BIOREMEDIATION OF SALINITY PROBLEM FROM THE LANDFILL BY USING COLLECTIVE MICROORGANISM AND FOAMED WASTE GLASS

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1. INTRODUCTION

High salt content of the landfill waste and the ash has become a serious environmental problem in Japan. The ash which is collected from the incineration plant contains a high salt concentration. The chemicals which are used to incinerate the waste can cause the increased amount of calcium chloride in the ash as shown in Eq. (1). The leachate from this landfill has the high saline content. The traditional method of removing the salinity before discharging in the environment is difficult as it will increase the amount of money for the landfill waste management (Andreolli et al. 2013). In this study, the new approach of bioremediation has been tried to remove the salinity from the ash by using some common bacteria.

$$2HCl + Ca(OH)_2 \rightarrow CaCl_2 + 2H_2O \qquad (1)$$

The recycled waste glass which is a porous material was used as the habitat for the bacteria. The foamed waste glass has been used to remediate the salinity from the tsunami affected rice field in the previous study (Moqsud and Soga, 2019). The bioremediation of saline soil caused by tsunami has been tried in the Tohoku area also (Moqsud and Omine, 2013). The objective of this study is to evaluate the bioremediation of landfill waste by using the common bacteria. The other objective of this research is to assess the effect of using compost and foamed waste glass in the bioremediation process.

2. MATERIALS AND METHODS

Landfill waste which is mainly ash was collected from the landfill in Shimonoseki city at Yamaguchi prefecture. The landfill waste is high in salt content. The electrical conductivity is around 10 mS/cm and the pH value are around 9 which indicated as an alkaline condition and salty condition which is unfavorable for the environment (Gao et al 2016; Moqsud et al. 2017). A model of semi-aerobic landfill has been created in the laboratory. A 13 L bucket with 28 cm height and 30 cm diameter was used. A perforated PVC pipe was used for gas outlet from the landfill. The small stone chips were used surrounding the perforated pipe which was placed in the middle of the model in the first experiment as shown in Figure 1. Foamed waste glass (FWG) was used instead of stone chips in the 2nd experiment. Compost was used as the nutrient source for the bacteria (Cai et al.2016). The collective microorganisms which are used in this experiment is prepared at the laboratory which is called CM-1 and CM-2. CM-1 is rich in lactic acid bacteria and the CM-2 is rich in effective microorganisms. The ash used in each model was around 8 kg and the bacteria used as liquid form is 480 ml. The laboratory experiment was conducted at 20^0 C for 6 weeks. The EC and pH were measured once in a week by following JGS standard. 500 ml water was sprinkled every week.

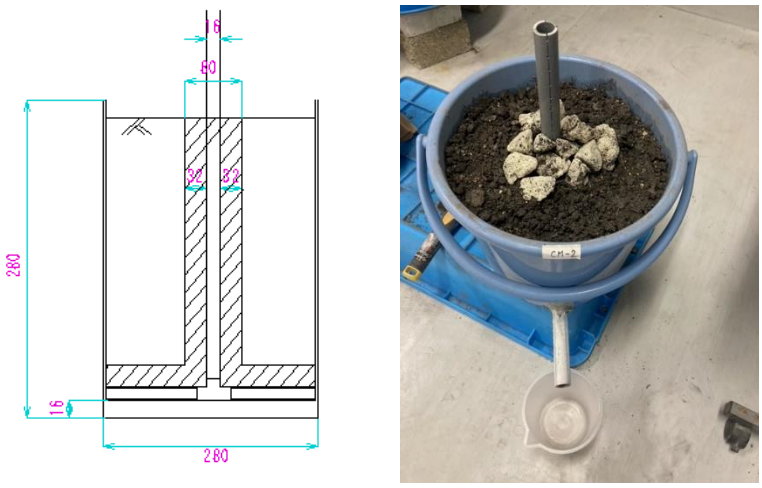

Fig 1: Cross-section and the model of the semi-aerobic landfill for bioremediation

