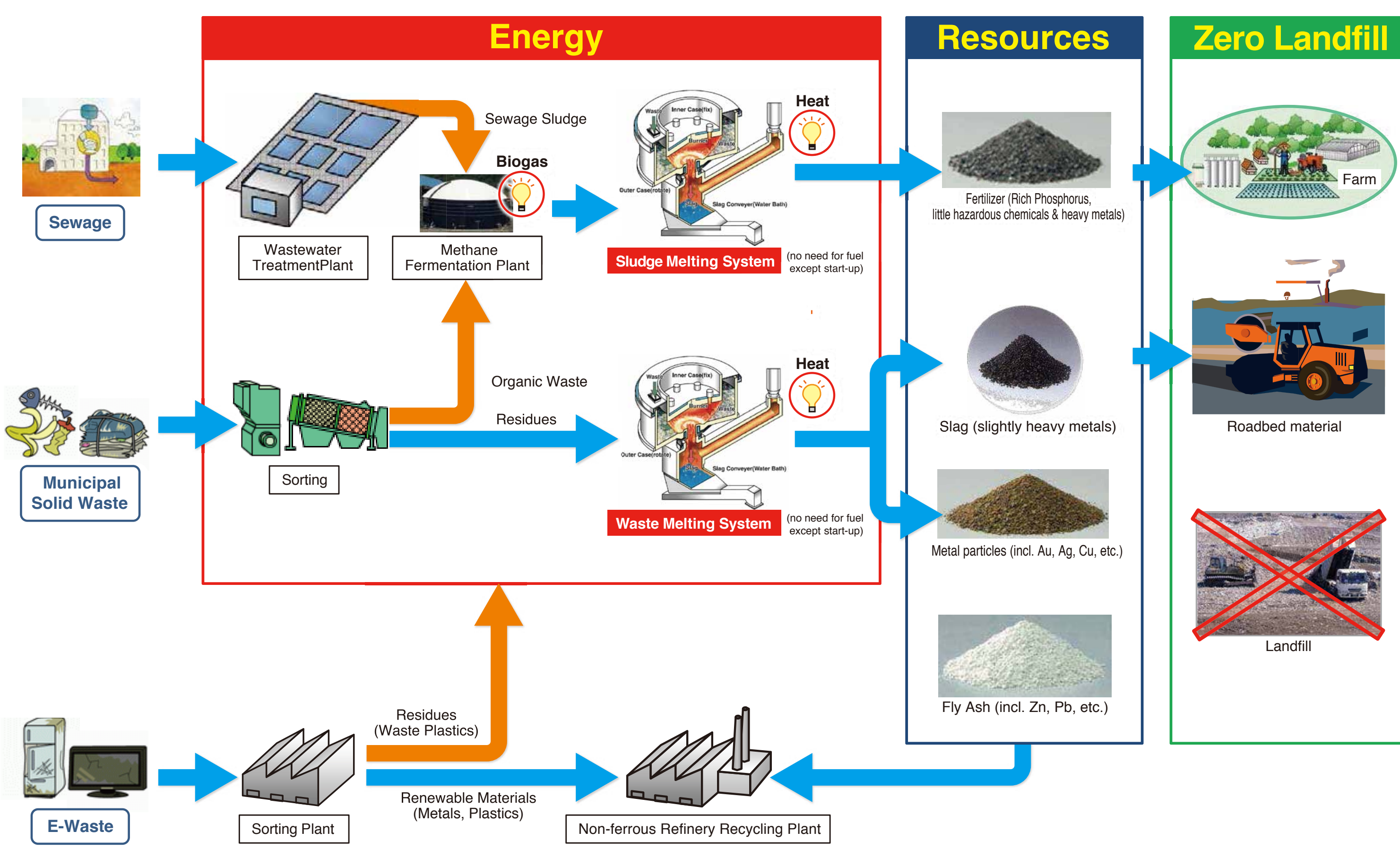


Solution for Wastewater & Waste Management

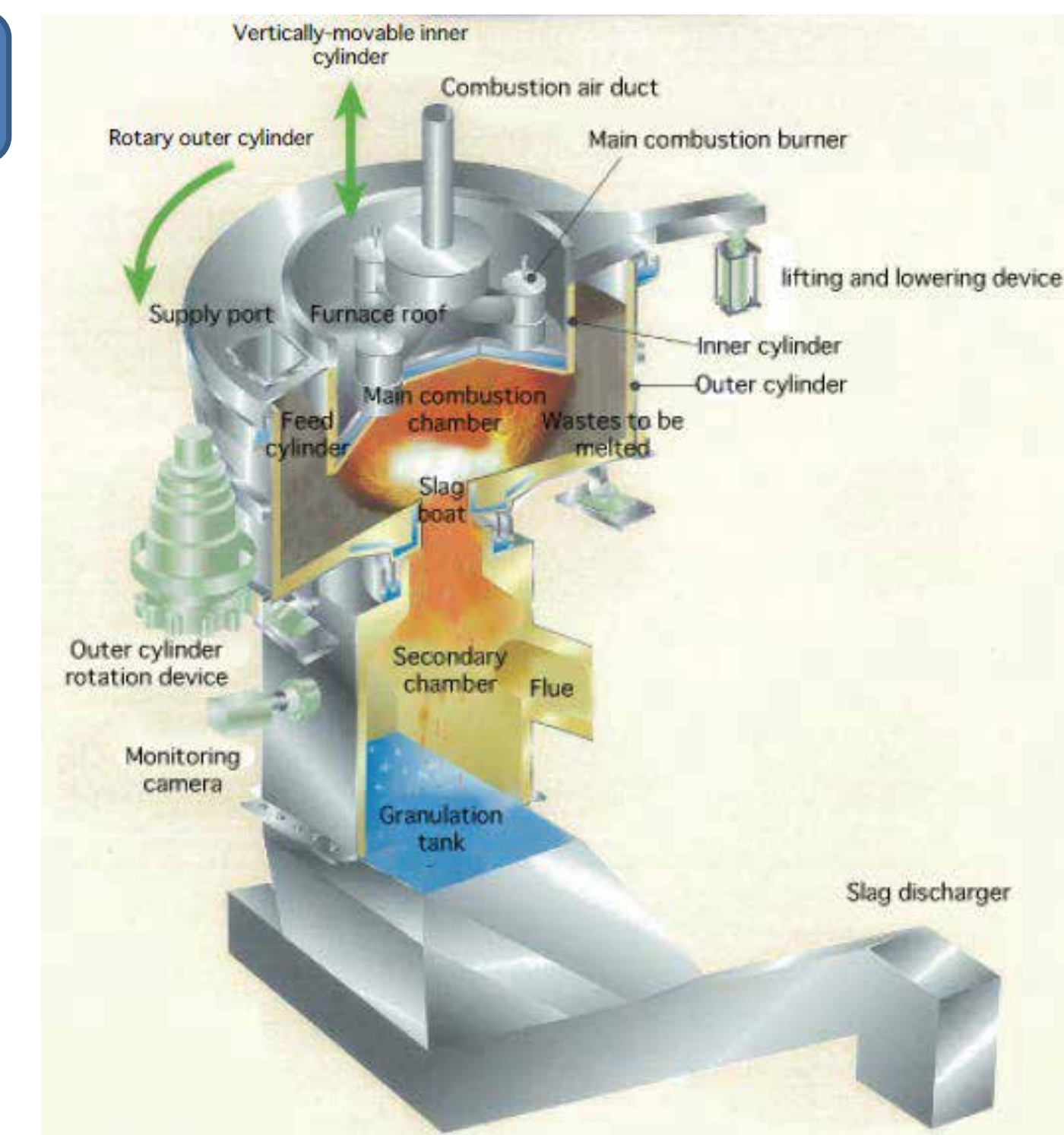
Our Concept Waste to **Energy** & Waste to **Resource** / **Zero