Torrefied Biomass (CO2 Free Fuel) Production by Antler Kiln

- Contribution for Reduction of CO2 Emission on Power Generation in Indonesia -

2nd December, 2015

Hiroshi Nambo
President
Japan Coal Energy Development Corporation

Coal Power needs CO2 Free Carbon Source

- Power Industry needs CO2 Free Fuel

Indonesian Government provide incentive for biomass fuel such as Feed in Tariff (FIT).

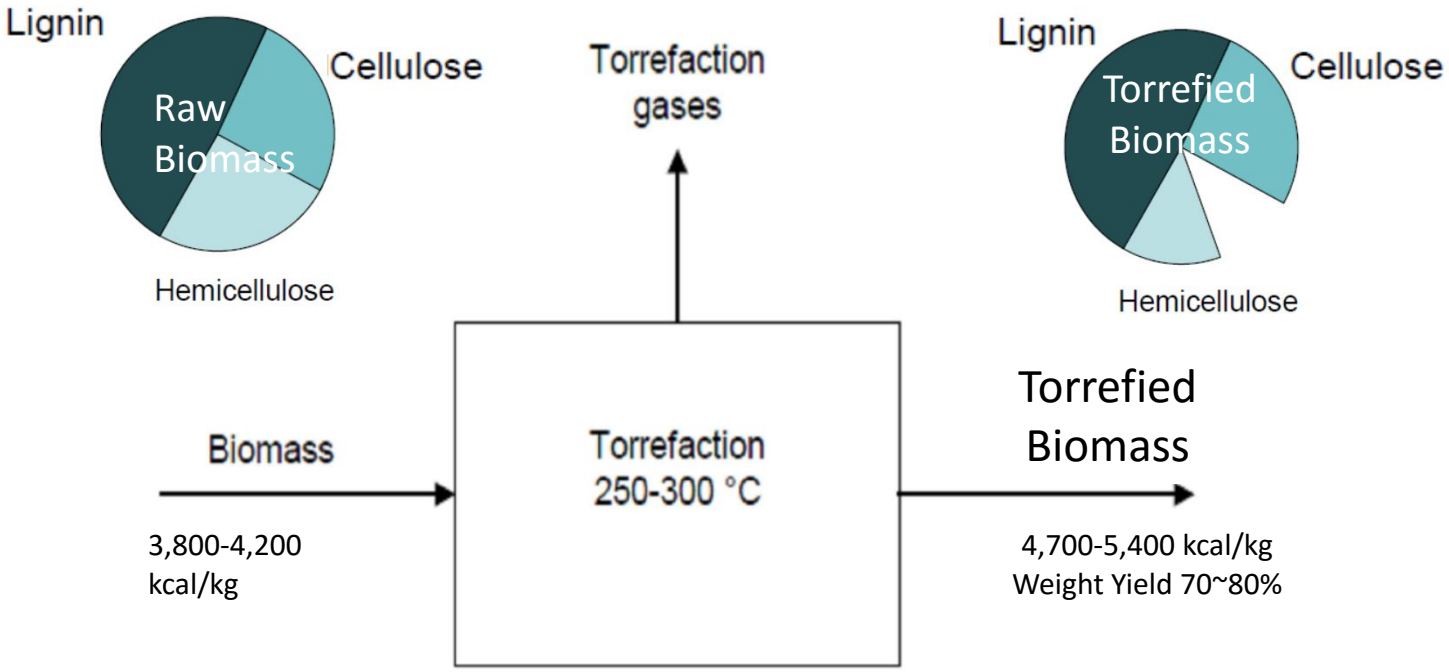
Issue with Biomass as Fuel

- Low Calorific Value (high volatile organic compound and oxygen)
- Low Energy Density
  (too bulky, not economical to transport over long distance)
- Non-Homogeneous
- Difficult to Pulverize like Coal in PC Boiler System
  (poor graindability)
- Hydroscopic (absorbs moisture during storage)
- Big Advantage : CO_2 Free

