Transforming Wastes into Resources

Presented by Catalyst K.K. and Dr. T. Kubota

Updated October 23, 2019 for TICAD 2019

株式会社 Catalyst

2. Business Profile

- Founded in 1991, SNC Research Institute has developed technologies and holds 11 patents.
- Catalyst K.K joined forces in 2016 and became the sales arm.
- President: Koji Yamakawa

  CEO: Hirokuni Tanioka

  CTO: Dr. Toru Kubota, Inventor

  CFO: Yuji Yamagata

  Global Catalyst: Peter Schuetz

  Directors: Walter Gutbezahl

  Henry Smith Igwe

eMAC system

3. Introduction

- Our mission: To create an environmentally-friendly planet by detoxifying all forms of pollution with cutting-edge technologies, as environmental destruction continues unabated on a global scale.
- We believe that all forms of waste can be recycled. We have developed a revolutionary Electromagnetic wave & Catalyst system (eMAC) which reduces the overall volume of wastes and transforms them physically and chemically into effective recyclable resources.
- eMAC was awarded the top prize in an incubator program sponsored by JR East Japan in 2017. We have 11 relevant patents and 8 patents pending.

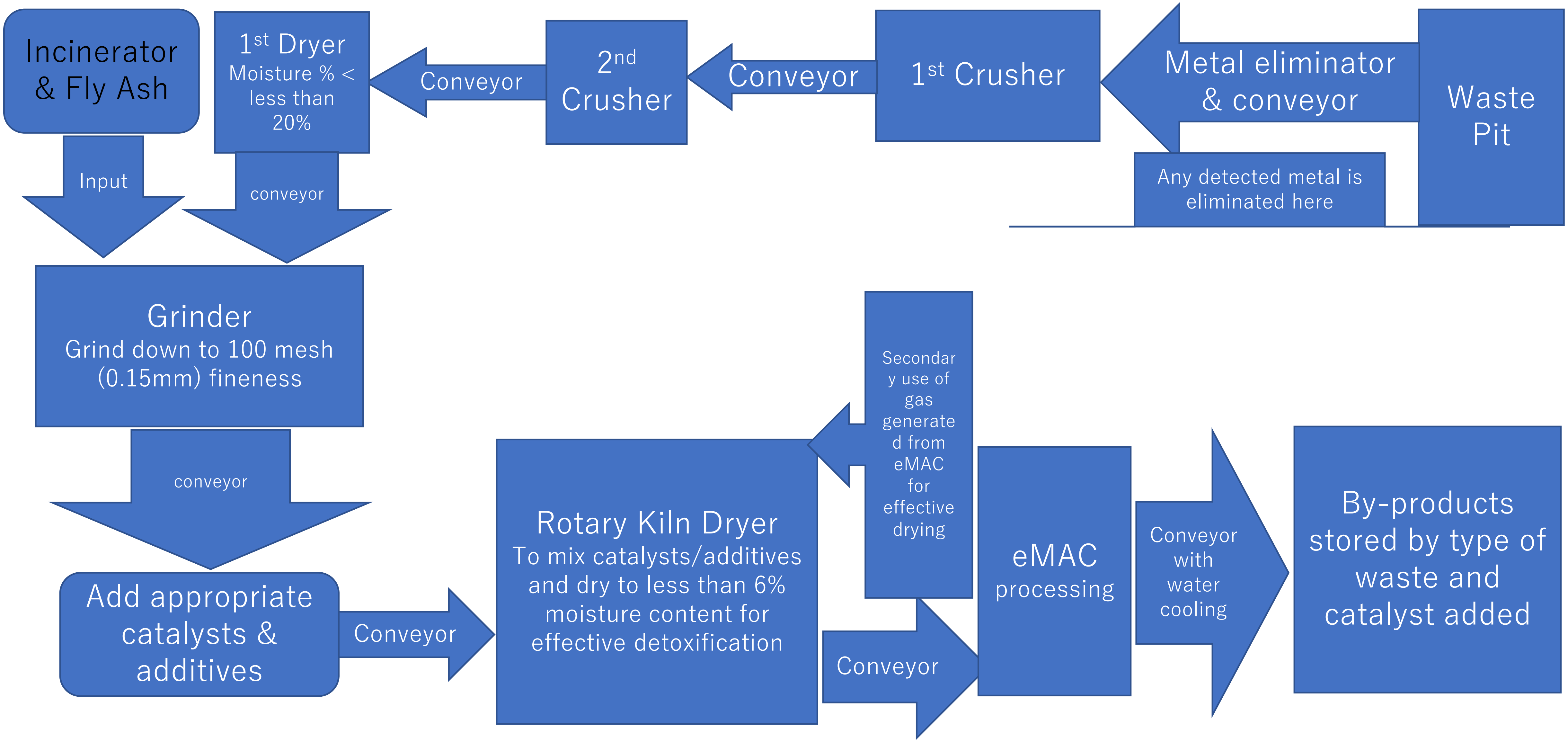
4. eMAC System Environmental Benefits

- No landfill sites are required due to waste volume reduction and detoxification → Huge space savings and environmental benefits
- Wastewater treatment is unnecessary because all wastes are dried out within the system → Huge cost savings
- Applicable to treating most waste types via different catalysts/additives
- Our system is far more economical than conventional incinerators → Below half price

