

Working Together Using Advanced Technology

Teshima Waste Treatment Project

— Restoration Project of Teshima Island Stained by Illegal Dumping —



Kagawa Prefecture

The Seto Inland Sea - with over seven hundred large and small islands with intricate shorelines, is a place of magnificent scenic beauty.

Illegal dumping cases of industrial wastes happened tragically at Teshima island on this beautiful Seto Inland Sea and this symbolizes Japan's typical "economy-first, others-second, society".

This case, eventually, induced the society to focus on "wastes problem" and led our country to create an environment-friendly "Recycling-Oriented Society".

The problem of Teshima let new effort for "Recycling-Oriented Society", in which emitted wastes are recycled and utilized as resources, as well as controlling the amount of waste. Non-recycling wastes are to be treated properly with the goal of becoming environment-friendly.

Environmental remediation at Teshima and wastes treatment and its recycling project (without any final landfilling of by-products such as fly ash and slag) at Naoshima, have already started to achieve our "Recycling-Oriented Society".

Teshima Island



marine tra



- Constructing a water insulating wall for the prevention of ocean pollution
- Purification of underground water and leachate
- Excavation and adjustment of wastes and contaminated soil
- Loading wastes and soil into container trucks

Concerning Environment and Safety

In this project over six hundred thousand tons of illegally dumped wastes and contaminated soil at Teshima are transported to Naoshima, where they are treated by incineration and melting, as well as recycling its by-products for effective use. These projects are managed with the consideration of environment and safety, under the advice of the Technical Committee of the Project. In addition, provisional measures for the conservation of the environment have been accomplished in order to prevent continuously the expansion of pollution around the environment during the treatment.

At the Intermediate treatment plant, we established original restriction which is stricter than Air Pollution Control Law, and execute the extreme flue gas treatment. In addition, we pay extra attention to our safety policy in marine transportation along with strong restriction laws.

Achieving recycling

The project can achieve a "Recycling-Oriented Society" with the latest technology. This project not only treats the illegally dumped wastes harmlessly, but also utilizes the by-products which are used to be landfilled before, with its best possibility.

The intermediate treatment plant of illegally dumped wastes and contaminated soil at Teshima are maintained in Mitsubishi Materials Inc. Site.

Fly ash from the intermediate treatment is transferred to Mitsubishi Materials Inc. where valuable metals are recovered, at the same time, slag is recycled and utilized as construction materials after the safety and quality check.

In addition, metals such as copper, iron, aluminum, which are produced during the intermediate treatment, are recycled.

Intermediate treatment plant at Naoshima recycles the wastewater from the plant and rainwater for quenching water and so on, with the closed system to keep the water within the facility. Waste heat from flue gas treatment is collected at the boiler to be changed into steam for utilization.

Naoshima Island



transportation



- Incineration and melting of wastes and soil
- Extreme flue gas treatment
- Effective utilization of by-products such as fly ash and slag
- Recycling of wastewater from plants and rainwater, efficient use of waste heat, and solar power generation

Open information

Each plant is under strict control by monitoring plants. The land and nearby sea environments in and around Teshima and Naoshima are always monitored. These data are always checked and evaluated for improving plant operation.

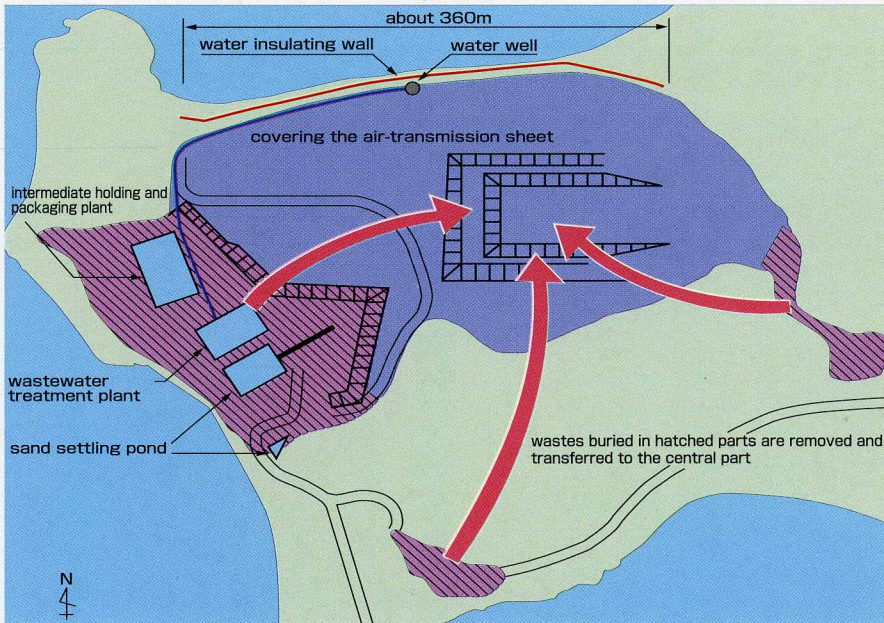
Plant information such as operating status or environmental measurement is available at public computers in town office and city hall so that residents do not have to visit each plant. Information and the latest news are also released positively via the net.

Provisional measures for the conservation of the environment

In order to prevent the expansion of pollution around the environment during the treatment, provisional measures for the conservation of the environment have been accomplished as listed below from Sep. 2000 to Mar. 2002.

- In order to prevent the leaching of underground water and leachate containing poisonous substances from the wastes layer, a water insulating wall (about 360 m long and 2-18m deep) was constructed along the coast.
- In order to prevent the expansion of leaching of poisonous substances and other pollutants into the ocean and to construct the wastewater treatment plant, wastes and others are relocated from the west coast part, slopes on the south, and other several parts to the central part of the site.
- In order to prevent the scattering of wastes and soil, and to drain rainwater all the wastes layer is covered with water-impermeable and air-transmission sheets.

