Current state of remedy of contaminated soil and groundwater related with sustainable remediation in Japan

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- Soil Contamination Countermeasures Law of Japan
- Development of Cost and Energy-Efficient Soil Investigation and Remediation technologies By Japan's Ministry of Environment
- Case Study of Calculation of CO_2 released from Different Remediation Methods by GEPC, Japan

The Background of the amendment of Japan's remediation law

- Previous SCC law announced in 2002.

  significant roles, but some problems

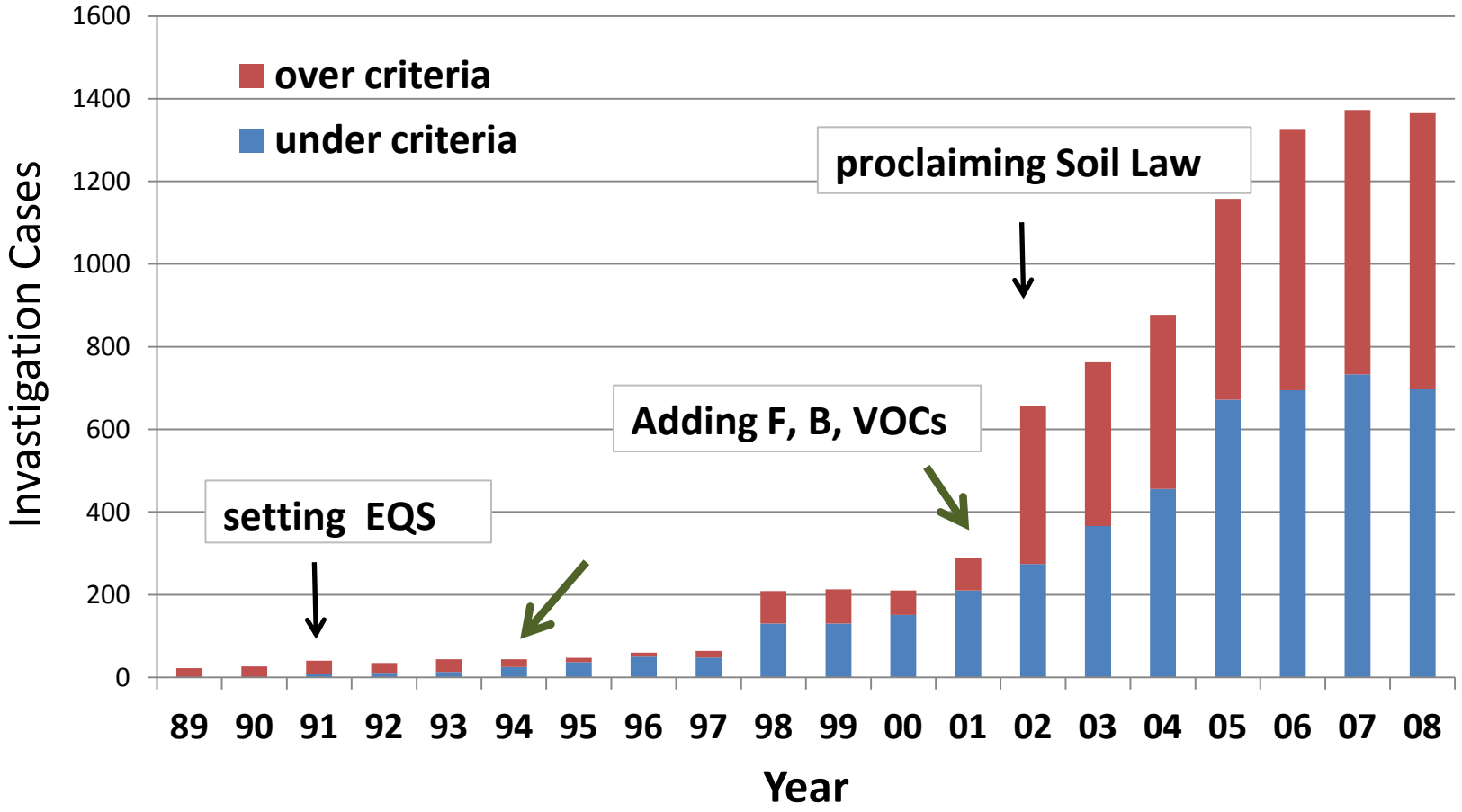
  e.g. ・increasing of independent soil investigation.

