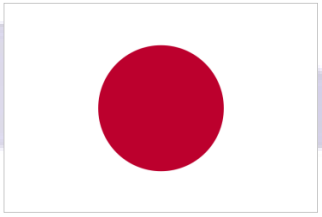
24th Jan, 2013 in Mongolia under the framework of NAMAs



TAIHEIYO CEMENT

Effective Utilization of Fly-Ash from Power Plant for Cement Production

YOSHIYUKI UENOYAMA

General Manager

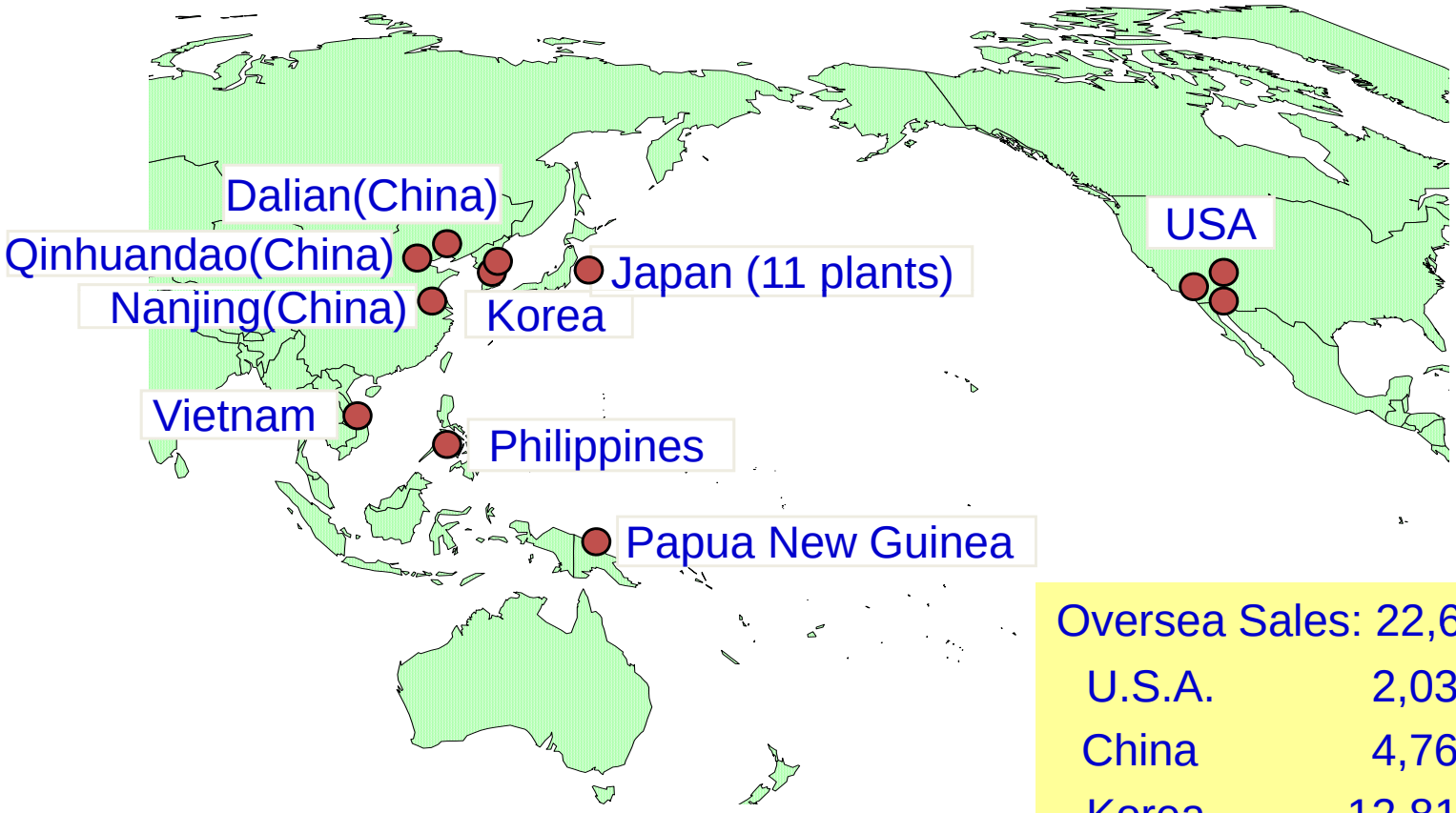
Green-Innovation Business Promotion Department

TAIHEIYO CEMENT CORPORATION

yosiyuki_uenoyama@taiheiyo-cement.co.jp

太平洋セメント株式会社

Taiheiyo Cement's activities span the world



Locations of Taiheiyo Group's cement plants

Oversea Sales: 22,649kt (2009)

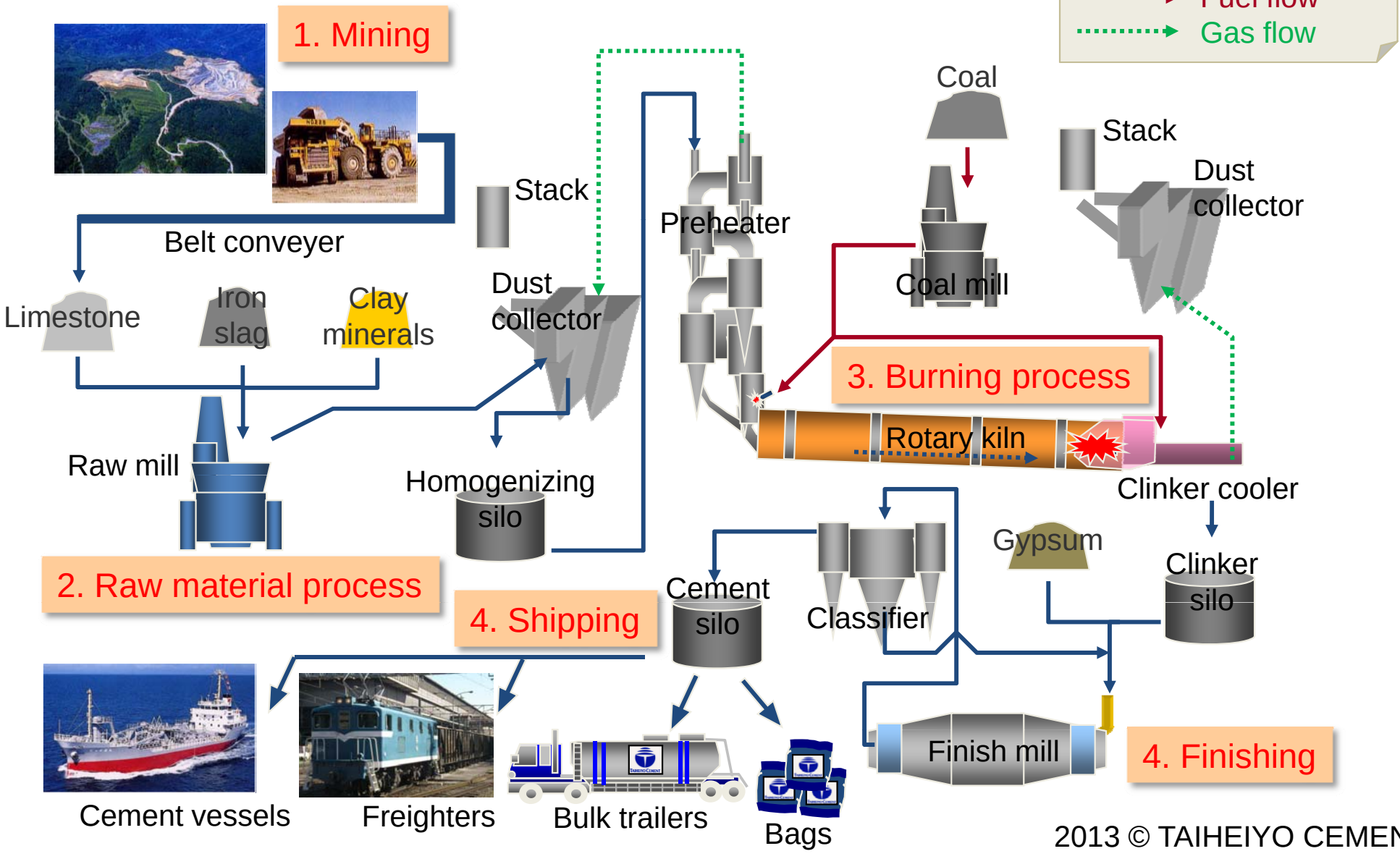
U.S.A.	2,035 kt	(9.0%)
China	4,766 kt	(21.0%)
Korea	12,815 kt	(56.6%)
Others	3,033 kt	(13.4%)

