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Geo-Pollution and A Clean-Up System

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Groundwater pollution nationwide should be recognized as the outcome of a variety of forms of geo-pollution.

Although groundwater pollution has, according to some reports, been on the wane in recent years, this is not so. In the urban areas especially, it shows no signs of decreasing.

This paper, first of all, classifies the instances of geo-pollution that have been recognizably caused by organic solvents, both by regions and by industrial segments.

The paper summarizes the newest discoveries about the harmfulness of chlorinated organic compounds, and makes clear four significant features that must be taken into account in any clean-up of geo-pollution. The author has investigated the present situation and the points at issue for the clean-up on both nationwide and local scales, and shows that, especially in the nationwide investigation, institutional problems have not yet been resolved: "Who is responsible for clean-up?", "Who has to pay the cost of the clean-up?", and so on. A further problem is whether or not the landowner should bear any responsiblity for the clean-up. On the positive side, the author introduces and analyzes the policy of advanced pollution abatement, adopted for example, by the Groundwater Clean-up Ordinance (Japanese type-Superfund) of Hadano in Kanagawa Pref., and the system developed by Chiba Pref., where the Pref. government gives both technical and financial assistance to the investigation of the pollution mechanism, and other features. In conclusion, while recognizing both the importance of geo-pollution and the significance of its clean-up, the author emphasizes the necessity for a policy which integrates the issues of groundwater and soil pollution as well as their clean-up.

1. Introduction, What is Geo-Pollution ?

In Japan, groundwater pollution has recently occurred on a nationwide scale.

Groundwater has been polluted by, for instance, such chlorinated organic compounds as trichloroethylene and nitrate. To counter this, a partial revision of the 1989 Water Pollution Control Law has implemented measures such as a ban on the infiltration underground of water containing hazardous substances. The condition of groundwater is thus now regulated by the law in the same way

that a "public water body" has to be. Thanks to this regulation, all prefectures of Japan are now required to make public the annual measured value of groundwater quality. Subsequently, the serious occurrence of groundwater pollution in Japan has become more generally known.

What is even worse, the pollution is not limited to groundwater. To begin with, groundwater pollutes the stratum with toxic substances, and then, as a matter of course, brings about groundair pollution at the same time. Consequently, three instances of pollution—in groundwater, in the sedimentary strata, and in the groundair—have been grouped together, and are now referred to as "geo-pollution". The effect of geo-pollution is to change the sedimentary strata (the cluster of soil particles), groundwater, and groundair into substances which are physically, chemically, and biologically disadvantageous to human beings, as well as inducing the chemical reaction of artificial substances.

It can then be deduced that a special type of soil pollution occurs in the sedimentary strata where various chemical substances of soil are transformed. As polluted substances in the water, and groundair, run through stratum gaps and stick to stratum components they work to change the quality of those (strata) components, and result in the harmful phenomenon now known as "geo-pollution". In other words, groundwater pollution occurs when polluted substances and water are dissolved or mixed with interstitial water in the sedimentary strata.

Sedimentary strata pollution by chlorinated organic compounds occurs when the sedimentary strata as the first pollution source works as the secondary polluter of groundwater.[1)]

Meanwhile, geo-pollution can be correlated with surface water during the process of circulation between land and water. The incessant fluctuation of atmospheric pressure leads to the inflow and outflow of polluted groundair, and the atmosphere is consequently polluted. In the end, polluted substances seep up to the surface of the earth; we call this "cross-media pollution".[2)]

The investigation carried out in this paper has three purposes: 1, to indicate the present situation of geo-pollution in Japan and the significant need for a clean-up of geo-pollution; 2, to scrutinize the abatement policies and the points at issue of geo-pollution as instituted or recognized by nationwide and local governments; 3, to elucidate the problems caused by geo-pollution which need to be solved.

2. Spread and Kinds of Geo-Pollution

2.1. The Present Situation

According to the findings of a survey on the general state of groundwater pollution carried out by the Environment Agency in 1994, concentrations of trichloroethylene in excess of water quality decreased from 0.9% in 1989 to 0.3% in 1993, while that of tetrachloroethylene decreased from 1.2% to 0.5%, respectively.

It seems at first glance that the decreasing percentages revealed by the data signify a reduction in groundwater pollution. When we scrutinize the data, however, it becomes obvious that the areas investigated were extended from the highly polluted urban areas to include the outskirts of the town.

Since groundwater pollution caused by chlorinated organic compounds does not usually spread sideways but penetrates vertically, the highly polluted area is limited. It is hard to detect pollution outside the periphery of the pollution source, except for a designated speculative zone.[3]

But once a full-scale investigation of the urban area is made, organic solvents can be quite easily detected in the groundwater. An investigation of 108 wells in Kawasaki City, Kanagawa Prefecture, detected trichloroethylene in 52 (48%) of the wells and found that 20 (19%) of them fell short of the environmental standard quality level, while tetrachloroethylene was detected in 60 wells (56%) and 13 wells (12%) were found to fall short of the environmental standard.[4]

In my book, "High-Tech Pollution," published by Iwanami in 1989, I blame geo-pollution mainly on the high-tech industry. Upon re-investigating the pollution problem, I can report that "high-tech pollution" has become more serious without our having realized it.

