Innovative Japanese Waste-to-Green Product Technologies for Establishment of Sustainable Waste Management System in Developing Countries

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Unutilized Resources

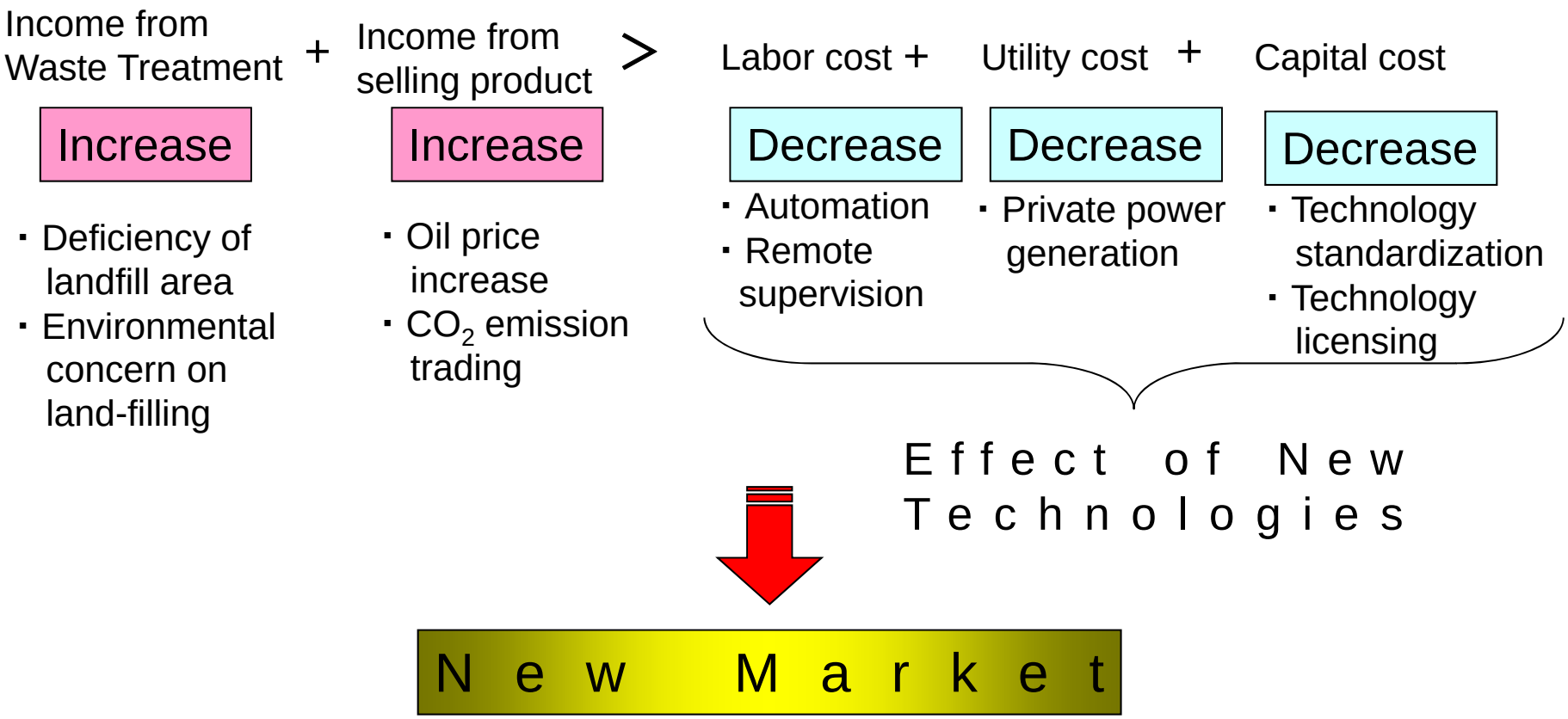
Municipal Solid Waste
(Jakarta, Indonesia)

Hospital Waste
(Bangkok, Thailand)

Waste Plastic
(Colombo, Sri Lanka)

Sewage Sludge
(Beijing, China)

Condition for Profitable Waste-to-Green Product Business



Waste-to-Green Product

① Hydrothermal Technology

Waste-to-Coal (Municipal solid waste, Hospital waste)

Waste-to-Fertilizer (Sewage sludge, Animal manure)

Waste-to-Animal Feed (Food residue)

② Pyrolysis Technology

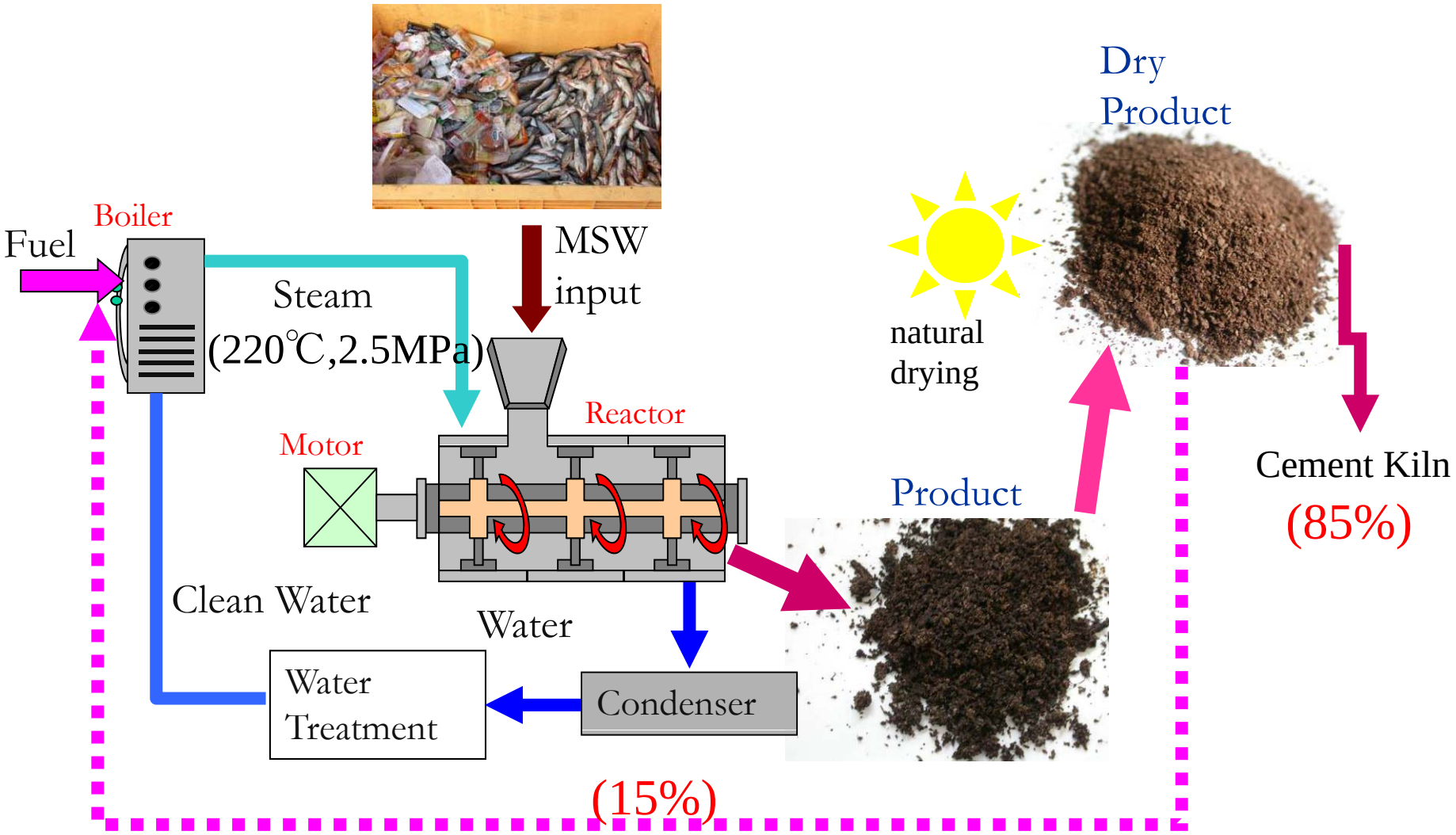
Waste-to-Oil (Waste plastics, Waste tire)