Domestic Sales:
14,829 kt + Export 5,009 kt

Contents

- Outline of dry process of cement production and energy efficiency
- Recycling - utilization of by-products and industrial waste including coal fly ash
- Taiheiyo's advanced technology for utilizing MSW incineration ash
- Conclusion

Typical cement production process



Raw material for cement

Cement is made from Limestone, Silica, Clay and Iron slag

Clay (dried)

Silica

Limestone

Iron slag

Limestone mine

Long distance belt conveyer

Limestone:
Occupying 70-80% of total raw materials and transported from a mine by a belt conveyer, for instance

Iron slag:
By-product of iron manufacturing

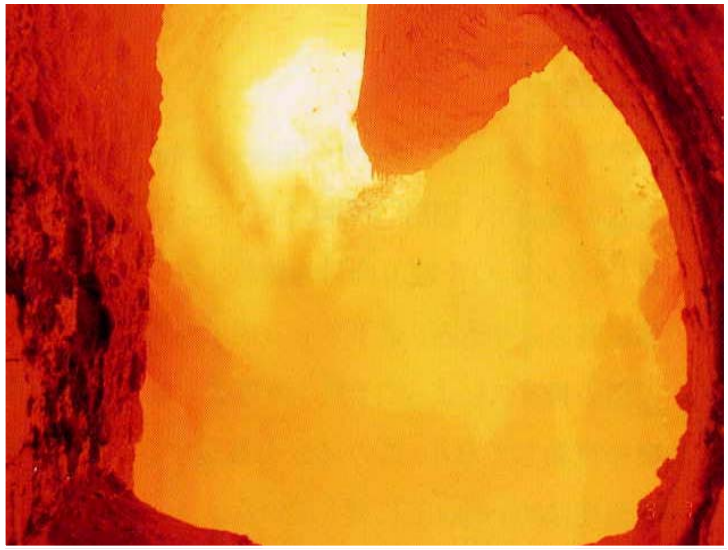
The composition of raw material effects property of cement

Burning process

Excellent cement can be manufactured by burning at very high temperature of 1450 ^{o}C

1. Raw material is heated gradually by hot gas in the preheater
2. Preheated raw material is burned in the rotary kiln at a temperature of 1450 ^{o}C
3. Approximately 30 min of burning, the raw material turns red-hot lava like lumps

Preheater (back) of 65m in height and Rotary kiln (fore) of 5.4m in diameter, 95m in length, 3200 ton/day production capacity, 250 kW powered