Execution plan of provisional measures for the conservation of the environment



Construction of a water insulating wall on north coast



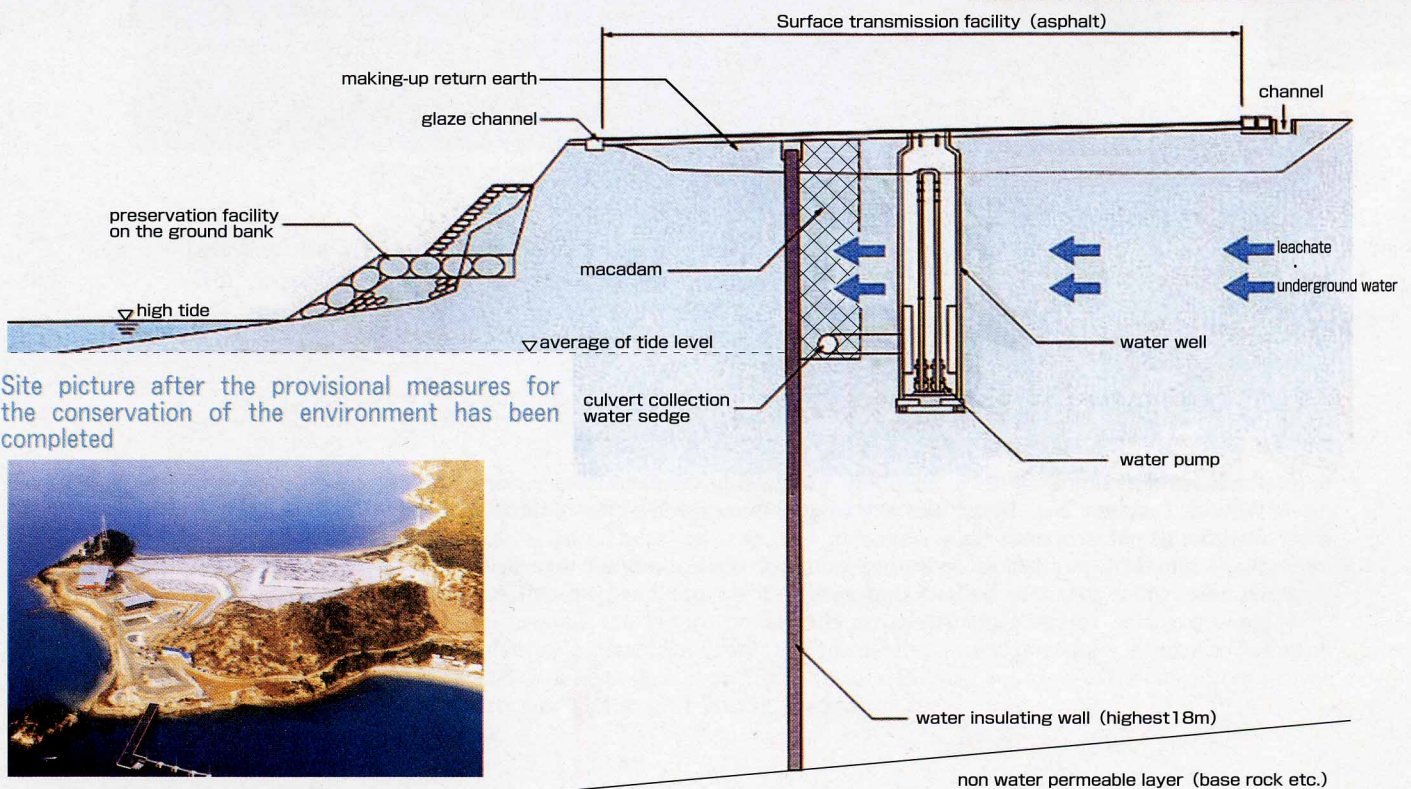
Relocating wastes and soil



Covering the air-transmission sheet



Section of the north coast with water insulating wall



Site picture after the provisional measures for the conservation of the environment has been completed



Outline of Wastewater Treatment Plant

The underground water and leachate, which were prevented from flowing into the ocean by water insulating wall located on north coast, are pumped up and purified at the wastewater treatment plant. The water quality of wastewater, which must be treated, is predicted as the chart shown on the right. The water is discharged after it is purified until it reaches the standards.

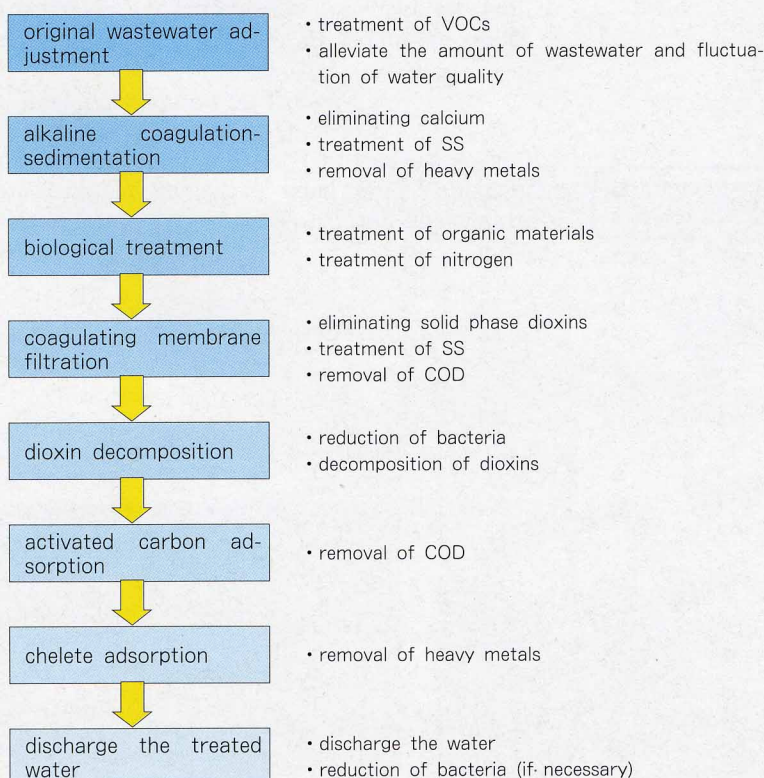
Characteristics of plant

- In order to manage the wastewater quality, these treatments are concerned listed below.
 - ① Considering that dioxins are contained both in solid phase (suspended solids) and in liquid phase, treatment units are combined to eliminate dioxins from both phases.
 - ② Since one part of original wastewater is polluted by dense VOCs, original wastewater adjustment tank is sealed off, and equipments for exhaust gas suction and VOCs adsorption are established.
 - ③ Since the salinity in original wastewater is high, protection against corrosion is considered by choosing the materials when constructing the plant.
- Utilization of rainwater
 Saved rainwater is utilized as washing water etc. at intermediate holding and packaging plant.

Outline of plant

Treatment capacity: 65m³/D
 Building structure: 2 storied facility on a steel frame work
 Total floor space: 97.78m²
 Capacity of raw water adjustment tank: 2,600m³

Flow chart of wastewater treatment plant



Planned water quality

component	water quality of wastewater	administrative standards for treated water
lead and its compounds	3	below 0.1
arsenic and its compounds	0.7	below 0.1
C1H=CCl2	1	below 0.3
C1H2CH2Cl	0.2	below 0.04
CH3CHCl2	2	below 0.2
C1H=CHCl	50	below 0.4
CH3CCl3	20	below 3
benzene	2	below 0.1
dioxins	800	below 10
BOD	300	below 30 (daily average 20)
COD	1000	below 30 (daily average 20)
SS	400	below 50 (daily average 20)
N	400	below 120 (daily average 60)

※unit: mg/L (dioxin: pg-TEQ/L)

