Utilization of Biomass in PC Boilers

14th January 2026

IHI Corporation

Basic Design Gr. Life Cycle Management Dept.
Carbon Solution Business Unit
Resources, Energy & Environment Business Area

Table of Contents

1.Introduction of IHI Corporation

IHI is a global company with 30 overseas bases and presence in 22 countries

Year of establishment

1853

Revenue (Consolidated)

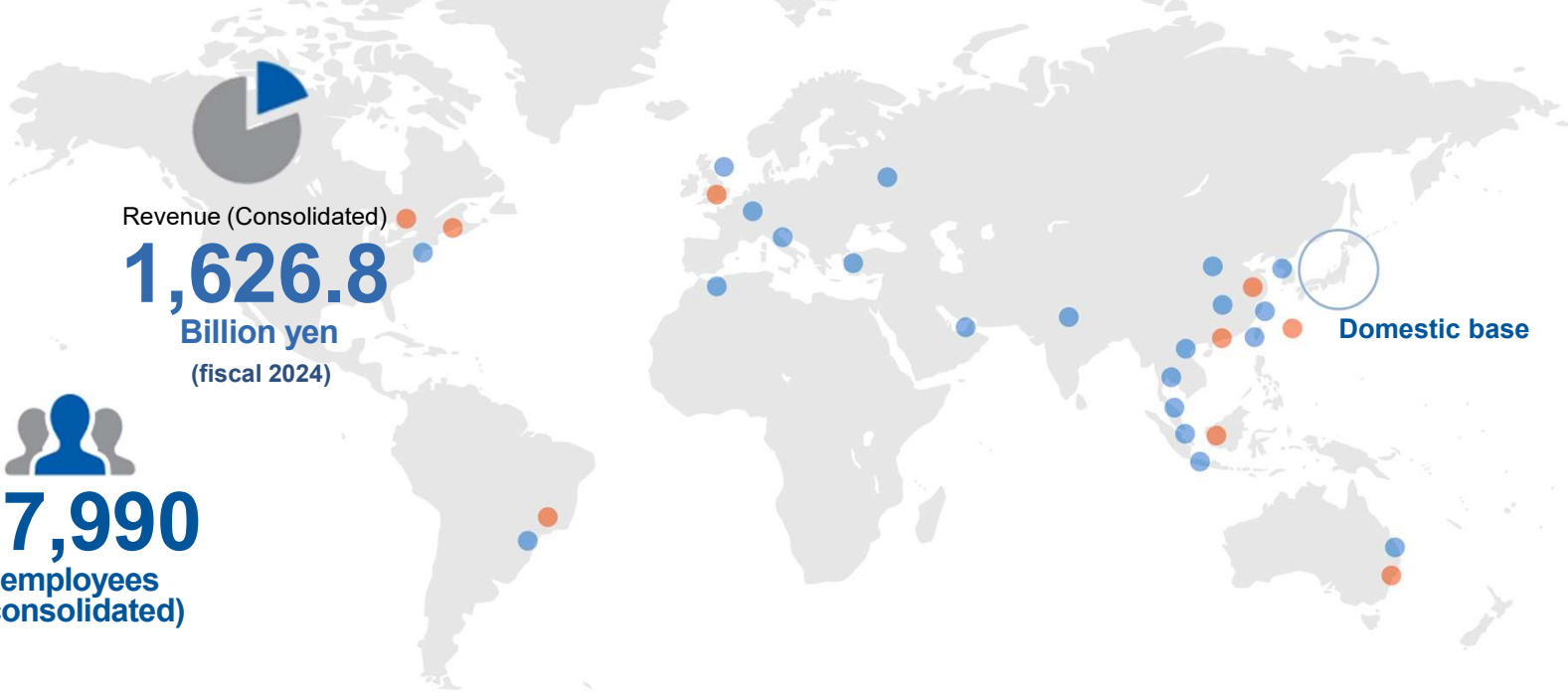
1,626.8

Billion yen

(fiscal 2024)

27,990

employees (consolidated)



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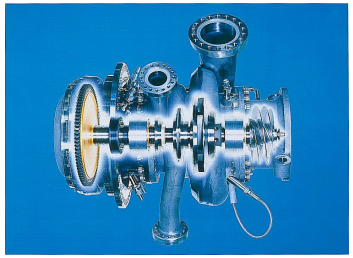
Areas of expertise

