Turn waste into valuable resources by fermentation and drying

ERS: High Speed Indigenous Microbes Fermentation System

Food waste/sludge and other organic waste

Fermentation and drying process using indigenous microbes

Feeds, fertilizer, fuel and etc. *(Depending on source)*
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7. Operation and Maintenance

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1. The Environment Issue and Possibilities of ERS

Local issues

1. Increasing costs of incineration and disposal
2. Increasing price of feeds and fertilizer
3. National reduction targets of CO\textsubscript{2} emission
4. Practical and systematic treatment solution
5. Aging facilities and infrastructure in need of modernization

Global issues

1. Demand for renewal of sewage treatment facilities in developed as well as developing countries.
2. Demand spurred by growing global population & urbanization trends.
3. Non-prioritization of global sewage treatment & organic alternatives
4. Basic infrastructure for water & sanitation not localized
5. Increasing feeds and fertilizer price
6. Global reduction targets of CO\textsubscript{2} emission

Major issue: feeds and fertilizer price increase

The price of phosphorus, essential in the production of industrial fertilizer is increasing. Consequently oil, ammonia, & potassium chloride prices are also increasing. Phosphorus mining rarely produces much volume so securing phosphorus is the focal point.

Counter the problem by recycling food waste with ERS to safeguard and maximize phosphorus resources
ERS: A high speed fermentation & drying system utilising indigenous microbes.

suitable for treating sludge & food waste

With a vapor generating system, such as boiler, provides ERS main unit with steam, reduces pressure, enables the high speed fermentation & drying process. Adding a vapor cooling system, it becomes a design for a no waste water, no odor (including feedstock odorless) process.

2. ERS System and specification

ERS Main Body

- No waste water design
- Deodorization with cooling, microbes
- Minimum water supply required
- Evaporation
- same indigenous microbe in FRS used as deodorizer

Specifications

<table>
<thead>
<tr>
<th>Specifications</th>
<th>Input</th>
<th>Output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process Capacity</td>
<td>Trash fish, Process waste</td>
<td>Convert to Fish Meal</td>
</tr>
<tr>
<td>Technology</td>
<td>Brewery waste (Bagasse)</td>
<td>Animal feed</td>
</tr>
<tr>
<td>Indigenous Microbes ※</td>
<td>Food waste</td>
<td>Animal feed or Bio Fertilizer</td>
</tr>
<tr>
<td>Application</td>
<td>Organic waste</td>
<td>Animal feed or Bio Fertilizer</td>
</tr>
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<td>Energy sources</td>
<td>Food processing waste</td>
<td>Bio Fertilizer</td>
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<tr>
<td>Specialty</td>
<td>Sewage and sludge</td>
<td>Bio Fertilizer or Fuel (Phosphoric can be collected)</td>
</tr>
<tr>
<td></td>
<td>Livestock dung</td>
<td>Fertilizer with microbes, Fuel (※ P recover)</td>
</tr>
</tbody>
</table>

※ Only 3 microbes selected & remained. These 3 kinds are IPOD registered
※ Patent for whole system are obtained in 2007

ERS: A high speed fermentation & drying system utilising indigenous microbes.

- Suitable for treating sludge & food waste
- With a vapor generating system, such as boiler, provides ERS main unit with steam, reduces pressure, enables the high speed fermentation & drying process. Adding a vapor cooling system, it becomes a design for a no waste water, no odor (including feedstock odorless) process.

2. ERS System and specification

- ERS: A high speed fermentation & drying system utilising indigenous microbes.
  - Suitable for treating sludge & food waste
  - With a vapor generating system, such as boiler, provides ERS main unit with steam, reduces pressure, enables the high speed fermentation & drying process. Adding a vapor cooling system, it becomes a design for a no waste water, no odor (including feedstock odorless) process.

