Introduction

- Wastes containing polychlorinated biphenyl (PCBs) have been stored by holders more than 30yrs in Japan.
- Concern about pollution by PCBs mounted.
- “PCB Special Measures Law” was enacted in 2001.
- PCB waste treatment scheme was established
  – Japan Environmental Safety Corporation (JESCO) was established as a special company for PCB waste treatment by the Government.
Outline of today’s presentation

- History of PCB issue in Japan
- PCB waste treatment scheme under the “PCB Special Measures Law”
- PCB waste treatment at JESCO
  - Facility, Technology, Environmental Safety
- Role of industrial sectors in PCB waste treatment
1. History of PCB issue in Japan
Domestic usage of PCBs in Japan

Electrical Appliances, 37,156 tons, 69%

Heat Medium, 8,585 tons, 16%

Non-carbon Paper, 5,350 tons, 10%

Others, 2,910 tons, 5%

Total of Amount Used (1954-1972): Approx. 54,000 tons

Number of Transformers
About 50,000

Number of Capacitors
About 160,000

Number of Ballasts
About 5,600,000
Rice oil was contaminated by PCBs used as heat medium at a factory of Kanemi Warehouse Company.

More than 13,000 people were poisoned by the rice oil in 1968.

Poisoning and pollution by PCBs became a serious social problem.
Prohibition of manufacture, use of PCBs

- Administrative guidance was given to prohibit production, order for recall (Obligation for storage) in 1972.
- “Law concerning the Evaluation of Chemical Substances and Regulation of Their Manufacture, etc. (Chemical Substances Control Law) ” was enacted in 1974.
- Manufacturing, importing and new use were prohibited by the law.
Storage of PCB Waste

- However, no safe technology, facility was available for treatment of Wastes containing PCBs.
- Later, a number of projects for PCB waste treatment were tried by private sector; however, they failed.
- PCB wastes have been stored by holders more than 30yrs in Japan.
- Concern about environmental pollution by PCBs mounted.
Containers are filled with PCBs.
2. PCB waste treatment scheme under the “PCB Special Measures Law”
Enactment of the “PCB Special Measures Law”

- Concern about environmental pollution by PCB mounted due to the long-time storage of PCB wastes.

- “Stockholm Convention on Persistent Organic Pollutants” took effect and Japan ratified it.

→ The “Law concerning Special Measures for Promotion of Proper Treatment of PCB Wastes (PCB Special Measures Law)” was enacted in 2001.
Overview of the PCB Special Measures Law(1)

- PCB waste holders
  - must treat PCB wastes by themselves, or contract someone to treat PCB wastes in a proper way by July 2016.
  - must report to their prefectural governor the status of PCB waste storage and treatment.

- Former manufacturers of PCBs and products containing PCBs must cooperate for the implementation of government and local government policies for PCB waste treatment.
Overview of the PCB Special Measures Law(2)

- Local government
  - Prefectures and specified cities are to establish plans for the treatment of PCB wastes, in response to the basic plan made by the national government.
  - Prefectural governors must disclose status of PCB waste storage and treatment in their jurisdiction.
Overview of the PCB Special Measures Law (3)

- National Government
  - The Minister of the Environment is to develop the PCB Waste Treatment Basic Plan.
  - The government should build PCB waste treatment facilities and take necessary action for treating PCB waste certainly and properly.
  → JESCO was established to do PCB waste treatment business.
Structure of PCB Waste Treatment

Prefectures and Specified Cities

PCB Waste Holders (at over 50,000 sites)

- Report of PCB wastes
- Authorize & Direct

Report of reported PCB wastes under jurisdiction

PCB Waste Treatment Plan
(Identification of PCB amount, Treatment Plan)

Ministry of the Environment (MOE)

Japan Environmental Safety Corporation

- Construction of Facility
- Operation of Facility

Regional Facility

Treatment

Regional Facility

Reservoir

Material for Recycle

Residence

Industrial Waste Treatment / Recycling Companies

- Supervise & Direct
- Approval of Business Plan

Subsidies for Construction of Facility

Local Authority

Acceptance of Facility / Supervise & Direct

Residents

PCB Waste Treatment Fund
(Consists of subsidies from the government, local governments etc.)

