial life in the soil.

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