Yet there is also no doubt that further investigation reveals many pollution sources around us quite apart from the high-tech industry.

As for "high-tech pollution itself," in addition to what is known of Toshiba, Taishi Semiconductor Plant of Taishi in Hyogo Pref.[5] and Toshiba Components of Kimitsu of Chiba Pref.,[6] which led to the partial revision of Water Pollution Control Law, recent research in Kumamoto has partially uncovered the mechanism of groundwater pollution.[7]

It is well known that geo-pollution and groundwater pollution are caused by the semiconductor and the electric parts plants all over the country: Yohkaichi in Shiga Pref.,[8] Takefu in Fukui Pref.,[9] Higashine in Yamagata Pref.,[10] Hadano in Kanagawa Pref.,[11] Itami in Hyogo Pref.,[12] to name a few.

Many related pollution problems also occur at medium and small-sized plants, the so-called high-tech subcontract plants: Machida in Tokyo,[13] Kumamoto area, Hadano, the Prefecture of Fukushima, Ichikawa in Hyogo

Pref.,[14] Mobara in Chiba Pref.,[15] Nishikata in Tochigi Pref.,[16] Tokura in Nagano Pref.,[17] Yatsuo in Toyama Pref.,[18] Shuto in Yamaguchi Pref.,[19] and so on.

The most common cause of groundwater pollution is tetrachloroethylene, the detergent of the cleaning industry. Since most laundries are medium and small -sized with few funds, they cannot afford to grapple with the clean-up or help to illuminate the pollution mechanism, and because very little well water is used in urban areas, outbreaks of geopollution are left untreated.

Pollution by tetrachloroethylene also occurs in the textile industry: at Tsukidate in Miyagi Pref.,[20] Yonezawa in Yamagata Pref.,[21] Tohkamachi and Gosen in Niigata,[22] Kyoto,[23] and so on.

As chlorinated organic solvents have been widely used and stored very carelessly even in the metal industries, general machinery, and precision machine companies, pollution is apt to occur in such small plants as city ironworks no less than in the major plants. A well-known pollution case is that of the metal hardware manufacturing factories at Tsubame in Niigata Pref.[24]

In addition, many pollution problems have arisen at the automobile parts plants at Odawara in Kanagawa Pref.,[25] Nishiki in Kumamoto Pref.,[26] Narashino in Chiba Pref.,[27] and at Ohno in Fukui Pref.

An inquiry into the siting of an automobile parts plant was brought to court because of the problem of possible groundwater pollution.[28]

To date, we can locate the areas in Japan where pollution occurs and we are able to identify the probable causes of the pollution: Metal processing plants: Naganuma in Chiba City,[29] Samukawa in Kanagawa Pref.,[30] Fujieda in Shizuoka Pref.,[31] Fujinomiya in Shizuoka Pref.,[32] Kyoto,[33] and Miki in Hyogo Pref.[34]; Surface treatment plants: Yokohama,[35] Nagano,[36] and Fujieda in Shizuoka Pref.[37]; Electric wire plants: Gotenba in Shizuoka Pref.,[38] Itami in Hyogo Pref.,[39] Tsuchiura in Ibaragi Pref.,[40] Tabuse in Yamaguchi Pref.[41]; Lens plants: Kanuma in Tochigi Pref.,[42] Fukushima, the Prefecture of Fukushima[43]; Watchmaker plants: the Prefecture of Fukushima and Kimitsu in Chiba Pref.[44]; Machine tool plants: Narashino in Chiba Pref.[45]; Painting plants: Tsuru in Yamanashi.[46]

Unexpectedly, the chemical industry has also been pointed out as another source of industrial pollution. To our surprise, such pharmaceutical plants as those at Takatsuki in Osaka Pref.[47] and Amagi in Fukuoka Pref.[48] and other chemical plants like those at Kashiwa in Chiba Pref.[49] have also been named. In addition, pollution is caused by general chemical product manufacturers, such as Kohriyama in Fukushima Pref., Himeji in Hyogo Pref.,[50] and Fujikawa in Shizuoka Pref.[51]

Apart from what an ordinal industrial classification reveals, pollution has

been found in the recycling of organic solvent itself, for instance, at Matsudo in Chiba Prefecture,[52] Kawasaki in Kanagawa Pref.,[53] Yamashina in Kyoto.[54]

The most important pollution source apart from industrial pollution are landfill sites for industrial waste, and at Ohmachi in Nagano Pref. even the head waters are polluted.[55]

According to an "Investigation Survey of Appropriate Management Measures for Landfill Sites"[56] of the EX Metropolitan Institute, there are many precedents of final landfill sites having caused pollution of both groundwater and surface running water.