Waste-to-Precious Metal (E-Wastes)

Hydrothermal Technology

① Waste-to-Coal Technology

Hydrothermal Treatment of MSW

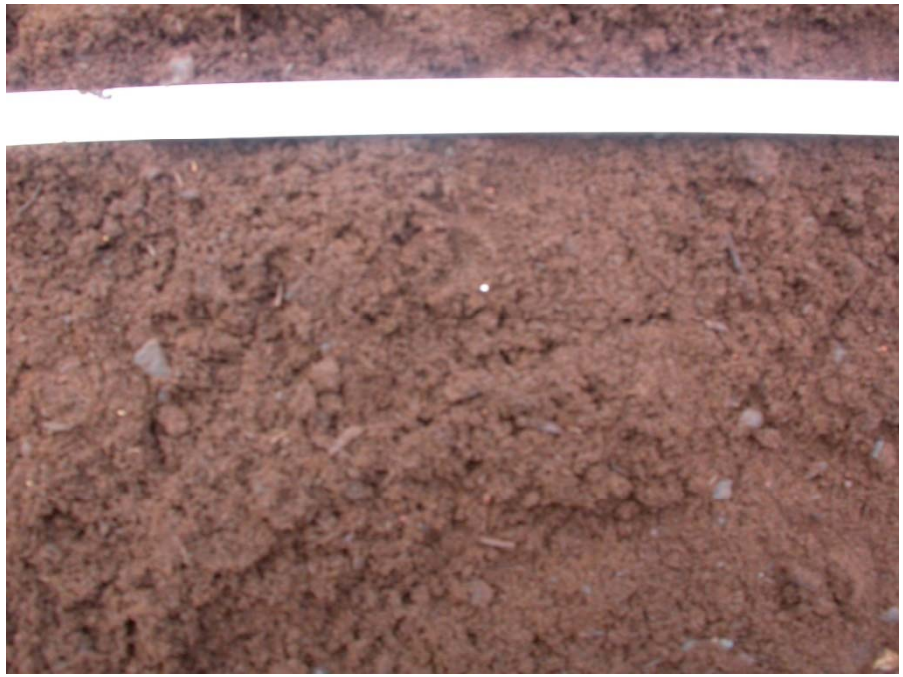


Crushing Performance

Wood

Before treatment

After treatment

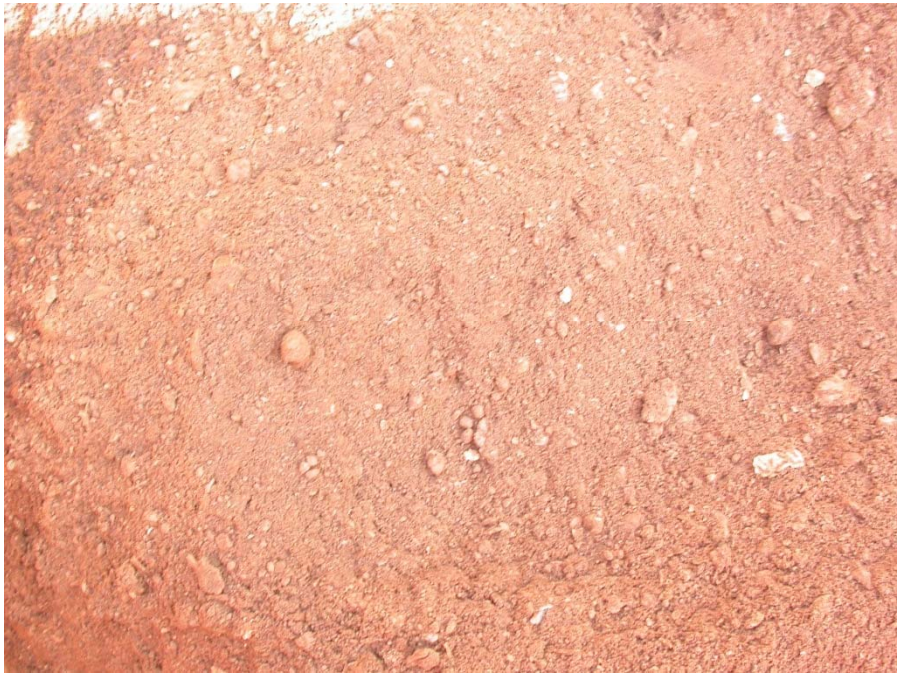


Crushing Performance

Telephone book

Before treatment

After treatment

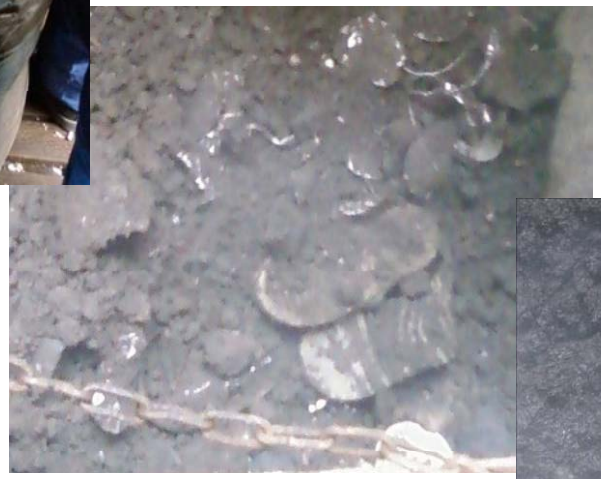


Commercial Hydrothermal Treatment Facility (Hospital Waste Treatment)

