環境省
Ministry of the Environment
Government of Japan

jSMCWM

Series of DWM Lecture

Handling/Managing Hazardous Waste

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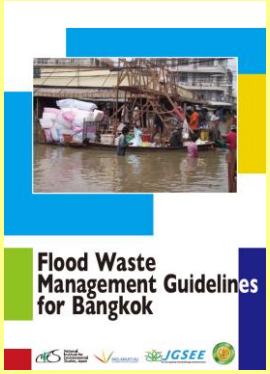
Self introduction

Tomonori Ishigaki

- Ph D.; background in environmental engineering
- Senior researcher
- Center for Material Cycles and Waste Management Research, National Institute for Environmental Studies
- 20 years research experience in (disaster) waste management

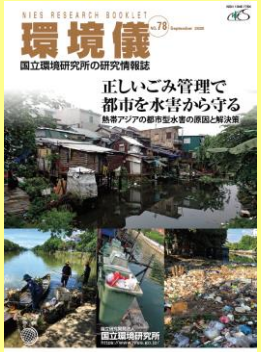


Flood waste management guideline for Bangkok

https://is.gd/YpxEiU

No Waste in canal

https://youtu.be/gw_xghsNU08
https://youtu.be/26FrxpQE5Ug
https://youtu.be/SIYe0sSQW6o



Appropriate waste management will save the urban from flood NIES Research Booklet

https://www.nies.go.jp/kanko/kankyogi/78/02-03.html

Aim and scope of this lecture

- ✓Understand the importance of safe handling of hazardous waste
- ✓Understand the importance of management of hazardous materials and substances
- ✓Understand preparedness actions for hazardous waste

HAZARDOUS WASTE
IN NATURAL DISASTER

Find out the potential hazard

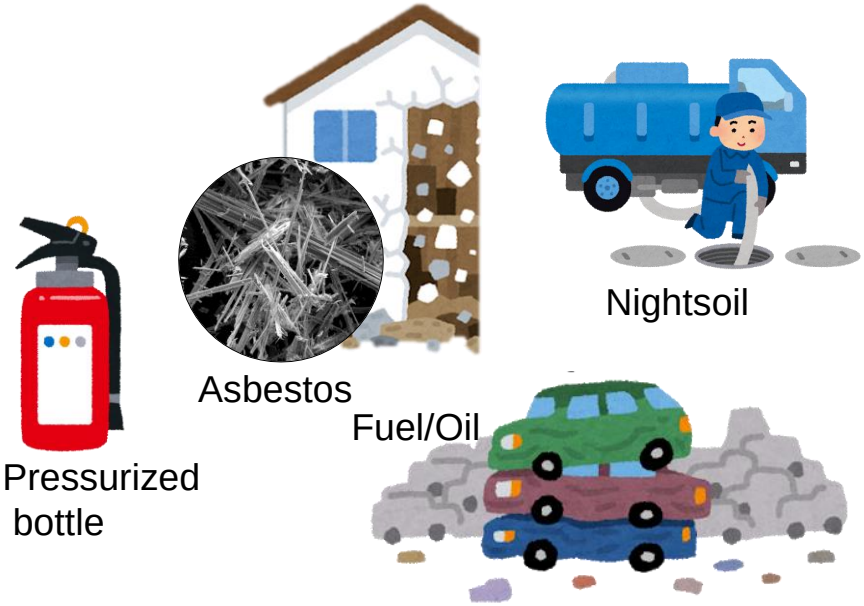
(Photo source: Great East Japan Earthquake Archive Miyagi)

Hazardous Waste in Disaster Occasions

The waste that is also regarded as the hazardous waste in normal situation.

Appropriate legislation and management system must be required before disaster. Then hazardous disaster waste is treated securely.

The hazard that is not apparent in normal situation, but disaster causes to expose to the living environment.



Special care to potential hazard is required at disaster time.

