Wastewater Sludge Recycling/Reuse in Japan

Workshop on Urban Fecal Sludge Management
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Classification of Sewage Treatment Processes in Japan

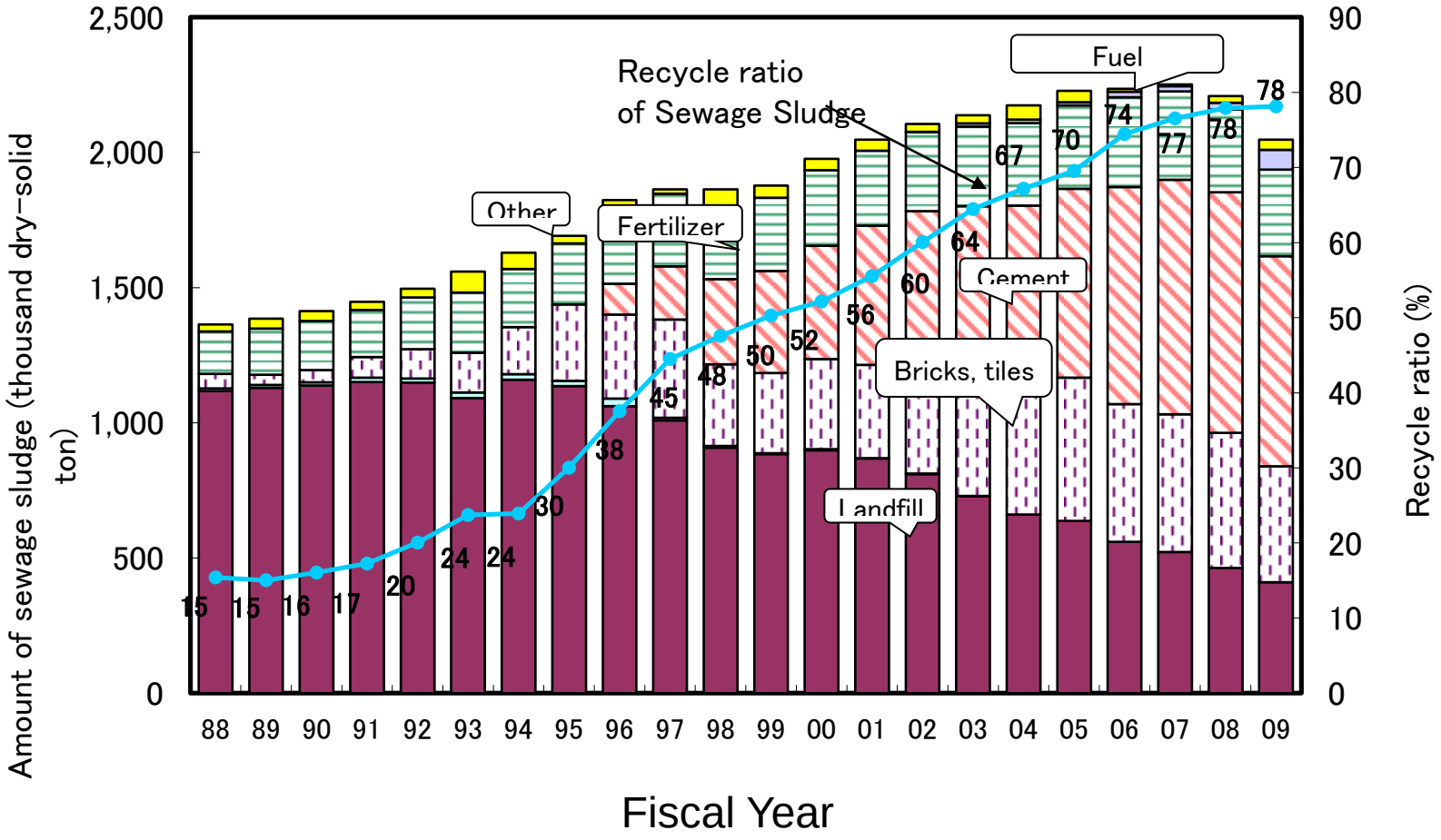
As of the End of FY 2006

Sewage Treatment Process 処理法		Desigh Daily Maximum Dry Weather Flow (thousand m³/d) 計画晴天時日最大処理水量(千m³/日)						
		Less Than 5 (5未満)	5 - 10	10 - 50	50 - 100	100 - 500	More Than 500 (500以上)	Total 合計
Primary Treatment 一次処理	Plain Sedimentation 沈殿法	1		1				2
Secondary Treatment 二次処理	Anaerobic-Anoxic-Oxic Process 嫌気-無酸素-好気法		4	7	6	14		31
	Recycled Nitrification/Denitrification 循環式硝化脱窒法	5	2	10	2	8		27
	Nitrification/Endogenous Denitrification 硝化内生脱窒法	2		1				3
	Step-Feed-Type Nitrification-Denitrification Process ステップ流入式多段硝化脱窒法	1	2	5	4	7		19
	Anaerobic-Oxic Activated Sludge 嫌気-好気活性汚泥法	11		5	5	7		28
	Conventional Activated Sludge 標準活性汚泥法	45	50	327	117	124	9	672
	Extended Aeration 長時間エアレーション法	34	6	2				42
	Oxygen Aeration Activated Sludge 酸素活性汚泥法	2	2	4	1	1		10
	Step Aeration ステップエアレーション	1		2	2	7		12
	Sequencing Batch Activated Sludge 回分式活性汚泥法	65	8	2	1	4		80
	Aerobic Biofilter 好気性ろ床法	22	6					28
	Biological Anaerobic-Aerobic Filters 嫌気好気ろ床法	41	1	1				43
	High-Rate Trickling Filter 高速散水ろ床法		1	2				3
	Contact Aeration 接触酸化法	14	1	2				17
	Rotating Biological Contactor 回転生物接触法	11	4	5	1			21
	Soil Covering-type Pebble Contactor 土壌被覆型礫間接触法	24						24
	Advanced Treatment Oxidation Ditch 高度処理オキシデーションディッチ法	34	8	1			1	44
	Oxidation Ditch オキシデーションディッチ法	783	88	37	1			909
	Other その他	29	8	13	4	7		61
Total 合計		1,125	191	427	144	179	10	2,076
Advanced Wastewater Treatment 高度処理		101	23	56	29	83	4	296