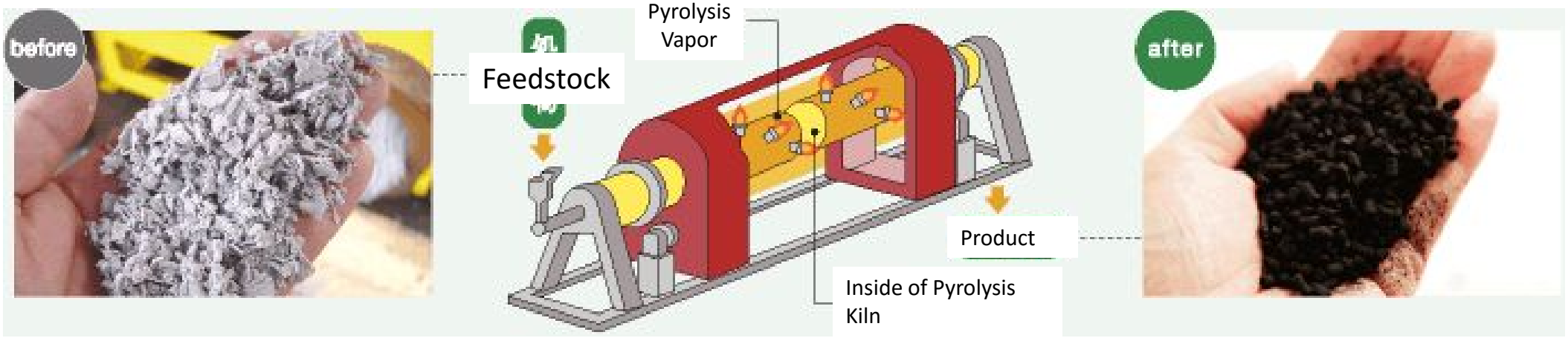
Solution : Mild Pyrolysis =Torrefaction -

- A thermochemical treatment process, similar to roasting or mild pyrolysis
- To remove some Volatile Organic Compounds (VOCs) and Hemicellulose in Biomass, leaving only cellulose & lignin to produce a charcoal-like carbonaceous product (Torrefied Biomass).
- VCOs and Hemicellulose are utilized fuel to generate process heat for Torrefaction.
- Depending on the process conditions, the Torrefied Boimass yield varies between 70% to 80% dry basis.

Effects of Torrefaction

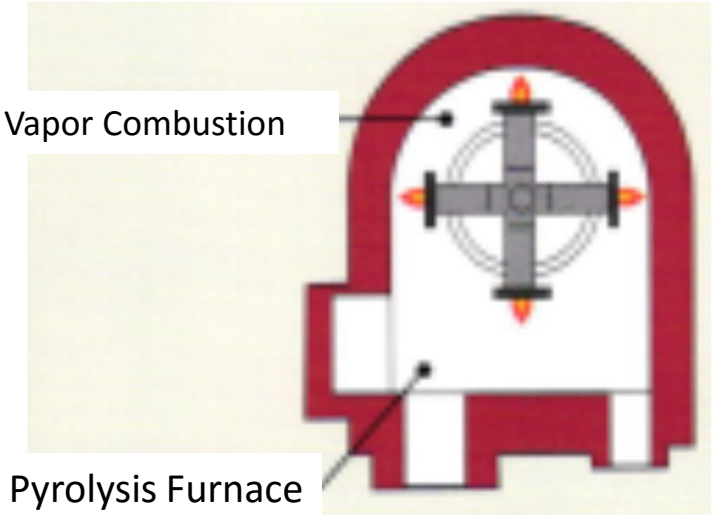


Hiroshima Gastechno▪Service's Antler Kiln



Antler kiln is a highly efficient and reliable pyrolysis technology to produce semi-coke and char from organic waste and biomass such as woody waste and palm kernel shell (PKS) without any trouble of by-product tar.

Feature of Antler Kiln



Organic waste and biomass are carbonized without air by in-direct heating of self-sustaining combustion of by-produced gas and tar, and only solid product such as semi-coke and char is produced. Moisture content of feed material for Antler Kiln is required under 15% to keep the flame of gas & tar combustion. Hiroshima Gastechno・Service successfully developed novel pyrolysis technology by industrializing conventional and proven pyrolysis technology without environmental pollution.

Large Scale Test Facilities of Antler Kiln in Hiroshima

Hiroshima Gastechno・Service has several test facilities to provide best solution for client by utilizing Antler Kiln. Test results clarify the quality of carbonized solid product, best pyrolysis conditions and commercial performance & design.

Small & Middle Size Test & Research Facilities of Antler Kiln in Hiroshima

[Test Dryer]

Wet material is dried to determine required heat quantity. Approximately 50kg wet material is processed per hour.

[Continuous Pyrolysis Test Kiln]

ID 0.5m x Length 3m

Processed material is carbonized continuously to determine best condition such as temperature and retention time. Approximately 20-30kg material is processed per hour.

[Batch Test Pyrolysis Furnace]

「Batch test clarifies best pyrolysis conditions before continuous pyrolysis test. Meanwhile, continuous pyrolysis test requires feed material size 20-30mm therefore batch test is utilized for carbonizing material as it is and also material hard to be crushed. Batch test pyrolysis furnace has 80 liter volume.

Past Record of Commercial Antler Kiln in Japan (1)

Paper mill sludge of which moisture contents 40-50% is dried and carbonized pollution free by Antler Kiln system effectively to minimize fossil fuel consumption.