What is the Hazard in terms of Waste

Explosive	Flammable	Toxicity	Spontaneously combustible
Oxidative	Corrosive	Infectious	

Additional Hazard in Disaster Situation

Threats to life and survival

- waste heap collapse
- Ignition and spread of fire

Threats to health

- Spread of medical infectious waste by hospital damage
- Deterioration of sanitary environment
- Asbestos
- Toxic gas

Threats to environment

- Soil contamination
- Aquatic pollution
- Air pollution
- Odor

Phase of Treatment of Hazardous Disaster Waste

Search and Rescue phase	Initial Recovery Phase	Substantial Recovery Phase
Emergency Relief	Stabilization and return to daily life	Long-term rebuilding, development, preparedness
Fast removal of hazard, to avoid the secondary damage	Prompt treatment of hazardous waste that blocks the recovery activity	Ensuring the treatment of inert waste that may contain hazardous substances

[i] Fast Removal of Hazard

Quick removal and treatment with high priority on

- ✓ Infectious waste
- ✓ Flammable, explosive pressurized cylinder
- ✓ Putrescible waste that may generate explosive gas
- ✓ Careful management of nightsoil for evacuator's sanitation
- ✓ Deconstruction debris that contains asbestos, heavy metal-treated wood, gypsum board

In case of urgent without enough capacity

- ✓ Transfer infectious waste from water source
- ✓ Keep flammable or explosive waste away from fire

[ii] Prompt treatment of hazardous waste

Treating the hazardous waste that may inhibit the recovery activity, such as

- ✓ Automobile includes fuel, oil, battery
- ✓ Home appliances include battery
- ➢ Consider the possibility of recycling in ordinary way

In case of urgent without enough capacity

- ✓ Avoidance of fire or ignition by removing the oil, fuel, battery

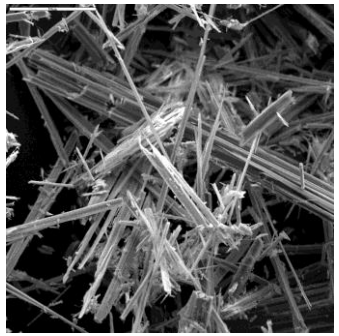
[iii] Ensuring the treatment of inert hazardous waste

Steadily Treatment of the inert waste (e.g. demolition waste) that possesses potential hazard

- ✓ Long placement of hazardous waste in TSS may cause contamination of soil or aquatic environment
- ➢ Treatment of temporary transferred hazardous waste

PRACTICAL CASE: ASBESTOS

What is Asbestos?



Source of SEM image
U.S. Geological Survey

- Asbestos is a naturally-occurring fibrous silicate mineral with a diameter of 0.02-0.35 μm and an extremely fine needle-like shape.
- It is an excellent electrical insulator and is highly heat-resistant, and it was used as a building material for many years.
- It is now a well-known health hazard and the use of asbestos as a building material is illegal in many countries.
  - Inhalation of asbestos fibers can lead to various serious lung conditions, including asbestosis and cancer.
- Most buildings constructed before the 1980s are thought to contain asbestos. Many developing countries still support the use of asbestos as a building material, and mining of asbestos is ongoing.

Asbestos waste

◆ Asbestos-Consisting Waste

- ☐ Sprayed coatings
- ☐ Insulation

Special care to remove Asbestos is required before full-scale demolition work. Safety gears such as dust mask, work clothes must be used, and they should be treated as asbestos-containing waste.

◆ Asbestos-Containing Waste

- ☐ Asbestos Insulating Board (AIB)
- ☐ Asbestos Cement Board
- ☐ Asbestos Cement Pipe (ACP)

Source of images: MLIT, GoJ

Generation of Asbestos Waste in Disasters

- Asbestos waste are generated when the buildings and structures are damaged by disasters.
- It is also generated by destruction of building in recovery phase.
- It is often focused when Earthquake strikes. However, any other disasters that may give the damages to the building/structure should have potential to generate it. It highly depends o the scale of disasters.

Type of Disasters	**Earth quake**	**Tsunami**	**Flooding**	**Typhoo/ Cyclone**	**Volcanic eruption**
Possibility of generation of asbestos waste	High	Middle	Middle	Middle	Middle-Low

TREATMENT OF ASBESTOS WASTE IN DISASTERS

How to treat Asbestos waste appropriately (1/5)

1) Preparedness in normal time

- Identifying the buildings that use asbestos
  - Refer to the document/results of survey on building materials containing asbestos and the history of their use and removal
- Establishing management system to prevent asbestos pollution/exposure
- Preparing working plan for treatment of asbestos waste
  - Securing materials and equipment necessary for special care of removal and transportation, and safety for residents

How to treat Asbestos waste appropriately (2/5)

2) To do in emergency relief phase

- Alerting to rescue clue and residents
- Distributing the dust masks in high-risk communities
- Moisturizing the potential asbestos waste

How to treat Asbestos waste appropriately (3/5)