Recycling of Resource and Energy from Sewerage

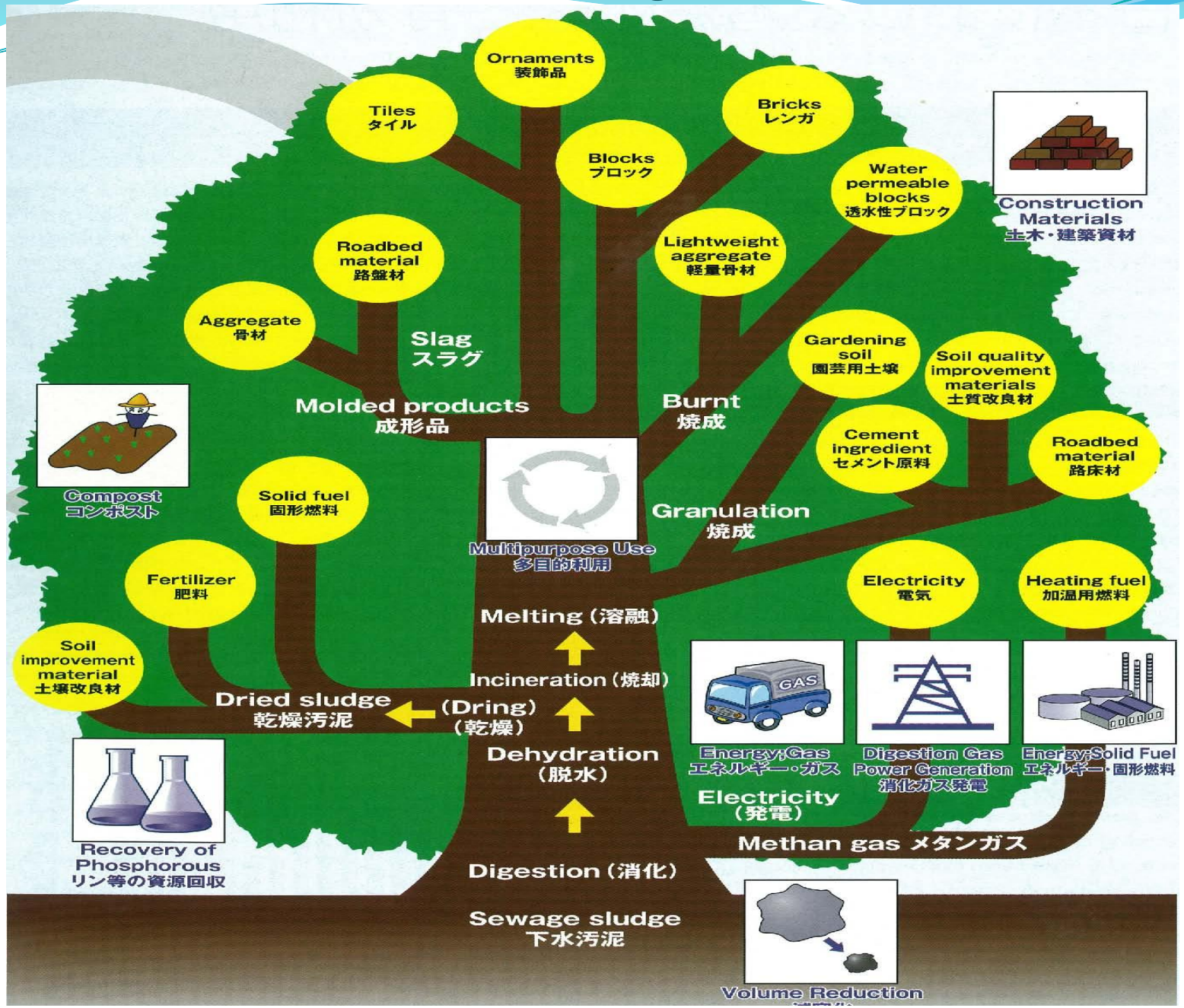
➢ **Recovery of Resource and Energy from Sewerage Sludge, in order to ensure stable treatment and to solve Global Warming**

Amount of Sewerage Sludge Production



Land fill site

Tree Chart of Sludge Resources



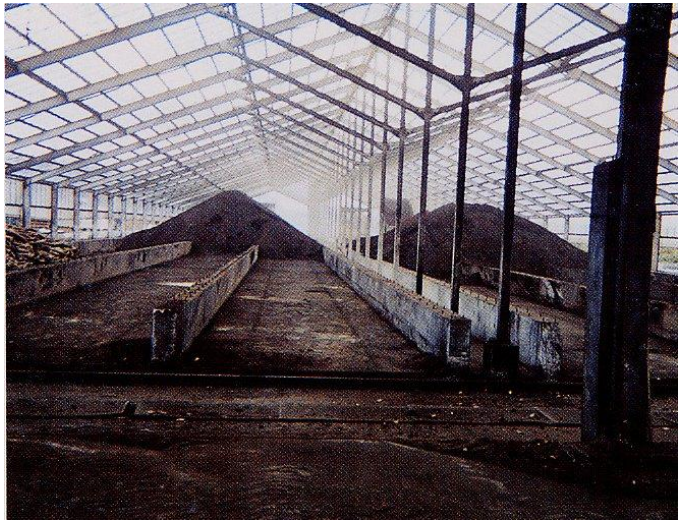
Tree chart of sludge resources

Publicity Tool

Sludge Utilization: Compost

Piled type composting

Horizontal shovel type



Sludge compost products

Photo-6 Curing tank (inside)

