Soil Contamination Countermeasures

Soil Environment Management Division
Environmental Management Bureau
Ministry of the Environment
Government of Japan
General description of the Soil Contamination Countermeasures Law※ (1)
※ Proclamation in May 2002; Enforcement in February 2003

Target chemical substances (designated hazardous substances)
(1) Health effects due to direct ingestion of contaminated soil e.g. heavy metals which accumulate in large concentrations in the surface horizon over long periods
(2) Health effects due to water contamination a soil leachate standard based on the ingestion of groundwater.

Mechanism

Investigation
- When specified facilities using hazardous substances are discontinued
- When a regulatory authority encounter the possibility of adverse health effects from soil contamination

Investigation and reports
- By landowner, site management
- By designated research institution

Designated Areas
(When standards for the registered districts are not met)
- Designated and announced by regulatory authorities and registered on the list of designated areas for public disclosure
General description of Soil Contamination Countermeasures Law※ (2)
※ Proclamation in May 2002; Enforcement in February 2003

Management of designated areas

Control of land character changes
• Notification to regulatory authority about character change of land in designated areas
• If inappropriate, regulatory authority direct applicants to redraft plans

When regulatory authority encounter the possibility of adverse health effects from soil contamination

Contamination remediation measures
regulatory authority direct the polluter* in the execution of contamination remediation.
• Measures to prevent direct ingestion: (1) area restrictions, (2) concrete capping, (3) fill, (4) replacement of soil, (5) treatment of contaminated soil
• Measures for prevent ingestion of groundwater: (1) groundwater quality control, (2) immobilization of contaminant to groundwater, (3) barriers, (4) remediation of contaminated soil

* Or if the polluter cannot be identified, the landowner should remediate the site with support from the authorities.

Designated areas are de-registered, when remediation is completed
How soil contamination creates health risks

1. Direct ingestion of contaminated soil (including soil particulate)
2. Dermal absorption
3. Ingestion of groundwater contaminated by hazardous substances eluted from contaminated soil
4. Inhalation of hazardous substances emitted from contaminated soil to atmosphere
5. Discharge of soil containing hazardous substances to municipal waterways → accumulation in aquatic ecology → ingestion by human beings
6. Accumulation of hazardous substances in crops and livestock raised on contaminated land → ingestion by human beings
## Classes of designated hazardous substances

### Class 1
**Designated hazardous substances (VOC)**
- carbon tetrachloride
- 1,2-dichloroethane
- 1,1-dichloroethylene
- cis-1,2-dichloroethylene
- 1,3-dichloropropene
- dichloromethane
- tetrachloroethylene
- 1,1,1-trichloroethane
- 1,1,2-trichloroethane
- trichloroethylene
- benzene

### Class 2
**Designated hazardous substances (Heavy metals etc.)**
- cadmium and compounds
- hexavalent chromium and compounds
- cyanide and compounds
- total mercury and compounds
- selenium and compounds
- lead and compounds
- arsenic and compounds
- fluorine and compounds
- boron and compounds

### Class 3
**Designated hazardous substances (Agrichemicals, PCB..)**
- simazine
- thiram
- thiobencarb
- PCB
- organic phosphorus compounds

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**Risk for direct ingestion** (9 items)

**Risk for ingestion through groundwater etc.** (25 items)
Risk of ingestion of groundwater

Soil contamination

Risk of direct ingestion

Soil Concentration Standard

Soil Leachate Standard

Risk of ingestion of groundwater

Soil is assessed as contaminated if it exceeds the standard.
### Target substances and standards