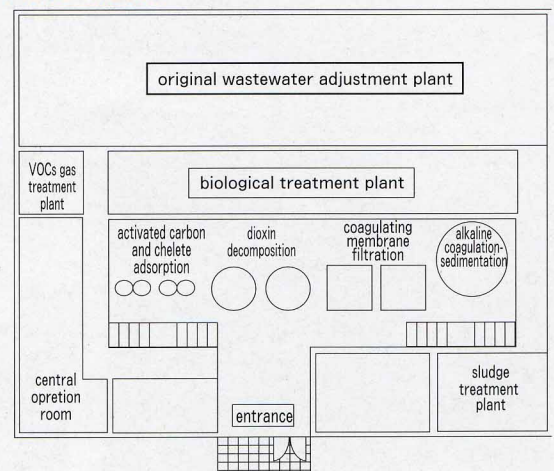
Plant panorama



Inside the plant

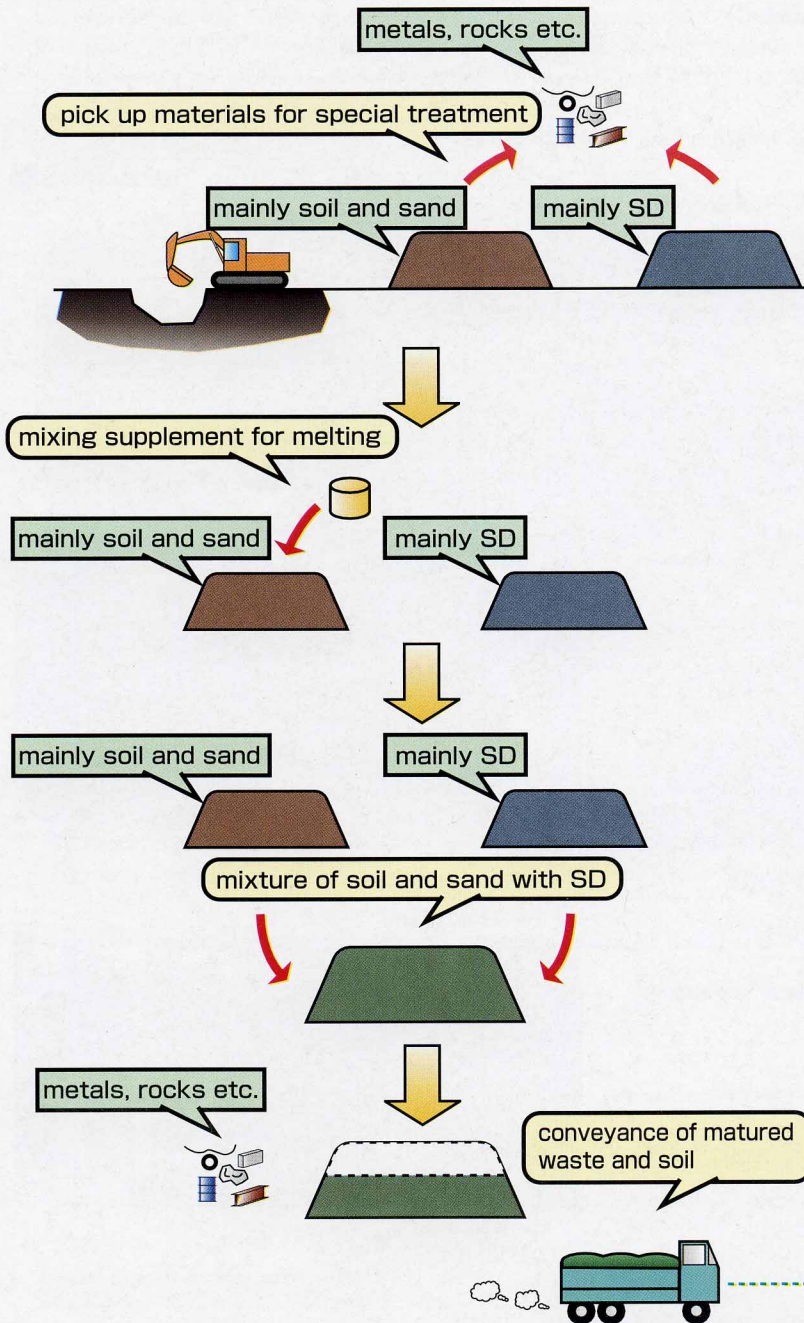


Plant sketch



Excavation and Conveyance of Waste and soil

Keeping a good labor environment, preventing accidents and conserving environment are most important. These procedures of excavation and conveyance shown below are taken in order to prepare the materials to incinerate and melt the wastes effectively, which contains various kinds of materials heterogeneously, including polluted soils.



<operating procedure>

- ① Check the excavation site by metal detection devices in order to find drums filled with dangerous materials.
- ② Excavate the sand and soil area, and shredder dust (SD) area with heavy duty machine to make a pile of them.
- ③ Select the materials for special treatment such as metals or rocks, and pick them up.
- ④ Add supplement for melting - slaked lime or CaCO_3 - to the pile of soil and sand, and mix them with heavy duty machine for an effective intermediate treatment at Naoshima.
- ⑤ Mix the pile of SD over the supplemented pile of soil and sand by heavy duty machine.
- ⑥ After mixing soil and sand with SD, mature them for two days considering the chemical reaction producing H_2 .
- ⑦ Convey the matured waste and soil to the intermediate holding and packaging plant. Convey metals and rocks to the special pre-treatment plant.

excavation site



mixing



Scenery of intermediate holding and packaging plant / special pre-treatment plant



Intermediate holding and packaging plant / Special pre-treatment plant

Wastes, which are conveyed from the excavating site, are stored temporarily and heaved into container trucks at the intermediate holding and packaging plant.

Special pre-treatment plant is also set up as an annex to the intermediate holding and packaging plant, for treating large sized wastes, such as big rocks, metals, sheets, hoses and so on.

Function of the plant

○Intermediate holding and packaging plant

- Five days transportation amount of wastes and soil is temporarily stored at its pit.
- Pressure inside the pit room is lower than atmosphere so that the dust and odorous components won't be leaked.

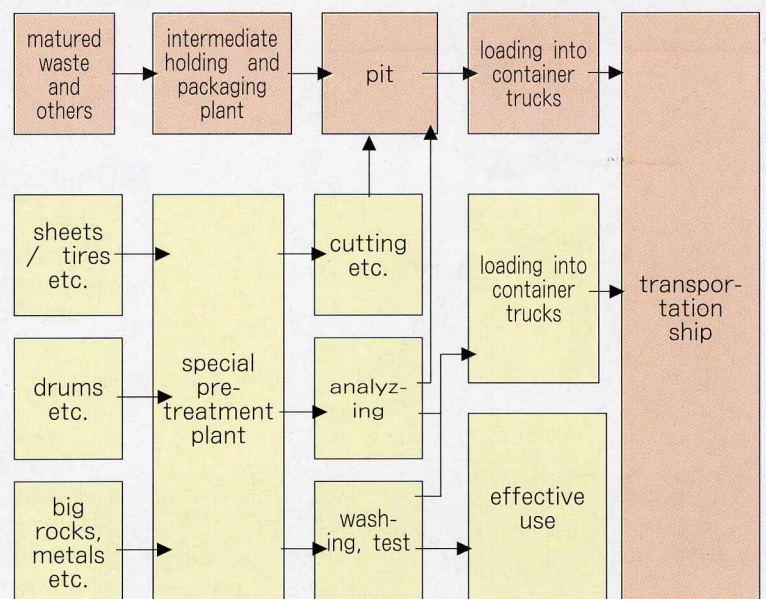
〈Operation procedure〉

- ① Homogenize the wastes and soil in the pit.
- ② Heave them from the pit to the container trucks by using crane and loading device.
- ③ Measure the amount of wastes and soil, and wash the outside of trucks.

○Plant for special treatment

- Large sized wastes such as sheets or hoses are selected and picked up at the excavating site. They are cut into small pieces and fed into the pit at intermediate holding and packaging plant.
- Big rocks, metals etc. are washed and utilized effectively after passing the quality test. Those which did not pass the test are incinerated at the rotary kiln furnace of intermediate treatment plant.
- As for the drum can and so on, after confirming the property of the content one, content one is separated from iron container shell and fed into the pit at intermediate holding and packaging plant. The iron container shell is put into another drum can and incinerated at the rotary kiln furnace.

