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Current Status and Future Perspective of the Japanese Remediation Industry: Technology and Market for Underground Remediation

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Contents

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Summary

1. Pollution of the underground environment including soil and groundwater has attracted much attention recently. The underground environment is as much a part of the natural environment as air and water, and plays a vital role in the survival of creatures and the kinetics of chemical substances. Unlike air and water pollution, however, pollution of the underground environment has specific characteristics.

(i) Pollutants have long retention periods and so accumulation is a problem; measures other than those against emission sources are thus required.

(ii) The polluter-pays principle is not always applicable.

(iii) It is difficult to develop countermeasures as the pollution concerns privately-owned goods.

2. Thus, measures against underground environmental pollution include aspects that do not apply to other types of environmental pollution. Since hazardous substances do not easily disperse underground, the remediation process is important for the cleanup and isolation of existing pollution, as well as end-of-pipe measures to prevent the accumulation of hazardous materials. This process is undertaken by the remediation industry. It has become a promising business in Europe and the United States, and is now recognized as an industry in its own right. This development has been helped by the creation of a remediation market under policies designed to address underground pollution issues.

3. The United States was the first country to address these issues, based on the so-called Superfund Act, which was passed in 1980. Although remediation was one of its original objectives, the rigid institutional design prevented coordination among the parties involved and so remediation was delayed. Following operational reform in 1993, however, the pace of remediation activities has risen significantly in recent years. This reform provides a model for creating a remediation market, particularly the mechanism of brownfield redevelopment projects to promote the utilization of decommissioned plant sites that have been abandoned due to business risks related to underground environmental pollution.

4. In 1999, Germany enacted the Federal Soil Protection Law, the most recent legislation for protecting the underground environment. In addition to addressing environmental issues, the German model is characterized by its industrial location policy considerations that promote the re-use of plant sites through rational remediation. It adopts several innovative mechanisms including trigger levels defined by land use and certain flexibility in remediation objectives. This new system draws on the experience gained by provincial governments as well as on the experience of the national government, which was directly involved in underground remediation

when privatizing ex-state enterprises in East Germany. This system should provide useful guidelines for Japan as it preempts the reforms in the United States in some aspects.

5. In Japan, policies for protecting the underground environment have been fragmented, primarily focused on specific functions such as groundwater and agricultural land. Not all polluted sites have been identified. Due to the lack of established rules, the remediation market in Japan relies on voluntary remediation needs of industries. Remediation firms that provide comprehensive services under strict information management have undertaken related works. It is therefore difficult to gain an overall picture of the market. One estimate based on certain assumptions suggests that the market is worth more than ¥5 trillion, albeit with a considerable margin of error reflecting the wide variation of remediation costs. This figure indicates the considerable potential of the remediation market, which is expected to be developed over the years as land alterations progress.

6. To develop this market, the remediation industry requires expertise in various fields including civil engineering, chemistry and biology as well as comprehensive engineering abilities that combine relevant technologies for the optimal remediation of polluted sites. Thus, many companies have entered the market, bringing their own expertise in specific fields. Reflecting the characteristics of the Japanese market, each company has sought to establish an entire remediation ability, by developing various technologies as well as exchanging and integrating technologies among industries. The technological level of Japanese companies is now considered almost equal to that of pioneering firms in Europe and the U.S.

7. Future development of the remediation industry in Japan depends on the creation of an open market to utilize accumulated technologies. As the Japanese remediation market gradually changes due to increased demand for the liquidity of real estate holdings and the trend toward international standardization including ISO standards, the introduction of practical rules and policies should help unlock the huge potential of the remediation market. In this regard, precedents in Europe and the U.S. will have major implications.

As rules are developed, specific policies are needed such as a Japanese version of the brownfield redevelopment projects and subsidies for small enterprises.

Introduction

Pollution of the underground environment including soil and groundwater has attracted much attention recently. Since pollutants do not easily disperse underground, it is important that anti-pollution measures include a remedial process to remove the existing pollution, as well as measures against emission sources. In this report, the remediation industry is that which undertakes this process.

Any consideration of underground environmental pollution necessarily involves privately-owned goods. In this context, the development of a social system to create a remediation market is important along with technological aspects. This report outlines the characteristics of the Japanese remediation market and the resultant remediation industry in comparison with conditions in the U.S. and Germany, the two forerunners in this field, and considers necessary measures based on the industry's current status and future perspective.

As a background to the discussion, Chapter 1 identifies the characteristics of underground pollution including soil and underground water, which constitute the remediation market. Chapter 2 outlines the reforms of the remediation system in the U.S., the first country to address this issue, while Chapter 3 takes a look at measures adopted in Germany, the country with the most recent soil protection legislation. In comparison with the two countries, Chapter 4 examines the current status of the remediation industry in Japan and discusses its future perspective.

I. Concept of the Remediation Industry

1. What is the Remediation Industry?

1.1 Pollution of the Underground Environment

There are various types of environmental pollution. Underground environmental pollution, such as the contamination of soil and groundwater, has attracted particular attention in recent years. Policy response to this type of pollution has been delayed considerably, even though the problem has long been recognized along with air and water pollution, as evidenced by the fact that soil pollution was added to the typical types of pollution during the 1970 Diet session, since dubbed the “Environmental Pollution Diet.” Legislation for soil protection has yet to be enacted except for agricultural land. Regulations against the infiltration of hazardous substances to groundwater including prohibition and improvement orders have only been introduced recently compared with the pollution of other environmental bodies. And yet soil is one of the most important components of the natural environment along with air and water. Why has the policy response been so different?

The primary reason is the difficulty of integrating the protection of the underground environment into a policy structure focused on measures against public nuisance. Most of the environmental policy structure in Japan was built during the fight against industrial pollution, and its main principles were:

(i) identification of causalities between damage to human health and other events, and emission sources that allegedly cause such events, and

(ii) regulation of emissions from identified sources.

However, these principles are not easily applicable to the pollution of the underground environment (geology) including soil and groundwater. Since hazardous substances that have penetrated the underground environment cause damage to human health only after a long period of movement and accumulation in the ground and through other environmental media, policy response is primarily confined to direct exposure channels such as air and water. Moreover, even when the underground environment is directly addressed, it is extremely difficult to identify causalities due to the time lag and geographical gap between the polluting activities and their consequences.

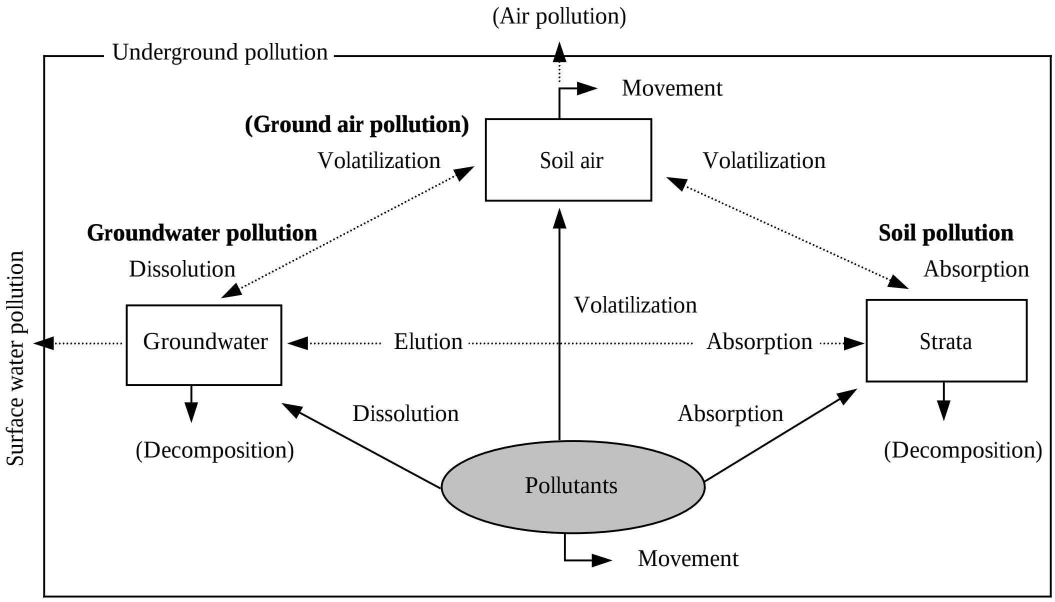
Measures against underground environmental pollution in Japan have therefore centered on preventing air and water pollution or waste control. Their direct coverage has been limited to agricultural land and groundwater, the pollution of which may have a direct impact on human body. This does not necessarily mean a delay in policy response. In the final analysis, however, preservation of the underground environment in Japan has typically been fragmented into specific measures such as groundwater protection (only covering part of the surface layer) and soil protection, whereas it should be treated as a single, comprehensive issue. Thus, when considering the need for soil protection legislation apart from the issue of groundwater protection, the reasons for removing hazardous substances that have not yet caused groundwater pollution become unclear.

1.2 Meaning of the Underground Environment and Its Pollution

The term “underground environment” used in this report needs to be defined. In Japan, some have discussed underground environmental pollution as a combination of separate problems such as soil and groundwater pollution, while others have addressed the problem of geological pollution by examining the underground environment in its entirety. This report uses the term “underground environment” in a meaning similar to that of geological environment, which comprises strata (solid phase), ground air (gas phase) and groundwater (liquid phase). Strata including soil, coupled with ground air and groundwater, play an important role similar to that of the atmosphere and hydrologic cycle, and provide the basis for the survival of creatures and for the cycle of materials. These elements cannot be considered separately when addressing underground pollution, and must be treated as a whole for remedial action.

What types of pollution are threatening the underground environment? Pollutants of underground environments vary widely in their characteristics and cause different types of pollution. Volatile organic compounds (VOCs), for example, can easily reach aquifers and cause underground pollution because they are heavier than water and highly penetrating. Heavy metals tend to be absorbed by the soil and accumulate in the surface layer. The mechanism of underground pollution is shown in Figure 1-1. Various types of pollution interact and cause dysfunction of the underground environment, which in turn affects human health directly or indirectly.

Figure 1-1. Concept of Underground Environmental Pollution



Sources: Osami Nakasugi, *Dojo Chikasui Chu deno Yugai Busshitsu no Kyodo*; "Dojo Chikasui Osen no Genjo to Sono Taisaku," *Gekkan Haikibutsu* May 1999, etc.

1.3 Characteristics of Underground Environmental Pollution

This section lists some of the distinctive characteristics of underground pollution as compared with air and water pollution.

First, pollutants are retained for a long period once their level has exceeded the self-purifying capacity of the underground environment, for their movement is far slower than in the atmosphere or surface water. This is why underground pollution is called a typical cumulative pollution. In the case of air and surface water pollution, end-of-pipe measures against emission sources are effective for pollution control, because pollutants are largely dispersed. In the case of underground pollution, however, the long pollutant retention period requires more than such end-of-pipe measures to halt the charging of pollutants, as the pollution has already accumulated due to previous charging.

Second, it is often difficult to apply the polluter-pays principle (PPP) to underground pollution, partly due to the characteristics described above. Underground pollution is not different from other types of pollution in that it is essentially a problem of external diseconomies arising from the fact that private individuals do not bear the cost of using the functions of the underground environment, thus creating a divergence between private and social costs. Therefore, it is natural that the PPP should be applied in this case to correct the price by attributing an additional cost (removal cost) to the polluter according to the marginal external cost. Due to its cumulative character, however, underground pollution may result from past activities of a person who no longer exists. In such cases, application of the PPP is extremely difficult because the external diseconomies have a substantial time lag.

Third, the functions of the underground environment including maintenance of the ecosystem and circulation have a highly public nature as in the case of the atmosphere and water, but they basically belong to the owner of the land. Restrictions on using the underground environment, which is covered by the property rights guaranteed by the Constitution, give rise to complicated arguments entailing coordination between private rights and public welfare. In this regard, discussions on groundwater in particular have continued over the years from the standpoint of private or public water theory. However, most of these discussions have not addressed the underground environment in its entirety. Nonetheless, this characteristic has substantial implications as it does not allow underground pollution measures to stay within the boundary of traditional environmental conservation policy.

1.4 Definition of Remediation

These characteristics of underground pollution also influence the development of countermeasures. As already mentioned, pollution of the underground environment is characterized by the fact that a fundamental solution is impossible once pollution has occurred, unless measures are taken for cleanup or to prevent diffusion. Any end-of-pipe restriction on the charging of pollutants does not reduce the pollution accumulated by previous charging. In this report, remediation is defined as the pollution removal process including cleanup and diffusion prevention, which are characteristics of underground pollution.

For the purpose of this report, the remediation industry[1] refers to the industry that undertakes the remediation process as a business. As mentioned in Chapter 4, it also includes in a broad sense the businesses that focus on the phase prior to pollution prevention.

2. Developments Concerning Remediation

This section outlines Japan’s policy for underground pollution so far. As discussed in the following chapters, most of the countries that have a policy response to underground pollution including the U.S. and Germany have experienced key incidents that provided the momentum. Japan is no exception. Many of the policy measures for the underground environment in Japan have been adopted in the wake of serious pollution cases. The fundamental objective of such policy measures was to address individual elements of pollution and to control those exposure channels posing a greater direct health risk, rather than to address the functions of the underground environment as a whole.

In the 1950s and 1960s, when cadmium and arsenic industrial pollution emerged, countermeasures focused on stricter emission controls in order to conserve air and water quality. In the 1970s, successive policy measures were developed for individual components of the underground environment. When soil pollution was added to the major types of pollution in

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[1] The same meaning as the environmental remediation industry in the U.S. and Altlastensanierungsindustrie in Germany.

the 1970 Diet session, measures were taken for agricultural land, the pollution of which was of greatest concern regarding adverse impacts on human health and the living environment. Subsequently, measures against emission sources were adopted including the Waste Disposal Law, as the so-called problem of urban soil pollution emerged in non-agricultural land due to the contamination with hexavalent chromium dross. At the same time, the Water Pollution Control Law was revised to protect groundwater. As regards uncontrolled urban soil, policy response included the introduction of a non-enforceable guideline.

Measures accelerated in the 1990s with the emergence of pollution from advanced technologies. Accordingly, the response to underground pollution has changed significantly recently, and the traditional policy framework may soon be altered. The introduction of cleanup orders for contaminated groundwater in the 1997 revision to the Water Pollution Control Law effectively extended the scope of regulation to the cleanup of underground air and soil. In 1999, new laws and regulations that have a major impact on underground pollution were enacted, including the Dioxin Control Law and the Pollutant Release and Transfer Register Law (PRTR Law). Although the Dioxin Control Law is only applicable to PCDDs, it defines enforceable environmental quality standards not only for the atmosphere and water but also for soil, thus institutionalizing protection of the underground environment in line with the Water Pollution Control Law. The PRTR Law requires companies to report the emissions of some 300 chemicals to the environment, making it possible to evaluate the aggregate potential of underground pollution. Moreover, the law encourages the prevention of underground pollution through stricter controls and emission reductions by companies.

Although the traditional policy framework remains, Japan is now at a turning point as regards underground environmental protection. As discussed in Chapter 4, future developments in the policy framework will have a considerable impact on the status of the remediation industry. This is also the case for Europe and the U.S., where the future of the remediation industry appears to be guaranteed, having been recognized as a business category. In those countries, the progress of policy response to underground pollution has been accompanied by the creation of open remediation markets, thus nurturing the remediation industry. In this context, policy response in foreign countries should be examined before considering the problems facing the Japanese remediation industry. The following chapters outline the measures taken in the United States, the first country to address this issue, as well as in Germany, which has recently developed relevant legislation at the federal level.