Resources, Energy & Environment

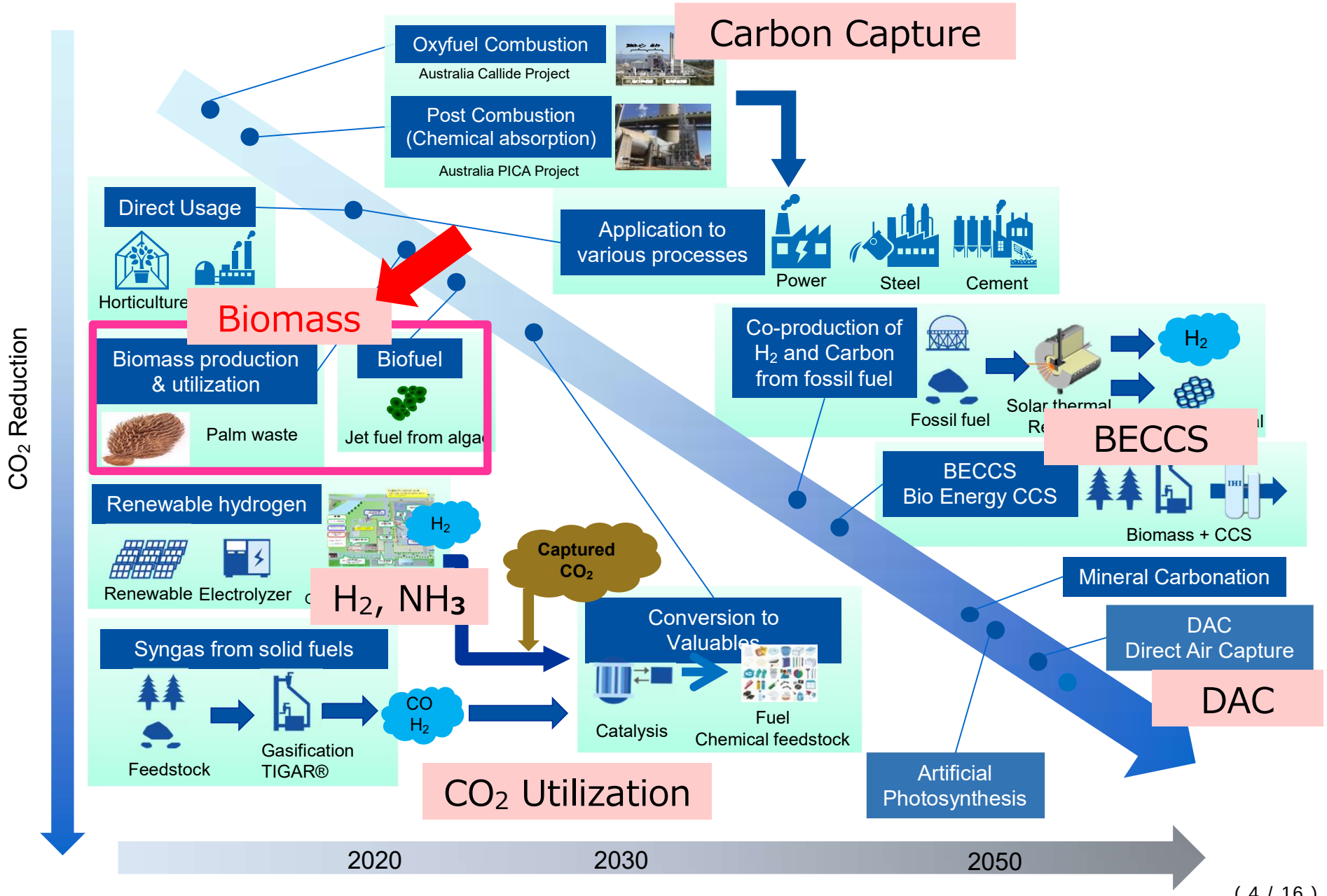
Industrial Systems & General-Purpose Machinery



Aero Engine, Space & Defense

Social Infrastructure

2. IHI's Vision for Carbon Neutrality



(1) Biomass Fuel Type

Various shape

Woody Chip
11.7 MJ/kg, 45%

Easy to handle in pellet form

Woody Pellet
16.7MJ/kg, 10%

Pruned Wood
8.0 MJ/kg, 43%

Bark
7.4 MJ/kg, 52%

WOODY

WASTE

Including Chlorine and foreign matter such as nails etc.

Waste Wood
13MJ/kg, 25%

High moisture
Low Calorific value

Paper Sludge
2.6 MJ/kg, 64%

AGRICULTURAL

Palm Waste
14.6 MJ/kg, 10%

Bagasse
6.9 MJ/kg, 49%

Coffee Grounds
8.8 MJ/kg, 60%

High moisture content

Biomass type
LHV, Moisture (Typical)

LHV: Lower Heating Value (as received base)

(2) IHI's development of technology related for biomass (Co-)firing.

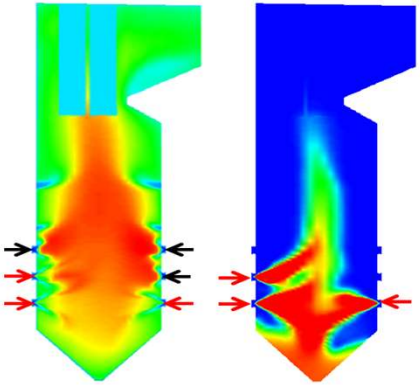
To reduce CO_2 emission (carbon neutral) from coal-fired power plant,
IHI is working on the development of technology for biomass (Co-)firing.

Clinker, Slagging/Fouling (Furnace, Heat Recovery Area)

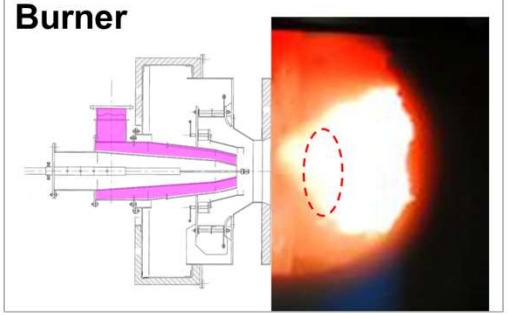
Ash Deposit Test

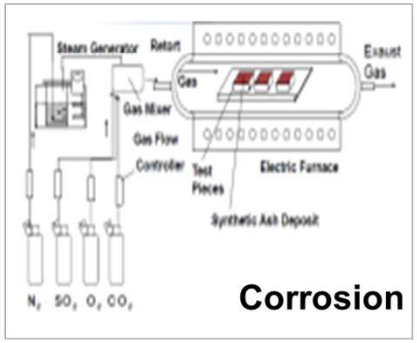
Coal Combustion Test Facility (CCTF)