Landfill** by 100% Recycle



Kubota Surface Melting Furnace

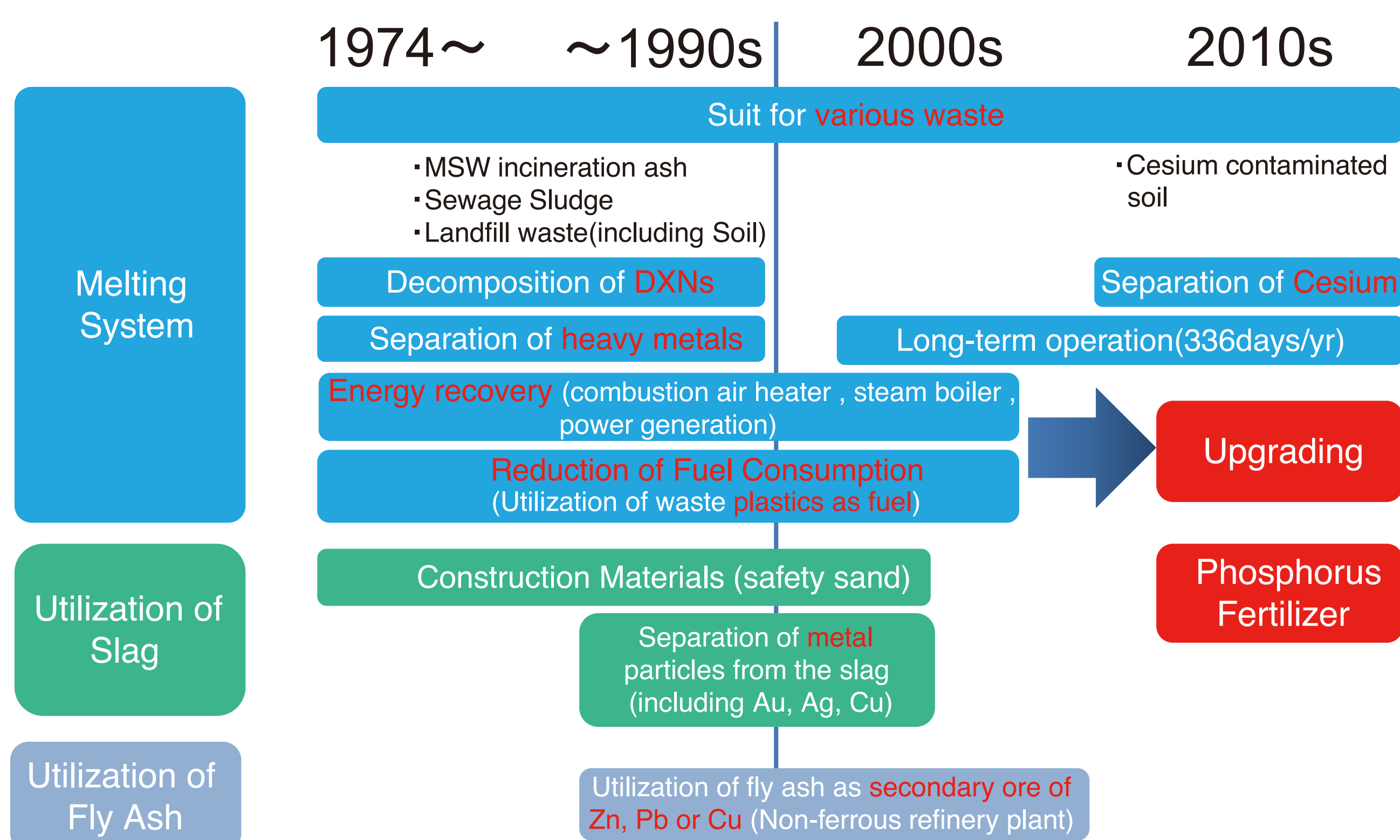
Key technology for separation and purification from wide variety of wastes.