Photo-7 Powder compost

Photo-8 20 and 500 kg bag

Quality of product (3)

Heavy metals and other undesirable substances

	Fertilizer management law	Waste disposal and Cleaning law	Dioxin management law	Management standard for prevention of Heavy metal accumulation in soil for agriculture	Law for prevention of agricultural land contamination	(Note) Environmental standard for soil contamination
	Content	Elution amount	Content	Content	Content	Elution amount
Alkilmercury		ND				ND
Total Mercury	2 mg/kgDS	0.005mg/l				0.005mg/l
Cadmium	5 mg/kgDS	0.3mg/l			1mg/kg-rice	0.01mg/l
Lead	100mg/kgDS	0.3mg/l				0.01mg/l
Organic Phosphorus		1mg/l				ND
Chromium (Ⅳ)		1.5mg/l				0.05mg/l
Chromium	500mg/kgDS					
Arsenic	50mg/kgDS	0.3mg/l			15mg/kgDS	0.01mg/l
Cyanogen		1mg/l				ND
PCB		0.003mg/l				ND
Copper					125mg/kgDS	
Zinc				120mg/l		
Nickel	300mg/kgDS					
Selenium		0.3mg/l				0.01mg/l
Dioxin			3ng-TEQ/g			1ng-TEQ/g
	Official standard for normal fertilizer	Official standard for normal fertilizer	for Ash, Slag, etc.	Standard for Soil itself	Only for paddy field Standard for soil itself	

The titles of the laws mentioned above are not the full titles.

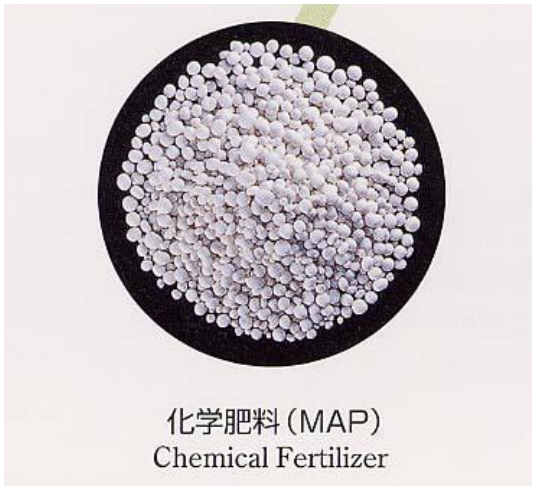
Dried and composted sludge

Thickening
Digestion
Dewatering

Drying → Incineration → Sintering

Carbonization

Supernatant

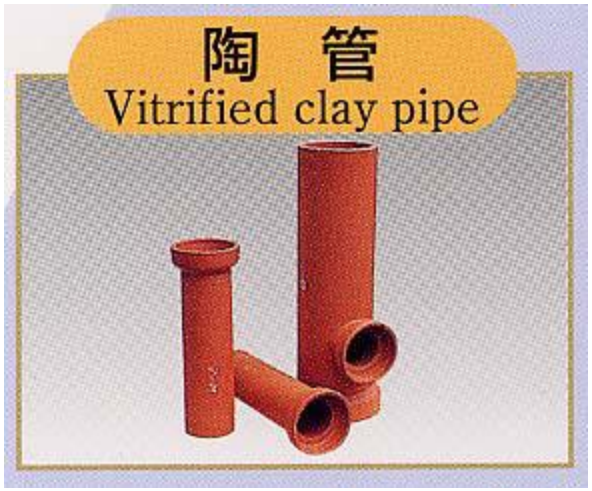

化学肥料（MAP）
Chemical Fertilizer

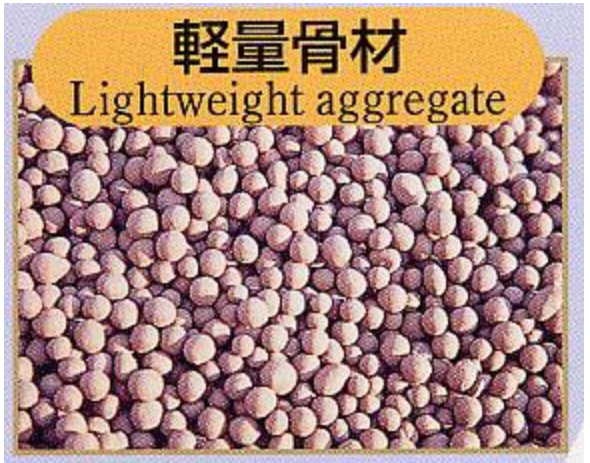

炭化汚泥
Carbonized biosolid

Utilization for agriculture and greenery

China Town in Yokohama City

Incineration ash





Recycling of Resource and Energy from Sewage

Gifu Prefecture

Phosphorus recycling system

Fertilizer produced from sewage sludge is used for the production of vegetables in Gifu, and the vegetables are famous for their excellent quality.

