State-of-the-Art Resources Recycling Technology, Low in Cost and Pollution to the Environment

ERCM SYSTEM: VOLUME REDUCTION OF ORGANICS & CERAMIC MANUFACTURING

INTERNAL THERMAL TYPE PYROLYSIS FACILITY

ERCM : **E**arth – **R**esource - **C**eramic - **M**achine

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Introduction "Misconception" about the ERCM System (Pyrolysis Facility)

- The ERCM System is often taken illogically as being an incineration facility because the ionized electron is sent into the furnace with a breeze while a "heat source" and "air (oxygen)" are assumed to exist there. This is, however, a complete "misconception."

- **“Incineration Facility" vs. "Pyrolysis Facility”**

- In "incineration facilities," sufficient air (oxygen) is secured to maintain combustion in the incinerator. While the theoretical combustion "air ratio" ranges usually 1.2 to 1.3, a larger quantity of air of the air ratio about 1.3 to 1.6 is actually supplied to achieve uniform complete combustion.
- In “pyrolysis facilities,” the organic waste is pyrolyzed at the air ratio less than 1.0 (under "reduction condition"), which is categorized into two types: external and internal thermal.

- ✓ In the “external thermal type," the pyrolysis furnace is kept not to let in air, and the waste is pyrolyzed under a so-called "steaming" condition, isolated from the outside air.
- ✓ In the “internal thermal type," the organic waste to be fed is locally oxidized with such a minute quantity of oxygen in the supplied air as not satisfying the "three elements of combustion," and the resulting reaction heat is supplied directly to the waste to maintain its temperature for the continued pyrolysis under the condition that the waste is heated to a level that will not usually exceed the max. safe percentage of oxygen, the oxygen concentration necessary for combustibles to continue to combust," as stated in the 2005 Ministry of the Environment Notice.

- **The ERCM System is NOT an "incineration facility.** It is an **“internal thermal type" pyrolysis facility**. While the ionized electron is sent into the pyrolysis furnace to promote pyrolysis By its organic wastes' own oxygen and moisture through electrons (therefore, they do not react with inorganic matter) , the applicable air ratio is as low as about 0.2 to 0.3 with the oxygen concentration not exceeding the max. safe percentage of oxygen: the pyrolysis is being continuously advanced by utilizing the "reaction heat."

Introduction: what is the ERCM System (pyrolysis facility)? [Comparison with Incineration Facilities]

Comparison of operating mechanisms: Incinerators vs. ERCM System(Pyrolysis Facility)

		Incinerators	ERCM(Pyrolysis Facility)
Combustioin Type		Complete Combustion	Partial Combustion(Incomplete Combustion)
Heat source	Starting up	Auxiliary Fuels(heavy oil, etc.)	Charcole
	Operation	Larger quantity of air	Radient heat from Thermal Storage Interlayer
	Heat source maintenance	Complete combust. By larger Q'ty of air Maintain force of flames by auxiliary fuels	Thermal storage of pyrolysis reaction heat
O2 conc.	O2 Q'ty	Sufficient Q'ty of O2 (eq. Q'ty of air)	Lower Q'ty of O2(sending into the minute Q'ty of Ionized electron)
	O2 conc.	about 21%	Lower conc. Of O2(less than 1%~6%) not exceeding the max. safe percentage of O2.
Air Ratio		Stoker: about 1.6/Fluidized bed: about 1.3	0.2~0.4
Temp. range		８００℃ or higher	３００～４００℃ (about 1000℃ at the surfave of the thermal storage interlayers)
Process	Mechanism	Ignited by auxiliary fuels at startup, a large Q'ty of air feed is constantly required to maintain complete combustion to complete the inceneration process.	Radient heat from Thermal Storage Interlayer(ERCM heat source) will excite organic molecules when pyrolysis is promoted by oxygen ionized and excited by electrons sent into as the ionized electron.
	Operating Key Points	Such a Q'ty of air as larger than that of the theoretical combustion air of 1.2 to 1.3 air ratio is supplied to the furnace to maintain complete combustion. In typical incinerators, auxiliary fuels are constantly supplied during operation to secure force of flames.	While the furnace becomes poorly oxygenated in building the heat storage interlayers by charcole fire at startup, the ionized electron is to be sent into the furnace to maintain such low conc. Of oxygen. Oxigen is ionized and excited by electrons sent into at the ionized electron to promote pyrolysis by its organic wastes' own oxygen and moisture through electrons at low temps.
Remarks			Research at Kumamoto University has demonstrated that when the electronic unit is shut down, decomposition progresses, as the heat source in the heat storage layer disappears, and therefore electrons are required.

What is the ERCM System（Vol-reducing Organics and Manufacturing Ceramic）?

The ERCM System employs an internal thermal type pyrolysis process with the air ratio less than 1.0 capable of decomposing organics for recycling the end product of inorganic and porous ceramic powder.

・Waste →ERCM → Ceramics →Recycled as Valuable Resources for Dealing

・ERCM operable at Air Ratio < 1.0 , an internal thermal type pyrolysis process totally different from those incineration facilities requiring a greater air ratio range

・Patents obtained:
Domestic Patent Nos. 4580388 and 6042297,
US Patent No. 7.648.615 B2,
and such other international patents as Chinese

ERCM

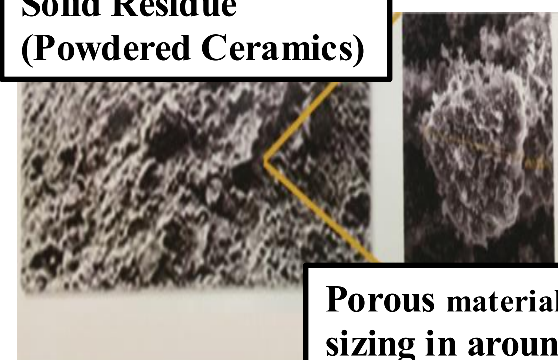
The ERCM SYSTEM employs the commercialized internal thermal type pyrolysis process for decomposition and pyrolysis process for decomposition and subsequent volume reduction of organics : the end products, ceramics , are to be recycled as valuable resources for dealing.