MSW Treatment

Physical Appearance

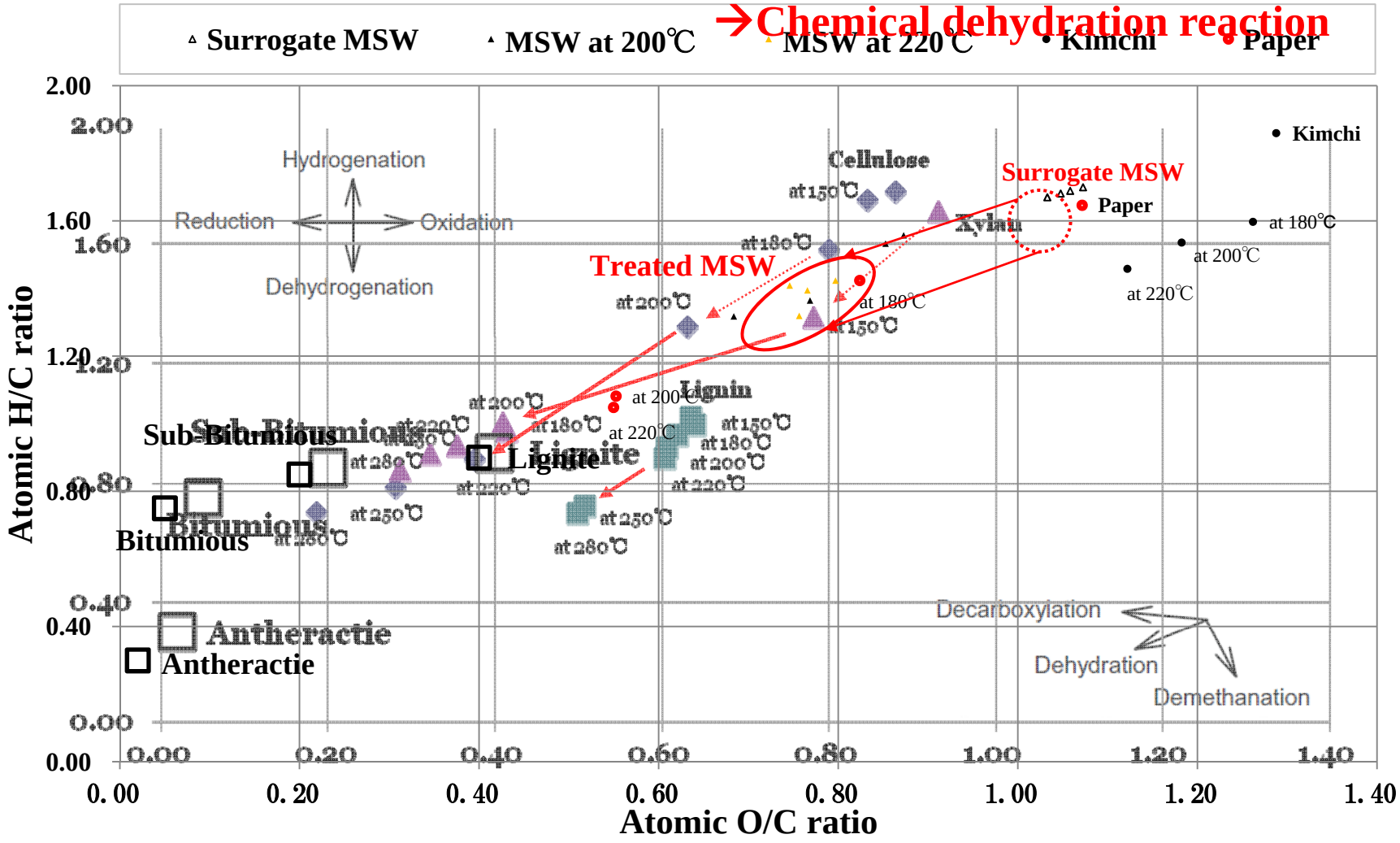
Raw MSW



2 MPa

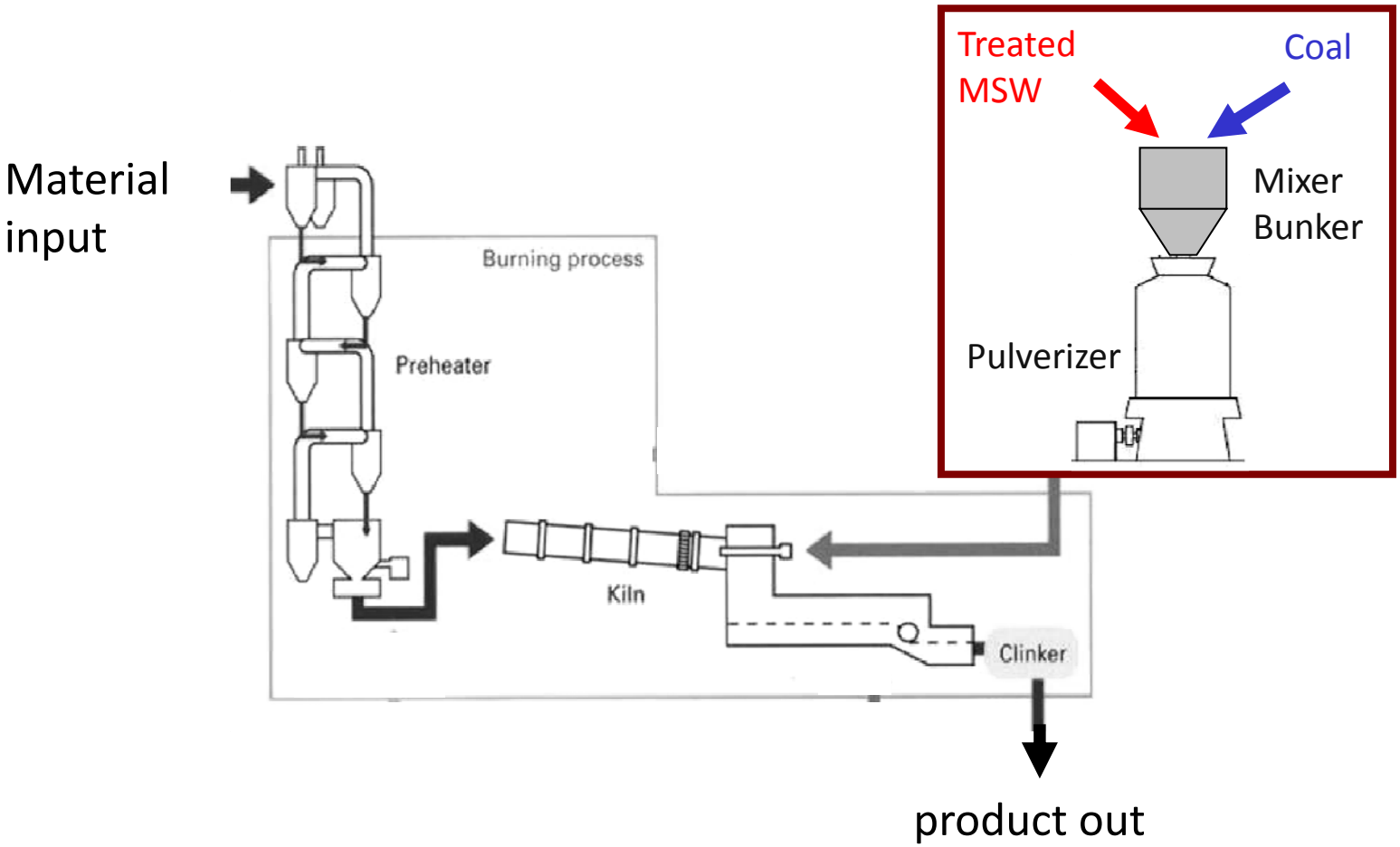
2.4 MPa

Coalification by Hydrothermal Treatment



Application of Waste-to-Coal

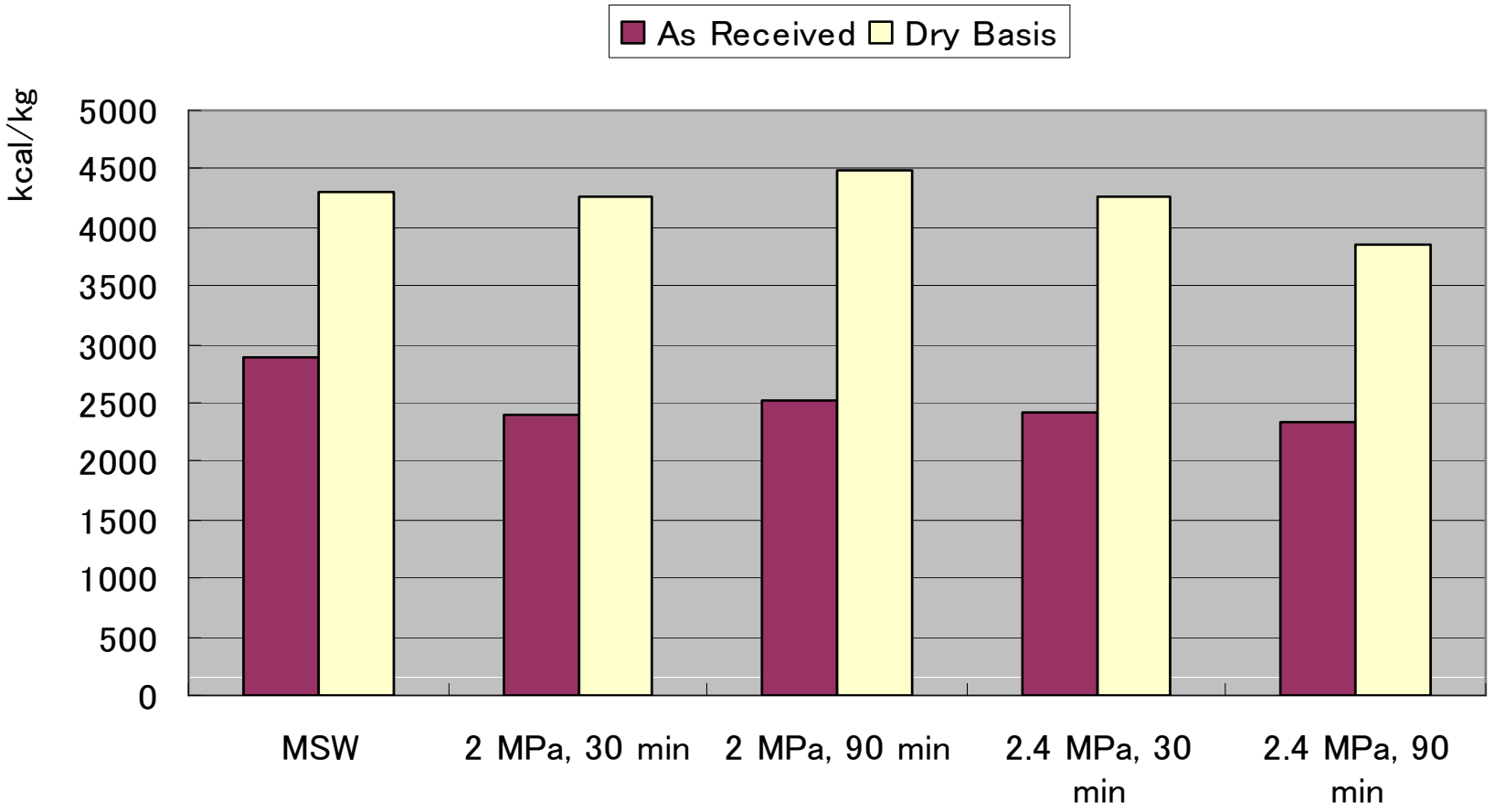
In Cement Production Line



MSW = Municipal Solid Waste