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<thead>
<tr>
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<tbody>
<tr>
<td>Carbon Tetrachloride</td>
<td>Class 1 (VOC)</td>
<td>≤ 0.002mg / L</td>
<td>≤ 0.002mg / L</td>
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<tr>
<td>1. 2—Dichloroethane</td>
<td></td>
<td>≤ 0.004mg / L</td>
<td>≤ 0.004mg / L</td>
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<tr>
<td>1. 1—Dichloroethylene</td>
<td></td>
<td>≤ 0.02mg / L</td>
<td>≤ 0.02mg / L</td>
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<tr>
<td>cis—1. 2—Dichloroethylene</td>
<td></td>
<td>≤ 0.04mg / L</td>
<td>≤ 0.04mg / L</td>
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<tr>
<td>1. 3—Dichloropropene</td>
<td></td>
<td>≤ 0.02mg / L</td>
<td>≤ 0.02mg / L</td>
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<tr>
<td>Dichloromethane</td>
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<td>≤ 0.02mg / L</td>
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<tr>
<td>Tetrachloroethylene</td>
<td></td>
<td>≤ 0.01mg / L</td>
<td>≤ 0.01mg / L</td>
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<td>1. 1. 1—Trichloroethylene</td>
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<td>≤ 1mg / L</td>
<td>≤ 1mg / L</td>
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<tr>
<td>1. 1. 2—Trichloroethane</td>
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<td>≤ 0.006mg / L</td>
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<tr>
<td>Trichloroethylene</td>
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<td>≤ 0.03mg / L</td>
<td>≤ 0.03mg / L</td>
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<tr>
<td>Benzene</td>
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<td>≤ 0.01mg / L</td>
<td>≤ 0.01mg / L</td>
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<td>Cadmium and its compound</td>
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<td>≤ 150mg / kg</td>
<td>≤ 0.01mg / L</td>
<td>≤ 0.01mg / L, and ≤ 1mg / 1kg rice on agricultural field</td>
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<tr>
<td>Hexavalent Chromium compounds</td>
<td>Class 2 (Heavy metal etc.)</td>
<td>≤ 250mg / kg</td>
<td>≤ 0.05mg / L</td>
<td>≤ 0.05mg / L</td>
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<tr>
<td>Cyanides compounds</td>
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<td>As isolated cyanides ≤ 50mg / kg</td>
<td>Less than detection limit</td>
<td>Less than detection limit</td>
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<tr>
<td>Total Mercury and its compounds</td>
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<td>≤ 15mg / kg</td>
<td>≤ 0.005mg / L</td>
<td>≤ 0.005mg / L</td>
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<tr>
<td>Alkyl Mercury</td>
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<td></td>
<td>Less than detection limit</td>
<td></td>
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<td>Selenium and its compounds</td>
<td></td>
<td>≤ 150mg / kg</td>
<td>≤ 0.01mg / L</td>
<td>≤ 0.01mg / L</td>
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<tr>
<td>Lead and its compounds</td>
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<td>≤ 150mg / kg</td>
<td>≤ 0.01mg / L</td>
<td>≤ 0.01mg / L</td>
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<tr>
<td>Arsenic and its compounds</td>
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<td>≤ 150mg / kg</td>
<td>≤ 0.01mg / L</td>
<td>≤ 0.01mg / L, and ≤ 15mg / kg soil on rice field</td>
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<tr>
<td>Fluorine and its compounds</td>
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<td>≤ 4000mg / kg</td>
<td>≤ 0.8mg / L</td>
<td>≤ 0.8mg / L</td>
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<tr>
<td>Boron and its compounds</td>
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<td>≤ 4000mg / kg</td>
<td>≤ 1mg / L</td>
<td></td>
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<tr>
<td>Simazine</td>
<td>Class 3 (Agrochemicals and PCBs)</td>
<td>≤ 0.003mg / L</td>
<td>≤ 0.003mg / L</td>
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<tr>
<td>Thiuram</td>
<td></td>
<td>≤ 0.006mg / L</td>
<td>≤ 0.006mg / L</td>
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<tr>
<td>Thioencarb</td>
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<td>≤ 0.02mg / L</td>
<td>≤ 0.02mg / L</td>
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<tr>
<td>PCB</td>
<td>Class 3 (Agrochemicals and PCBs)</td>
<td>Less than detection limit</td>
<td>Less than detection limit</td>
<td></td>
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<tr>
<td>Organic phosphorus compounds</td>
<td></td>
<td>Less than detection limit</td>
<td>Less than detection limit</td>
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Enforcement situation of the Soil Contamination Countermeasures Law