Plant Size: Small
Sludge Processing Capacity: Approximately 800kg/h
Product Application: Lagging Material for Steelmaking

Plant Size: Middle

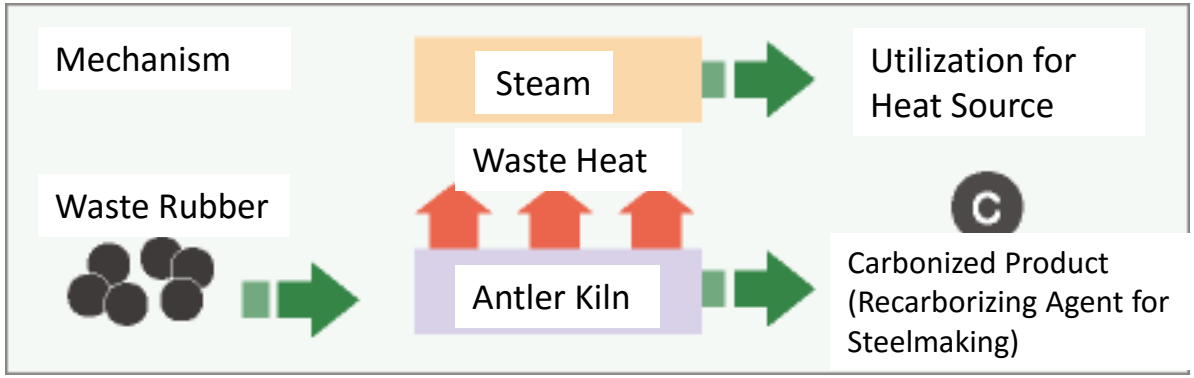
Sludge Processing Capacity: Approximately 3,500kg/h
Product Application: Lagging Material for Steelmaking

Plant Size: Large

Sludge Processing Capacity: Approximately 6,500kg/h
Product Application: Soil Conditioner

Past Record of Commercial Antler Kiln in Hiroshima , Japan (2)

Waste rubber such as car sashes is carbonized pollution free and steam generated by waste heat from pyrolysis is utilized as heat source for production and hearing in plant. Effective utilization of waste heat reduced fossil fuel consumption by reducing steam consumption from existing boiler.



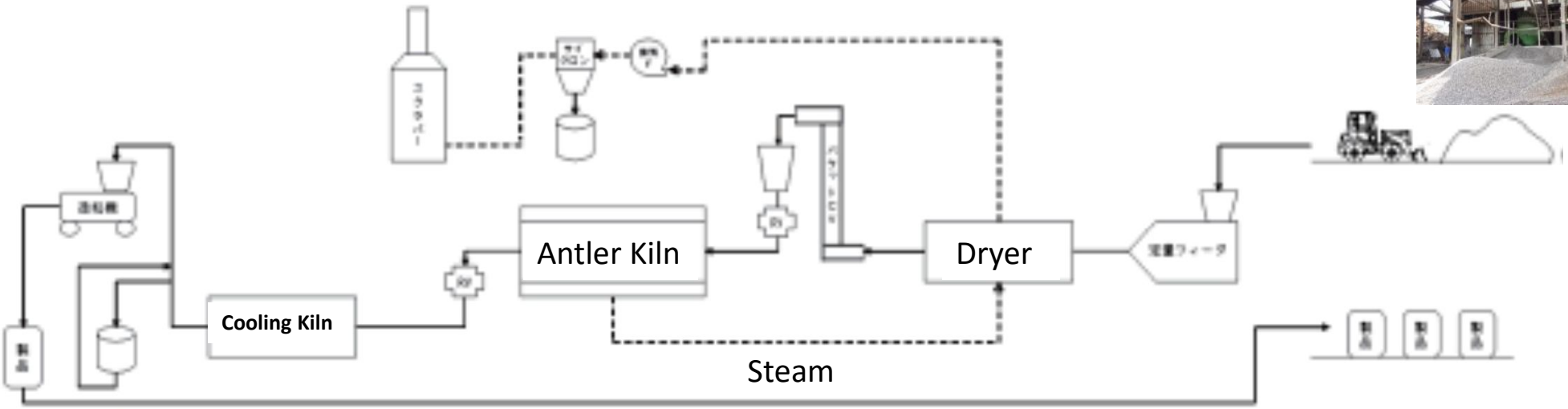
[Technical Data]
Waste Rubber Processing Capacity: 140ton/month
Carbonized Product Production Capacity: 50-60ton/month (sale to Steel Mill as Recarborizing Agent)」