- ▶ **Wide variety of wastes are acceptable.**
Wet / Dry
Combustible / Incombustible
Bulky wastes : after pretreatment (< 30mm)
- ▶ **Continuous and stable feed :**
The waste are fed into the furnace by continuous outer cylinder rotation.
- ▶ **High temperature treatment : 1250~1350°C**
Organic hazardous substances such as DXNs, PCBs, POPs are decomposed in the furnace.
- ▶ **Recovery of Resources**
 - ✓ Separation of heavy metals from slag : Heavy metals such as Pb, Cd, Zn, Hg are separated from slag and condensed into fly ash.
 - ✓ Immobilization of phosphorus in slag with high recovery rate (> 80%).
- ✓ 40 years history, More than 30 track records



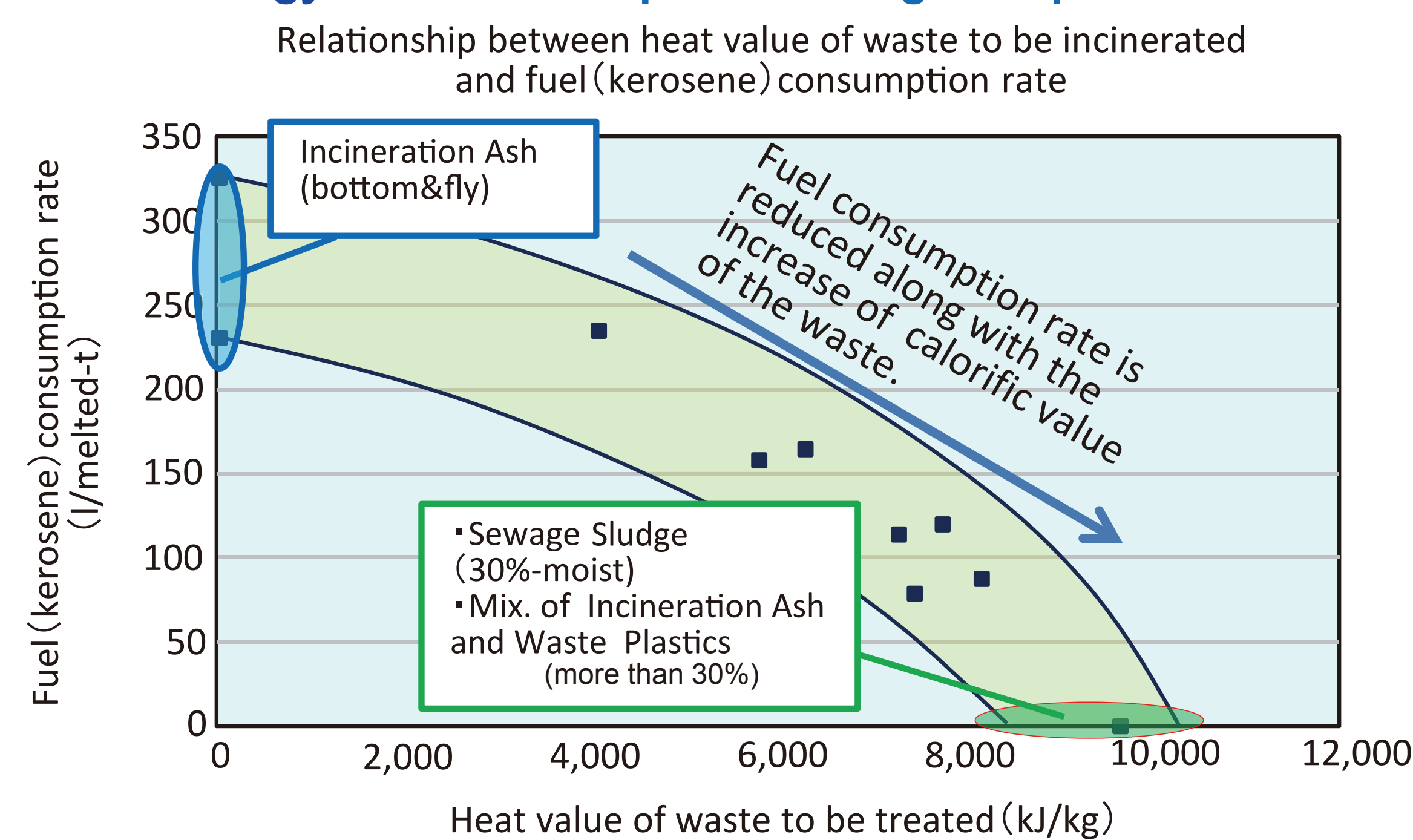
Schematic diagram of KUBOTA Surface Melting Furnace

History of Kubota Surface Melting Furnace



How can we melt Sludge/Waste with no fuel ?