- Specifications
  - Process Capacity: Systems from 0.5 to 100 tons/day (please refer manual)
  - Technology: Heated and depressurized speed fermentation and dry
  - Indigenous Microbes ※: Local microbes selected & cultivated from soil nearby the installation. (Further supply is not required)
  - Application: Any organic materials
  - Energy sources: Electricity (For whole system), Class A fuel Oil (for steam boiler)
  - Specialty: High speed ferment & dry. Need no bacterial replenishment, no waste water design
  - ※ Only 3 microbes selected & remained. These 3 kinds are IPOD registered
  - ※ Patent for whole system are obtained in 2007
### 3. System Specifications

<table>
<thead>
<tr>
<th>Type</th>
<th>ERS-0</th>
<th>ERS-1</th>
<th>ERS-2</th>
<th>ERS-3</th>
<th>ERS-4</th>
<th>ERS-5</th>
<th>ERS-6</th>
<th>ERS-7</th>
<th>ERS-8</th>
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<tr>
<td><strong>Max. Quantity per day</strong>&lt;br&gt;一日当たり最大処理工程数（※1）</td>
<td>12hours operation&lt;br&gt;12時間稼働時</td>
<td>250kg/day</td>
<td>1ton/day</td>
<td>2ton/day</td>
<td>4ton/day</td>
<td>7.5ton/day</td>
<td>12.5ton/day</td>
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<td><strong>Max. Quantity per process</strong>&lt;br&gt;一工程最大処理量</td>
<td>24hours operation&lt;br&gt;24時間稼働時</td>
<td>500kg/day</td>
<td>2ton/day</td>
<td>4ton/day</td>
<td>8ton/day</td>
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<td><strong>Max. process times per day</strong>&lt;br&gt;一日当たり処理工程数</td>
<td>12hours operation&lt;br&gt;12時間稼働時</td>
<td>5 times&lt;br&gt;5回(2時間発酵乾燥/回×5回+2時間仕上乾燥)</td>
<td>10 times&lt;br&gt;10回(2時間発酵乾燥/回×10回+2時間仕上乾燥)</td>
<td>24hours operation&lt;br&gt;24時間稼働時</td>
<td>5 times&lt;br&gt;5回(2時間発酵乾燥/回×5回+2時間仕上乾燥)</td>
<td>10 times&lt;br&gt;10回(2時間発酵乾燥/回×10回+2時間仕上乾燥)</td>
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<td><strong>Processability to Feed/Fermentation/Fuel</strong>&lt;br&gt;飼料/肥料化/燃料化処理</td>
<td>○</td>
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<td></td>
<td></td>
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<td><strong>Decomposition/Powder Reduce</strong>&lt;br&gt;強減容/分解/廃棄</td>
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<td><strong>Treatment of finish products</strong>&lt;br&gt;処理後物の用途</td>
<td>Feed/Fermentation/Fuel&lt;br&gt;飼料/肥料/燃料</td>
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<td><strong>Size of ERS</strong>&lt;br&gt;本体サイズ</td>
<td>Width&lt;br&gt;幅(W)</td>
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<td>4.9</td>
<td>6.8</td>
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<td>Dimension&lt;br&gt;奥行き(D)</td>
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<td></td>
<td>Height&lt;br&gt;高さ(H)</td>
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<tr>
<td><strong>Height of Hopper</strong>&lt;br&gt;ホッパー高さ</td>
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<td><strong>Operation Capacity</strong>&lt;br&gt;処理能力</td>
<td>m³/cycle</td>
<td>0.2</td>
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<td>2.5</td>
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<td>12</td>
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<td><strong>Weight of main unit</strong>&lt;br&gt;本体重量</td>
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<td>15</td>
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<td><strong>Power Supply</strong>&lt;br&gt;本体動力</td>
<td>Electricity &amp; Boiler&lt;br&gt;電気及び蒸気</td>
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<td><strong>Attachment</strong>&lt;br&gt;付属機器</td>
<td>Membral devolatilization and cooling equipment&lt;br&gt;微生物脱臭・冷却装置</td>
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<td></td>
<td>Automatic Hopper&lt;br&gt;自動投入装置</td>
<td>Special&lt;br&gt;別途</td>
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<td>Steam Boiler&lt;br&gt;蒸気ボイラ&lt;br&gt;※2</td>
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<td>Outlet device&lt;br&gt;取出し装置</td>
<td>Special&lt;br&gt;別途</td>
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<td><strong>Function</strong>&lt;br&gt;機能/特長</td>
<td>No Drain&lt;br&gt;無排水</td>
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<td></td>
<td>Mixed Material&lt;br&gt;異物混入</td>
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<td></td>
<td>Culture Medium&lt;br&gt;微生物培地</td>
<td>Not needed&lt;br&gt;不要</td>
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<td>Automatic Hopper&lt;br&gt;自動投入</td>
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<td></td>
<td>Automatic Outlet&lt;br&gt;自動排出</td>
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<td>Close system/no odor&lt;br&gt;密閉型/無臭気</td>
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</tbody>
</table>