Subsidize small & medium-sized enterprises

Transportation Fee

Transportation Contract

Approval of Business Plan

Acceptance Plan

PCB Waste Treatment Basic Plan
(Identification of PCB amount, Establish Treatment Framework)

Regional Facility

Carry In

Treatment

Environmental Restoration and Conservation Agency (ERCA)

Explain Information Disclosure Material for Recycle

Acceptance Plan

Transportation Fee

Transportation Contract

Approval of Business Plan

Acceptance Plan

PCB Waste Treatment Fund
(Consists of subsidies from the government, local governments etc.)

Subsidize small & medium-sized enterprises

Transportation Fee

Transportation Contract

Approval of Business Plan

Acceptance Plan

PCB Waste Treatment Basic Plan
(Identification of PCB amount, Establish Treatment Framework)
3. PCB waste treatment at Japan Environmental Safety Corporation
Outline of JESCO (1)

- Established in 2004 under the “Japan Environmental Safety Corporation Law (Law No.44 of 2003)
- Special company wholly owned by the government
- The only national body conducts PCB wastes treatment subject to contract with holders of the waste.
- Constructed and operate 5 regional PCB waste treatment facilities throughout Japan, under supervision of the national government
- Granted subsidies by the national government for construction of the facilities
Outline of JESCO (2)

■ Business Results and Financial Standing (Unit: million yen)

<table>
<thead>
<tr>
<th></th>
<th>FY 2004 (1st Period)</th>
<th>FY 2005 (2nd Period)</th>
<th>FY 2006 (3rd Period)</th>
<th>FY 2007 (4th Period)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Income (Loss)</td>
<td>143</td>
<td>2,854</td>
<td>5,358</td>
<td>11,209</td>
</tr>
<tr>
<td>Net deficit for period</td>
<td>2,399</td>
<td>7,803</td>
<td>12,687</td>
<td>9,678</td>
</tr>
<tr>
<td>Total assets</td>
<td>85,181</td>
<td>89,456</td>
<td>87,322</td>
<td>114,081</td>
</tr>
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</table>

■ Lot Area and Floor Area of Each Facility (Unit: square meters)

<table>
<thead>
<tr>
<th>Facility</th>
<th>Kitakyushu</th>
<th>Toyota</th>
<th>Tokyo</th>
<th>Osaka</th>
<th>Hokkaido</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lot Area</td>
<td>54,000</td>
<td>9,800</td>
<td>30,500</td>
<td>28,600</td>
<td>40,000</td>
</tr>
<tr>
<td>Total Floor Area</td>
<td>15,400</td>
<td>21,000</td>
<td>37,200</td>
<td>25,200</td>
<td>26,300</td>
</tr>
</tbody>
</table>

■ Employee Number of JESCO (As of March 2008)

<table>
<thead>
<tr>
<th></th>
<th>Number of Staff</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>210</td>
</tr>
</tbody>
</table>
Location of JESCO Facilities

- **Kitakyushu Facility**
  - Kitakyushu City, Fukuoka
  - Operation started: Dec. 2004

- **Osaka Facility**
  - Osaka City, Osaka
  - Operation started: Oct. 2006

- **Hokkaido Facility**
  - Muroran City, Hokkaido
  - Operation started: May 2008

- **Tokyo Facility**
  - Koto-ku, Tokyo
  - Operation started: Nov. 2005

- **Toyota Facility**
  - Toyota City, Aichi
  - Operation started: Sep. 2005

As of May 2008
## Schedule for Treatment

<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>Kitakyushu</td>
<td>Dec.</td>
<td>Phase 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toyota</td>
<td>Sept.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Tokyo</td>
<td>Nov.</td>
<td></td>
<td></td>
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<tr>
<td>Osaka</td>
<td>Oct.</td>
<td></td>
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<tr>
<td>Hokkaido</td>
<td>May</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Additional facility</td>
</tr>
</tbody>
</table>
Outline of Regional PCB Waste Treatment Facilities