II. Progress of Reforms of the U.S. Superfund Scheme

According to the Environmental Protection Agency (EPA), the scale of the remediation market in the United States as of 1995 totaled ¥800 billion ($7.5 billion) on a realized basis and is estimated to exceed ¥2 trillion ($187 billion) on an unrealized basis. The U.S. market was stimulated by the introduction of the so-called Superfund Act, a comprehensive law against environmental pollution that led other countries in promoting the remediation industry. This chapter outlines the series of policy measures taken by the U.S. over the years.

1. Changes in the Superfund Act

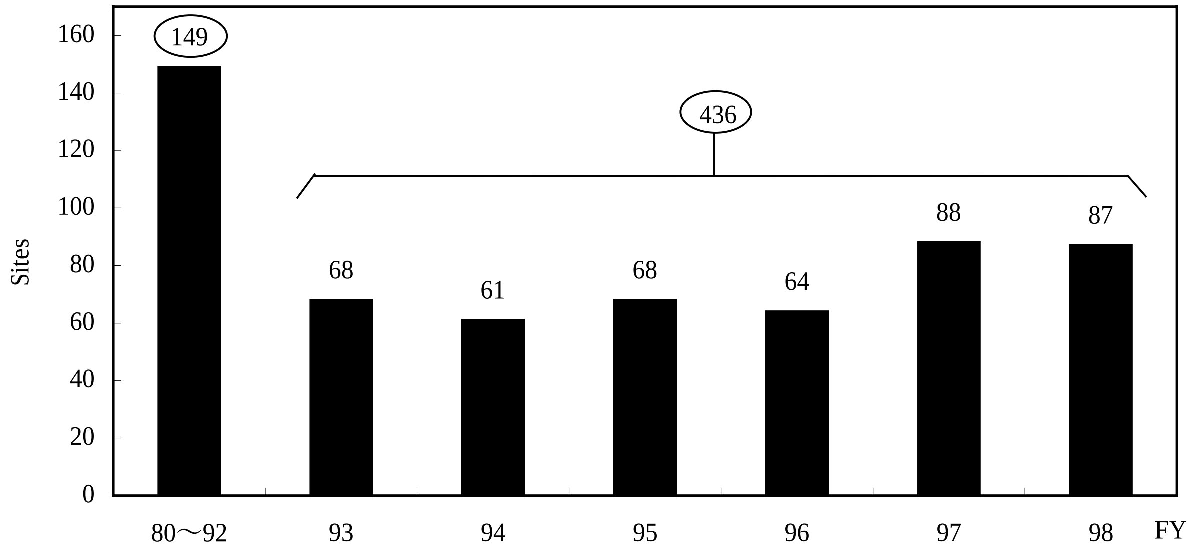
The U.S. Superfund Act is formally known as the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) of 1980 and its Amendments and Reauthorization Act. As indicated by its name, the Act seeks to address threats to the health of the population or to public welfare caused by the release of hazardous substances into the environment through comprehensive control of various types of pollution. Therefore, the coverage of the Act is not limited to the pollution of soil and other underground environments. The cost of remediation is imputed to the polluters as much as possible. If this principle is not applicable, the Act also provides for a special fund (Hazardous Substance Superfund) financed by the general account. The Superfund Act owes its name to this special fund.

With the Superfund Act, the United States led other countries in addressing cumulative environmental pollution problems. As discussed later, however, the process was not smooth. In particular, the severe pursuit of liabilities led to numerous lawsuits, thus delaying remedial action, and many such cases have been reported even in Japan.

Nonetheless, there has been substantial improvement in recent years. Among the heavily polluted sites that require remediation measures (registered on the National Priorities List (NPL), discussed later), Figure 2-1 shows the number of sites for which remedial action has been completed. During the 12-year period between 1980 and 1992, the action was completed for only 149 sites, but the pace of remediation accelerated more than five-fold in the next six years, with the number increasing to 436 sites. Figure 2-2 shows the distribution of the NPL sites by stage of remediation. As compared with the condition in January 1993, it is clear that the share of sites under remediation or completely restored had risen significantly by the end of 1997.[2]

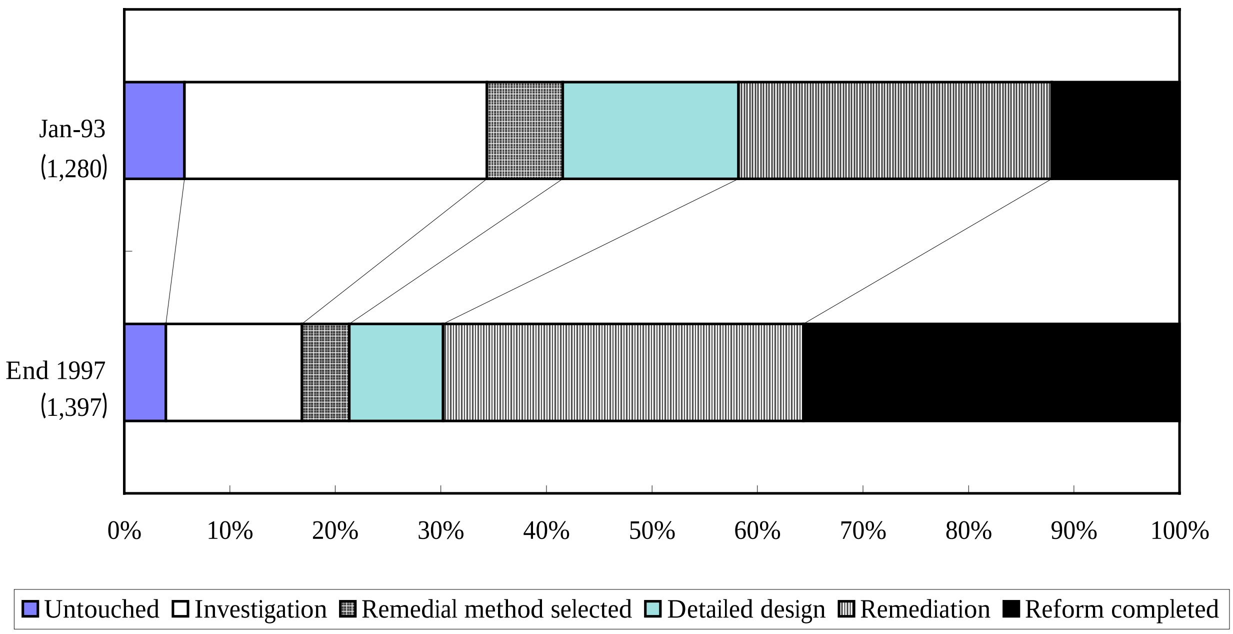
[2] The share has risen further by May 1999, with the number of restored sites reaching 599. Moreover, 185 sites have been removed from the list with the completion of subsequent monitoring. 1,396 sites are still on the NPL.

Figure 2-1. Number of Completed Action



Source: EPA Superfund Reforms Annual Report FY1998.

Figure 2-2. Distribution of NPL Sites by Remediation Stage



Note: Figures in parentheses ( ) indicate the number of NPL sites under EPA control at the time.
Source: EPA Home Page.

How did these changes come about? As a preliminary discussion, the following section provides an overview of the Superfund Act.

2. Outline of the Superfund Act

2.1 Brief History

The Comprehensive Environmental Response, Compensation and Liability Act (hereinafter referred to as the Superfund Act) was signed in December 1980 as previous legislation proved insufficient in addressing the health damage caused by past dumping of hazardous waste, which became a political issue with the Love Canal incident in the late 1970s.

Initially, the Act provided for a fund of $1.6 billion with a time limit of five years. It was subsequently revised by the Superfund Amendments and Reauthorization Act (SARA) of 1986, which basically established the present form of management. (The fund was increased to $8.5 billion to be used in five years.) Numerous discussions on further revisions have not materialized since that time, and the validity of the Act has been extended mainly through the EPA Appropriation Act.

2.2 Outline of the Scheme

The aim of the Superfund Act is to address the danger to citizens' health or public welfare caused by the release of hazardous substances from facilities or ships into the environment, or by the threat of such release.

Here, hazardous substances include not only those defined in the Act itself but also a range of hazardous substances designated as such by the Clean Water Act, the Clean Air Act and the Waste Disposal Act. In addition, the Act applies to pollutants or contaminants that are not designated as hazardous substances when they may pose an urgent and significant risk to citizens' health or public welfare (Article 101 (14)).

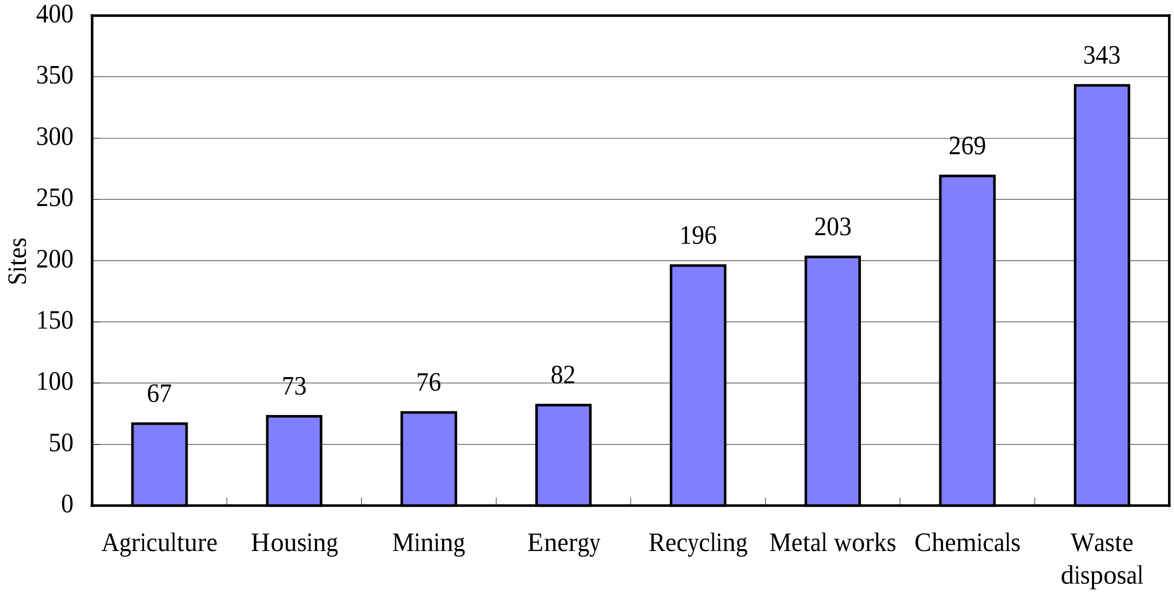
When these substances have been released into the water, air, surface or ground in the United States or when there is a serious threat of such release, the President is authorized to take countermeasures based on the National Contingency Plan (NCP). Two types of measures are defined: "remedial action" to seek permanent restoration of the polluted area, and "removal action (in principle, not more than $2 million in cost and 12 months in duration)" to eliminate the imminent danger. Remedial action is taken for NPL sites (discussed later) only, but removal action may be taken anywhere at any time. In any case, there are no uniform thresholds of volume or density of pollutants at which the President (therefore, the EPA as his proxy) is authorized to exercise his right.

When a suspected site has been identified, the EPA conducts an assessment. If further investigation is deemed necessary, the site is listed on the Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS). The system serves as a database, and records an exhaustive list of suspected sites.

The EPA conducts a preliminary assessment (PA) for the sites listed on the CERCLIS, followed by site inspection (SI) if necessary. Based on the information obtained, the level of danger is quantified using the Hazard Rating System (HRS). If the calculated hazard value exceeds a certain level, the site is then registered on the National Priorities List (NPL) for remedial action.

Figure 2-3 shows the previous use of the sites appearing on the NPL. Most of them were formerly used as industrial sites or waste disposal sites. Once a site has been listed on the NPL, a remedial inspection (RI) is conducted to collect materials for judging the remedial measures to be taken. The results are then used in a feasibility study (FS) to compare possible measures for cleanup. The tentative plan thus established is circulated among those concerned and opinions are collected. The final draft plan for cleanup is published as a definite record. The plan is executed after the refined design (RD) has been developed. The stage of operation and management (O&M) follows the completion of remediation, and the site is removed from the NPL if the achievement of the planned objectives has been confirmed. The figures cited at the beginning of this chapter indicate that an increasing number of NPL sites have recently entered the O&M stage following the completion of remediation.

Figure 2-3. Previous Use of NPL Sites (as of 1994)



Source: EPA.

2.3 Characteristics

The scheme is operated as outlined in the previous subsection. The Superfund Act has some special features to ensure smooth operation of the scheme.

The first feature concerns the wide coverage of responsible parties and the substantial scope of liabilities. Those who assume responsibilities under the Superfund Act are called potentially responsible parties (PRPs). The scope of their liabilities is considerably large as the Act stresses that cleanup costs should be borne by PRPs as much as possible.

The Act defines the following parties as PRPs:

(i) present owners and operators of the polluting facilities,
(ii) owners and operators at the time of the disposal of hazardous substances,
(iii) generators of hazardous substances, and
(iv) transporters of hazardous substances.

Numerous parties have been identified as PRPs as relevant cases have accumulated.

In addition, the liabilities imposed on responsible parties are extremely severe. Since the liabilities under the Superfund Act constitute strict liabilities, immunity cannot be granted even if hazardous substances have been handled with due attention. The liabilities are further magnified by the following two principles added by court cases.

One of them is the principle of joint responsibility. When two or more PRPs exist and the damage is indivisible, the EPA can demand full compensation for the damage to any of the responsible parties. The amount of compensation includes the costs attributable to any absent or insolvent parties. As a result, PRPs with large financial capacities have often been forced to pay large sums of money despite their insignificant contribution to the pollution, lending credence to the allegation that the Act constitutes a “deep pocket” policy.

The other principle is that of retroactive responsibility. That is to say, the liabilities under the Superfund Act are also applicable to actions before it took effect. This is justified on the ground that the Act itself regulates past polluting activities and that it is not a criminal law, to which the principle of non-retroactivity applies. Thus, the number of PRPs has increased further.

Admissible arguments in defense include:

(i) forces majeure

(ii) acts of war, and

(iii) action or inaction of a third party.

However, these arguments have rarely been admitted in court.

As the second feature of the scheme, no clear standards have been defined as regards the objectives to be attained after cleanup action, just as no standards existed for the EPA to exercise its authority in terms of minimum emissions of hazardous substances. Standards to be applied in cleanup include: (i) protection of human health and the environment, and (ii) ARARs. ARARs are a concept added by the revision to the Act in 1986 and require that cleanups meet "legally applicable or relevant and appropriate requirements" defined in other federal laws and state environmental laws for each substance. The introduction of ARARs was based on the judgement that they were better suited for a flexible response than uniform standards because pollution involves multiple hazardous substances in most cases and their contribution differs in individual sites.