*1 Water content dried from 85% to lower than 35%<br>*2 Conventional system applicable
4. ERS Process Flow (Fertilizer, Animal feed, and Energy)

- **Microbial deodorization equipment**
- **Water evaporation**
- **Selling Electricity**
- **Cogenerator**
- **Biomass Boiler or Once-through boiler**
- **Auxiliary fuel**

**Path of Re-Input**
- **Hopper**
- **Automatic dosing device**
- **ERS**
- **Main Unit**
- **Outlet Equipment**
- **Trommel(Sieve)**

- **Waste feeding**
  - Segregation not Required

- **Fermentation & Drying Process**

- **Fermented dried product Output Segregation**
  - Fermented & Dried Powder(Pass)
  - Fermented & Dried Powder(On)
5. Core Technologies and Properties

Core technology: Indigenous microbes selections

- Specific microbes are resident (Aerobic microbes) (Different from regular anaerobic microbes)
- Microbes are selected and cultivated from local soil nearby the installation
- Resident inside ERS main unit, no need to replace or refill microbes thereafter
- Stop operation, restart, no need to refill microbes (Ref. other pages)

Excellent total cost effectiveness

- Simple machines. No pre-process needed (mix ratio adj.), odor treatment or inter process setup
- Easy maintenance (Simple structure, less troubles and high durability)
- Space saving (Save cost for buildings and etc.) *maintenance cost around at 5% every 7 years
- Wastewaterless design (Saves on wastewater treatment cost)
- Substantial volume decreaser (effective transportation). Dried, easy for handling
- High nutrition fertilizer produced (higher market price bigger total cost saving)

Heated & depressurized hi-speed ferment and drying

- Efficient fermentation and drying produce high quality and high value products
- The condition inside the system is controlled for best environment for microbes to multiply, growth and mitigate

Indigenous microbes control

- Flexible application

  Possibility to collect phosphorus, CO$_2$ reduction, combination with conventional system and many other possibilities

- Environmentally friendly

  Indigenous microbes organically eliminating the bad odors emanating from raw materials
6. Microbes and the Intellectual Property

Patented Microbes

ERS utilize specific microbes which are collected from the local soil for the fermentation and drying process. 3 types of microbes are specified and deposited to International Depositary Authority for the purpose of the patented procedure.

<table>
<thead>
<tr>
<th>Patent Right</th>
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<tbody>
<tr>
<td>Patent Number 4153685</td>
</tr>
<tr>
<td>Patent registered on July 11, 2008</td>
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<tr>
<td>Name of Invention: Microbes, Combinations of Microbes, and the methods of making organic fertilizers by using these microbes.</td>
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<table>
<thead>
<tr>
<th>Microorganisms received</th>
</tr>
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<tbody>
<tr>
<td>1. Deposit Number</td>
</tr>
<tr>
<td>FERMBP-7504 • FERMBP-7505 • FERMBP-7506</td>
</tr>
<tr>
<td>2. Deposit on</td>
</tr>
<tr>
<td>March 14, 2001</td>
</tr>
<tr>
<td>3. Identification of Microorganisms</td>
</tr>
<tr>
<td>Shimose1 • Shimose2 • Shimose3</td>
</tr>
</tbody>
</table>

※ 3 microbes are the first Associated Microbes which were received for deposit in the world.
7. Operation and Maintenance

■ Operation and maintenance
  • Microbes selections, multiplication and seeding required around 1 week.
  • Manual raw material input and finish product output handling required.
  • During operation, monitoring manpower 1 person required (job task is to monitor the running condition, suitable vacuum condition for microbes, checking all the parameters etc.)
  • When problems occur the operation can be paused and continued the next day.

