Drastic Mitigation in Greenhouse Gas Emission by Sewage Sludge Gasification System in Kiyose Water Reclamation Center

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Contents

Introduction

Introduction

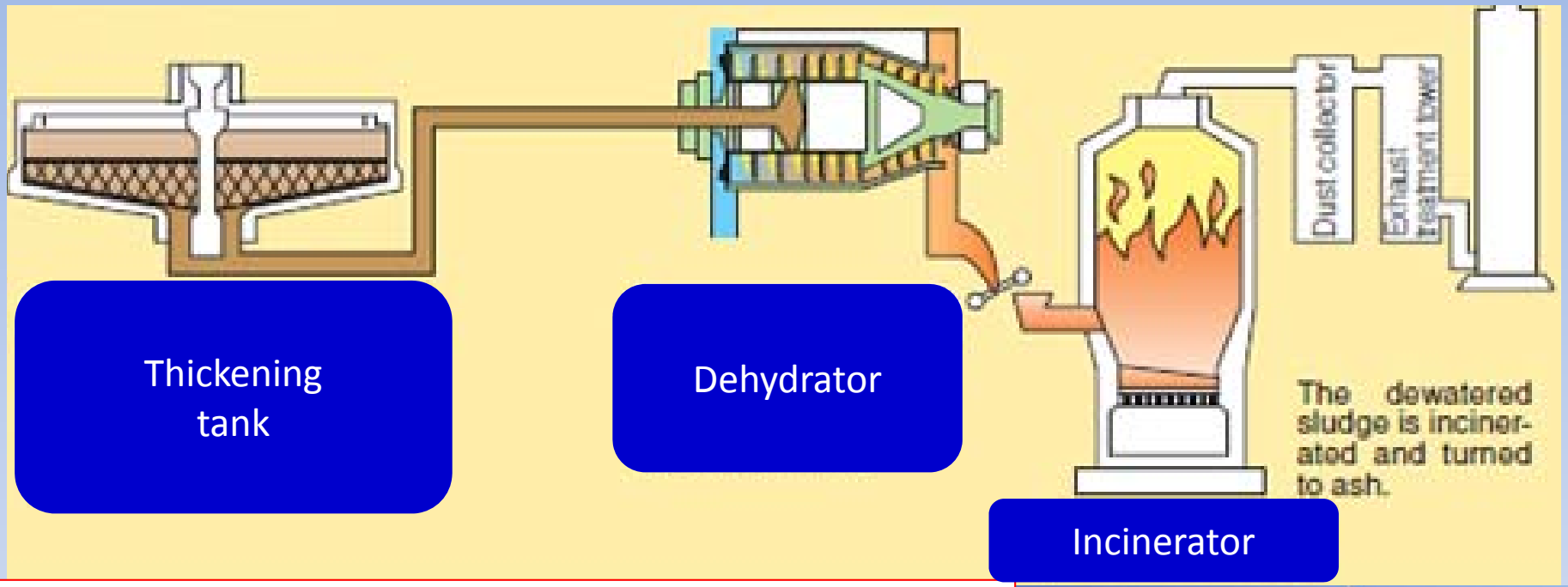
Gasification incinerator

Kiyose Water Reclamation Center

「Earth Plan-2010」 in Tokyo

Source :Japan Center for Climate Change Actions Web site (http://www.jccca.org/)

Sludge Treatment System



Thickening tank

Dehydrator

Incinerator

Sludge generated in Regional Sewage is all incinerated and effectively recycled.