Inside view of Rotary kiln operating at a very high temperature of 1450 ^{o}C

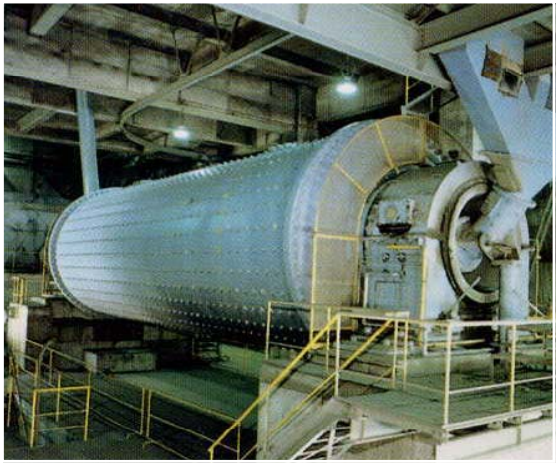
Finishing process

Grinding clinker with gypsum into fine powder, that is cement

Clinker

Gypsum

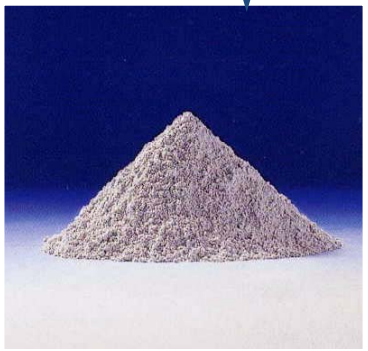
To control setting time of cement



Finish mill

Power required: 3875 kW
Milling capacity: 120 ton/h
Size: 4.6m dia. and 13.1m

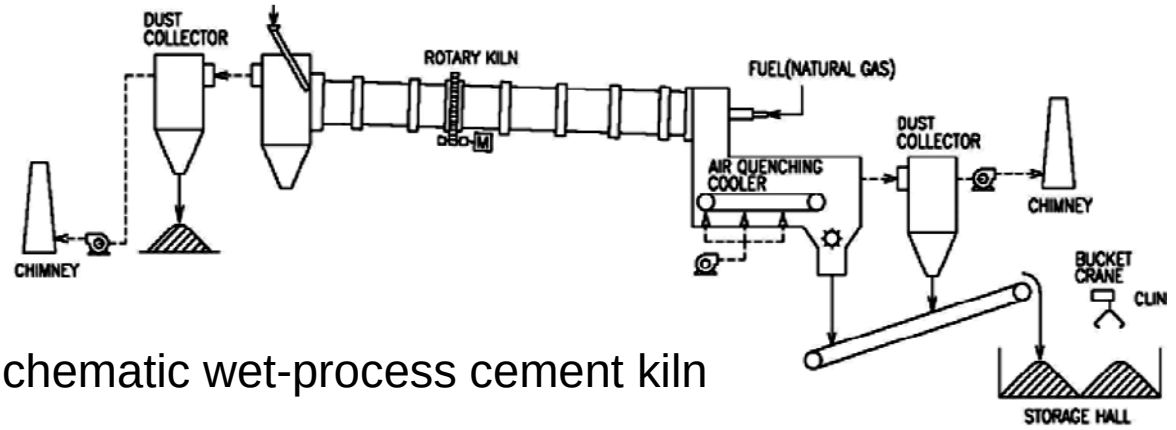
Classifier



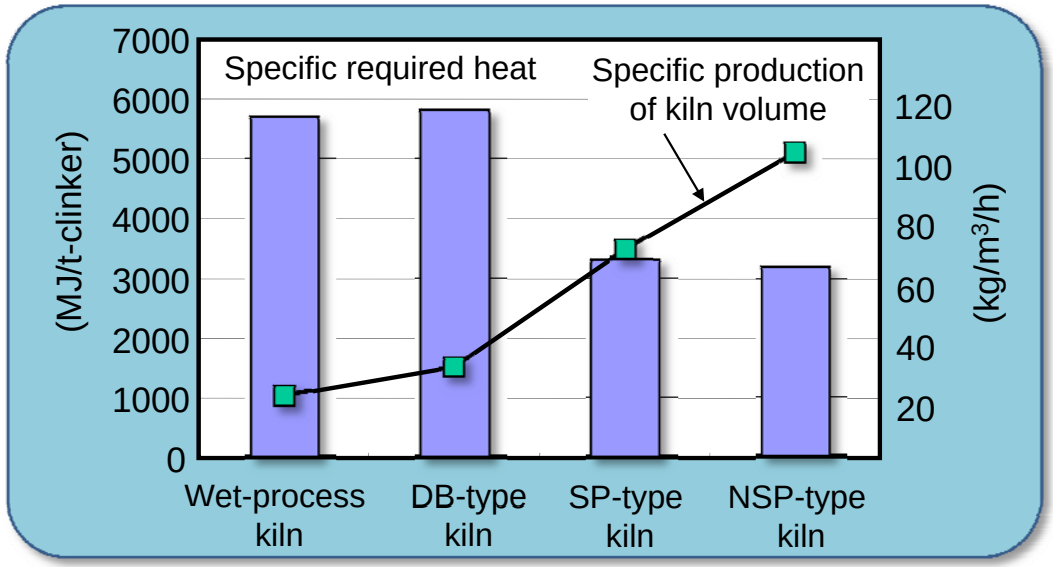
Cement

Difference of wet-process kiln in energy efficiency

Providing slurred raw material directly into rotary kiln

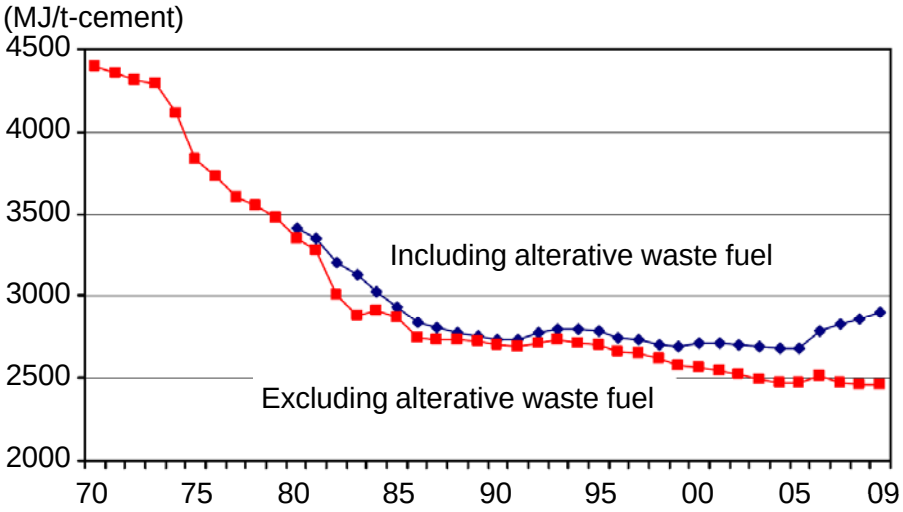


Schematic wet-process cement kiln



Specific required heat and production on various types of kiln

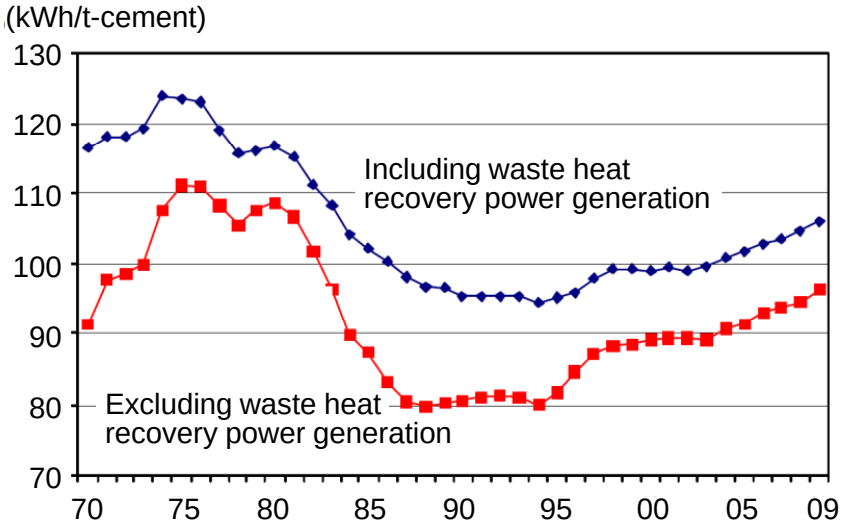
Specific required energy and energy efficiency



Transition of unit heat energy

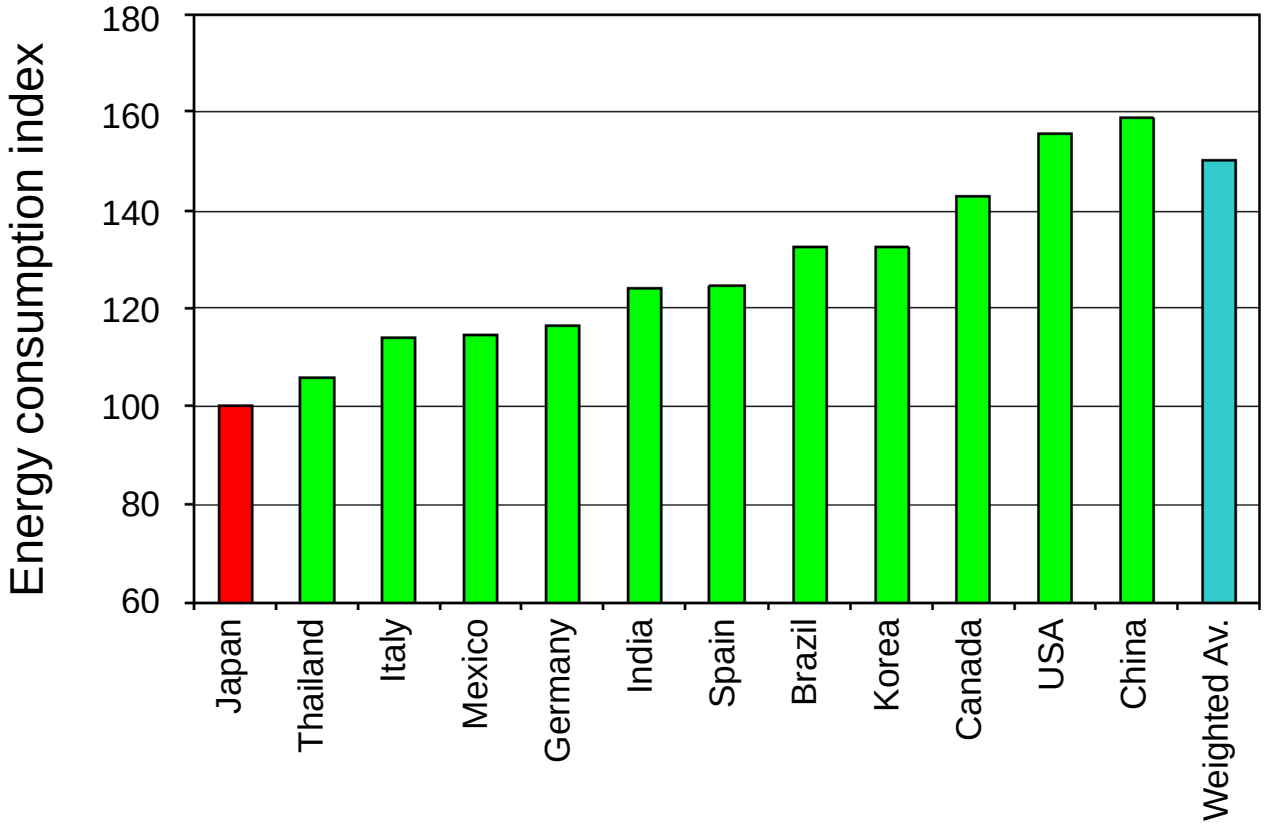
Typical technology on heat efficiency
- NSP type burning system
- Five-cyclone cascaded preheater
- Air beam type clinker cooler
- Pulverizing coal constant feeder
- Automated quality monitoring

Typical technology on power efficiency
- Vertical type mill
- Pre-grinding system
- High efficiency classifier
- High efficiency blower fan