This may be one of the reasons why the Superfund Act could not easily achieve the expected results. The EPA, responsible for making judgements on Requirement (i) above, tends to prepare for the worst by requiring the most severe standard, which should be applicable to housing areas, regardless of how the site is used. This has resulted in unnecessary inflation of cleanup costs, thus undermining the possibility of agreement among parties concerned and obstructing the progress of remediation.

ARARs have also caused similar problems. The requirement of different clarification levels by state laws may lead to huge gaps in the remedial action and cost among polluted sites, even though the obligations under the Superfund Act are exclusively administered by the EPA. Furthermore, the identification of ARARs is difficult in the first place because various hazardous substances may be involved. The resultant confusion and disputes among parties concerned have considerably delayed the required remedial action.

Third, the scheme is characterized by the existence of the Hazardous Substance Superfund (hereinafter referred to as the "Fund"), to which the Act owes its name. The EPA may conduct cleanup works using the Fund when PRPs cannot be identified or when urgent cleanup is needed. Although the legislation is widely known as the Superfund Act, the Fund has limited functions. Its financial sources include various taxes including the oil tax, appropriations from the general account, the money collected from PRPs and return on investment. The Fund is managed and operated by the Treasury. For each fiscal year, the EPA has to submit the Fund's draft budget to the Congress for approval. The budget includes the direct costs of clarification as well as all the costs borne by the EPA as regards the Fund.

As mentioned in Chapter 1, it is often difficult to apply the polluter-pays principle (PPP) to underground pollution, which only becomes visible after a long period of accumulation. The injection of public funds is required in some form to address such marginal problems, which the U.S. has done by creating a special fund.

2.4 Problems

With the above-mentioned characteristics, the Superfund Act was initially blamed for its ineffectiveness in achieving results, but this is attributed to various factors. For example, the remediation of cumulative pollution requires a considerable time after detection. Also, the EPA focused on addressing as many polluted sites as possible, rather than on completing the cleanup of such sites. The biggest problem, however, was the proliferation of lawsuits, which took considerable time and money away from the required cleanup activities. As described above, the scheme identifies a wide range of persons as PRPs, which usually results in the identification of two or more PRPs, who are likely to be involved in protracted disputes concerning the distribution of remediation costs. Unclear cleanup objectives under the Superfund Act have also facilitated litigation.

This problem was recognized at an early stage. The basic policy of the government has focused on accommodation to avoid lawsuits. Thus, the Amendments and Reauthorization Act of 1986 added a provision that requires the President to seek accommodation whenever it is practical and promotes public benefit. Various powers were also given to the President for this purpose. Nonetheless, the revision has failed to produce the expected results due to unresolved problems such as the treatment of orphan shares (discussed later) and the protection of PRPs that have accepted accommodation.

However, these are transitional problems, as the Superfund Act has had an idealistic nature since it was the first law to address cumulative pollution. Indeed, as described earlier in this report, the Superfund Act has undergone considerable improvements in recent years to tackle such problems, and the process of these improvements provides useful lessons for countries preparing to take similar measures in the future. The following section discusses this aspect.

3. Reforms of the Superfund Scheme

3.1 Three Rounds of Reforms

Various draft amendments have been submitted for discussion as regards the Superfund Act. Many of them were intended to alleviate the burden of cleanup costs by denying retroactivity to make the Fund pay for pollution resulting from activities prior to a certain date, or by denying joint responsibility to enable flexible attribution of liabilities. Such revisions have not been adopted so far because consensus could not be reached on paying the potentially huge remediation costs from the national budget.

In contrast, the draft amendment presented by President Clinton to the 103rd Congress in 1994 was very practical in that it focused on resolving institutional problems described above without changing the fundamental character of the Act. Although the bill died on birth, various draft amendments have since been presented. The current Superfund Act is thus in transition to a comprehensive review.

In this context, the EPA has preempted the revision in the legislature by improving the Superfund Act in terms of administrative procedures. This institutional reform launched in 1993, known as the Superfund Reform, seeks to improve the effectiveness of the scheme through operational improvements within the existing framework that defines remediation by PRPs as the top priority. The EPA regards it as an administrative effort for improving the Act that should lead to an amendment in the legislature.

The reform has been conducted in three rounds.

The first round, launched in June 1993, presented 17 initiatives to improve the scheme's effectiveness within the framework of the current legislation. They reflect the suggestions made in the 90-Day Study and the 30-Day Study, which had been conducted for the Superfund Reform. The second round, launched in February 1995, presented 12 initiatives, directly followed by the third round, which presented a further 20 initiatives in October 1995. Those initiatives have been implemented progressively.

The set of reform initiatives cover various areas such as cleanup, risk assessment, economic redevelopment, the enhancement of PRP-led activities, public involvement and advanced technologies. As indicated by their motto, "faster, fairer, more efficient," these initiatives seek to make the scheme operate more efficiently. Among various aspects of the initiatives, the following section examines (i) reforms for facilitating accommodation, and (ii) improvement of the decision-making process on remedial action.

(i) Reforms for facilitating accommodation

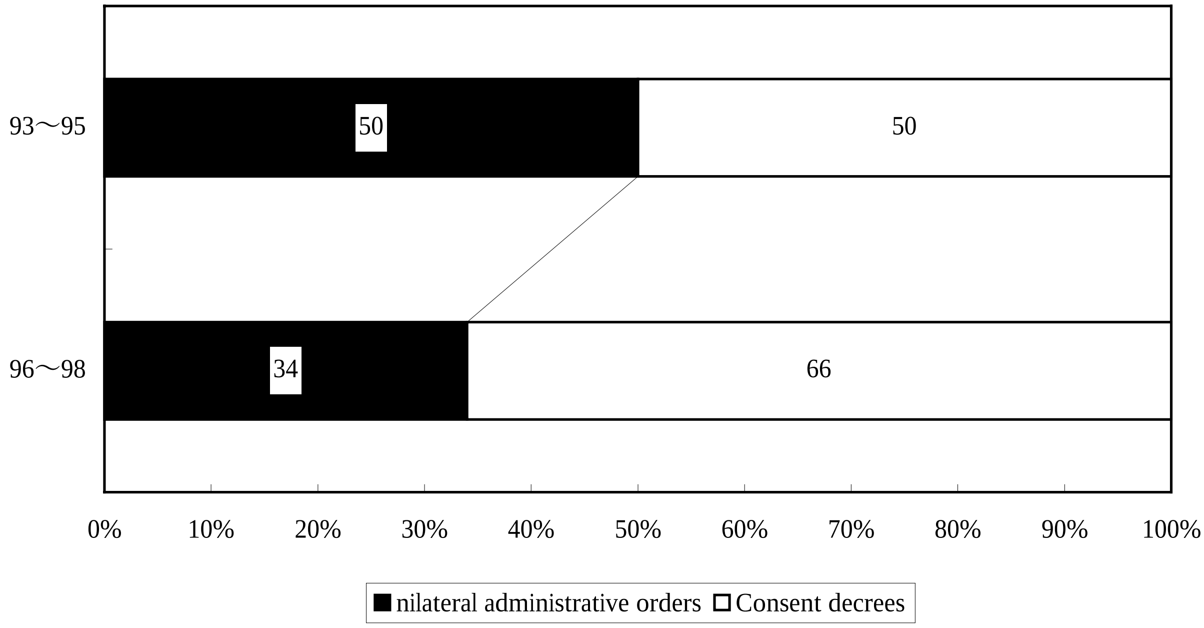
In terms of facilitating accommodation, the orphan share compensation in the third round deserves special attention. This system provides an incentive for accommodation by contributing the part of the remediation cost that cannot be attributed to any PRPs due to their absence or insolvency (orphan share). Initially, the EPA acted on the principle that accommodation should be limited to the cases where the whole cost of site remediation can be recovered. In practice, however, disputes over the attribution of the orphan share prevented accommodation in many cases, thus delaying remedial action and increasing litigation costs. To overcome this, the amendment in 1986 provided that the Fund may contribute part of the required cost for accommodation. This system was called mixed funding settlement. The orphan share compensation system takes this one step further and enables the fund to assume the orphan share.

The change in the operation of site-specific special accounts also deserves particular attention. The accounts were initially opened in the Superfund for individual sites to manage accommodation payments. The EPA, after coordination with the Treasury and other agencies, changed the rule to retain any interest accrued on accommodation payments in individual accounts to be used as compensation in remediation.

These changes represent an institutional reform that facilitates accommodation (and so prompt initiation of remediation) by containing disputes over cost allocation through increased compensation from the Fund.

Figure 2-4 breaks down the PRP-led remediation cases into those based on accommodation (consent decrees) and those based on unilateral administrative orders. The previous 50-50 parity prior to the reform has changed considerably in favor of accommodation with the progress of the reform.

Figure 2-4. Breakdown of PRP-Leads



Source: EPA Superfund Reforms Annual Report FY 1998.

(ii) Reform of the decision-making process on remedial action

The reform of the decision-making process on remedial action improves the uniformity and efficiency of countermeasures while reviewing past decisions to incorporate technological advances. It seeks to enable more effective and less expensive remediation. Typical initiatives in this regard include the establishment of the National Remedy Review Board (NRRB). The Board was officially launched in January 1996 with the membership of experts in the technology and policy departments of the EPA. Its mission is to review the options for remedial action (including urgent remedial action) in terms of cost-effectiveness without undermining legal stability. The Board had reviewed the decisions on 33 sites by September 1998, thus contributing to a cost reduction (including future effects) of $43 million in total (Table 2-1).

Table 2-1. Effect of Reform on the Decision-making Process on Remedial Action

FY	1996	1997	1998	Total
National Remedy Review Board				
Number of sites covered	12	8	13	33
Cost reduction effect ($ million)	25	6	12	43
Updating of remedy decisions				
Number of sites covered	60	80	>60	>200
Cost reduction effect ($ million)	355	390	>255	>1,000

Source: Superfund Reforms Annual Report FY 1998.

Another initiative involves the updating of remedy decisions at selected sites, in order to enable more cost-effective remediation by updating past remedy decisions to reflect subsequent technological advances and scientific expertise. As shown in Table 2-1 above, the EPA and other competent authorities updated decisions on more than 200 sites between FY1996 and 1998, potentially reducing the remediation cost by over $1 billion. In addition, the remedial period will be reduced on many sites by using state-of-the-art technologies. This method has been considered most effective among related reforms.

Including but not limited to these two major components, the reform package represents a practical application of the Superfund scheme that used to be idealistic. Two points should be noted here. First, the Superfund Act, initially deprived of uniform standards, is focusing more on the standardization and unification of procedures to improve efficiency in many aspects including the choice of remedial action, risk assessment and accommodation procedures. Second, the role of the Fund has been enhanced as a provider of public money to enforce the principle of PRP-led remediation. These observations, as well as their comparison with the design of the German system as will be discussed later, will provide useful information in considering the design of a similar system in Japan.

3.2 Brownfield Redevelopment

One of the main features of the Superfund reforms is the initiative of brownfield redevelopment, which was introduced in the second round.

Brownfield is defined as abandoned, idled, or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination. The concept encompasses decommissioned business sites that are not easy to reuse due to pollution. Such brownfield sites have increased rapidly since the 1980s and their number is estimated to exceed 400,000 at present. This represents a negative effect of the Superfund Act, because land buyers including developers were unwilling to reuse those sites for fear of the stringent cleanup responsibilities imposed by the Act and the huge cost thereof. The expansion of brownfields leads to various problems such as the deterioration of local employment conditions, as well as under-utilization of the infrastructure that served the sites including water works, sewage works and roads. In addition, it may also cause destruction of the natural environment because undeveloped sites (greenfields) are preferred as new business sites due to the lower risk of contamination.

To overcome this situation, the federal government designated brownfield redevelopment as a major component of the Superfund Reforms, and various measures have been taken since 1995. Emphasis has been placed on (i) providing incentives for redevelopment and (ii) identifying the potential risk and its scope.

(i) Provision of incentives

The brownfield redevelopment incentives are based on a subsidy scheme for demonstration projects. Such projects, known as brownfield pilot projects for non-Superfund sites, have been classified into three categories since FY1998 according to their character: (a) Assessment Demonstrations, (b) Job Training Partnerships, and (c) Showcase Community Collaboration Projects.

Assessment Demonstrations, which attract an annual subsidy of $200,000 for two years at the maximum, conduct various research and demonstrations for solving brownfield problems. 227 sites had been designated by FY1998.

Job Training Partnerships aim to give brownfield management skills to the local population, including inspection and cleanup. 11 sites were identified in FY1998, and 10 sites will be added to the list in FY1999.

Showcase Community Collaboration Projects seek to demonstrate synergy between federal support and community involvement in addressing brownfield problems. Each of the selected areas receives a subsidy of up to ¥1 million as well as on-site support from federal staff. 16 sites were designated for FY1998.

In addition to this subsidy scheme, preferential taxation and policy finance measures have also been taken for the cleanup and redevelopment of brownfields.

(ii) Identification of potential risk and its scope

As unidentified risk has slowed the progress of brownfield redevelopment, registration on CERCLIS and NPL has also been reviewed. As mentioned earlier, CERCLIS was intended to serve as a database of potentially polluted sites, but it did not specify registration requirements. Once a site is listed on this system, it may never be removed from the list even after remediation has been completed. As a result, numerous sites were considered risky by potential investors, even though they were not at all contaminated or could have been reused with slight remediation. The system has therefore been accused of hindering brownfield redevelopment.

To fend off such criticism, the EPA has been improving the CERCLIS registration system since early 1995 as part of its Brownfields Economic Redevelopment Initiative. In 1996, the Agency developed a guideline for registration on the system, which considers the character of individual sites. According to this guideline, the Agency has identified for publication the sites for which assessment and required non-NPL action have been completed. By FY1998, this "safety declaration" has been made for 75% (31,000) of the listed sites.

Likewise, as presented by the reform programs, NPL sites for which possible cleanups were completed have been progressively removed from the list.

Any country could face brownfield problems in seeking comprehensive solutions to soil pollution. As described in Chapter 1, soil pollution problems typically take a considerable time to reach the surface as they result from cumulative pollution of privately-owned goods. Therefore, the acquisition of decommissioned business sites is generally avoided, as these are considered high-risk investments, thus delaying the reuse of such sites. In the United States, this tendency has been amplified by the strict system design that does not admit in some cases the "procurers in good faith" defense, even if a site assessment was conducted at the time of procurement. Nonetheless, the attempts to encourage remediation through individual policies that focus on the redevelopment of decommissioned business sites while integrating the development of local industries are noteworthy as one way of creating a remediation market.

III. Progress of Soil Protection Policy in Germany

In February 1998, 18 years after the United States, Germany passed a Soil Protection Law at the federal level (effective since March 1999). Of course, this does not mean that no soil protection policies had existed until then. Reflecting the fully decentralized system, such policies had been taken by individual Länder (provinces). As the superstructure above those provincial laws, the newly established Federal Soil Protection Law created uniform standards at the national level for the first time. Why was this law needed? This chapter outlines the development of the new soil protection policy in Germany, including the unprecedented experience of coping with soil pollution in former East Germany.

1. Outline of Soil Protection Policy

1.1 Current Condition of Soil Pollution

In Germany, polluted sites are defined by the concept of "Altlasten," comprising former waste disposal sites (Altablagerung) and former industrial sites (Altstandort). The term was first used in a report presented in 1978 by the Specialized Committee on Environmental Issues (Sachverstädigenrat für Umweltfragen). It covered the cases where pollution existing in former waste disposal or industrial sites posed a threat to the environment. Literally, this means the present soil pollution caused by past economic activities. Since then, the concept of Altlasten has been established as one of the categories constituting soil pollution in a broad sense.