- ▶ **Combustible wastes such as sewage sludge, waste plastics are energy source to keep furnace high temperature.**



Project Example —Illegal Dumping Site Remediation by Melting System—

[Teshima project(Japan)]

- ▶ Outline of the project
 - ✓ Commissioned: 2003
 - ✓ Capacity: 200t/d (100t x 2)
 - ✓ Waste type: Illegally dumped waste: 96%
Municipal solid waste: 4%
 - ✓ Energy recovery: The exhaust heat is collected as steam and reused



Table: Actual achievement of treatment and the state of effective utilization

		FY2003	FY2004	FY2005	FY2006	FY2007	FY2008	FY2009	FY2010	FY2011	FY2012	FY2013	Total	Reused to
Teshima Waste (input)	Melt(KSMF)	26,472	52,243	53,186	51,261	53,183	58,983	66,130	68,653	65,181	65,057	64,428	624,777	—
	Incinerator (Klin-type)	136	836	759	936	1,027	1,521	3,885	6,089	5,538	5,638	4,402	30,767	—
	Rocks(Wash)	73	219	81	24	17	93	138	201	276	257	633	2,012	—
	Total	26,681	53,298	54,026	52,221	54,227	60,597	70,153	74,943	70,995	70,952	69,643	657,556	—
Products	Slag	11,095	32,399	34,706	32,114	31,428	30,751	34,851	33,843	34,709	33,950	34,317	344,162	⇒ Concrete aggregate
	Copper	273	405	450	626	519	492	609	790	851	966	941	6,922	⇒ Non Ferrous Smelting
	Ferrous materials	17	324	330	348	322	381	581	770	653	619	587	4,933	⇒ Steel making
	Aluminium	88	48	58	58	215	232	409	291	418	495	336	2,650	⇒ Al Smelting
	Fly ash	1,180	2,404	2,355	1,976	2,118	2,295	2,496	2,958	2,563	2,732	2,251	25,327	⇒ Non Ferrous Smelting
	Rocks	63	200	75	21	16	81	104	104	267	251	609	1,789	⇒ Backfilling material

- ▶ More than 600kt wastes were treated
- ▶ All by-products are reused : **Landfill site is Urban Mine !!**



Reference

1. Melting municipal waste incineration residue

No.	Customer	Melting furnace throughput capacity	Wastes to be melted	Fuel type	Inner diameter of furnace (mm)	Facility (furnace) size	Construction completion date
1	Ishihara City Environmental Center	12.3t/d × one furnace (18.5t/24h)	Incinerated ash: 55% Fly ash: 45%	Kerosene	3.2	118t/day (59t/24h × two furnaces)	March, 1987
2	Sayama City Clean Center	15t/d × one furnace	Incinerated ash: 67% Crushed bulky wastes: 33%	Kerosene	3.5	100t/day (50t/24h × two furnaces)	March, 1991
3	Niigata City (old Shirose Sanitary Center Associations) Shirose Green Tower	7t/16h × one furnace (10.5t/24h)	Incinerated ash: 100%	Bunker A	2.8	100t/day (50t/16h × two furnaces)	October, 1994
4	JFE Kariyo Solutions Corporation [Ryugasaki Local Refuse Disposal Associations] [Clean Plaza Ryu]	12t/d × two furnaces	Incinerated ash: 59.6% Fly ash: 40.4%	Bunker A	2.8	180t/day (90t/24h × two furnaces)	July, 1999
5	Ishihara City Environmental Center	24t/d × one furnace	Incinerated ash: 18.7% Fly ash: 13.4% Landfilled solid waste: 67.9%	Bunker A	3.8	118t/day (59t/24h × two furnaces)	January, 2000
6	Hitachi Zosen Corporation [Nishimurayama Wide Area Administrative Affairs Associations] [Sagae District Clean Center]	14t/d × one furnace	Incinerated ash: 58.5% Fly ash: 21.9% Other plastics: 19.6%	Bunker A	3.0	100t/day (50t/24h × two furnaces)	March, 2001
7	JFE Kariyo Solutions Corporation [Urao City Clean Center]	16.3t/d × one furnace	Incinerated ash: 63.9% Fly ash: 16.1%	Bunker A	3.0	150t/day (75t/24h × two furnaces)	March, 2002
8	JFE Kariyo Solutions Corporation [Sayama City Clean Center]	8t/d × one furnace	Incinerated ash: 60% Fly ash: 40%	Kerosene	2.3	80t/day (40t/24h × two furnaces)	November, 2002
9	Mogami Wide Area Municipal Administrative Affairs Associations [Eco-Plaza Mogami]	14t/d × one furnace	Incinerated ash: 66.3% Fly ash: 33.7%	Kerosene	3.0	90t/day (45t/24h × two furnaces)	February, 2003
10	Itto City Environmental Center	10t/d × one furnace	Incinerated ash: 53.9% Fly ash: 46.1%	Kerosene	2.6	70t/day (35t/24h × two furnaces)	March, 2003
11	HI Corporation [Waste Disposal of Tokyo's 23 Cities Administrative Affairs Associations] [Tamagawa Clean Plant]	30t/d × one furnace	Incinerated ash: 63.1% Fly ash: 36.9%	City gas	4.4	300t/day (150t/24h × two furnaces)	June, 2003
12	Kawasaki Plant Systems Ltd. [Hirakata City] [Hirakata City Tobu Clean Plant]	24t/d × two furnaces (including one spare furnace)	Incinerated ash: 78% Fly ash: 22%	City gas	3.6	240t/day (120t/24h × two furnaces)	December, 2008

2. Melting incineration residue of municipal waste and pyrolysis residue

No.	Customer	Melting furnace throughput capacity	Wastes to be melted	Fuel type	Inner diameter of furnace (mm)	Facility (furnace) size	Completion of construction
1	Mie Prefecture Environmental Conservation Agency Waste Disposal Center	66.5t/d × three furnaces	Incinerated residue: 93.4% Pyrolysis residue: 5.1% Animal and plant residues: 1.5%	Kerosene	6.5	240t/day (80t/24h × three systems)	December, 2002