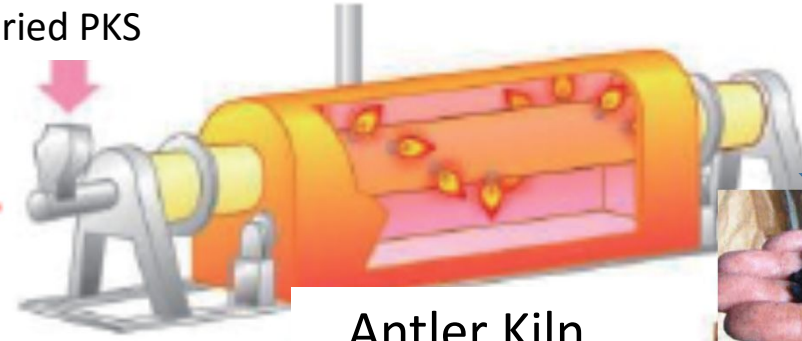
Past Record of Commercial Antler Kiln in Nagasaki, Japan (3)

Automobile Shredder Residue (ARS) Processing 1t/h plant

Diameter 1.6m x Length 12m

Expected PKS Torrefaction Process by Antler Kiln

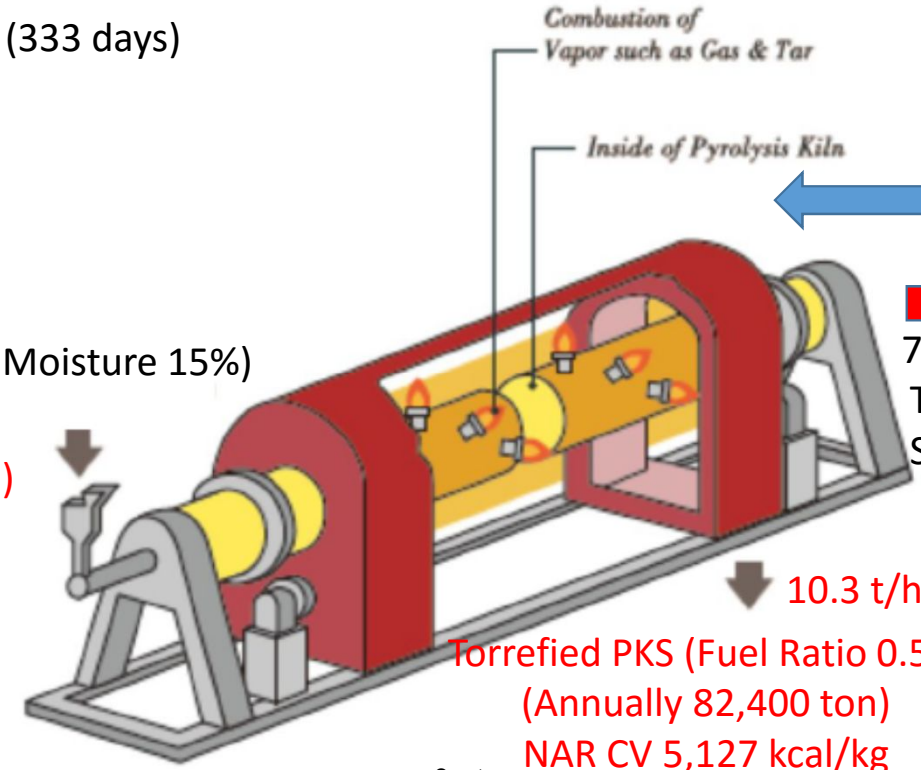




Torrefied PKS

PKS Torrefaction by Ready-Made Antler Kiln

Annual Operation : 8,000 hours (333 days)



Ignition

Oil

10 kg/h

10 kg/h

Combustor (800℃)

750℃

Temp. Control

Hot Gas

Steam

Waste Heat Boiler

1.1 t/h

PKS (Moisture 15%)

17.3 t/h
(Annually 138,400 ton)

10.3 t/h

Torrefied PKS (Fuel Ratio 0.54)
(Annually 82,400 ton)
NAR CV 5,127 kcal/kg
CO2 Free Fuel