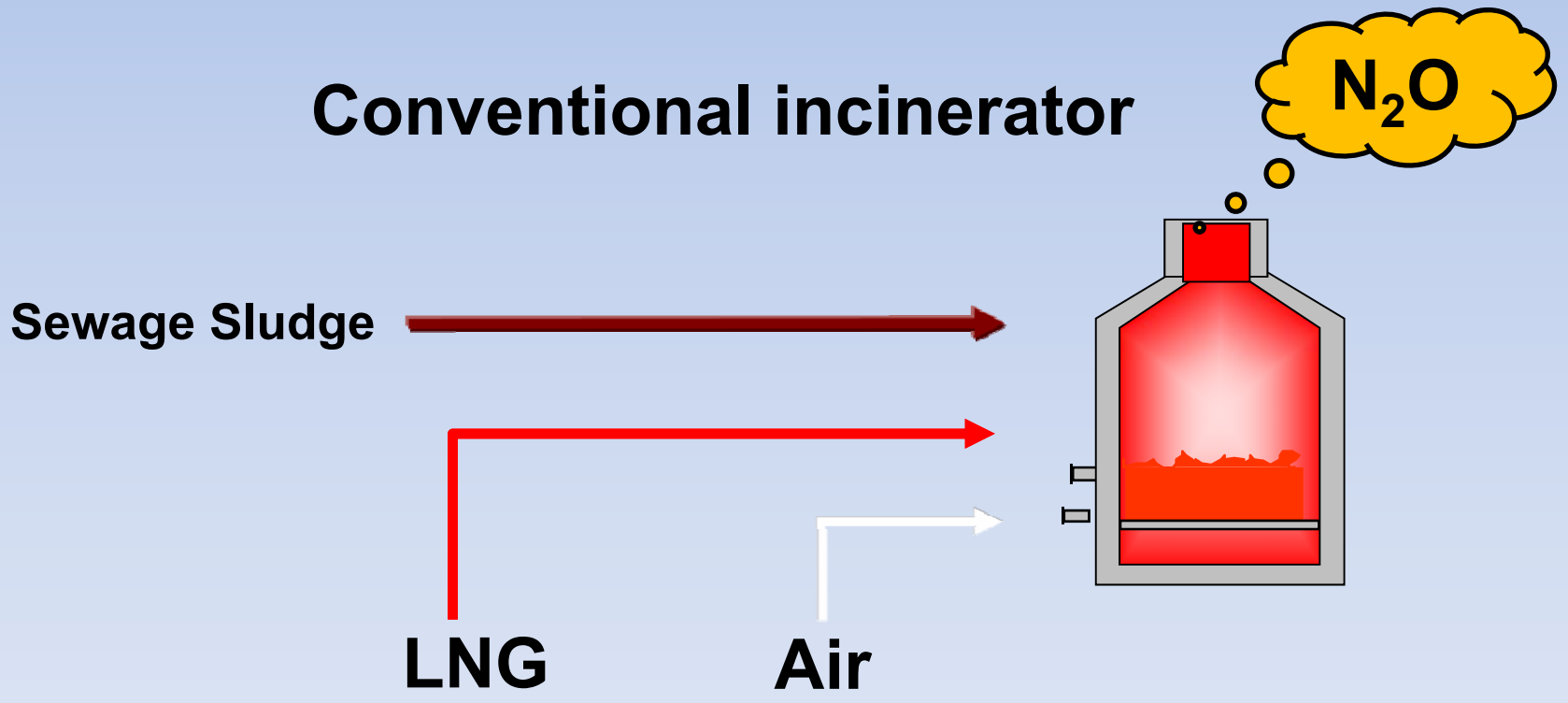
Some facilities need to be renovated, because around 15-40 years has passed since All W.R.Cs operation started.

Outline of the Sewage Sludge Gasification System

Conventional incinerator

Dewatered sludge is incinerated with fuel such as LNG.

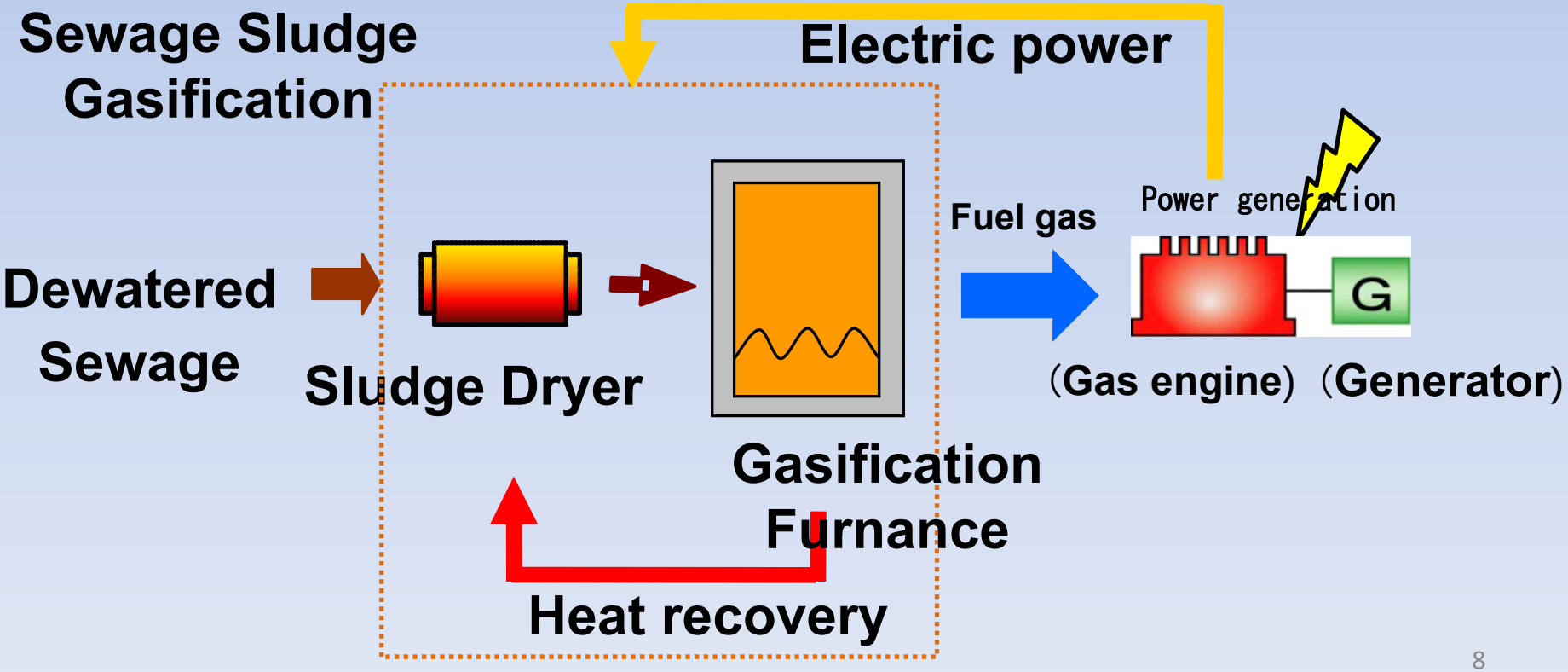
Nitrogen content in sludge is burnt, So N_2O is generated.



