Feasibility Studies with the Aim of Developing a Bilateral Offset Credit Mechanism FY2011

Studies for Project Development and Organization

CO_2 Emission Reduction in Power Plant by Steam Tube Dryer (STD)

New Energy and Industrial Technology Development Organization (NEDO)
Tsukishima Kikai Co., Ltd.
Sojitz Corporation

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Study Background

Indonesia has abundant Low Rank Coal (LRC) reserves such as lignite and sub-bituminous coal, and the number of LRC power plant is expanding but LRC power generation efficiency is low due to its low calorific value caused by high moisture content.

Therefore, pre-drying of LRC is expected to improve power generation efficiency and decrease CO_2 emission. STD, Indirect heating dryer is expected to be suitable for this system, because low pressure steam and low value energy generated in power generation can be utilized.

Target

- Confirming applicability of coal drying technology for Indonesian LRC
- Clarifying the potential to reduce CO_2 emissions by reducing moisture in LRC, utilizing Japanese high efficiency coal drying technology
- Developing a methodology of CO_2 reduction and MRV with a combination of reliable simulator, Coal Quality Evaluation System (C-Quens).
- Promotion of Steam Tube Dryer (STD) in Indonesian Market

Configuration of Tsukishima Kikai (TSK)'s Steam Tube Dryer (STD)

Gearing Up for Sustained Growth

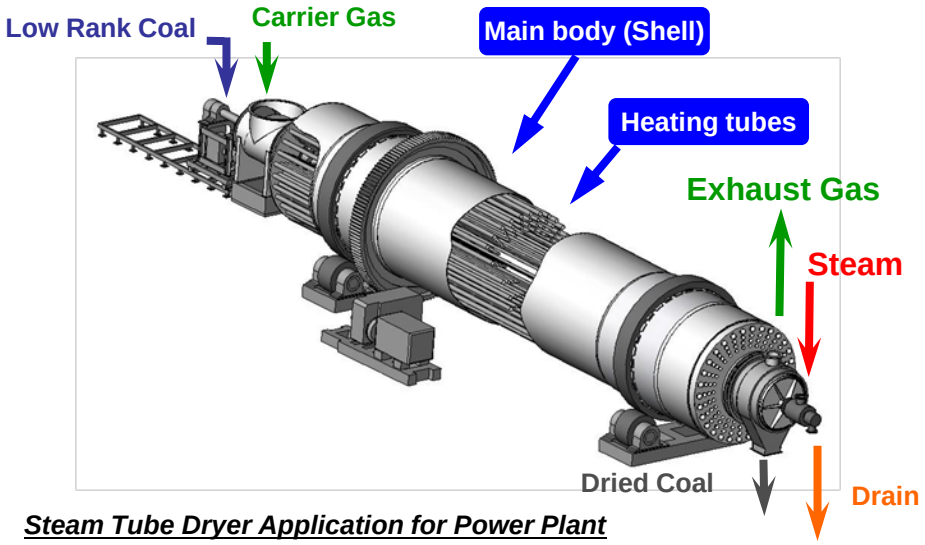
Configuration of TSK's Steam Tube Dryer

① STD is an indirect heating dryer, in which low pressure steam can be utilized as heating source.
: Steam drain can be recycled as boiler feed water.