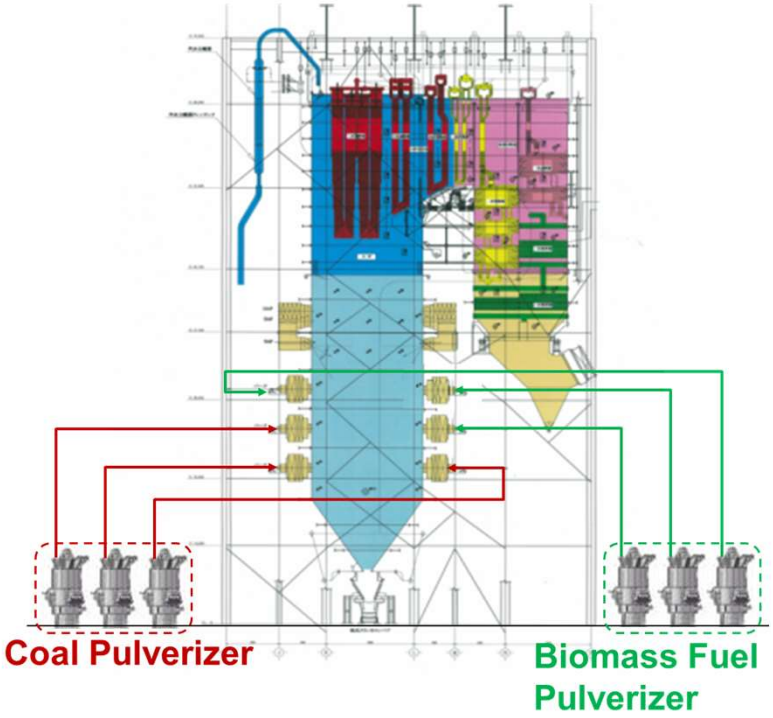
Combustion Flow Analysis



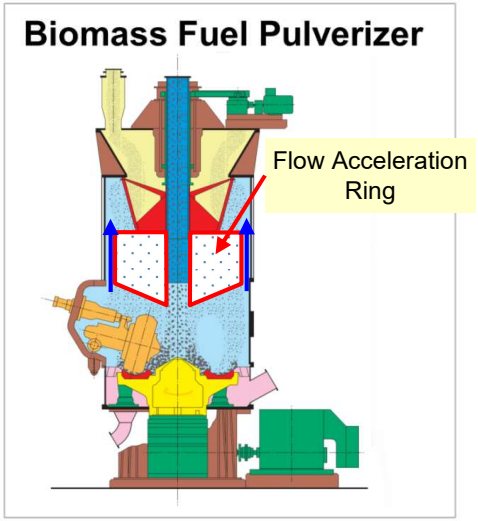
Burner







Biomass Fuel Pulverizer



(3) IHI biomass (Co-)firing power plants

- Modification for existing coal firing boiler / Newly construction
- Various Co-firing rate
- Achieved dedicated-firing with modification

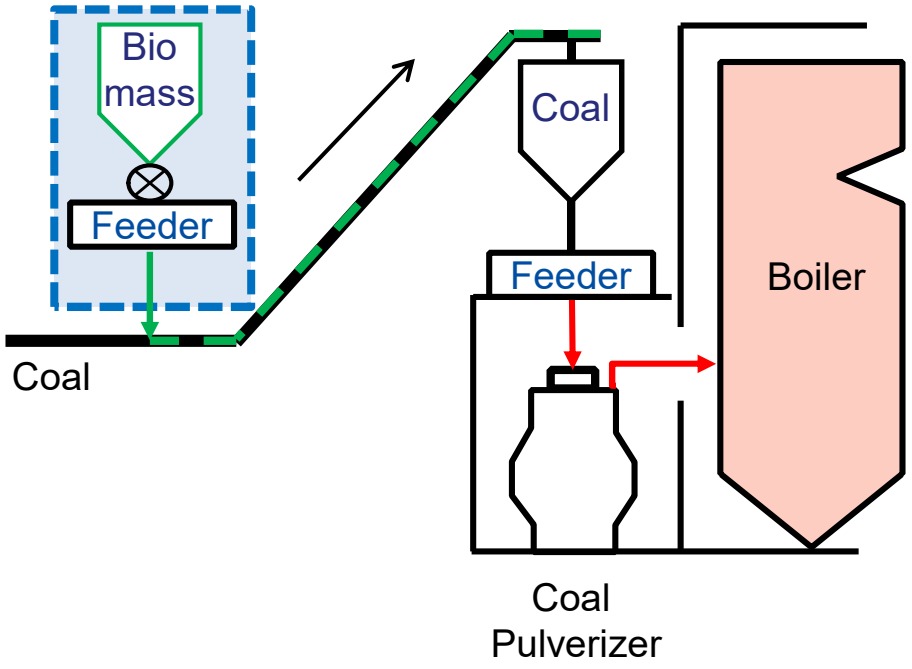
IHI biomass (Co-)firing power plants in Japan

Project	Output [MW]	(Co-)Firing rate [cal%]	Year
Many Ref.	-	2~3	2005-Current
K	149	8,25	2015
N	110	30	2017
I	149	25/42	2018/2023
O	500	15	2020
T	600	16	2022
S	112	100	2022
A	200	100	2023
NO	700	15	2025
TK	145	25	2025