【Features of the ERCM SYSTEM】

・No external fuels are required to mineralize organics, significantly reducing their volumes.

・Not loading the environment with the generation of waste heat, hazardous gases, dust, noise and vibration in such volume reducing process.

Solid Residue (Powdered Ceramics)

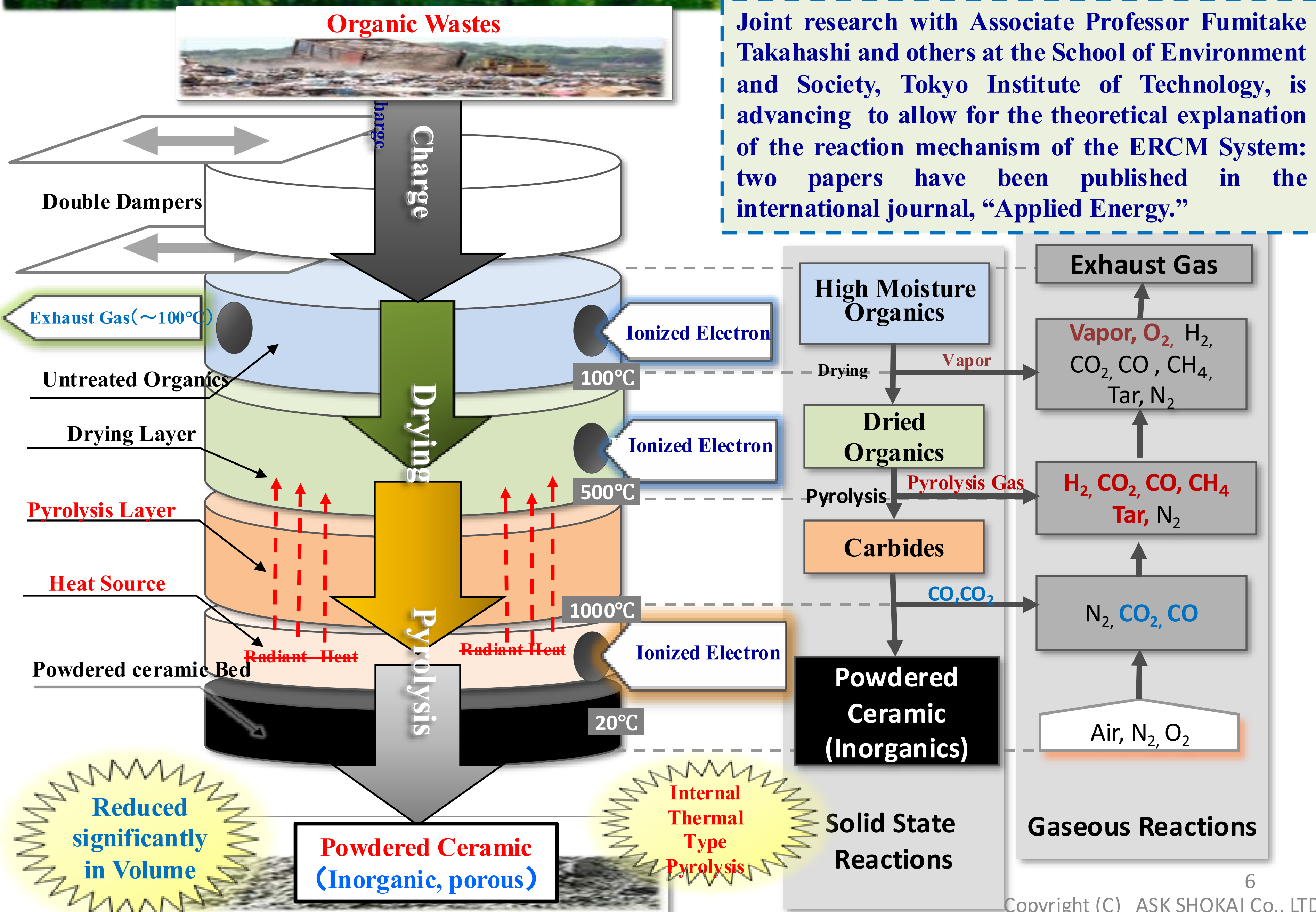


Porous materials sizing in around 50μm

*Pyrolysis : the decomposition and volume reduction of organics are accelerated by heating them (the external heat source is from the ceramic powder at the heated furnace bed).
The main difference from "incineration" is that pyrolysis is a decomposition reaction that will destroy the molecular structure of organics and break them apart by heat, rather than by flame combustion.

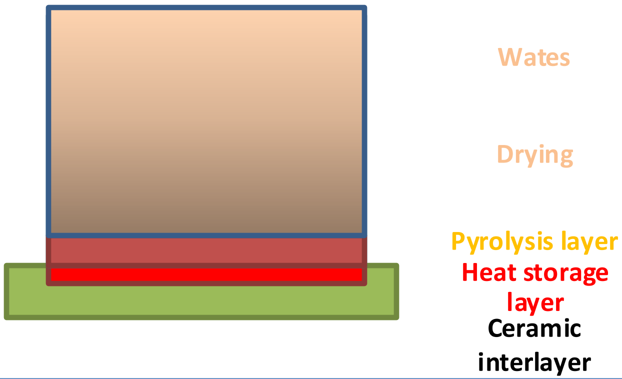
Reaction Mechanism of the ERCM System ①

Joint research with Associate Professor Fumitake Takahashi and others at the School of Environment and Society, Tokyo Institute of Technology, is advancing to allow for the theoretical explanation of the reaction mechanism of the ERCM System: two papers have been published in the international journal, “Applied Energy.”