① Polluted water leaked from the broken tank of a seeping water treatment plant. ② Many fireflies raised by firefly breeders died from polluted water. ③ A paddy field near a landfill site was damaged by salt from waste water. ④ Owing to leaking water containing a high concentration of iron and manganese, the plant was forced to postpone the suspension of its operation. ⑤ While managing the reclaimed land after the completion of the reclamation, the neighboring residents began to doubt the safety of the reclaimed land and finally came to the conclusion that the reclaimed land was the pollution source of neighboring groundwater. ⑥ With the aim of establishing environment protection, they introduced seepage control work by covering the reclaimed waste in the landfill site of nonflammable material with a polyethylene sheet.

Groundwater pollution occurs at the local site at Mizuho in Tokyo.[57] Similarly, at Hinode in Tokyo, groundwater pollution has been caused by components other than chlorinated organic compounds produced at the landfill site.[58] At Tago in Katori, Chiba Pref., trichloroethylene and other chemicals have been detected in water of the wells in the neighborhood of the landfill site, and, as a result, the neighboring residents have asked for a shutdown of the operation.[59]

Other examples of illegally dumped waste as a pollution source can be found at, Iwaki in Fukushima Pref.,[60] Kashiwa in Chiba Pref.,[61] Kawanishi in Hyogo Pref.,[62] Karatsu in Saga Pref.[63]

A survey carried out by the Water Works Division of the Ministry of Health and Welfare reported that the number of water supply sources polluted by organic solvent amounted to 92 in all for March, 1993, and, in detail, 50 in the Kanto District, 20 in the Central District, and 15 in the Kinki District. (See Table 1.)

One more important pollution source that we cannot disregard is the military base. It cannot be denied that pollution in a military base is connected with the use of heavy metals, Polychloriated biphenyl (PCB), and asbestos, quite apart from organic compounds. It is assumed that the American military supply base at Sagamihara in Kanagawa Pref., for instance, is one of the pollution sources of

Table 1. Waterworks Polluted By Trichloroethylene in Japan

Area	Drawing of Drinking Water from Headwaters: Practice discontinued	Treatment	Dilution	Monitoring	Total
Hokkaido					
Tohoku				1	1
Kanto	14	21	1	14	50
Chubu	7	7	1	5	20
Kinki	4	8		3	15
Chugoku	1				1
Shikoku				1	1
Kyushu	1	3			4
Okinawa					
Total	27	39	2	24	92

(Source) Ministry of Health and Welfare, Waterworks Division, 1993.
(Note) The waterworks include simple waterworks and special waterworks.
The number shows the waterworks where concentrations in excess of water quality standards were detected up to 1993.

trichloroethylene.[64]

A survey carried out by the Environment Agency says that the types of business which cause geo-pollution are, among others, the chemical, the electroplating, the electrical appliance manufacturing industry, and so on.

As pollution substances, trichloroethylene and tetrachloroethylene have been newly added to heavy metal lead, hexavalent chromium (Cr^6), and quicksilver (See Table 2).

2. 2. Harmfulness of Chlorinated Organic Compounds

Tetrachloroethylene, a chlorinated organic compound and a potential source of geo-pollution, has been widely utilized as a detergent by the cleaning industry.

Recently there has been a reduction both in the quantity of output and the amount used, but its toxicity is stronger than that of other chlorinated organic detergents.

Only at the rate of about one tenth of a test tube (3cc) of tetrachloroethylene to an ordinary pool 25 meters long (about 460m^3) of water, it exceeds environmental standards. According to the valuation of U. S. Environment Protection Agency, tetrachloroethylene belongs among carcinogens to Group B2. That indicates sufficient evidence in animals and inadequate or no evidence in humans.

According to the valuation of the International Agency for Research on Can-

Table 2. Geo-Pollution Classified By Industry and Substance

Industry	Cases	Cd	CN	Pb	Cr^6	As	Hg	PCB	CCl_4	①	②	MC	TCE	PCE	Cu	Zn	Ni	Phenol	F	Oil	Other	Total
Textile	2	1	1	1		1	1	1						1							1	8
Wood proc.	2				2	2									1			1			1	7
Chemical	33	8	3	12	4	8	17	2				1	2	1	3	2	1	3	1	1	5	74
Oil, Coal	1											1	1	1								3
Plastic	1	1			1																	2
Rubber	1												1	1								2
Ceramic	7	2		2	1	1	1					1	1	2								11
Steel	4	1	1	2	2	1	1	1								1						10
Nonfero-metal	9	4		5	1	4							2	1		2						20
Nonfero-mine	1	1																				1
Metal proc.	45	4	13	7	27	2	1	1				5	8	4		2						74
(Elect. plate)	(29)	(2)	(9)	(3)	(24)	(1)	(1)	(1)				(2)	(4)	(3)		(1)						(51)
Genera. Machine	2											1	1									2
Elect. machine	29	2	1	5	3		1	4				4	13	5		1						39
Trans. machine	8	1	1	2	3	2	1						2			1				1		14
Prec. machine	2											1	2	1								4
Gas	3		3				1													1		5
Recycle	4			1				2						1								4
Dry-cleaner	21											1	2	21								24
Waste disposal	8	2		2	1		1	1				1	2	2		1	1			1		15
Res. institute	8	3		5		2	7	1					1			3						22
Others	12			2		1	2	3												6	1	15
Unknown	28	6		8	1	4	8	3	1	2	3	2	6	6	1	9		1		2		63
Total	232	36	23	54	46	28	42	19	1	2	3	18	44	47	5	22	3	5	1	12	8	419