Sewage Sludge Gasification System

●Sludge is gasified by heating under low-oxygen condition after drying.

- Because of low-oxygen state,Reductoin of N2O can be done.
- Gas is used as a source of heat and to generate electricity.



Sewage Sludge Gasification System

- **Purpose of this project**

  Major reduction effect of greenhouse gas

  Utilization of renewable energy

- **The scale of Gasification system**

Sludge treatment Capacity	100	t-wet/day
The amount of sludge treated	33,000	t-wet/year

Outline of this project

- **Method of this project**

  Open-type Design Build Operate (DBO) proposal system

  [1] Private sector's know-how

  [2] Optimal distribution of project risk

Outline of this project

- **Period of project**

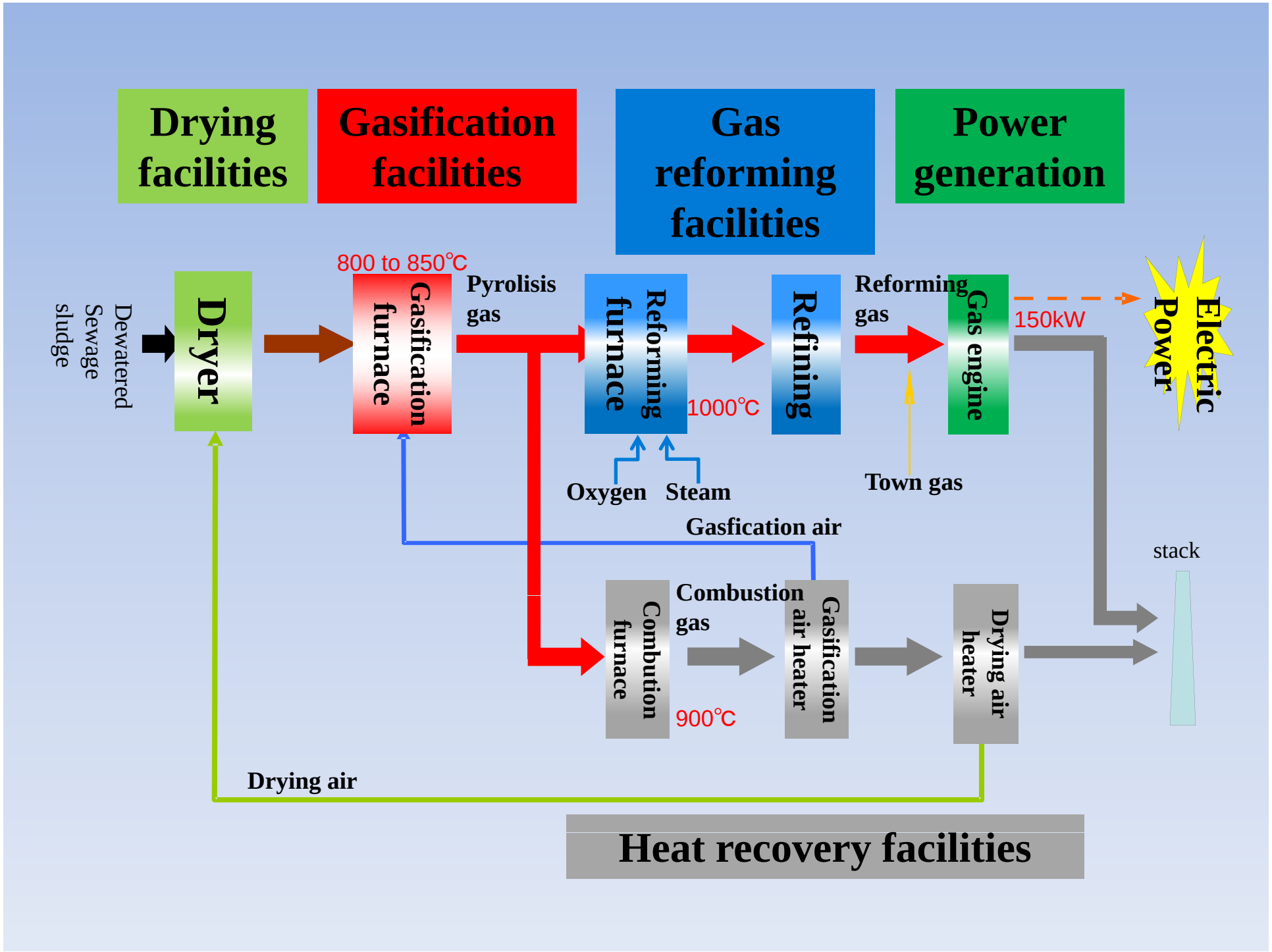
  [1] Design and construction

  From July 2008 to end of June 2010

  [2] Operation and Maintenance

  From July 2010 to end of March 2030