Reaction Mechanism of the ERCM System ②

Pyrolysis Process of the ERCM System

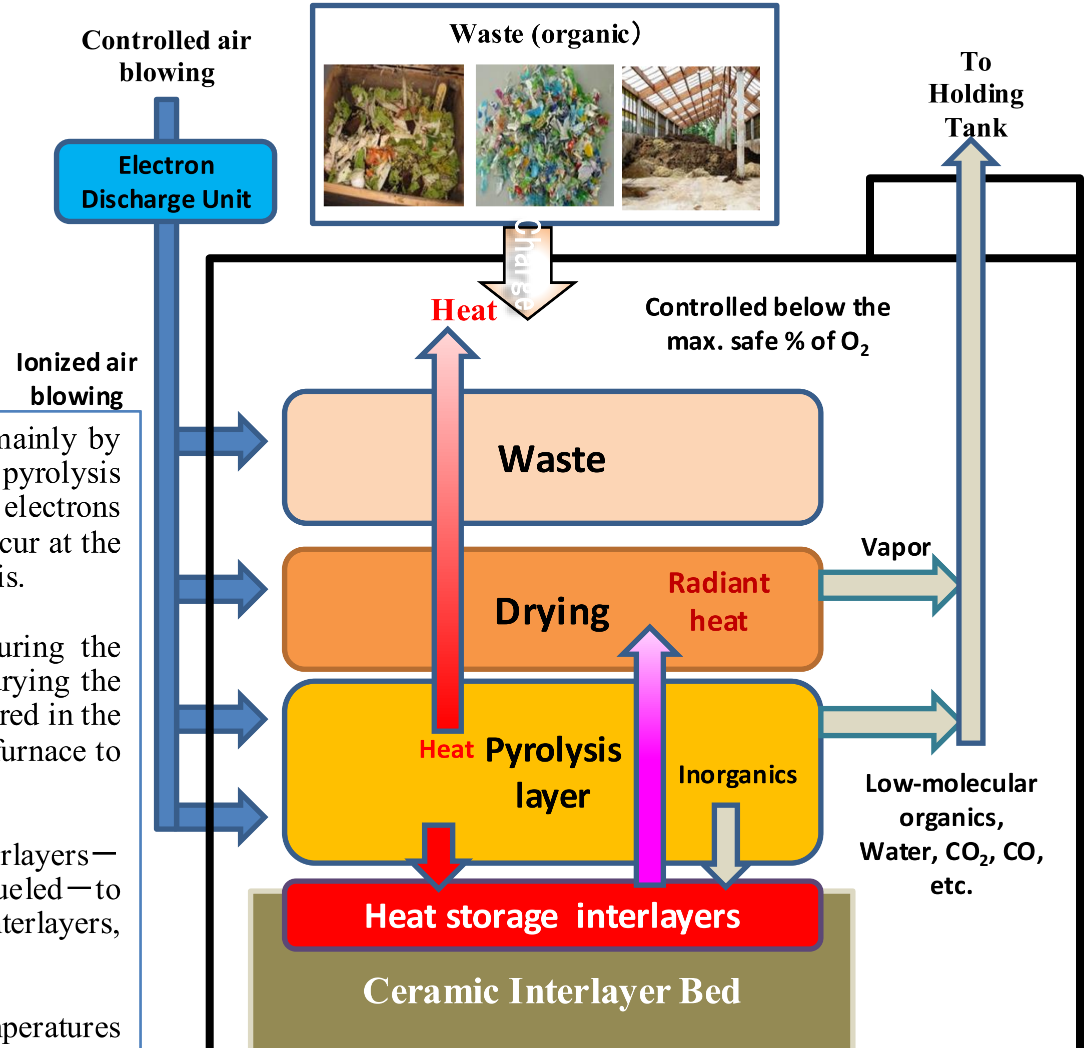


In the pyrolysis layer, organic molecules are excited mainly by radiation heat from the thermal storage interlayers, and pyrolysis is promoted by the oxygen ionized and excited by electrons blown into as the ionized air. The pyrolysis will then occur at the range of temperatures lower than that of normal pyrolysis.

The reaction heat (exothermic reaction) generated during the pyrolysis of organic wastes is used for heating and drying the waste in the upper part of the pyrolysis layer, while stored in the surfaces of the ceramic interlayers at the bottom of the furnace to continue to promote the pyrolysis.

Heat will be stored in the surfaces of the ceramic interlayers—whose heat source is sustainable without additionally fueled—to eventually raise the temperatures of these ceramic interlayers, since ceramic is extremely low in thermal conductivity.

The ERCM System achieves the pyrolysis at lower temperatures through "heat storage in ceramic media" and "electrons effective as the ionized air."