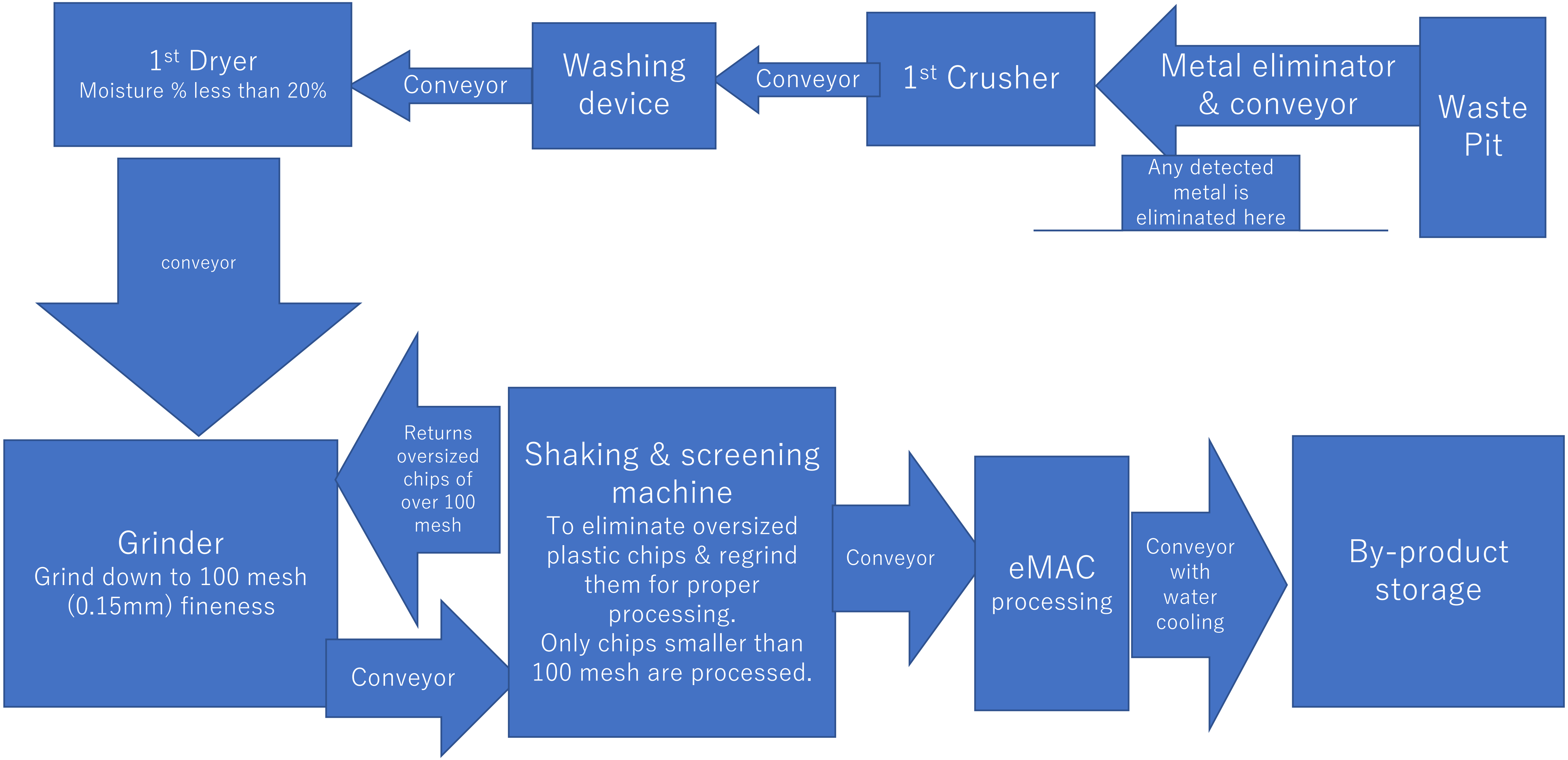
  Automatic separation of metal chunks from wastes

  The required floor area is one sixth that of conventional incinerators → Huge space savings
- No Dioxin emissions are generated → Huge environmental benefits
- CO_2 emissions are less than 1/100 those of conventional incinerators

5. Catalyst eMAC process: For general wastes including plastics



6. Catalyst eMAC process : For plastic wastes only



7. System Benefits: Useful Byproducts

- eMAC produces various useful by-products, as below, from general wastes, plastics, animal dung, meat residues and toxic incinerator ash (which has been processed at below 1200℃).