■ Raw material type exchange
  When changing the raw material type, the cleaning method depends on the next raw material output usage (feed or fertilizer).

■ Maintenance
  General maintenance only required. The main body is tough enough for continuous operation permanently.

■ Consumable parts
  Motors need to be changed about every 7 years. Vacuum pump, cooling water pump, vacuum valve replacement when exhausted.
8. Application and potential industry: Outline (Japan)

- **Dams, Lakes**
  - Ferment & dry of dam/lake sludge

- **Sewage sludge**
  - Ferment & dry Excreta, sewage sludge
  - (Phosphorus resource, CO₂ reductions)

- **Livestock farming**
  - Produce fermented animal feeds
  - Pig Manure/excreta treatment
  - Cow Manure/excreta treatment
  - Chicken excreta treatment
  - Carcass disposal

- **Agricultural**
  - Rooftop greening, vegetables farming
  - Tourist attraction and hotel waste recycling
  - Systematic recycling of industrial waste

- **Construction/Shores**
  - Agricultural product supplier
  - Shores sludges treatment by fermentation and drying

- **Food Related**
  - 1. Brewer’s grains (Ferment & Dry)
  - 2. Brewer’s waste liquid (Ferment & Dry)
  - 3. Kitchen waste recycling system
  - 4. Pre-dry system for mixed kitchen waste
  - 5. Convert mixed kitchen waste into RDF
  - 6. Waste of food industry into fertilizer, feed
  - 7. Sludge from food industry

- **Fisheries**
  - Process small fishes, carcass, starfishes and etc. into fish meals

都市の水・資源の循環を支えるシステム
The system that maintains the cleanliness of water and resource recycling for the city
Application and potential industry: ‘Wastes from Convenience Stores’

- Expired merchandise from convenience stores and supermarkets can be processed directly without segregation.
- Animal feed / Fertilizer can be separated from plastics easily, after fermentation.
- As the process can be completed within 24 hours, animal feed and fertilizer is produced within a compact space.

**Without segregation**
- Lunch boxes, Rice rolls, Juice in paper boxes
- Bread, Ice cream etc.

**Additional Equipment**
- Gas Boiler (LPG)
- Device for microbe de-odorizing & cooling

**Fermented animal feed**

<table>
<thead>
<tr>
<th>分析試験結果</th>
<th>2010.7.26 Japan Food Center Analysis</th>
<th>No.10059581001-01</th>
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<tr>
<td>分析試験項目</td>
<td>結 果</td>
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<tr>
<td>水分</td>
<td>Moisture</td>
<td>6.9 %</td>
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<tr>
<td>粗たんぱく質</td>
<td>Protein</td>
<td>23.6 %</td>
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<tr>
<td>粗脂肪</td>
<td>Lipid</td>
<td>14.3 %</td>
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<tr>
<td>粗繊維</td>
<td>Fiber</td>
<td>0.9 %</td>
</tr>
<tr>
<td>粗灰分</td>
<td>Ash</td>
<td>26.0 %</td>
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<td>可溶無窒素物</td>
<td>NFE</td>
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<td>塩分（NaClとして）[Na還算]</td>
<td>Salt (as NaCl) [Na eq.]</td>
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<td>pH</td>
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**Fuel of Disposal**

- Segregate with Sieve

**Notes:**
1. 窒素・たんぱく質換算係数: 6.25
2. 計算式: 100×(水分+粗たんぱく質+粗脂肪+粗繊維+粗灰分)
3. 10%懸濁液について測定した。
Application and potential industry: ‘Wastes from Cake, Bread Bakery’