4. Design Consideration for Biomass (Co-)Firing

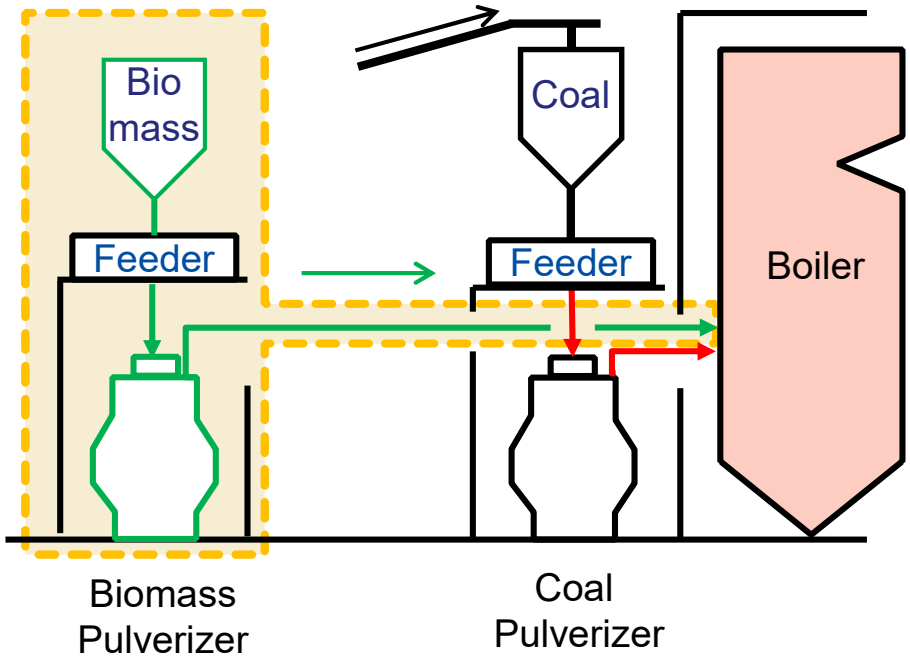
(1) Concept of (Co-)firing system

Mix-pulverizing system with coal pulverizer



◆ Current system
◆ Co-firing rate :
Max. **a few** % (in calorific value)
(Depends on pulverizer capacity)

Dedicated use pulverizing system for biomass (in particular wood pellet)

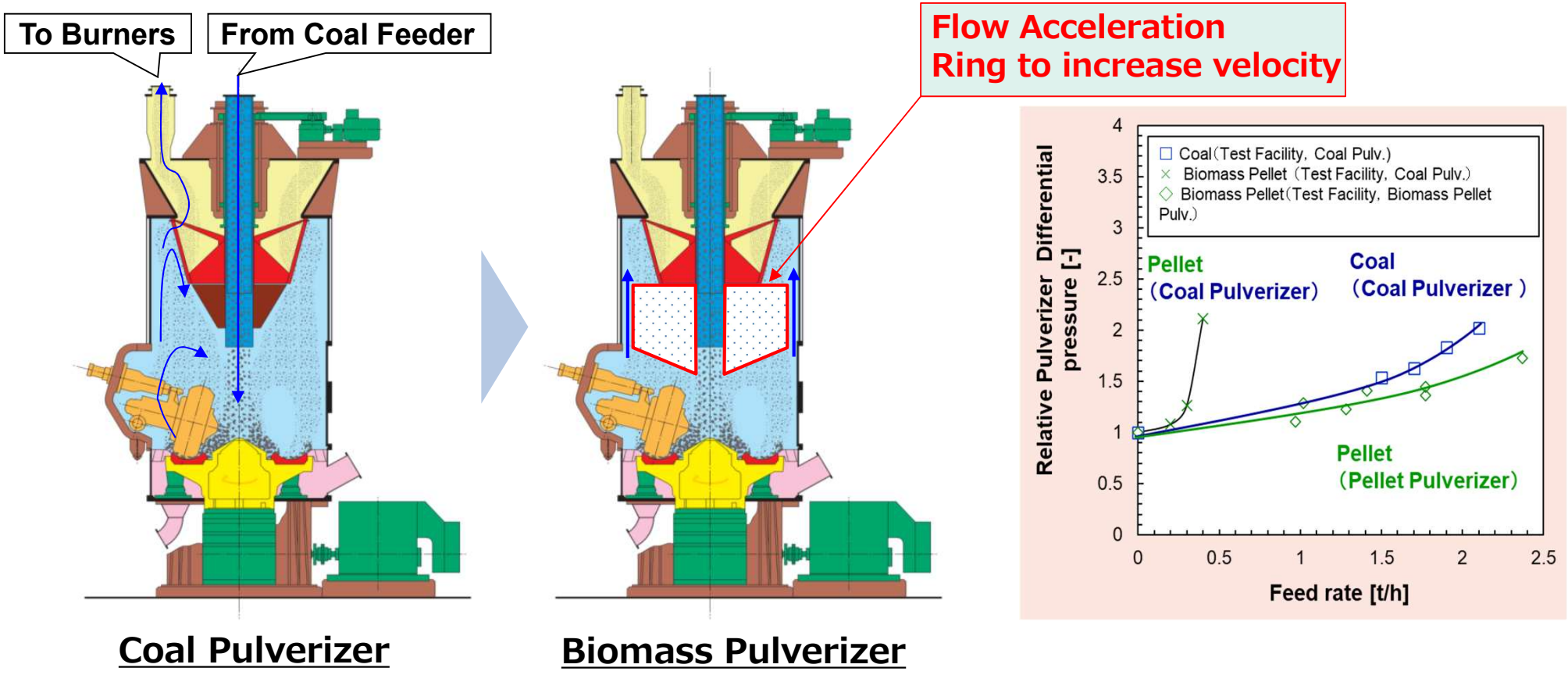


◆ Developed system
◆ Co-firing rate :
more than a few% (in calorific value)

