Decomposition of Contamination Within a Site Using Microbes at the Former Site of Gas Manufacturing Factory in Hoshu, Tokyo

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Contaminants: Benzene and Oil

Cause of Measure: Discovered by independent investigation during the re-development accompanying the land rezoning.

One by one, the blue farm tractor is stirring up a row of soil, which was piled up in the site, leaving spaces in between. The Tokyo tower and skyscrapers are standing high outside the fences, which go around the site. Here is the bay ground of the center of Tokyo where re-development of the land is in progress. It is the former factory site of "Tokyo Gas" located in the wharf of Hoshu.

In Hoshu district, land re-development by the city is in progress. In order to advance district rezoning, Tokyo Gas investigated, from July 1998 to November 1999, whether there was soil contamination. In some parts of the 50,000 m^3 site, it was discovered that there was contamination by volatile organic compounds (VOC's), which included benzene and oil, as well as contamination by arsenic and other heavy metals.

Tokyo Gas launched the clean-up of soil contamination in February 2001. For soils with low concentration of oil contamination, the process is carried out in the purification yard established in one corner of a vast site of an area of about 8900m^2. This work, similar to the cultivation of a field by a tractor, is one process of purification of the oil-contaminated ground.

Decomposition of Oil in 90 Days

The decomposition technology used for cleaning of oil-contaminated soils is called bioremediation, which makes use of microbes. By activating the activity of microbes inhabiting the oil-contaminated soils, the decomposition of oil can be achieved.

In order to feed the nutrient sources to the microbes, the preparation is performed in a building located in the purification yard. The prepared sand and soils are thrown into the hoppper. The soils are ground finely and sawdust-like bark is mixed in. The chemical nutrients and the soil improving agent (Enretech-1) are further mixed into the soil, which is now carried to another equipment by conveyor.

Fig. 1:
The soils are stirred with a farm tractor as though farming. Supplying the oxygen to the microbes present in the soils improves the decomposition of contaminants. Troughs beside the farm tractor were covered with a sheet for protection.

"The carried-in soils and sand contain water and thus are in lumps. When grinding the lumps into small pieces, the gases (VOC's) are produced," explains Nobuichi Kojima of Simizu Construction JV, who is in charge of this whole process. The produced VOC gases are collected and are absorbed into activated carbon.

The nutrient-mixed soils are piled beside the building in the purification yard. The reason for mixing the soils by a farm tractor is so that the microbe activity is activated due to the incoming supply of oxygen into the soils. "They are mixed once or twice a week. In summer, the decomposition of oil contaminants is achieved in a month and a half," says Kojima.

In order to confirm the decomposition of contaminants, investigation by an analytical laboratory is required. If it is confirmed that purification is finished by this investigation, the soils are buried back into the site.

"It is cheaper than carrying the soils outside"

To explain why a bioremediation method was used, the Local Administration Department Lot Environmental Maintenance Manager Ryoshi Maruyama explains, "it is cheaper to carry out this process within the site than carrying the dug soils outside. It even takes less time if not dug out."

In this site as well, similar to the previous site, emphasis is given for the protection of the surrounding environment.

For example, rows of treated soil are covered with sheets as a protective measure against dust generation. The drainage generated in the process is collected and is purified through processing equipment. In addition, when trucks that carry contaminated soils enter and leave the yard, their tyres are washed. It is to prevent the spreading of contaminants outside the site.

The contaminated soils, which are due to other than benzene and oils, are processed after they are carried outside of the site because microbes cannot decompose substances such as cyanogens and arsenic. To process differently, soils with cyanogens are heated and ones with arsenic are washed.