  For **20years**

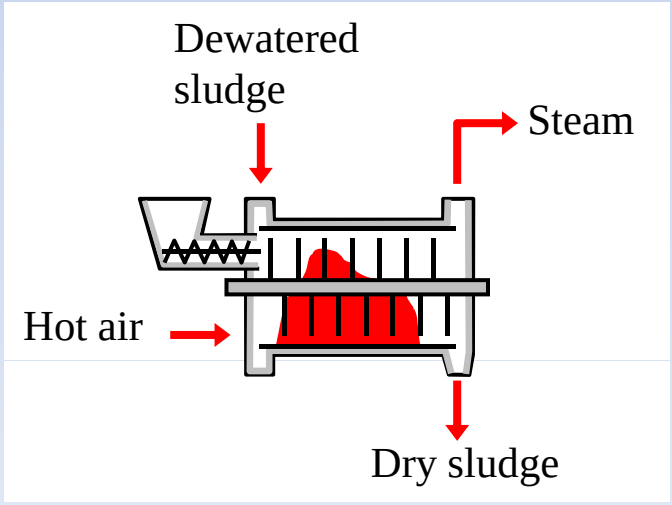

Drying facilities
Gasification facilities
Gas reforming facilities
Power generation
Dewatered Sewage sludge
Dryer
800 to 850℃
Gasification furnace
Pyrolisis gas
Reforming furnace
1000℃
Refining
Reforming gas
Gas engine
150kW
Electric Power
Oxygen
Steam
Town gas
Gasfication air
stack
Combustion furnace
Combustion gas
900℃
Gasification air heater
Drying air heater
Drying air
Heat recovery facilities

Sewage Sludge Gasification facilities

Drying facilities

The sludge having the water content of about 77% is dried to approximately 20%. As a heat source, dry gas obtained by using combustion heat in a heat recovery furnace is used.

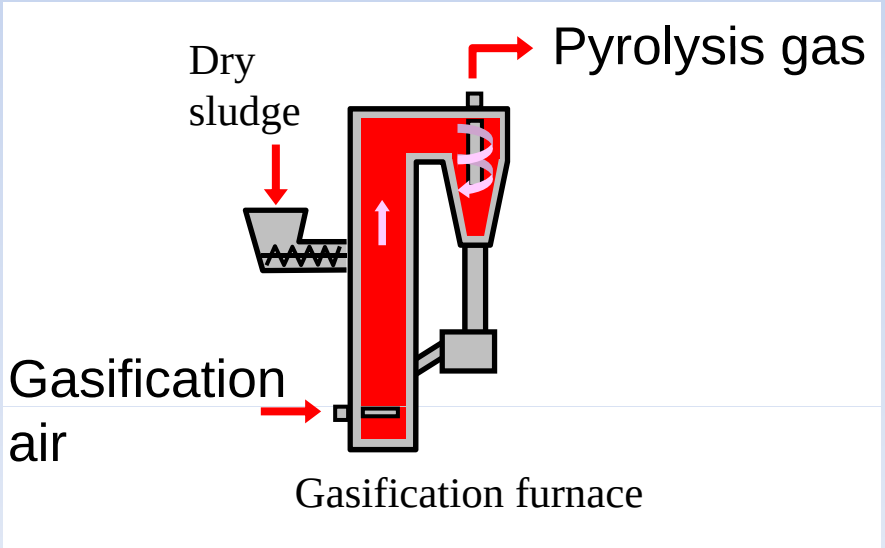
Type : Rotary dryer
Capacity : 100 wet-t/day
Outline dimensions : D:2.3mφ× L:9.5m



Gasification facilities

The dry sludge is pyrolyzed in low-oxygen state to generate pyrolysis gas.