4. Design Consideration for Biomass (Co-)Firing

(2) Grindability and processing capacity

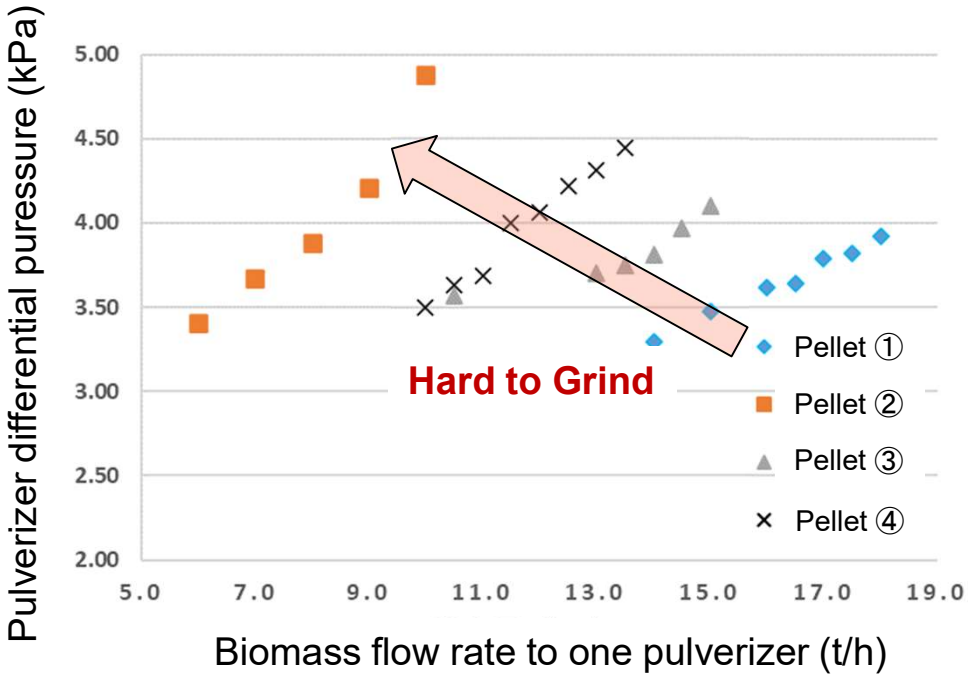
- ✓ One of the key issues of biomass firing is the difficulty in discharging the larger particle size of biomass from pulverizers to the boiler.
- ✓ In order to assist discharging the larger size of biomass IHI has developed the technology that this pulverized biomass (wood pellet) is exhausted by increasing flow velocity inside the pulverizer equipped with “flow acceleration ring”.



※The test results are based on the results of the “Pamphlets for Low Carbon Technology Research and Development Program” project commissioned by the Ministry of Environment in Japan.
https://www.env.go.jp/earth/ondanka/cpttv_funds/pdf/prod2015/p20150404.pdf

(2) Grindability and processing capacity

✓ **Biomass Type and Grindability**
The grindability of biomass varies depending on their type, such as differences in origin or brand.