In Germany, over 300,000 sites are listed nationwide as Altlasten, including 106,000 waste disposal sites and 198,000 industrial sites. 208,000 sites are located in former West Germany, while 96,000 sites are in former East Germany.[3] The total figure represents the sum of sites identified under soil protection legislation in individual provinces. Such sites should not be simply added up because each province has its own definition of Altlasten. However, the number can be compared with past figures calculated similarly. The data indicate that the total number of the listed Altlasten increased steadily from 140,000 sites in 1993 to 170,000 sites in 1995. As in the United States, not all sites polluted in the past in Germany have been identified yet.

However, it should be noted that the figures merely show potentially polluted sites. Experience indicates that in Germany, only 10-20% of such potentially polluted sites require actual remediation. Therefore, it is estimated that 30,000-60,000 sites have been identified as actual Altlasten. In addition, Altlasten sites are likely to exist in arms plants destroyed during World War II and military posts used by the former West Germany and East Germany during the cold war (Militärische und Rüstungsaltlasten).

1.2 Policy Response

Within the German environmental policy system, there had been no uniform laws or regulations at the federal level until the Federal Soil Protection Law was promulgated in February 1998, as each province had the autonomy to decide its response. Immediately after reunification of Germany, over 30 standards existed on soil pollution control, which contrasted with the systematically established protection policies on other environmental media (e.g. the Emission Protection Law for air and the Water System Law for water).

Under such circumstances, an effective environmental policy could not be implemented. Also, in order to ensure smooth progress of the reuse of existing business sites (site recycling:

[3] The sites in Berlin are all included in former West Germany.

Flächenrecycling), which is effective for protecting the surrounding undeveloped areas from developmental pressure, a clear guideline was needed for facilitating the identification of potential risk emanating from soil pollution. In addition to these environmental policy requirements, uniform standards have been deemed necessary from the viewpoint of industrial location policy, as national and international investors complained of the difference in the level of soil pollution risk.

The Federal Soil Protection Law, passed in February 1998, seeks to address these issues by unifying relevant standards and regulations at the national level. Its original draft was presented in 1992, and the final draft considers various court cases accumulated since then. The Law came into force in March 1998 following the moratorium period for revising any contradictory provincial laws and regulations. A regulatory order (Rechtsverordnung) defining quantified objectives was published in June, three months after the Law took effect. The following section highlights the content of the Law, the latest of its kind among the developed countries.

2. German Federal Soil Protection Law

2.1 Outline

The Federal Soil Protection Law is officially known as the “Law for Protection against Hazardous Soil Alteration and for Cleanup of Polluted Sites (Gesetz zum Schutz vor shädlichen Bodenveränderungen und zur Sanierung von Altlasten).” Its aim is to maintain and restore the various functions of soil. As indicated by its official name, the Law seeks to achieve this goal by preventing “hazardous soil alteration” as well as by cleaning up contaminated soil on “Altlasten” and addressing the resultant water pollution (Gewässer-Verunreinigung).

The Law defines “hazardous soil alteration” as the damage to soil functions that causes serious disadvantage or load. “Altlasten” is defined as:

a) the final waste disposal facilities that have stopped operation and the land on which waste has been subjected to intermediate disposal, storage or reclamation (Altablagerungen), and

b) the land on which any industrial facilities have been operated or any environmentally hazardous materials have been handled (Altstandort).

Thus, a conceptual distinction is made between the ongoing soil contamination and the soil pollution already caused by past economic activities. In this report, both concepts are included in “soil pollution,” unless noted otherwise.

Article 4 of the Law requires investigation and confirmation of any possible soil pollution (for both a) and b) above) as well as cleanup action in case the existence of such pollution has been confirmed. Cleanup activities are classified into several categories (Table 3-1). The Law clearly stresses cleanup and remediation over containment as it provides that decontamination action takes precedence over other measures.

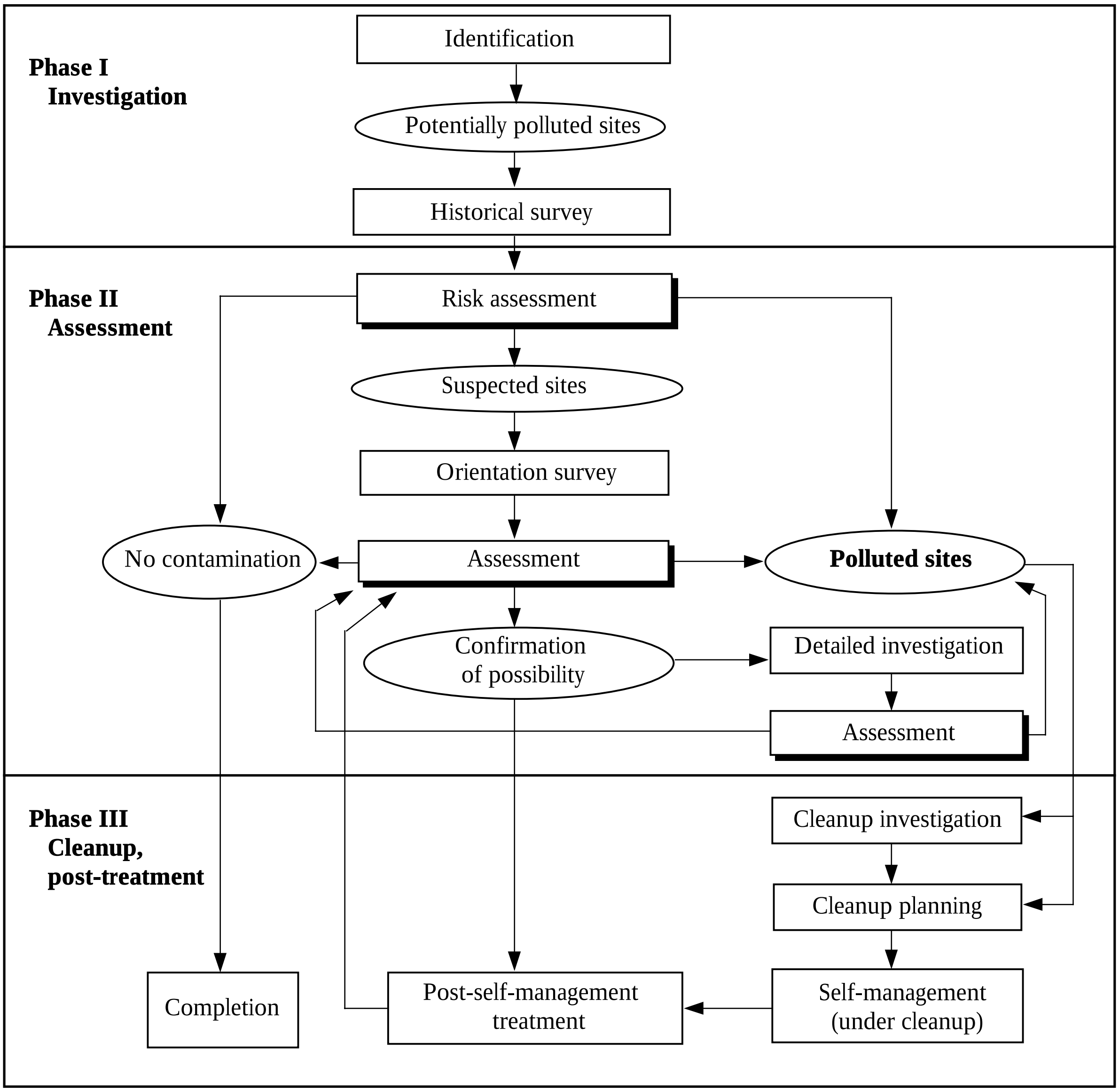
Table 3-1. Classification of Cleanup Activities

1.	Measures for removal or reduction of hazardous substances (“decontamination action”: Dekontaminationmaßnahmen).
2.	Measures for preventing or reducing diffusion of hazardous substances in the long term without removing them (“conservational action”: Sicherungsmaßnahmen).
3.	Measures for removing or reducing hazardous alteration of physical, chemical or biological characteristics of soil.
4.	Restriction on use and other measures taken for prevention and reduction of danger, disadvantage and load to individuals and the public (“protective/restrictive action”: Schutz und Beschränkungsmaßnahmen).

Figure 3-1 shows the flow of Altlasten remediation. The whole process is conducted in three phases: identification, risk assessment and action. Between the identification and risk assessment phases, a traditional approach is adopted, according to which Altlasten sites are selected progressively by repeating increasingly detailed investigations and the assessment of their results. Particular attention should be paid to the procedure following the "cleanup planning (Sanierungsplan)" in the action phase. According to the provision of Article 13, the competent authorities shall require the parties responsible for cleanup to submit a cleanup investigation report and cleanup plan, which are necessary for determining the type and scope of cleanup action. The cleanup plan must include:

a) outline of risk assessment and cleanup investigation
b) past and future use of the cleanup site, and
c) cleanup objectives, how to achieve them and estimated period of cleanup.

Figure 3-1. Procedure of Polluted Site Remediation in Germany



Source: Umweltbundesamt

Although the German Soil Protection Law provides for the development of standard trigger levels for cleanup action, it does not envisage the definition of cleanup objectives as standard values (for achievement). This is based on the judgement that the definition of achievable goals for individual cases is more practical since the condition of pollution differs substantially from site to site. The German system is highly flexible as it ensures that the development and achievement of cleanup goals are assumed by responsible parties as well as the assessment of the present situation.

Of course, care has been taken to ensure that the cleanup plan does not set intentionally low-level objectives. The competent authorities may order the cleanup plan to be drawn up by external experts. They are also mandated to develop or complement the plan as necessary, if the content of the submitted cleanup plan is deemed insufficient. They may declare the submitted plan as binding (verbindlich) while reserving their right of revision.

Moreover, a responsible party who is required to submit a cleanup plan must voluntarily provide information regarding its content as early as possible to other interested parties including the owners and users of the site. Although this provision on disclosure only seems to require simple notification after the plan has been developed, the federal Ministry of Environment expects more substantial effects, namely, that the responsible party is expected to present available information to other interested parties from the outset and develop the cleanup plan based on consultations with such parties. In this way, the cost of cleanup may be reduced eventually, as remedial action will not be delayed by any disputes among parties involved over the objectives to be achieved.

After the completion of cleanup action, the site is reinvestigated following a certain period of self-management. If no further problems are detected, the remediation process is considered complete.

Thus, the German Soil Protection Law is intended to allow flexible cleanup action fit for individual site conditions. The following subsection focuses on some of its characteristics in comparison with the U.S. system discussed in the previous chapter.

2.2 Characteristics

(i) Introduction of uniform national standards

First, it should be noted that the Law harmonizes somewhat inconsistent provincial standards and integrates issues that have been settled in court. In particular, the Law seems to have been inspired by the lessons learned in the United States as regards the scope and liabilities of responsible parties, cleanup process and uniform standards.

Responsible parties

The parties responsible for cleanup are defined in Article 4 and include those who have caused hazardous soil alteration or contamination of the sites (Verursacher), successor to their comprehensive rights (Gesamtrechtsnachfolger), land owners (Grundstückeigentümer), occupants and others who have effective control over the piece of land (der Inhaber der tatsächlichen Gewalt über ein Grundstück). The article also provides specifically for the remediation responsibility of the corporations that control the owners of the polluted sites. As a result, liabilities have been clarified for the controversial areas of successors of comprehensive rights and Conzern-controlling companies, as well as for causers, owners and occupants, traditionally held responsible under the German legal system.

No provisions are made for retroactive liabilities, which have been established through court cases under the U.S. Superfund Act. This is because the remedial responsibility for soil pollution is considered as a variant of danger removal under the police law, thus posing no difficulty regarding its retroactivity. Although it has a similar effect to that of the U.S. law, the German law does not apply retroactively to any owners who have not contributed to contamination. Former owners are exceptionally held responsible if they transferred ownership after the Law had taken effect in March 1999 and knew, or should have known, about the pollution at that time.

Standard objectives

Article 8 authorizes the federal government to introduce standard objectives for remedial action in the form of a regulatory order (Rechtsverordnung) after collecting views from those concerned and obtaining agreement of the Bundesrat (Senate). The article envisages three types of quantified objectives as shown in Table 3-2. The investigation value and the action value represent the thresholds for conducting investigation or for taking concrete measures. In other words, they quantify the "danger and serious disadvantage to individuals or the public" generally stated in legislation. Naturally, those values are not preconditions for issuing orders. The competent authorities may order an investigation or remedial action as deemed necessary according to actual evidence.

The prevention value, on the other hand, represents a standard for preventing the occurrence of soil pollution in the first place before any investigation or cleanup action becomes necessary. It corresponds to the responsibility of prevention (Article 7), as will be described later. Unlike the above two values, the prevention value constitutes a necessary condition for defining the responsibility for prevention.

Table 3-2. Standard Values

1. Investigation value (Prüfwert):
   Exceeding this value may trigger an investigation on individual sites to determine the (non-)existence of pollution.
2. Action value (Maßnahmenwert):
   Exceeding this value may be deemed indicative of the existence of pollution in light of previous soil use, and subsequently trigger cleanup action.
3. Prevention value (Vorsorgewert):
   Exceeding this value signifies the possibility of hazardous soil alteration in light of geological conditions or hazardous substances emanating from the surrounding biotope.

The establishment of a mechanism that clearly defines uniform trigger levels for investigation and cleanup action constitutes the core of the Federal Soil Protection Law as it seeks to remove the obstacle of inconsistent state standards. It also preempts the reforms of the U.S. Superfund Act described in Chapter 2.

Incidentally, the Law provides that the goals of remediation to be attained through testing and action shall be defined by regulatory orders in the form of "requirements (Anforderung)" rather than "values (Wert)." Therefore, the government is not given the power to determine any quantified objectives through regulatory orders. According to Sanden (1998), one of the reasons for such qualitative cleanup objectives is that any uniform objective would undermine the development of flexible cleanup plans in response to the condition of individual sites (Article 13).[4]

The regulatory order – Federal Order on Soil Protection and Polluted Sites (Bundes-Bodenschutz und Altlastenverordnung) – was adopted by the Cabinet Meeting in June 1996 (approved by the Bundesrat on April 30). The Order, comprising five chapters, provides in

[4] Sanden/Schoeneck: Bundes Bodenschutzgesetz Kurzkommentar, p.187.

detail for hazardous soil alterations, investigation procedures on Altlasten and requirements concerning cleanup. For example, the investigation value appearing in the Appendix Table are set progressively according to land use where human beings are directly exposed to the contaminated soil. Four types of land use are identified: a) playgrounds for children, b) residential areas, c) parks and recreational facilities, and d) industrial sites.

The action value has only been set for PCDDs (PCDD/F) so far. Values will be developed for other pollutants, possibly integrating into the process the standards to be set by the EU directive on soil protection now being negotiated.