3. Gasification melting furnace

No.	Customer	Melting furnace throughput capacity	Wastes to be melted	Fuel type	Inner diameter of furnace (mm)	Facility (furnace) size	Completion of construction
1	Isakita Aira Environment Management Associations [Mirakani Public Center]	7.6t/d × two furnaces	Pyrolysis residues	Kerosene	3.0	40t/24h × two furnaces	March, 2003
2	HI Corporation [Chita City Clean Center]	14t/d × two furnaces	Pyrolysis residues	Kerosene	3.8	130t/day (65t/24h × two furnaces)	March, 2003

4. Melting landfilled solid waste (illegally dumped waste)

No.	Customer	Melting furnace throughput capacity	Wastes to be melted	Fuel type	Inner diameter of furnace (mm)	Facility (furnace) size	Completion of construction
1	Kagawa Prefecture Kagawa Prefecture Naoshima Environmental Center	100t/d × two furnaces	landfilled solid waste	Bunker A	8.5	200t/day (100t/24h × two furnaces)	September, 2003

5. Melting industrial waste incineration residue

No.	Customer	Melting furnace throughput capacity	Wastes to be melted	Fuel type	Inner diameter of furnace (mm)	Facility (furnace) size	Completion of construction
1	Sincere Corporation	25t/d × two furnaces	Incinerated ash, fly ash	Kerosene	3.0	130t/day (65t/24h × two furnaces)	May, 1998
2	Kubota Bettech Incorporated [Kikakami Recycling Center]	18t/d × one furnace	Incinerated ash, fly ash	Bunker A	3.4	101t/day (101t/24h × one furnace)	October, 2003
3	Saga Prefecture Environment Clean Foundation [Clean Park Saga]	23t/d × one furnace	Pyrolysis residues	Kerosene	3.8	84t/day (42t/24 × two furnaces)	March, 2009