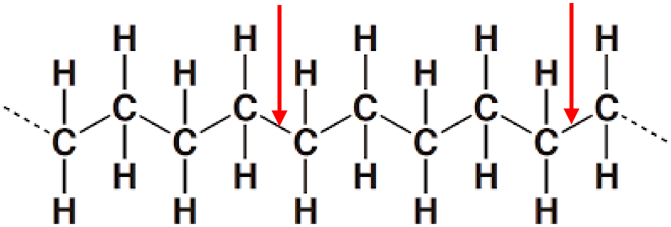


Pyrolysis Process of Organics in the ERCM System

Pyrolysis in the ERCM System

Organics will undergo the molecular cleavage, resulting in low molecular weight and volatilization temperature compounds, as shown here for example by properties of the low molecular weight compounds of pyrolyzed polyethylene. The target material will be discharged out of the furnace by raising its temperature above the boiling point of such material.

Cleavage by low conc. Oxygen ion



Molecular weight:
tens of thousands/
B.P.100～140℃

Pyrolysis at
300～400℃

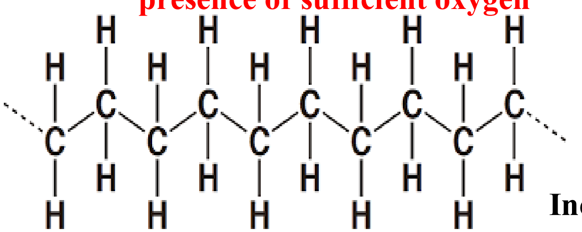
H-$(CH_2)_n$-H
Hydrocarbons (n=1～20)

CO_2
CO
H_2O

While low molecular weight compounds with the BP 30℃ or higher will be liquefied by cooling, including the water scrubber, those C4 or smaller with the BP lower than the former will be discharged as exhaust gas.

(ref) "Incineration"

Complete decomposition in the presence of sufficient oxygen



Molecular weight:
tens of thousands/
B.P.100～140℃

Incineration at 800℃ or higher

CO_2
CO
H_2O

Low molecular Compounds of pyrolyzed Polyethylene

Material name	M. Structure	B.P. (℃)
Polyethylene resin	CN : *	—
Wax	CN : *	400～500
Heavy oil	CN : C15～20	300～400
Light oil	CN : C15～18	250～350
Gasoline	CN : C4～12	60～150
Acetic acid	CH_3COOH	118
Water	H_2O	100
Carbon dioxide	CO_2	−78
Methane	CH_4	−162
Carbon monooxide	CO	−191

NOTE (*): tens of thousands

Conformity of the ERCM System to National Processing Standards for Pyrolysis Facilities (1)-1/2

- **The ERCM System conforms to the Japan Waste Management and Public Cleaning Law on Processing Standards for Pyrolysis Facilities: Construction and Method**

Construction (as per Article 1-7-2-b of the Enforcement Regulations of the Law)

	Requirement	Status: Countermeasures for Conformity	Checked
1	Such furnace construction as to prevent the combustion of the charged waste	･Ventilation is to send electrons into the furnace. ･Ventilation is controlled at such air flowrate that the oxygen concentration will not exceed the max. safe percentage of oxygen, i.e., the air flowrate is regulated to be significantly lower than that required for conventional incineration facilities.	✔
2	Retention of the temp. and pressure to be compatible with the pyrolysis process under way	･The pyrolysis will progress in the zone located right above the system heat source having the temperature around 1000°C. ･The carbides in contact with this high-temperature heat source will consume self-containing oxygen to help retain the pyrolysis temp. with their radiated heat. ･The ERCM System is neither equipped with the unit intended for the system pressuring nor the unit for depressurizing.	✔
3	Periodical monitoring of the furnace temp. and pressure	･T/C temperature meters are mounted at upper, middle and lower levels of the pyrolysis furnace for the continuous furnace temp. monitoring. ･For operational safety measures, the furnace pressure is monitored with differential pressure meters (manometers).	✔
4	Cooling of the residues including carbides	･No extra cooling unit is required. ･The residues are deposited at the zone beneath the system heat source as powdered ceramics (mainly composed of inorganics). ･ Only the lowest layer of the deposited powdered ceramics having been heat-dissipated away from the heat source is to be discharged.	✔
5	Treatment of the gases generated following the pyrolysis process	･Plural retention tanks are provided to liquefy the gases generated. ･The retention tanks are equipped with showering functions where larger diameters of liquefied particles are removed. ･The electrostatic precipitator in the downstream of the retention tank captures smaller diameters of particles in the exhaust gas. ･The exhaust gas undergoes atmospheric discharge after the removal of CO by the electrocatalyst unit.	✔

Conformity of the ERCM System to National Processing Standards for Pyrolysis Facilities (1)-2/2

- **The ERCM System conforms to the Japan Waste Management and Public Cleaning Law on Processing Standards for Pyrolysis Facilities: Construction and Method**

Method (as per the Year 2005 Notification No. 1 by the Ministry of the Environment)			
	Requirement	Status: Countermeasures for Conformity	Checked
1	To prevent the leakage of the gases generated following the pyrolysis process from other than the exhaust port	The system is designed and fabricated to be of such construction as having the piping arranged to eliminate such leakage.	✔
2	To prevent the scattering of the residues from the discharge port	The system is designed and fabricated to have such construction that the solid residues of powdered ceramics will not scatter towards the outside.	✔
3	Treatment of the gases generated following the pyrolysis process: to prevent the discharge of flames and black smoke	As described in “Item 5 in Table above on Facility Construction,” the ERCM System is not equipped with any combustion treatment unit for the gases generated. It is therefore self-explanatory that neither flames nor black smoke will be discharged.	✔
4	Treatment of the gases generated following the pyrolysis process: to conserve our living environment	As described in “Item 5 in Table above on Facility Construction,” the gases generated are treated accordingly with no intervention of combustion.	✔

Conformity of the ERCM System to National Processing Standards for Pyrolysis Facilities (2)

