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A Study on the advanced barrier with wasted materials to prevent TPH pollution

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INTRODUCTION

Introduction

- Preventing the diffusion of pollutants is essential to prevent environmental pollution
- There is a problem in terms of groundwater flow with a traditional method like a slurry wall
- Therefore, there is a need for advanced technology that can block only pollutants
- Coal Mine Drainage Sludge(CMDS) has a small particle size and a high iron contents, so it can replace bentonite

Objective

- Develop an advanced barrier with CMDS that can selectively block TPH
- Analyze the physico-chemical properties of barriers
- Determine the optimum mixing ratio of each material

MATERIALS & METHODS

Materials

- Ottawa sand, Polyolefin, Spillhound, Bentonite and CMDS were used in this study
- Fig. 1 shows the SEM image of Polyolefin
- Since polyolefin has a porous surface, it is expected to exhibit impermeability when it contact pollutants
- Fig. 2 shows the SEM image of CMDS
- CMDS has a micro pores, it is expected to replace bentonite
- Samples were made with various ratio
- Table 1 shows the mixing ratio of materials for each barriers

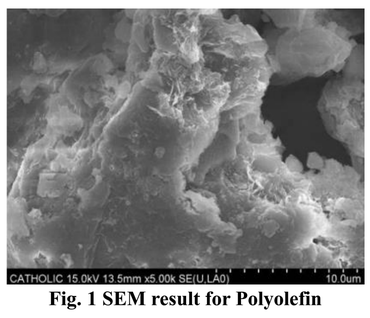

Fig. 1 SEM result for Polyolefin

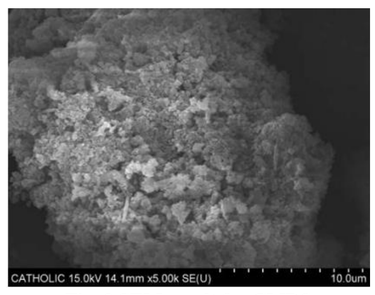

Fig. 2 SEM result for CMDS

Table 1. Mixing ratio of materials for each barriers

Materials / Case No.	Ottawa sand (w/w%)	Polyolefin (w/w%)	Spillhound (w/w%)	Bentonite (w/w%)	CMDS (w/w%)
Case 1				12	3
Case 2				9	6
Case 3	55	9	21	6	9
Case 4				3	12
Case 5				0	15

Method

- To develop an advanced barrier, the Environmental Hazardous of raw materials, Hycraulic Conductivity of each barrier and Compaction test had conducted
- Table 2 shows the method of analysis in this study

Table 2. Analysis Method

Analysis	Method
Environmental Hazardous	Leaching Test(Korea Standard Leaching Procedure (KS 06400))
Mineralogical Analysis	SEM-EDS(HITACHI (S-4800))
Compaction test	Korean Industrial Standard KS F 2312
Hydraulic Conductivity	Korean Industrial Standard KS F 2322

RESULT & DISCUSSION

Environmental Hazardous

- Environmental Hazardous analysis was conducted to determined wheter secondary contamination occurs when barriers are installed underground
- Table 3 shows the result of the Korea Standard Leaching Procedure
- As a result of KSLP, heavy metals were not detected, so it was determined that there was no effect on environtent

Table 3. The Results of Compaction Test

	Ottawa sand (mg/L)	Bentonite (mg/L)	Polyolefin (mg/L)	Spillhound (mg/L)	CMDS (mg/L)	Criteria (mg/L)
Pb	N/D	N/D	N/D	N/D	1.001	3
As	0.53	0.924	N/D	N/D	0.001	1.5
Cd	N/D	N/D	N/D	N/D	N/D	0.3
Cu	N/D	N/D	N/D	N/D	N/D	3
Cr^{6+}	N/D	N/D	N/D	N/D	N/D	1.5

Compaction Test

- Table 4 shows the results of compaction test
- The OMC increases from 23.01 to 31.52 % as the CMDS ratio increased
- The increase in OMC is due to the higher moisture content of CMDS than bentonite

Table 4. The Results of Compaction Test

	Case 1	Case 2	Case 3	Case 4	Case 5
Optimum Moisture Content (%)	23.01	25.22	26.88	28.08	31.52
Dry Density (g/cm^3)	1.40	1.52	1.60	1.76	1.84

Impermeability

- Table 5 shows the hydraulic conductivity of each sample according to the mixing ratio
- The hydraulic conductivity before TPH contact shows a value of 1.5×10^{-3} to 3.1×10^{-3} and 5.8×10^{-6} to 5.3×10^{-5} after contact

Table 5. The Results of Hydraulic Conductivity

	Case 1	Case 2	Case 3	Case 4	Case 5
Before Contact TPH	3.1×10^{-3}	2.1×10^{-3}	2.0×10^{-3}	1.8×10^{-3}	1.5×10^{-3}
After Contact TPH	5.8×10^{-6}	5.9×10^{-6}	7.1×10^{-6}	3.5×10^{-5}	5.3×10^{-5}

CONCLUSION

- The physicochemical properties of materials and samples were analyzed
- Each material used for barrier has no hazardous effect on environment
- The change in the hydraulic conductivity was showed in all samples, and the largest change was from 2.1×10^{-3} cm/sec to 5.9×10^{-6} cm/sec
- The advanced barrier developed in this study can be applied to prevent TPH contamination without hindering the groundwater flow

REFERENCE

- Choi et al (2019)
- Jang (2019)

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