<table>
<thead>
<tr>
<th>Facility</th>
<th>Location</th>
<th>Assigned to treat PCB wastes of below area</th>
<th>Types of PCB wastes treated</th>
<th>Capacity (PCB Oil)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitakyushu</td>
<td>Kitakyushu City, Fukuoka</td>
<td>17 prefectures in Chugoku, Shikoku, Kyushu, and Okinawa Regions</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Phase: Transformers, capacitors, PCB oil stored in Kitakyushu City&lt;br&gt;2&lt;sup&gt;nd&lt;/sup&gt; Phase: Transformers, capacitors, PCB oil, and PCB contaminated wastes stored in all assigned areas (Wastes to be treated together with 1&lt;sup&gt;st&lt;/sup&gt; phase facilities)</td>
<td>1.5 tons per day&lt;br&gt;(Contaminated wastes: 10 tons per day)</td>
</tr>
<tr>
<td>Toyota</td>
<td>Toyota City, Aichi</td>
<td>4 prefectures in Tokai Region</td>
<td>Transformers, capacitors and PCB oil</td>
<td>1.6 tons per day</td>
</tr>
<tr>
<td>Tokyo</td>
<td>Koto-ku, Tokyo</td>
<td>4 prefectures in South Kanto Region</td>
<td>Transformers, capacitors, fluorescent ballasts and PCB oil</td>
<td>2.0 tons per day</td>
</tr>
<tr>
<td>Osaka</td>
<td>Osaka City, Osaka</td>
<td>6 prefectures in Kinki Regions</td>
<td>Transformers, capacitors and PCB oil</td>
<td>2.0 tons per day</td>
</tr>
<tr>
<td>Hokkaido</td>
<td>Muroran City, Hokkaido</td>
<td>16 prefectures in Hokkaido, Tohoku, North Kanto, Koushinetsu, and Hokuriku Regions</td>
<td>1&lt;sup&gt;st&lt;/sup&gt; Facility: Transformers, capacitors and PCB oil&lt;br&gt;Additional Facility: PCB contaminated wastes</td>
<td>1.8 tons per day&lt;br&gt;(Contaminated wastes: to be determined)</td>
</tr>
</tbody>
</table>
# Amount of PCB Waste Treated at JESCO Facilities

<table>
<thead>
<tr>
<th>Facility</th>
<th>Fiscal Year</th>
<th>Treated PCB Waste (units)</th>
<th>Amount of PCB decomposed (t)</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Transformers</td>
<td>Capacitors</td>
<td></td>
</tr>
<tr>
<td>Kitakyushu (Phase 1)</td>
<td>2004</td>
<td>50</td>
<td>200</td>
<td>9.5</td>
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<tr>
<td></td>
<td>2005</td>
<td>238</td>
<td>755</td>
<td>55.8</td>
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<tr>
<td></td>
<td>2006</td>
<td>241</td>
<td>1,038</td>
<td>67.7</td>
</tr>
<tr>
<td></td>
<td>2007</td>
<td>214</td>
<td>1,595</td>
<td>78.6</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>743</td>
<td>3,588</td>
<td>211.5</td>
</tr>
<tr>
<td>Toyota</td>
<td>2005</td>
<td>49</td>
<td>1185</td>
<td>31.5</td>
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<tr>
<td></td>
<td>2006</td>
<td>77</td>
<td>1,605</td>
<td>63.7</td>
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<tr>
<td></td>
<td>2007</td>
<td>191</td>
<td>2,289</td>
<td>115.8</td>
</tr>
<tr>
<td>Tokyo</td>
<td>2005</td>
<td>119</td>
<td>454</td>
<td>30.7</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>0</td>
<td>46</td>
<td>26.0</td>
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<tr>
<td></td>
<td>2007</td>
<td>82</td>
<td>721</td>
<td>52.4</td>
</tr>
<tr>
<td>Osaka</td>
<td>2006</td>
<td>76</td>
<td>1,941</td>
<td>33.9</td>
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<tr>
<td></td>
<td>2007</td>
<td>290</td>
<td>4,862</td>
<td>165.7</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>366</td>
<td>6,803</td>
<td>199.6</td>
</tr>
<tr>
<td></td>
<td>2005</td>
<td>406</td>
<td>2,394</td>
<td>117.9</td>
</tr>
<tr>
<td></td>
<td>2006</td>
<td>394</td>
<td>4,630</td>
<td>191.3</td>
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<tr>
<td></td>
<td>2007</td>
<td>777</td>
<td>9,467</td>
<td>412.4</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>1,627</td>
<td>16,691</td>
<td>731.1</td>
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</tbody>
</table>
## Treatment Method Adopted at Each Facility