◆Assessment of the ERCM System in terms of Air Ratio

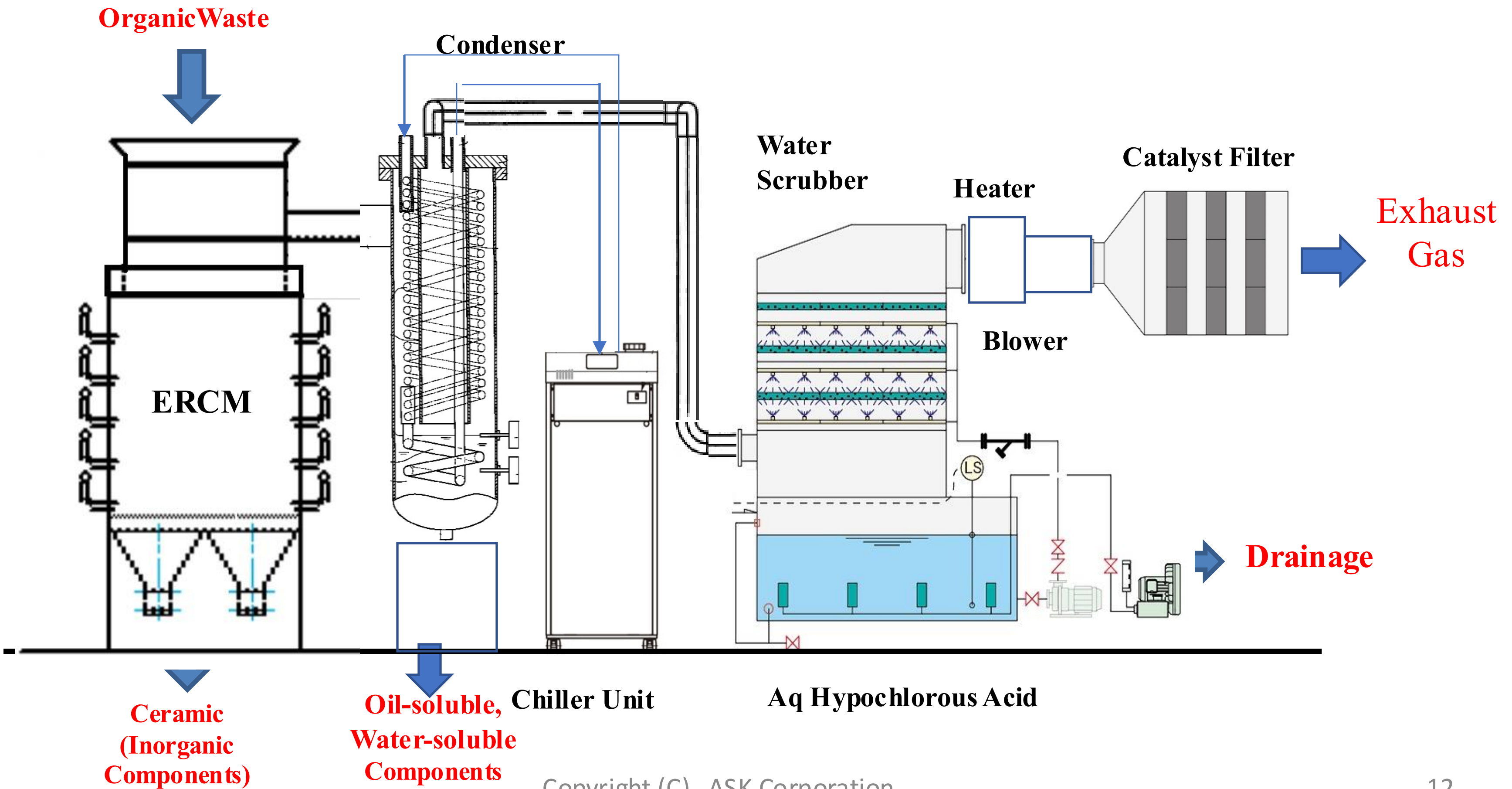
- The air ratio (m) is defined as the ratio of the amount of air theoretically required for complete combustion of fuel (A_0) to the amount of air actually delivered for combustion (A). Thus, $m = A/A_0$.

- **The ERCM System is operated at the air ratio less than 1.0, equivalent to those commercial internal thermal type pyrolysis facilities, however, it is totally different from those conventional incineration facilities that require a higher air ratio.**
- **The ERCM System with electrons charged into the pyrolysis furnace is capable of more efficient and sophisticated pyrolysis than that of those conventional pyrolysis facilities.**

Conventional Incinerators	Conventional Internal Thermal Type Pyrolysis Facilities	ERCM System
The air ratio obtained from the theoretical combustion air volume generally ranges between 1.2~1.3, whereas in order to achieve complete and even combustion in the furnace, air is actually supplied at the ratio more than this theoretical range 1.2~1.3. The following are typical air ratios adopted: around 1.6 for stoker furnace; around 1.3 for fluidized-bed furnace.	Organic wastes are pyrolyzed at the air ratio less than 1.0 to recover carbides and combustible liquids and gases. In the internal thermal type, a smaller amount of air is supplied: partial combustion (incomplete combustion) is carried out at the air ratio 0.2 to 0.4, and the combustion heat is used as a heat source for the ongoing pyrolysis. The following are typical internal thermal type pyrolysis furnaces in commercial operation in Japan: ・JEE Eng. Corp.: Updraft, fixed-bed gasifier (pyrolysis furnace) ・Ebara Corp.: Fluidized-bed pyrolysis furnace	For wood chips, the air ratio is set at about 0.3. While the system is categorized as an internal thermal type, it features such innovative process as charging electrons (effective as the ionized air) into the furnace to facilitate the ongoing pyrolysis in which carbides will consume self-containing oxygen to promote the oxidation reactions, helping retain the heat source even at lower oxygen concentrations.