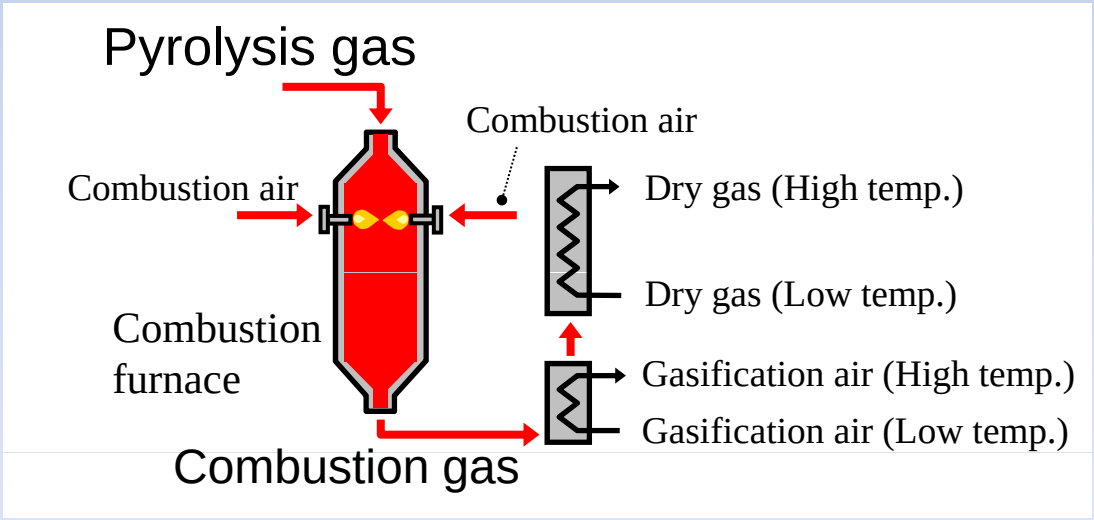
Type : Circulating fluidized bed reactor
Capacity : 100 t/day
(Dewatered sludge rate)
Outline dimensions : ID:960mm × H:10m



Heat Recovery Facilities

The energy of pyrolysis gas is exchanged into heat.
The pyrolysis gas is combusted to suppress generation of N_2O considerably.
The recovery heat is used for the gasification furnace and drying facilities.

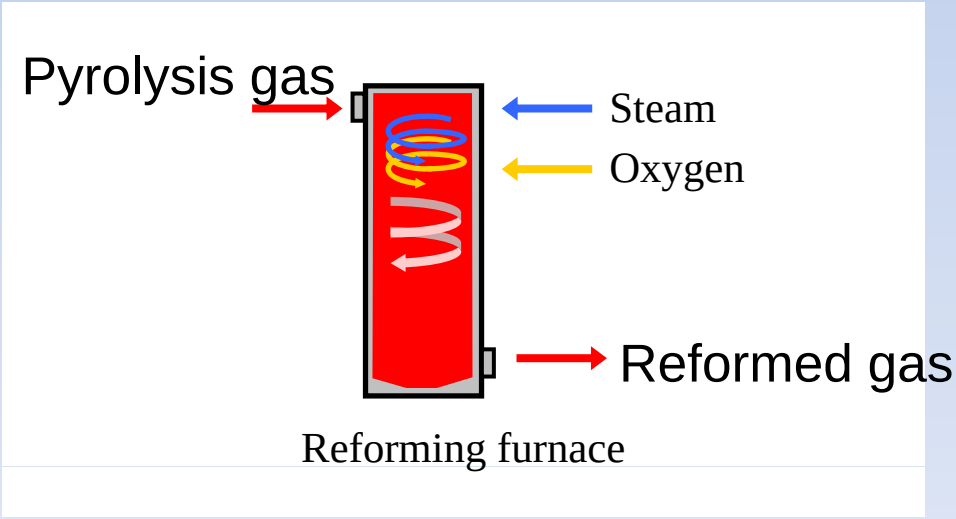
Type : Vertical cylindrical
Outline dimensions : ID:3.5m × H:15m



Reforming facilities

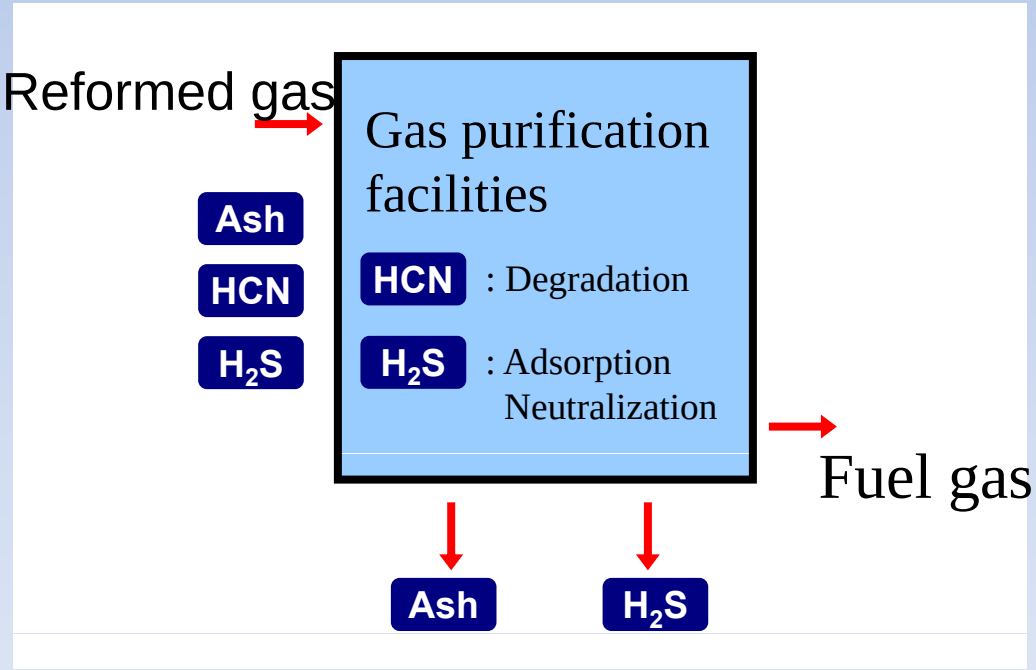
By reforming the generated gas, a high-quality combustible gas containing H_2 and CO is generated.