  ・improper treatment of contaminated soil after being hauled out of the site.

  ・unnecessary use of Excavation method

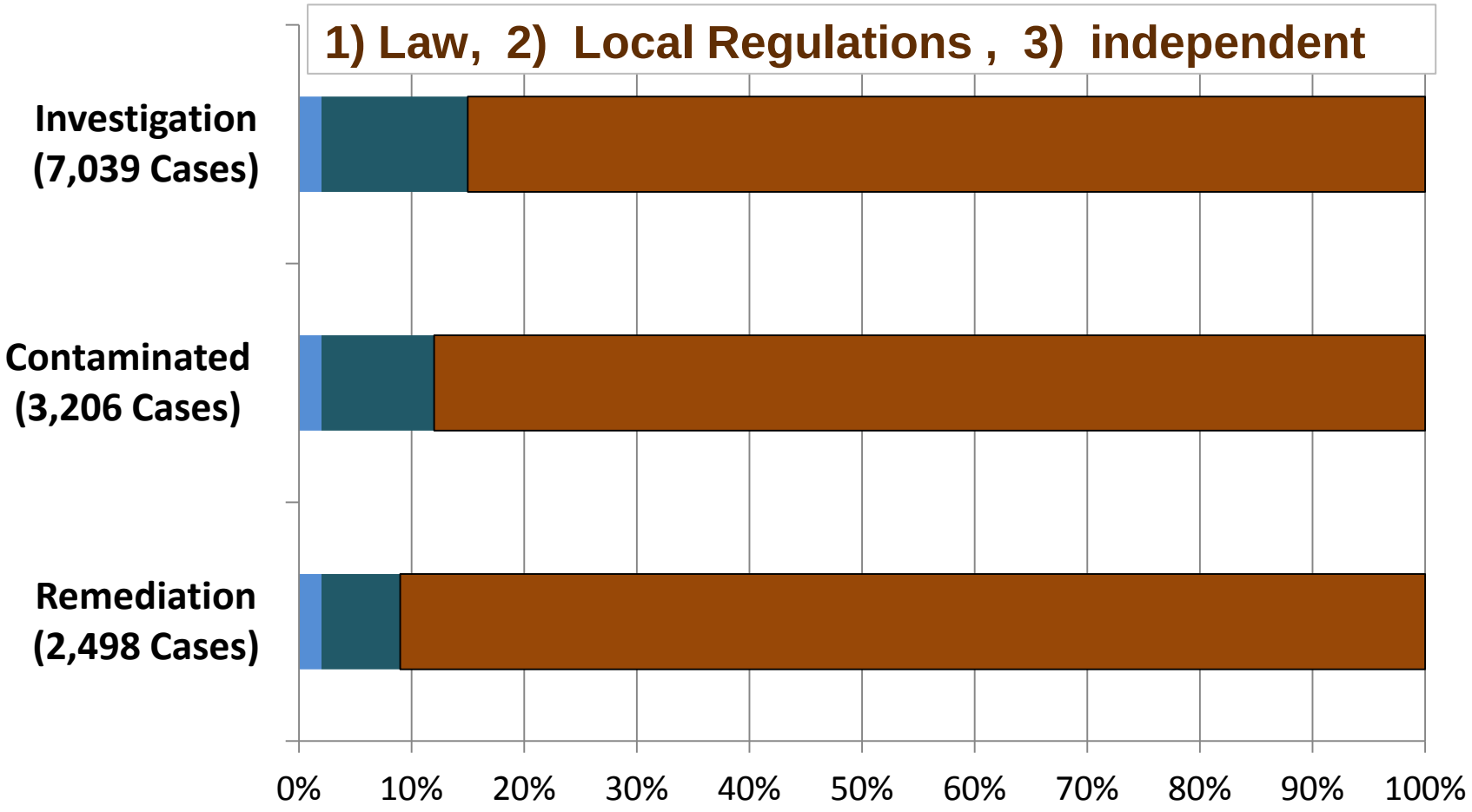
- Proclaiming an amended law in 2009

The numbers of investigation Cases of contaminated sites

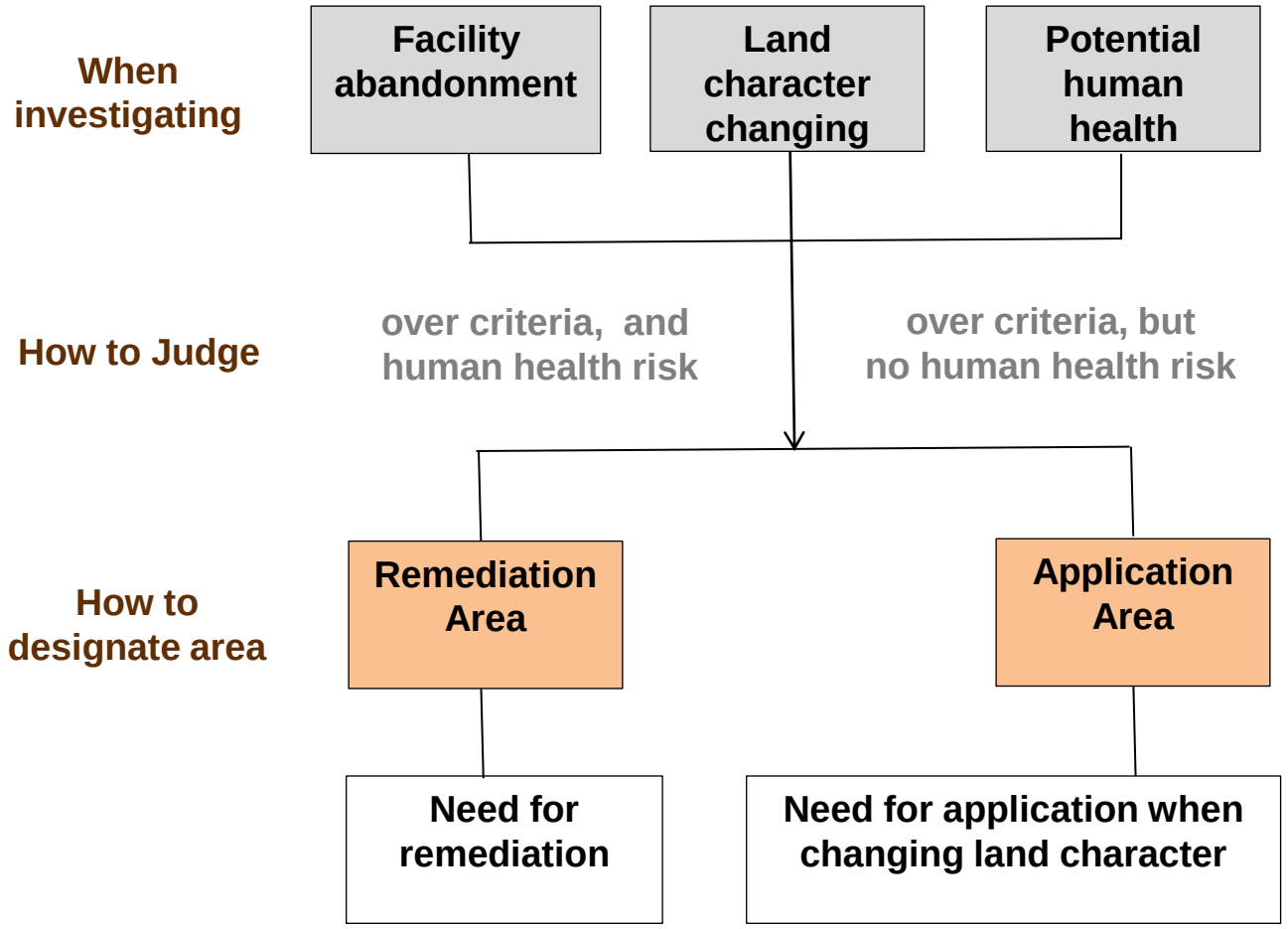


Cases of investigated sites at different investigation purposes

(data based on the GEPC's Survey, 2007)



The framework of Japan's remediation law



The triggers of investigation

- **When facility is abandoned**