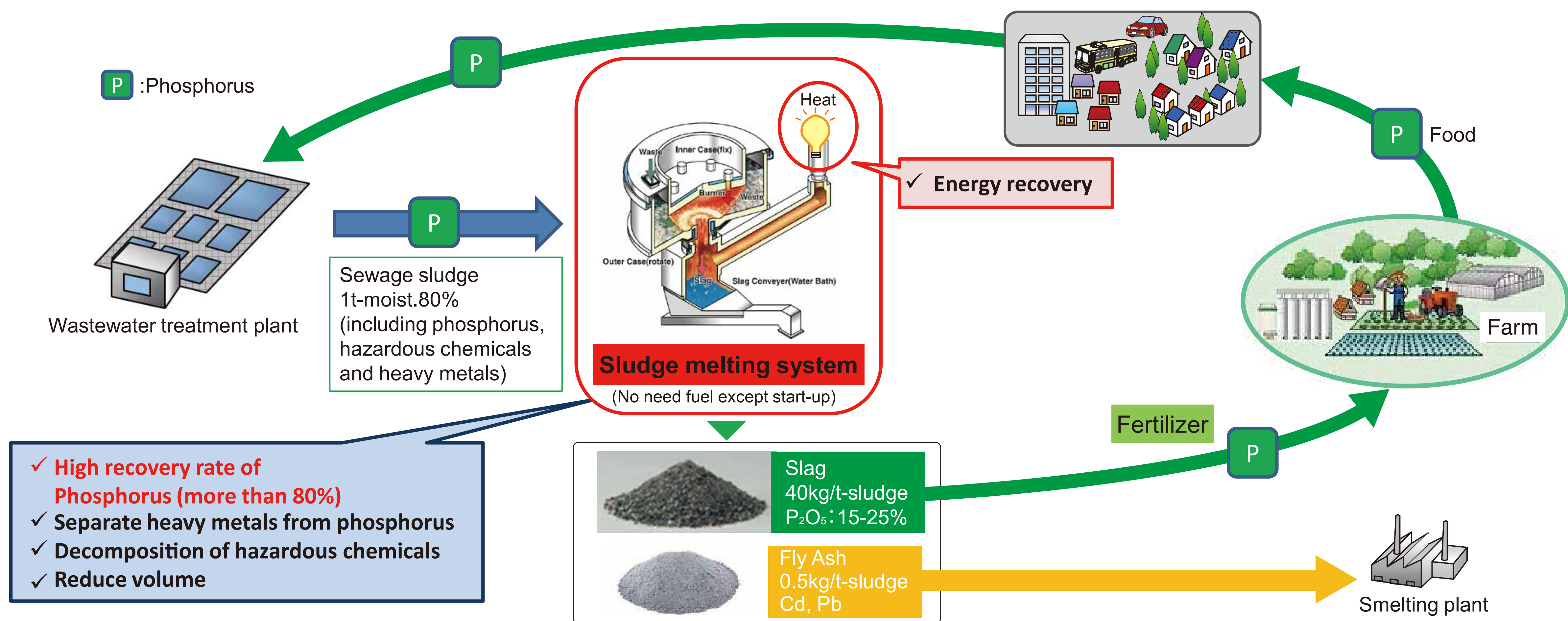
6. Melting sewage sludge

No.	Customer	Melting furnace throughput capacity	Wastes to be melted	Fuel type	Inner diameter of furnace (mm)	Facility (furnace) size	Completion of construction
1	Kobe City Seibu Disposal Plant	1.7t-ds/d × one furnace	Sewage sludge	Kerosene	1.2	3t/day (3t/24h × one system)	1979
2	Toiyama Prefecture Japan Sewage Works Agency Futagami Clean Center for Oyabe River Basin Sewage system	5.3t-ds/d × one furnace	Sewage sludge	Bunker A	2.7	27t/day (27t/24h × one system)	August, 1988
3	Japan Sewage Works Agency Osaka Minami Waste Disposal Center	25t-ds/d × two furnaces	Sewage sludge	Kerosene	6.0	228t/day (114t/24h × two systems)	December, 1990
4	Japan Sewage Works Agency Osaka Minami Waste Disposal Center	12.5t-ds/d × one furnace	Sewage sludge	Kerosene	4.2	57t/day (57t/24h × one system)	1991
5	Toiyama Prefecture Japan Sewage Works Agency Futagami Clean Center for Oyabe River Basin Sewage System	12t-ds/d × one furnace	Sewage sludge	Bunker A	4.0	60t/day (60t/24h × one system)	March, 1993
6	Japan Sewage Works Agency Osaka Minami Waste Disposal Center	35t-ds/d × one furnace	Sewage sludge	Kerosene	7.0	159t/day (159t/24h × one system)	December, 1995
7	Mikasa River and Naka River Basin Sewage System Mikasa River Clean Center	20t-ds/d × one furnace	Sewage sludge	Digestion gas + Kerosene	5.4	100t/day (100t/24h × one system)	April, 1997
8	Toiyama Prefecture Japan Sewage Works Agency Jintsu River Left Bank Basin Sewage System	9t-ds/d × one furnace	Sewage sludge	Bunker A	3.4	45t/day (45t/24h × one system)	March, 2001
9	Toiyama Prefecture Japan Sewage Works Agency Futagami Clean Center for Oyabe River Basin Sewage system	16t-ds/d × one furnace	Sewage sludge	Bunker A	4.7	80t/day (80t/24h × one system)	March, 2006
10	Toiyama Prefecture Japan Sewage Works Agency Jintsu River Left Bank Basin Sewage System	12t-ds/d × one furnace	Sewage sludge	Bunker A	4	60t/day (60t/24h × one system)	March, 2012
11	Toiyama Prefecture Japan Sewage Works Agency Futagami Clean Center for Oyabe River Basin Sewage system	16t-ds/d × one furnace	Sewage sludge	City gas	4.7	80t/day (80t/24h × one system)	March, 2017 (planned)

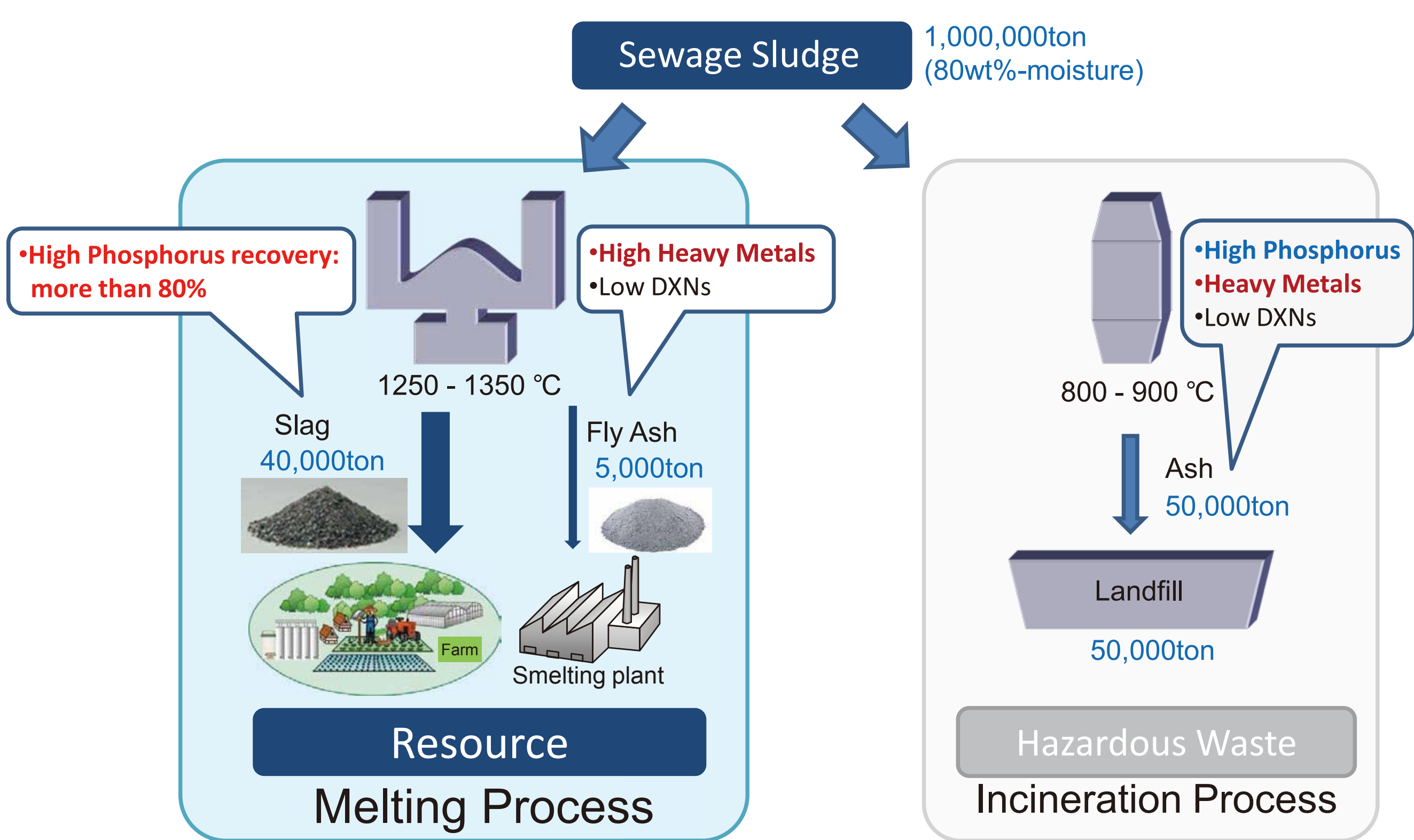
Note: Sewage sludge is loaded into the melting furnace with 20-30% water content, making actual loading volume 1.25-1.43 times larger than throughput capacity.