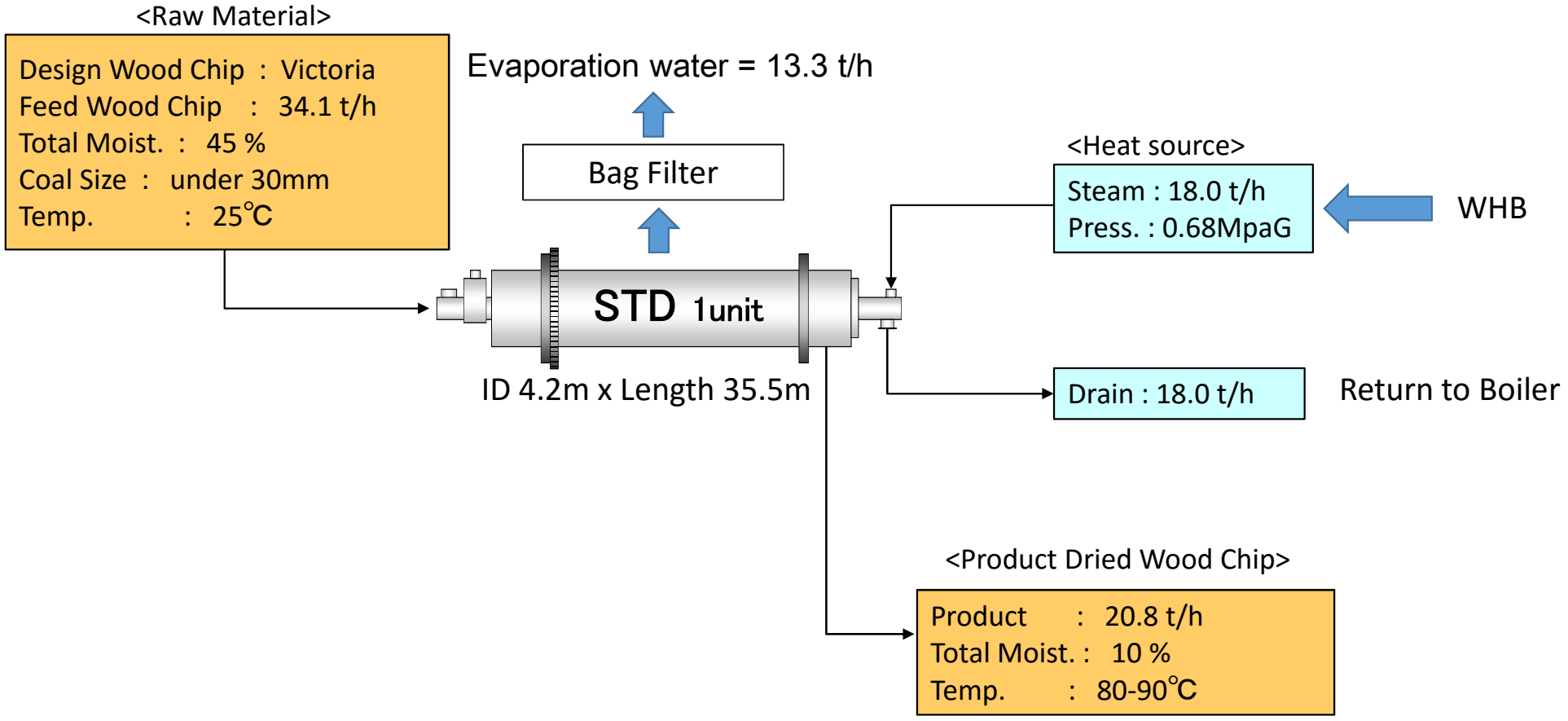
Demineralization
Water

13.3 t/h

Steam
(0.68MPa/170℃)

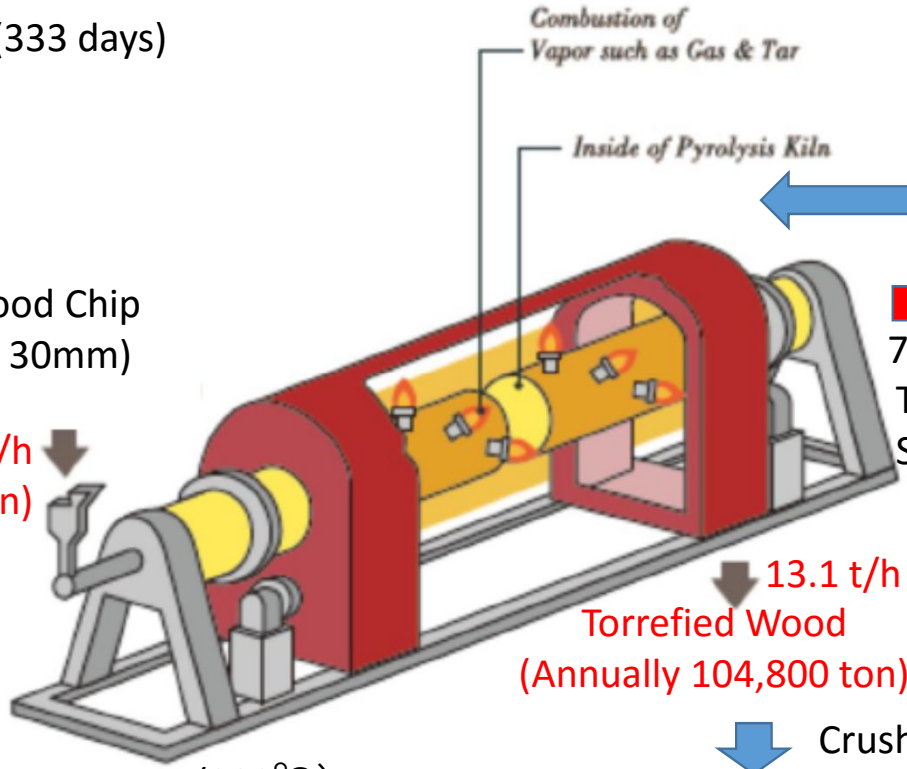
Torrefaction Temperature (290℃)
ID:4m x Length 23.5m x 1 unit