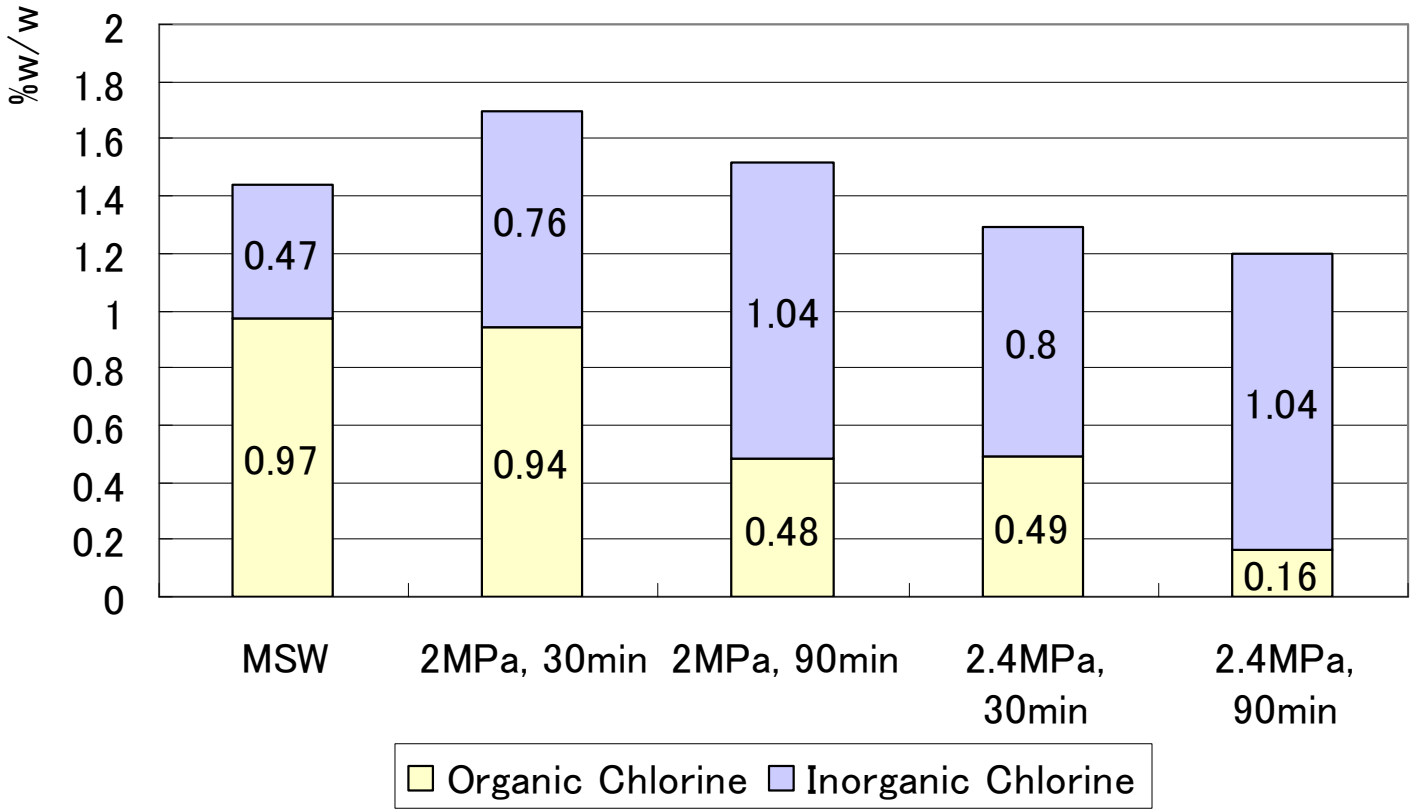
Large Scale Experiment

Calorific Value



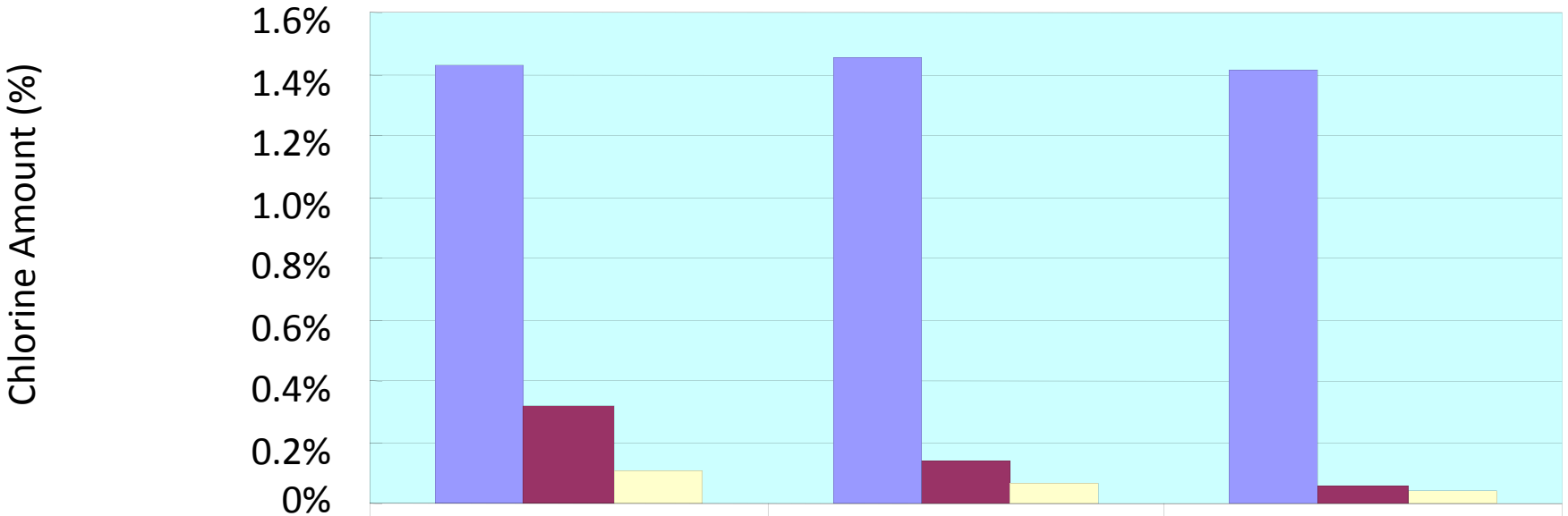
Large Scale Experiment

Chlorine Conversion by Hydrothermal Process



- Organic chlorine is reducing while inorganic chlorine is increasing
