Demonstration Project for Regional Sustainable Biomass Energy System Employing Vertical Methane Fermentation Technology for Mixed Biomass, etc.

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1. Project period:

Start: August 2016

End (projected): March 2020

2. Ultimate goals

R&D items	Research issues	Goals
1.Verification of biomass material procurement	① Verification of mixed biomass quality & quantity	73.2 tons/day
2 Verification of energy conversion technology .	① Verification as high-efficiency waste sorting device	Biomass recovery rate of 80% or higher (10% or less nonconforming matter)
	② Verification of biogas output and methane concentration for mixed biomass	Daily average 9,490 Nm^3/day (CH_4-55±10%)
3 Verification of energy use の検証	① Verification of biogas use volume, etc.	Daily average 8,029 Nm^3/day
	② Assessment of calorific value of fermentation residue and carbonate residue & verification at incineration facilities	Verification of usability as supplementary fuel
4 Verification of the system as a whole	① Verification of greenhouse gas reduction	Reduction volume: Greenhouse gas: 9,887 ton-CO_2/year
	② Material balance of the total system & verification of landfill disposal volume	Material balance of the total system and the total facility, energy balance & verification of landfill disposal volume
	③ Verification of operation feasibility	Verification of biomass operation feasibility for the total system and total facilities

3. Results & progress status (summary)

Procedures pertaining to relevant laws and regulations and necessary permits for implementation of the verification project have been completed. Construction work was completed at the end of March 2018. Preparations for starting up the facility have been completed. At the same time, the essential regulatory regulations and procedures have been identified. At present, inspection is under way for the operation of various devices and measuring instruments to prepare for project facility startup in October 2018. At the same time, the methane fermentation tank has been started up for operation with introduction of seed sludge and raw materials.

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- Comparative study of methane fermentation processing methods
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- Report of results
- Future schedule
- Progress status
- Conclusion

Company profile

≪Outline≫

- Company name / Fuji Clean Co., Ltd.
- Type of business / Collection, transport and processing of g
- Established / July 1975
- Capital / 300 million yen
- Head office / 2994-1 Yamadashimo, Ayagawacho, Ayauta
- Business sites / Tokushima Branch Office, intermediate trea :c
- Employees / 118

Kagawa Prefecture

≪Background≫

Sep 1974: Company established

Jan 1976: Industrial waste treatment business license issued by Kagawa Prefecture

Apr 1995: Large, intermediate waste treatment facility permit issued by Kagawa Prefecture

Feb 1997: Intermediate treatment (incineration) facility completed

May 2001: Solid fuel production facility completed

Dec 2001: General & industrial waste management facility completed

Feb 2004: ISO14001 certification (JQA-EM3780)

Oct 2006: Industrial waste disposal business license issued by Ayagawacho

Dec 2006: License under the Industrial Waste Treatment Facility Special Measures Law issued by Kagawa

Sep 2008: Additional construction of grinding facility & granulation/solidification facility

Nov 2009: Designated Kagawa Prefecture Eco-friendly Model Business Site No. 10

Feb 2013: Ministerial certification for low-concentration PCB waste detoxification (PCB waste, etc.)

Mar 2015: Ministerial certification for low-concentration PCB waste detoxification (other wastes)

Head office

≪Fuji Clean Business Profile≫

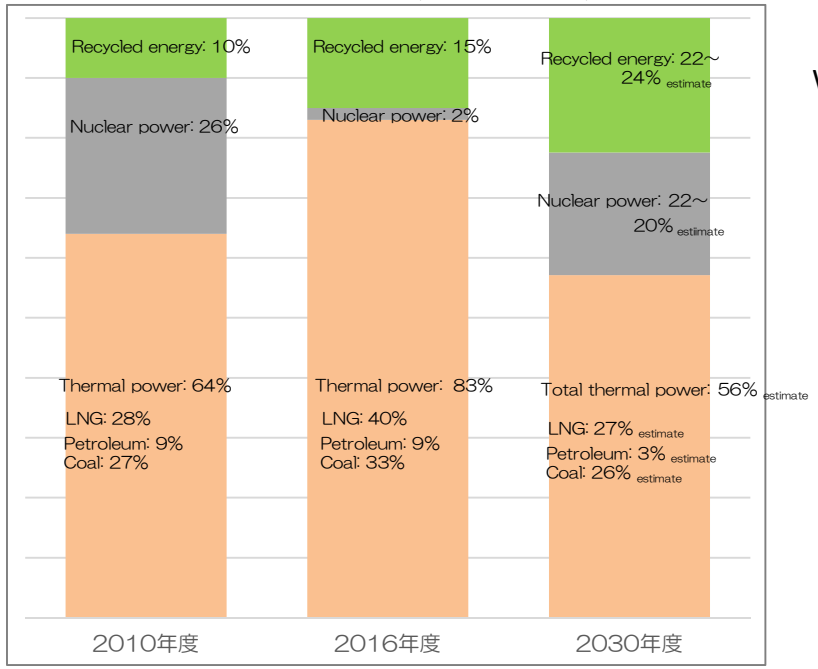
Establishment of an integrated waste processing system, starting from collection and transport, intermediate treatment and ultimately to final disposal and recycling