Cost imputation

Clearly, the responsible parties should bear the cost of cleanup. As regards the right to indemnity and the imputation of investigation cost, however, various arguments have been made and a consistent interpretation has not been established in court cases. One of the major characteristics of the Law is that it sheds light on such issues as well as on the identification of responsible parties and standard values. It provides for the mutual right to indemnity between responsible parties in conformity with civil law provisions, with a negative prescription of three years. As regards the imputation of investigation cost, the Law clearly provides that the cost of investigation for risk assessment shall be borne by the responsible parties if, based on actual evidence, there is enough reason to suspect the existence of pollution.

If a responsible party is unable to bear the cost, as in the case of the orphan share in the U.S., public funds will be directly injected. Apparently, it was considered difficult to introduce under the German legislation a U.S.-style fund which does not require any direct relationship between source and use. Any injection of public funds is recorded on the register book (land ledger) along with the amount of money injected. In this case, the responsible parties (owners) are only required to compensate for any substantial (nicht nur unwesentlich) rise in the land price due to remediation (Article 25). Actual judgement on such a substantial rise is made case by case. This clause is intended to collect any excessive profits gained by the owners due to cleanup using public funds. However, the provision is highly unlikely to be applied in practice, because prior to injection of public funds, it must be carefully checked that the owners really cannot pay the cost in any other way.

(ii) Introduction of prevention principle

Second, the Law is characterized by its provision for the responsibility of prevention in addition to the cleanup liabilities; requiring landowners and users to prevent any risk of "hazardous soil alteration." The federal Ministry of Environment highly evaluates the introduction of the prevention responsibility in soil protection policy, which is primarily focused on past contamination. In line with this preventive obligation, the competent authorities are granted the power to issue orders for the prevention of hazardous soil alteration. From the viewpoint of legal stability, however, this power may only be exercised when requirements are established by regulatory orders.

The Federal Order on Soil Protection and Polluted Sites quantifies the requirements in the form of prevention values. The responsibility of prevention arises when a hazardous substance is detected in an amount that exceeds the prevention value, or when the content of other hazardous substances is so high as to cause hazardous soil alteration judging from the material characteristics.

(iii) Distinction of polluted site problems

Third, in light of the particularities of polluted site (Altlasten) problems, the Law provides for special measures to promote efficient cleanup. Namely, the Law takes into consideration the fact that problems related to Altlasten differ from other soil pollution problems in that they result from past economic activities. The Law and its regulatory order have several specific provisions for the cleanup of Altlasten for the furtherance of ordinary policies against soil contamination. As mentioned at the beginning of this chapter, the most typical of those measures is the cleanup planning system that allows a flexible response to site characteristics. The declaration that a cleanup plan is binding also contains other authorizations required for the cleanup action, effectively bypassing the red tape and enabling actual work to start promptly. In addition to such measures for efficiency, the Law provides that the polluted sites shall be placed under the surveillance of the competent authorities, indicating enhanced safety considerations. Where necessary, the competent authorities may order the responsible parties to conduct monitoring and to maintain and submit the results even after the cleanup action has been completed.

3. Response to Soil Pollution in Former East German Territory

3.1 Soil Pollution in Former East German Territory

This section deals with the situation in the former East Germany, which is considered to pose the most difficult soil pollution problems in the history of Germany. In addition to the industrial development prior to World War II, the industrial policy under the post-war socialist regime seems to have caused serious soil pollution in the territory. Waste was carried into mixed treatment facilities (Mischdeponie) in an uncontrolled manner without distinction between domestic waste and industrial waste. Moreover, such facilities were dispersed all over the territory to reduce transport cost (i.e., to save fuel cost). In addition to the existence of such relatively small polluted sites, policy measures promoted large-scale industrial concentration symbolized by industrial complexes, which led to the existence of large-scale, densely-polluted sites in specific areas. Initial problems such as the leakage of hazardous substances during production, storage and transportation due to outdated facilities, reduced investment and the shortage of replacement parts were further complicated in the early 1980s, when waste from the mining, chemical and energy sectors increased under the autarchy policy (Autarkiebestrebung) and were disposed of on sites that were inappropriate for reclamation both geologically and technically.

From a legislative viewpoint, the former East Germany had a relatively forward-looking law against soil pollution. As the achievement of objectives was made top priority under the planned economy, however, safety was neglected in practice when treating hazardous substances.

Following reunification of Germany, the government was obliged to address such soil pollution problems faced by former state-owned companies. Besides grave concern over its adverse effect on human health, soil pollution in the former East Germany required an immediate response in order to facilitate privatization of state-owned companies, which was the highest priority at that time. Thus, an anti-pollution scheme was hastily built from scratch. Since the polluters were former state-owned companies, the government was forced to pay a considerable part of the remediation cost, making efficient cleanup action essential in order to minimize the impact on the national budget. This consideration in particular may have exerted a strong influence on the development of subsequent policies including the above-mentioned Federal Soil Protection Law.

3.2 Brief History of Soil Pollution in Former East German Territory

In the new Länder created prior to the formal reunification, uniform countermeasures were to be voluntarily applied to Altlasten based on the experience in former West German provinces. On the initiative of the state of Saxony, the Polluted Site Committee / Joint East Working Group (Arbeitsgruppe Ost des Altlastenausschusses) was organized within the Joint State Waste Program (Länderarbeitsgemeinschaft Abfall: LAGA) as the central organ for tackling the problem. The Committee immediately started work on identifying Altlasten by introducing a matrix used in the former West Germany to determine the possibility of soil pollution. 2,000 sites had been identified by the mid-1990s as potentially polluted sites.

As the currencies were unified with the establishment of the monetary, economic and social union on July 1, 1990, the Framework Law on Environment (Umweltrahmengesetz) went into force (June 20), effectively enlarging the scope of the German environmental protection legislation to the former East German territory. Although the law officially made each province part of the soil protection policy, the development of legislation for soil protection did not progress smoothly in practice.

Thus, a major role in addressing this issue was handed over to the Treuhand-Anstalt (THA), the federal agency in charge of the privatization of state-owned companies. Although the THA was originally a public-law entity established in March 1990 to administrate the state-owned companies in the former East Germany, it was subsequently transformed into one of the world's largest holding companies owning 14,000 former state-owned companies. The federal agency also took charge of their privatization.

The THA became involved in soil pollution problems, which were initially not within their scope of responsibility, because they were closely related with the privatization policy. European and American industries, which were potential investors in the former East German territory, had come to consider the risk of potential pollution as a matter of course when purchasing land. Therefore, privatization could not progress without measures being taken regarding the risk of soil pollution facing such ex-state companies. The basic position of the government on this issue had already been clarified in the aforementioned Framework Law on Environment and the Law for Removing Obstacles to Privatization (Hemmnisbeseitigungsgesetz) of 1991. These laws provided that under privatization contracts, liabilities of investors should be limited when any such liabilities occurred in the future due to the detection of polluted sites (Altlasten). According to this immunity clause (Freistellung), the remaining liabilities were to be assumed by the federal government (THA). Specifically, investors were only required to pay a small part of the cleanup cost (Sockelbetrag) for any Altlasten that had existed prior to July 1, 1999, while the THA was to bear the remaining cost and up to 90% of the total cleanup cost.[5]

The key issue was how to administer this immunity clause. Investors wished to blame the load existing on the purchased land to past contamination in order to receive as much public funds as possible for remediation. As no applicable laws existed at the federal level while the development of soil pollution legislation did not progress at the provincial level, the THA inevitably had to assume the role of provincial governments, including the determination of Altlasten. In practice, the involvement of the THA became the first involvement of the federal government in soil pollution problems.

The THA organized an Altlasten Committee to examine issues such as risk assessment, provision of immunity in privatization contracts and risk-sharing between the federal and

[5] From the viewpoint of the PPP (polluter-pays principle), this clause has a character of subsidy since the government sector pays a substantial part of the cleanup cost to be borne by the private sector. Indeed, the clause was examined by the EU Commission, which found that it did not constitute a subsidy that runs counter to its policy on competition.

provincial governments. Altlasten was defined as “the load of hazardous substances to soil that threaten public safety and order.” The identification of Altlasten proceeded rapidly by utilizing the expertise gained in the former West Germany. In the former West German territory, Altlasten usually refers to business facilities that have already been closed. In the former East German territory, however, investigation also covered business facilities in operation as risk needed to be assessed for privatization. Consequently, the number of potential Altlasten increased substantially.

In December 1992 the anti-Altlasten scheme for the former East Germany was finalized by the conclusion of a federal-province administrative agreement (VA-Altlasten: published in March 1993). This agreement integrated into the scheme the provincial governments, which had remained uninvolved until then. It provides that, when privatizing a former state-owned company, the part of the remediation cost for which investors are exempted from payment shall be distributed between the federal authorities (THA) and the provincial governments in the ratio of 6 : 4 for ordinary projects and 7.5 : 2.5 for large-scale projects.

Table 3-3 outlines the large-scale remediation projects selected for the purpose of operating the scheme. Requirements for the designation as large-scale projects include:

(i) environmental risk

(ii) estimated cost (over DM100 million)

(iii) existence of significant loads as compared with other provinces (brown coal mines, chemical complexes, etc.), and

(iv) scale of the employment created by the remediation.

Appearing first in the table, the Bitterfeld/Wolfen site in Saxony-Anhalt is considered to be the largest Altlasten of all. The area was developed for a large-scale chemical complex under the socialist regime, as the main plant of the largest German chemical company (IG-Farbe) had been located there even before the war. In the meantime, industrial waste continued to be dumped in a former brown coal mine, causing serious combined pollution. The complex was closed and partially privatized following the reunification, but most of this large area is still under remediation and the threat to the groundwater artery has not disappeared. The serious situation is reflected in the level of remediation cost, which will amount to DM0.8-1.2 billion.

Table 3-3. Large-scale Altlasten Remediation Projects in Former East Germany

DM1 million

Project	State	Outline	Remediation cost
Bitterfeld/Wolfen	Saxony-Anhalt	• Caused by chemical complexes and film plants that existed in an industrial area in central Germany. • Soil and groundwater have been polluted over a wide area with hazardous substances dumped in a closed open-air brown coal mining site.	800-1200
Buna	Saxony-Anhalt	• Caused by chemical complexes that existed over a large area including Schkopau and Merseburg. • Soil and groundwater have been contaminated over a wide area with heavy metals and organic solvents.	1000
Industriegebiet Spree	Berlin	• The largest industrial area in Berlin since 1879. • Combined pollution of ground water and soil with hazardous waste emitted from the concentration of various industries including chemical, energy and metallurgy.	370
Leuna	Saxony-Anhalt	• Caused by Leuna, which was originally established in 1916 as a BASF ammonia plant and was transformed into an integrated chemical plant after WWII. • Combined pollution of soil and groundwater with BTX and heavy metals.	100-200
Mansfelt	Saxony-Anhalt	• Caused by mines (copper, brown coal, potash) that existed in the Mansfelder Basin. • Mainly contaminated with heavy metals.	100-150
DresdenCoschuetz/ Gittersee	Saxony	• Caused by a former uranium processing plant (1951-1962) and a tire plant (1962-1992). • Contamination with radioactive substances and heavy metals.	140
PCK Schwedt	Brandenburg	• Caused by the concentration of oil refining facilities established in 1964 as well as fertilizer, feed and chemical plants. • Soil and groundwater contamination with hydrocarbons and naphthalene.	120-130
Region Oranienburg	Brandenburg	• The oldest industrial area in eastern Germany. Soil pollution caused by past industrial waste disposal and the leakage of hazardous substances from bombings during WWII.	100
Rositz	Thuringia	• Caused by a tar plant closed in 1990. • Combined pollution of soil and groundwater due to tar disposal and the leakage of hazardous substances from bombings during the war.	110-190
Erdoel-Erdgas Gommern	Saxony-Anhalt	• Caused by a former oil and gas complex. • Combined pollution of groundwater and soil with heavy metals from the sludge buried in numerous places within the site.	At least 100

Sources: German Federal Ministry of Environment documents.

3.3 Huge Remediation Costs and Role of Government

As the identification of polluted sites progressed, the discussion became focused on the costs of remediation for business sites in the former East Germany. Table 3-4 shows the principal estimates at that time. The estimated figure ranged widely from DM10 billion to over DM200 billion, largely due to the difference in judgement on the increase in the number of potentially polluted sites and on the share of the sites that actually need remediation. Reportedly, one estimate even suggested that the costs would total at least DM500 billion. Even though this figure was somewhat exaggerated, it was commonly agreed at that time that it would take more than DM100 billion to clean up the Altlasten in former East Germany. This issue was discussed intensively because, as already mentioned, the particularities of the former East German territory dictated that most of the remediation costs would have to be paid by the government. In other words, remediation was considered as an additional cost of reunification.

Table 3-4. Estimates of Soil Remediation Cost in Former East Germany

DM million

Organization	Year	Estimated cost	Notes
Institut für Oekologishche Wirtschaftsforschung (Berlin)	1990	45,200	• Does not include costs related to uranium mines. The share of Altlasten is estimated to be 48%. • The figure indicates the minimum amount required.
Ifo-Institut (Munich)	1991	10,600	• Based on a 1990 investigation, the share of Altlasten is estimated to be 8%. • Does not include costs related to uranium mines and Soviet military posts.
Wirtschaftsminister-konferenz	1991	36,000-270,000	• Altlasten are estimated to represent 30% of the 30,000 suspected sites. • Average remediation cost: DM2-15 million. Does not include military-related sites.
Ifo-Institut (Munich)	1992	26,000	• Costs are calculated separately for former disposal sites and industrial sites by multiplying investigation, remediation and management costs by their respective unit prices and adding the costs for sites identified subsequently. Does not include Soviet military posts but includes uranium mines.
IWH (Halle)	1993	56,000-75,000	
Former East German provinces	1993	75,000-113,000	• Aggregate of the estimates conducted in individual provinces.

Source: Volker Franzius Kosten und Finanzierungbedarf der Altlastensanierung in den Neuen Bundesländern.

Faced with the huge cost of remediation, the THA and its successor organ, the Special Federal Agency on Unification (Bundesanstalt für vereinigungsbedingte Sonderaufgabe: BvS), developed a concept to be applied in actual remediation activities. It separated the level of remediation to be achieved from abstract ideas of danger and objectives. Instead, it stressed that the remediation required by soil protection laws and regulations being developed by individual provinces should be set at reasonable levels that can be achieved both environmentally and economically. Typically, the concept developed a method that relies on external experts for determining whether pollution exists or not. If the existence of pollution is confirmed, the most economically reasonable technique is selected taking into consideration waste problems (excavation of contaminated soil), the amount of resource use (capacity of the disposal site, energy use) as well as greenhouse gases and other loads generated in intermediate disposal and long-distance transportation.

As uniform laws and regulations did not exist at the federal level, with as many as 39 definitions of Altlasten further complicating the problem, various estimates of remediation costs made at that time applied in most cases the highest cleanup standards and costs in the former West Germany to the eastern territory without any adjustment. The concept developed by the THA and BvS provides a reasonable review of such practice.

The assessment and cleanup according to this concept have brought two large benefits to the federal government (THA/BvS).

