BIOREMEDIATION AND GAS ANALYSIS OF LANDFILL WASTE BY COLLECTIVE MICROORGANISMS

Yamaguchi University Regular Member ○Azizul Moqsud

1. INTRODUCTION

The salinity problem is one of the most serious environmental problems in the landfill waste treatment all over the world (Moqsud, 2021). The industrial waste and the commercial waste are often burnt in the incineration plants and the remaining ashes are dumped into the landfill. This practice of burning is to reduce the volume of the total solid waste which is supposed to be dumped into the landfill. However, to incinerate the solid waste properly, calcium hydroxide and hydrochloric acid have been added during the burning process. These two types of chemicals ultimately increase the salinity of the ashes by producing the calcium chloride salt which is remained in the ash. The traditional method to remove this salinity before discharging into the environment as liquid is very difficult and cost taking (Cai et al.2016; Moqsud and Omine, 2013). In this research, a new technology of salinity removal by using the collective microorganisms and the foamed waste glass has been used as a bioremediation of landfill waste. The porous foamed waste glass material was used as the habitat for the common bacteria. The foamed waste glass has also used to remove the salt from the tsunami affected salt soil in the Tohoku region (Moqsud, 2021). However, the mechanism of salinity removal and the gas generated during the gas removal is needed to be explained. So, the objective of this study is to analyses the gas generation from the bioremediation with the collective microorganisms. The other objective is to use the organic waste to improve the bioremediation effectiveness.

2. MATERIALS AND METHODS

Landfill waste has been collected from the local landfill at Yamaguchi prefecture in Japan. The landfill waste/ash was mainly forming the industrial waste and has very high salt content and the higher pH value. The electrical conductivity (EC), which is one of the major indicating factor high salinity is about 10mS/cm. This type of environment is not suitable for the living creatures and the total ecosystems. A landfill simulator of 30 cm height and 28 cm diameter has been created in the laboratory. A perforated PVC pipe was used for the gas outlet from the landfill. A foamed waste glass has been used surrounded the PVC pipe. The two types of organic waste such as rice bran and kitchen garbage have been used with the ash to supply nutrients to the microorganisms and to reuse the organic waste instead of burning them. The collective microorganisms which are made of different salt tolerant lactic acid bacteria has been used for the bioremediation. To collect the generated gas, a bag has been covered and the gas has been collected for the gas chromatography. The room temperature was set constant at 20 ^{0}C for 6 weeks. The EC and pH were measured once in a week by following JGS standard. No additional water has been added during the experiment. Gas analysis has been done by using gas chromatography.

3. RESULTS AND DISCUSSION

Figure 1 illustrates the variation of electrical conductivity (EC) with duration in the experiment by using different types of organic waste. It was observed that EC decreased with time both for kitchen garbage and rice bran. The rate of decreasing was faster during the first 7 week. After 1 week, the decreasing trend became almost constant. In the initial stage, the collective microorganisms are more active with the supply of abundant food. For that reason, the bioremediation activities increased at that time. After 1 week, the activities of bacteria reduced and consequently, the bioremediation process became slower. By comparing the 2 different types of waste with same collective microorganisms, it was found that rice bran showed the more effective than the other. However, the blank one did not show any significant changes of the electrical conductivity. This indicates that the bioremediation is effective for the salinity reduction.

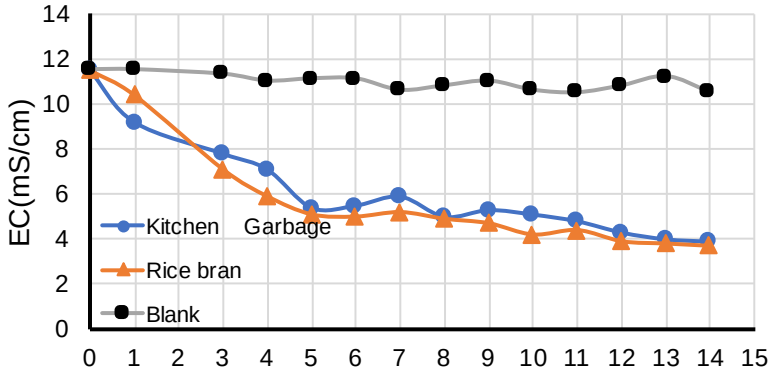

Fig 1 Variation of electrical conductivity with duration

Figure 2 shows the variation of pH with time. It was observed that the pH value did not vary much with the duration. However, it showed the alkali trend for the blank sample. The landfill simulators with the microorganisms and the organic waste showed a lower trend compared with the blank sample. Both the kitchen garbage and the rice bran showed the neutral trend after 5 days of the bioremediation.