Kobe-city

Biogas Station

Biogas Refinery

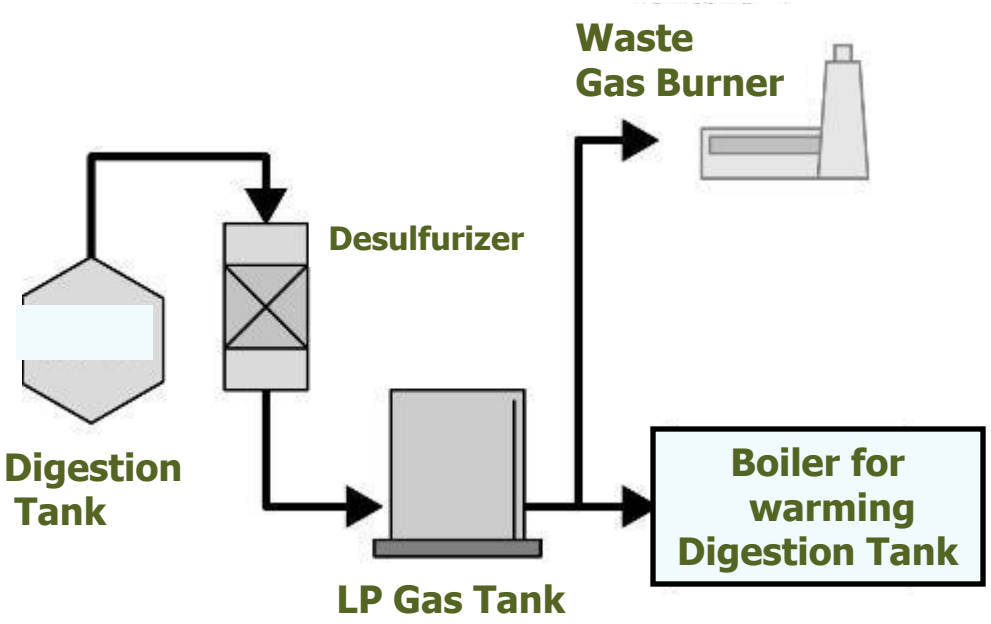
Tokyo

Carbonization of Sewer Sludge

Solid Fuel

Electric Power Generation

Problems with Digestion Gas




Malfunctioning by Siloxane

Problems for utilization

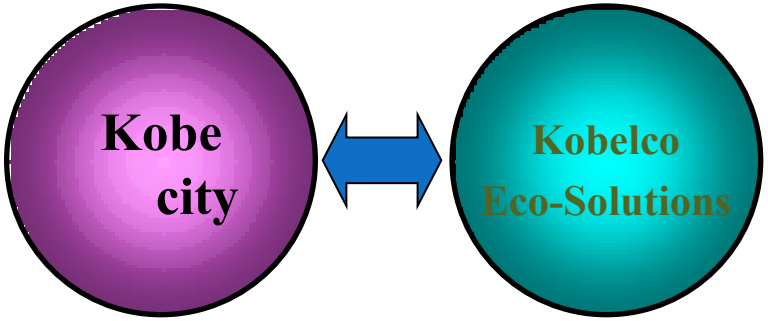
① Warming facilities and gas tank are corroded by digestion Gas which contains hydrogen

② Digestion gas which contains Siloxane creates problem by crystallization to warming facilities and gas blower.

③ Methane concentration is approximately 60%. Consequently, heating capacity is lower with about half of the capacity of the city gas.

Refining Digestion Gas to Bio Natural Gas

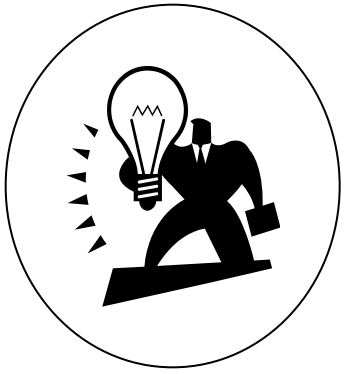
■ 2004

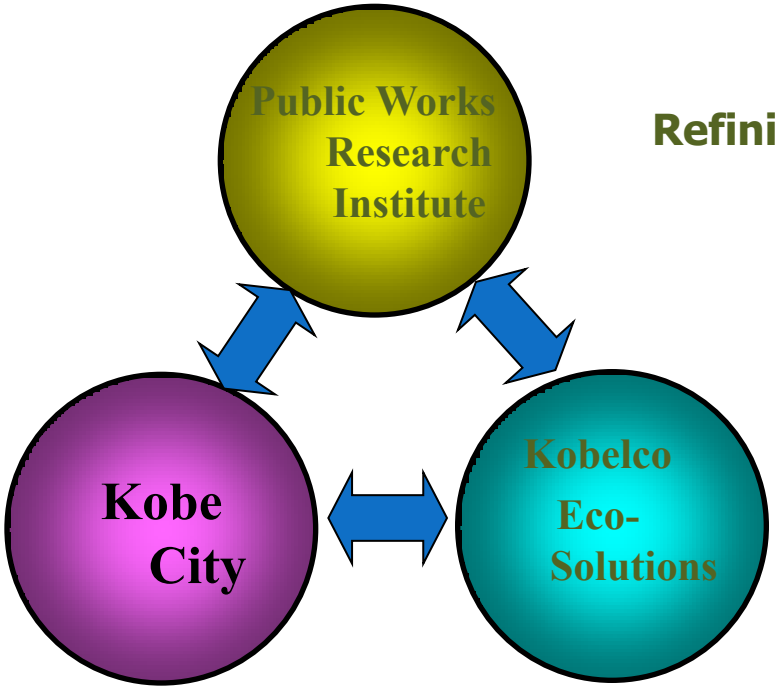


Refining Digestion Gas to Natural Gas (Joint Research)