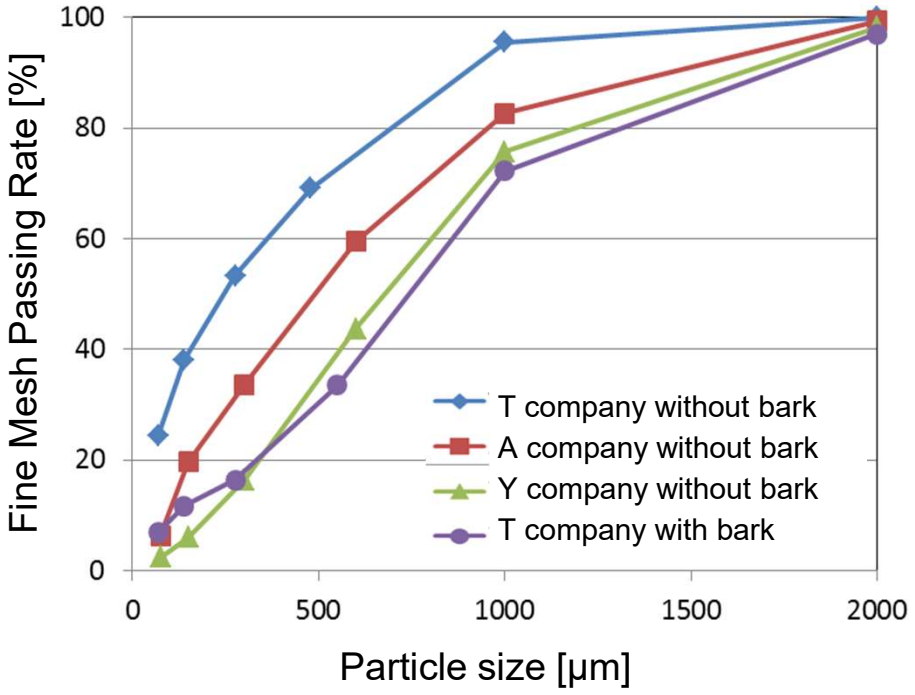


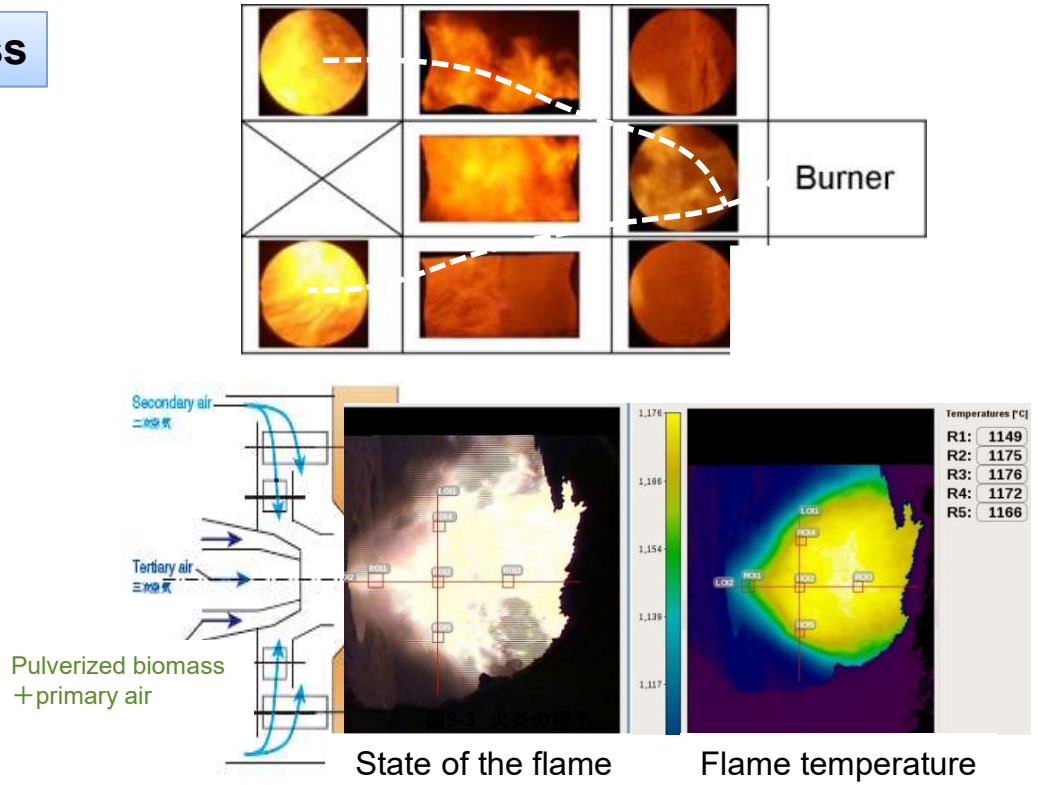
✓ **Dimple Roller**
To improve the grindability, IHI developed a dimple roller with multiple dimples on the surface of the roller.
It has been adopted in some plants and has proven effective.

(3) Combustibility

If the primary particle size distribution and actual pulverized particle size are equivalent to ISO I2 standard, the stable combustion will be achieved.
Pulverized biomass with a particle size of 2mm or more will lead an incomplete combustion due to the insufficient mixing with combustion air. As a result, it is not burned completely, and the unburned biomass accumulates at the furnace bottom.

Particle size distribution of pulverized biomass





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(3) Combustibility

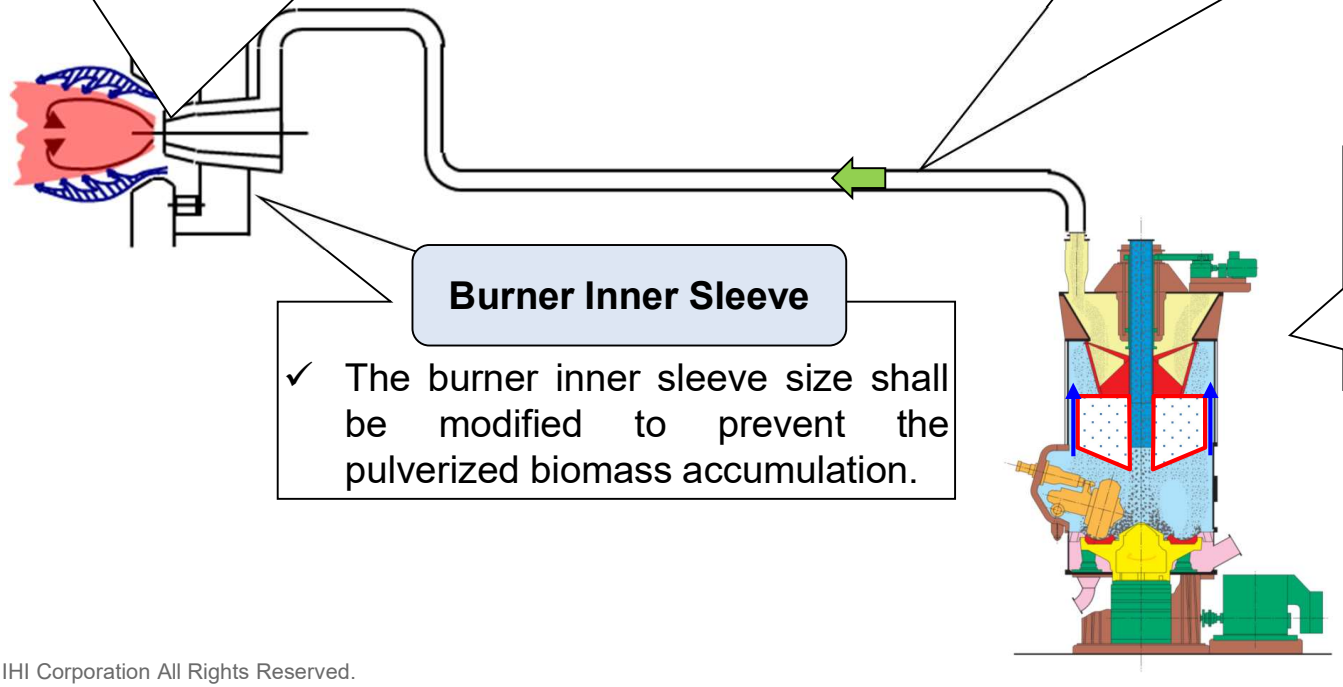
When converting the exiting equipment to biomass dedicated use, **① Optimization of some equipment** and **② Appropriate Selection of Biomass Fuel** are necessary.
The following shows the typical target equipment of optimization for biomass dedicated use. The actual scope of modification shall be decided to consider the original design and the biomass fuel specification.