(Source) Environment Agency, 1995.

(Note) ① means 1.2 Dichloroethane.

② means cis-1.2. Dichloroethane.

cer, it belongs to Group 2B.

This implies, evidence for carcinogenicity to humans is inadequate, evidence for carcinogenicity to animals is sufficient.

Although trichloroethylene has been widely used as a detergent for washing semiconductors, electronic parts and metal products, there has been a temporary reduction both in production and consumption now that it is regulated as a designated chemical substance.

And since 1. 1. 1.-trichloroethane has recently been named by the Montreal Protocol as contributing to the greenhouse effect the amount used has been reduced. Consequently, the use of trichloroethylene, as a substitute for 1. 1. 1. -trichloroethane, is again increasing in amount.

Although trichloroethylene has been classified as a carcinogen for some time, according to the valuation of the International Agency for Research on Cancer, trichloroethylene belongs to Group 3 (chemicals not classifiable as carcnogenic to humans).[65]

It is, however, evident that trichloroethylene is acutely toxic, and that even under standard permissible concentrations, it inflicts various kinds of damage upon human health.

In fact, many children at Woburn in the United States have suffered from leukemia, caused by their drinking well water contaminated with trichloroethylene.

Consequently, it cannot be denied that there is a epidemiologically passive correlation between trichloroethylene and leukemia.[66]

In place of trichloroethylene and 1. 1. 1.-trichloroethane, which have now been regulated, the use of dichloromethane has been rapidly increasing. (See Table 3)

Table 3. Production Amounts of Organic Solvent Used in Japan (Ton)

Year	Trichloroethylene	Tetrachloroethylene	1. 1. 1. Trichloroethane	Dichloromethane
1990	56850	83619	184991	77466
1991	51679	67139	177146	82259
1992	61080	63225	168440	83519
1993	68416	63866	77568	93349
1994	77159	57777	54629	88877

(Source) MITI, Statistical Year Book of Chemical Industry.

But the problem still remains: It is not yet clear what influence dichloromethane has on a human being's central nervous system.

Thus, the regulation and the use of organic solvent are trapped in what has

been called "a vicious circle," and the development of a non-organic-solvent rinse without any chlorinated organic solvent is therefore badly needed.

New methods and techniques of rinsing are being gradually developed: rinse with alcohol or pure water or manufacturing techniques without the need for a rinse.

2. 3. The Significance of the Clean-Up of Geo-Pollution

Once groundwater is proved to be polluted and is no longer suitable for drinking water, tap water can be easily substituted for groundwater. There is no doubt, however, that the source of pollution is left untouched.

Even if it is easy and possible to switch water from groundwater to tap water, tap water is sure to be contaminated with trihalomethanes that lower the safety of the water and have a harmful influence on human health. Ignorance of geo-pollution and negligence of the appropriate clean-up of geo-pollution only accelerate the spread of the polluted areas.

As an appropriate example, at Fuchu, Tokyo, the authorities stopped drawing water from the well because groundwater was contaminated with a chlorinated organic compound, but subsequently neglected to take proper measures against the contaminated groundwater.[67]

The result was the spread of contaminated groundwater throughout the city.

As groundwater sources are connected with each other through underground veins, groundwater pollution easily spreads outside the administrative zone, for instance, at Yohkaichi, Ohmi-hachiman and Azuchi in Shiga Pref.,[68] Takefu and Sabae in Fukui Pref.,[69] Narashino and Chiba in Chiba Pref.,[70] Tochigi and Nishikata in Tochigi Pref.,[71] Sagamihara and Zama in Kanagawa Pref.[72]

It is obvious from investigation reports of such sites polluted by groundwater as Kimitsu and Taishi[73] that, below ground, trichloroethylene, a lower toxic chlorinated compound, is decomposed into 1. 1.-dichloroethylene, a more toxic chlorinated organic compound, which is about 100 times as carcinogenic as trichloroethylene.

This fact indicates that we have to consider the long-term influence of polluted groundwater on the environment, now that we are being confronted with the spread of polluted groundwater.

Yet even when geo-pollution occurs around us, many people refuse to grapple either with the clarification of the pollution mechanism or with the clean-up of geo-pollution.