Sustainable Phosphorus Cycle by Kubota Sludge Melting System

Phosphorus Recovery from sewage sludge with high recovery rate by KUBOTA Melting System



Why we use Melting System for Sewage Sludge treatment?



Phosphorus Recovery from Sewage Sludge by Kubota Melting System

More than 90% of phosphorus in sewage sludge can be recovered.

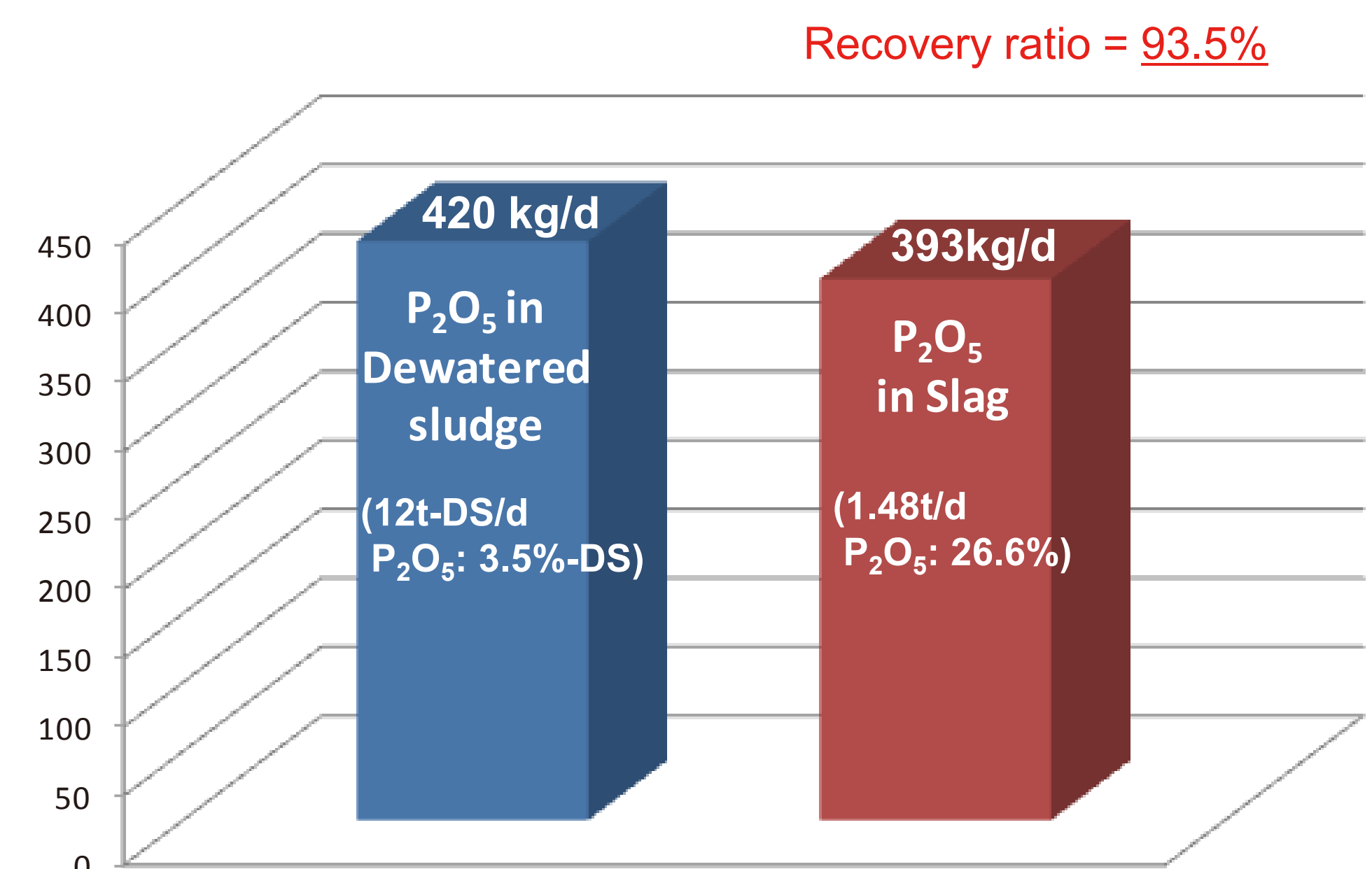


Fig. Mass balance of P₂O₅ in Dewatered sludge vs. Slag (experimental value in Japan)

Safety of the Slag —Heavy metal content test and leaching test—

	Contents		Leaching Test	
	Slag (mg/kg)	GüMV (mg/kg)	Slag (mg/l)	Environmental quality standards for soil (Japan) (mg/L)
T-P ₂ O ₅ (C-P ₂ O ₅)	266,000 (254,000)	-	-	-
As	1	40	<0.001	0.01
Cd	<1	1.5	<0.005	0.01
Cu	650	900	-	-
T-Hg	<0.5	1	<0.0005	0.0005
Ni	51	80	-	-
Pb	13	150	<0.005	0.01
Cr ⁶⁺	<2	2	<0.02	0.05

NOTE: C-P₂O₅: Citric acid soluble P₂O₅ (Plant available P₂O₅)
C-P₂O₅/T-P₂O₅ = 95.7%