  the specified facility: produced, used, or treated hazardous substances

- **When Land character will be changed**

  area: larger than 3000㎡

  e.g. excavation, replacement of soil

- **When having potential human health risks**

  administrative judgment: soil and groundwater contamination, potential human health risk

Designation of contaminated area

Remediation area (need to be remediated within certain time)

soil leaching standards exceeded, and

groundwater used as a drinking water.

soil content standards exceeded, and

person can get into the site.

Application area (need to be applied when changing land character)

the standards exceeded , but no potential human health risks.

e.g. groundwater is not used as a drinking water.

access limitation to the contaminated area.

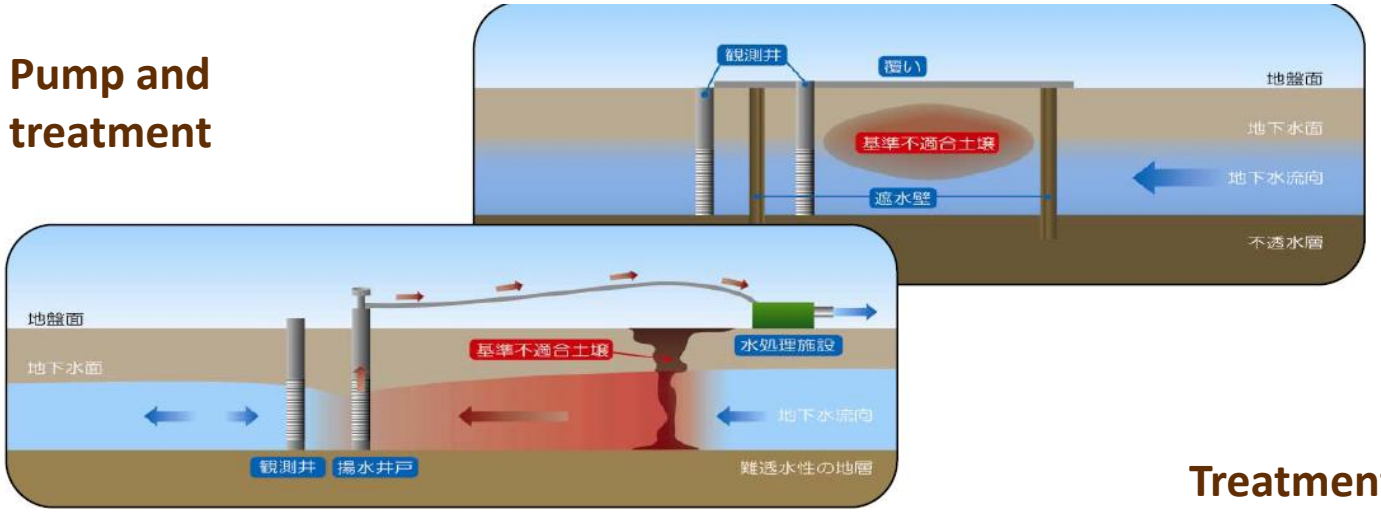
Remediation methods of contaminated soil

- **Prevent of contaminated soil direct ingestion.**
  access limitation, surface capping, filling,
  replacement of soil, treatment (excavation,
  thermal, washing, chemical, bioremediation, etc.)