**Article 3 related**  (As of August 31, 2006)

- De-registration of specified facilities  2,631
- Reporting of Soil Investigation Results  511
- On-going Soil Investigation  59
- Deferred Soil Investigation by regulatory authority  2,027
- Under consideration of deferral for Soil Investigation  70
- Others  85
  (cases being considered by authorities whether investigations should be conducted or deferred)

**Article 4 related**  (As of December 31, 2006)

- No. of cases where investigations were ordered  4

**Article 5 related**  (As of December 31, 2006)

- No. of sites registered as a designated area due to exceedance of designated standards  161
  (of which Article 3 related : 159, and article 4 related : 2)
  (Remediation measures conducted at 70 of the 161 designated areas, and have been de-registered.)
Cases of Soil Contamination per fiscal year

For fiscal year 2004
Total investigation cases: 838
Exceedance of standards: 454

- Soil Environmental Standards set (August 23, 1991)
- Addition to Soil Environmental Standard (1994: 15 VOC parameters)
  (2001: Boron and Fluorine)

Fiscal year

No. of cases

No exceedance
Exceedance cases


Soil Contamination Countermeasures Law
When specified facilities produce, use or treat designated hazardous substances are abandoned, the landowner, owner or site management is obliged to commission designated investigation companies to investigate soil contamination of manufacturing/operating areas where the specified facilities were previously located and the results reported to the prefectural governors.

Paragraph 1, Article 3 states:
Regulatory authority can allow the delay of investigations for cases where:

(1) Continued use and management of a site where unauthorised access is controlled
(2) Continued use of a site with unchanged operational conditions
(3) Small-scale factories (where factory owners reside within or adjacent to the premises)
(4) Mines in operation
2. Direction by regulatory authorities to conduct a soil contamination investigations (Article 4)

(1) Governors and others can direct land-owners and other parties to investigate and report on the soil contamination conditions when encountering concerns of adverse health hazards caused by soil contamination.

(1) When groundwater contamination is identified and where it is used as drinking water in the surrounding area.

(2) When a land parcel is considered to be a potential contaminated site which is accessible to the general public.
Process of status survey on soil contamination

1. Identification of target area and substances for investigation
2. Categorization of potential soil contamination
3. Setting of sampling areas
4. Sampling & measurements
5. Assessment and reporting of soil contamination status

Report to regulatory authority

(1) Land without potential for contamination
(2) Land with less potential for contamination
(3) Other

(1) No potential: No need for investigation
(2) Little potential: 1 sample per 900 m² (Composite samples to be taken from multiple locations for Class 2 and 3 hazardous substances)
(3) Potential: 1 sample per 100 m²

Class 1: Soil Gas Investigation and Soil Leachate Investigation
Class 2: Soil Leachate and Content Investigation
Class 3: Soil Leachate Investigation
Identification of contamination (Sampling Grids)

Example of Class 2 Designated Hazardous Substances Investigation Methodology

- Direct Target Areas
- Partially targeted areas

Composite of 5 or less soil samples (equal volumes to be composited)

Grab soil sample per grid
Identification of contamination
(Result of investigation)

- Compliant with standards
- Exceedance of standards
- Omission of sampling etc
- Uncontaminated grid
- Contaminated grid
- Grid deemed to be contaminated

Omission of individual grid analyses (deem that the composite sample result is representative of the two grids).
3. Designated Areas (Article 5)

- Land which does not meet the *designation standard* based on the results of a soil contamination investigation (Article 3 or 4)
  - Designation and announcement of areas as contaminated by designated hazardous substances
  - Registration on the list of designated areas
  - Restriction to land character changes
  - Implementation of measures such as contamination remediation