Table 1: Details of the experiment listed

Bacteria	Amount of waste/ash	Amount of bacteria in liquid form	Compost	Oxygen condition	Constant temperature	Water applied
	(kg)	(ml)	(kg)		(°C)	(L/1w)
CM-1 CM-2	8	480	0.24	Semi-aerobic	20	0.5

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3. RESULTS AND DISCUSSION

Figure 2 illustrates the variation of electrical conductivity (EC) with duration in the experiment 1. It was observed that EC decreased with time both for CM1 and CM2. The rate of decreasing was faster during the first 2 weeks. After 2 weeks, 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 2 weeks, the activities of bacteria reduced and consequently, the bioremediation process became slower. By comparing the 2 different types of collective microorganisms, it was found that the collective microorganisms with the mixing of effective microorganisms showed the more effective than the other.

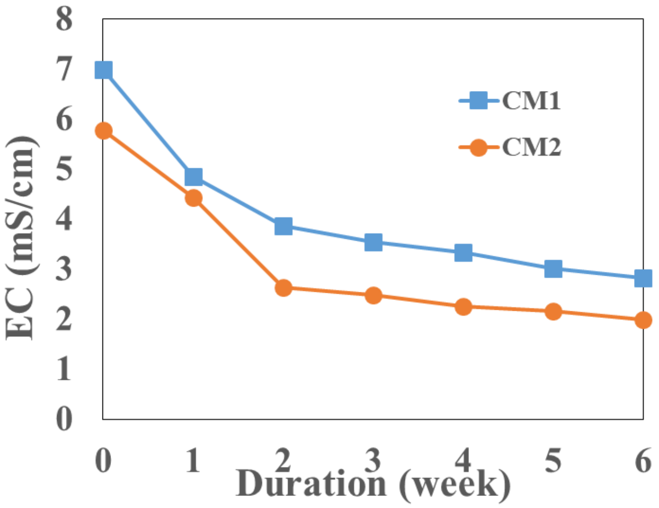

Fig 2: Variation of electrical conductivity with duration mixing with compost and stone chips near the gas pipe

Figure 3 shows the variation of electrical conductivity with duration. It was observed that when recycled waste glass (FWG) was used in the middle of the landfill model the EC value decreased rapidly. The main objective of the using of FWG is to provide some additional habitat for the bacteria. Again, the CM2 could reduce the EC more effectively that the CM1. However, it was understood that when the FWG was used then the EC value reduced better compared to the stone chips. The EC value reduced almost 70% after 6 weeks of bioremediation which is quite significant.

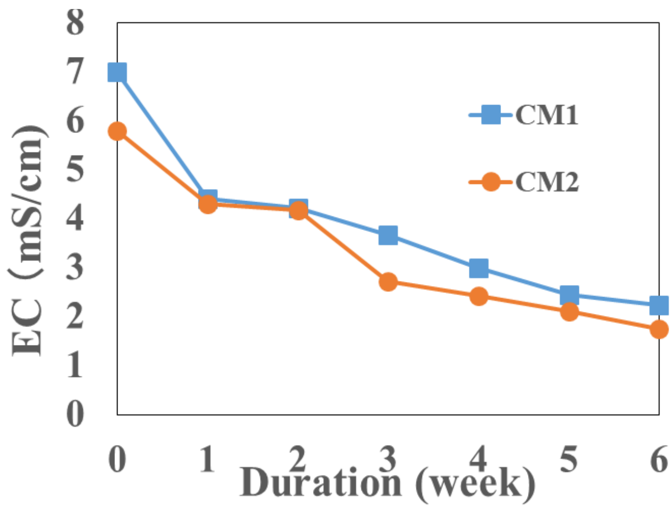

Fig 3: Variation of electrical conductivity with duration by using foamed waste glass instead of stone chips

4. CONCLUSION

The following conclusions have been drawn from the current research:

1) Bioremediation of saline soil/ash from landfill can be possible with the effective collective microorganisms.
2) Foamed waste glass can increase the efficiency of the bioremediation instead of the stone chips surrounding the gas dissipation pipe.
3) Compost mixed with the effective microorganisms can be a good way to conduct the bioremediation of the saline soil/landfill ash.
4) Salinity reduced around 70% from its initial value after the bioremediation by using the commonly available collective microorganisms.

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