Burner Nozzle

✓ The burner nozzle shall be modified to consider emission of volatile component and mixing with secondary air because the biomass fuel is not easy to discharge the volatile matter compared with coal.

Coal Pipe

✓ The coal pipe size shall be modified to prevent the pulverized biomass accumulation.



Burner Inner Sleeve

✓ The burner inner sleeve size shall be modified to prevent the pulverized biomass accumulation.

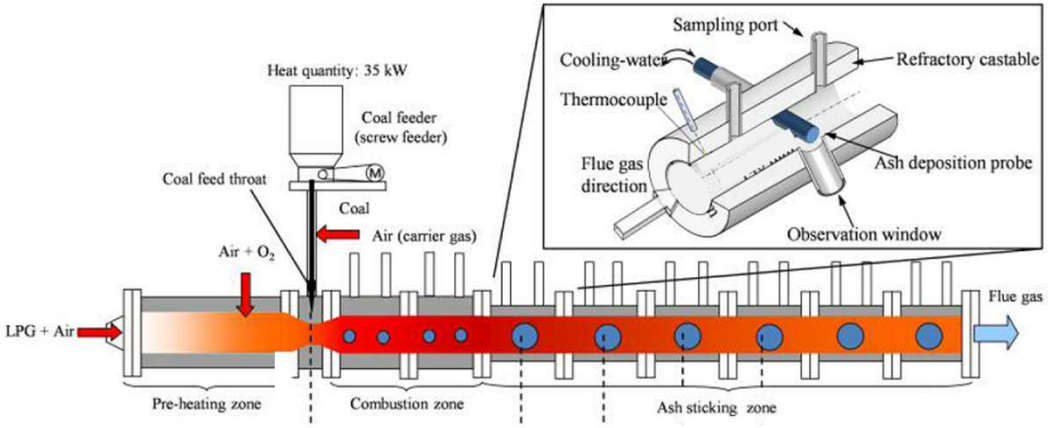
Biomass Pulverizer

✓ The coal pulverizer shall be modified to consider the grindability and discharge capacity.

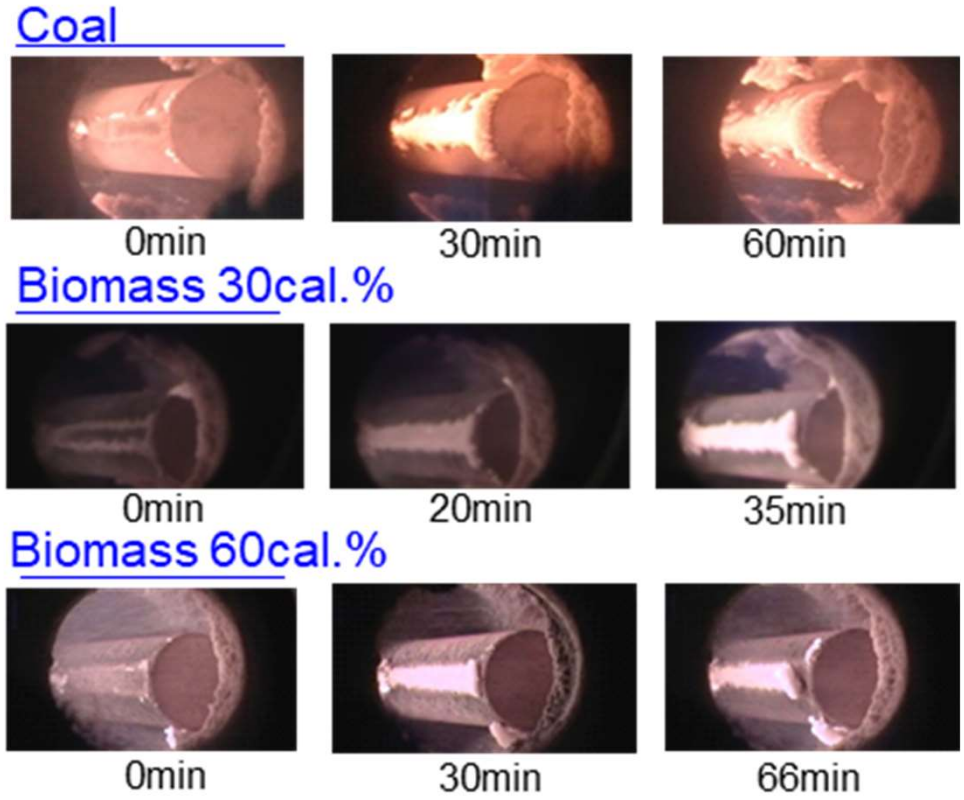
(4) Clinker (slagging/fouling)

