The Characteristics of Soil Contamination in Industrial Complex in Korea

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Abstract

It is expected that the possibility of soil contamination will be high as industrial complex will be treated with many harmful chemicals during industrial activities. Therefore, the Korea Environment Corporation has been conducting a detailed survey of Korea's industrial complex since 2004.

There are about 1,193 industrial complexes in Korea. A total of 60 industrial complexes, 6,201 business companies, were surveyed between 2004 and 2018. Among them, 347 companies exceeded the standard for soil contamination, with a rate of about 5.5 percent.

The contaminated soil area of industrial complex is about 383,199 ㎡, the amount of contaminated soil is 663,849 ㎥. 282 companies are contaminated with soil, 17 are contaminated with groundwater, and 48 are contaminated with both soil and groundwater. The most significant excess of these contaminants were TPH, Zn, BTEX, Pb, and Ni.

The source of contaminants includes leaked storage facilities, mishandling and mismanagement, and brought in contaminated materials or contaminated land during industrial activities.

In the future, based on the results of this survey, the manual will be improved so that efficient investigations can be carried out in terms of time and cost, and used as promotional materials to prevent soil contamination.

Keywords: Soil Contamination, Industrial Complex in Korea, Contaminants, Source of contaminants

1. Introduction

In Korea, the 「Soil Environment Conservation ACT」 was enacted in 1995 for overall soil management, such as prevention, survey, remediation and establishing policies of soil.

The 「Soil Environment Conservation ACT」 defines surveys of various facilities to identify soil contamination in advance. Especially, the industrial complexes were expected that have more high potential for soil contamination than other areas because it usually used heavy metals and oil on process. Thus, the government has conducted a survey of soil contamination in industrial complexes and ordered the person responsible for remediation to treat contaminated soil if soil contamination is confirmed. The Korea Environment Corporation(shortly, "K-eco") has carried survey of soil contamination in industrial complexes based on same law.

There are a total of 1,193 industrial complexes in South Korea. Industrial complexes consist of companies with such as machinery, petrochemicals, transportation equipment, electrical electronics and steel. We surveyed 60 industrial complexes, and 6,201 companies from 2004 to 2018.

2. Soil Contaminants and Survey Method

The soil contaminants managed in South Korea are a total of 21 types, and added 1,2-dichloroethane and dioxine in 2019. The contamination standards are divided into three different categories: residential region(Region 1), park(Region 2) and industrial region(Region 3). The soil contaminants and contamination standards is shown in Table 1.

The survey procedure carried out in three stages according to the order of preliminary survey, basic survey, detailed survey based on 「Soil environment conservation ACT」, "Regulations on detailed methods of soil precision survey".

The process of survey is shown as Figure 1.

Figure 1. Process of Survey

Preliminary Survey	Basic Survey	Detailed Survey
- Desk Review - Listening Survey - Site Investigation	- Soil Sampling - Investigation surrounding storage tank, etc.	- Carried out on the points exceeding or feared to be contaminated - Estimated the area and volume of soil contamination

Table 1. Soil Contaminants Standards

Contaminants	Region 1	Region 2	Region 3
Cadmium(Cd)	4	10	60
Copper(Cu)	150	500	2,000
Arsenic(As)	25	50	200
Mercury(Hg)	4	10	20
Lead(Pb)	200	400	700
Chrome(VI)(Cr^{6+})	5	15	40
Zinc(Zn)	300	600	2,000
Nickel(Ni)	100	200	500
Fluorine(F)	400	400	800
Organicphosphorus Compounds	10	10	30
Polychlorinated biphenyl(PCBs)	1	4	12
Cyanide(CN)	2	2	120
Phenol	4	4	20
Benzene	1	1	3
Toluene	20	20	60
Ethylbenzene	50	50	340
Xylene	15	15	45
Total Petroleum Hydrocarbon(TPH)	500	800	2,000
Trichloroethylene(TCE)	8	8	40
TetraChloroethylene(PCE)	4	4	25
Benzo[a]pyrene	0.7	2	7

3. Results

According to the survey results conducted on 6,201 companies from 2004 to 2018, a total of 347 companies were found to have exceeded the contamination standards. So, a contamination discovery rate of about 5.5 percent. The area of contamination soil is 383,199 ㎡, volume is 663,849 ㎥.

There are 282 companies contaminated with only soil, 17 with only underground water, and 48 with both soil and underground water.

The petrochemical companies had high ratio of TPH, BTEX(Benzene, Toluene, Ethylbenzene, Xylene), while steel, machinery, transportation equipment companies had a high ratio of TPH and heavy metals(Zn, Pb, etc.). The Number of contaminated companies by type and contaminants is shown in the Figure 2 and Table 2.

Contamination sources for contaminants were expected to storage facilities leakage(146 companies), mishandling and mismanagement(80 companies), contamination during industrial activities(50 companies), and brought in contaminated materials or soil(50 companies)(permission for repetition).

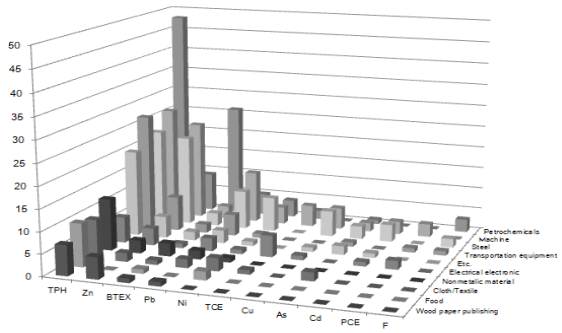

Figure 2. Number of contaminated companies by type an d contaminants

Table 2. Number of contaminated companies by type and contaminants

	TPH	Zn	BTEX	Pb	Ni	TCE	Cu	As	Cd	PCE
Wood paper publishing	7	5	1	1	0	0	0	0	0	0
Food	10	0	1	0	2	0	0	0	0	0
Cloth /Textile	9	2	1	2	3	1	0	2	0	0
Nonmetalic material	12	3	3	2	1	0	0	0	0	0
Electrical electronic	6	4	1	3	1	5	1	0	1	2
Etc.	20	5	2	3	1	0	1	2	1	0
Trans-portation equipment	27	8	2	5	1	0	0	1	0	1
Steel	22	21	3	9	8	0	6	3	4	0
Machine	26	23	3	12	4	5	5	2	3	3
Petro-chemicals	48	9	26	5	4	2	0	1	0	0

* Phenol(1), Cr^{6+}(1), Hg(1), TCA(1), P(a)B(1), CN(0), PCB(0)

4. Conclusion

During 15 years, a total of 347 companies were found to have exceeded the contamination standards by surveying 60 industrial complexes(6,201 companies). Early detection and remediation of contaminated soil and groundwater could protect the health of the people from the spread of damage caused by secondary contamination. Considering the causes of contamination, management of the aging and damage of storage facilities is necessary and leakage should be minimized during industrial activity. In addition, appropriate management methods should be adopted in each case because of different type of contaminants in different industries.

In the future, the results of this survey used to improving the manual so that an efficient survey can be carried out in terms of time and cost and used to promotional materials for prevention of soil contamination.

References

Ministry of Environment Government (2013), Soil&Groundwater Environment White Paper of Industrial Complex