Treatment flow

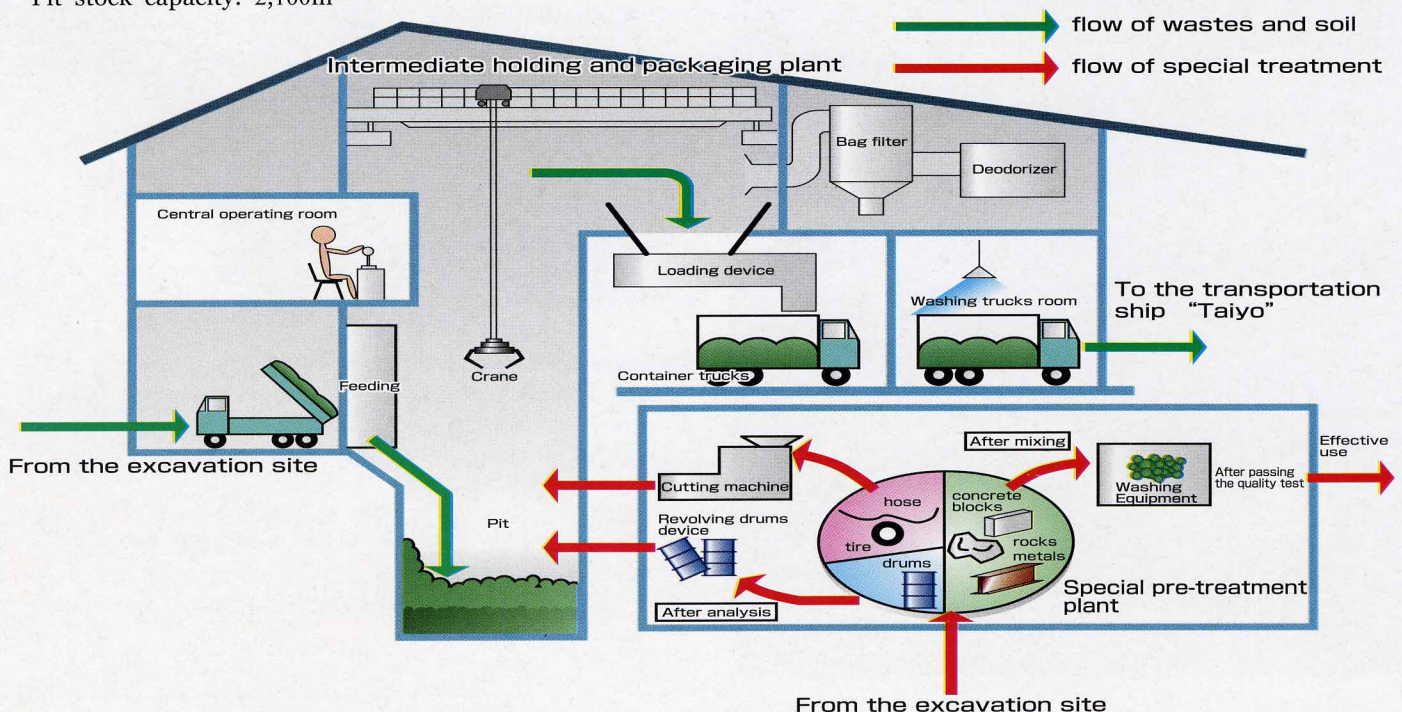


Outline of plant

building structure: two storied facility on a steel framework

total floor space: 3,111.72m²

Pit stock capacity: 2,100m³



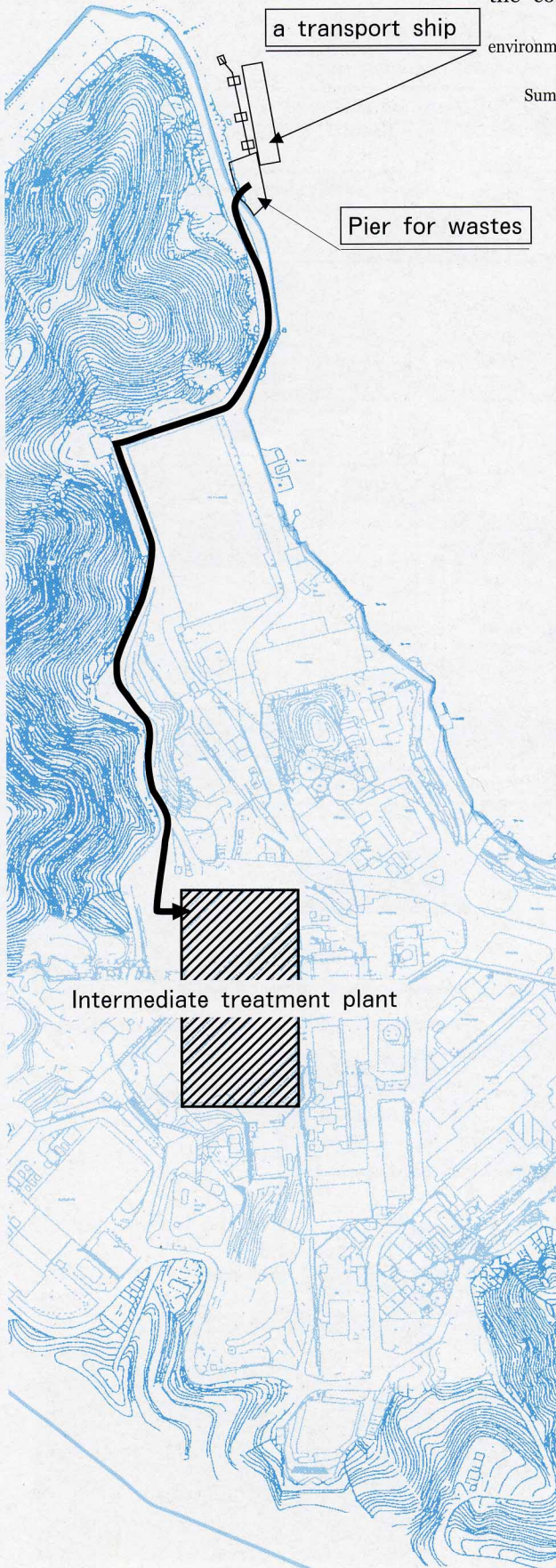
Transportation of wastes

Naoshima Island

Wastes and soil are transported to the intermediate treatment plant in Naoshima. They are transported by sea by a special transportation ferry-type ship so that it can carry the container trucks directly.

environment graphic design
planning and supervision
Sumiko Imai design office corporation

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Outline of transportation

- 150t of wastes and soil in 18 container trucks per transport.
- Two rounds of transportation per day between Teshima and Naoshima, carrying 300 t of wastes and soil in total
- approximately 200 operation days per year

Characteristics of transportation ship

- about 40 minutes transportation in about 8km between Teshima and Naoshima
- ship body is structured to make the running wave quite small to be environment-friendly.

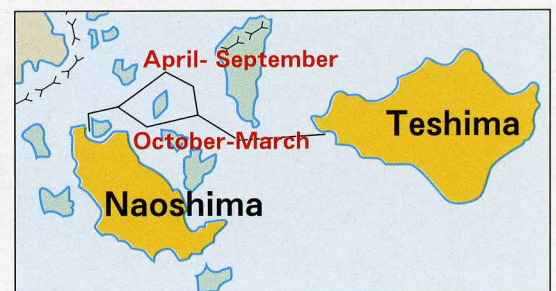
Safety measures

- "roll-on, roll-off style"
"Roll-on, roll-off style" means that trucks directly go into the ship carrying its freight like ferry. Wastes and soil are loaded into the container trucks and they are transported in a special ship by sea directly.
- Container trucks carry sealed off containers, which are approved by ISO (International Standardization Organization) based on CSC (Container Safety Convention) so that wastes and soil or wastewater won't leak outside.
- This ship is approved by ISM Code, which is an international administrative standard.