Cement enhancer: Bonding power is strengthened due to zero oxidization in the system, thus extending the useful life of concrete structures.

Soil conditioner, produced in a similar manner to cement enhancer, is particularly useful for solidifying unpaved road surfaces.

Bulking agent for activated carbon is effective for purifying river water, especially sewage and bottom mud.

Mineral supplementation of fertilizer for enhanced vegetable growth.

Catalysts (new ceramics) from high-temperature processed (1200℃) incinerator ash and coal ash, which are key components of the detoxification process.

8. Waste Volume Reduction Processing and By-products

Type of Waste	Pre-processing by crusher, grinder & drying	eMAC Reduction Process	Volume Reduction %	Recyclable by-products
Incinerator & coal ash (incl. various metal powders) : Ash processed at > 1,200C and ash processed at < 1,200C.	Only a grinder and a mixer are required. Moisture content should be < 6% before putting ash into eMAC	Occurs within an electro-magnetic wave field via far infrared radiation, with targeted catalyst/additive mixtures for producing different by-products	By 40-50%	Ash processed at > 1,200C produces catalysts (new ceramics), and ash processed at <1,200C produces cement enhancer, ceramic material, etc.
General waste including plastics, except for metal chunks	Two crushers and a grinder make wastes < 100 mesh (0.15mm). Same drying process as above	Ditto	< 1% of original volume	Soil conditioner, cement enhancer, and filler for activated carbon
Plastic wastes only	Two crushers and a grinder make wastes < 100 mesh (0.15mm). Drying to < 6% moisture via different drying process	Ditto	Ditto	Pulverized coal for use in thermal power generation, cement filler for reducing costs by increasing cement volume
Animal dung, meat & residues	Similar treatment to general wastes	Ditto	Ditto	Mineral supplementation to enhance fertilizer

9-A. Comparison of Waste Disposal Methods

	eMAC System	Conventional waste disposal
Method	Processed with electromagnetic waves via chemical reactions with catalysts	Incinerated by combustion
Processing temperature	From 200 to 400° C	Over 800° C
Processed residue	Recycled into various by-products see slide #7	Final disposal as incinerator ash containing toxic heavy metals
Co2	Virtually zero emissions, which reduces global warming	Substantial emissions which accelerate global warming
Dioxin	Not generated	Generated
Waste sorting	Automatic sorting	Extensive manual sorting
Plant sizes	Approx. 500m2	Approx. 3,000m2
Lead time	4 Months (+8 months) see slide #12	1 -2 Years
Price (100t per day capacity)	¥1.2 Billion list price	Approx. ¥8 Billion
Maintenance costs	¥3-4 Million per annum	High maintenance costs
Workforce	9 staff per month 24H / 7D	15 staff per month 24H / 7D

9-B. Conventional Waste Incineration Issues

- When incinerating organic matter (C, O, H, N), chemical reactions with chlorine at 500 ~ 600 ℃ generate toxic dioxin.
- Designated hazardous metals (lead, chromium, mercury, cadmium, arsenic, and selenium) remain as oxidized compounds or chlorinated compounds.
- Since chlorinated compounds and oxidized compounds are water-soluble, they are ionized by rain and leach out along with other toxic metals to pollute groundwater and rivers
- Incinerator ash is either treated in a high-temperature melting furnace at 1,200 C (decomposing dioxin) or buried in a strictly final landfill site. The final disposal method is restricted by the type of disposal site, so processing costs rise. High-temperature melting furnaces are expensive to construct and operate.
- Landfill waste discharges methane gas.

10. eMAC Recycling Mechanism and Benefits

- **Heavy metals are stabilized and reduced inside an electromagnetic field via far infrared radiation and chemical reactions with catalysts/additives (low oxygen atmosphere).**

① No dioxin is generated within a low temperature reaction range of 200 – 400 Celsius.

②Designated hazardous metals turn into water-insoluble sulfur and phosphorus compounds.

③ These compounds, processed at high temperatures, turn into safe ceramic fine mineral powder crystals (New Ceramics).

④eMAC can significantly reduce large volumes of waste (down to below 1% for general waste, plastics and meat/dung).

⑤Smaller than normal amounts of fuel are required:

· Our reduction chamber only uses a burner at ignition and the waste material decomposes inside the electromagnetic field.

· By maintaining a temperature of 200-400 Celsius, it is possible to decompose the dioxin contained in incinerator ash.

⑥Other benefits as already shown.