<table>
<thead>
<tr>
<th>分析試験項目</th>
<th>結果</th>
</tr>
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<tbody>
<tr>
<td>水分</td>
<td>13.0 %</td>
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<tr>
<td>粗たんぱく質</td>
<td>11.0 %</td>
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<tr>
<td>粗脂肪</td>
<td>10.5 %</td>
</tr>
<tr>
<td>粗繊維</td>
<td>0.1 %未満</td>
</tr>
<tr>
<td>粗灰分</td>
<td>1.8 %</td>
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<td>可溶無窒素物</td>
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<td>pH</td>
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注1. 窒素・たんぱく質換算係数：6.25
注2. 計算式：100-(水分+粗たんぱく質+粗脂肪+粗繊維+粗灰分)
注3. 10%懸濁液について測定した。
Application and potential industry: ‘General waste’

- Waste can be thrown altogether.
- The output can be easily segregated from plastics and organic product easily. No pre-segregation process required.
- Undecomposed product is processed by the ERS again

- General waste (garbage)
- General waste (processed food)
- Undecomposed products
- Product (fuel or renewable resources)
- Product (fertilizer and fuel)
Application and potential industry: ‘Brewers’ grains’

- Remove alcohol and odor by high speed fermentation efficiently.
- Due to all moisture vaporized, no water and treatment facilities required.
- Japan Sake and Shochu Makers Association as a subsidy business.

Can be dried to powder if needed.

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<td></td>
<td>3.6 g/100g</td>
</tr>
<tr>
<td>Ash</td>
<td></td>
<td></td>
<td>1.6 g/100g</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td></td>
<td></td>
<td>26.9 g/100g</td>
</tr>
<tr>
<td>Energy</td>
<td></td>
<td></td>
<td>202 kcal/100g</td>
</tr>
<tr>
<td>Alcohol content</td>
<td></td>
<td></td>
<td>0.3 g/100g</td>
</tr>
<tr>
<td>pH</td>
<td></td>
<td></td>
<td>3.8</td>
</tr>
</tbody>
</table>
Application and potential industry: ‘Food processing waste’

- Raw fish can be thrown in as it is.
- After fermented and dried, the output is odorless fertilizer/feeds.
- High protein fish meal is produced and small bones residue can be segregated.

After segregation using mesh screen (high calcium bones and high protein feeds)
Application and potential industry: ‘Livestock farming excreta’

- Cow, pig, chicken manure can be fermented and dried very fast. Solid-liquid separation unnecessary.
- Manure and urine can be thrown together and there will be no waste water.
- The number of bacteria is drastically reduced by ERS processing.

**Pig manure**

**Chicken manure (layers, broiler)**

**Cow manure (milking cow, beef cow)**
Reference: Comparison with the conventional method of processing livestock manure processing

**Conventional processing methods**

- *Input*: Slurry
- *Process*: Solid-liquid separation
- *Facility*: Sewage treatment facility
- *Output*: Discharge

**Fermentation facility**

- *Primary fermentation*: 20 days
- *Secondary fermentation*: About 150 days
- *Total*: About 5-6 months

**High Speed Indigenous Microbes Fermentation System**

- *Input*: (Unnecessary solid-liquid separation)
- *Facility*: Fermentation facility
- *Compost*: Secondary fermentation

**Sewage treatment facility**

- *Cow manure* (milking cow, beef cow)
- *Chicken manure* (layers, broiler)

**Solid-liquid separation**

- *Primary fermentation*: 1 day
- *Secondary fermentation*: About 3 days
- *Total*: About 4 days
• Whole body of dead pigs (frozen body is OK) can be put into the system. For a small ERS system the body should be cut into pieces.
• Odor-free materials (fertilizer, fuel) can be produced by ERS processing.
• Oil can be separated from fertilizer by compressing with screw press.
• Materials are processed under diminished pressure (close to vacuum) with ERS as compared to high pressure with conventional system.

Feature of ERS processing

No bad smell
- The odor can not be leaked because the materials are fermented under diminished pressure (close to vacuum).
- The microbes decompose the causative substance of ammonium odor.

No drainage
- Discharging water system is not needed because no discharge of water.