According to the "Report of an Administrative Inspection Result on Water Quality Protection Measures,"[74] the Administrative Inspection Bureau of the General Affairs Agency, which targetted 56 districts of 12 Prefectures over the whole of Japan, the local authorities offered three reasons why they did not

investigate the groundwater pollution source: 1, It costs too much money to investigate (15 districts). 2, They did not know the procedure and the measures for specifying pollution source (18 districts). 3, Water works are in very common use in their districts and so it is not always necessary to clean-up the groundwater (10 districts).

Here let me once more summarize the significance of the clean-up of geo-pollution.

The first reason is the issue of (concern for) human health.

Whether or not groundwater is required for drinking, groundwater pollution has some connection with both sedimentary strata and groundair pollution through the "geo-pollution of cross-media".

The second issue is how we should rank the importance in our lives of the precious quality of water. In Japan, the rate of groundwater supply for our everyday lives is about 30%, and in order to convert all drinking water into surface water, much more money is required. As the 1994 drought indicated, it is very difficult under the many restrictions of geographical conditions to tap much more surface water over a brief period of time. Groundwater is ranked highest of all sources of water because of its delicious, safe, and useful quality.

The third issue, related to the second, is that the clean-up of geo-pollution can contribute to the elevation of the value of land and water resources. For instance, in the United States, it is necessary to examine the state of land at the time of sale, and the consequent confirmation of any geo-pollution is indispensable if the sale is to go through. That is because the landowner is responsible for the clean-up of the land. It is a matter of course that once the land is polluted, the value of the property is impaired.

The fourth is that the chlorinated organic compounds which cause geo-pollution, just as does 1. 1. 1.-trichloroethane, also contributes to global warming.

In order to preserve a clean environment for the earth, we should gradually cut down on the use of chlorinated organic compounds, clean-up the polluted soil, and recover the toxic chemical compounds.[75]

3. Tackling the Clean-up

3. 1. Problems at the National Level

One of the reasons why, in Japan, geo-pollution has been ignored, is that there are no regulations regarding geo-pollution at a national level.

Geo-pollution can be divided into two types, soil and groundwater pollution.

As far as soil pollution is concerned, in urban areas other than farmland, the Agricultural Land Soil Pollution Prevention Law is not applied, while there are no definite legal regulations for the clean-up of groundwater pollution.

Article 19 of the Water Pollution Control Law, revised in 1989, specifies the

" strict liability of a trader responsible for discharge and seepage into the underground to compensate for damages caused by discharge and seepage," yet the duty of clean-up is not specified.

The " Waste Disposal and Public Cleaning Law " provides in Item 4 of Article 19 (Measure Order) that the government can order those responsible to take necessary measures to remove obstacles or prevent the damage in the belief that the living environment would be or might be damaged.

This regulation, however, mentions only the disposal of present waste; this differs from the Superfund Law (CERCLA/SARA) of the United States, and is not applicable to any pollution caused in the past.

In these circumstances, geo-pollution in urban areas has been dealt with as a soil pollution problem only.

Up to now, there are no legal regulations regarding soil pollution in urban areas other than farmland.

In 1986, the Environment Agency announced " Provisional Guidelines for Clean-up targetted at the Contamination of State Property." In the Guidelines, criteria for soil contamination and level of actions/measures for clean-up were provisionally proposed for nine contaminants, mainly of heavy metals.

It was not until 1991 that an environment quality standard for soil pollution, required by the Basic Law of Environmental Pollution Control, was finally established. (It names 10 substances, 25 substances subsequently, not applied to a landfill site.)

Along with this, in 1992, the Provisional Guidelines of 1986 were revised and named " Guidelines for the Clean-Up of Soil Contamination of State Property " (9 substances are named).

But the provisional measure guidelines published prior to the revision have been the principles for dealing with soil pollution of private land that most local governments have followed.

In November of 1994, the " Guidelines to Investigate and Measure for Soil and Groundwater Pollution " were first issued. Its main points are: ① Chlorinated organic compounds as well as heavy metal are subject to investigation; ② With relation to chlorinated organic compounds, groundwater pollution as well as soil pollution is subject to investigation; ③ Not only state property but also land in general is subject to investigation.

Consequently, the earlier " Guidelines for Clean-up of Soil Contamination of State Property " were rescinded.

The new guidelines are a slight improvement upon the previous ones for the reason that they mention land in general, thus integrating soil and groundwater pollution with geo-pollution.

But they have neither legal binding force nor do they mention the institu-

tional issue of the person who is to be in charge of clean-up and the allocation of cost.

The problems of comprehending the actual condition of groundwater pollution are:

The Environment Agency will assist in bearing the cost of any groundwater quality investigation executed by the local government (the subsidiary rate is one third of the total cost, and in 1993 it amounted to about ¥90 million), and requires the Director of the Water Quality Preservation Bureau to inform it of the measured value of water quality investigation and the locations of wells by districts.