First, it was made possible to provide potential investors with estimates of remediation costs on a uniform basis. Even though there was already an immunity clause, investors could still be held liable for about 10% of the remediation cost. Providing them with such valuable information helped to remove the uncertainty about investment conditions. Moreover, the remediation costs themselves turned out to be much less expensive than had been estimated initially. A thorough reassessment indicated that they would never exceed DM30 billion, which was substantially lower than the earlier maximum estimate of DM500 billion. Table 3-5 shows the status of Altlasten cleanup projects as of April 1999. In total, 4,554 sites have been identified as Altlasten requiring cleanup. Contracts of large-scale projects have been concluded for 557 sites, while 1,215 sites are covered by ordinary contracts. No contracts have been concluded for the remaining 2,772 sites. Table 3-6 indicates the estimated burden of the BvS in conducting the large-scale and ordinary cleanup projects (as mentioned above, 75% and 60% of total cost respectively). In addition to the DM5 billion already incurred, the BvS has committed itself to paying over DM500 billion for some of the projects still to be contracted. Thus, the current risk for the BvS totals DM5.5 billion. Figure 3-2 shows the trend of the total risk. The fact that the cumulative payment during the same period amounts to some DM1.4 billion (Figure 3-3) indicates the effectiveness of the reassessment by the new reasonable method of estimation.

Table 3-5. Altlasten Cleanup Projects in Former East Germany (Number of Contracts)

As of April 1999

	Large projects	Ordinary projects	Untouched projects	Total
Berlin	36	94	241	371
Brandenburg	98	158	341	597
Mecklenburg vor Bommern	0	156	326	482
Saxony-Anhalt	169	134	386	689
Saxony	102	325	887	1,314
Thuringia	152	348	591	1,091
Total	557	1,215	2,772	4,554

Source: BvS.

Table 3-6. Risk Assessment by BvS (as of April 1999)

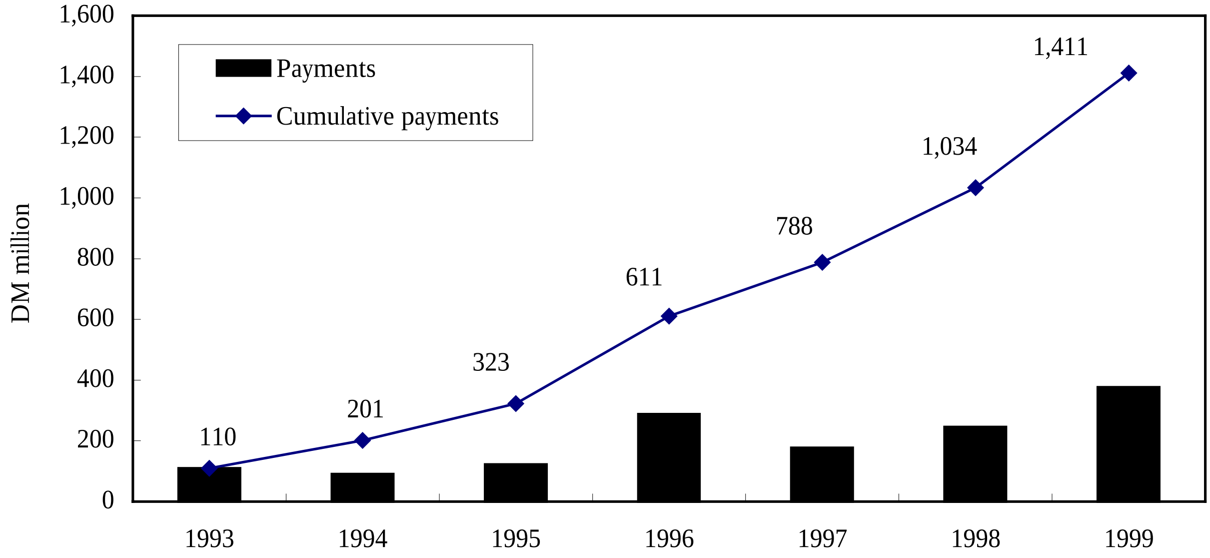
DM million

	Large projects	Ordinary projects	Total
Berlin	234	238	472
Brandenburg	118	331	449
Mecklenburg vor Bommern	27	89	116
Saxony-Anhalt	1,805	825	2,630
Saxony	209	319	528
Thuringia	372	399	771
Total	2,765	2,201	4,966

Note: The total risk assessment amounts to DM5,493 million, as a further DM527 million is likely to be spent on untouched projects.
Source: BvS.

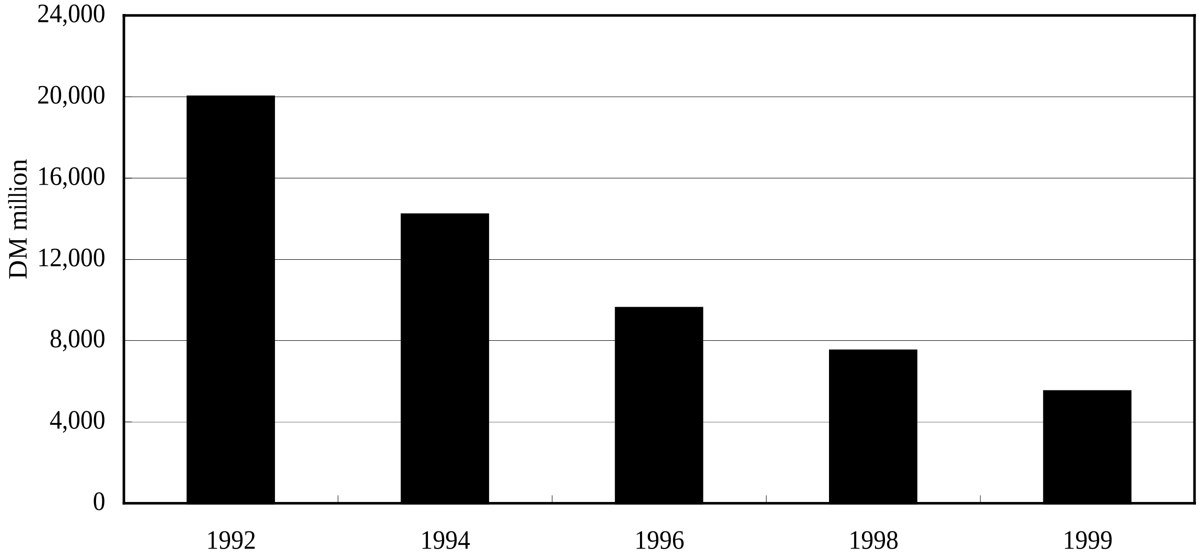
Second, the decline of land prices due to the existence of Altlasten could be grasped comprehensively. This information was necessary because any sites unfit for privatization as business sites had to be sold in the real estate market for other uses.

Figure 3-3. Trend of Payments by THA/BvS



Source: BvS.

Figure 3-2. Trend of Total Risk for THA/BvS



Source: BvS.

3.4 Implications of Measures Taken for Former East German Territory

Thus, the attempt of the THA and BvS served as a precursor to the aforementioned federal policy on soil protection in that it demonstrated the necessity and effectiveness of uniform criteria in addressing Altlasten issues. Also, it clearly showed the kinds of problems faced by the government when intervening in soil remediation. One of its implications is that explicit criteria need to be established for determining the level of pollution when public funds must be injected due to the inapplicability of the PPP. In addition, it is extremely important for the government to internalize the ability to assess the condition of polluted sites in determining the scale of the projects in order to avoid moral hazards. In the case of the former East German territory, for example, investors tend to make maximum use of the indemnity clause, while state governments would like to see its activities designated as large-scale projects.

4. Future Perspective of Underground Environmental Protection Policy in Germany

This chapter has outlined the soil protection legislation in Germany, the latest of its kind introduced among the developed countries, with reference to preceding efforts in the former East Germany. The establishment of a uniform soil protection policy at the federal level will substantially accelerate the comprehensive identification of Altlasten and cleanup costs, including those in the eastern territory. Indeed, the unified standards have stimulated the movement toward creating a database on Altlasten.

The systematic development of soil protection policy signifies that market conditions for the remediation industry have improved. In Germany, the notion of the remediation industry has been highly inclusive. In the broadest sense, remediation includes the transition from dependence on brown coal to expanded use of renewable energies to prevent future Altlasten from emerging. It is sometimes argued that the recycling industry should be developed so that construction of final disposal sites (Deponie) can be halted. Even in a narrower sense, soil cleanup activities have emerged particularly in the mining and construction industries. Reportedly, industries have crossed the national border and are expanding cleanup activities abroad, including Central and Eastern Europe. The government also considers them as important export industries. Although the scale of the national market cannot be identified until the number of potential sites has been confirmed using a uniform measure, it is estimated to reach ¥4 trillion for untouched sites.[6]

As pointed out by an environmental group (BUND), the German Soil Protection Law does include some problems such as its narrow scope of applicability. This problem, however, is common to many environmental protection laws and regulations. Considerable investment can be expected subsequently as the Law will be integrated into the Environmental Code currently under consideration. In any case, the underground environmental protection policy in Germany will continue to progress in the short to medium term, because it preempts the reform of the U.S. Superfund scheme including the development of progressive standards based on land use and the admission of flexible cleanup objectives in response to site characteristics.

[6] The figure is estimated using the cost per site according to the ifo-Institut based on the assumption that 20% of the 304,000 potential sites will receive actual remediation. However, this may represent an underestimate in light of the scale of the German economy. Indeed, the Netherlands is reported to have a remediation market of 80 billion florins (about ¥5 trillion), although this figure is based on the assumption that all sites will be receive the highest level of cleanup applicable to residential areas.

IV. Current Status and Future Perspective of the Japanese Remediation Industry

As discussed in the previous chapters, the remediation industry has been recognized as a promising business in countries like the U.S. and Germany. In both cases, the establishment of the industry was preceded by institutional development covering the problem of underground pollution to boost the potential remediation market. In comparison with those examples, this chapter examines the current status and future perspective of the remediation industry in Japan.

1. Remediation Market in Japan

1.1 Past Developments

As in Europe and the U.S., policy response to underground pollution in Japan has been stimulated by incidents that have had a major social impact. However, a comprehensive legal system for the underground environment has not been developed in Japan partly due to the difficulty in integrating it into the traditional policy framework focused on the fight against industrial pollution. This point was discussed in Chapter 1. Policy response was limited to that part of the underground environment which directly affects human health, such as agricultural land and groundwater. Consequently, other problems such as so-called urban soil pollution have mostly been left untouched, and there has not even been a nationwide site investigation to identify the condition of underground pollution in Japan.

Currently available data include the results of a questionnaire survey for local governments that is conducted every five years by the Environment Agency. According to the survey, 872 pollution cases were identified during the period from April 1, 1975 through March 31, 1997, of which 467 cases were investigated. Pollution standards were exceeded at 171 sites (Table 4-1). The number of identified cases is naturally far smaller than those in the U.S. and Germany, where the identification of polluted sites is required by legislation. Nonetheless, the result shows some of the characteristics of underground pollution:

(i) The pollution involves a wide range of industries (Figure 4-1).

(ii) In most cases, the pollution of surface soil coincides with that of sewage and infiltration water.

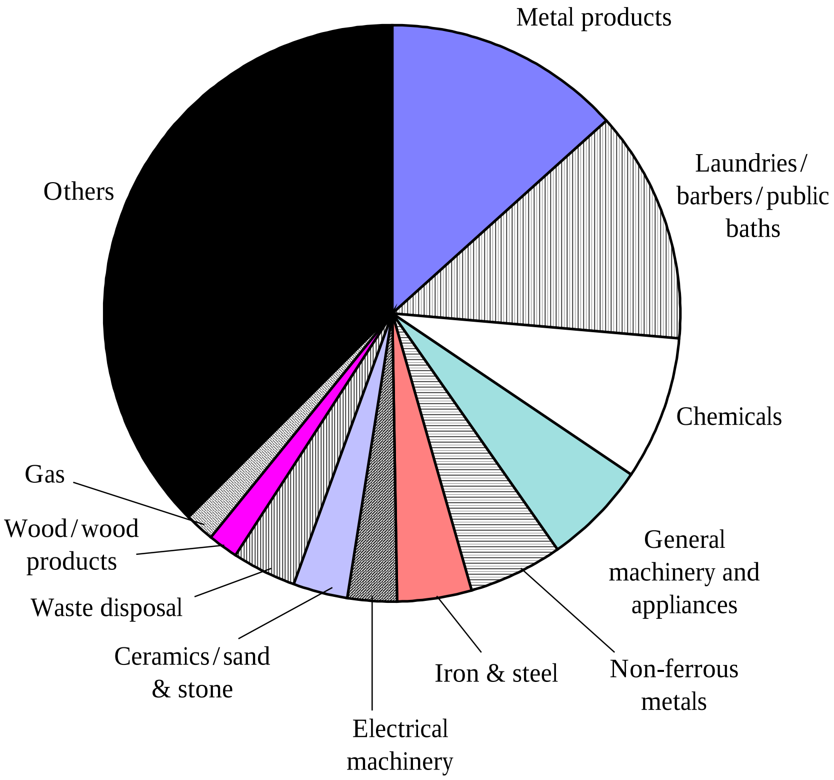
(iii) Different pollutants cause different types of pollution. For example, pollution by heavy metals affects a wide area and is mostly found in relatively large-scale business sites, but its depth remains relatively shallow.

Table 4-1. Investigation of Soil Pollution (Number of Cases)

	Cumulative total	Identified in FY1997
Total cases	872	46
Investigated cases	467	44
Contamination cases	171	39

Source: Environment Agency.

Figure 4-1. Industrial Distribution of Contamination Cases (n=171)



Note: Categories are according to the intermediate classification in the Japanese Standard Industrial Classifications. "Others" include 15 industries, academic research and public operations as well as unidentified cases.
Source: Environment Agency.

1.2 Characteristics of Remediation Market So Far

As can be deduced from the survey results, information on remediation activities is extremely limited in Japan, and not even the local authorities have sufficient data. This is because there has been no incentive for companies conducting remediation to disclose their information. Aside from the cases like groundwater pollution after the revision to the Water Pollution Control Law, where pollution affects other environmental media under control, any measures against underground pollution taken by private firms so far have preempted future regulations that do not exist at present. For example, a company may decide to clean up a site when an investigation has identified pollution that might affect a groundwater source, for fear of the eventual social impact and costs. In Japan, such cases are likely to be reported by the media as scandals, thus considerably damaging the reputation of the company. For such reasons, most remediation organizations take remedial action with great care under strict information control, and enter into confidential contracts with specific executing firms. The Japanese remediation market constitutes a highly closed system, as such activities are conducted individually in many places and related data is available only in narrow areas including local authorities. As described later, this is a characteristic of the Japanese remediation industry, which is geared to providing integrated services covering the whole remedial process.

The absence of rules to provide a common basis for understanding has left the market undeveloped and highly opaque. However, the number of cases investigated by the Environment Agency – currently standing at 467 in total, of which 171 cases require countermeasures – will increase rapidly as the system develops. In fact, the example of the former East Germany discussed in the previous chapter indicates that, following the initial dependence on local authorities for the voluntary identification of polluted sites, institutional development resulted in a substantial increase in the number of potentially polluted sites.

1.3 Discussions on Scale of Remediation Market

How many polluted sites exist in Japan that require remediation? Several forecasts have been made from different viewpoints including the theory of market scale for the remediation industry (Table 4-2). The market scale is extremely difficult to measure as indicated by the wide range of estimated values according to different viewpoints and approaches.