11. Costs and Benefits

Investment costs

- eMAC system: ¥1.2 Billion standard price (100 tons per/day processing capacity). Four months lead time for eMAC only. Initial catalysts (new ceramics) are included in the price.
- Including Crushing/grinding machines, drying machines, conveyor belts etc.:– Lead time for these machines could be 8-12 months depending on inventory/order backlog.
- If the electricity supply is unstable, solar power could also be employed.
- If ODA becomes available, the system cost to you will be reduced greatly.

Benefits

- Massive reduction of disposal costs. These cost savings can be utilized for improving waste collection systems and education/training in developing countries.
- Generating revenue from waste collection (Private sector in Japan, ¥30,000 per/ton on average). Substantial disposal cost reduction for Japanese municipalities.
- Revenue generated from products created by the system - cement enhancer, fertilizer.
- Running costs are very small compared to the benefits (Costs: utilities, payroll, catalysts, etc.)

12. Profit and Loss Forecast in Japan

Government Sector

	Annual Figures	Remarks
Annual Volume (tons)		
Processing wastes	30,000 tons p.a.	100 tons x 300 days
Cost reduction (Yen in Mil.)	Yen in Millions	
From processing wastes	1,080	30,000 t x 12 mo. x ¥30K per ton avg.
From sale of byproducts	TBD	
Total cost reduction	1,080 + byproduct sales	
Utilities and other costs	48	Electricity, water, kerosene (240L/day), catalysts and additives *See slide #14 for details*.
Labor costs (unskilled)	32.4	¥300K x 12 mo. x 9 staff
Net Cost Reduction	1,000 + byproduct sales	

13. Premise for Government Sector Profit & Loss Forecast

The total cost reduction figure in the previous slide is based solely on annual operating expenses.

The huge cost savings that would stem from eliminating final landfill disposal sites, waste water treatment plants and smaller capital expenditures are not included.

The partial cost savings that would stem from eliminating waste separation/sorting work are not included.

Including these extra cost savings would lead to a vast reduction in total costs. These reduced costs could be utilized for improving waste collection systems and education/training in developing countries.

14. Breakdown of 48M yen annual costs in slide #12

Electricity 3.6M yen
Kerosene 8.6M yen
Maintenance 12M yen (for entire system)
Insurance 2.4M yen
Depreciable asset tax 14M yen (annualized 20 year ave. amount) 償却資産税
Miscellaneous 7.6M yen (including water and office expenses)

Total 48M yen

Notes on Chemical Reaction Mechanism

Professor Kimoto Mimura, Kyoto University and Dr. Toru Kubota

Chemical reaction structure when, besides metal, most of a substance consists of carbon (C), oxygen (O), nitrogen (N), and hydrogen (H).

With a catalyst, many compounds can be synthesized from syngas ($H_2 + CO$).
Both zeolite and ceramic material can be produced via this chemical reaction.
A strong acidic proton (H_2) sometimes exists on the wall surface of a cavity, and if it is used as energy by burning hydrocarbons and carbon resources, carbon eventually becomes carbon dioxide (CO_2) and hydrogen becomes water H_2O).

With this method, the surface chemistry advances until the solid surface of the raw material is enlarged, the solid surface can be used as a new material, and the material is treated as intermediate material via reactions on the solid surface such as adsorption, catalysis, electrode reaction, etc.

In addition to solving resource problems, the far infrared ray induces thermal decomposition due to the chemical structure, electronic state, vibration state, atomic arrangement, etc. of the solid surface, and the self-burning state spreads continuously to become carbon. An atom consists of a nucleus and an orbital electron, and an atomic nucleus is composed of a neutron and a proton. Protons and electrons are elementary particles that are charged with opposite positive and negative charges, and the neutron state is maintained whereby pluses and minuses are balanced as atoms overall with the same number of atoms.

Far-infrared radiation generated from ceramic material adsorbs electrons in a stable state via catalytic and magnetic energy, makes it an unstable crystal, saturates the bonding of atoms on the surface, and does not show any chemical activity. Energy includes thermal energy, electrical energy, mechanical energy, etc., which are mutually converted.

From such a neutral atomic state, ionization occurs and radiation is emitted. Although this is an electromagnetic wave, it creates both an electric field and a magnetic field, and an electromagnetic wave is generated whereby its wavelength and frequency are repeated, thus replacing heat with a synergistic effect.

Wastes replace carbon resources in this manner. Adding potassium carbonate (K_2CO_3) to the biomass and raising air pressure will turn it into liquid fuel at 300 °C and improve combustion efficiency.

In conclusion, the thermal decomposition of biomass via the use of catalysts within a magnetic field differs from decomposition in incinerators and carbonization furnaces. Thermal decomposition induced by chemical reactions creates carbon resources.

URL and Contact

- Catalyst Co. Ltd.（株式会社Catalyst）URL
  catalyst-eco.jp

- E-mail: peter@rock-solid.biz