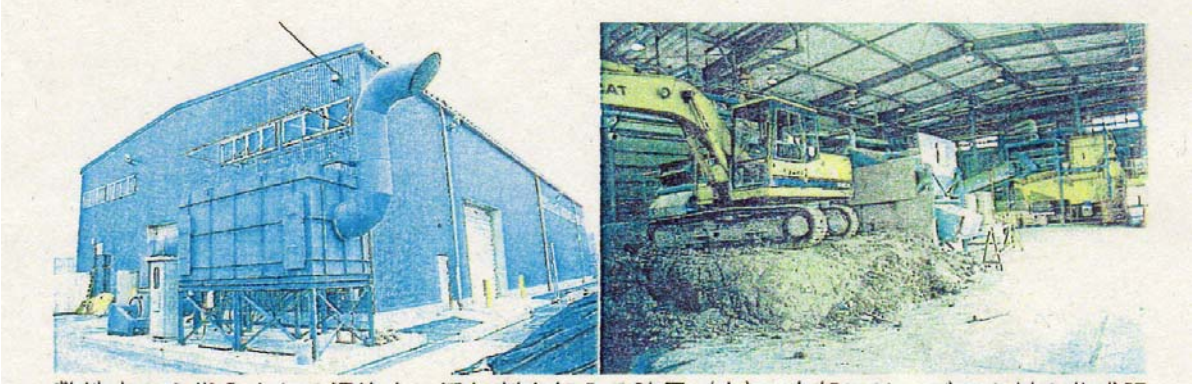
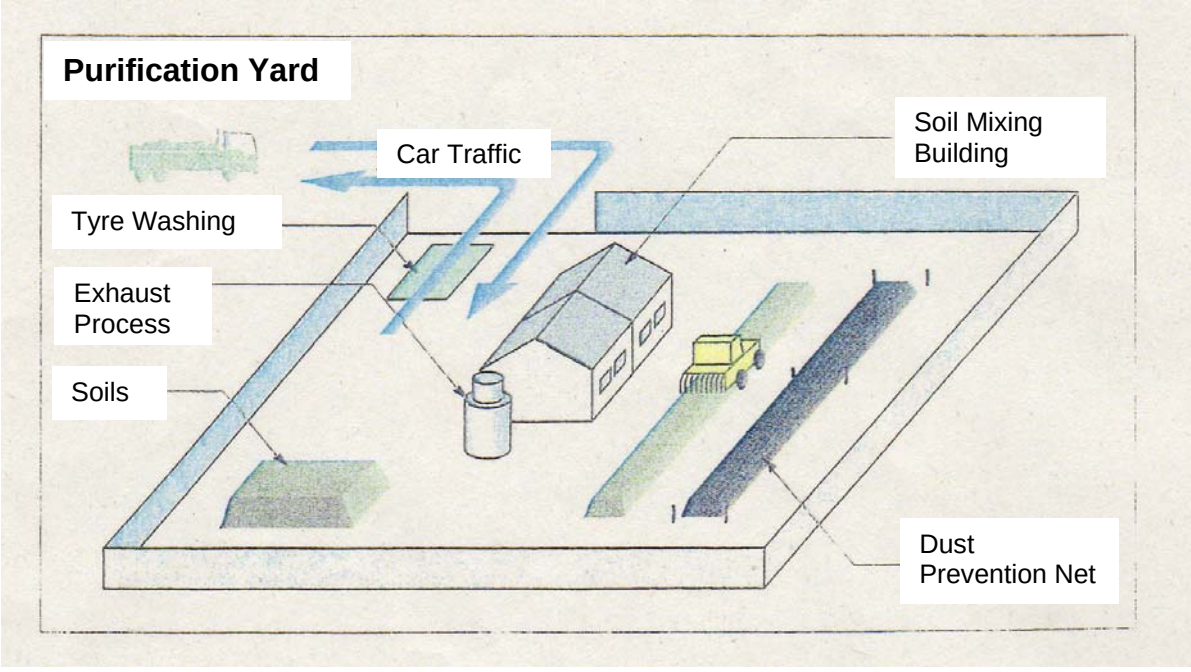


Fig. 2: The building, which adds additives to the soils carried in from the site (left). Inside, a plant, which mixes materials such as bark and chemical manures, was set up.



Independent Investigation Carried Out in All 250 Lots

Tokyo Gas conducted an independent investigation in lots such as former sites of coal gas manufacture factories where there is a potentiality of soil contamination. The investigation was completed by June 2002. The investigation results are published in the company website, http://www.tokyo-gas.co.jp.

The investigation was launched in 1999. After each ground history was researched in about 250 lots, there were 30 lots where more detailed investigation was considered to be necessary. Contamination was discovered in 26 lots. Benzene, cyanogens, and arsenics were detected as major contaminant substances.