Gas refining system

■ 2005

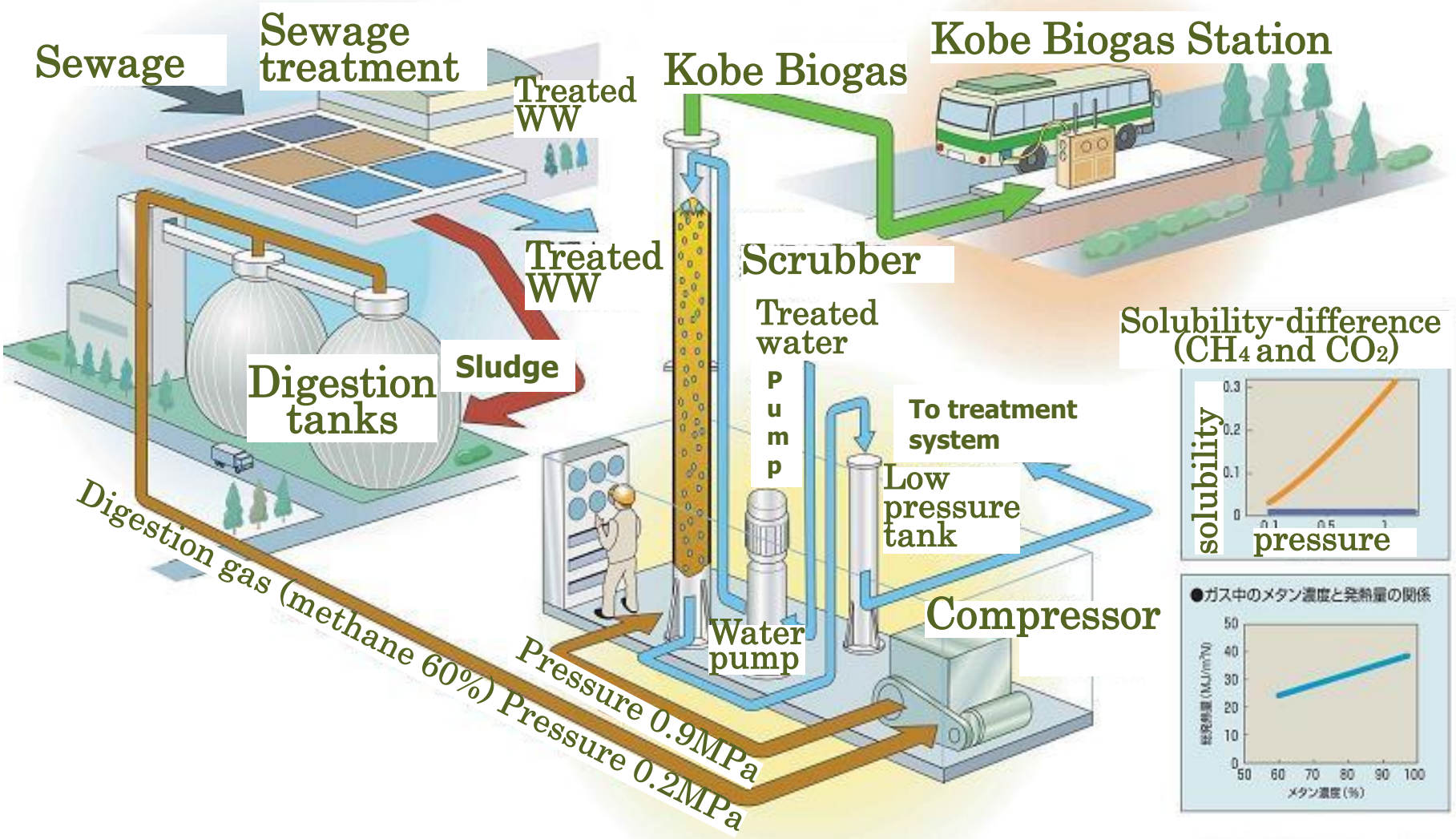




Refining Digestion gas to Natural Gas and commercialization for car fuel (joint Research)

Kobe Bio Gas Station

Refining System of Digestion Gas (water scrubbing process flow)