Sterilization
- The number of bacteria is reduced by ERS processing drastically at over 125 degrees C.
Application and potential industry: ‘Dead Cow’

- Dead cows can be input directly (even frozen ones).
- After fermented & dried by ERS, become odorless products (fertilizer, fuel).
- Comparing with traditional high pressure process, ERS is processed under less pressure and therefore can be treated at a lower temperature.
- Processed by grinder to become fuel powder.

ERS Specialties

- Odorless
  - Because fermentation and drying processes are under vacuum status, odors are sealed inside and no emission.
  - Other odors such as ammonia are decomposed by microbes.
- No waste water
  - With unique system design, no waste water will be generated, no need for waste water treatment.
- Sterilization
  - Sterilization can be conducted above 125°C, if necessary.
Application and potential industry: ‘Blood from body at slaughter’

- The blood from the bodies at slaughter requires rapid processing due to its fast oxidization.
- The blood from the bodies can not be dried up with heated air because the slight change of the temperature affects the drying treatment.
- Since the blood is oxidized fast, it gives off a bad odor.
- The blood is fermented and dried under diminished pressure (close to vacuum) with the ERS system and the processed blood is used as fertilizer.
- The number of bacteria is reduced drastically by ERS processing.
Application and potential industry: ‘Sewage and sludge treatment’

- Water content of sludge can be reduced from 80-98% into 20% contents with speed drying.
- When dried sludge is incinerated, phosphorus can be extracted from the ashes.

ERS substantially reduced the volume hence save transportation cost
- Land remedial usage also possible

* If the sludge didn’t contain heavy metals, viral microbes unlikely to survive so it can be used as it is for fertilizer
Application and potential industry: ‘Dredging sludge treatment’

- Silty sludge becomes aggregated structure with microbes
- Volume reduction of silty sludge
- Processed silty sludge can be recycled
Application and potential industry: ‘Septic tank sludge and raw human waste’

- Direct input to the ERS treatment tank from the vacuum truck containing raw human waste (98% moisture content)

Put into ERS direct

Fertilizer and fuel

Processing start
Fermentation process
Concentration process
Processing end
Application and potential industry:
‘Volume reduction on sludge containing radioactive materials’

- High speed drying on sludge with 80-98% moisture contain into 20%.
- Reduce volume of sludge containing radioactive materials (to about 1/5).
- Reduced sludge is wrapped to prevent absorption of water when underground burial.

<Effects from fermentation>
- Organics decomposed by microbes reduces the volume of sludge further (only drying but no ash).
- Pelleting by the function of microbes results in volume reduction.
- Radioactive material immobilization by the function of microbes can be expected (preventing flying ash).
Application and potential industry:
‘Volume reduction and recycling of mild and other liquid products’

- Fruit juice contains a lot of sugar. When it is dried up, the residue could impair the stirrer.
- The BOD (biochemical oxygen demand) is very high and it is very difficult to be processed with effluent treatment facility.
- Therefore, it is usually incinerated.
- The residue of fruit juice (sugar) is decomposed with ERS. Since there is no residue, nothing can impair the equipment.

Body outlet photo:
Before processing | After processing

No adhesion of the treated product
Application and potential industry: ‘Tea dregs’

- No need for solid/liquid separation, can be fermented & dried as it is wet leaves.
- Fermented & dried tea dregs results in animal feed (like silage).
- Coffee dregs can be treated too.

Tea dregs (Moisture<90%)

80% Volume Reduction

Feed・Fertilizer・Fuel (Moisture<10%)
Application and potential industry: ‘Coffee dregs’

- With fermentation, moisture contained in porous type powder can be removed completely, and no need for re-fermentation.
- With fermentation, because it will not oxidize even after long-term storage, there is no odor and liquidation.
- Tea dregs can be treated, too.

Coffee Dregs (Moisture 65%) → Fermented & dried (70% Volume Reduction) → Fertilizer・Fuel (Moisture<10%)
Reference: An example of a city’s power generation equipment
This factory uses the product of dead pigs after ERS processing as part of the fuel
Reference: An example of a company’s woody biomass power generation facilities (3MW/h)

Steam turbine and generator (3MW/h)

Biomass boiler