Environmental policy

Development of a recycling society, assimilation with local communities and efficient energy use and new energy creation

Introduction

[Breakdown of power sources in Japan]



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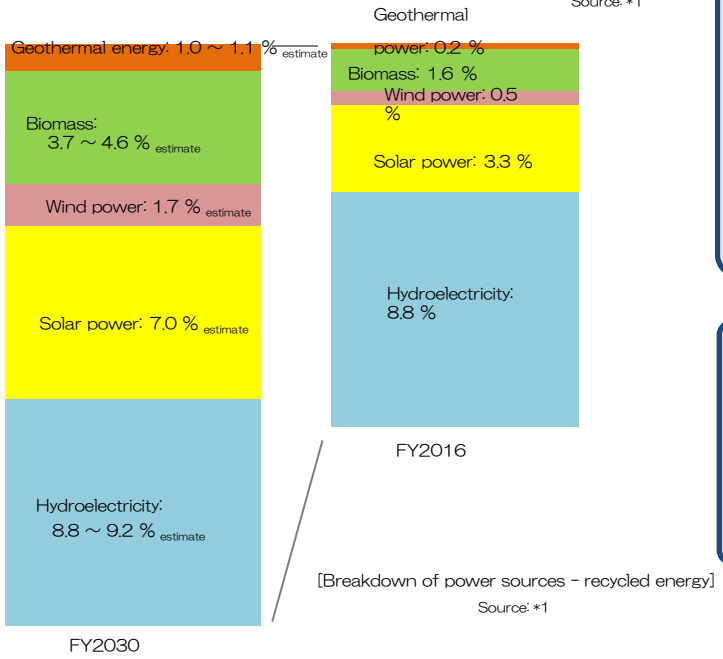

[Breakdown of power sources - recycled energy]

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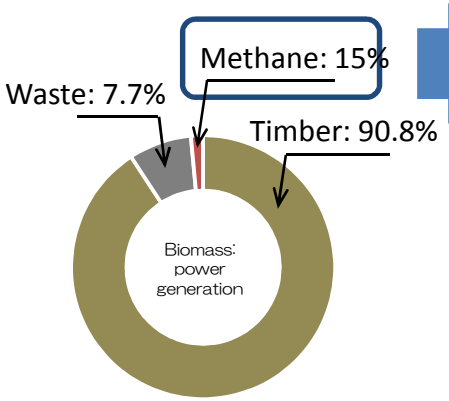


[Breakdown of biomass power sources]

Source: *2

Issues that bar methane fermentation business

- Difficulty in raw material collection
- Restriction in energy generation
- Treatment cost for digestive fluid
- Difficulty in securing liquid fertilizer market
- Compliance with Waste Disposal and Public Cleaning Act

Issues at Fuji Clean

- Skyrocketing fuel cost due to use of heavy oil and electricity at incineration facilities, etc.
- Concern in decline of waste volume with anticipated decline in population (Decline in sales)
- Elimination of negative image toward waste treatment business & Fulfillment of social responsibility in environmental management

Strengths of the industrial waste processing business

Business track record
Management experience
Community-building
Extensive hardware
.
.

Issues in various regions

- Population decline
- Aging incineration facility
- Autonomous & diversified society

Regional renaissance

Sustainable society

Regional characteristics, etc.