Transportation route

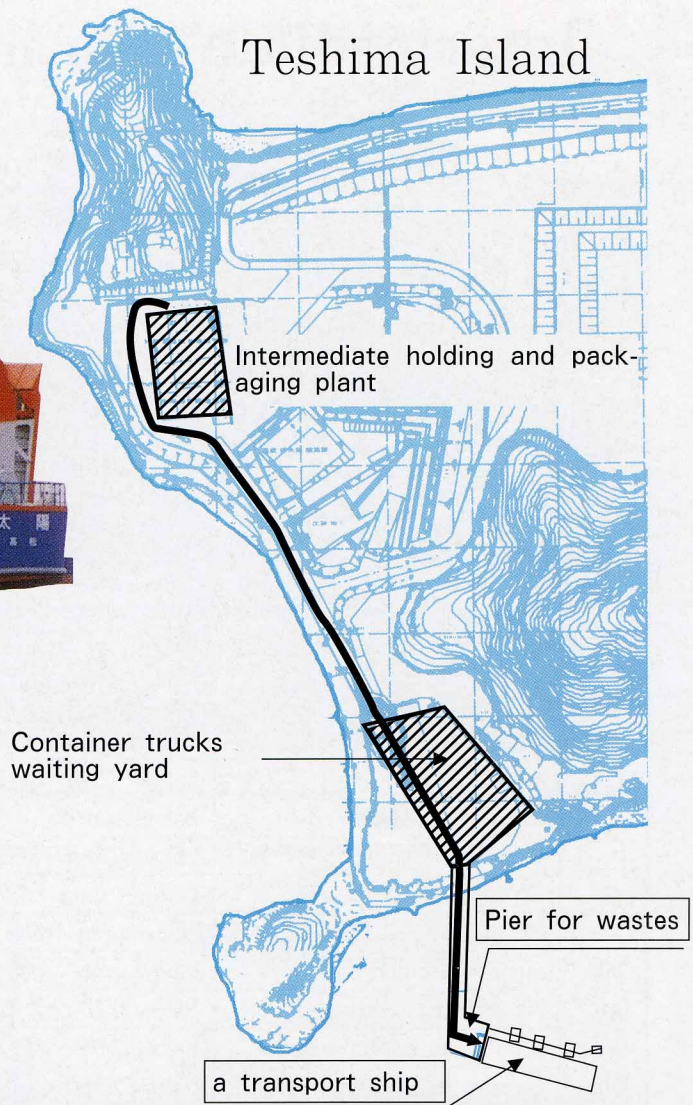
- Concerning the fishing season around the area, transportation ship has safe, short cuts of two routes; one route in April- September and another one in October-March.

Intermediate holding and packaging plant at Teshima
↓ ↑ (land transportation)
Pier for wastes at Teshima
↓ ↑ (ocean transportation)
Pier for wastes at Naoshima
↓ ↑ (land transportation)
Intermediate treatment plant at Naoshima





Teshima Island



■ Pier for wastes

- (Teshima side) car platform: 600m²
load/unload: 66m
(dolphin structure)
- access bridge: 75m
- (Naoshima side) car platform: 380m²
load/unload: 66m
(dolphin structure)

■ Transportation ship

- Name: "Taiyo"
- Length: 65m
- Total weight: 994t
- Carrying capacity: 18 container trucks

■ Container trucks

- Length: 9.08m
- Height in front: 3.75m
- Total weight: 22t



■ Basic design of exterior

This project is considered as a place for environmental learning and education. The exteriors of the plants (building, trucks and transportation ship) are designed by an environmental designer who imagined recovery of beautiful Seto Sea and the circulation of resources. Teshima side plants use the color of "Red of Sunshine", Naoshima side plants use the color of "Blue of Sea", and there is a Bee logo on the transportation ship.



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Intermediate treatment plant

Plant panorama



Wastes and soil transported from Teshima are incinerated and melted at an intermediate treatment plant constructed at Naoshima. Naoshima municipal refuse is also treated together here.

Characteristics of plant

○Recycling-oriented plant

By-products such as fly ash, slag and others produced in the melting process are recycled and utilized effectively. Wastewater from plants are also recycled and utilized to be recycling-oriented.

○Rotating surface melting furnace for decomposing dioxins at high temperature

As a main melting plant, one of the biggest rotating surface melting furnaces in Japan is constructed. This enables to supply and melt the materials steadily by revolving the furnace itself.

○Rotary Kiln furnace for incinerating ferrous materials, rocks etc.

By heating up the surface of ferrous materials or rocks directly with a burner, combustible wastes and others are incinerated which are adherent to its surface.

sulfur oxides	below 20ppm
nitrogen oxides	below 100ppm
HCl	below 40ppm
dust	below 0.02g/m ³ N
CO	below 30ppm
dioxins	below 0.1ng-TEQ/m ³ N
Cd and its compounds	below 0.2mg/m ³ N
Pb and its compounds	below 5mg/m ³ N
Hg and its compounds	below 4mg/m ³ N
As and its compounds	below 0.25mg/m ³ N
Ni and its compounds	below 2.5mg/m ³ N
Cr and its compounds	below 20mg/m ³ N

○Flue gas treatment

With the set up of the strict standards regarding the harmful substances in flue gas, treat the flue gas thoroughly.

○Environment-friendly

There are several to be environment-friendly projects. Wastewater from plants and rainwater are purified to be recycled for gas quenching, as well as collecting waste heat to utilize as steam. Solar power generation is also operated.

○Effective use of by-products

Fly ash, which is produced in melting process, is treated and its valuable metals are recovered at Naoshima Refinery facility at Mitsubishi Material Inc. located next to the plant. Slag is recycled and utilized as construction materials. In addition, metals such as copper, iron, or aluminum are also collected and effectively utilized.

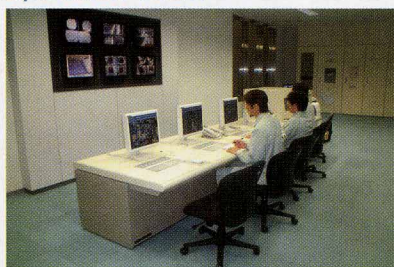
Outline of plant

furnace type/capacity: rotating surface melting furnace 100t /d×2
rotary kiln furnace 24t /d×1