Type : Vertical cylindrical
Outline dimensions : ID 770mm × H:4m



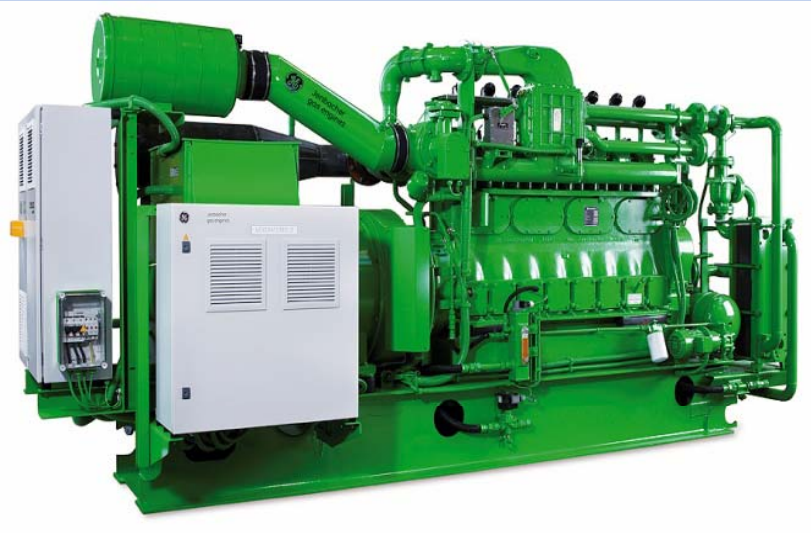
Gas purification facilities

Ash,nitrogen,sulfur and other impurities in the reformed gas are removed to the one suitable for gas engines.

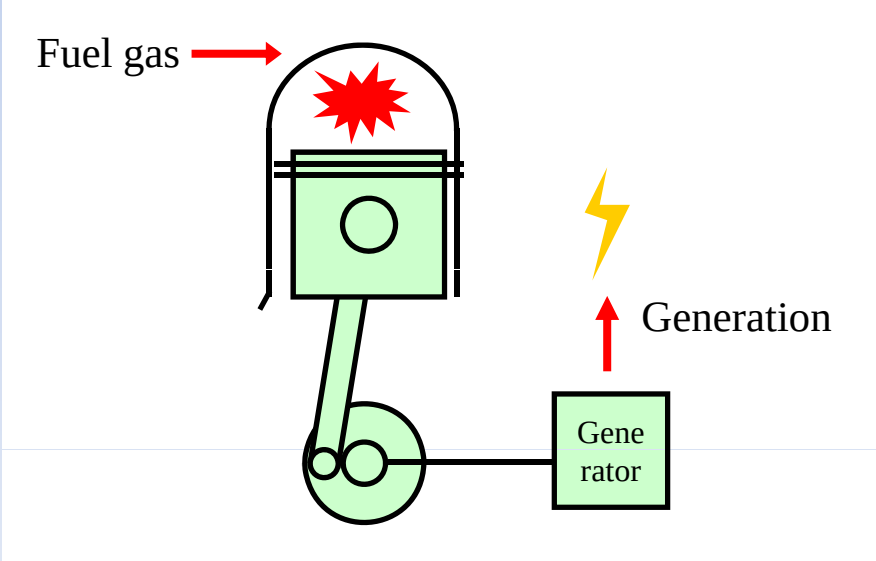


Power generation facilities

The gas is burnt to generate electric power of 150 kw, which accounts for approximately 30% of the entire power consumed in this system.