<table>
<thead>
<tr>
<th>Facility</th>
<th>Pre-treatment</th>
<th>PCB Decomposition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitakyushu</td>
<td>Precise Recovery Cleansing Method</td>
<td>Dechlorination Method</td>
</tr>
<tr>
<td>(Phase 1)</td>
<td>Vacuum Thermal Recycling Method (VTR Method)</td>
<td>Sodium Dispersion Method (SD Method)</td>
</tr>
<tr>
<td>(Phase 2)</td>
<td></td>
<td>Melting Method</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Plasma Melting Method</td>
</tr>
<tr>
<td>Toyota</td>
<td>Solvent Extraction Decomposition Method (SED Method) &lt;Includes Vacuum Heating</td>
<td>Dechlorination Method</td>
</tr>
<tr>
<td></td>
<td>Separation Method</td>
<td>Ontario Hydro Technologies Sodium Dispersion Method</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(OSD Method)</td>
</tr>
<tr>
<td>Tokyo</td>
<td>MHI Chemical Cleansing Method &lt;Includes Vacuum Heating Separation Method&gt;</td>
<td>Hydrothermal Oxidation Decomposition Method</td>
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<tr>
<td></td>
<td></td>
<td>Hydrothermal Decomposition Method</td>
</tr>
<tr>
<td>Osaka</td>
<td>Solvent Cleansing Method</td>
<td>Dechlorination Method</td>
</tr>
<tr>
<td>Hokkaido</td>
<td>Solvent Extraction Decomposition Method (SED Method) &lt;Includes Vacuum Heating</td>
<td>Dechlorination Method</td>
</tr>
<tr>
<td>(1st facility)</td>
<td>Separation Method</td>
<td>Sodium Dispersion Method (SP Hybrid Method)</td>
</tr>
<tr>
<td>(Additional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>facility)</td>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

Note: Translated names of above methods are informal
Flow of PCB waste treatment (Example at Hokkaido Facility)

Pre-treatment

PCB Extraction

Disassembly

Washing

PCB Elimination Test

PCB Oil

Reaction Tank

Isopropyl Alcohol (IPA)

Antichlor (SD)

Secondary Reaction Tank

Extracted Oil

Waste Alkali

PCB Decomposition

High-voltage Transformers

High-voltage Capacitors

Insulator

Copper Wire

Paper, Wood

Non-impregnated Material

Impregnated Material

Vacuum Heating Separation

Antichlor (SD)

Secondary Reaction Tank

Extracted Oil

Waste Alkali

Iron, Copper

Iron, Copper

Paper, Wood

Waste Alkali

PCB Elimination Test

Secondary Reaction Tank

Extracted Oil

Waste Alkali

PCB Oil

PCB Oil
Location of Tokyo Facility
Tokyo Facility
Line for Disassembly of Large Transformers at Toyota Facility
Vacuum Heating Separation Device at Osaka Facility

Capacitors before treatment

Capacitors after treatment
Hydrothermal Oxidation Decomposition Reaction Tank
Safety Design Concept

Multiple Safety Measures

1. Safe design of treatment process
2. Operation Monitoring System
3. Fail-safe Functions
4. Safety Nets

Cooperation with the location area and related authorities
Information disclosure
Managing system for operations, maintenance and security
Ensuring safety of the workers
Occupational Health – Minimize Exposures to PCBs

- Exposure of Workers to PCBs should be limited in order to comply with “Occupational Health and Safety Law”.
- Management of PCB concentration in working environment
  - local exhaust ventilation equipment, negative pressure control, on-line monitoring of air quality
- Work practice management
  - personal protective clothing and equipment
- Health care of workers
  - special medical examination, monitoring of PCB concentration in blood of workers
Examples of Safety Nets

Exhaust gas is treated in exhaust treatment equipment, and furthermore, filtered through activated carbon as a safety-net.

Carrying in, Acceptance and Inspection

PCB wastes are carried directly inside the treatment building.

Exhaust Gas Monitoring

Exhaust gas is monitored online and offline, and only released if it meets standards.

Multiple Measures to Prevent Underground Infiltration

Leak-proof facilities and piping:
- Oil Pan
- Oil Retaining Dike and Impermeable Floor (Or Shield Floor)

PCB Decomposition Facilities

Shield Floor (Double structure)
Control Zones Divided Based on the Possibility of PCB Exposure
Negative Pressure Control

Higher Negative Pressure Level (Air does not flow to lower level)

Negative Pressure Control:

-7mmAq

-4mmAq

-2mmAq

Shield (Stainless steel inner surface)

Control Zone Level 3

Control Zone Level 2

Control Zone Level 1z

Buffer Room

Window

Control Panel

Remote Control

At operations where PCB is handled, a shield covers the area, to protect the workers from exposure to PCB.