Transition of unit power

The top runner on energy efficiency

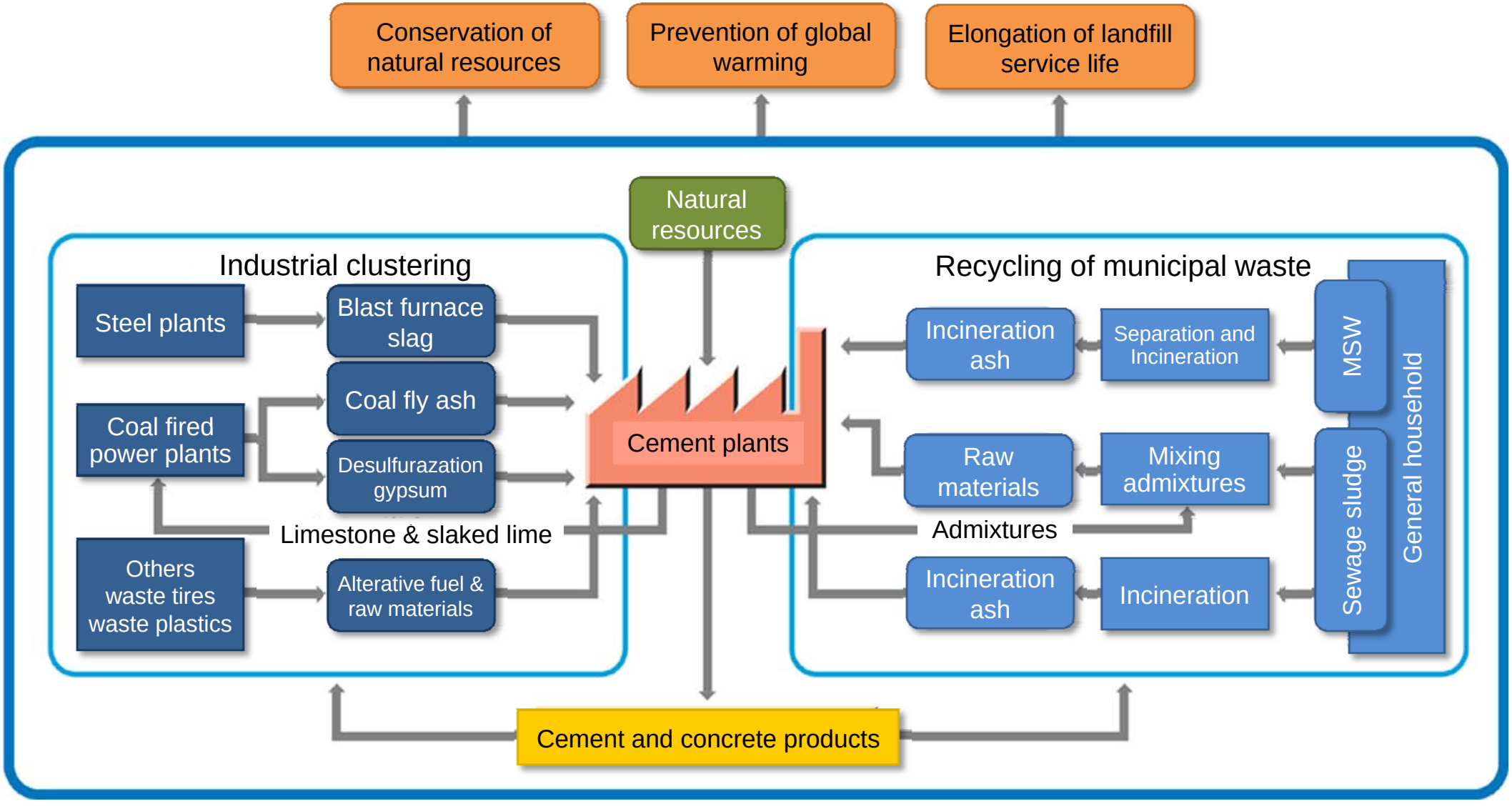


Comparison of Energy consumption index on clinker and cement manufacturing

Reference :The International Energy Agency (IEA), Worldwide Trends in Energy Use and Efficiency 2008

Business scheme of material recycling

Practically performed “Waste to Resources” business scheme on cement plants



Utilizing by-products and waste

Why by-products and waste can be utilized at cement plants?

Because:

1. Cement majorly contains CaO, SiO_2, Al_2O_3 and Fe_2O_3.
   Waste containing such components may be used as raw material.

2. Combustible waste may be used as fuel for burning process in the rotary kiln.

3. No secondary waste is generated because cinders of combustible waste will be consumed as raw material.

4. Hazardous materials such as dioxin can be decomposed in the rotary kiln under the high temperature of 1450 ^{o}C.

Chemical compositions of waste

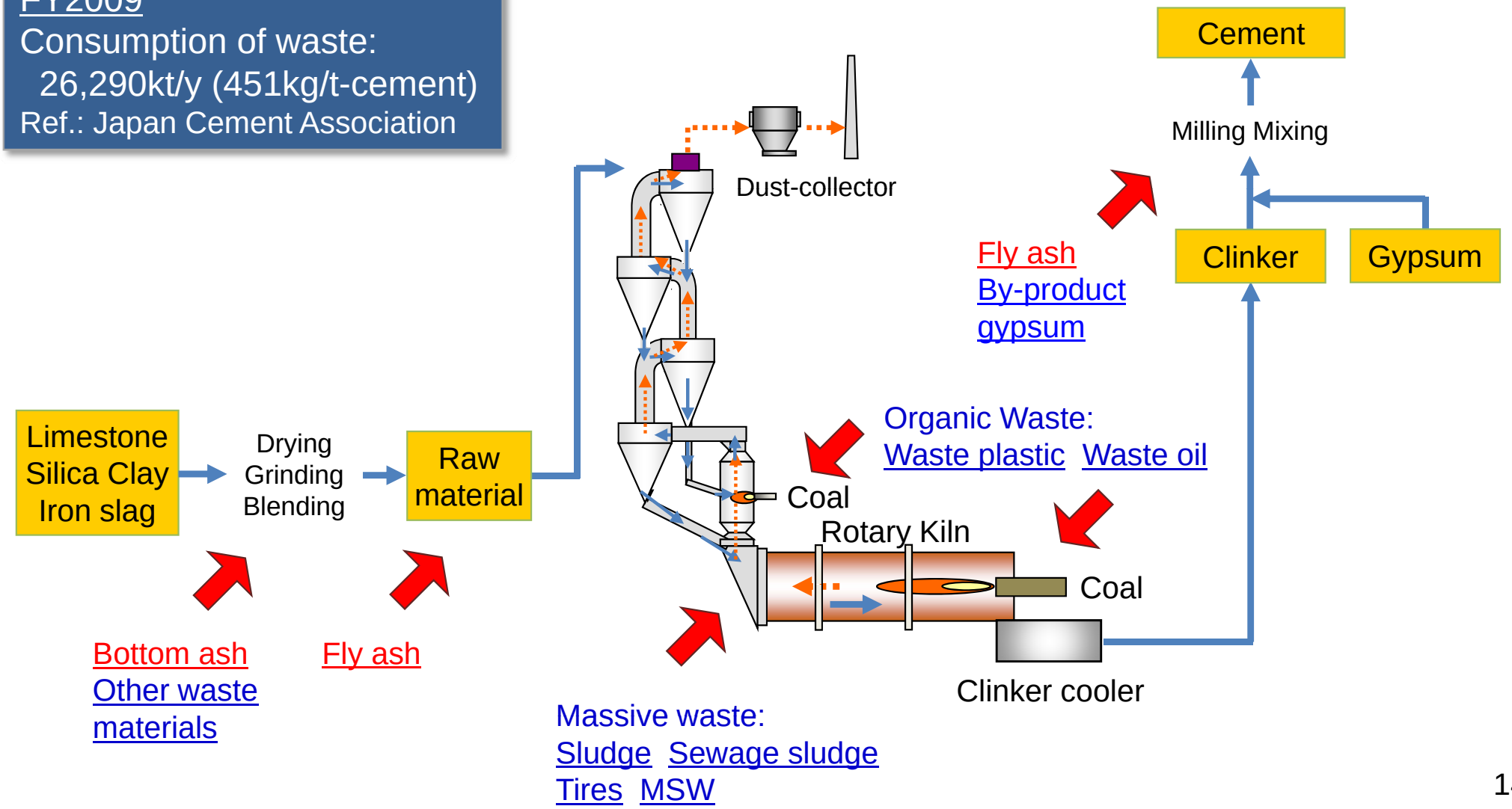
The reason why by-products and waste can be utilized at cement plants

		Composition of major elements (%)				
		SiO_2	Al_2O_3	Fe_2O_3	CaO	Total Alkali Na_2O eq.
Ordinary Portland Cement		20~23	3.8~5.8	2.5~3.6	63~65	0.3~0.7
Major natural resources	Limestone	~4	~2	~2	47~55	~0.2
	Clay	45~80	10~30	3~10	~5	2~6
	Silica	70~95	2~10	~5	~2	0.5~3
By-products and waste	Coal fly ash	40~65	10~30	3~10	5~20	0.5~20
	Blast Furnace slag	20~45	10~20	~5	30~60	0.1~0.5
	Sewage sludge	20~50	20~50	5~15	5~30	1~5
	Casting sand	50~80	5~15	5~15	~5	1~5

Clark numbers: O=49.5 Si=25.8 Al=7.56 Fe=4.70 Ca=3.39 ....