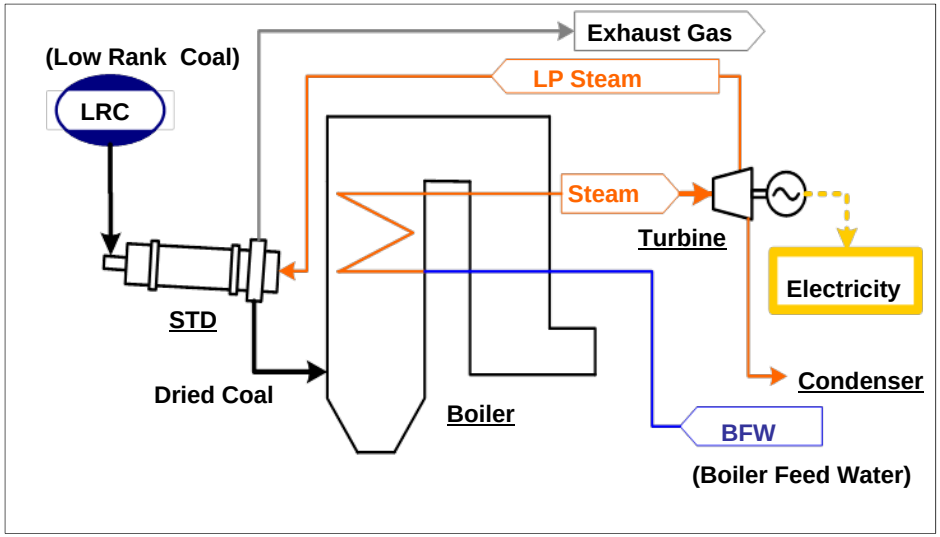
② Easy to scale-up, suitable for large capacity.
: 500t/h capacity, Coal moisture is 10 to 6% after pre-drying.

③ Simple configuration. One year continuous operation is available.
: Reliable operation is suitable for power generation unit

④ Minimal exhaust gas from STD allows less capacity for exhaust gas treatment.
: Safer operation with lower oxygen concentration in exhaust gas.



Steam Tube Dryer Application for Power Plant



Abundant Track Records & Proven Technology

Tsukishima Kikai Co., Ltd.(TSK) has supplied more than 500 sets of STD for various applications.

Commercial Drying plant for coking coal & thermal coal

New way, New value

Drying Test & Combustion Test

Content

Drying test and Combustion Test of Indonesian Low Rank Coal were already executed by Pilot Plant at Indonesia.

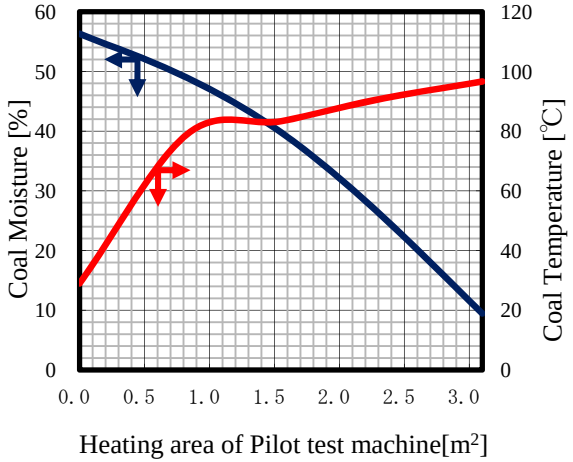
Result

STD can achieve the appropriate drying speed without coal properties change during drying process.

It was confirmed that STD is highly applicable to dry for Indonesian LRC and the dried coal has good combustion characteristics.

Pilot plant for Drying test

Pilot plant for Combustion test



Drying curve

Coal Quality Evaluation System (C-Quens)

"Coal Quality Evaluation System (C-Quens)" developed by Gifu University was used in this study to verify the potential of reduction of CO_2 emission by reducing low rank coal moisture.

Overview

- C-Quens is a simulation software which originally designed for determining performance of coal power plant with coal plant condition and coal analysis data.
- C-Quens's outputs are not only CO_2 emission but also coal usage, efficiency, ash quality and so on. (Simulates coal supply volume to minimize electricity generation cost, negative impacts on the environment, operational troubles on plan, etc)
- Abundant track records in Japan
  - 23 coal power plants -
  (Tohoku Electric Power Co., Chubu Electric Power Co., J-Power, Okinawa Electric Power Co., Cugoku Electric Power Co. and Kobe Steel., LTD)

The details are given in the MRV pages

Application of C-Quens for MRV Tool

Current Operation & Monitoring Practice in Rembang Power Plant

Key Parameters & Formulas Defined in Methodologies of CDM

ACM0011
- Consolidated baseline methodology for fuel switching from coal and/or petroleum fuels to natural gas in existing power plants for electricity generation

