

## **2-7 Water Quality Survey on Heavy Metal Pollution from Waste Disposal Facilities in Pacific Countries**

Hideaki NAGARE

*Graduate school of Environmental Science, Okayama University, Japan*

### **ABSTRACT**

Proper management and treatment of the effluent from solid waste dumping site is necessary for the protection of water environment in downstream. Nonetheless, the actual condition in developing countries is not clearly determined. In this research, water quality survey was conducted in Palau for a case study.

### **KEYWORDS**

Leachate, water quality, Palau

### **INTRODUCTION**

In general, effluent from solid waste dumping site includes various kinds of metal. Therefore, the effluent can be a cause of environmental pollution and health problems without adequate management and treatment. However, in developing countries such management and treatment of effluent are not always properly administered. In this research, water quality surveys were conducted to reveal the situation of environmental pollution due to effluent in Palau for a case study.

### **MATERIALS AND METHODS**

#### **1. Research sites**

In this research were selected two dumping sites in Palau; one is in Airai state and another one is in Koror state.

The site in Airai is always open for residents, so they can access to withdraw their waste anytime. Since segregation of waste is not common yet in the country, various kinds of stuff are intermingled together at the site. However, plastics including bag and bottles are the major stuff. Impermeable sheet is not settled underground.



Fig. 1 Dumping site in Airai state



Fig. 2 Dumping site in Koror state



Fig. 3 Segregation in Koror site



Fig. 4 Segregation in Koror site



Fig. 5 Sampling at the hillside of Airai site



Fig. 6 Oxidation pond in Koror site



Fig. 7 Sampling in the downstream of Airai site



Fig. 8 Sampling at near the Koror site

Another dumping site is located in Koror which is the largest state in Palau. This is the controlled type dumping site, in which some of the effluent is collected into oxidation ponds to be treated through drainage trench in underground. The treated water is dispersed at the surface of the site. This site is located by the sea, and there is no river accepting the effluent.

Water samples were collected within and downstream of the dumping site in Airai. Samples were also taken around the site in Koror along with the oxidation ponds. Totally samples were collected at 15 points.

## **2. Methodology**

The collected water samples were kept in polyethylene bottle and stored in refrigerator as long as possible before being taken back to Japan. In case of the second survey in January, dissolved oxygen (DO) concentration, electric conductivity (EC), oxidation-reduction potential (ORP) were measured with portable equipments at the site. The concentration of 22 metals (Ag, B, Ba, Bi, Ca, Cd, Co, Cr, Cu, Fe, Ga, In, K, Li, Mg, Mn, Na, Ni, Pb, Sr, Tl, Zn) were measured with ICP-AES. Phosphorus concentration was also determined for consideration of phosphorus recovery from the effluents.

# **RESULTS AND DISCUSSION**

## **1. Water quality conditions**

At every observation point and for every water quality item no critical concentration causing health and environmental problems was determined. Even the oxidation pond in Koror state dumping site showed EC of at most 660 (August) to 1130  $\mu$ S/cm (January).

Fujiwara et al. conducted a questionnaire survey to study solid waste generation in Palau at the same of the water quality survey in August. They revealed that major waste generated from houses is plastics because most of residents disperse kitchen garbage in their house yard, and carefully use electric appliances for long time. This result is in accordance with the fact that plastic stuff such as bag and bottle is the majority of the wastes in the dumping sites in Palau. Since such plastic waste is non-biodegradable, and contains less heavy metals, this is the reason for the relatively low concentration in effluent.

## **1. Water quality conditions**

No extremely high concentration of metal was observed in Palau as mentioned above. However, some samples taken outside the dumping sites were suspect of being the leachate from within the sites. Then similarity of water quality between sampling points was investigated by means of multi variable analysis.

Water quality data of pH, EC, Ca, Fe, K, Mg and Na were firstly used in principle component analysis. Then derived three largest principle components were adopted to cluster analysis to evalu-

ate the similarity between the sampling points. Figure 9 shows the result indicating the similarity. As shown the figure those points were separated into four groups.

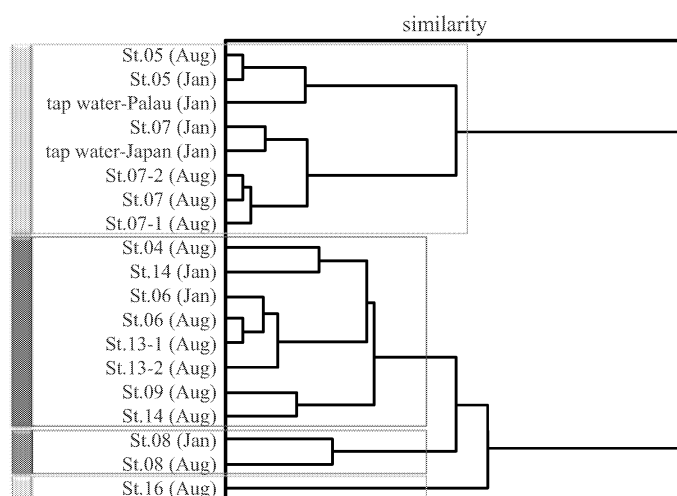


Figure 9 Dendrogram derived as the result of cluster analysis showing water quality similarity between sampling points of the water quality survey.

Point #4 is inside the Airai dumping site where stream water was taken, while the sample of the oxidation pond in Koror site was derived at point #14. Those two sampling points were obviously the effluent from the dumping sites, and were both categorized in the second group. This means those sampling points in the second group had the water quality like the effluents. The group includes the hillside of Airai dumping site shown in Figure 5, and also the puddles at the bank of Koror site in Figure 8. As those two points are adjacent to the dumping sites, it was thought that effluent from the dumping site leaked out to the surface as leachate.

In this research, phosphorus concentration in water sample was also determined for evaluating the feasibility of phosphorus recovery. However, every points showed low concentration (about some mgP/L) which is too low to recover the phosphorus.

## CONCLUSIONS AND PERSPECTIVES

Water quality surveys were conducted to reveal the situation of environmental pollution due to effluent in Palau for a case study. At every observation point and for every water quality item no critical concentration causing health and environmental problems was determined. The concentrations in effluent from two dumping sites were both relatively low than expected. Less disposal amount of organic wastes and hazardous metals was thought to be the reason for such low concentration. However, at some sampling points by the dumping sites, water quality was similar to the effluent and thought to be the leachate.