(1) Registration of designated areas

- Ingestion of groundwater
  - leachate standard (leachate to solution)

- Direct ingestion of contaminated soil
  - concentration standard (analyzed by HCl extraction (standard molar concentration specified))

(2) De-registration of designated areas

- When the reason for designation is no longer applicable due to removal or remediation of contaminated soil
  - De-registration of the entire or part of the designated area and its notice

- Measures such as *capping, filling, or containment of contaminated soil* to prevent its ingestion by human beings
  - Restriction of land character changes as a designated area

The area becomes designated if one of the standards is exceeded.
4. Measures for Designated Areas (Article 7)

- Designated areas, where the potential of contaminated soil ingestion or indirect ingestion via groundwater exists.
- Land without on-going groundwater contamination is targeted for investigation, if the surrounding groundwater is used as drinking water (even if groundwater impacts are still not identified).
- Land is not applicable if contamination remediation measures have already been undertaken.

(1) Individuals targeted for Remediation Orders

- **Polluter.**
  If it is deemed appropriate to order the polluter to conduct remedial measures, and agreed by the landowner agrees.
- **The landowner** if the polluter is unknown.

(2) Contamination causing activities targeted by Article 7

- Activities which bury, disperse, discharge or inject into groundwater, designated hazardous substances or materials that contain the designated hazardous substances in the liquid or solid form.
(3) Description of remediation measures

• Prevention of contaminated soil direct ingestion
  (1) access limitations
  (2) surface capping
  (3) filling
  (4) replacement of soil; and
  (5) treatment of contaminated soil

• Prevention of groundwater ingestion etc.
  (1) groundwater monitoring

  (2) immobilization of contaminant to groundwater
  (3) barriers; and
  (4) remediation of contaminated soil
Land character change in designated areas

- If substances exceed contamination standards within a designated area
  → Prevention of risk by **changing land character**

(examples of risk)
  - contaminated soil exposure through excavation
  - contamination of groundwater through contaminated soil being in contact with an aquifer
  - reuse of excavated contaminated soil for fill

Restriction of land character change

- Notification required at least 14 days in advance, if the land character is to be changed within designated areas.
- If the planned methods do not comply with the regulatory standards stipulated by the Ministry of Environment, authorities must require the redrafting of the plan.

Removal of contaminated soil from designated areas

- Procurement of appropriate transportation of contaminated soil
  → contaminated soil strictly covered by waste manifests
- Procurement of appropriate treatment
  → final waste disposal sites etc, and disposal facilities authorised by prefectural governors and others
Description of essential items of Law on Real-estate Trade and Building lots

Restriction of buildings, and building lots according to the regulations
Notification of land character change within designated areas according to the Soil Contamination Control Law

Law on real estate trade and building lots (Article 35, paragraph 1)
Important considerations for disclosure of contamination to concerned parties in real estate transactions.

Designated investigation companies

Investigation companies are registered with the Environment Minister for soil contamination investigations, (1669 institutions registered, as of Jan. 2007)

→ This system defines that only designated investigation companies can undertake soil contamination investigations as the findings affects the registration of designated areas, and the selection of contamination remediation measures, and therefore the investigations should be reliable.
1. Objective: reference for land-owners to resolve oil contamination issues*.

2. Composition and general description
   - Chapter 1: basic considerations of control measures
   - Chapter 2 (basic): for land-owners without basic or technical knowledge.
   - Chapter 2 (specific): for operators of investigations and remediation

* Oil odor or floating oil film resulting from oil contaminated soil causes issues for individuals using or planning to use sites where land comprises soil, ponds, groundwater, well-water, or other water media contaminated with oil.