Assume dried coal i/o natural gas

STD Installation Case (C-QUENS)

New MRV Tool

For Rembang Power Plant, including Data Input Table for Monitoring Items Automatic Calculation for Emission Reduction Reporting format for Verification

Result of CO_2 Reduction from C-Quens simulation

C-Quens

Subroutine of boiler efficiency decreased by steam extraction

- Steam Extraction (0.72 Mpa (G), 30 t/h)

Condition

- Moisture Content : 35wt%(without STD)→25wt%(with STD)
- Electricity Generation : 315MW × 2plants
- Capacity Factor : 85%

Result

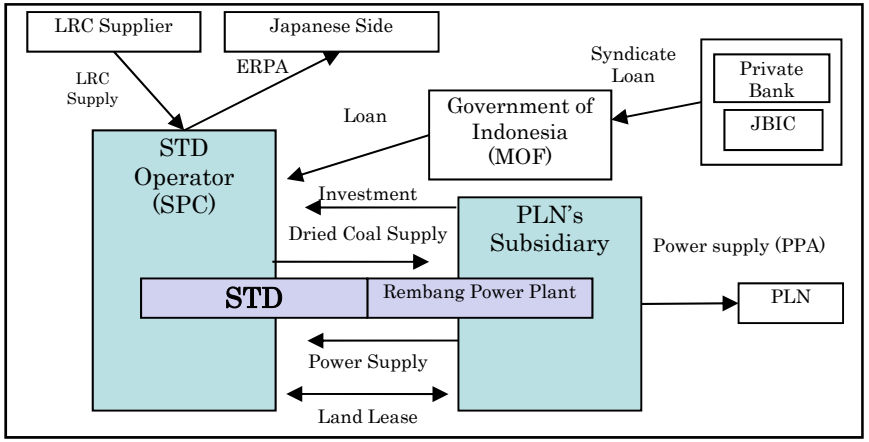
[Annual CO_2 Reduction]

Baseline Emission		Project Emission		Leakage Emission		
2,104,860 t-CO2/y × 2plants	-	2,091,176 t-CO2/y × 2plants	-	0 t-CO2/y × 2plants	=	27,368 t-CO2/y

Cash Flow Analysis

PJ Scheme for Cash Flow Analysis

- PLN establishes a SPC which owns and operates STD.
- Dried coal made by STD is supplied to Rembang Power Plant. SPC procures LRC and sells dried coal to PLN under the supply agreement.
- CAPEX is covered by PLN's equity and JBIC's Export credit.



Condition

- STD Cost

Machinery: US$ 36.6 M, Installation: US$ 23.4 M

- Coal Price (Jan 2012)

Indexes form HBA	FOB Price
Eco Coal (Moisture: 35wt%)	56.94 [US$/ton]
Eco Coal (Moisture: 25wt%)	74.11 [US$/ton]

- Finance (JBIC Export Credit)

Percentage	STD Cost ×85% (The remaining 15% is a down payment as equity portion)
Ratio	JBIC: 60%, Private Bank: 40%
Period	2y (Construction Phase) + 10y (Operation Phase)
Interest	JBIC: CIRR (affected by market) + Risk Premium (1.32%) Private Bank: Libor 6M (affected by market) + Spread (1.5%) MOF: 1%
Private Bank's Fee	Upfront Fee (Private Bank Portion×1%) + NEXI Cost

Results

Credit Price (EUR/CO2-ton)	8	9	9.5	10	10.5	11	12
Project IRR (%)	5.30	5.35	5.38	5.40	5.43	5.45	5.51
Equity IRR (%)	6.47	6.57	6.62	6.67	6.72	6.78	6.88
NPV (US$, Million)	3.96	4.33	4.51	4.70	4.89	5.07	5.44
Pay Back Period (Years)	16	16	16	16	16	16	16