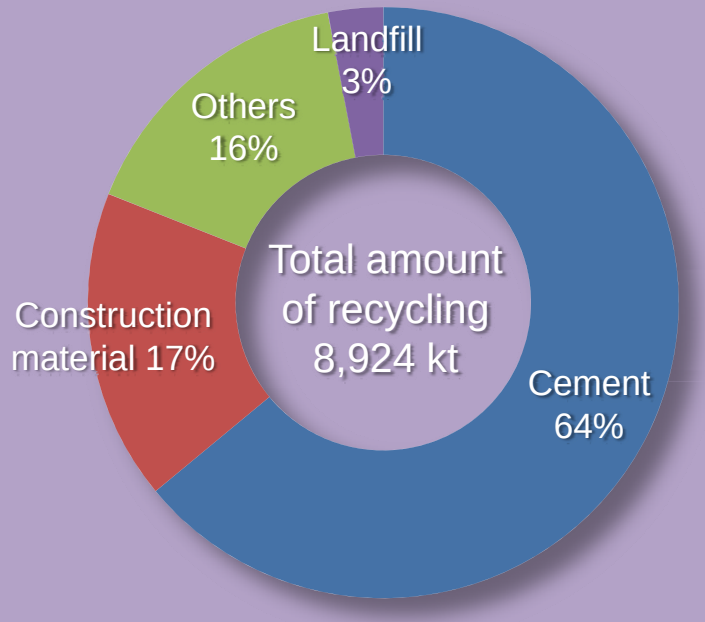
Fly- and Bottom-ash recycling on cement production

FY2009
Consumption of waste:
26,290kt/y (451kg/t-cement)
Ref.: Japan Cement Association

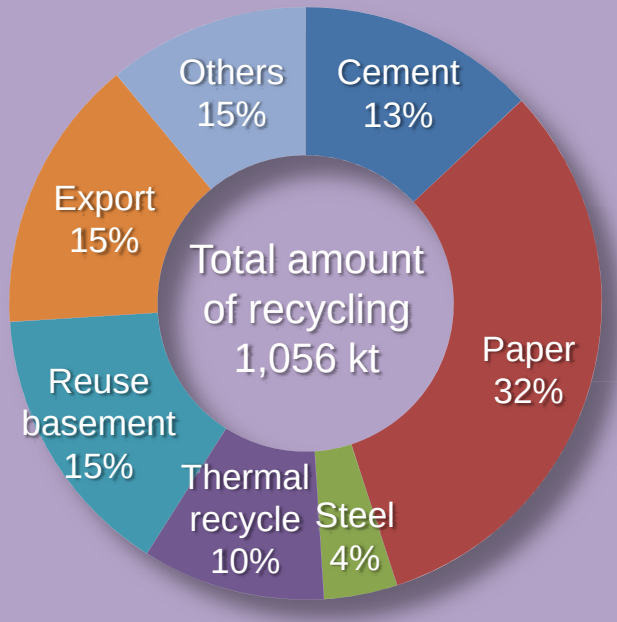


Cement industry as an MVP of recycling

Approximate 26 million tons of industrial waste including 6 million tons of coal fly ash was recycled in cement industry in 2009



Usage of coal fly ash



Usage of waste tires

References: Japan Fly Ash Association and Japan Automobile Tyre Manufacturers Association