Type : Reciprocating engine
Generation capacity : 150kW

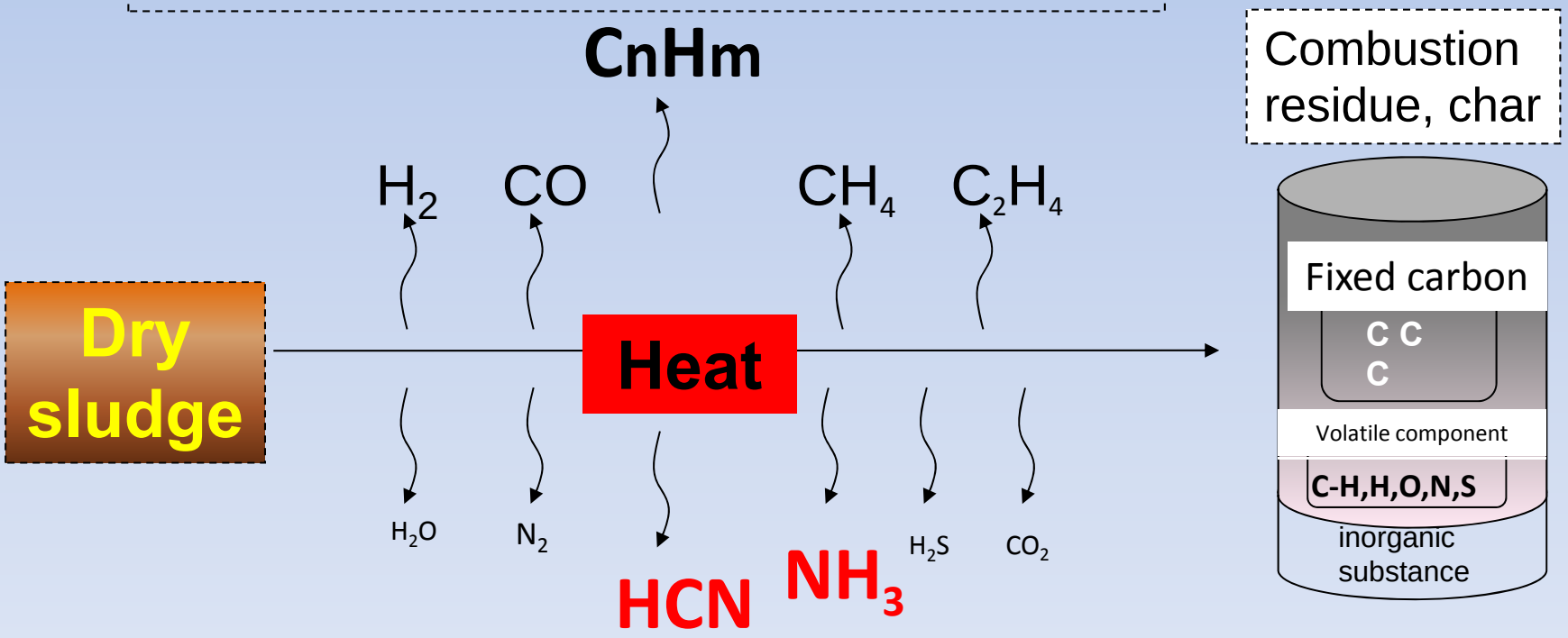


Mechanism of the Sewage Sludge Gasification System

Chemical reaction of the sewage sludge gasification

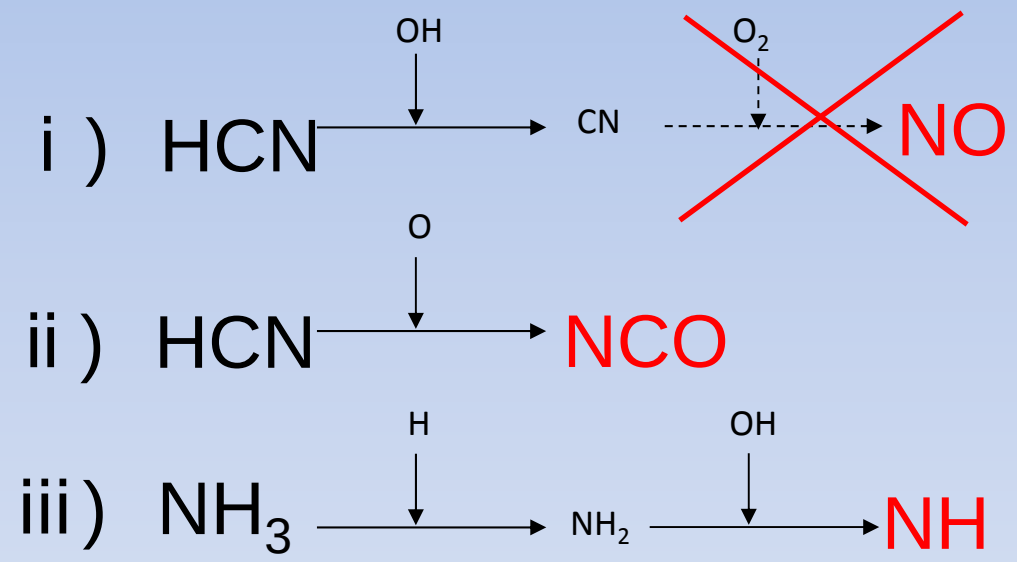
Gasification

Generation of pyrolysis gas



Chemical reaction of the sewage sludge gasification (Reforming)