Material Balance of STD 1 Unit for dying
Wood Chip Moisture 45% → 10%



Dried Wood Chip Torrefaction by Ready-Made Antler Kiln

Annual Operation : 8,000 hours (333 days)



Ignition

Oil 10 kg/h

10 kg/h

Combustor (800℃)

750℃

Temp. Control

Hot Gas

Steam

Waste Heat Boiler

1.1 t/h

Drain Water from STD

20.6 t/h

Steam for STD
(0.68MPa/169℃)

Dried Wood Chip
(Moisture 10% Size under 30mm)

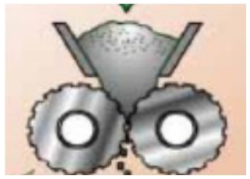
20.8 t/h
(Annually 166,400 ton)

13.1 t/h
Torrefied Wood
(Annually 104,800 ton)

Crushing

Pyrolysis Temperature (280℃)
ID:4m x Length 23.5m x 1 unit

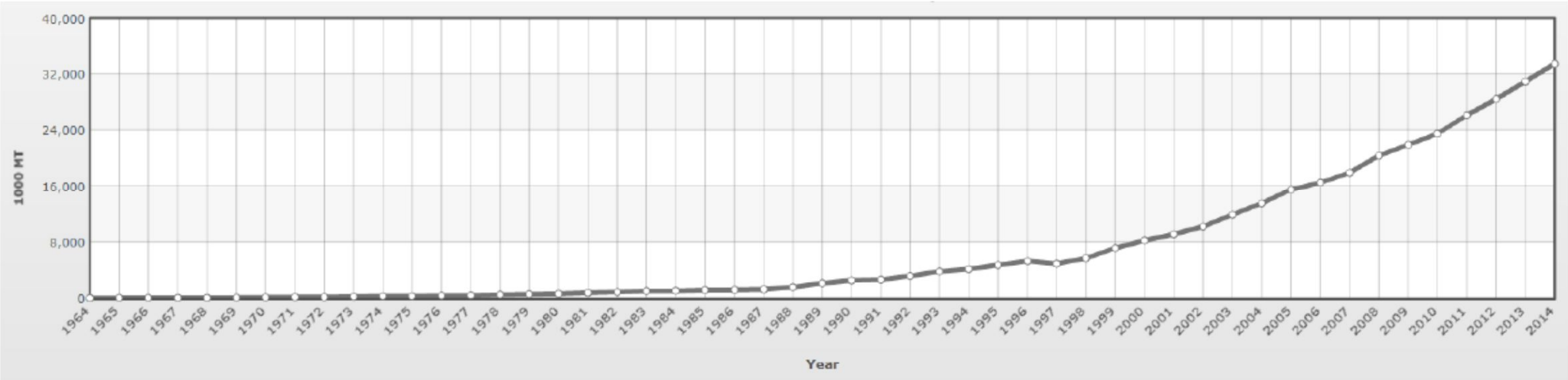
No need binder
because remained
lignin is good binder