Utilizing by-products and waste

Organic waste is potentially used as fuel

Waste tires

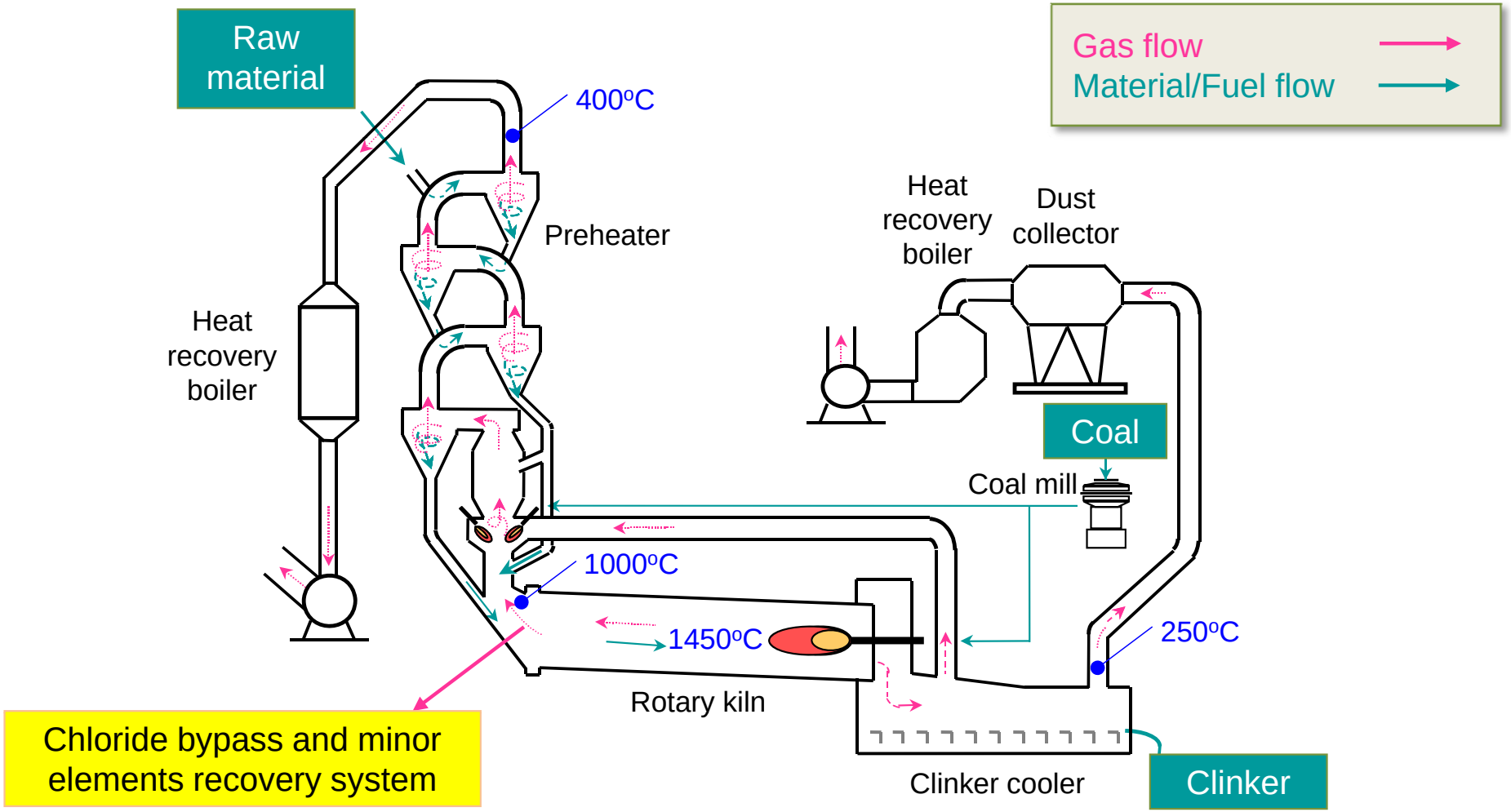
Waste plastics

Wood chips and other biomass

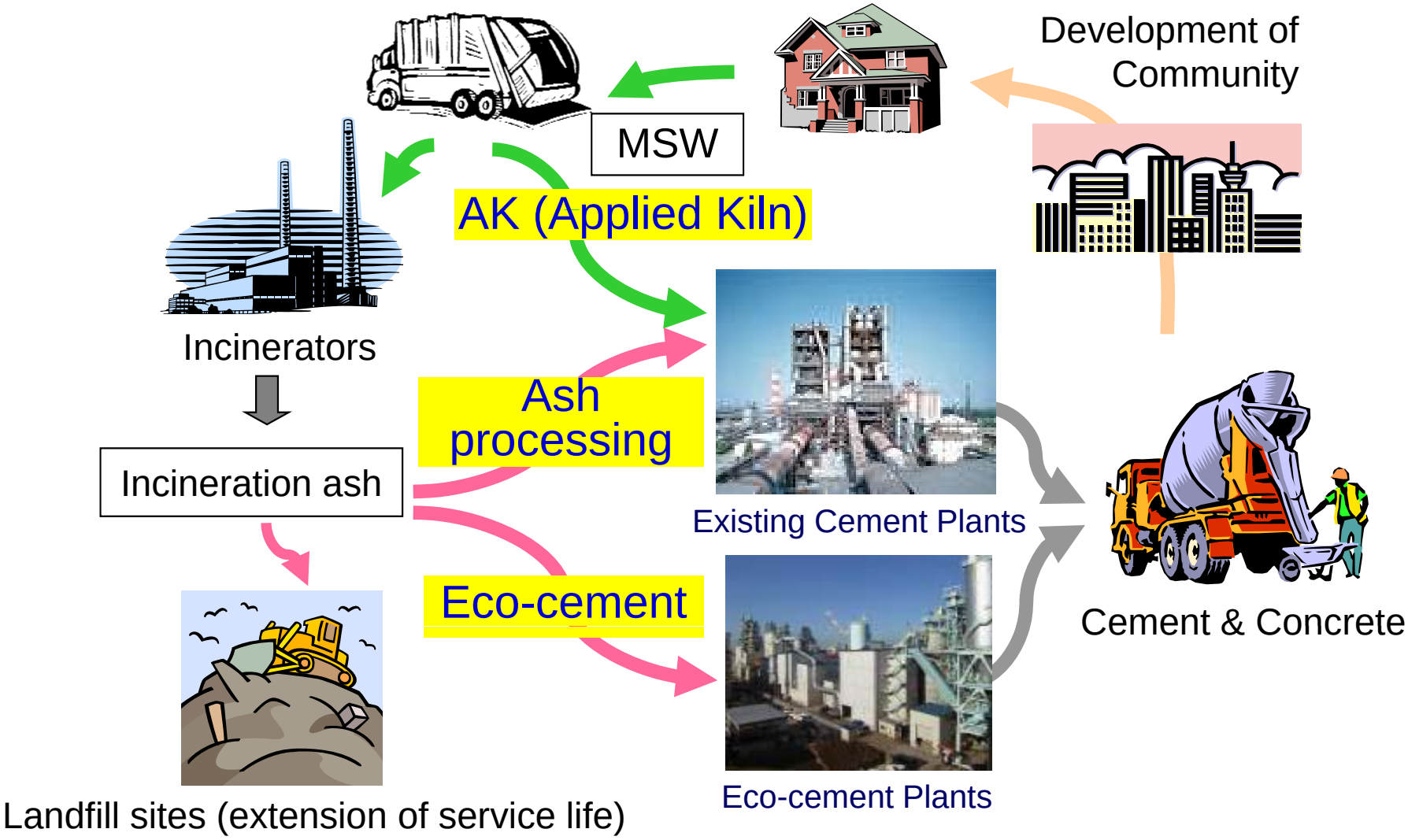
Recycled oil

Key technology of bypass system

Enables to utilize respectively inorganic waste as raw material and organic waste as fuel, and to recover minor elements



Waste to Resources on MSW management



AK（Applied Kiln）System

Crushing and separating

Aerobic bio-digester

Saitama Plant, TCC

Hidaka City:
Population 50,000
MSW 15,000 ton/y

Incinerators

Cement production line making use of digested MSW

Ash processing systems

Eco-cement plant

Futatsuduka Landfill, Tokyo

One third of MSW in Tokyo has been recycled as Eco-cement since 2006.
Tokyo Metropolitan Government has constructed the plant in their landfill site and operation has been commissioned to TCCs subsidiary.

- Input MSW (as incineration ash) 300t/d
- Output Eco-cement 430t/d

Conclusion

1. Coal fly ash generated at thermal power plants can be recycled as alternative clay raw material in large quantities and continuously.

2. The cement manufacturing process with advanced quality and process controls enables to recycle by-products and waste generated by other industries as alterative raw material and fuel.

3. By means of installing Chloride bypass technology, the cement plant can recycle municipal solid waste (MSW) and its incinerated ash as raw material.

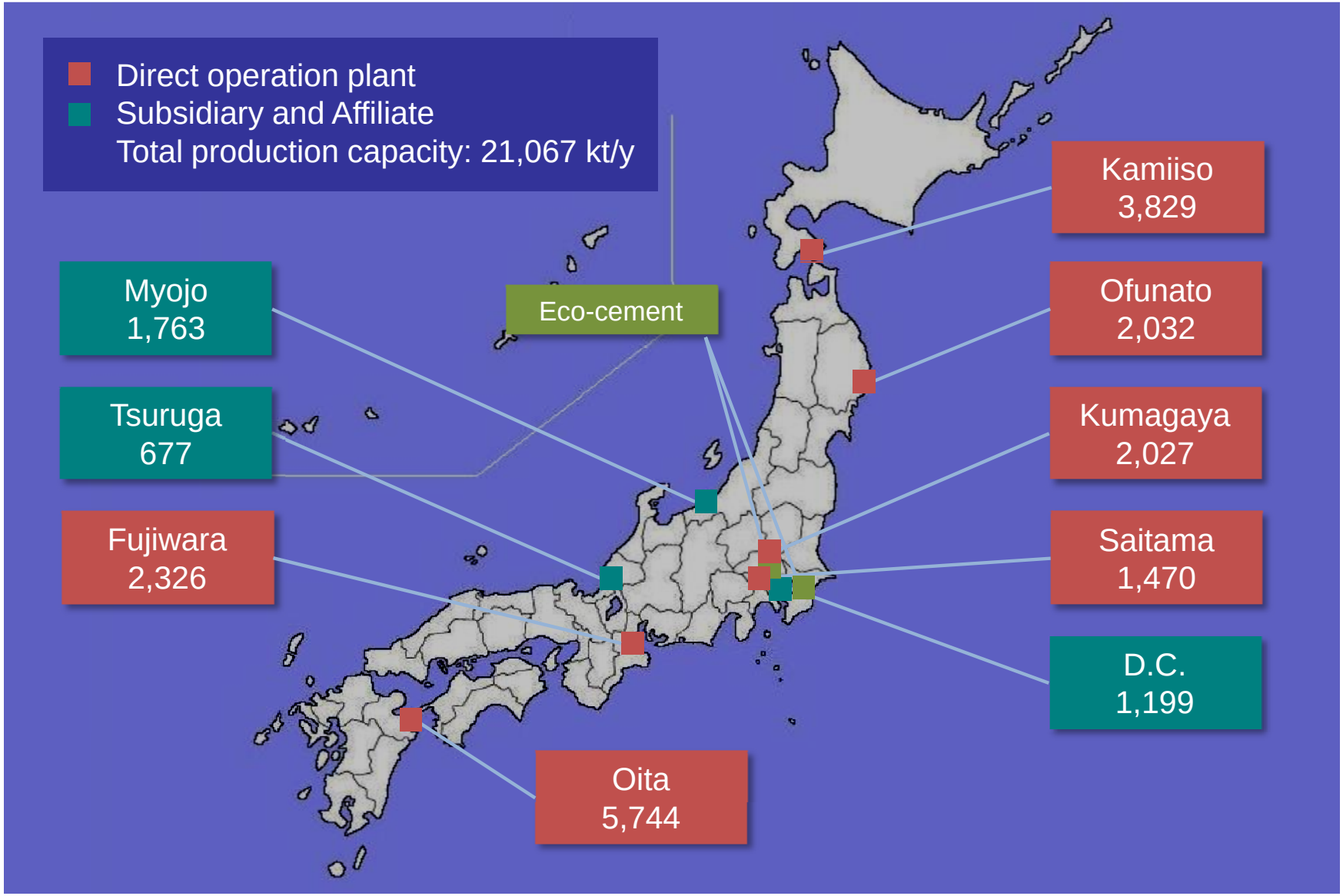
4. Taiheiyo Cement has accumulated advanced technologies and experiences related environment as mentioned above and energy efficiency as well, and intends to consult with possible customers and to provide such technologies.

Thank you for your attention.

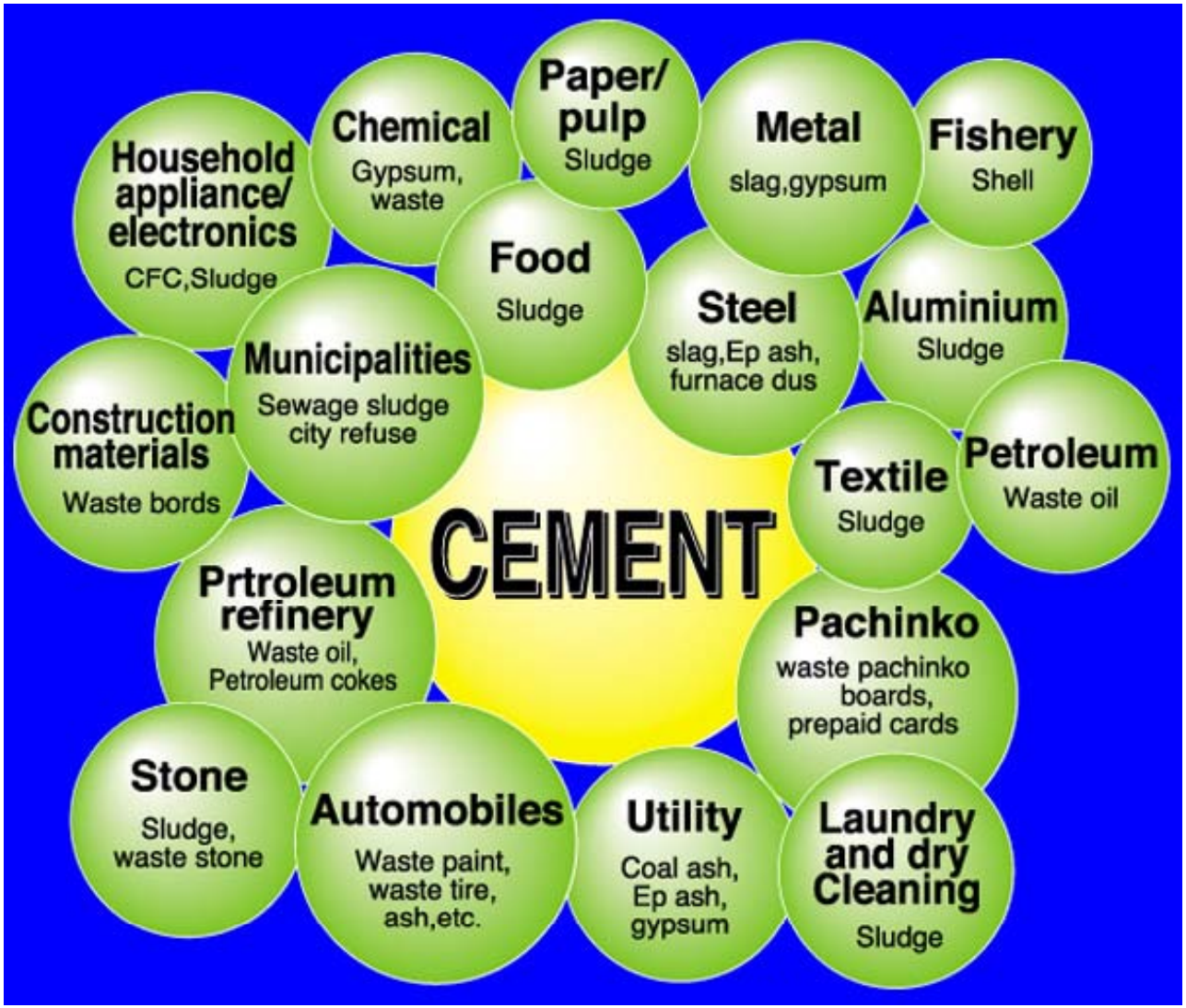
Баярлалаа !