But the Environment Agency is not in real earnest in its attempt to grasp the extent of the pollution to be confirmed, the sources of pollution to be specified, and the clean-up action to be followed, since no report of the investigation from the local government is required.[76]

The Environment Agency gives two plausible excuses of making slow progress in the clean-up of geo-pollution[77]:

1. The goal of clean-up has not yet been set.
2. It has not yet been determined how the cost will be allocated.

This is how they explain the allocation of cost:

① At present, it is difficult to specify the pollution source and the person responsible for the pollution.

② It is hard to find if the pollution source is the result of illegal dumping, even when it can be specified as such, still less can the polluter be specified.

③ General regulations for underground seepage control issued by the Water Pollution Control Law, and the waste disposal standards provided by the Waste Disposal and Public Cleaning Law, have already been published.

There is, however, another consideration: whether it is reasonable or not to demand the payment of the clean-up cost for an offense prior to the drainage and the groundwater seepage regulation relating to toxic substances of trichloroethylene and so on.

④ It is very difficult to allocate clean-up costs for small-scale business.

If we assume that the clean-up will make little progress in the present serious situation because it has not been determined who will bear the clean-up cost, we have to admit that the doctor may well refuse to diagnose the patient until the patient's solvency is confirmed.

Although the real reason for the poor progress in clean-up is, therefore, the failure to recognize the importance of the pollution problem and the significance of its clean-up, the problem of allocating the clean-up cost needs, nevertheless, to be discussed separately.

Of the four points mentioned here, the first and the second (the identification

of the polluter) are both attended with serious difficulty.

But it is quite obvious from the example of Chiba that it is almost impossible to clarify the pollution mechanism without the concept of geo-pollution. The question is, therefore, similar to the problem of earlier illegal dumping: how to specify the unidentified polluter.

The third issue is the problem of retroaction, and the fourth is the problem of the solvent of small-scale businesses, both of which need to be discussed separately.

3. 2. The Action of Local Governments: Technical and Financial Assistance to Clarify Pollution Mechanism-The Chiba Method

The major obstacles to clarification of the geo-pollution mechanism are the financial and technical problems. In order to solve these two problems, Chiba Prefectural government has established a technical and financial support system for her cities, towns, and villages, and, consequently, achieved a remarkable success in the clarification of both mechanism and clean-up.

The national government took the opportunity provided by the groundwater case brought against Toshiba Components in Kimitsu, Chiba Pref. to revise the "Water Quality Pollution Control Law" on the national scale. Revisions are bound to be partial-otherwise you would scrap the law and start again.

In Chiba Pref., the "Guidelines for Groundwater Pollution Preventive Measures" were enacted in 1989.

Based on the guidelines, various measures were taken by the Chiba Prefectural government, such as monitoring groundwater quality, giving guidance to traders, measures to confirm pollution and so on, as well giving technical and financial assistance to her cities, towns, and villages.

The details of technical assistances are: ① To institute meetings for the study of groundwater pollution preventive measures; ② to assist in locating new sources of pollution; ③ to investigate and clarify the pollution mechanisms and to offer guidelines for its remediation.

Of these three technical means of assistance, ③ is the most essential.

The investigation teams are organized by the prefectural government, municipalities, and a private geological consultantancy company in order to work out methods of investigation and enforcement of removal action within the pollution site to be investigated. The team is a sort of "a group of doctors," specializing in the cure of "geo-pollution." These acts of technical assistance are possible because Chiba prefectural government has specialists of the geo-environment in its Water Quality Conservation Institute.

Simultaneously, Chiba prefectural government subsidizes the task of groundwater pollution prevention and assists in the physical examination which checks

the influence of trichloroethylene and other chemicals.

The previous subsidy assisted tasks for water quality investigation by confirming the actual nature of the pollution, and for the investigation of clarifying pollution mechanism (18 cities), as well as for measures to wipe out pollution (12 cities).

The rate of the subsidy has been proportional to the index of each financial power, from 20% up to 70%, and it amounts to about ¥0.3 billion (54 cities) altogether as of the fiscal year 1994.

It is obvious that in spite of the small amount of the subsidy, the pollution mechanisms have been clarified in more than 20 cities and towns and that in 12 cities and towns particularly, the clean-up of pollution is being promoted.[78]

3.3. Local Government Action: Japanese-type Superfund — Hadano City Ordinance

The most helpful reference for solving the problems of the clean-up of geo-pollution in Japan is "The Groundwater Pollution Prevention and Clean-Up Ordinance" promulgated by Hadano City, Kanagawa Pref. Hadano, which depends more largely on groundwater than any other district of Japan, has been afflicted by serious groundwater pollution. Hadano, herald to the whole nation, issued "The Groundwater Pollution Prevention and Clean-Up Ordinance" in July, 1993.

It is characteristic: the person whose actions in the past brought about geo-pollution has an obligation to make a detailed investigation and clean-up of the pollution (retroaction).