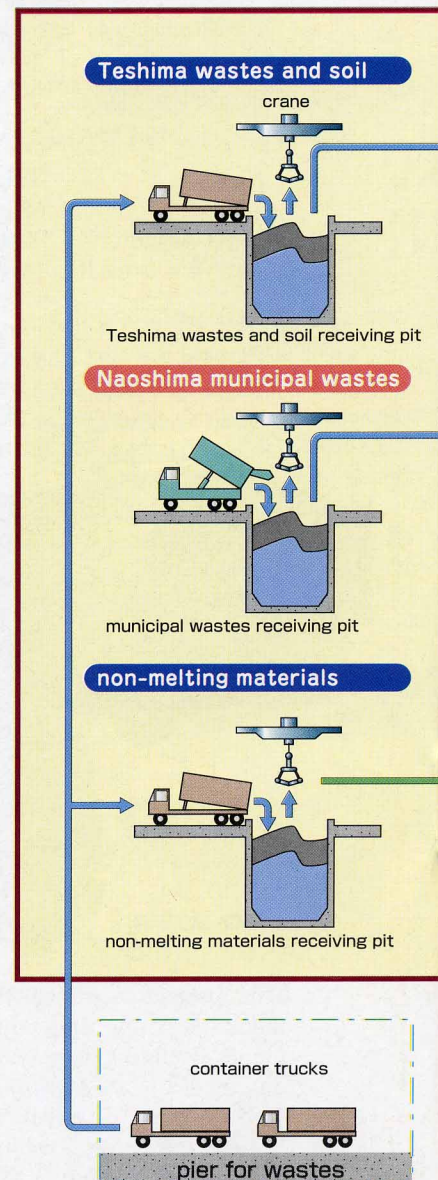
building structure: six storied facility on a steel framework
(some parts; steel reinforced concrete)

total floor space: 16,664.18m²
buildings: 8,283.22m²

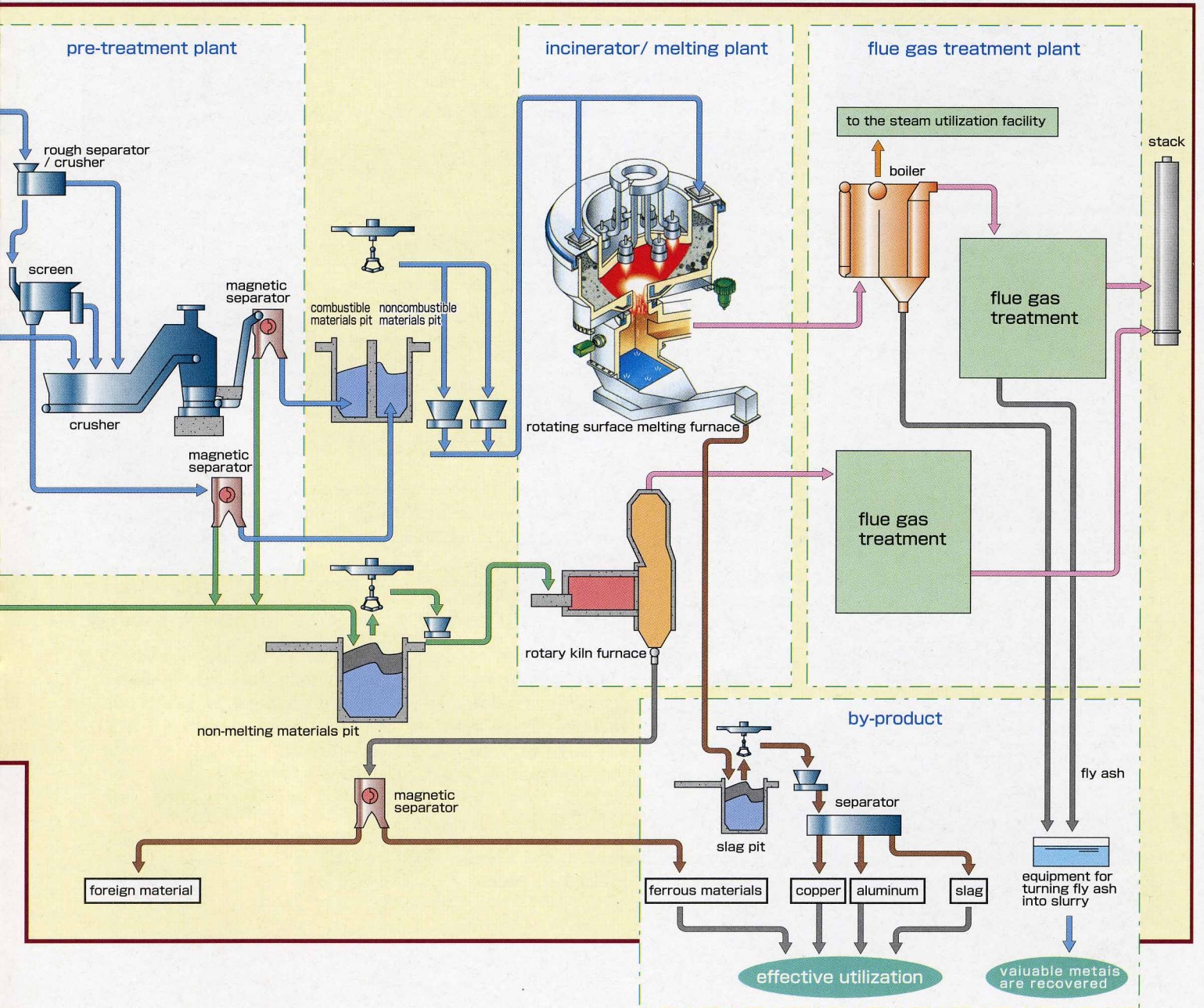
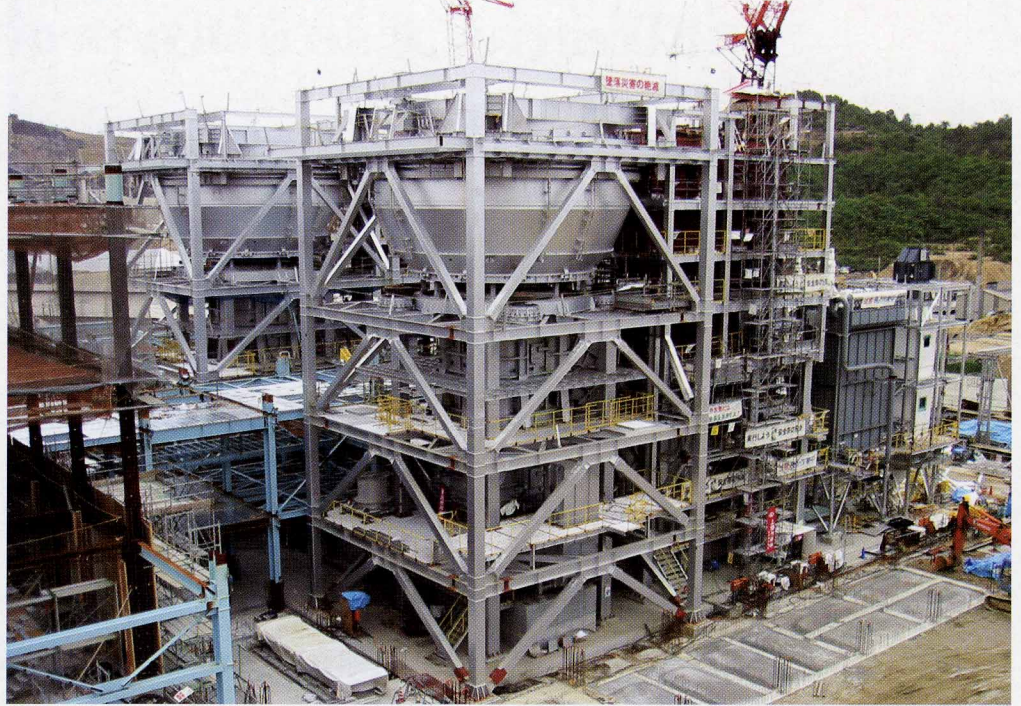
Operation room