- Very less chlorine in condensed water; therefore, inorganic chlorine, instead of HCl, was formed by hydrothermal process → **inorganic chlorine washing!**

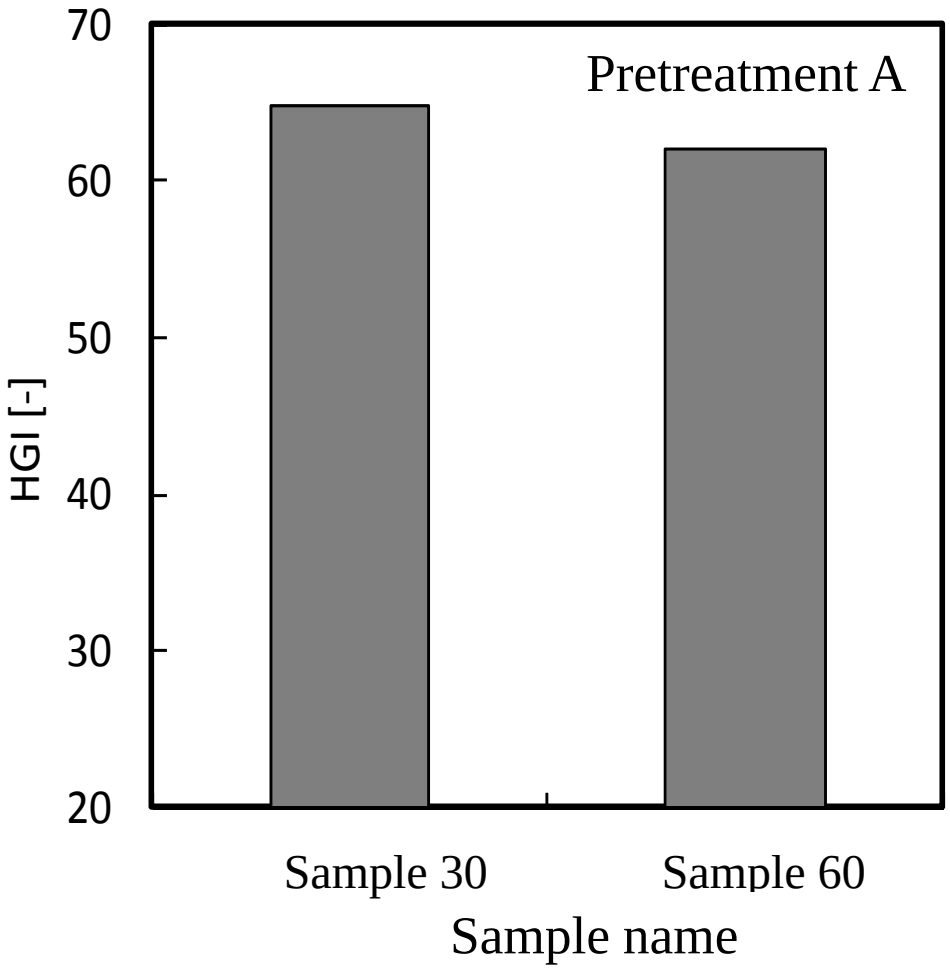
Chlorine Removal



Sample:Water ratio	1:1	1:2	1:4
Before Washing	1.432%	1.452%	1.413%
1st Washing	0.321%	0.143%	0.053%
2nd Washing	0.106%	0.062%	0.043%