Thank you for your attention

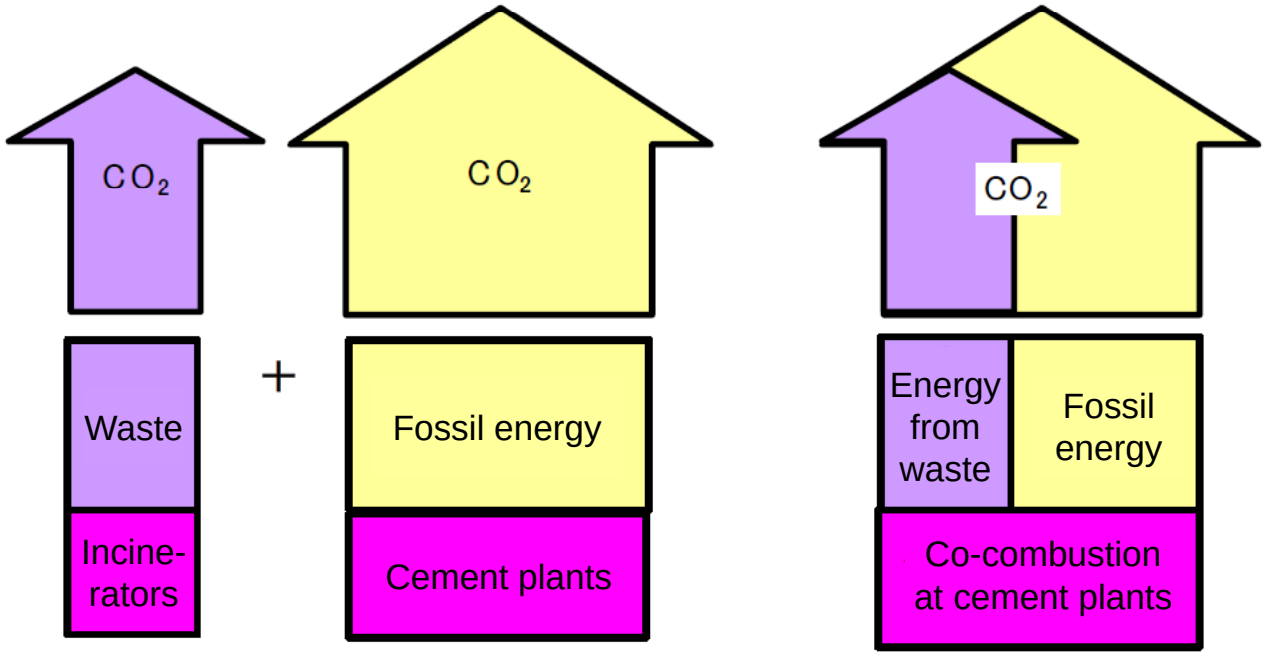
Locations of Domestic Plants



Recycling systems clustered on cement industry



Reducing CO_2 Emission by utilizing waste as fuel

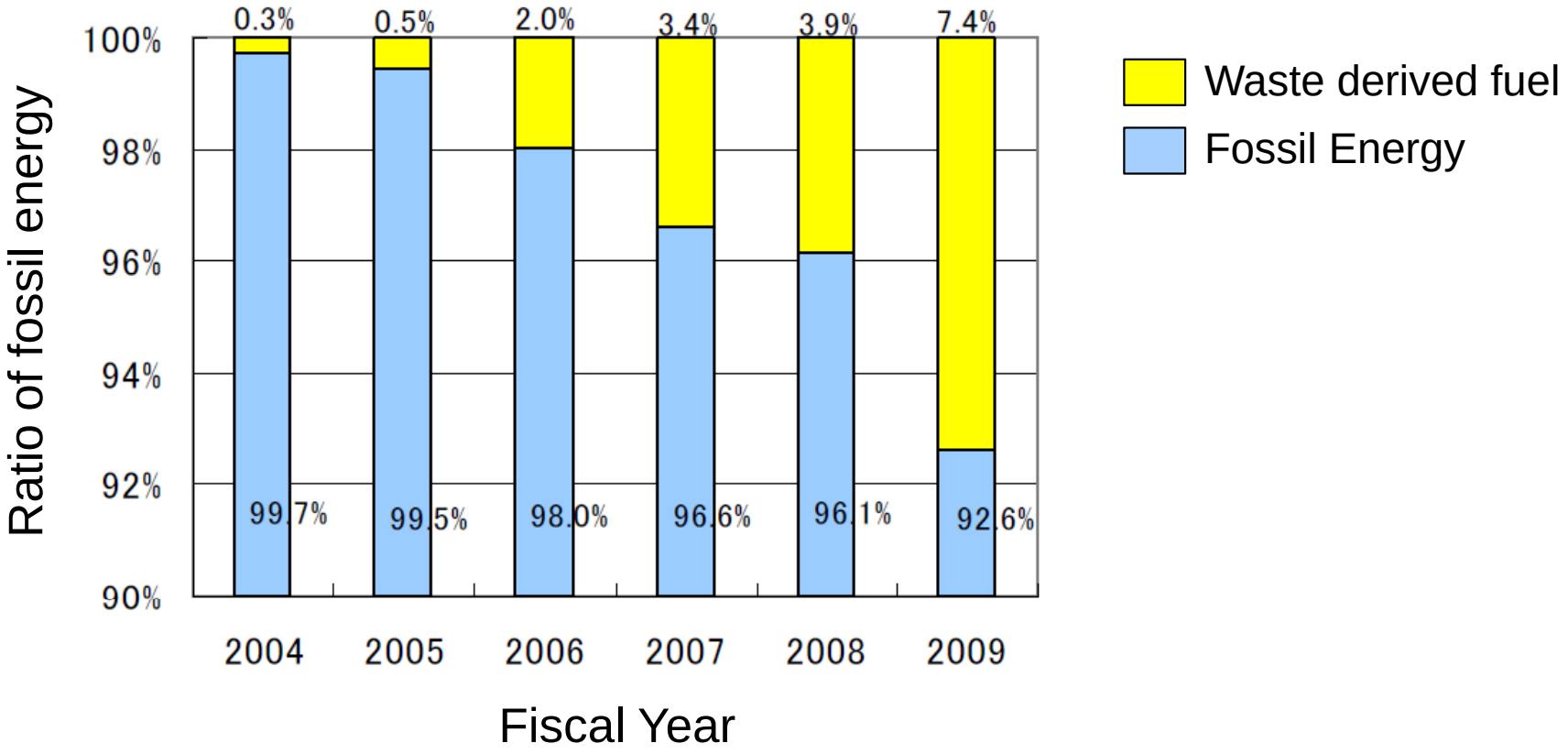


Reference: CEMBUREAU, Alternative Fuels in Cement Manufacture, 1997
http://www.cembureau.be/Documents/Publications/
Alternative_Fuels_in_Cement_Manufacture_CEMBUREAU_Brochure_EN.pdf