Briquetting

Torrefied Wood Briquette

Indonesian Palm Oil Production by Year

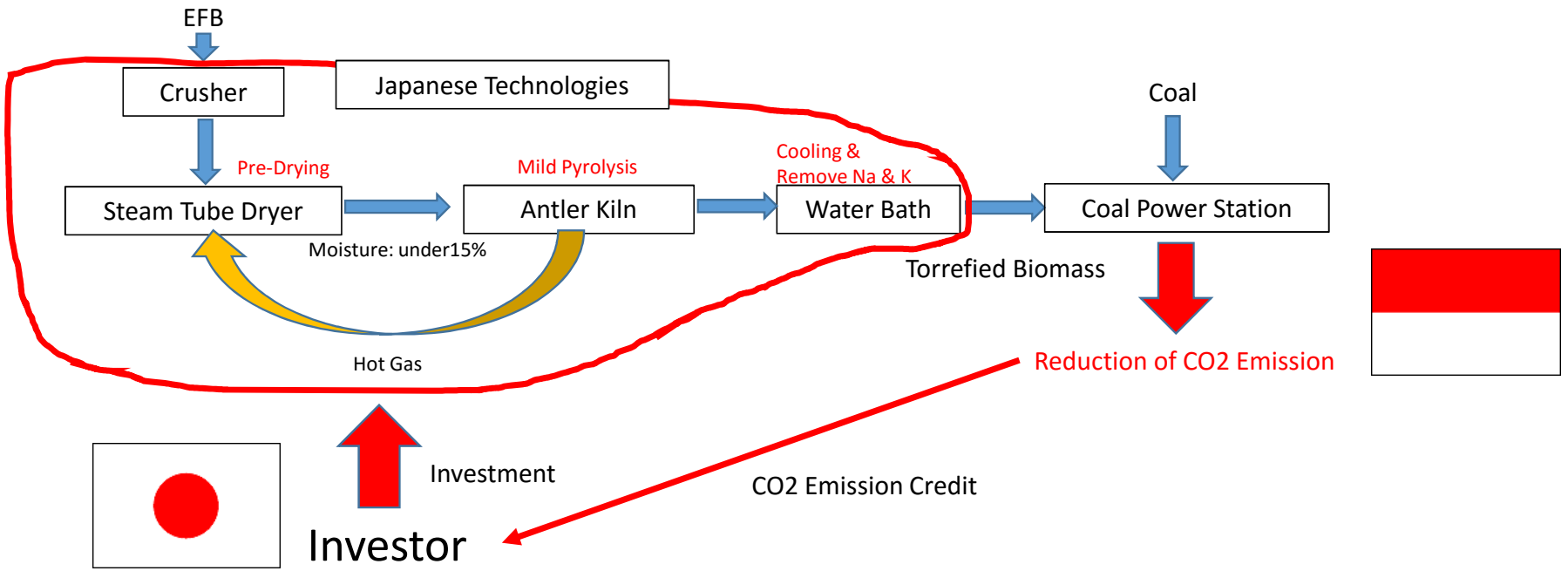


Yield of Palm Products and Its Amount in Indonesi

Appellative		Yield (wt%)	Yield on CPO (wt%)	Production in 2014 (million ton)
FFB (Fresh Fruit Bunch)		100	370	122.10
	CPO (Crude Palm Oil)	20	100	24.44
	PKO (Palm Kernl Oil)	7		8.56
	PKS (Palm Kernel Shell)	7	26	8.58
	EFB (Empty Fruit Bunch)	23	85	28.05
	Fiber	13	48	15.84
	Othres	30	111	36.63

- The utilization of EFB as a fuel is one of important issues in Indonesia.
- The advantage of EFB is huge big amount and disadvantage is high moisture and high Na & K content that are not good for combustion.

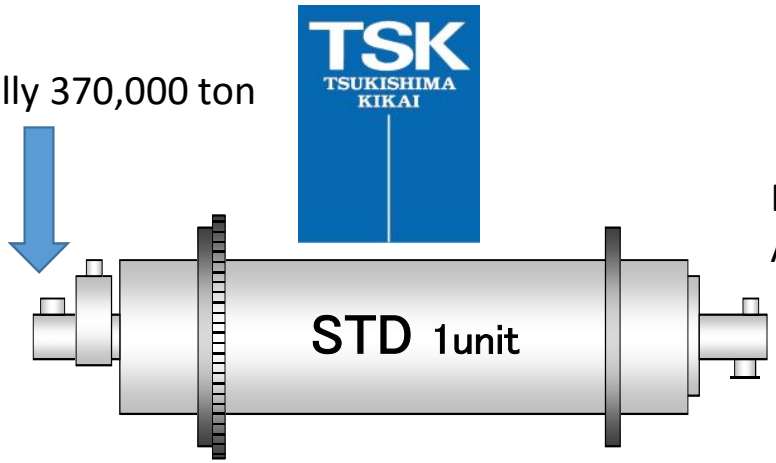
Concept of CO2 Reaction in Coal Power Generation
- Trading of CO2 Emission Credit -



Japanese Power Utilities can reduce their CO2 emission in Japan by utilizing this scheme.

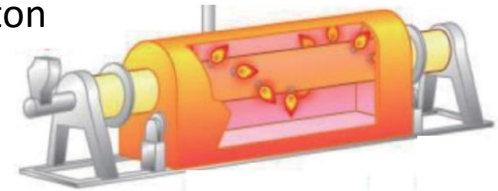
Expected Torrefied EFB Production by STD & Antler Kiln