By using sample to water ratio of 1:1, 2 times recycled washing was adequate to reduce the chlorine content down to 1060 ppm

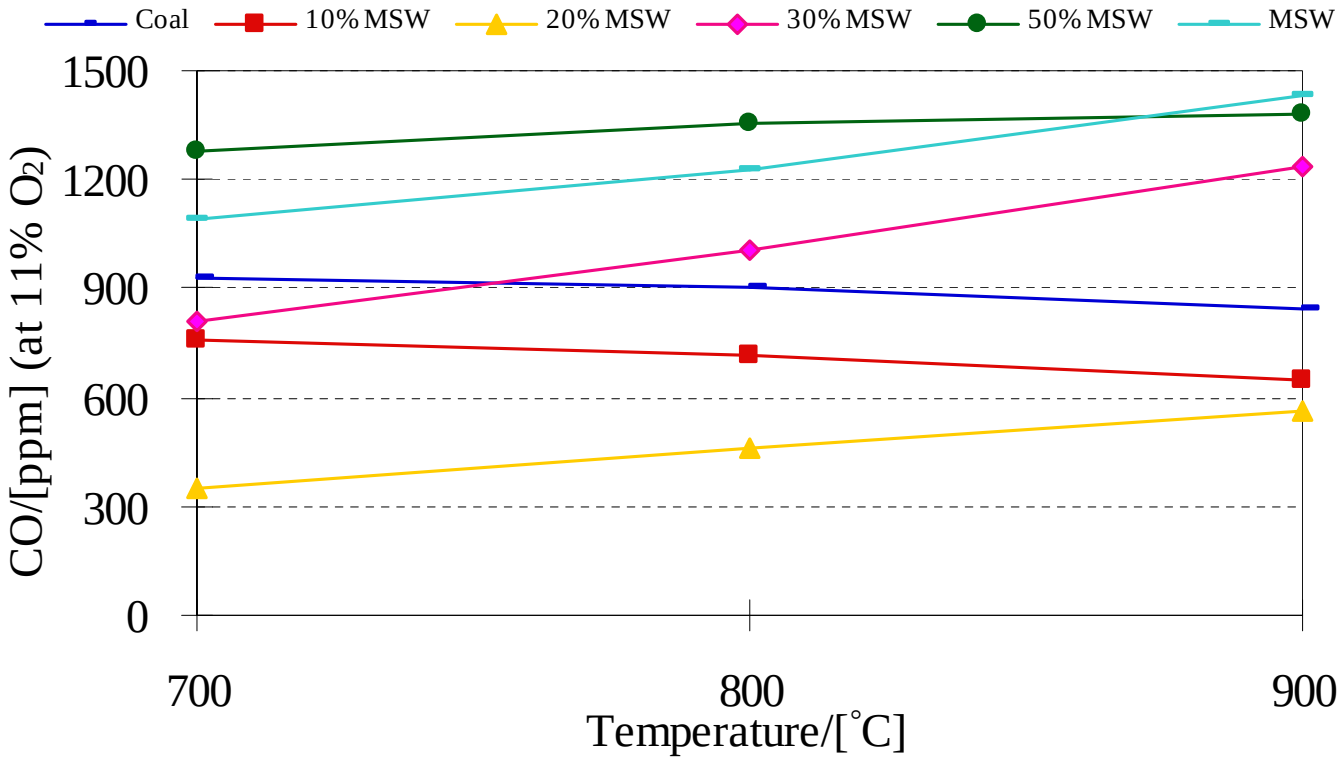
Grindability Test



Hydrothermal treatment product from MSW in 30 minutes holding period (Sample 30, left) and 60 minutes holding period (Sample 60, right).

Hydrothermal treatment product from MSW after Pretreatment A

Co-combustion Test with Coal



Carbon Content in Ash (%)

T(˚C)	Coal	10 % MSW	20 % MSW	30 % MSW	50 % MSW	MSW
700	15.34	14.89	14.29	14.19	15.58	17.23
800	12.01	11.03	10.87	10.73	12.86	19.33
900	8.04	7.45	7.63	8.12	10.23	22.32

Commercial Plant in Japan (MSW)

Volume(Φ1800×6000mm)	15m³
Loading volume	10m³
Rated Operating Pressure at reactor	1.5 MPa
Operating Temperature	190℃
Boiler output	2.0MPa

Commercial Plant in China (Shanghai, MSW)

② Waste-to-Fertilizer Technology

Sewage sludge treatment

Water content 80%

Hydrothermal treatment

Water content 85%

Mechanical dehydration

Separated water

Water content 55%

Fast natural drying
（24 hours）

Water content 10～20%

速効性の有機肥料 有機バイオ

粉体15kg袋詰

20L液肥

500ml液肥（一般家庭用）

※一般家庭用の500ml液肥は「ワタミファーム倶楽部」で販売しております。

500ml液肥（スプレー容器付）

￥1,800（送料込）

「有機バイオ」は有機物を水熱反応（200度200気圧）で処理した肥料です。
高温・高圧処理によって低分子化されたアミノ酸、オリゴ糖主体の肥料で、発酵タイプの肥料と比べて1/3量の使用で効果があります。

使用効果例

速効性があります！

低分子のアミノ酸とオリゴ糖が主成分のため、低温や曇天時に大きな効果が出ます。
稲の試験では、1ヶ月で通常の稲に比べ根量が1.5倍となる結果が出ています。

粉体は全層施肥でなく、溝施肥、穴肥、通路肥として使用すると効果的です。

液肥は界面活性効果があり、葉面散布、潅水、水田などに使用すると、育苗及び肥大期に効果的です。

Commercial Plant in China
(Sewage Sludge,100t/day, Inner Mongolia)

Three Reactors
(7.8m^3, 3MPa)

Coal Fired Boiler
(2t/h, 3MPa)