ERCM System for Recyclable Resources Recycling (1)

Organic wastes (charged) are pyrolyzed by the ERCM System when (1) oil-soluble components (such as tar and low molecular hydrocarbons), (2) water-soluble components (such as water, acetic acid, hydrochloric acid and alcohol, (3) inorganic components (such as ceramic consisting of oxides and chlorides of silica, aluminum and calcium,) and (4) exhaust gas (comprising carbon monoxide, carbon dioxide, and vapor) are discharged and recovered. **Most of these discharged components are to be recycled as recyclable resources.**



ERCM System for Recyclable Resources Recycling (2)

The charged organic compounds are pyrolyzed by the ERCM System when (1) oil-soluble components, (2) water-soluble components, (3) residues (such as ceramic), (4) exhaust gas, and (5) drainage are discharged and recovered. Subject to the component ratio of the charged wastes, the resources recycling or proper disposal are being performed.

Discharge		M. Balance(%)	Potential of Resources Recycling, Proper Disposal Situation, etc.
Oil-soluble	Tar, low molecular hydrocarbons	40~70	(Example) Elemental analysis of oil-soluble components showed that no hazardous components were detected, the moisture content was about 35%, and the combustion heat value was 8,500 to 9,000 cal/g, eq. to that of heavy oil or gasoline. High polymer organic compounds (plastics) are decomposed into low molecular weight hydrocarbons, which can be used for thermal recycling as combustion oil, and as for chemical recycling as raw materials for plastics by fractional distillation.
Water-Soluble	Water, HCl, Alcohol, CH3COOH, etc	20~40	Wood vinegar, from wood-based waste, is usually used as a natural ingredient for insect repellents and antiseptic, and its solution was analyzed to show that no hazardous components were detected and the combustion processing was possible, although the combustion heat was not sufficient.
Ceramic (Residual inorganics)	Silica, Aluminum, Calcium oxides, and Chlorides	5 and less	Volume-reduced to inorganic compounds (ceramic), metals, and glass as decomposing residues. Ceramic powder can be recycled as cement material. Containing hazardous components, the residues can be recycled by slagging as construction materials free of elution of hazardous substances. The slagging costs almost as much as the general waste treatment. Molten slag is sold at about 200 yen/ton and used for construction materials such as roadbed.
Exhausut gas	Low molecular gasified components such as CO2, Co, and vapor	5~25	The exhaust gas components can be discharged into the atmosphere, since the system treatment unit complies with the applicable emission standards. The emission level of carbon dioxide for the ERCM System is much lower relative to those incinerators, causing a smaller environmental impact, because organics are not completely decomposed to carbon dioxide, no auxiliary fuels are used, and the electricity consumption per unit processing is low.
Drainage	Moisture cont. of the charged waste	–	The drainage water treated in absorption of hazardous substances and odor is then oxidized and decomposed with hypochlorous water, and can be discharged into the sewage system after simply treated to comply with the applicable effluent standards.

(Note) subject to the waste charged to the ERCM System, the components of the resulting discharge will vary together with the composition.

Organic Wastes to be accommodated by the ERCM System

Kitchen Waste, Food Processing Residue

High- moisture items
Including: garbage, fermentation residue, guts, and shells.

Sewage Sludge (Dehydrated Cake)

High-moisture, malodorous items
Including: excrement sludge, wastewater sludge, and incinerated ash.

Livestock Manure

High-moisture, malodorous items, subject to sterilization, disinfection. Including: chicken manure, cattle manure and pig manure.

Other wastes accommodated:

- **Eliminated harmful animals such as deer and boars**
- **Waste plastic recycling residues**
- **Demolition waste wood**

Waste Plastics

Including: PP, PE, vinyl, and styrofoam.

ASR

Including: shredder dust, waste tires, and cables (with core metals such as wires recovered).

Infectious Medical Waste

Wastes such as needles and diapers can directly be charged for sterilization/ disinfection.

The waste items categorized here are not necessarily designated to be treated as a single item; the System is capable of treating a mixture, e.g., food processing residue + plastic container and package.

Note: Organics that can be charged into the ERCM System are mainly biomass (natural materials) derived from plants and animals, comprising C (carbon), H (hydrogen), and O (oxygen), and plastics (chemical materials) derived from fossil fuels. The majority of infectious medical waste is currently consisting of plastic materials, while biomass-derived plastics have been developed and marketed.

Features of the ERCM System (1)

◆ **Low-cost to construct, operate and maintain, because:**

- No auxiliary fuels are required, since organic wastes are processed in the thermal decomposition at low oxygen concentrations;
- Higher in power saving, e.g., max. 150,000 JPYen/month for our 20m^3 /day capacity model;
- Simple and compact construction, requiring no refractories;
- Easy to operate and maintain, requiring no circulation of cooling water.

◆ **Such high volume reduction rate of waste, as demonstrated:**

- All organic wastes processed are converted to fine ceramic powders;
- Volume reduction rate is attainable from 1/100 to 1/500 (against 1/10 to 1/20 attainable at typical incineration facilities)

◆ **Causing less environmental pollution, because:**

- Emissions from the thermal decomposition process employed are quite low in concentrations of contaminants such as NOx and dioxins;
- Soot and dust generated from the process is quite low in concentration;
- Such operating mode as requiring no auxiliary fuels + high power saving features will cause quite low emissions of CO2;
- Almost no waste heat will be generated from the thermal decomposition processed at low temperatures;
- The decomposed gases are detoxicated through liquefaction, electrostatic precipitation, and electrocatalysis.