At the same time, the local government has established a fund made up of municipal contributions, while the Mayor, the Head of the local government, runs the business of making the detailed investigation and of cleaning up the polluted land as well as allocating the cost later when the polluter has been identified (Fund Method).

The purpose of the ordinance is, first of all, to "prevent the pollution of groundwater caused by chemical compounds and to clean up pollution" (Article 1), which covers the whole problem of the geo-environment. 11 compounds, including chlorinated organic compounds, are named as subject to the regulation and investigation, as well as the companies which have used such material (Article 2). In order to prevent geo-pollution, it stipulates that the founder of the plant has the obligation to report upon the appropriate management of designated substances, as well as upon the balance of the substances (From Article 4 to Article 20).

As to the investigation and clean-up of pollution, it provides for the detailed investigation and clean-up task required of the geo-polluter, as caused both by

his previous as well as present actions (Article 22) ; this implies a retroaction system.

The Mayor is provided with the authority to make a fundamental investigation in order to grasp the general condition of the real pollution situation (Article 21). The trader is required to make a further detailed investigation and to run the clean-up business, by the "polluter pays principle" (PPP), while the Mayor is also required to endeavor to give whatever technical and financial assistance he can (From Article 24 to Article 26, Article 46).

The person responsible for making the detailed investigation and running the clean-up business is determined to be the one (the trader concerned) responsible for the geo-pollution of his land (the polluted land).

The action level is above the target level of clean-up recognised by the Mayor. Depending on the individual situation of the polluted land, the Mayor is also empowered to designate not only the enterpriser in the present or in the past, but also anyone who polluted the geo-environment in the process of collection, transportation, and disposal of designated substances (Article 22).

Hence, "the owner or possessor of polluted land has to cooperate with the related trader's or the Mayor's detailed investigation and clean-up business" (Article 35). It does not mean, however, that he is charged with the responsibility of the direct clean-up. Without the Mayor's approval and supervision, the designated trader is not able to make a plan and carry out and complete the clean-up business (From Article 24 to Article 33).

Although a considerable number of factors have to be dealt with, such as the unidentified polluter, the unknown whereabouts of the related trader, the insolvent trader, and so on, the Mayor handles the business in their place.

But when the polluter's whereabout can be found, the Mayor can allocate the cost to him the cost later (Article 34). The target of clean-up is when the content of the groundwater of soil and the strata is below the standard water quality of tap water (An attached list of Article enforcement regulations). The clean-up level of soil, strata, and groundwater is provided numerically for each sampled test solution. In order to make sure that the business smoothly, the fund raised for groundwater pollution measures is financed both by the city and by the relative trader's contribution.

The fund is allocated to the relevant trader's detailed investigation and clean-up business, as well as to the cost for investigation, clean-up, and health injury prevention supervised by the Mayor (From Article 36 to Article 41).

The fund, at present, has raised up to ¥1 billion. The first proposal for a compulsory cooperative fund met with opposition from the Ministry of Home Affairs because it would entail a new local tax, and consequently, was changed to an optional contribution.

As to "the announcement and the punishment," Article 51 provides that "in the case of a geo-polluter the mayor can announce (make public) the situation through a public relations magazine, and that the person who neither makes a detailed investigation nor runs a clean-up business without a legitimate reason, is named a unscrupulous offender by the provisions of the Article." But there is no mention whatever of any punishment.

This is based on the concept that the punishment of a polluter in the past violates the principle of "no-punishment for retroaction"[79] (Constitution Article 31, 39). At first, the conception of retroaction met with opposition from the Regional Legal Affairs Bureau, but was admitted on the condition that provision of punishment was excluded.

For all these reasons, Hadano City Ordinance is the most advanced in Japan from the viewpoint of investigation, clean-up, and funding.

In detail, it is notable for these four points:

① The detailed investigation and the clean-up business are, as a rule, established as the duty of the polluter (the trader or the manager of disposal), to which is attached the duty of retroactivity and joint liability.

② In the case of a missing or insolvent polluter, the city runs the clean-up business.

③ To check pollution at the time of commencement and achieving the clean-up business, "the clean-up standard" has been established, based on the standard quality of tap water.

④ A fund has been established to execute the business of the municipal and the polluter's clean-up.[80]

The Hadano City Ordinance has very great significance as a model for systematically solving future geo-pollution problem.

4. The Problem to Be Solved

4.1. The Landowner's Clean-Up Responsibility

What shall we do about the landowner's responsibility for clean-up when the landowner and the polluter are not the same person?

For the purpose of identifying the polluter, the U. S. A. "Superfund" (CERCLA/SARA) holds the landowner responsible for clean-up; consequently, the responsibility for clean-up is very likely to be brought into court by the potentially responsible parties of polluter and landowner.

Dr. Hisashi Nirei of the Water Quality Conservation Institute of Chiba Pref. explains the actual condition of geo-pollution in Japan, citing five examples from Chiba Pref., as follows:[81]

One: the problem of pollution outside the landowner's zone that has been caused by the landowner's small enterprise.