Businesses
Population
Local products
Agriculture…

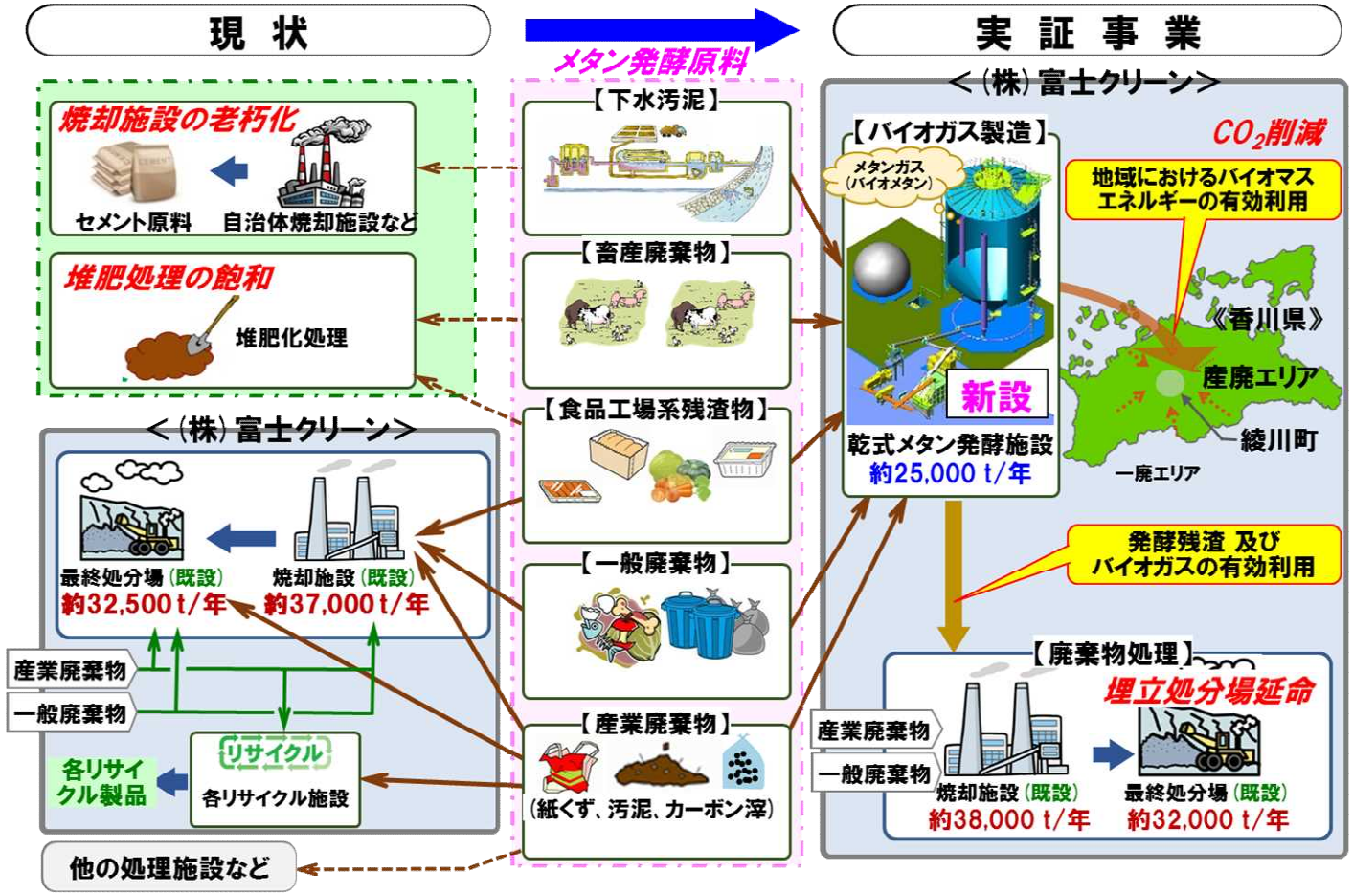
*1 Source: METI Agency for Natural Resources and Energy website

*2: Source: Biomass White Paper 2016

Project objective

Issues in establishing the methane fermentation processing system employing wastes that is both sustainable and economical

1. Study into raw material procurement: Securing sustainable biomass quantity and quality
2. Study of energy conversion technologies: Efficient biomass energy recovery & reduction in necessary cost
3. Study into energy use: Increase in options for efficient use within the facility, in neighboring areas and in industry
4. Study of the system as a whole: Identifying the optimal processing scale that is both a sustainable and economical



Research issues
1① Verification of mixed biomass quality and quantity.
2① Verification as high-efficiency waste sorting device
2② Biogas generation output vis-à-vis mixed biomass & verification of methane concentration
3① Verification of biogas use volume, etc. .
3② Assessment of calorific value of fermentation residue and carbon powder & verification at incineration facilities .
4① Verification of greenhouse gas reduction
4② Material balance for the total system and verification of landfill disposal volume .
4③ Verification of operation feasibility

Comparative study of methane fermentation processing methods

	Wet type	Dry type
Sludge concentration	2 - 5 %	15 - 30 %
Summary	Processing by flotation of methane bacteria in low concentration	Processing with methane bacteria in high sludge concentration
Characteristics	・ Easy operation and management ・ Wastewater treatment necessary	・ Treatment of solids possible ・ Large gas output
Principal applications	Kitchen garbage Sewage sludge Livestock waste	City garbage Solid waste
Target waste [Scope of acceptance)	Narrow	Broad
Tolerance toward presence of nonconforming matter in fermentation tank	Low	High
Wastewater treatment	necessary	Unnecessary *1
Fermentation tank maintenance	Necessary regularly	Nearly unnecessary
Domestic operations	Many	Few

Existing facilities are incineration facility and landfill site

Use of existing facilities expand the scope of application for fermentation residue

There are existing facilities for heat use and electric power use.

Use of existing facilities and able effective use of biogas.

Waste output per business is low compared to developed areas.

Due to small-lot waist, the types of raw material are varied.

Raw material based on city garbage accepted as well.

Increase in foreign matter mixture rate.

The planned facility installation is located in the mountainous areas of central Kagawa Prefecture.

Study into wastewater treatment facility not possible.