A probe is inserted the inside of the same temperature as the furnace(1300℃) or as the Super Heater / Re Heater (600℃). Probe surface temperature is controlled to the same level as that of the boiler tube, and ash is attached on the prove. Deposited ash ratio of only coal to 60cal.% biomass mixed sample are the same level in any temperature conditions.

Experimental apparatus



Test Results



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(5) Corrosion

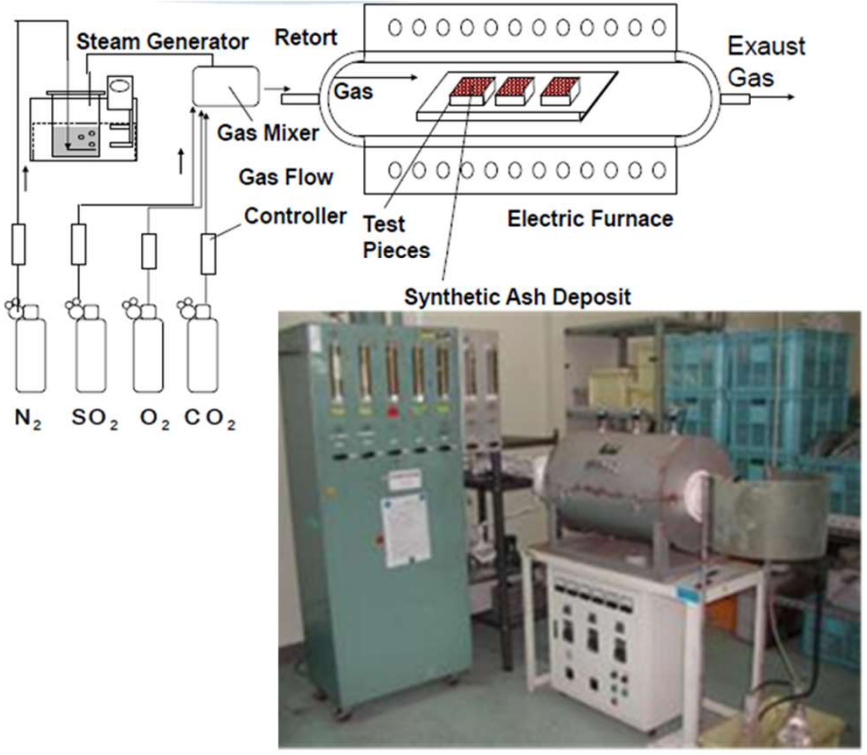
Furnace condition

Corrosion is the same level regardless of biomass mixing ratio.

Super Heater / Re Heater condition

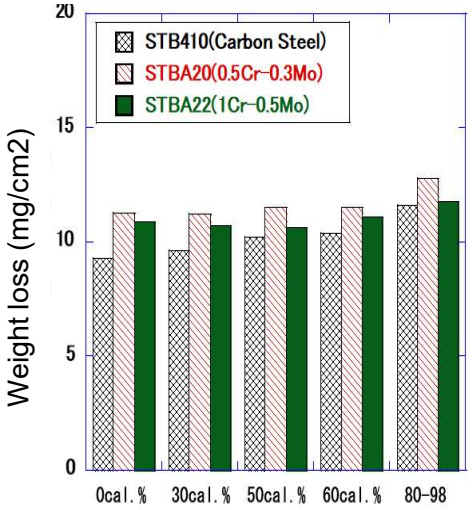
0～60.cal%：The influence of biomass mixing ratio is small. As alkali salt concentration is increased, corrosion is also increased.

Experimental apparatus



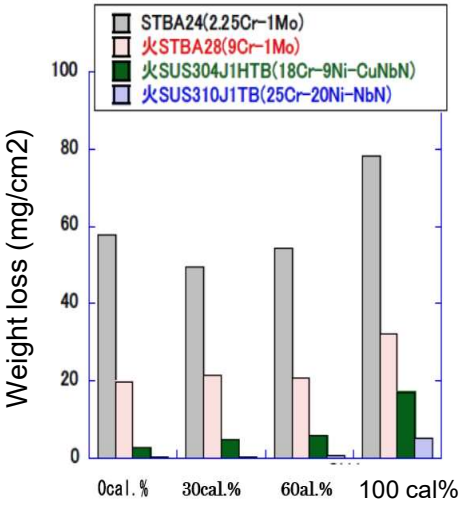
Test Results

Furnace condition



Corrosion amount comparison (500℃, 500Hr)

SH/RH condition



Corrosion amount comparison (650℃, 500Hr)

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5. Summary

1. Biomass co-/dedicated firing have been implemented at several coal-fired power plants in Japan.

2. The appropriate biomass fuel selection is essential to the biomass firing.

3. Modifications to pulverizers and burners are required, and optimization is also necessary for several other equipment.

4. IHI will contribute to the reduction of CO_2 emissions along with everyone involved in coal fired power generation.

IHI

Realize your dreams