Animal feed Production by Hydrothermal Treatment

Solid feed

Liquid feed

Natural Drying

Solid

Liquid

Centrifuge

Fuel

Boiler

Vapor

Food residue

Reactor

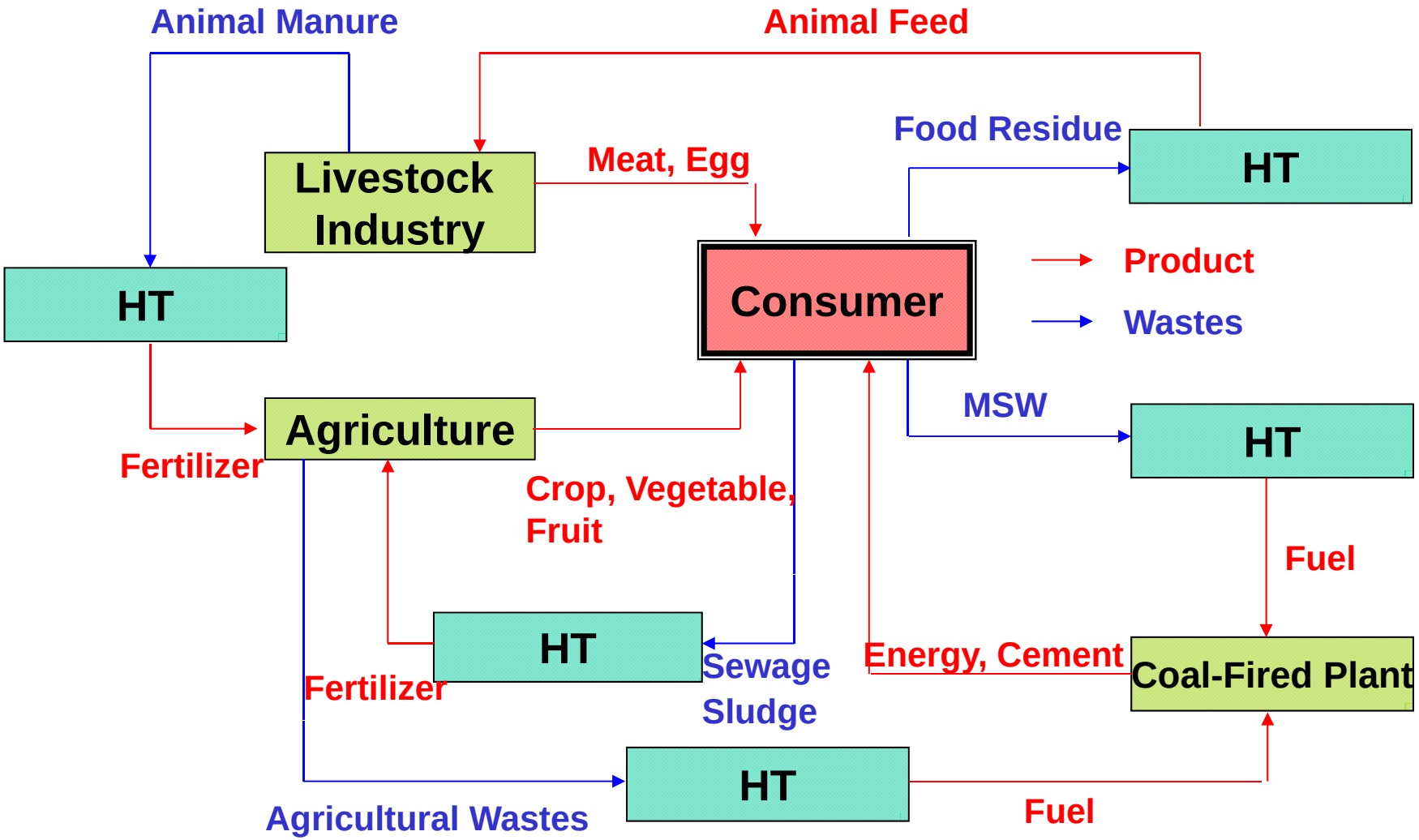
Motor

Waste water

Water treatment

Condenser

Product



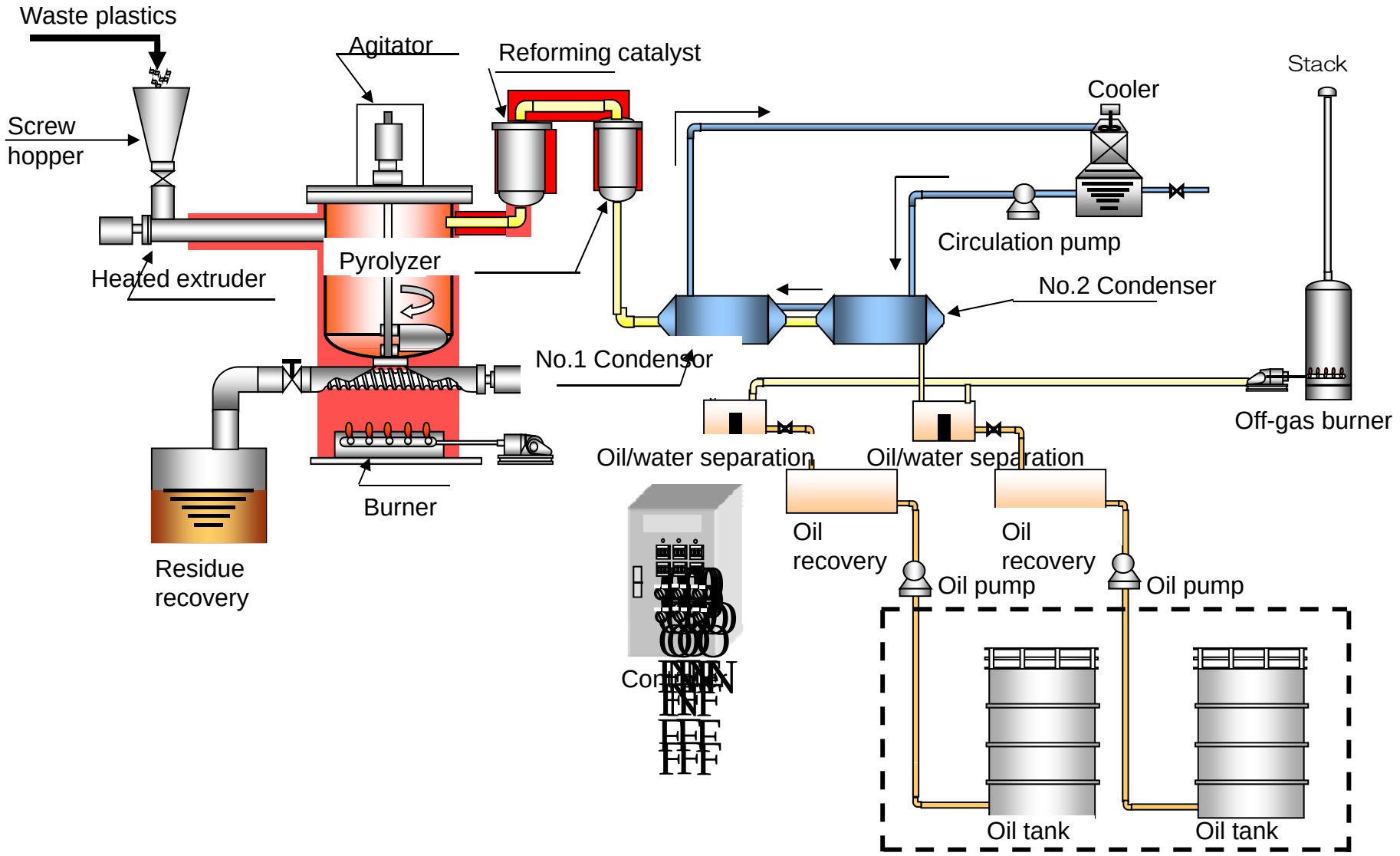
Waste-resource Circulation System

Economic Feasibility

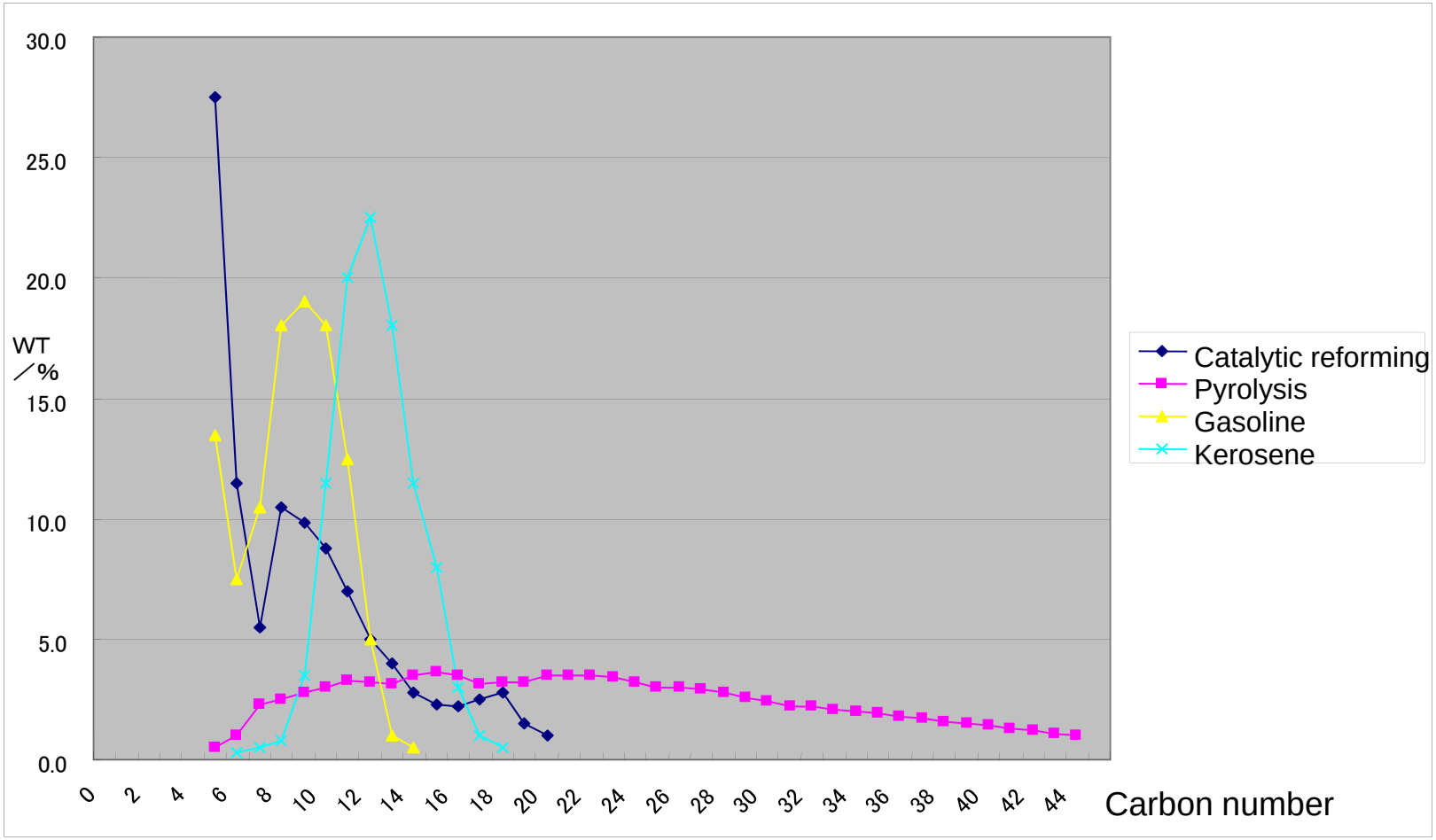
- Treatment capacity of MSW : 100tons/day
- Investment for full treatment plant with 2 reactors - $ 3Mn
- Moisture content of MSW : 65 %
- Production per annum on dry basis –12,600 MT (100MT X 0.35 X 360 days)
- Boiler fuel: 15% of RDF will be utilized as a boiler fuel – 1,890 MT
- Annual operation period: 360days
- Daily operation: 24 hours/day
- Maintenance cost/year (3% of the capital cost) - $ 90,000 per annum
- VC and FC – (labor, electricity…) - $ 60,000 per annum
- Capital cost (5 years depreciation) - $ 600,000 per annum
- Total operational cost - $ 750,000 per annum
- Production cost per MT of final product - $ 70 ($ 750,000/10,710 MT)

Pyrolysis Technology

Flow of oil production from waste plastics