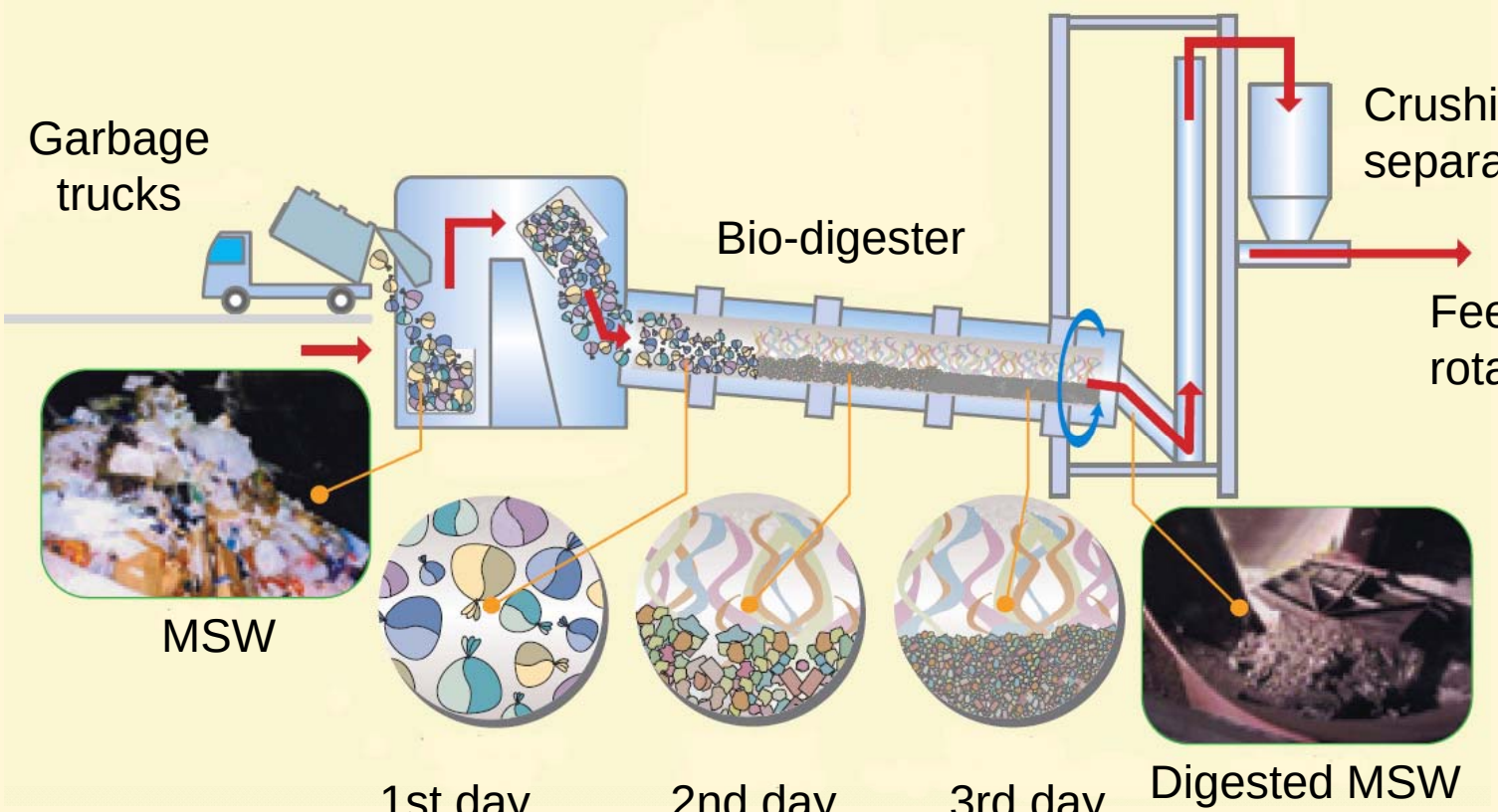
Utilizing by-products and waste

Transition of ratio of waste derived fuel

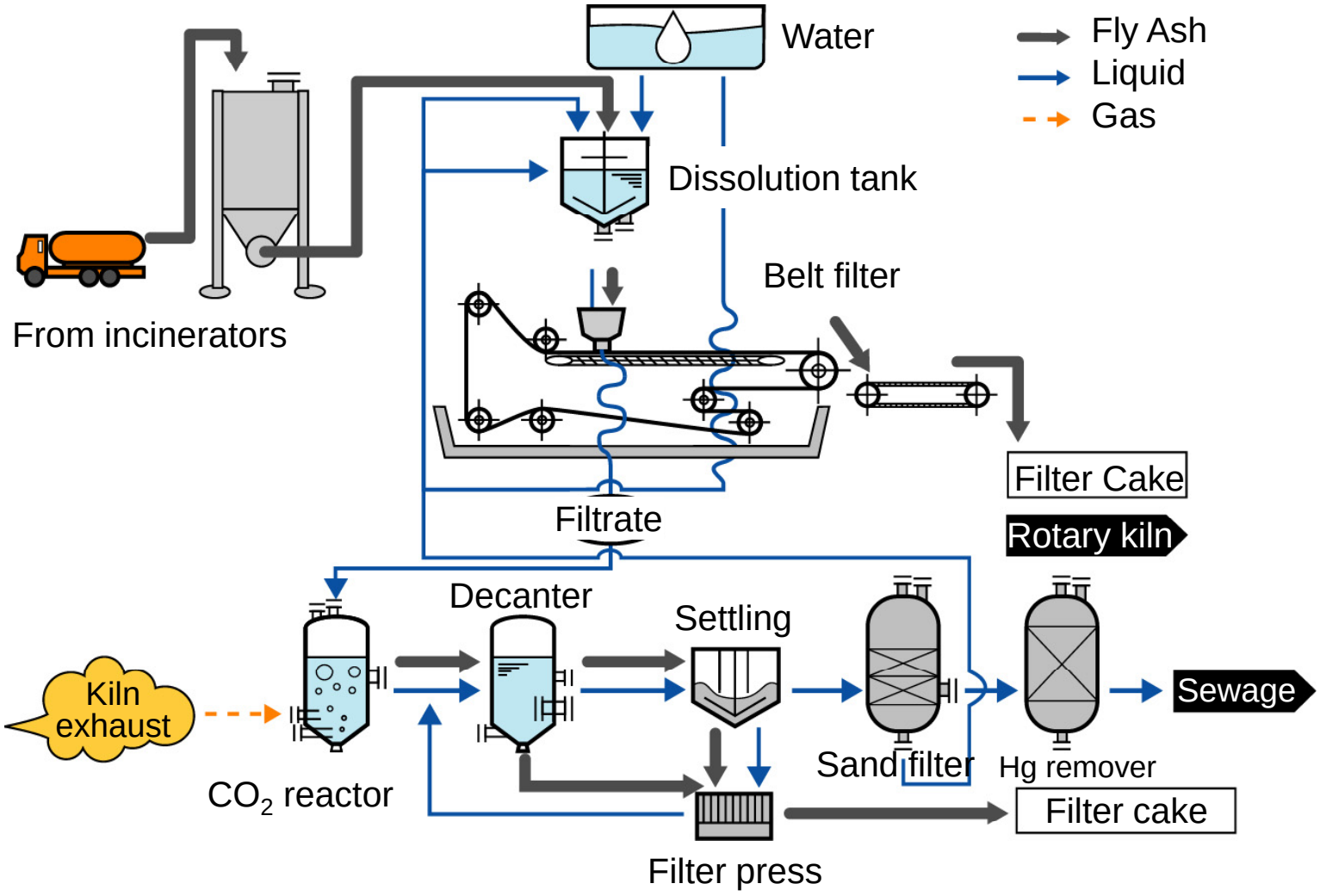
Reference: Japan Cement Association



Technical configuration of AK System



Fly ash processing system



Advantages of Eco-cement

✓ More ash can be recycled

Approximately 50% or more of incineration ash
and less natural limestone can be used as raw material.

✓ Standards provide easy use of Eco-cement

Eco-cement is regulated in JIS (Japanese Industrial Standards),
and can be used easily for practical purposes.

✓ Heavy metals can be recovered

Some of heavy metals, such as Cu, Pb and Zn can be recovered
from collected dust.