3) To do in initial recovery phase

- Surveying the exposed asbestos
- Surveying damage situation of buildings using materials containing asbestos.
- Taking emergency measures to prevent scattering and exposure to asbestos
  - Quick removal of exposed asbestos
  - Temporary cover for asbestos
- Providing information to residents

Once mixed demolition waste generates, it is hard to identify and separate Asbestos-containing waste

- Preliminary identification and removal is essential

How to treat Asbestos waste appropriately (4/5)

4) To do in Substantial recovery phase

- Implementing the work plan of treatment
  - Working plan is adjusted to the real situation of the generation of asbestos waste, that is determined in initial recovery phase
- Demolition of buildings/structures
  - Asbestos-consisting materials must be removed in advance.
  - Boards, pipes or other materials that contains asbestos should be carefully removed manually after wetting.
  - Refer to the specific manual in each country, if it exists.
- Removal of asbestos from mixed disaster debris
  - Asbestos-consisting waste would contaminate the mixed debris generated in areas affected by tsunami or flood damage.
  - It is recommended to remove immediately since the risk of asbestos is increased due to natural drying and deterioration in the temporary storage site.

Mixed Disaster Debris (Tsunami Debris)

Tsunami debris

May be polluted by several hazardous substances, such as spilled oil, chemicals, and asbestos

Removal of asbestos is essential to keep the safety and quality control

Washing and Fractionation

Recycled Construction Material

Source: Press release of Kajima Corp. on 2 Dec.2013
https://www.kajima.co.jp/news/press/201312/2c1-j.htm

How to treat Asbestos waste appropriately (5/5)

4) To do in Substantial recovery phase

- Storage
  - Asbestos waste should be double-packed with waterproof materials, cautionary labeled, and stored separately without mixing with other disaster waste.
- Collection and transportation
  - Transporting by normal truck with container/cover, avoid press packer truck.
- Intermediate treatment and final disposal
  - Asbestos waste is not suitable for recycling or incineration.
  - Melting or other detoxification (including solidification) technology can be implemented if they are available
  - It is disposed of the site that is permitted to accept in compliance with relevant laws or regulations.
  - It must not be mixed with other waste, by using sealed containers, wrapping to prevent scattering
  - Displaying the cautionary label on designated area.

It is necessary to establish a reliable management scheme before disaster

ON-SITE IDENTIFICATION OF ASBESTOS WASTE

What is suitable equipment for on-site identification of asbestos?

[A] Loupe

x 10-20 magnification

[B] Torch

[C] USB Stereomicroscope

x 100 magnification

[D] NIR Mobile Asbestos Analyzer

Useful, but relatively expensive

[E] X-ray Diffraction Analysis

Precise, but requiring the time

Identification of Asbestos waste

1) Simple/Preliminary Identification: On-site

✓Quick but inaccurate

◆Visual Observation

◆Microscopic Observation (Stereomicroscope)

◆Mobile NIR asbestos analyzer

2) Accurate Identification: In Laboratory

✓Requiring the skill, taking several days

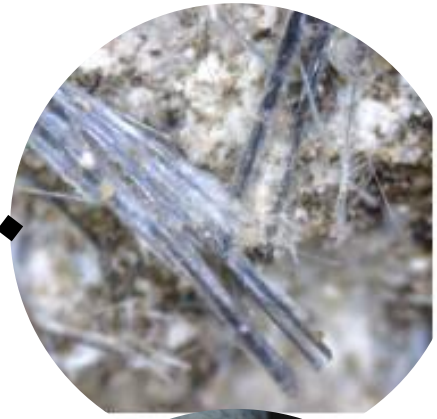
◆Observation by Polarizing microscope

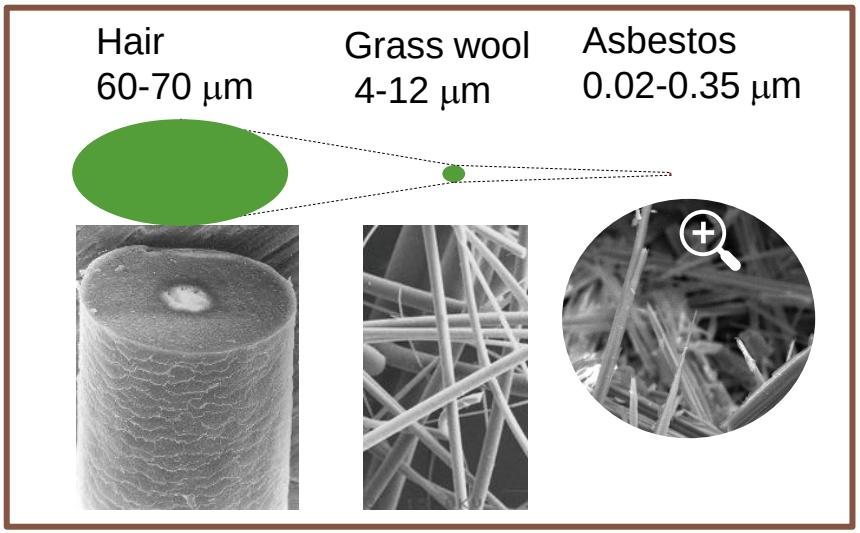
◆Observation by Phase-contrast microscope