Carbon number distribution



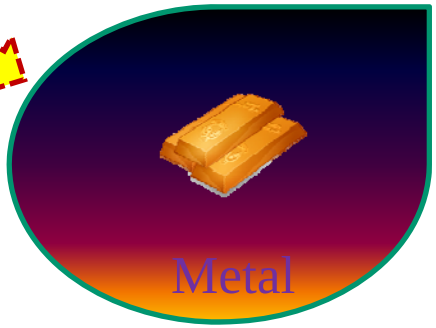
Pyrolytic Reformed Oil

Commercial Plant for Metal and Oil Recovery from Waste Mobile Phones and Computers （500kg/hour）

Recycling of E-Waste

Recycled oil

Carbonized solid



When E-wastes such as cellular phones and PC board are process by this technology, we can recover rare metals together with oil.

Economic Feasibility

- Treatment capacity of waste plastics : 10tons/day
- Investment for full treatment plant - $ 1.2 Mn
- Net oil production per annum –1,800,000 L (5,000 L X 360 days)
- Annual operation period: 360days
- Daily operation: 24 hours/day
- Maintenance cost/year (3% of the capital cost) - $ 36,000 per annum
- Labor cost/year - $ 20,000 per annum
- Capital cost (5 years depreciation) - $ 240,000 per annum
- Total operational cost - $ 296,000 per annum
- Production cost per liter of final oil product - ¢ 16.4 ($ 296,000/1,800,000 L)

Fuel Cost Reduction Possibility

Fuel	Heating Value (GJ/t)	Cost (US$/t)	per GJ Cost (US$/GJ)
Coal	24	200	8.3
RDF	20	70	3.5
Diesel Oil	45	1250	27.8
Pyrolysis Oil	43	164	3.8