Two: is the problem of the landowner, who bought polluted land without knowing that it was polluted. In this case, the landowner is a "innocent purchaser," as "Superfund" stipulates.

Three: the problem of land transfer. The landowner, who did not pollute the land, transfers it to someone else.

Four: the problem that arises when a landowner becomes bankrupt. The landowner, who is also the polluter of the land, sells the land and goes bankrupt.

Five: the problem of the landowner's responsibility for pollution caused by illegal dumping. The landowners in this case have something in common.

As another Japanese example, Yokohama City established "Guidelines for Pollution Measures at Landfill Sites" (1986) in order to enforce small entrepreneurs to check soil pollution upon removal and to abolish the plant.

The number of reported cases totalled 103 in March, 1993, and in detail, 15 cases (mainly caused by metal) were under guidance, while 15 cases (proved to be polluted) were under investigation.

The landowner, even in the rare case of being a different person from the small enterpreneur, cooperates with the investigation. (According to the Water Quality and Geo-Environment Section of Yokohama Environment Conservation Bureau)

Kawasaki City authorities say in "Guidelines for Soil Pollution Measures" established in 1993 that it requires the small entrepreneur and the landowner to perform soil investigation and dispose of polluted soil; he must also report the result of any transfer, abolition, or re-development of his factory.

In Kawasaki, too, it does not matter whether or not the landowner is a different person from the small entrepreneur.

But the problems that arise over land-transfer cases, having once occurred, are likely to occur more frequently from then on. (According to the Water Quality Section of Pollution Dept. of Kawasaki Environment Conservation Bureau)

As to the landowner's responsiblity for illegal dumping, according to the findings of the questionnaire on "the Actual Situation and the Problem of Illegal Dumping" sent out by the National Industrial Waste Federation, 60.9% (39 bodies all told) of all the local governments "guide the landowner and the land manager in means of remediation" in the case of illegal dumping.[82]

Similarly Prof. Yoshinori Kitamura, who investigated the hearings of all national local governments, says that as a result of administrative guidance, the landowners are actually required to treat pollution and mostly suffer the loss because all the cost falls on them.[83]

According to the explanation offered by Prof. Tadashi Ohtsuka,[84] Article 717 of Civil Law of Japan (If any damage has been caused to another person by

reason of any defect in the construction or maintenance of a structure on land, the person in possession of the structure shall be liable in compensation for damages to the injured party; however, if the person in possession has exercised due care in order to prevent the occurrence of such damage, compensation for the damage shall be made by the owner) and a claimable real rights (" dinglicher Anspruch " in German) of the existing law (If, in the cases mentioned in the preceding two paragraphs, there exists any other person who is responsible for causing the damage, either the possessor or the owner may excercise the right to obtain reimbursement against such other person) impose on the no-fault landowner both the liability of damages and/or the bearing of the cost of disturbance removal.

But it is limited only to cases where there is fear of clear " damage " and " the danger of disturbance."

Professor Ohtsuka therefore suggests that the landowner should perform his supplementary duty only in the case of a missing, absent, and insolvent polluter because it is fundamentally difficult to allocate the cost to the landowner who has contributed to pollution but without evidence of clear " damage " and the danger of disturbance.[85]

But he recognizes that if the clean-up cost is borne by the landowner, a sufficient pollution prevention incentive and a certain amount of clean-up incentive would be operative.[86]

I fundamentally agree with his view in that it conforms to the Polluter Pay's Principle of imposing the most important responsibility on the polluter while it conforms to the actual Japanese situation and the Japanese law system where the landowner has to perform his supplementary duty only in the case of a missing, absent, and insolvent polluter.

If it is possible that the landowner is required to do his duty of partially bearing the clean-up cost, the incentive both for pollution prevention and proper land management is surely raised, which is equivalent to the enactment of legislation to investigate soil pollution at the time of land sale.

The result would be an increase in the rate at which instances of soil pollution are found.

Trials similar to those brouht by " Superfund " in the U. S. A. are not always appropriate because they hold the landowner responsible for the clean-up, and are due in large measure to the particular features of American society and its law system.

4. 2. Conclusion

The burden of this account has been to insist that the clue to geo-pollution is whether we are able to realize how important geo-pollution is and how significant

the clean-up must be in consequence.

On the basis of a full recognition of the significance of what has been carried out in Chiba Pref., it is necessary to clarify the mechanisms that cause pollution, basing our account on the concept of geo-pollution.

In order to set about clarification, it is necessary to establish a Japanese-style Superfund system to conduct research and to clean up pollution, such as the one supported by a fund raised on the Polluter Pay's Principle, as is required by the Hadano City Ordinance.

The establishment of an attainable Japanese style superfund system must be our present goal.

It is quite reasonable to expect that Japan as a nation should learn from these valuable experiences, and should establish a geo-pollution control and clean -up system as soon as possible, integrating in its program both groundwater pollution and soil pollution.

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