*1: Wastewater treatment facility may become necessary, depending on the moisture content of fermentation residue, etc.
*2: May become necessary depending on the fermentation tank system

Use of vertical dry methane fermentation system

- High tolerance to mixture of nonconforming matter
- Adaptable to mixed biomass
- Outstanding digestibility with high-temperature fermentation
- Space-saving & energy-saving
- Vertically structured & use of natural incline
- Mixing power not necessary inside fermentation tank
- Dehydration of fermentation residue not necessary
- Moisture content of fermentation residue (65-80%)

Schedule

May 13, 2015 ～ Mar 20, 2016
Demonstration project for regional autonomous biomass energy system / demonstration project for regional autonomous system
Feasibility study (FS)

Aug 5, 2016 ～
Demonstration project for regional autonomous biomass energy system / demonstration project for regional autonomous system
Demonstration project

Apr 1, 2018 ～
startup

Feasibility study (FS)

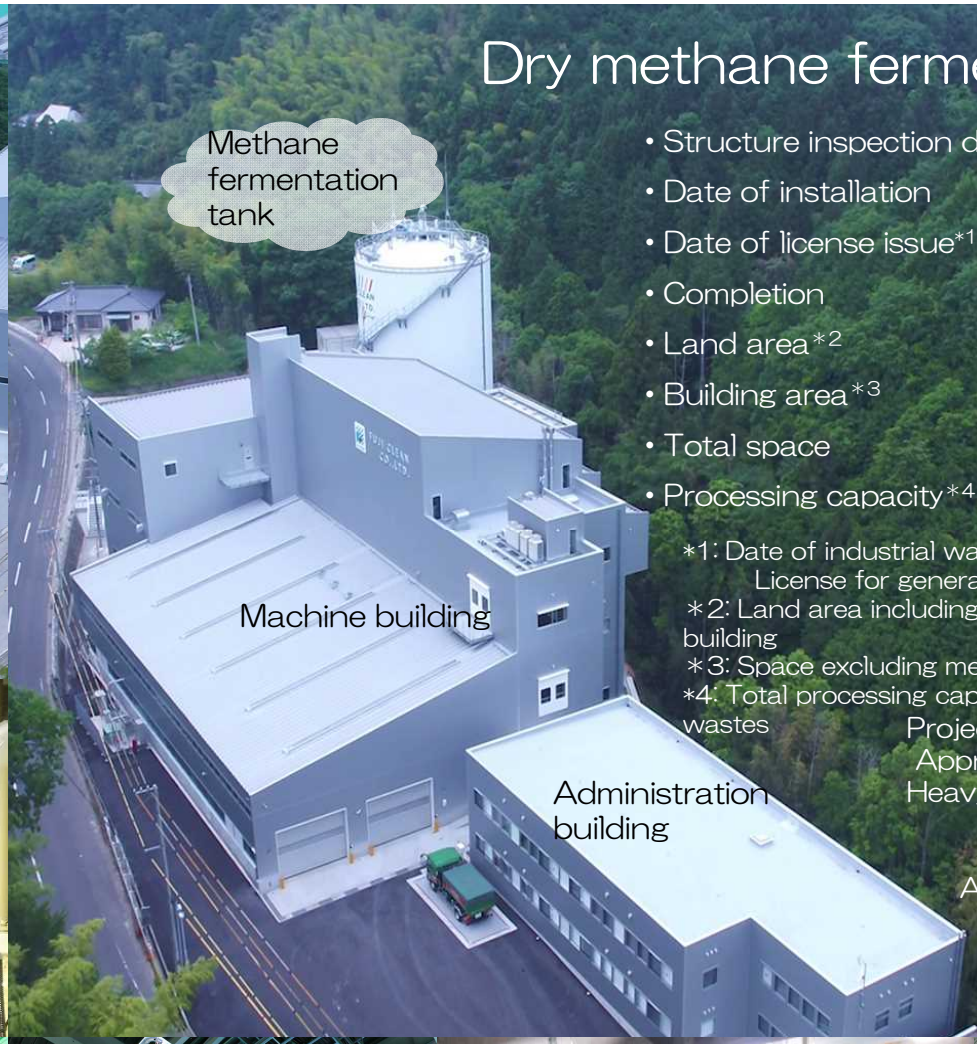
Demonstration project

Earthwork/construction/machinery work

Pilot operation

Proving test operation

Dry methane fermentation facility



- Structure inspection date Mar 28, 2018
- Date of installation May 21, 2015
- Date of license issue*1 May 20, 2018
- Completion June 7, 2018
- Land area*2 Approx. 6100 m^2
- Building area*3 Approx. 2600 m^2
- Total space Approx. 5000 m^2
- Processing capacity*4 73.08 tons/day

*1: Date of industrial waste license issue
License for general waste was issued on May 23, 2018
*2: Land area including administration building and machine building
*3: Space excluding methane fermentation tank & gas holder
*4: Total processing capacity for industrial and general wastes