3. Basic considerations for remediation
   - Basic remediation measures for oil contamination to eliminate discomfort / unpleasantness caused by oil odors or floating oil films.
   - Basic definition of oil odors and floating oil films perceivable to humans.
   - TPH concentrations are used to address levels perceivable to humans and to establish a common understanding of the individuals and parties affected.
Countermeasures for Lead-containing Contamination on Rifle Ranges

Recently, lead-containing contamination on rifle ranges has been considered with regard to soil elution and water contamination in the surroundings of rifle ranges. Control measures have been taken on some rifle ranges.

However, no unified method of investigations / remediation is yet established.

Guidelines on the investigation and control measures for rifle range sites is necessary, if use of rifle ranges is to continue.

Guidelines established within FY2006
Development and promotion of lower cost investigation techniques

1. Evaluation of remediation techniques for contaminated soil

- High cost and time-consuming investigations and control measures
- Excess burden for medium, small and micro-sized enterprise polluters

- Necessity for the development and promotion of practical methods for lower cost remediation

- MoE’s adoption of public subscription methods for investigation and control measures and associated technique evaluations

Technique evaluation results are posted on the web for;
- Promotion of use of best techniques
- Facilitation for investigations and control measures for soil contamination

(1) Surveys on techniques of investigation and control measures on low cost
(2) Surveys on remediation techniques for soil contaminated by dioxin
Promotion of remediation of contaminated soil

Background

• Rapid increase of voluntary investigations and remediation of contaminated soil in recent years due to the trend of urban redevelopment and merger & acquisitions.
• Concerns regarding the adequacy of investigation and remediation methods. (Contamination exacerbation through contaminated soil excavation).

Main subject: Procurement of excavated soil disposal
**Consideration of remediation for brown-field sites**

**Background and issues**
- Number of cases of soil investigations and remediation has increased recently.
- Concerns of brown-field abandonment without investigation/remediation is rising.

**Brownfield sites abandonment without preferable land use**

- **Causes**
- **Problems**
- **Actions**

Understand the practical problems and issues regarding brown-field sites by hearing from individuals/parties engaging in real estate transactions, city redevelopment, real estate businesses, trust banks and real estate appraisers.

Establishment of investigative commission consisting of academic experts

**Brownfield Programs in Japan**

~How to deal with Brownfield sites~
System for remediation of soil contamination based on the “Dioxin Special Measures Law”

Areas with standard exceedances (public access possible)

Designated areas
(Designation of control measures for dioxin-related soil contamination; Article 29, prefectural governors)

Establishment of plans
(Establishment of remediation plans for dioxin-related soil contamination; Article 29, prefectural governors)

Remediation
(i.e. removal of contaminated soil)
Subsidies from the Ministry of Environment

De-registration of designation
(De-registration under the Dioxin Special Measures Law; Article 30, prefectural governors)

Continued Monitoring

Article 26 (prefectural governors)

Procedure for prefectural governors
• Hearings with Environment Council etc.
• Hearings with municipal mayors

Procedure for prefectural governors
• Hearings with municipal mayors
• Public hearings
• Agreement with the Environment Minister

Cost burden estimation
(Law on Operator’s responsibility for Cost of Contamination Prevention) Operator’s responsibility applicable if causality is scientifically clear.

Bank raising of grant rate
(Law on special measures of national financial administration for contamination prevention)

Procedure for prefectural Governors
• Hearings with the Environment Council etc.
• Hearings with municipal mayors
Outline of Law on Soil Contamination Prevention in Farmland

- **Potentially Contaminated sites**
  - Control on a Gradual basis (Detailed survey)

- **Designation of areas**
  - Establishment of plans
  - Remedial measures operation
  - Control on a gradual basis (survey of remediation areas)

- **State**
  - Subsidy (55% of total operation cost; 45% = cost burden of enterprise)
  - Law on special measures of national financial administration for contamination prevention

- **Polluting enterprises**
  - Law on Operator's responsibility for Operation Cost of Contamination Prevention
  - Control on a gradual basis (survey of deregistered areas)

- **Registration of Special Areas**

- **Deregistration of Special areas**

- **Release of designation**

Proclamation in 1970
Contamination Prevention Law for Farmland