Effective use of Kobe Biogas

Vehicle for officials

Taxi

Truck for sludge cake

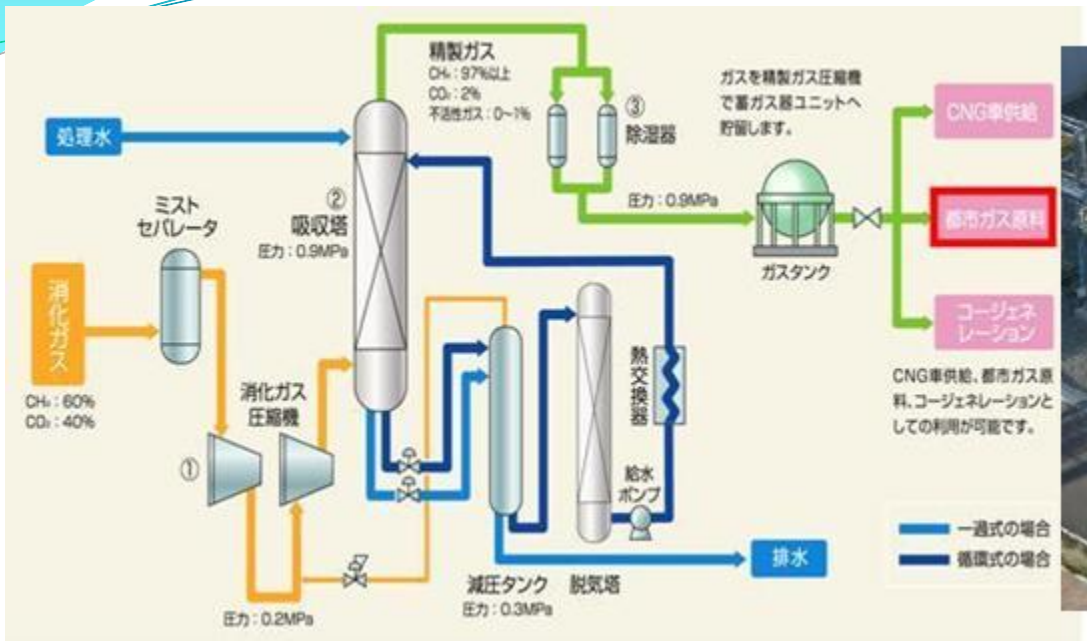
Kobe city bus

Garbage wagon

Drain pipe sweeping machines

Home dispatch

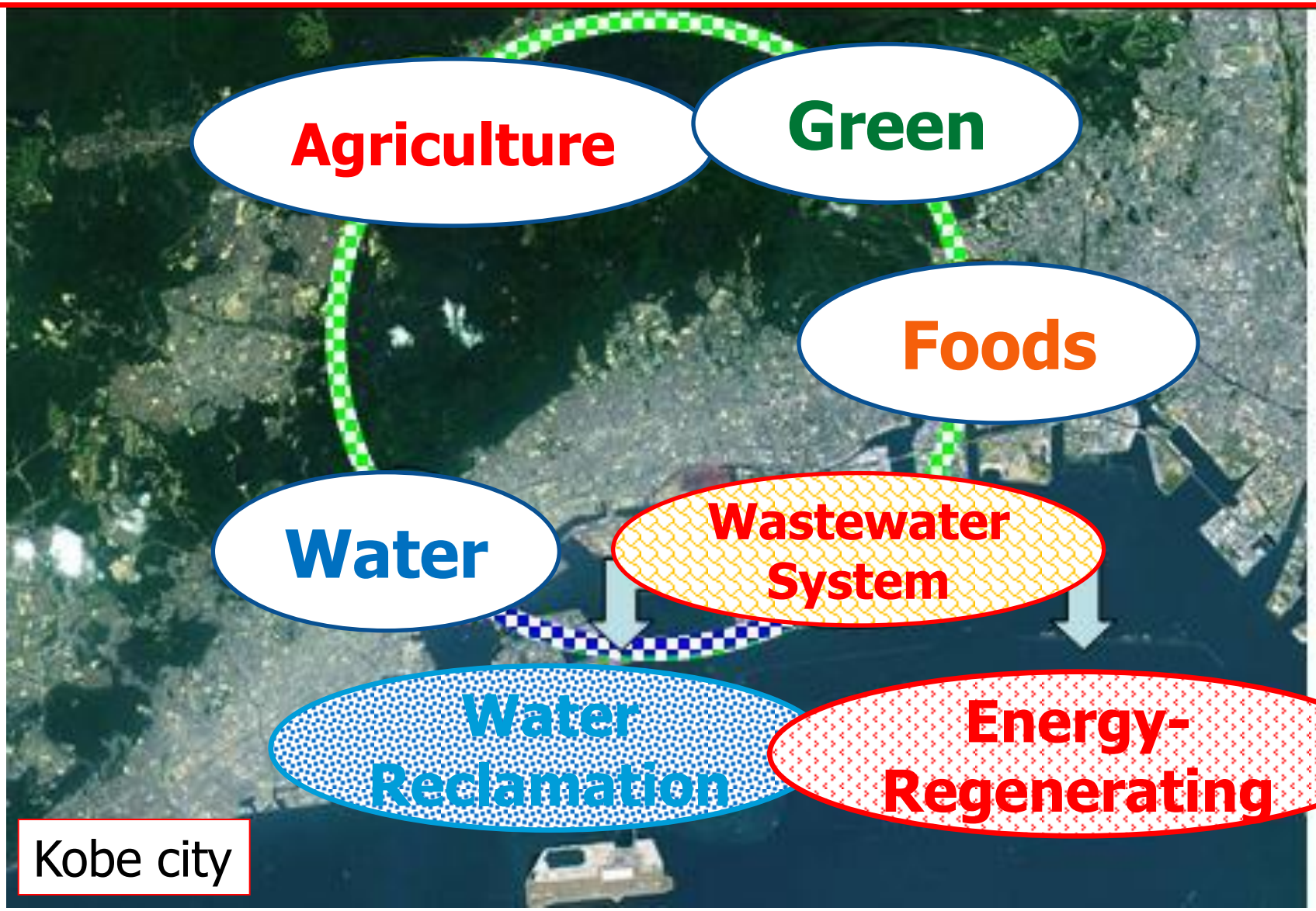
Project: Pouring into the City Gas




Actual proof facility of Pouring into the city gas.

Properties	Unit	Digestion Gas (Pre-Desulfurization)	Kobe Bio Gas	Acceptance standard value by Osaka Gas
Methane	Vol%	59.7	98.2	–
Carbon dioxide	Vol%	37.0	0.6	≦0.5
Oxygen	Vol%	0.4	0.2	≦0.01
Nitrogen	Vol%	0.8	1.0	≦1.0
Hydrogen Sulfide	ppm	330	＜0.1	≦0.65
Siloxane	mg/Nm³	14.53	0.005以下	–
High rank calorific value	MJ/Nm³	23.8	39.3	45.0
Smell	mg/Nm³	–	–	12～16

Networking of renewable biomass energy



Study on Economical Biomass Methane Fermentation in Small City

by Suzu City and JIWET (Japan Institute of Wastewater Engineering Technology)

The most important issue for sewage sludge treatment is the increase of treatment cost. Suzu City, which is located in a coastal area, expects to face an increase of cost for its sludge treatment. Suzu City is therefore promoting waste recycling by combining sewage sludge with other biomass and raw garbage from businesses to obtain methane fermentation. By using biogas energy to dry sewage sludge for utilization as a fertilizer, Suzu City expects to realize important cost saving for sludge treatment and other biomass treatment. The facility specifications were decided in 2005. The facility performance has been evaluated since the time it went into operation in 2007 to 2008. The purpose of this study is to evaluate the effects of such facility.