◆X-ray diffraction Analysis

On-site identification of Asbestos waste

1) Simple/Preliminary Identification
   - ◆Visual Observation
   - ◆Microscopic observation
     - ➢*Bundles of fibrils*
       - ✓*Single fiber is not asbestos*
     - ➢*Incombustibility*
       - ✓ *Burnt fiber is unblackened, unmelted*
     - ➢*Size*



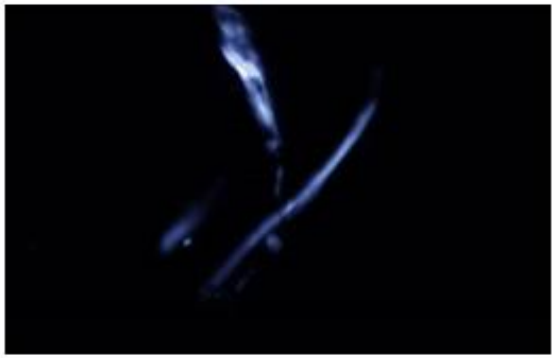


- ◆Mobile NIR asbestos analyzer

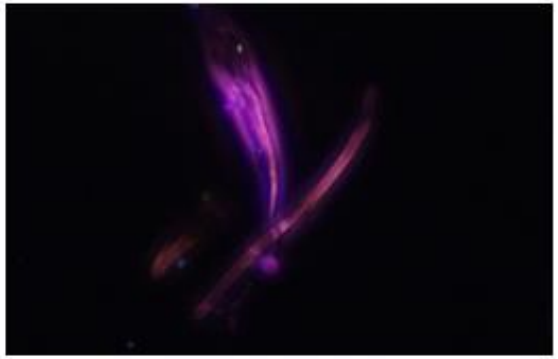
In-lab identification of Asbestos waste

2) Accurate Identification

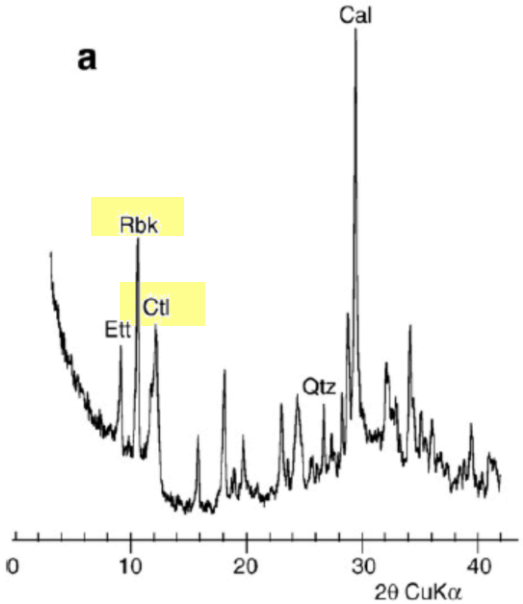
- ✓Requiring the skill, taking a 3-4 days
- ◆Observation by Polarizing microscope
- ◆Observation by dispersion staining with phase-contrast microscope
- ◆X-ray diffraction Analysis



Polarizing microscope image
CERI, Japan



Phase contrast microscope image
CERI, Japan



XRD pattern
Dellisanti et al.(2009) Int. J. Miner. Process.91, 61-67

WRAP-UP

- ◆Safe handling and appropriate treatment of hazardous disaster waste will be achieved by preparation before disaster
  - ✓ Collecting information on distribution of the potential hazard
  - ✓ Expanding the treatment/disposal capacity
  - ✓ Preparing the equipment for quick identification/ safety gear
- ◆Local vulnerability against major disaster on management of hazards must be identified and solved as much as possible before disasters.