Keywords: Landfill, Bioremediation, Salinity, Organic waste
Contact address: Department of Civil Engineering, Yamaguchi University, Ube city, Japan, Tel: +81-0836-859322

The bacterial activities have been affected the organic acid generation inside the landfill and consequently decrease the pH value. Nevertheless, the pH value was within the neutral range after the bioremediation which is good for the geoenvironment. Figure 3 shows the result of the gas chromatography of the generated gas from the landfill simulator. It has been observed that some gas containing chloride has been released during the bioremediation inside the landfill simulator. The microbial activities have helped to separate the chloride and made it some chloroform to resealed into the environment. However, the content of that chloroform is so small that it can be dissipate inside the atmosphere quickly and not so much harmful for the people.

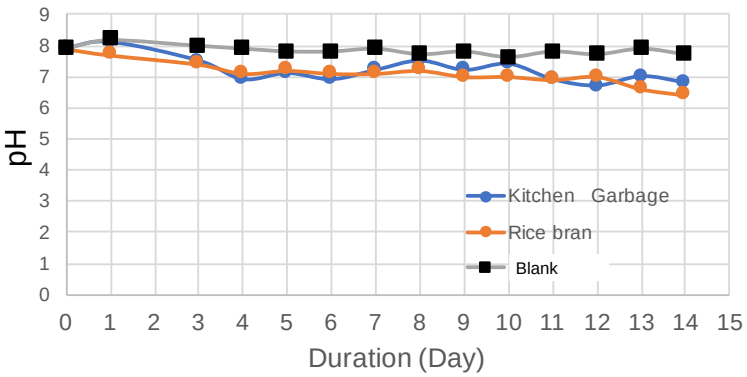

Fig 2 Variation of pH with duration inside the landfill simulator

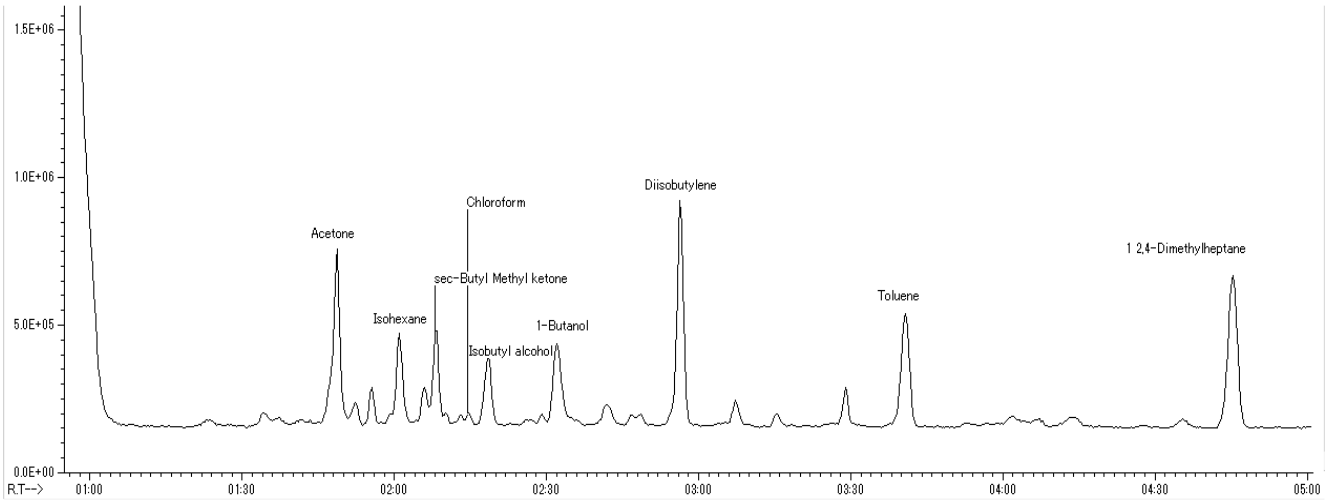

Fig 3 Gas chromatography result inside the landfill simulator

4. CONCLUSIONS

The Bioremediation of extreme bad soil/landfill ash can be done with the help of collective microorganisms. The single bacteria might not survive in the situation for the bioremediation however, they can help each other to support the total process. The organic waste can increase the bioremediation of the landfill ash as they provided the extra nutrient to the bacteria for increasing their activities. The gas analysis by gas-chromatography shows that the chloride gas compound has been released during the bioremediation process that decreases the salinity. This phenomenon has proved the mechanism of the bioremediation of the saline soil.

Acknowledgement

The author acknowledges the financial support from the Kajima Foundation for conducting this research. The author is also grateful to Mr. Teramoto and Mr. Sakaba for conducting the experiment. Special thanks for Mr. Kimura for the kind help during the gas chromatography test. The authors also appreciate the kindness of Dr. Hara, the president of Nihon Kensitsu Gijitsu for providing the foamed waste glass for the research.

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