Location of Suzu City

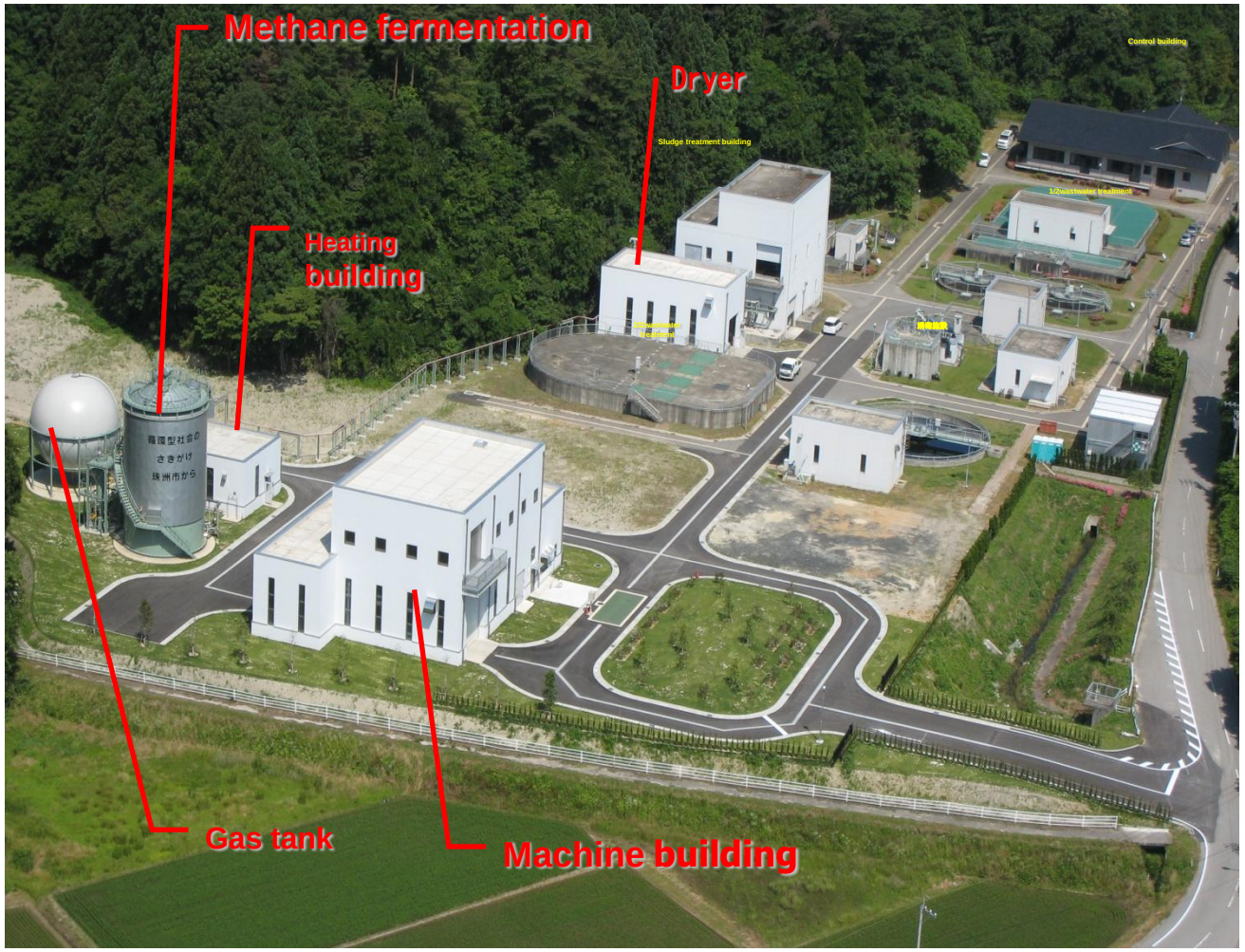


Photo.1 Biomass methane fermentation treatment plant in Suzu City.

