2016년도 한국해양과학기술협의회 공동학술대회
5월 19일(목)~5월 20일(금) 부산 벡스코(BEXCO)

오염연안저질에 함유된 PAH와 중금속의 생물정화를 위한 생물활성촉진제의 현장적용

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Bioremediation of Polycyclic aromatic hydrocarbons (PAHs) and Heavy metals in contaminated marine sediments at filed scale study using biostimulant ball

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Abstract *: The Study mainly focused on bioremediation of 16 types PAHs and heavy metals in contaminated marine sediments at filed scale study using slow release biostimulant ball (BSB) was investigated. In our experiment, filed scale study (1m x 1m) was performed and the effect of BSB on PAHs and heavy metals were analysed. BSB size and distance were determined and optimum size and distance were 3cm and 5.5cm respectively. BSB containing nutrients of acetate, nitrate and sulphate which can enhance the activity of microorganism to increase degrading capacity of PAHs and enhance the heavy metals stabilization also to decrease bioavailability. PAHs containing 16 types of 2, 3, 4, 5 and 6 rings compound PAHs were found and to degrade upto 100% in 2, 3 rings, upto 90 to 94% in 4 and 5 rings and 6 ring compound was degrade up to 70%. For heavy metals stabilization percentage was increased using BSB sediment and exchangeable portion was decreased and residual portion was increased in all analysed heavy metals. BSB enhance the PAHs degradation and stabilization of heavy metals percentages. BSB is a promising method for remediation of PAHs and heavy metals in contaminated marine sediments.*

Key words *:Bioremediation, Coastal sediment. Biostimulant ball, Poly aromatic hydrocarbon, heavy metal, stabilization,sulfate reducing bacteria*

1. Introduction

PAHs represent a wide spread class of environmental chemical pollutants and are ubiquitous contaminants with two or more fused aromatic rings in marine environment and are classified as hydrophobic organic compounds (Jarvis et al., 2014). Marine sediments are important carrier for heavy metals as well as PAHs and play a significant role in the storage of potentially deleterious material (Alonso Castillo et al., 2013) and it making problem to environment as well as human beings. therefore Bioremediation is a current issue and most economical and eco friendly. The aim of the study is to investigate the field scale study effect of BSB to degrade 16 types of PAHs and heavy metal stabilization in contaminated coastal sediment.

2. Materials and Methods

2.1 Methodology

The sediment was collected from Busan Northport and characterized according to standard method (APHA, 1998). The sequential extraction of heavy metals analysed according to Song et al., (2009) and it was measured by ICP-AES. For PAHs analysis, using Soxhlet extraction method followed by HPLC for further purification and analysis. PAHs extraction was determined by gas chromatograph equipped with mass selective detector in ion monitoring mode.

2.2.Field scale study

In this field scale study, 1m x 1m x 1m reactor was used

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and contaminated sediment was filled with the reactor (Figure 1). 3cm BSB was submerged with 5.5cm distance and covered with sand and gravel. The reactor was submerged into seawater and according to the time interval the sediment was collected and analysed.

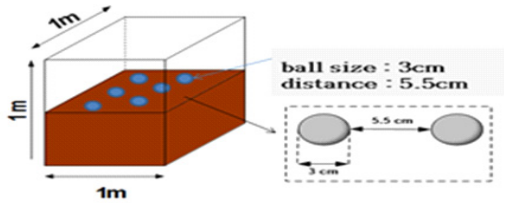

Fig 1. Schematic diagram of field scale study (1m x1m x1m) using BSB with distance

3. Results and Discussion

The concentration of 16 detected PAHs in the marine sediment in filed scale study with different month interval was shown in Figure 2. BSB containing nutrients to enhance the activity of SRB are able to degrade the PAHs in contaminated coastal sediment. Among these 16 PAHs, napthalene, anthracene, chrysene were degraded upto 100% in BSB added sediment at the end of 12 month time interval. While compared to control sediment, BSB degraded % were 44%, 35% and 15% respectively. PAHs containing 16 types of 2, 3, 4, 5 and 6 rings compound PAHs were found and to degrade upto 100% in 2, 3 rings, upto 90 to 94%in 4 and 5 rings and 6 ring compound was degrade upto7 0%.This reason may be SRB present in the marine sediment are utilize the BSB nutrients to enhance the activity and are able to degrade the PAHs in contaminated coastal sediment. similar result was found that Coates et al., (1997) and Rothermich et al., (2002) reported that marine SRB are able completely degrade some of hydrocarbon in marine sediment.

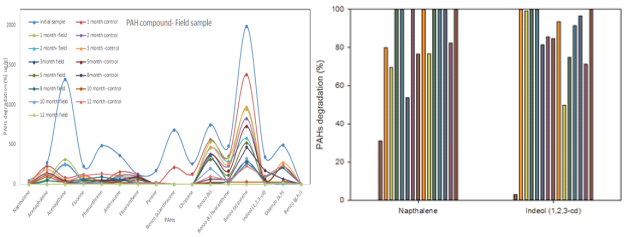

Fig. 2 (a) PAH degradation percentage at different month intervel using BSB (b) 2 ring compund and 6 ring compound degradation

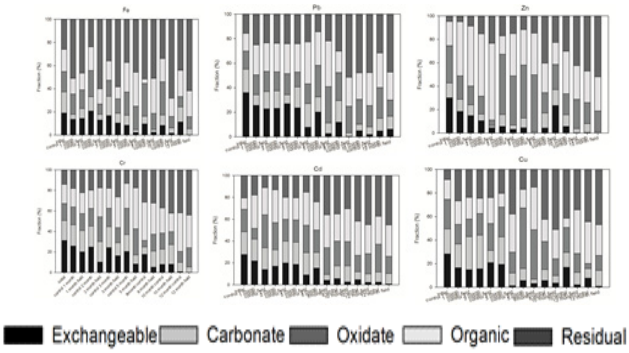

Fig. 3 Distribution of heavy metals percentage at different depth analysis (a) Fe (b) Zn (c)Cr (d)Cu e) Pb (f) Cd

The results showed the exchangeable fraction percentage was decreased up to 1% in all the analysed heavy metals except pb at the end of 12 month. While compare to control, residual % increased in the order of Fe, Zn, Pb, Cr, Cd and Cu were 62%, 52%, 47%, 44%, 45%, and 47% respectively .Large portion of the heavy metals in sediment present in the crystal lattice and residual fraction is stabilized in bottom of the sediment, while exchangeable and carbonate are altered to stabilized form.

4. Conclusion

Polysulfone coated BSB was prepared by using uncontaminated sediment and 1 m x 1m x 1m field scale study was examined and 12 month time interval carried out from the study. the parameters of 16 types PAHs and heavy metal stabilization were analysed. From the results, 2, 3, rings were degraded up to 100% 90 to 94% of 4, 5 rings and 6 ring compound was degraded upto 70% at the time interval of 12 month in BSB added sediment. Heavy metal exchangeable was decreased upto 1% in all analysed heavy ,metals and residual portion was increased. BSB containing nutrients of acetate, nitrate and sulphate are able to enhance the activity of SRB and degrade the PAHs as well as stabilise the heavy metal present in the contaminated coastal sediment.

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