Buffer rooms protect workers from effects from sudden change of pressure when entering different control level zones.
On-line Monitoring

- Exhaust gas and working atmosphere is monitored on-line.
- Should any abnormal events occur, prompt action will be taken.

Exhaust gas

Working atmosphere

• Automatic sampling
• Automatic concentration analysis

Constant monitoring at central control room

Appearance of equipment

Output example of monitoring data

Figures from online-monitoring and analyzed figures from official method (conducted offline) show a strong correlation
Glove Box at Kitakyushu Facility
Personal Protective Clothing and Equipment

- **Personal Protective Clothing and Equipment**
  
  Workers must wear personal protective clothing and equipment appropriate for the Control zone they work.
  
  [Example of personal protective clothing and equipment at control zone level 3]
  
  - Chemical protection suit*
  - Chemical protective gloves* and inner gloves
  - Chemical protective boots*
  - Half-face gas mask + protective glasses

*: PCB anti-permeability is tested

- **Upon Entering and leaving control zone**
  
  Procedures are stipulated and strictly enforced
Standards for Acceptance of PCB Wastes at JESCO

- Standards that carriers of PCB wastes must comply with when carrying in PCB wastes to JESCO facilities.
- Standards are established for each facility, based on environmental agreements with local authorities at the site of each facility.

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<tbody>
<tr>
<td>1</td>
<td>Effect</td>
</tr>
<tr>
<td>2</td>
<td>Carriers Allowed at JESCO</td>
</tr>
<tr>
<td>3</td>
<td>Items Accepted</td>
</tr>
<tr>
<td>4</td>
<td>Transportation Container</td>
</tr>
<tr>
<td>5</td>
<td>Transportation Vehicle</td>
</tr>
<tr>
<td>6</td>
<td>GPS System</td>
</tr>
<tr>
<td>7</td>
<td>Training Requirement for Workers</td>
</tr>
<tr>
<td>8</td>
<td>Measures for Safety of Transportation</td>
</tr>
<tr>
<td>9</td>
<td>No Water to be Attached</td>
</tr>
<tr>
<td>10</td>
<td>Transportation Route</td>
</tr>
<tr>
<td>11</td>
<td>Opening hours for Acceptance</td>
</tr>
<tr>
<td>12</td>
<td>Refusal of Acceptance</td>
</tr>
</tbody>
</table>
GPS System for Ensuring Safety of PCB Transportation

- PCB waste holder
- Transportation company
- JESCO
- The Internet

- Inquiry of a manifest slip
- Transportation status list
- Vehicular swept path
- Daily report (Available for transportation company only)

- Communications Center
- System datacenter

- Vehicle with GPS antenna
- GPS satellite
- Communication satellite
Loading of a Capacitor into Inner Tray
Loading of Inner tray into Leakproof Metal Container

One leakproof metal container can hold up to 4 inner trays.
Loading Completed
4. Role of industrial sectors in PCB waste treatment
Self treatment of PCB wastes by industrial sectors

- Holders of PCB wastes does not need to contract JESCO to treat PCB wastes if they treat the wastes certainly and properly by themselves.
- Some holders of PCB wastes, electricity power suppliers, chemical companies, etc., treat PCB wastes by themselves in their facilities.
Summary: Role of industrial sectors in PCB waste treatment(1)

- Holders of PCB
  - have responsibility of PCB waste treatment.
  - This is the same as the responsibility of the holders of ordinary industrial waste in Japan.
  - This is based on the principle provided for in the “Waste Management Law”

- Former Manufacturers of PCBs and products containing PCBs
  - are required to cooperate for government policies for PCB waste treatment.
  - actually, contributed to “PCB Waste Treatment Fund” which subsidize small and medium-sized businesses with PCB wastes treatment costs.
Summary: Role of industrial sectors in PCB waste treatment (2)

- Developer of PCB waste treatment technology
  - A number of PCB waste treatment technology were developed by industrial sectors.

- Transport contractors
  - transport PCB wastes from holders to JESCO subject to contract with holders.

- JESCO
  - conduct PCB waste treatment subject to contract with holders.
Summary: Role of industrial sectors in PCB waste treatment(3)

- Industrial sectors play great roles in PCB waste treatment in Japan.

- However, that has not happened for a long time. Only after the enactment of PCB Special Measures Law, the industrial sectors started their work for PCB wastes treatment.

- Japan’s experience shows that framework which defines the role of industrial sectors, government and other stakeholders is necessary for the appropriate management of POPs.