Rotary kiln furnace



Rotating surface melting furnace [when under construction]



Effective Use of Byproducts

By-products, which are produced in the process of intermediate treatment (incineration/melting) are utilized effectively as below;

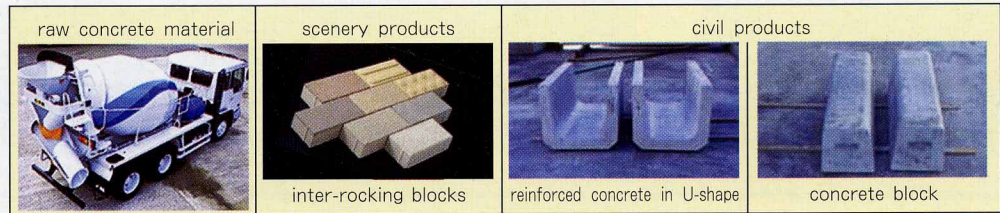
fly ash

Fly ash is utilized as sub-materials in the process of copper refinery. Its valuable metals are recovered at Naoshima refining facility of Mitsubishi Materials Inc. after fly ash is dechlorinated at the plant for fly ash recycling.



slag

Slag is regularly sampled, and it is utilized as construction material after its safety and quality check.



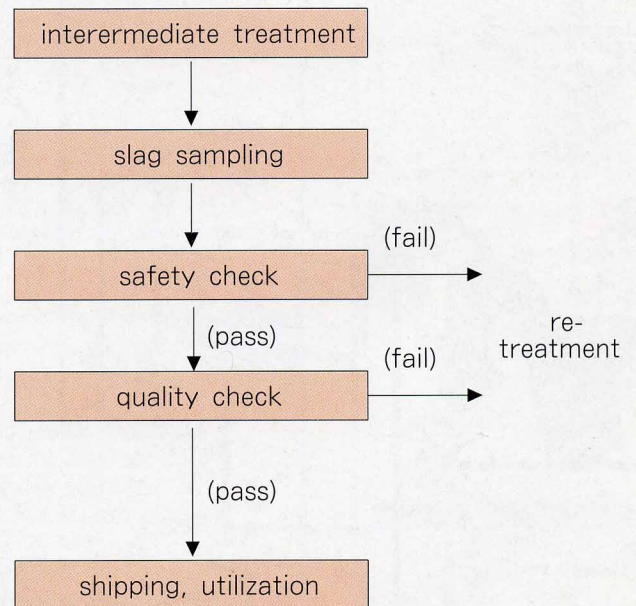
slag safety check

component	elution standard(mg/l)	contamination standard(mg/kg)
Cd	below 0.01	below 150
Pb	below 0.01	below 150
Cr ⁶⁺	below 0.05	below 250
As	below 0.01	below 150
Hg	below 0.0005	below 15
Se	below 0.01	below 150
note	Environmental Quality Standard for Soil	Soil Pollution Law

slag quality check

item	standard (mg/l)
particle size	proportion of over 5mm has to be 0%
proportion of magnetic reacting materials	metal iron components must be less than 1%
shape	needle shape must not be contained
aggregate materials	
specific gravity (dried)	over 2.5
water absorption rate	below 3%
alkali-silika reaction test	need to be harmless

treatment flow of slag



metals (ferrous materials, copper etc.)

Few amount of metals such as copper, ferrous materials, aluminum etc. are also produced in the melting treatment process which are utilized in each way.



aluminum



copper

Positive release of information

Information and the latest news about the project are always released to people, and may be used for environmental learning and education.

Open system of environmental information

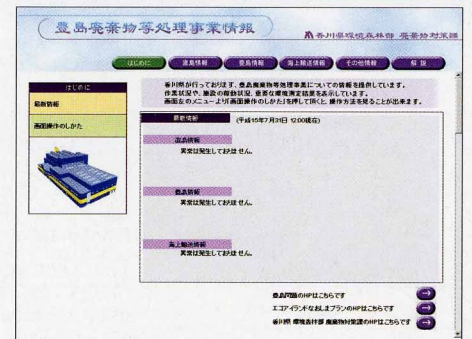
It is possible to know the information of an operation state of each of the plants, a navigation state of the marine transportation, the water quality and the measurement data of exhaust gas and so on, even if one doesn't go to each of the plants.

The personal computer terminals are installed in the Teshima Exchange Center, in the Naoshima Town office and in the Tamano City office, which provides all the informations for the habitants. Information and the latest news are also released via the net.

(Main environmental information shown on information system)

division	topic	contents
Teshima info.	operation info.	operation schedule of excavation and conveyance, treatment quantity of wastewater treatment plant
	Environmental info. of automatic measurement (every 1 hr)	COD, pH, SS, etc. at wastewater treatment plant water level, moisture content of soil, flow rate and quantity of rainfall
	Environmental info. of regular measurement	COD, BOD, pH SS, Total-N, Total-P, toxic substances, etc. at wastewater treatment plant
Naoshima info.	operation info.	quantity of treatment at each furnace, fly ash, slag, and others
	Environmental info. of automatic measurement (every 1 hr)	concentrations of dust, HCl, NOx, SOx, and CO
	Environmental info. of regular measurement	besides above, concentrations of dioxins, heavy metals
Ocean transportation info.	transportation info.	scheduled transportation time, transportation quantity
	Environmental info. of regular measurement	water quality, sediment quality
others		result of environmental measurement, result of monitoring around the area, result of slag check

(examples of display)



Monitoring around the environment

Monitoring results are processed in order to evaluate the environmental influence of the project on the land and nearby sea environments in and around Teshima and Naoshima. Environmental monitoring is researched in advance or during the construction time. These results have already proceeded and are available on the internet.

Environmental education opportunity

Conference rooms (capacity:40 people) are located at both intermediate treatment plant at Naoshima and intermediate holding and packaging plant at Teshima. This conference room is available for visitors to watch video or listen to the explanation of plant in general. In addition, visitors can view the excavation site of wastes from the conference room at intermediate holding and packaging plant at Teshima.