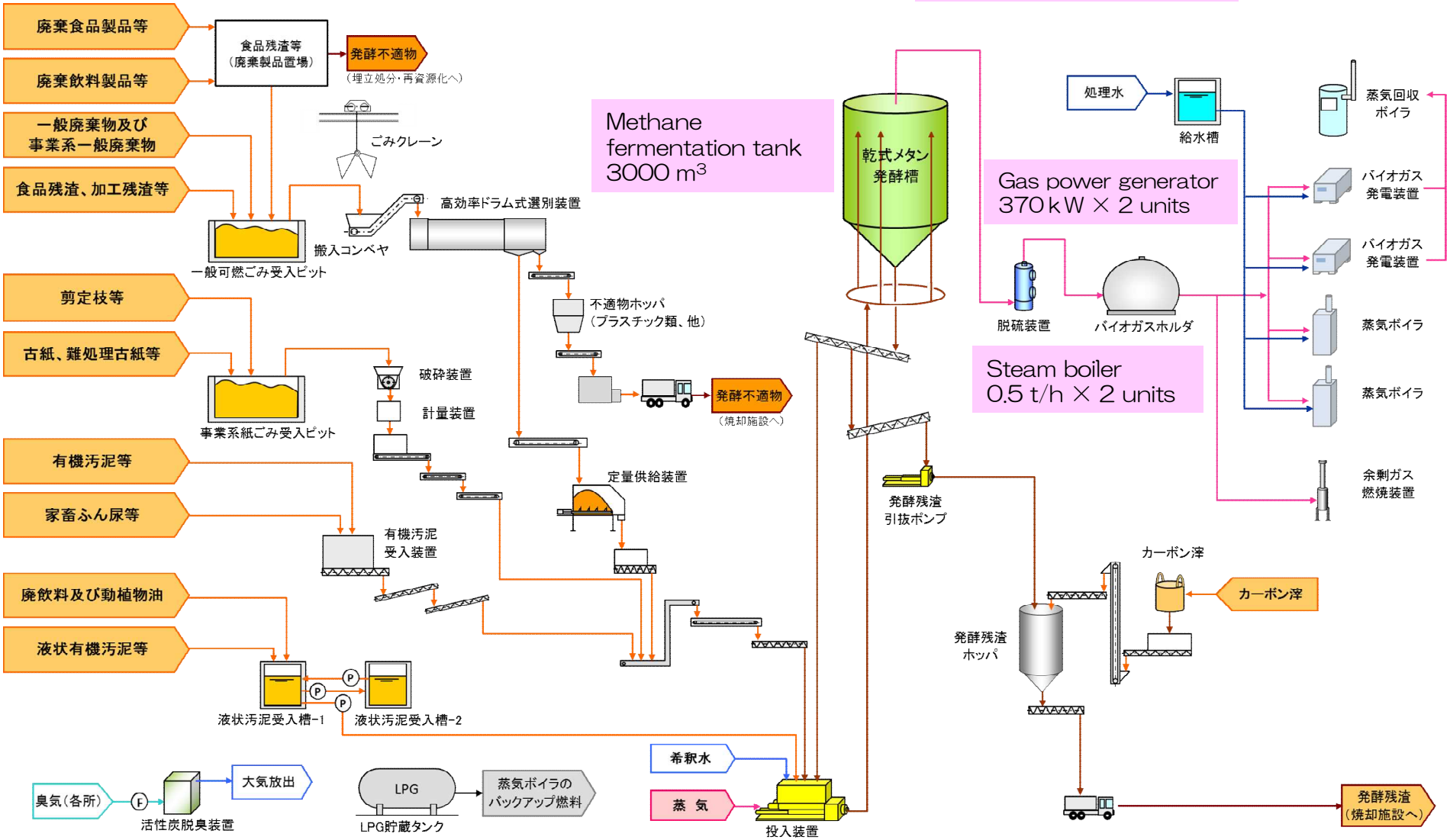
Projected biogas output:
Approx. 9500 Nm^3/day
Heavy oil equivalent*5
Approx. 4.8 kL/day
Total power output*6
Approx. 18.6 MWh/day

If total biogas output is used
*5: Equivalent at 55% CH_4 concentration
*6: Equivalent at 55% CH_4 concentration; power generation efficiency of 35.9%

Results ≪Dry methane fermentation facility flow sheet≫

Mixed biomass processing capacity: Approx. 73 tons/day

Projected biogas output
Approx. 9500 Nm³/day



Results: ≪Requirements for machine design≫

	Item	Design requirements		Holding time	
General waste Organic residue	General flammable garbage receiving pit	1,383	m^3	7	days equivalent (daily average)
	Garbage pit crane (shared with paper garbage)	1.3	tons (rated load)		
	High-efficiency drum-type sorter	10.81	tons	3.9	hours
Paper garbage	Commercial paper garbage receiving pit	258	m^3	14	days equivalent (daily average)
	Paper garbage grinder	580	kg/hr		
Organic sludge (solids) Livestock manure	Organic sludge receiver hopper	39.15	m^3	2	days equivalent (daily average)
	Organic sludge receiver delivering conveyor	1,000	kg/hr		
Organic sludge (liquid)	Liquid waste receiving tank - 1	73.56	m^3		
	Liquid waste receiving tank - 2	145.02	m^3		
	Liquid waste transfer pump	0.92	m^3		
Sorted garbage & various raw materials	Receiver hopper	2.40	m^3		
Sorted residue	Sorted residue compressor	1,190	kg/hr		
Fermentation residue Carbon residue	Fermentation residue discharge pump	3,790	kg/hr		
	Fermentation residue transfer conveyor hopper	1.11	m^3	10	min.
	Carbon residue supplier hopper	0.52	m^3	1.4	hours
	Carbon residue delivering conveyor	680	kg/hr		
	Fermentation residue hopper	34.57	m^3	0.4	day
	Fermentation residue delivering conveyor	15.72	ton/hr		
Biogas	gas filter	396	Nm^3/hr		
	Gas holder	1040	m^3		
	Steam boilers (2)	500	kg/hr (per unit)		
	Gas power generator (2)	370	kg/hr (per unit)		
	Exhaust gas boiler	630	kg/hr		
Water & wastewater	supply tank	129.6	m^3		
	Wastewater tank	10.4	m^3		
Odor	Odor fans (2)	377	m^3/min (per unit)		
	Activated carbon deodorizing towers (2)	400	m^3/min (per unit)		