- **Prevention of groundwater ingestion .**
  monitoring, containment (sheet pile, etc.),
  barriers, immobilization,
  treatment (excavation, thermal, washing, chemical,
  bioremediation, pump and treat, etc.)

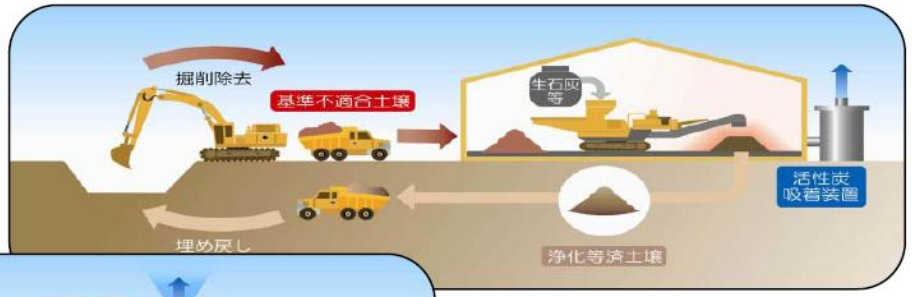
Containment method etc.

Pump and treatment

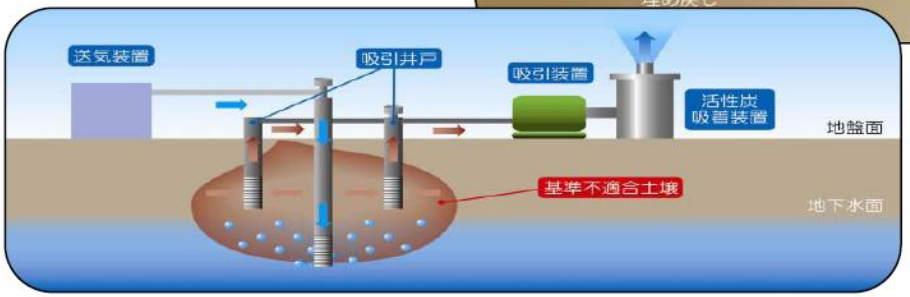


Containment method

Treatment on-site



Treatment in-situ



http://www.env.go.jp/water/dojo/gb_me/01.pdf

The target levels of remediation

	Items	Target level for soil		Target level for groundwater (mg/L)
		Leachate (mg/L)	Total content (mg/kg)	
Ⅰ	carbon tetrachloride	0.02	-	0.02
	1,2-dichloroethane	0.04	-	0.04
	1,1-dichloroethylene	0.02	-	0.02
	cis-1,2-dichloroethylene	0.04	-	0.04
	1,3-dichloropropene	0.002	-	0.002
	dichloromethane	0.02	-	0.02
	tetrachloroethylene	0.01	-	0.01
	1,1,1-trichloroethane	1	-	1
	1,1,2-trichloroethane	0.006	-	0.006
	trichloroethylene	0.03	-	0.03
	benzene	0.01	-	0.01
Ⅱ	Cd	0.01	150	0.01
	Cr (VI)	0.05	250	0.05
	CN	ND	50 (for free cyanide)	ND
	Hg	0.0005, ND for alkyl mercury	15	0.0005, ND for alkyl mercury
	Se	0.01	150	0.01
	Pb	0.01	150	0.01
	As	0.01	150	0.01
	F	0.8	4,000	0.8
	B	1	4,000	1
Ⅲ	simazine	0.003	-	0.003
	thiobencarb	0.02	-	0.02
	thiuram	0.006	-	0.006
	PCBs	ND	-	ND
	organic phosphorus	ND	-	ND

Qualification licenses of interest

These licenses are qualified by ministry of environment, or the local governments.