Brief History of Teshima Case

- February 1978 Teshima Sogo Kanko Kaihatsu Co., Ltd., a disposal company in Teshima got permission as an industrial waste disposal contractor. (limited to deal only sludge, wood waste, and excreta, and manufacture them into soil meliorate by earth-worms)
- January 1983 The waste disposal contractor took the permission as metal waste contractor.
- from late 1975 to 1990 The waste disposal contractor transported industrial wastes such as shredded waste, waste oil and sludge into Teshima island, where the contractor burned them off in the field or illegally dumped them.
- November 1990 Hyogo police compulsively investigated the waste disposal contractor's office and its field.
- December 1990 Kagawa Pref. withdrew its permission as a waste disposal contractor, as well as issuing a command of removing the illegal wastes from the island.
- November 1993 Teshima residents officially submitted an environmental pollution dispute to arbitration based on the Law Concerning the Settlement of Environmental Pollution Disputes. Kagawa Pref. issued a command for contractor to measure for the conservation of the environment in disposal site.
- May 1994 Kagawa Pref. made a charge against the disposal waste contractor.
- October 1995 The committee of the adjustments such as the pollution shows a local investigation result and seven measure plans.
- January 1997 Kagawa pref. announced the policy which processes the wastes by melting.
- July 1997 Intermediate agreement was reached between Kagawa Pref. and Teshima residents. The Technical Study Committee of Kagawa Pref. for the Restoration of Teshima was established.
- August 1998 The Technical Study Committee submitted a report on "subjects concerning provisional measures for the conservation of the environment" and a report on "subjects concerning the intermediate treatment plant".
- May 1999 The Technical Study Committee submitted a "final report for the restoration of Teshima in secondary version".
- August 1999 Kagawa Pref. offered proposals for Naoshima treatment plan at Naoshima town assembly.
- November 1999 The Technical Study Committee submitted a "final report for the restoration of Teshima in third version".
- March 2000 Naoshima mayor announced to accept the Naoshima plan by Kagawa Pref.
- June 2000 Teshima residents reconciled with Kagawa Pref. regarding the environmental pollution dispute. The Technical Committee of the Teshima Project was established. (Technical study continues by the committee).
- August 2000 The Consultation Committee of Teshima waste treatments was established.
- March 2002 Construction of provisional measures for the conservation of the environment at Teshima was completed.
- April 2002 The study Committee of Safety Measure in Ocean Transportation summarized the safety measures.
- March 2003 Intermediate holding and packaging plant and special pre-treatment plant were completed.
- April 2003 Wastewater treatment plant was completed. Marine transportation between Teshima and Naoshima started.
- September 2003 Intermediate treatment plant was completed. Opening ceremony of Teshima waste treatment project was held.

Illegally dumped industrial wastes



Site research at Teshima disposal site



The Technical Study Committee



Reconciliation of the environmental pollution dispute

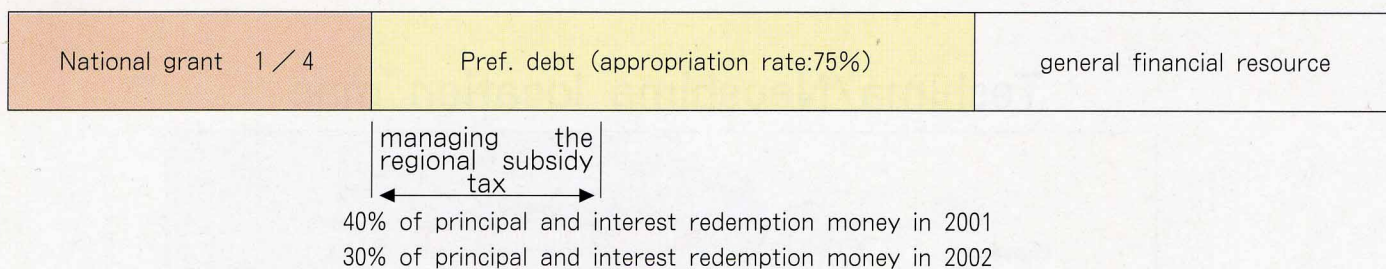


Start of the marine transportation

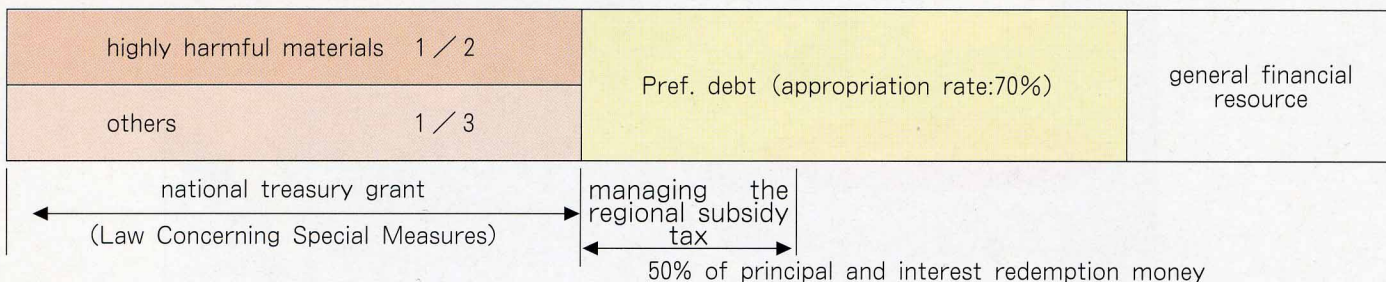


Financial scheme of the project

Plant consolidation



treatments expenditure



Technical Committee for the Restoration of Teshima

Based on the Reconciliation of the environmental pollution dispute, we manage the Teshima waste treatments under the guidance and advice of special experts in related fields.

member list of the Technical Committee of the Teshima Project (as of August, 2003)

	name	official title
chairman	Katsuya Nagata	Prof., Faculty of Science & Engineering, Waseda Univ.
vice chairman	Nobuo Takeda	Prof., Grad. School of Engineering, Kyoto Univ.
committee	Akira Inokuma	Director, Road Technology Research Group, Incorporated Administrative Agency Public Works Research Institute
"	Tomotoshi Okaichi	Emeritus Prof. of Kagawa Univ.
"	Osami Kawara	Prof., Dept. of Environmental and Civil Engineering, Okayama Univ.
"	Koji Sakai	Prof., Dept. of Safety Systems Construction Engineering, Kagawa Univ.
"	Hiroshi Sakamoto	Prof., Faculty of Systems Science and Technology, Akita Prefectural Univ.
"	Saburo Suzuki	Prof., Dept. of Natural Studies, Kobe Univ. of Mercantile Marine
"	Hiroshi Takatsuki	Prof., Environment Preservation Center, Kyoto Univ.
"	Masaru Tanaka	Prof., Dept. of Environmental and Civil Engineering, Okayama Univ.
"	Osami Nakasugi	Director, Research Center for Environmental Risk, NIES
"	Sigeru Montani	Prof., Grad. School of Fisheries Sciences & Faculty of Fisheries, Hokkaido Univ.
"	Hiroji Yokose	Emeritus Prof. of Kagawa Univ.

(omit titles from names)

Consultation Committee of Teshima Waste Treatments

Regarding the management of Teshima wastes, we established the consultation committee based on the Reconciliation of the environmental pollution dispute consisting of representatives of Teshima residents and Kagawa pref. staff, (Chairman:Hiromasa Minami, Emeritus Prof. of Hitotsubashi Univ.) We will do our best to promote this treatment with our "joint-creative" mind.

Also, in the direct island city where intermediate treatment plants were constructed, too, the organization to report on an operation state and an improvement state of the processing business such as Teshima waste treatment project and so on is established.

Teshima/Naoshima location map



Project Office for Promoting Recycling and Disposal, Waste Management Division, Environment & Forest Department, Kagawa Prefectural Government

4-1-10 Bancho, Takamatsu-city, Kagawa Pref.
Tel: +81-87-832-3225 Fax: +81-87-831-1273

Kagawa Pref. Naoshima Environment Center
(Intermediate treatment plant)

2628-1 Naoshima-cho, Kagawa-gun, Kagawa Pref.
Tel: +81-87-892-2981 Fax: +81-87-892-2985

Kagawa Pref. Naoshima Environmental Center, Teshima annex office
(Intermediate holding and packaging plant)

3158-1 Teshimaieura, Tonosho-cho, Shodo-gun, Kagawa Pref.
Tel: +81-879-68-2310 Fax: +81-879-68-2311

Teshima HP: <http://www.pref.kagawa.jp/haitai/teshima>