Table 4-2. Various Forecasts of Market Scale for Remediation Industry

Organization	Scale	Note
Japan Society of Industrial Machinery Manufacturers	FY 1996 actual, ¥3 billion 2010 forecast, ¥24 billion	Actual and forecast figures for related facilities and businesses
Think tank (Sumitomo Marine Risk Research Institute)	Number of business facilities for which pollution diagnosis is preferable = over 440,000 sites	Forecast of the number of sites based on soil environment standards
Think tank (Japan Research Institute)	¥2-3 trillion	
Remediation firm	100,000 sites, ¥1 trillion	
WEDGE magazine	200,000 sites, over ¥60 trillion	Half of 440,000 sites x cost per site (¥300 million)

Sources: Various documents.

Since the condition of polluted sites varies substantially, the methods of investigation and remediation cannot be determined automatically. As described later, to provide optimal solutions according to individual site conditions, most firms involved in remediation try to develop comprehensive treatment skills and a wide variety of cleanup methods and techniques. This is why remediation technology is called the “art of combination.” Also, the most important determinant of remediation cost is the duration of the cleanup. In an extreme case, the cleanup cost for the same polluted site may differ substantially between removal of polluted soil by excavation (despite the astronomical cost) and long-term, progressive remediation by installing individual cleanup equipment while keeping the facilities operating. Also, the cost may vary greatly depending on the level of remediation required.

Taking those limits into consideration, Table 4-3 shows a rough estimate of the market scale for the Japanese remediation industry. Supposing that, as in Europe and the U.S., division of labor has developed within the remediation industry with leading vendors for each process, an estimate should consider:

(i) number of potentially polluted sites × unit cost of general investigation,

(ii) number of sites requiring detailed investigation × unit cost of detailed investigation, and

(iii) number of sites requiring remediation × costs of cleanup and monitoring.

However, no credible data exist on those figures. Moreover, the Japanese typically prefer continuous services that integrate investigation with the remediation process. The estimate therefore excludes the cases where only investigation is conducted and supposes that any preceding investigation cost is included in the remediation cost.

Prior to any estimate, substitutional values must be determined for the number of sites requiring cleanup, the amount of soil and the unit cost of treatment.

The number of potentially polluted business sites may be calculated as the sum of business establishments in the industries suspected to be polluting the underground environment. Based on the pollution matrix used in Germany, this report focuses on the pollutants controlled by the Japanese environmental quality standards for soil pollution and the Water Pollution Control Law in selecting the polluting industries. As indicated by the aforementioned Environment Agency survey, the "possibility" of pollution covers almost all manufacturing industries, and the total number of polluting industries exceeds 400,000 including laundries (excluding intermediate agencies) and gas stations. Since the figure represents potentially polluted sites, the number should also be estimated for the sites subjected to investigation and subsequent cleanup. Judging from the share of the investigated cases (467) in the total cases (872) identified by the Environment Agency survey, the number of sites requiring investigation amounts to just over 280,000. If we apply the actual rate of 10-20% in Germany, the number of sites requiring remediation ranges from just under 30,000 to 70,000.

The next issue in considering the market scale is how much soil will have to be cleaned up in those sites. This calculation requires data on the surface area per business establishment, the depth of pollution and the share of contaminated soil in the total volume (contaminated soil ratio). This report adopts as the surface area per site the land area of the manufacturing industry given in the Report on Basic Land Survey divided by the number of manufacturing business establishments reported in the Industrial Statistics. The surface area of a gas station and a laundry is assumed to be 300m^2 and 100m^2 respectively. The depth of pollution is considered to be 3.8m, in line with the result of the Environment Agency survey.

The soil contamination ratio is substituted with the ratio of planned building area to total site area according to the Table of Results of Survey of Plant Location Trends. This is because pollutants tend to leak where there are buildings of some kind.

Finally, it is not possible to define the unit cost of treatment in a single manner; different techniques and methods are used according to the pollution situation. The period required for cleanup also differs substantially between on-site and off-site remediation. The fight against soil pollution is often compared to medical treatment. This is because the process of diagnosing the condition of individual patients to select and carry out the optimum treatment resembles that of investigating suspected sites, identifying the condition of pollution and selecting the optimal cleanup method. And just as it is impossible to talk about medical costs without considering the patient's condition, costs related to remediation cannot be determined without considering actual cases. According to data obtained from hearings, this report estimates the cost to be ¥25,000-100,000 per cubic meter.

An estimate based on the above assumptions indicates that the scale of the remediation market exceeds ¥5 trillion, with a considerable margin of error reflecting the variance of related costs (Table 4-3). As indicated by other estimates, it is safe to say that there is a huge potential market, though several points must be considered as follows.

First, as long as the pollution stays within a plant site, remediation is an issue only when some kind of land alteration is conducted such as redevelopment after the closure of a plant. Therefore, the several trillion yen potential of the remediation market will materialize over a very long period as land is altered.

Second, the scale and emergence of the market largely depend on the rules concerning remediation. The aforementioned assumptions may change considerably according to the coverage and level of remediation required. This is also evident from the fact that, as regards the problem of Altlasten, the cost calculated by the BvS according to its own scheme was very different from the initial estimate of the remediation costs. This issue is examined at the end of this chapter.

Table 4-3. Example of Calculating Market Scale

a. Number of suspected sites	409,332 sites	
b. Investigation ratio	53.6%	Environment Agency survey: investigated cases/total cases
c. Number of sites requiring investigation (a × b)	219,218	
d. Ratio of sites requiring remediation	10-20%	Estimated from Environment Agency survey result, German cases, etc.
e. Number of sites requiring investigation	21,922-43,844	
f. Average area per site (m^2)	12,156	National Land Agency, "Report on Basic Land Survey," Industrial Statistics, etc.
g. Depth of pollution	3.8m	
h. Volume of contaminated soil (m^3) (e × f × g × contaminated soil ratio)	214,069,781-428,139,561	Contaminated soil ratio is substituted with planned building area/site area
i. Contaminated soil treatment cost (¥10,000/m^3)	2.5-10	Hearings, etc.
j. Scale of remediation market (h*i)	53,517-428,140	

Notes:
1. The investigation ratio is substituted with the ratio of actually investigated cases (467) to total cases (872) appearing in the Environment Agency survey (FY1997).
2. The ratio of sites requiring remediation represents the actual figure for potential Altlasten in Germany (10-20%). Incidentally, contaminated sites account for 36.6% of the sites covered by the Environment Agency survey (171/467).
3. The area per site for manufacturing represents the land area appearing in the "Report on Basic Land Survey" divided by the number of business establishments in the Industrial Statistics. Data for gas stations are based on information published by the Standard Oil Report, while the average area of a laundry is assumed to be $100m^2$. The figure appearing in the table is a weighted average based on the number of business establishments.
4. The depth of pollution is estimated from average values in the Environment Agency survey.
5. The contaminated soil ratio is estimated to calculate the volume of soil actually subjected to remediation. It is substituted with the planned building area/site area ratio (21%) appearing in the "Table of Results of Survey of Plant Location Trends."

Sources: Various documents.

2. Progress of the Japanese Remediation Industry

2.1 Technologies and Expertise Accumulated by Entrepreneurs

Having outlined discussions on the characteristics and scale of the remediation market, this section examines corporate behavior in the market. Thus far, there have been no clear rules in the Japanese remediation market, which has been nurtured by the closed relationships between users and remediation firms. Due to such particularities, the firms operating in the remediation market are organized to provide a complete set of services ranging from investigation and analysis to cleanup and subsequent monitoring. They are also prepared to respond to every kind of pollution, dealing in as many cleanup techniques as possible. This contrasts very much with the European and American markets, where open competition has led to the existence of various firms specialized in individual processes. Under competition, the optimum method has to be selected for each polluted site, as individual sites have their own characteristics in terms of the type of pollutants, the depth of pollution and contaminated area. In Japan, weakness in any particular department directly leads to a disadvantage in the competition for winning orders.

2.2 Development of Various Technologies

Remediation technology is called the art of combination. This means that a wide variety of technologies in different industries need to be combined, including chemicals, engineering, mining, machinery and biotechnology, so as to design and execute optimal remediation that fits the characteristics of individual sites.

Reflecting this character, many of the companies operating in this field have entered the market with their own specialties. Most of them have come from the construction (general contractors) or machinery (plant makers) industries, while other firms represent a wide variety of industries such as mining and chemicals. Many of those companies actively entered the remediation business in the late 1980s and have sought to integrate various technologies in many ways since then. However, the development of the business differs somewhat according to the core businesses of the firms. Table 4-4 shows some examples of the companies operating as remediation businesses. The following discussion focuses on those firms and determines the characteristics of the industries of origin.

(i) Construction

Construction firms, with their integrated engineering abilities, have commonly expanded the scope of remediation tool combinations by developing and introducing individual techniques. This trend is most visible in Kajima. In addition to its traditional methods geared to generality, the company has actively developed and introduced new techniques. At the same time, its strategy seeks to enhance its integrated engineering ability, i.e. the ability to prescribe and execute optimal remediation according to site conditions identified by investigation and analysis. In practice, the company conducts its remediation business based on a comprehensive tie-up with a major U.S. engineering firm to strengthen its project-making ability.

If the remediation business can be divided into the investigation/analysis stage and the cleanup stage, the former may be called “software” and the latter “hardware.” So far in Japan, the work has not been considered as an integrated and organic process, and emphasis was placed on either of the two; this is the most difficult issue to address. The emphasis of the construction industry on integrated engineering including post-remediation redevelopment is oriented toward providing a solution to the problem.

As regards individual techniques, existing civil engineering techniques are directly applied to the containerization and anti-diffusion techniques. The introduction of external techniques and technological development have focused on decomposition and dissolution techniques including bio-remediation and heat treatment. Since remediation technology is considered as a component of integrated engineering, construction firms do not generally seek advantage in individual remediation techniques. Indeed, a wide range of activities have been undertaken to achieve low-cost remediation on site.

Table 4-4. Examples of Firms Involved in Remediation

Firm	Industry of origin	Examples of typical remediation tools	Note
Obayashi Corporation	Construction	• Bio-remediation • Electro-chemical cleanup technique (heavy metals) • Soil cleanup technique • Long-term stable encapsulation technique • Containerization (sophisticated liner wall system, etc.)	• Integrated response to soil cleanup and waste disposal site problems • Responsible for oil-polluted soil treatment in Kuwait after the Gulf War conducted by the Oil Industry Revitalization Center
Taisei Corporation	Construction	• Soil gas suction method • Lime-mixing extraction method • Bio-remediation • Law-temperature heating cleanup & containerization (transmissive groundwater cleanup wall, etc.)	• Joint development with the National Institute for Minamata Disease (low-temperature heating cleanup method) • Enhancement of remediation business for dioxin-contaminated soil with biotechnology
Shimizu Corporation	Construction	• Classification & washing system • Vacuum extraction method, pumping aero- exposure • Containerization (earth-cut method, etc.) • Bio-remediation	• Responsible for oil-polluted soil treatment in Kuwait after the Gulf War conducted by the Oil Industry Revitalization Center • Development of bio-treatment technology through technical tie-up with Parsons (U.S.)
Kajima (ERS)	Construction	• Soil aero-exposure method, pumping aero-exposure method • Solidification and encapsulation of heavy metals • Containerization (vertical liner facilities, etc.) • Oil pollution cleanup by bubble hauling method, etc. • Bio-remediation	• Engineering tie-up with Jacobs (U.S.) • Establishment of a subsidiary (ERS) specialized in environmental risk assessment
Hazama	Construction	• Pumping treatment, soil gas suction • VOC treatment by carbonic water injection • Hexavalent chromium treatment by organic starch • Removal of PCB dissolved in water by special high polymer • Containerization	• Application of research result from Kyoto University Disaster Prevention Institute • Technological fusion for organic starch with Hayashibara (Okayama)
Konoike Construction	Construction	• Pumping treatment, soil gas suction • Soil cleansing • Bio-treatment • Thermo-chemical treatment	• Top-ranked contractor with public sector for soil treatment • Tie-ups with SCC-Environment, etc. for enhancement of thermo-chemical treatment • Envisages mutually-reinforcing business tie-ups
Ebara	Machinery	• Land application method • BCD process • Soil gas suction, pumping aero-exposure • Bio-remediation • Terrasteam, Terrawash	• Introduction of technology (PCB) from EPA (U.S.) • Introduction of technique (heavy metal) from Lulugi (Germany) • Promotion of a separate zero-emission initiative
Kurita Water Industries	Machinery	• Fingerprint investigation method • Pumping aero-exposure method • Bio-remediation • Supercritical water oxidation system • Soil gas suction system	• Technological tie-up with Groundwater Technology, Inc. (GTI: U.S.) • Opened a Business Development Center to promote development and commercialization of various environmental techniques
Japan Organo (Kankyo Techno)	Machinery	• Air stripping • Heavy metal solidification • Supercritical water oxidation system • Mobile laboratory investigation method	• Establishment of Kankyo Techno as joint venture with Tosoh Corporation • Integration of Organo's VOC treatment technique with Tosoh's heavy metal treatment technique • Consortium for diffusion of mobile laboratory method
Maezawa Kogyo	Machinery	• Airspersing method (in-situ aero-exposure of gas and liquid) • Groundwater pumping method • Air-injecting soil gas suction method • Soil gas suction method	• Combination of original technology with techniques introduced from NWR Environment (U.S.) through technological tie-up
Shinko Pantech	Machinery	• Metal sodium method (PCB contaminated oil) • Solvent extraction decomposition method (containers, etc.) • Supercritical water oxidation system • Membrane separation technique	• Combination of original technology with dechlorination technique of Powertech (Canada) • Expansion from PCB treatment technique to general remediation technology
Dowa Mining	Non-ferrous metals	• Washing classification treatment • Heat treatment • Bio-remediation • Pumping treatment • Solidification • Encapsulation	• Coverage of whole process with original technology within the group including Dowa Koei Technoclean, Dowa Clean Techs and Hanaoka Mining

Sources: Various corporate documents.

As regards technology imports, the increase in remediation tools prevalent at the initial stage has recently been complemented by a strategic qualitative transformation of remediation technology. For instance, Konoike Construction has reduced the emphasis on traditional techniques such as containerization, and has shifted the focus of its remediation tools to neutralization techniques. As part of its efforts, the company has been actively introducing thermo-chemical treatment technology such as heat desorption and fusion. Thanks to the introduction of thermo-chemical treatment, which is fit for mass treatment and widely applicable, the remediation tools of the company now cover a wide range of neutralization technologies, substantially expanding its choice for efficient remediation planning.

The trend toward efficient remediation is also significant in terms of technological development. For example, Obayashi Corporation has used its experience in heavy metal treatment to improve the practical encapsulation technique in parallel with more traditional techniques such as decomposition and dissolution. Against VOC and oil pollution, the company focuses on bio-remediation and has been developing various stimulation and augmentation techniques. This approach is intended to achieve the most efficient remediation, since it is often impractical to completely clean up heavy metal pollution and because the remediation cost for VOC and oil pollution varies substantially according to the technique used. There have also been various developments to improve the efficiency of application, as companies such as Taisei Corporation and Hazama have expanded the applicability of traditional methods. Other noteworthy techniques include the hexavalent chromium reduction method using polysaccharides (food additive) and the removal of PCB in water with synthetic rubber, whose molecular structure is very similar to that of adipose, a major accumulator of PCBs. These examples are also significant in that they involve the integration of technologies from different industries.