Transportation of contaminated soil

Site Investigation

Treatment of contaminated soil

Development and Promotion of Cost and energy efficient Investigation and remediation Technologies.

initiated by Ministry of Environment of Japan from 2002

Purposes and evaluation aspects

- Aim : developing and promoting the new technologies.
- Adoption process:

  collection, demonstration, evaluation, adoption
- Evaluation aspects:

  effectiveness, economy,
  impacts on the surrounding environment,
  practicability, simplicity,
  comprehensive evaluation.

The technologies adopted by Ministry of Environment of Japan

Year	Investigation	Soil Washing	Thermal Tech.	In-Situ（on-site）			other
				Stabilization	Bio-Treatment	Chemical Degradation	
2002	2	4	1	1	1		
2003	1				3	1	2
2004	1			1	1	1	
2005		2	2			2	
2006		1	2			1	
2007	3	1	1		1		
2008	1		1		1	2	
2009		1			1	1	1
2010		1					1
2011						1	

Evaluation cases of technology of Benzene treatment on-site

1) Economy

Investment in energy 0.57MJ / kg - contaminated soil

efficiency: 24kg / person / hour

\8200 Japanese Yen / t - soil (for 40t soil)

2) Impact on the surrounding environment

Surrounding atmosphere: treated at tightly sealed equipment, so do not discharge hazardous substances into the surrounding atmosphere

wastewater: treatment of wastewater in the plant and discharge, and drainage shall meet the standards.

Noise: 58dB Vibration: 36dB (within background level)

CO_2 emissions: 6.44 kg-CO2 / t (for 1000t soil)

Case study on the calculation of the CO_2 released from the remediation activities

conducted by Geo-Environmental Protection Center, GEPC ,Japan

The Ge-Environmental Protection Center GEPC, Japan

established in 1996, Japan's sole non-government public service corporation involved in the issues of soil and groundwater contamination.

more than 100 members, mainly composed by the companies engaged in the activities of investigation, analysis and remediation.

The main activities

- studying investigation and remediation technologies,
- studying the evaluation and management methods
- organizing various meetings and seminars
- also carrying out grant work of qualification for the investigation and remediation of soil and groundwater.

Hypothetical conditions of the model site

Site No.	Site Area (㎡)	Contaminated Area (㎡)	Depth (m)	Transportation Distance (km)
1	9,600	1,200	10	20
2	96,000	12,000	10	20
3	960,000	120,000	10	20
4	9,600	1,200	10	200

Contaminant : arsenic (As).

Five remediation methods and different stages

Five remediation methods

a. Containment with sheet pile and asphalt capping
b. Containment with soil mixing wall and asphalt capping
c. Excavation and stabilization treatment on-site
d. Excavation and soil washing
E. Excavation and haul to cement plant