Features of the ERCM System (2)

＜Other Features＞

- **Recovery of Oil-soluble Components and Utilization of Exhaust Gas**
  - ✓ Pyrolyzed low molecular weight hydrocarbons can be recycled as combustion oils or recycled raw materials.
  - ✓ Carbon monoxide, hydrogen, etc. in the exhaust gas can be recovered as useful resources.

- **Capable of Highly Safe Operation, since:**
  - ✓ The furnace pressure is round the barometric pressure;
  - ✓ The furnace temp. is round 100°C, except for the heat source zone:
    - ➢ The external wall temp. remains such low during operation as to be touched with hands.

- **Requiring the small number of operators, since:**
  - ✓ The high safety of the system enables the unmanned night shit operation.
  - ✓ Manual labor is almost limited to waste charging, minimizing the labor cost.

- **Zero Final Disposal**
  - ✓ The end product of ceramic powder will completely be recycled.

- **Capable of accepting those difficult to process, except for the incombustibles.**
  - ✓ Such difficult items can directly be charged, even as mixed.

Our 20m³/day Type
(delivered to Food Industry in Nagoya City, Japan)

Advantages of the ERCM System (pyrolysis facility) over those conventional Incineration Facilities

- **Easy to Operate.**
  - No sorting-out of charged materials such as waste will be required, while incombustibles such as metals and glass can easily be recovered from the solid residues.
    - ･Such charging items are, however, limited as sizing about a small plastic bottle.
    - ･"Incombustibles" of conspicuous size should be removed before charging to let the ERCM System demonstrate its original performance.

- **Capable of pyrolyzing such materials as wastes of high moisture content.**
  - Such materials as wastes of high moisture content, which cannot be incinerated in a conventional incinerator as they are, can directly be charged into the ERCM System.
    - Capable of pyrolyzing the dewatered sludge cake with a moisture content of 60-70% without pre-drying or heating with auxiliary fuel.

- **The end products can be recycled (Zero Final Disposal).**
  - The ceramic powder product contains very little carbon residues and can be recycled after refining.
    - For the time being, this ceramic powder product will be reused as bedding for the newly constructed ERCM System, while it will be reused for concrete aggregate, water purifying agent, etc. in the future.

- **Low in the emissions of environmental pollutants.**

- **CO_2 emissions are significantly reduced during operation, since:**
  - the ERCM System requires no auxiliary fuels and is of electric power saving, resulting in extremely low CO2 emissions.

Reasons for less environmental pollutants emitted from the ERCM System (pyrolysis facility) , relative to conventional incineration facilities.

Soot and dust (fly ash)

Since the ERCM System is not involved in the flame combustion employed by those incineration facilities, no soot and dust (fly ash) will be generated. Therefore, neither filters nor dust collectors for such soot and dust are required, while only the exhaust gas treatment unit is required for pyrolysis gases of low molecular weight organics such as tar and char.

Dioxins

In the ERCM System, no soot and dust (fly ash), the source of dioxin formation, is generated, and the rapid temperature change occurs across the upper and lower layers of the pyrolysis furnace. This creates the environment, which is conducive to the suppression of dioxin formation.

NOx (Nitrogen Oxides) and SOx (Sulfides)

Similar to the suppression of dioxin formation, the ERCM System provides the environment in which formation reactions for these chemical species are to be easily suppressed due to the poorly oxygenated reduction atmosphere and rapid temperature changes.

HCl (Hydrogen Chloride)

The HCl in the exhaust gas is removed by water scrubbing, whereas the HCl in the drainage is removed by neutralizing precipitation.

Comparison of current Treatment Facilities (such as Incineration Facilities) and the ERCM System (pyrolysis facility)

Conventional treatment facilities, such as incineration facilities, require challenging extensive knowledge and experience to operate and maintain, because of a wide variety of processing /operating modes and component equipment involved.

	ERCM System (pyrolysis facility)	Current Treatment Facilities (such as Incineration Facilities)
Structure of facilities	The mechanism and structure are simple, requiring no refractories for the furnace. The component equipment such as electron charger, blower, and pump can hardly fail.	The plant is complex and large-scale consisting of a large number of operating and stationary equipment.
Skills required for operators	Even non-technical personnel can operate the system, however, it will take 2 weeks to 1 month to learn, esp., the maintenance work.	It takes several years to train skilled operators, as a wide range of knowledge and experience need to be acquired on the equipment and facilities involved.
Potential troubles or failures	The system is designed to accommodate non-uniform and mixed waste, when troubles are unlikely to occur. *The waste in the form of liquid or powder cannot be charged as they are: they need to be packed, for example, in bags.	A variety of troubles and failures will occur due to the treatment of the waste in non-uniform shape and properties, and the handling of highly corrosive gases and liquids.
Fuels/chemicals consumption	Extremely low in power consumption. In addition to water for wet scrubbing, activated carbon and zeolite are necessary as consumables. Requiring no aux. fuels or chemicals, the running cost is low.	Requiring large Q'ty of consumables such as electricity, fuels, chemicals, and water, since a wide variety of processes are involved.
Prevention of the environmental pollution	The cost of preventing the environmental pollution is low because of the pyrolysis mechanism, which generates few pollutants, while generating very little exhaust gas.	Strict management is required to preserve the surrounding environment, which is actually more stringent than required by laws and ordinances, resulting in a significant cost burden.
Maintenance	Maintenance is performed on regular basis, but is simpler, requiring no large-scale repair.	Periodic repair work is required every year.
Dependence on Manufacturer for tech. support	The construction itself is such simple as basically requiring no special skills to handle, however, high quality skills are required to understand it .	Users are highly dependent on the manufacturer's technical support, even in the maintenance phase, due to the complexity and sophistication of the system involved.