EFB
Annually 370,000 ton



Maximum Size of STD
ID 4.2m x Length 35.5m

Dried EFB
Annually 150,000 ton



Maximum Size of Antler Kiln
ID:4m x Length 23.5m x 3 units

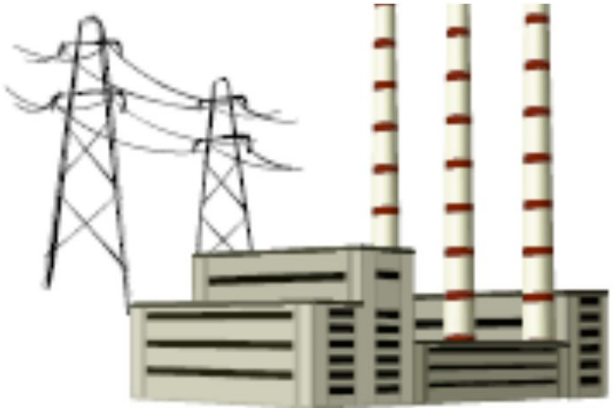
Torrefied EFB
100,000 t/y

CO2 Reaction in Coal Power Generation by Torrefied Biomass

Japan Coal Energy Development Corporation

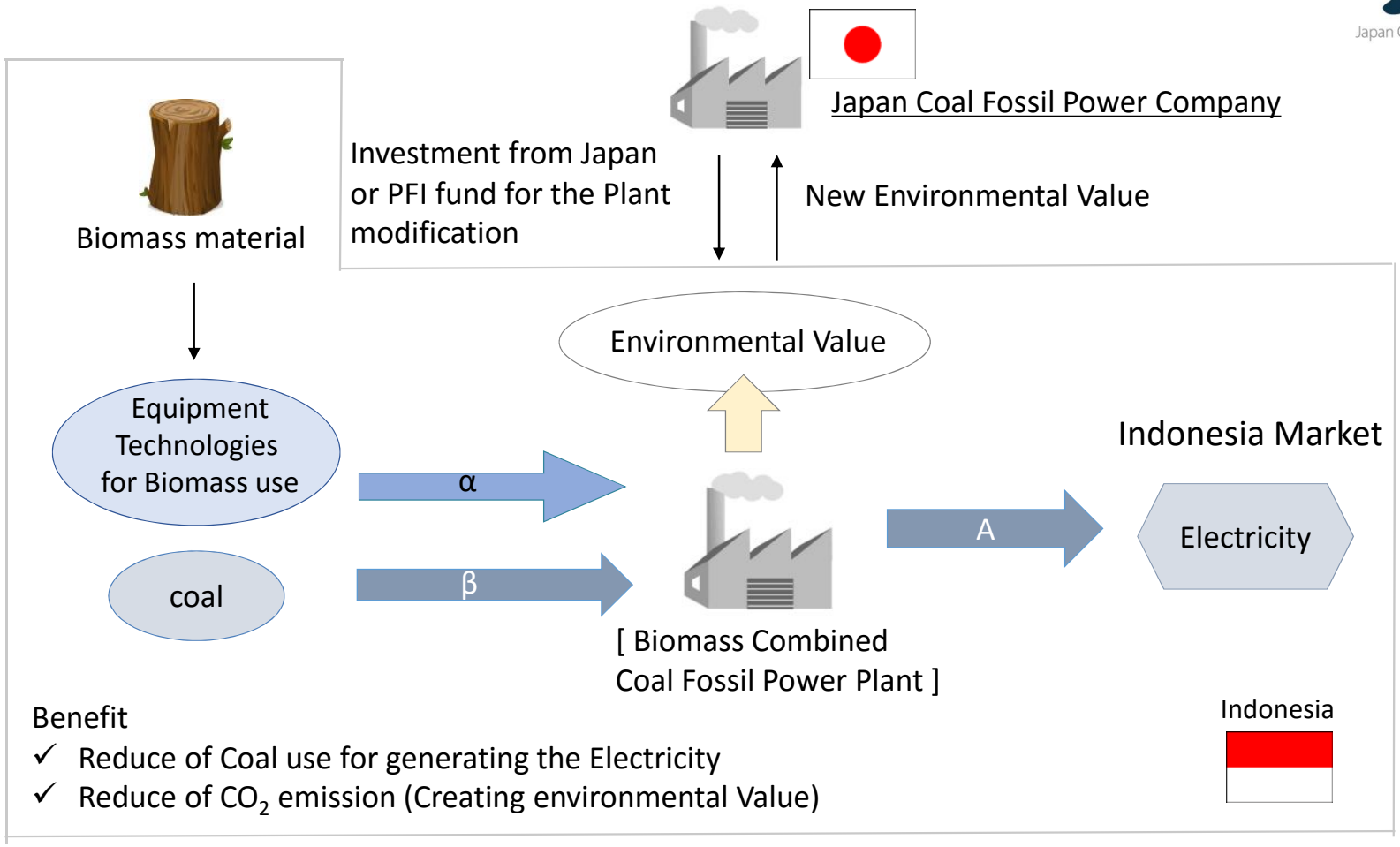
Torrefied Biomass
Annually 100,000 ton

300MW Coal Power Plant



CO2 Reduction Rate : 10%
Annual CO2 Reduction : 200,000 ton

New Biomass/Coal plant technology creates New Environmental Value



Biomass/Coal combined Fossil Power Plant will create Environment Value,
Which could reduce not only CO_2 ,But also Investment cost.

Thank You!