The processes were based on the removal of contaminated soils by digging, installation of water floodgate, water pumping, and a process called air sparging, which promotes the gasification of contaminants by sending air into the contaminated soils. The Company Manager Maruyama says, "The land sales are not our purpose. We opt for a measure based on the level required in order to prevent the contamination spreading.

These processes are ordered from major construction firms on a special mission. "The hearing was carried out to some construction firms and we considered whether the processes can actually be done." (Manager Maruyama).

Site Name	Area	Soil Content		Groundwater Levels		Contents Of Measure					Time
	(ha)	Ratio	Major Contaminants	Ratio	Major Contaminants		Digging Removal	Floodgate	Water Pumping	Air Sparging	
Former site of Yokohama Factory (Kanagawa)	17.1	9300	Benzene	3500	Benzene	Purification	--	❍	❍	--	1 yr
Kofu Branch (Yamanashi)	0.5	1900	Benzene	1400	Benzene	Purification	❍	❍	❍	--	5mo
Hoshu (Tokyo)	49.7	1500	Benzene	100	Benzene	Purification	❍	--	--	--	6y2m
Tsurumi Office (Kanagawa)	18.0	1400	Arsenics	1400	Arsenics	Purification	❍	❍	❍	--	1 yr
Fukagawa (Tokyo)	3.1	1300	Benzene	1500	Benzene	Purification	❍	❍	❍	❍	2y11m
Senjyu (Tokyo)	11.1	420	Cyanogens	260	Arsenics	Purification	❍	❍	❍	--	3yr
Kofu Branch (Yamanashi)	1.1	280	Benzene	--	--	Purification	❍	--	--	--	3mo
Omori (Tokyo)	7.7	140	Arsenics	1700	Arsenics	Purification	❍	❍	❍	--	2yr
Yokosuga (Kanagawa)	0.5	140	Benzene	330	Benzene	Purification	❍	--	❍	--	5mo
Unuma (Kanagawa)	3.2	77	Benzene	180	Benzene	Purification	❍	--	--	❍	1y1m
Utsumiya (Tochigi)	0.7	47	Benzene	--	--	Purification	❍	--	--	--	3mo
Tamachi (Tokyo)	3.2	45	Cyanogens	15	Cyanogens	Purification	--	--	❍	--	3mo
Former site of Suehiro Factory (Kanagawa)	3.9	39	Cyanogens	390	Benzene	Purification	❍	--	❍	--	6mo
Hidachi (Ibaraki)	1.6	28	Cyanogens	22	Benzene	Purification	❍	❍	❍	--	3mo
Maebachi (Gunma)	0.3	14	Cyanogens	6	Cyanogens	Purification	❍	❍	❍	--	6mo
Nagano Branch (Nagano)	0.6	13	Cyanogens	--	--	Monitoring	--	--	--	--	-
Tachigawa (Tokyo)	1.7	10	Cyanogens	--	--	Monitoring	--	--	--	--	-
Mokkowan (Chiba)	12	9	Benzene	4	Benzene	Purification	❍	--	❍	--	7mo
Hachioji (Tokyo)	0.3	7	Cyanogens	--	--	Monitoring	-	--	--	--	-
Takahashi (Gunma)	0.4	7	Cyanogens	5	Cyanogens	Purification	❍	❍	❍	---	6mo
Rokuwan (Kanagawa)	1.1	6	Lead	3	Boron	Monitoring	--	--	--	--	-
Chibakencho (Chiba)	1.0	5		1.5	HCl	Purification	--	--	--	--	7mo
Hiratsuka (Kanagawa)	1.1	3	Arsenics	1	Cyanogens	Monitoring	--	--	--	--	-
Aikohara (Kanagawa)	2.2	2	Lead	49	Lead	Monitoring	--	--	--	--	-
Kumadani (Saitama)	0.5	1	Lead	--	--	None	--	--	--	--	-
Fujiwara (Kanagawa)	0.5	--	--	2	Cyanogens	Purification	--	--	❍	--	3mo

Conditions / Properties of 26 sites in which Tokyo Gas found to be contaminated
Attn: "Ratio" is a measured value to an environmental standard value.
-- indicates a value below standard or N/A.