The % amount of CO2 released from different remediation methods

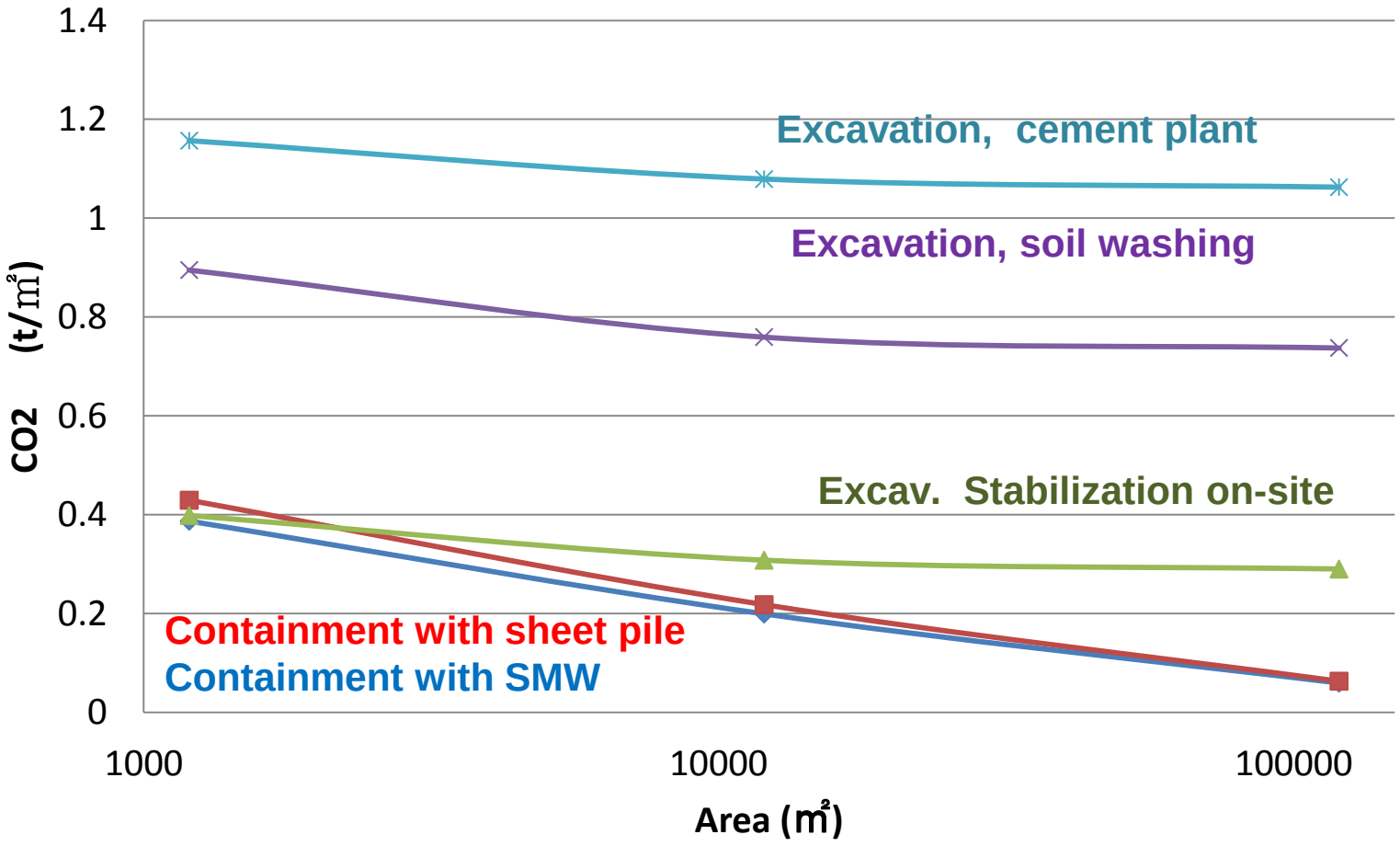
（Case 1: contaminated area is 1,200 ㎡）

methods	Different stages of remediation and material							
	①	②	③	④	⑤	⑥	⑦	⑧
Containment with sheet pile, asphalt	-	**84**	1	1	14	0	0	0
Containment with SMW, asphalt	-	**65**	2	1	31	0	0	0
Excav. stabilization on-site	-	18	21	1	**60**	0	0	0
Excav. , soil washing	-	**29**	**38**	1	21	11	0	0
Excav. to cement plant	-	21	**28**	0	17	**34**	0	0

Different Stages of remediation process

① Design activities ② Material, ③ Transportation activities,
④ Investigation activities, ⑤ Construction and remediation activities,
⑥ Treatment activities at cement plant or soil washing facility
⑦ Groundwater treatment activities, ⑧Disposal of solid waste

The amount of CO_2 released from different remediation methods



Conclusions

- **There is no requirement of sustainable remediation yet in the Japan's soil remediation law so far.**
- **But there are more and more similar concepts incorporated into the law and relevant remedial activities.**
- **In the future, the principles and practices of sustainability remediation are expected to be spread and applied much more in Japan.**

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