Results: ≪Machinery installation & work status≫

Gas power generator installation status

Methane fermentation tank installation status

Active carbon deodorizer installation status

Gas holder earthwork status

High-efficiency drum-type sorter installation work status

Paper garbage grinder work status

Results ≪Various applications & reports≫

[Report related to wastes]

Installation of industrial waste treatment facility　Kagawa Prefecture Guidelines on Industrial Waste Treatment, Etc.
Article 15 (Application for preliminary guidance on installation of industrial waste treatment facility, etc.)
Article 6 (Agreement on installation of facilities for waste handling businesses)

Industrial waste treatment and business license　Article 14 Enforcement Order on the Wastes Management and Public Cleansing Act

Installation of general waste treatment facility　Article 5 (Application for general waste treatment facility installation permit), Waste Management and Public Cleansing Act

General waste treatment business license　Article 7, Waste Management and Public Cleansing Act

[Report related to construction & fire prevention]

Construction of dry methane fermentation facility　Article 6 (construction inspection application), Building Standards Act

Use of fire prevention targets　Article 8 (Report on appointment of fire prevention manager & report on fire prevention plan), Fire Service Act
Article 31-3 (Report on installation of fire prevention facilities, etc.), Ordinance for Enforcement of Fire Service Act

[Report related to installation of equipment]

Gas powered generator　Article 66 (Report of construction plan), ordinance for enforcement of Electricity Business Act
Article 44 (Report on installation of power generation facilities), Takamatsu City Regulations on Fire Prevention

Exhaust gas boiler: Article 10 (Report on boiler installation), Safety Regulations on Boilers and Pressurized Cookers
Article 14 (Application for inspection of boiler completion)

Ceiling crane　Article 11 (Report of Crane installation), Safety Regulations on Cranes, Etc.

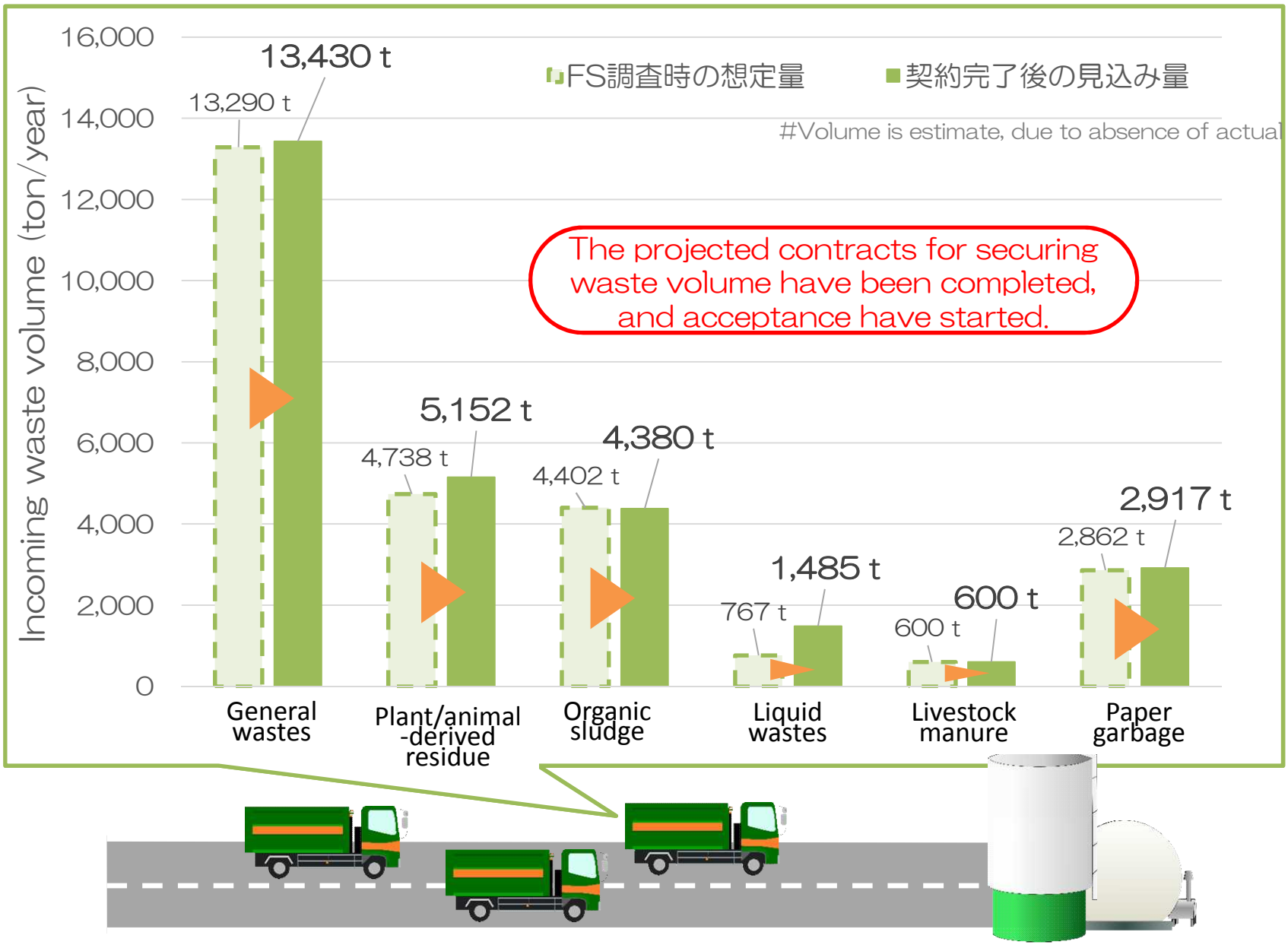
Steam boiler: Article 44 (Report on boiler installation), Takamatsu City Ordinance on Fire Prevention
Article 91 (Report on small boiler installation), Safety Regulations on Boilers and Pressurized Cookers

