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Analysis the depth effect of organic pollutants and heavy metals using biostimulant ball in contaminated coastal sediments

해양오염저질의 오염물질 정화를 위한 생물활성촉진제 투여 깊이 연구

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Abstract: *Sediments play a major role in determining pollution pattern in aquatic systems and reflecting the pollutant deposition. In the present study analysis the depth effect of organic pollutants and heavy metals using slow release biostimulant ball (BSB) in coastal sediment. BSB size fixed at 3cm, depth varied from 0cm to 10cm depth and 1 and 3 month interval period was carried out for the study. The organic pollutants of chemical oxygen demand, total solids and volatile solids were significantly changed at the surface sediment (0cm)in 1 month and 3 month interval time using BSB. In contrast, sediment depth increase upto 10cm the reduction percentage decrease like to control. Vertical distribution of heavy metals are not consistent from the surface layer toward the bottom layers. Heavy metals fractions were significantly changes, the exchangeable fraction was reduced and other organic and residual fractions were stabilized percentage are increased. This finding concluded BSB is effective for reduce organic pollutants, heavy metals stabilization from the contaminated sediment.*

Key words :*Coastal sediment, Biostimulant ball, organic pollutants, heavy metals*

1. Introduction

Marine sediment is a carrier of organic pollutants and it is main sink and source of heavy metals and PAH..Contaminated sediment serves as a significantly potential role in storage of deletious material. Therefore remediation of contaminated sediment is current issue. Nowdays several in-situ and ex-situ approaches are used (Pelero, 2010). BSB is an effective considerable attention because of its low cost, good efficiency, environmentally friendly and less toxic. The aim of present study is analysis of depth effect on organic pollutants, heavy metals stabilization and PAH in contaminated coastal sediment. Further more, different month interval effect also analysed.

2. Materials and Methods

The sediment was collected from busan Northport and characterized according to standard method (APHA, 1998).(Table 1). pH was measured by pH digital meter, and COD analysed by potassium permanganate oxidation method.. Sequential extraction of heavy metals analysed according to Song et al., 2010 and it was measured by ICP-AES.

Table 1 Physico-chemical characteristics of marine sediments and sea water

Sample	Parameters	North port sediment	Dredged sediment
Marine sediment	Sand (%)	17.4	12.1
	Silt & clay(%)	82.6	87.9
	pH (at 25°C)	8.69	8.26
	Temperature	19.3	20
	COD Mn g/kg	26.46	12.2
	Water content (%)	51	47
	TS (g/kg)	49.04	7.4
	VS (g/kg)	15.37	3.6
	Cr(mg/kg)	96.9	2.37
	Cd(mg/kg)	7.34	ND
	Cu(mg/kg)	153.51	7.0
	Zn(mg/kg)	498	61.8
	Pb(mg/kg)	78.3	10.5
	Fe(mg/kg)	37273	20882

Contaminated sediment was filled in 20L column, half of the portion was filled with sediment and half portion was filled with sea water. BSB was submerged in the sediment at different depth in the oder of 0cm (surface sediment), 3cm, cm and 10 cm respectively. Totally 12 column was prepared

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along with blank. The prepared column was kept in the refrigerator and the temperature was monitored in the sea and set as per sea water temperature. The entire work was carried out by 3 months, according to the month interval the samples were collected and analysed the results as per standard methods.

2.3 Experimental Procedure

For BSB preparation, 1 kg uncontaminated sediment mixed with 0.5M sulfate,1M nitrate and 0.5M acetate and then dried it for room temperature. The BSB size and distance were prepared based on RSM model. After making the BSB and dried it at 60°C for 48 hrs, then the dried ball were coated with polymer solution of polysulfone (10 wt%).

3. Results and Discussion

Figure 1 (a-f) explained the depth effect of contaminated sediment and the depth was varied from 0 to 10cm, the pH and water content was not significantly changed. BSB treated samples and also month interval also not influence for pH and water content. But small changes occurred in the temperature in the spring season. Because, increased temperature is effective for microbial growth according to the climatic condition (Jeong et al., 2013). Fig 1(c) result found that there was no significant change occurred in water content in 0cm to 10cm depth and it around 44 to 45%. COD reduce upto 24.92 g/kg in 0-3cm and it was gradually increased in 10cm depth (26g/kg) (fig 1d). Fig 1(e and f) explained TS and VS reduction and maximum reduction was observed in 3cm depth of BSB added sediment and the time interval also highly influence for TS and VS reduction.

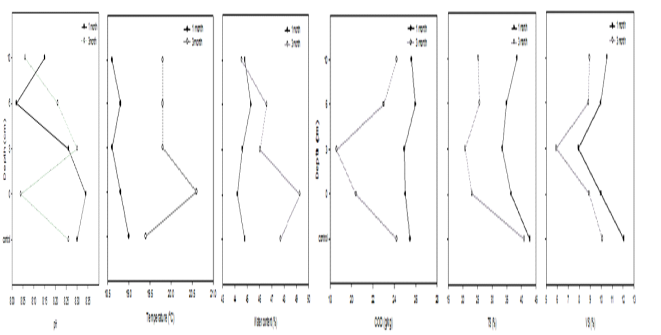

Fig. 1 Depth analysis of selected physochemical properties in contaminated sediment with different month interval (a) pH (b) Temperature (c) water content (d) COD (e) TS reduction (f) VS reduction

During time course experiments along with vertical distribution of heavy metals in control and BSB treated sediment samples were depicted in fig 2.(a-e).

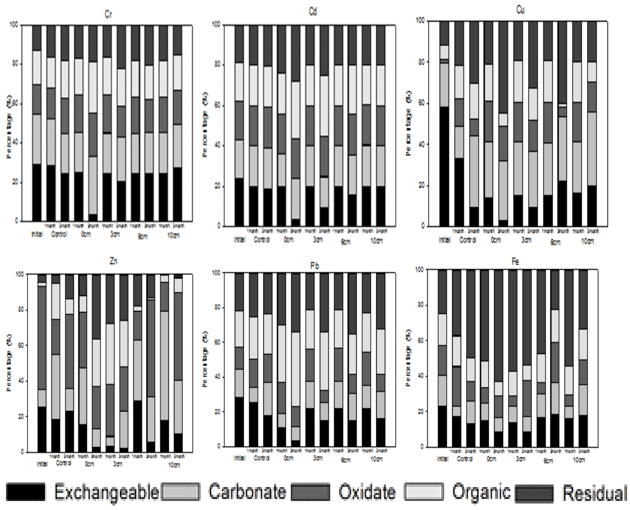

Fig. 2 Distribution of heavy metals percentage at different depth analysis (a) Cr (b) Cd (c)Cu (d)Zn (f) Fe

The results showed the exchangeable fraction percentage was decreased up to 3% at surface sediment in all the analysed heavy metals while compared to 6 and 10cm depth the reduced % was high (Cr, Cd, Cu, Zn, Pb decrease % 3%, 3.3%, 2.7%, 3.4%, and Fe 8.5%, simultaneously residual % increased in the order of 18%, 28%, 44%, 36%, 34%, 62% respectively .Large portion of the heavy metals in sediment present in the crystal lattice and residual fraction is stabilised in bottom of the sediment, while exchangeable and carbonate are altered to stabilized form.

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