[Source] TERASHIMA, Hitoshi (2008), "Maintenance and Management Technology of Waste Treatment Plants, Current Status and Issues," Kankyo Gijutsu Gakkai, No. 131 (translated).

Domestic Delivery Records:

- Demonstration
- Commercial

NHK Coverage and a Demonstration Test in Hirono Town, Fukushima Prefecture (1/2)

New debris treatment system to be introduced on a trial basis— NHK (Japan Broadcasting Corp.) News “Good Morning Japan” November 27, 2013.

A new debris treatment system has been developed to significantly reduce the volume of radioactive debris by thermal treatment under oxygen-free conditions and decomposing them into ceramic and other materials, while eliminating the generation of incinerated ash containing radioactive materials. The system will be installed in Hirono Town, Fukushima Prefecture, on a trial basis next month.

The equipment, developed by a Tokyo-based environmental equipment manufacturer, decomposes debris into gas, oil, and powdered inorganic compound called ceramic by thermal treatment in the furnace free of oxygen without emitting flames. According to the manufacturer, the volume of the debris is reduced to an average of 1/300th of its original size, and since the ceramic product adsorbs radioactive materials, it is expected that incinerated ash containing radioactive materials will not be generated.

In a demonstration test conducted in Hirono Town in Fukushima Prefecture last month, the volume of debris was reduced to 1/268 and most of the radioactive materials were adsorbed by the ceramic product, and it has been decided that this equipment will be introduced in the town on a trial basis starting next month.

Other municipalities that are struggling to dispose of debris are also interested in this equipment. Meanwhile, Hirono Town is planning to introduce the equipment on full-scale basis after further verifying its performance. Deputy Mayor Koki Kuroda said, "Reducing the amount of debris at temporary storage sites is critical, and we are expecting much for this undertaking. We will repeat the verification and if it proves to be effective, we would like to introduce it as soon as possible.

Customer: Kashima City Sanitation Center, Ibaragi Pref.

Delivered Plant: Commercial 15 m^3/day Model

Exhaust Gas Analysis Data for Kashima City Pyrolyzed General Waste
Sampling Place / Date: Kashima City Sanitation Center/ May 2012
Metrological Certification Procedure: Nihon CCL Co., Ltd.

(equivalent to 12% O_2)

Pollutants to analyze	Unit	Measured Value	Standard Permissible Value
NOx	ppm	45～63	250
Hydrogen Chloride	mg/Nm^3	32	700
Dust/ Soot	mg/Nm^3	4.4	150
Dioxins	ng-TEQ/m^3	2.6	5

[Note 1] Excluded from the charged wastes were: incompressible Futon (bedding), clothes, soft polyvinyl chloride materials, and garbage.

[Note 2] “Kashima City Sanitation Center “was translated, since no official registered name in English was found.

Customer: Tamamiya Food Co., Ltd. (Nagoya City)

Commercial 20m^3/day Model

Food residue

Plastic residue

Demonstration Test at Large Shopping Center (Sagamihara City, Kamagawa Pref.)

- Test Equipment：Model 0.5m^3/day Demonstration Test Furnace
- Test Period：3rd November, 2020 through 22nd January, 2021（about 3 months)
- Charged wastes： Food processing residue（garbage）, Waste Plastics（containers, packages, etc.）, waste wood
- Throughput：2,564kg⇒Ceramic formation：19.8kg（vol. reduction rate≒1/128）

Capacity:
0.5m^3/day

Charged wastes（garbage, waste plastics, etc.）

Overseas Delivery Records:

- **Demonstration**
- **Commercial**

JICA Maldives Project

Japan International Cooperation Agency

Tokyo International Center, 7th March, 2017

Company in Chiba Prefecture solves waste management problems in Maldives: Low installation and operating costs eliminate the need for landfill of generated ceramic ash.

The Japan International Cooperation Agency (JICA) announced on 26th January that in its "Small and Medium-Sized Enterprises Overseas Development Support Project ー Feasibility Study", it awarded Kowa Technos Co. Ltd. (Ichihara City, Chiba Prefecture, President Shinichi Kanda) a contract for the "Feasibility Study on Waste Treatment Systems <u>Using Next-Generation Pyrolysis Furnaces in Malé and island regions in Maldives."</u>

Malé, the capital of Maldives, is home to approx. 117,000 people, or 35% of the country's population, where, however, the amount of waste from Malé and resort islands has been increasing year by year, causing problems such as malodor, illegal dumping, and generation of toxic substances. Therefore, solving these waste problems has become a key issue.

The ERCM (Earth Resource Ceramic Machine) proposed here is capable of pyrolyzing organic wastes using only electricity, while drastically reducing their volume. Further, since the ERCM does not use auxiliary fuels such as heavy oil to combust wastes like conventional incinerators, it will assure low-cost and environmentally friendly treatment.

Customer: Solvi, Brazil

Delivered Plant: Commercial 100㎥/day Large Model

Delivered to Dalian, China

Commercial 100㎥/day Large Model

Delivered to Dalian, China

Mobile Trailer-Mounted Model with Power supplied by Solar Generation

This mobile trailer is ready to be used in disaster areas to dispose of local organic wastes as quickly as possible. Efforts are being made to diffuse and have this method accepted by local governments.