Sludge treatment flow in Suzu City

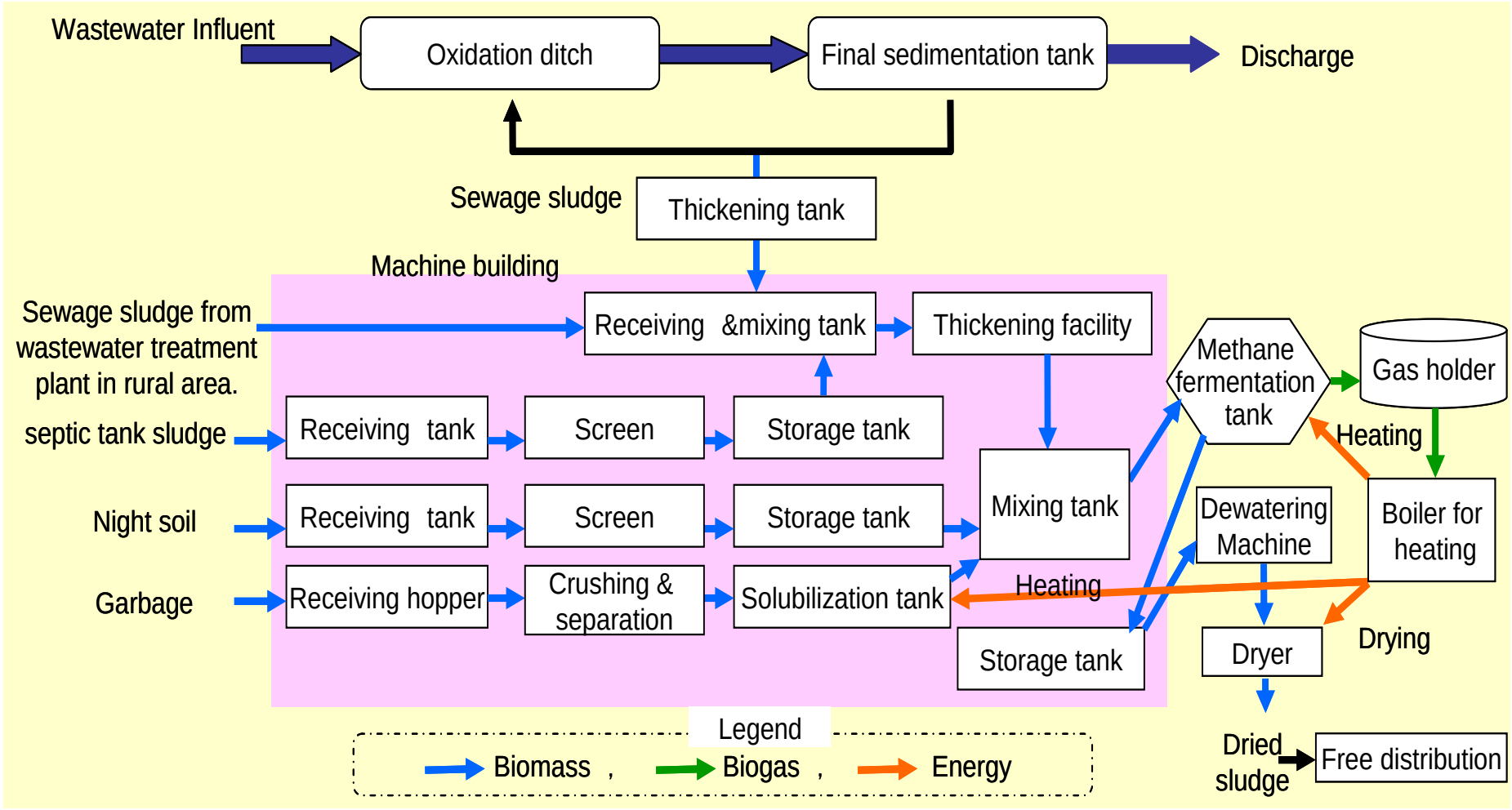


Figure 1 Schematic diagrams of biomass methane fermentation treatment facility

Possibility of utilizing dried sludge as a fertilizer

- The results of a pot test show no hindrance for plant growth with dried sludge. It was also confirmed that dried sludge is thoroughly useful as a fertilizer.
- Drying conditions has shown and confirmed that dried sludge meets EPA standards and is totally safe for health.

Photo.2 Results of a pot test showing no hindrance to plant growth by dried sludge.

Photo.3 Dried sludge.

Life ycle cost（LCC) and life cycle CO2（LCCO2) impacts

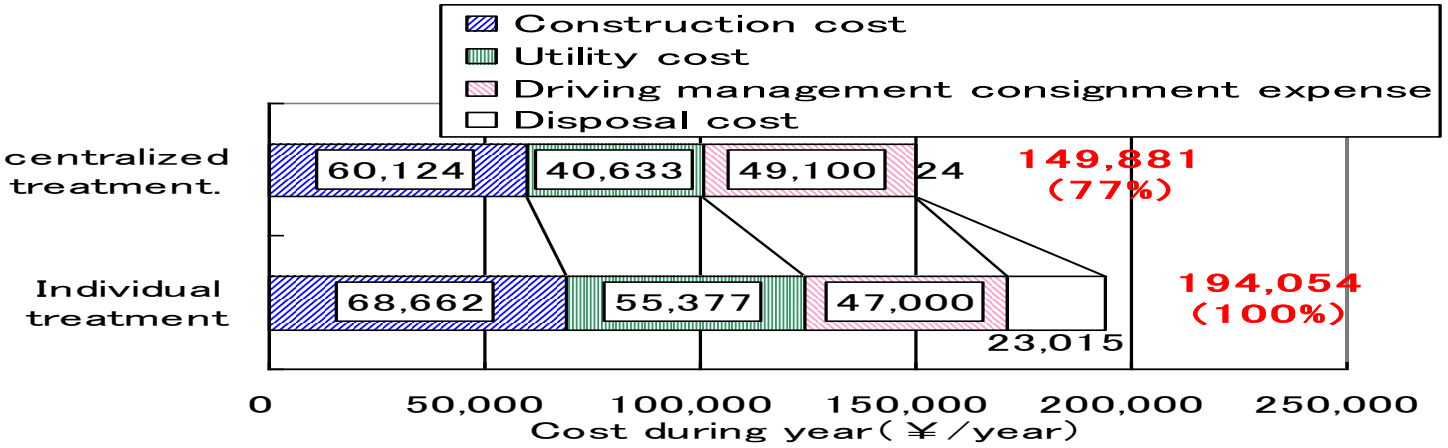


Fig.1 Comparison of LCC

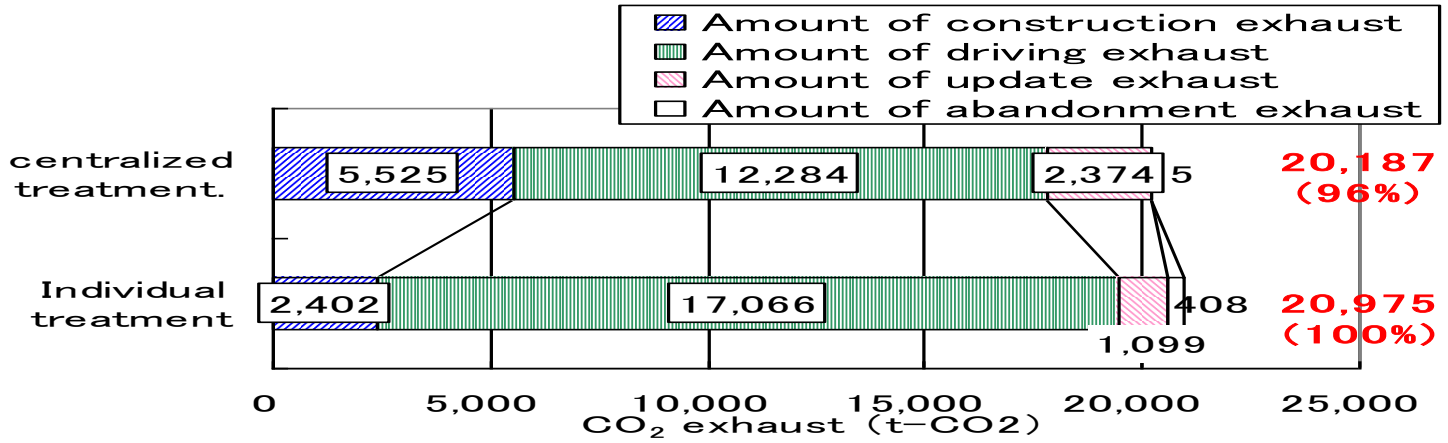


Fig.2 Comparison of $LCCO_2$