[Test Condition]
Particle size : <2mm
Solvent : distilled water + HCl (pH:5.8 to 6.3)
Liquid/Solid ratio : 10L/kg

Growing Test on Rice Planting by Slag as phosphorus fertilizer

	1. Slag (<0.3mm)	2. Commercial phosphorus fertilizer	3. No phosphorus fertilizer (blank)
Picture			
Weight of the paddy(dry) (g)	11	10.7	4
Content of heavy metals			
Pb (mg/kg-dry)	<1	<1	<1
Cd (mg/kg-dry)	<1	<1	<1
As (mg/kg-dry)	<0.5	<0.5	<0.5
Hg (mg/kg-dry)	<0.5	<0.5	<0.5
Cr ⁶⁺ (mg/kg-dry)	<5	<5	<5

- ▶ Effectiveness: Same as commercial fertilizer
- ▶ Safety: No contamination of heavy metals

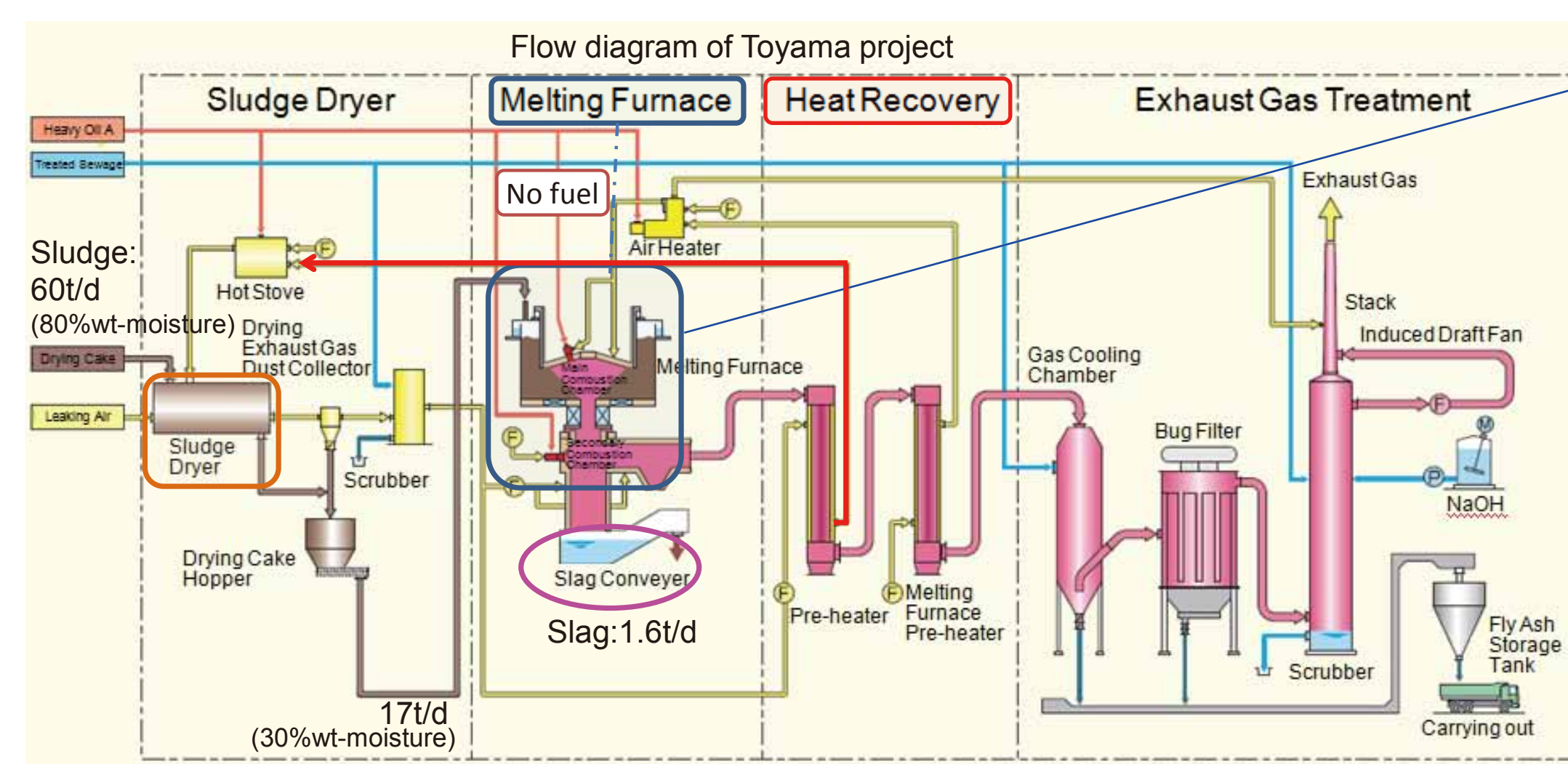
Project Example —Sludge treatment by Melting System—

[Toyama project(Japan)]

Outline of the project

- ✓ Commissioned: 2012
- ✓ Capacity: 60t/d (≒200,000 PE)
- ✓ Waste type: Sewage sludge (80wt%-moisture)
- ✓ Energy recovery: The exhaust heat is recycled for pre-drying

Slag is recycled as backfilling/ interlocking block



- ▶ No fuel for Melting treatment
- ▶ Slag is reused (reusable as phosphorus fertilizer)
- ▶ Zero landfill



Components of the slag

Compounds	Contents
P ₂ O ₅	31.0%
SiO ₂	13.8%
CaO	13.9%
Fe ₂ O ₃ + Al ₂ O ₃	38.7%
As (mg/kg)	<1
Cd (mg/kg)	<1
Hg (mg/kg)	<1
Ni (mg/kg)	40
Pb (mg/kg)	4