Finally, technological cooperation is moving further upstream to include preventive techniques. For example, Shimizu Corporation, in collaboration with Toshiba and Hokuriku Advanced Technology Institute, is promoting the IMS international joint research project (on a sophisticated environmental monitoring system in production areas) to prevent contamination, in parallel with the development of remediation technology. This case indicates the large and growing potential of remediation technology.

(ii) Machinery

In most cases, the machinery industry including plant makers utilizes water treatment technology to promote technological innovation. Geared toward making technological breakthroughs, they focus on advantageous areas including VOC treatment, to which their expertise in water treatment and chemical plants is directly applicable. Typically, they also introduce remediation tools against other pollutants including heavy metals.

The technological innovation ranges from upgrading existing methods to developing new technologies.

A typical example of upgrading existing technology is how Maezawa Kogyo improved the Airspersing method. Upon entering the remediation business, the company chose this technique that was emerging in the United States, in addition to existing methods such as pumping aero-exposure and soil gas suction. The company intends to commercialize the method through a technological tie-up with the U.S. firm. In addition to various improvements to make the technique commercially suitable for the Japanese market, the company is currently improving its efficiency for traditionally unfavorable geology including clay layers. The research is based on using the Airspersing method to activate microbes by injecting air into soil. If the experiment succeeds, a new in-situ remediation method will emerge in combination with bio-remediation. Elsewhere, Ebara has introduced the Terrasteam method from a German firm, Lulugi, for heat-treating heavy metals; the technique is currently applied to large-scale remediation projects. The company has also introduced the BCD process from the U.S. Environmental Protection Agency mainly for PCB treatment, and is now preparing for its practical operation. Thus, foreign technology has been assessed and improved for use in the domestic remediation business.

New technology also includes the supercritical water oxidation technique, which is a potential next-generation remediation technique, as well as various bio-remediation techniques developed by individual firms in their own way. For example, Organo is using its expertise in VOC-related techniques based on water treatment technology, as it has a large market share in pumping aero-exposure facilities (paced tower method). The company is establishing comparative advantage by concentrating managerial resources on this field and developing the supercritical water oxidation technique. This case shows how remediation firms from the machinery industry tend to specialize in core businesses to achieve technological innovation. Kurita Water Industries is also focusing on bio-treatment in parallel with the development and application of water treatment technology. In the field of bio-stimulation, the company has established a practical technique, having completed the demonstration test for anaerobes as well as for aerobes. The company is also stepping up research and development on bio-augmentation for practical use in the future. The company is thus building on its core businesses while ensuring synergy with other environment-related businesses, and it created new R&D centers in 1998 for remediation and other environmental technologies, and reorganized its R&D system accordingly. Likewise, Ebara has been developing land applications and other remediation techniques utilizing the results of pollution prevention techniques being developed separately under the zero-emission initiative. Machinery manufacturers also typically enter the remediation market after establishing an original technique. Thus, Shinko Pantech is growing its underground remediation business based on expertise gained in developing technology for decomposing PCB in waste oil or adhered to containers, which was conducted both in-house and in collaboration with a foreign firm.

Furthermore, efficient investigation and analysis tools have been developed for linking such techniques with a comprehensive remediation plan. For instance, Ebara has established a system for identifying the optimum remediation plan by conducting a preliminary test using samples of contaminated soil and comparing various remediation methods (treatability test). Organo has developed a mobile laboratory method, which enables soil gas to be analyzed quickly, accurately and with high sensitivity. The company is now promoting this technique as a suitable investigation tool in view of the subsequent remediation process.

(iii) Non-ferrous metals (mining)

The mining industry differs somewhat from other industries such as construction and machinery, which add other techniques to their fundamental technologies as necessary. The mining process flows from the detection of ore deposits to excavation, to selection and refining. Ore deposits can be regarded as pollution created by nature as they contain huge amounts of impurities such as heavy metals. In principle, the expertise of the mining industry for locating, excavating and separating such deposits with minimum impact on the surrounding environment and then reusing clean earth and sand, can be applied directly to the pollution caused by human economic activity. Dowa Mining, a company actively involved in the remediation business, calls this aspect the “parallel movement of technology and facilities.” As regards underground remediation, the company has established a system by which firms within its group can undertake the whole remediation process, ranging from investigation to planning and execution. Using its techniques developed for mining, the company offers comparative advantage in off-site treatment including washing classification. This advantage is attributable not only to the individual techniques themselves but also to the well-established system of the company. The company is also involved in the shipping business, and can thus reduce transportation cost, which is the biggest disadvantage of off-site treatment.

2.3 Emergence of Technological Innovation and Integration

As described above, many Japanese remediation firms have used their existing technology to enter the market in the past decade, and have expanded their technological base by introducing and developing expertise from other sectors in collaboration with domestic and foreign companies. The industry is also characterized by technological integration, as companies seek to provide comprehensive services according to market needs. The seeds of remediation technology vary considerably, ranging from traditional ones to original, innovative ones. The fact that some European and American firms are now interested in modern technology developed in Japan is clear evidence of the substantial progress made by the remediation industry in Japan since its inception in the early 1990s.

Future developments will include joint ventures between companies as well as the pursuit of comprehensive services by individual firms. There has already been cooperation on individual projects between machinery and civil engineering techniques, as firms may find it difficult to cope with individual site conditions on their own. Such cooperation is expected to become more organized in the future; indeed, the trend has already begun as Organo formed a consortium for promoting the aforementioned mobile laboratory method. Konoike Construction is also considering entering into strategic tie-ups with other companies that have skills and techniques which can help them to provide more cost-effective remediation.

Collaboration also exists within public institutions as well as between private companies. For instance, the Research Institute of Technology on Earth's Environment (RITE), working with firms including Ebara, Organo and Kajima, has started an experiment on the cleanup of VOC-contaminated soil by microbes in Kimitsu, Chiba Prefecture. This is the first demonstration test in Japan on bio-augmentation according to a safety assessment mechanism established by the Sub-Committee on Class 2 Use Technology of the Technical Group on DNA-Recombination Technology in the wake of the MITI guideline on microbe use published in May 1998. It is also reported that a research team of the National Institute for Environment Studies has succeeded in removing pollution caused by mercury-contaminated water using DNA-recombined microbes. Tie-ups between the private, academic and public sectors are expected to increase, as the results of research conducted by national universities have been successively reported in the media.

Separately from this movement, technologies are also being developed for preventing contamination before it can occur. Promising new pollution-prevention technologies have emerged such as the (semi-)dry metal cutting technique developed in the metalworking machinery industry, as well as new cleaning devices that do not use VOC. Although these areas may be included in the remediation industry in a broad sense, the business viability of such technologies is not known due to the cost of introducing preventive technology. However, in view of the huge remediation cost once pollution has occurred, preventive technology could develop rapidly if appropriate rules are introduced, as discussed in the following section.

3. Development of the Japanese Remediation Industry

3.1 Pending Issues

In response to the aforementioned peculiarities of the market, companies with various technological skills have entered the Japanese remediation industry. The technological level of the industry has risen as the companies have broadened their abilities by introducing and combining various techniques as well as developing their own technologies.

If the response to environmental problems is divided into technical aspects and social aspects, the industry has reached a sufficient level regarding the former. Therefore, it remains to design systems and rules for creating an open market that ensures the efficient use of such techniques.

However, the Japanese remediation market is already changing, with some firms taking a more forward-looking attitude toward remediation. Although such cases have been limited so far to leading electrical machinery companies, there have been many media reports on cases of active remediation with information disclosure about the existence of pollution. This is largely due to the guidance issued by the Ministry of International Trade and Industry in fiscal 1997 following public interest in the contamination of groundwater with VOC. This movement is expected to spread to other industries due to recent changes in the managerial environment. Such changes are the result of international standards as well as pressure for greater liquidity of real estate holdings as business restructuring and specialization in core businesses proceed.

In a real estate transaction, the vendor assumes the risk of guarantee against problems in case the property is already polluted, regardless of the existence of legal provisions concerning soil protection. Moreover, contracts usually provide for measures to be taken in such cases (cleanup by the vendor, termination of the contract), regardless of whether the parties include any foreign affiliates. As pressure for liquidity mounts in all industries on idle business sites in particular, the number of cases will increase where remedial action must be considered also in view of maintaining land prices.

An increasing number of firms are obtaining ISO14001 certification for environmental management. As environmental management becomes more established, the more difficult it becomes to avoid tackling pollution issues. Moreover, the standardization of site assessment methods by ISO14015 is scheduled to take effect by the summer of 2001. Although the standard will not be legally binding, this international standardization of pollution risk assessment will have a substantial impact as corporate acquisitions and related real estate transactions become increasingly internationalized.

Thus, the number of cases where remediation is necessary is expected to increase, but the lack of rules defining pollution thresholds and the level of required remediation will make it difficult for firms and local authorities to address the problem. As is clear from cases in Germany, the inability to prove the cleanliness of a business site based on rules will be a disadvantage in international competition for industrial locations, thus discouraging investment by foreign companies. The development of rules as a social system will not only help regulate the remediation market but also help companies to respond to changes in the managerial environment described above. This is why underground environmental protection policy is considered as an industrial policy as well as an environmental policy in both the U.S. and Europe.

3.2 Direction of Practical Response

What kind of rules and regulations are necessary? Much can be learned from the cases and examination processes in Europe and the U.S. described in the previous chapters. The Superfund reform in the U.S. and the Federal Soil Protection Law in Germany both show the importance of building a flexible system. Here, flexibility means the diversity of standards and the existence of auxiliary tools for operating the system.

Clearly, regulation has to require remediation under certain conditions. The first issue is how to develop such standards. As in Germany, standard values will have to be made progressive according to land use. At least two sets of standard values should be required: the level that triggers remedial action and the level to be achieved as a result of remediation. Since actual pollution levels vary substantially as well as the levels that can be achieved economically and technically, standards that are too rigid are likely to be impractical.

Although many firms in the remediation industry agree on this point, there is disagreement on the actual levels of trigger standards and objective standards. Some argue that the current soil environmental quality standards should be used as trigger standard values, while objective standard values should be defined as multiples of these. Others argue against introducing any standard values that are not supported by WHO or other reliable institutions. Views also differ as to whether the same standards should be applied to small enterprises with little financial capacity. In order to clarify such issues, suspended discussions on trigger levels for remedial action need to be resumed promptly.

Under the German system, a remediation objective is set for each site following a specified procedure, which enables practical response to individual cases. In Japan, it is difficult to introduce such flexible objectives under the present regulatory system in view of equity and equality. With the upcoming administrative decentralization, however, a system design that reflects the characteristics of local communities should be considered, as in the case of noise regulation. Many questions remain to be answered, such as who determines its orientation and how to respond to criticisms regarding equity. One possible solution would be to define an objective for each site through a transparent process of collecting the views of local residents.

Another important issue is how to develop auxiliary methods to operate the system, which involves two main aspects. The first is the “insurance” aspect. As in the case of the Orphan Share in the U.S., applicable rules should be established for when responsible parties do not exist or cannot be identified, to enable compensation for the unallocated remediation cost to be defined. The second aspect concerns providing incentives to companies that actually conduct remedial activities.

In the former case, where responsible parties do not exist, cannot be identified or are insolvent, the injection of public funds in some form is unavoidable. This is also true in the U.S. and Europe. Whether it takes the form of a special account or ad-hoc budgetary arrangement is a fiscal choice that requires separate discussion.

More importantly, clear rules should be defined for cases where the injection of public funds is authorized, the decision-making process on remedial activities in such cases, as well as claims for compensation for any substantial rise in land prices after remediation.

As regards providing incentives to companies conducting remediation, some would argue that such incentives are not necessary if the PPP is to be applied. However, it may not be possible to determine whether the current operator is responsible for the pollution. Moreover, voluntary remediation activities should be encouraged even if the pollution has not reached the level that triggers remedial action. Although the provision of such incentives should be restricted for regulatory purposes, subsidy measures should be considered including the deduction of a certain percentage of the remediation cost from taxable income.

The discussions on introducing soil protection regulations intensified temporarily following the mid-term report presented by the Working Group on Soil and Environmental Conservation in 1995. But the discussions have died down recently and shifted toward a response through an enhanced guideline. However, as described earlier in this report, these issues have a strong impact on industrial policy as well as on environmental policy, and so serious discussions will be resumed soon. The arguments outlined above will be considered from various viewpoints and in light of developments in foreign countries so far.

3.3 Japanese Brownfield Redevelopment Projects

In parallel with the preparation of rules, the development of large-scale projects using remediation techniques developed so far should be considered. These could be regarded as a Japanese version of brownfield redevelopment projects. In other words, they should be open remediation and redevelopment projects involving the national and local governments, the remediation industry, owners of former business sites subjected to remediation and NPOs specialized in environmental issues.

The projects should be selected through public bidding from the former business sites for which redevelopment has been delayed for more than a certain period due to pollution. The competition should be conducted openly as regards the identification and remediation of the pollution, with the most cost-effective company being selected to undertake the work. Before starting the project, innovative techniques should be chosen from those submitted by venture businesses through public bidding to form an additional demonstration segment. This process should involve representatives from local authorities to give them opportunities to learn on-site about the expertise in selecting investigation and remediation methods. And to help provide business facilities for the site which will be an open experiment, the project should be subsidized at a certain percentage of total cost. Such a nationwide project with disclosure of the processes and results in a database would greatly assist the development of the remediation industry in Japan.

The project would bring benefits such as the reduction of developmental pressure on undeveloped areas, as good business sites would be supplied from existing developed areas; the accumulation of local authority expertise in conducting remediation projects; the promotion of progress in environmental protection measures to national and international investors; and the provision of opportunities for venture businesses keen to demonstrate their expertise. More importantly, however, the attitude of companies participating in the projects will be positively evaluated. This mechanism could break the vicious cycle in which accusations against companies involved in remediation scare other firms into inaction, resulting in the worsening of pollution that could otherwise be mitigated.

In addition to this overall plan, measures should be considered for small enterprises including laundries and gas stations in urban areas. Since many such enterprises cannot afford the huge cost of remediation, the costs need to be reduced. Effective measures include low-priced rental of remediation equipment purchased by local authorities, a system that has already been launched in some local areas. Support for such initiatives should be considered.

In summary, the Japanese remediation industry has the potential for rapid growth given an open market that allows accumulated remediation technologies to be used effectively. This market can be formed by (i) introducing systematic and rational rules and (ii) developing ad hoc policies to support the application of such rules. In light of potential markets in the rapidly industrializing Asian region, comprehensive discussions on this issue must be started immediately. The remediation industry should be recognized as a promising industrial sector in the framework of environmental policy, which represents one of the pillars of the Millennium Project launched by the government.

Underground pollution concerns not only environmental policy but is related to many policy issues including industrial location and urban policies. And it is a problem that many companies will have to face due to international standardization and the changing environment for corporate management. The approach will therefore affect the development of major policies in Japan in the 21st century including industrial renovation and the Life Space Doubling Program. Appropriate measures will encourage work on these policy issues, whereas mismanagement will produce obstacles.

The ministries are now collaborating on technological assessment of the remediation industry. Further inter-ministerial discussion and coordination will be needed including the development of relevant rules.

[Keisuke Takegahara (E-mail: ketakeg@dbj.go.jp)]

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