Chemical reaction of Nitrogen compound in the reforming furnace



N_2O reaction

① NCO + NO = N_2O + CO

② NH + NO = N_2O + H

③ C(固体) +2NO = N_2O + CO

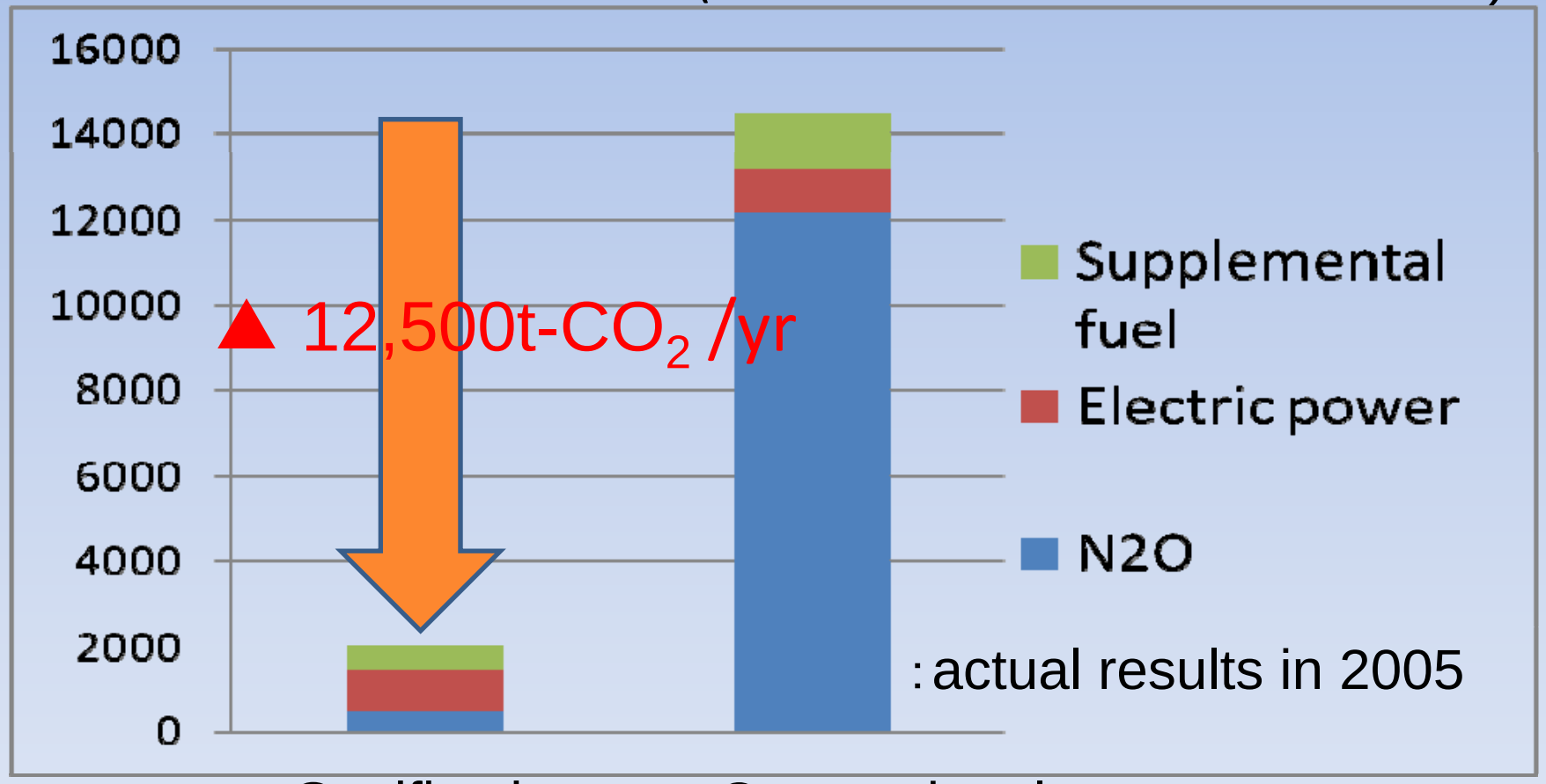
NO and N_2O are not generated in low-oxygen state

Project effect

Comparison in GHG emissions to one conventional incinerator

Reduction of 12, 500 t-CO_2 /yr

(converted into annual emission)



Operation results

【treatment】

	Plan	Results
The amount of treatment	33,000 t-wet	28,843 t-wet
Operation days	330 days	287 days
Water content of dewatered sludge	76.0%	77.2%

The amount of treated sludge is less due to because of the influence of the Great Eastern Japan Earthquake disaster.

Operation results

【Regulation】

- The regulations of the gas emitted into the atmosphere were obeyed.
- The odor, and the wastewater is also under regulations.

Operation situation

【Influence of the Earthquake】

- Gasification facility was shut down for 14 days.(Incinerator had been operated preferentially, because it is easier to stop and start operation.)
- During planned power cut ,Sludge treatment was kept to in a minimum.
- From April 2011, the operation is stable.

Conclusions

- Compared to the conventional incineration, GHG emission is reduced considerably.
- This system is mostly operated by rated capability.
- The water content of sludge is higher than assumption. So more supplemental fuel is used.

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