LPG storage tank: Article 9-3 (Report on start of storage of handling of pressurized acetylene gas, etc.), Fire Service Act

High-voltage receiving panel: Article 44 (Report on installation of transformation facilities), Takamatsu City Regulations on Fire Prevention

Results ≪Status on raw material procurement≫

■Progress status on waste acceptance



Project schedule

2018 → 2019 → 2020

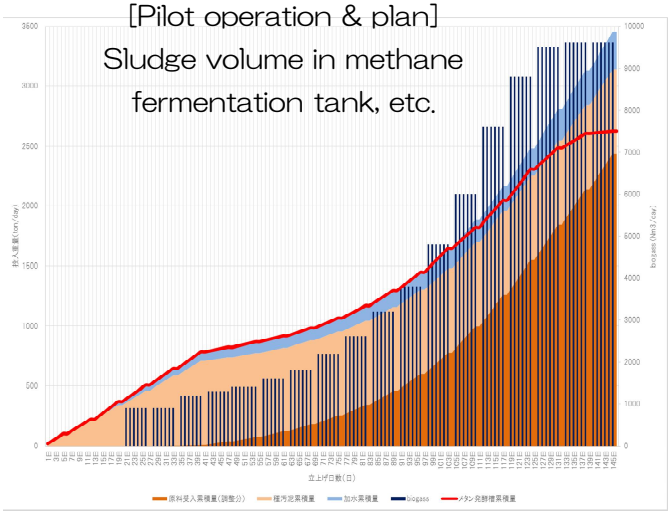
Apr 2018

Pilot operation

Oct 2018

Proving test operation (collection of various types of data)

[Pilot operation & plan]
Sludge volume in methane fermentation tank, etc.



1 ① Verification of mixed biomass quality & quantity

2 ① Verification as high-efficiency waste sorting device

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3 ② Assessment of calorific value of fermentation residue and carbonate residue & verification at incineration facilities

4① Verification of greenhouse gas reduction

Progress status

Seed sludge acceptance status

May 8 ～ Aug 6, 2018

Nitrogen purging status

May 20, 2018

Input of high-temperature digestive sludge from other cities

Approx. 1100 tons

Industrial waste acceptance status

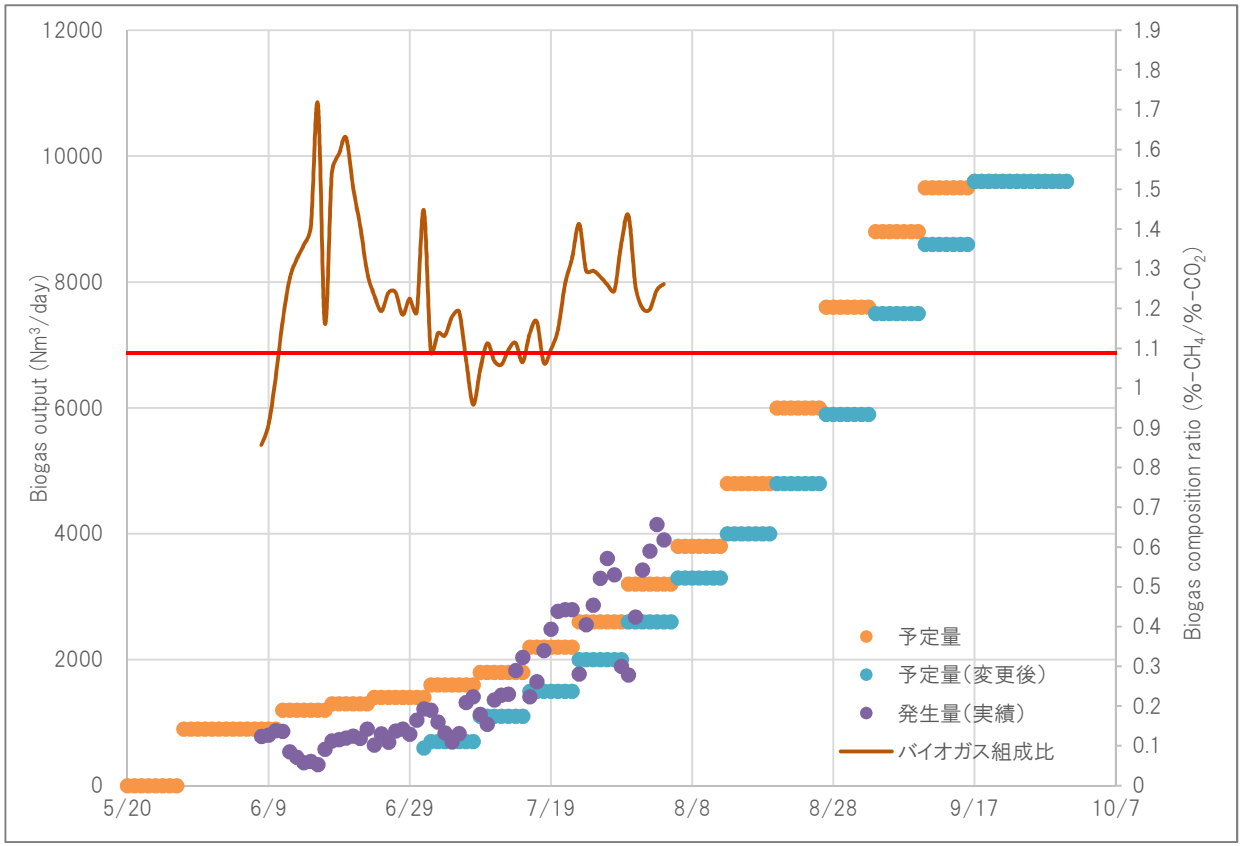
Jun 2018 ～

General waste acceptance status

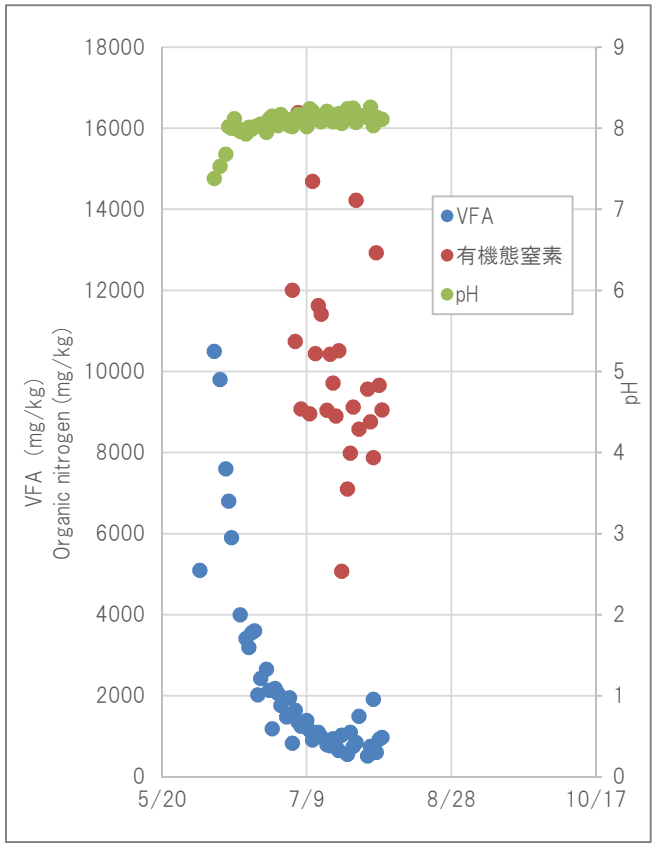
Jun 2018

Progress status

≪Biogas output & composition ratio≫



≪pH & VFA change over time≫



Conclusion

Since FY2016, installation of facilities for the demonstration project and application for processing business license were executed in accordance with the procedures set forth by Kagawa Prefecture and under Waste Management and Public Cleansing Act (hereinafter called "Waste Management Act"). The license application has been submitted in accordance not only with the Waste Management Act but also with laws and regulations related to energy use, statutory laws related to the facility (Air Pollution Control Act, Act for Assessment of Environmental Impacts, etc.).

Through these procedures, the laws and regulations relevant to planning biomass energy projects and the permit & licensing system have been clarified further.

In terms of raw material procurement, final consultations were conducted with waste discharging businesses regarding the location and volume of waste disposal, confirmation of collection vehicles, etc., to prepare for demonstration operations starting in FY2018. Through review into the collection method by the collection vehicle, containers suited to the properties and shape of the waste were prepared. This has enabled collection of wastes (raw material) suited to the needs of each client and reconfirmed that raw material procurement target of 73.2 tons/day can be achieved.

For implementation of this demonstration project from August 2016, selection, design, & construction preparations, etc., for machinery and equipment were executed. For machinery and equipment, action started from execution of performance capacity design followed by finalization of the installation layout and moving to construction design (detailed design). In doing this, re-examination of the process was conducted repeatedly with attention to sampling, data collection, & equipment renovation, etc. during project operation, resulting in the completion of plant construction (mechanical completion) for the project at end of March 2018.