PENCONSULTING PROMOTES COAL WATER SLURRY APPLICATION TO FUEL POWER GENERATION

PENConsulting has engaged in studies for the commercial application of coal water slurry (CWS) to provide clean coal based fuel for industrial boilers and steam turbine power plants in Indonesia, utilizing Indonesia produced coal. In July 2008, PENConsulting established an energy business affiliate, PT Pramarta Energi Nusantara (PENAlliance – “PEN_A”), which in turn took participating interest in CHIPS Energy Company Ltd (“CHIPS Energy”), a corporation for advanced clean coal and green energy application, based in Hongkong, China. CHIPS Energy holds the license of the CWS technology developed by the Institute of Thermal Power Engineering of the Zhejiang University in China for the CWS fuel additives and combustion system design.

Results of the studies indicate that CWS has potential application to substitute Marine Fuel Oil / Heavy Fuel Oil (MFO/HFO) used in industrial and steam power plant boilers with significant cost savings and ease of handling. The studies also indicate that CWS can be used as an alternative low rank coal–based, clean fuel in new industrial and power plant boilers at competitive steam / electricity generated prices.

The application of CWS technology developed by Zhejiang University has been proven in more than 90 steam and power generating plants utilizing CWS in China, with capacity ranging from 1.5 MW to 200 MW. It’s also been applied in Japan, Italy and Russia.

PENConsulting and its associates conducted a pre-feasibility study to convert MFO/HFO into CWS at a 2x50 MW steam power plant in Central Java, Indonesia. By replacing the boiler unit, fuel combustion system and minor upgrade on the fuel piping system, using coal of 5,600 – 5,800 kcal/kg heat value, the fuel conversion could save approximately USD 41 million annually to generate the same capacity of electricity by spending approximately USD 62 million for the fuel conversion. This fuel conversion project assumes the CWS is produced at the coal mine-mouth and delivered CIF (cost, insurance, and freight) to the power plant site.

Attached is a copy of an article on “Application Of Coal Water Slurry In Power Generation”, by Pontjo H. Soedjanto, CEO - CHIPS Energy Co., Ltd.; and Prof. Zhijun Zhou, Ph.D , Associate Professor, Institute for Thermal Power Engineering, Zhejiang University, Hangzhou, China.

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APPLICATION OF COAL WATER SLURRY IN POWER GENERATION

By Ir. Pontjo H. Soedjanto, CEO - CHIPS Energy Co., Ltd.; and Prof. Zhijun Zhou, Ph.D., Associate Professor, Institute for Thermal Power Engineering, Zhejiang University, Hangzhou, China

I. INTRODUCTION

I.1. Indonesia Coal Supply

Despite mounting concerns over regulatory risks, Indonesia’s coal sector remains very attractive. With strong growth potential, improved bargaining power, broader market scope, consolidation opportunity and favorable industry dynamics all offer a compelling investment story. Indonesia will remain the world’s largest coal producer for the next five years. About 80% of Indonesia’s coal reserves fall under low/medium rank coal, such as lignite and sub-bituminous coal.

However, coal has one or two disadvantages; among those are its mineral content, especially the sulfur bearing component, and the problems in handling and storing of coal, such as dust and the need for expensive mechanical handling and reclamation systems.

By contrast, liquid fuels are naturally low in mineral content, can be freed of their sulfur compounds, and are easily handled and stored.

On the other hand, coal is abundant, widespread, and fairly cheap to produce; while oil reserves are much smaller and are concentrated in politically unstable areas, and the commodity can become very expensive indeed, regardless of production costs.

I.2. Increasing Utilization for Medium-Low Coal

Utilization of coal as primary feedstock for power generators in the future will still remain a high priority; as indicated based on the continuous development of coal processing technology. While remaining reserve of high rank coal (6.100 – 7.100 Kcal) continue to decrease, future use of Indonesia’s largest coal reserves which 80% belongs in medium / low category (5.100 – 6.100 Kcal and < 5.100 Kcal), will surely experience
significant growth in terms of consumption. This trend has started to show, as indicated by effort performed by some countries to modify and retrofitting power plant configuration for this purpose.

II. DESCRIPTION OF CWS

II.1. What is CWS?

Coal Water Slurry (referred to as “CWS”) is an environment friendly coal based liquid-fuel that can be used to replace petroleum.

It is prepared through particular technical process from 65% ~ 70% coal, 29% ~ 34% water, and minor (1%) quantities of chemical additives.

Hence, CWS is Slurry of powdered coal and water, which maintains a stable state over a long period when a small amount of additive is provided properly.

Standard Specifications

- **Density**: 65-70%
- **Viscosity**: ~1000CP
- **Size**: d<50µm
II.2. Advantages of CWS

1. Good Combustion Efficiency
   The combustion efficiency of CWS is 96% - 99%, boiler efficiency is about 90%, which reach the level of oil.

2. Good Effect on Environmental Protection
   The Combustion temperature of CWS is approximately 1200 – 1300° and emissions of $SO_2$ and $NO_x$ are low.

3. Advantages on Technology
   CWS can be transported and burned like oil, non flammable liquid and its manufacturing temperature is low, so it is safe.

4. Less Investment
   The investment in transportation is about 1/3 of railway and 2/5 of electrical wire, and to be compared with retrofitted to coal, the cost of oil fire boiler retrofitted to CWS fuel is 1/3 -1/2 of coal fire boiler, the retrofit time is just 1/3 that of coal fire boiler.

II.3. Coal Water Slurry as New Energy Source

For CWS Combustion Process, the atomized CWS burns in the furnace in four stages of combustion:

- Moisture evaporation
- Releasing volatile materials and ignition
- Fix carbon combustion
➢ Coke burn-out

Â Ignition temperature: 425 deg C – 550 deg C
100 deg C lower than pulverized coal
Â Combustion temperature: about 1350 deg C
100 deg C – 200 deg C lower than fuel Oil

Â Burner and Nozzle
For CWS Steady Combustion a special burner and nozzle must be used. The nozzle must be made from high abrasive and corrosion resistance material

II.4. The CWS Technology Development & Its Application Benefits

1. Using coal to replace oil reduces fuel cost of users:
   a. For retrofitting: 1.8 – 2.2 Ton of CWS can replace 1.0 Ton of heavy fuel oil, depending on the heating value.
   b. Investment pay-out of retrofitting is about 5 months. Investment cost to build new CWS boiler is about the same with new oil fired boiler, but the operating cost is significantly lower on the CWS boiler.

2. To realize clean use of coal, use energy source economically and rationally, improve environmental protection
   a. The raw coal for CWS is cleaned coal – low in ash and sulfur content.
   b. CWS burning temperature is 100 – 200 deg C lower than oil or pulverized coal….it can effectively reduce NOx and SO2 and can easily meet national and local environmental protection standard
   c. Additional de-sulfurizer can be provided if further reduction of sulfur dioxide is required

3. Energy saving effect is remarkable
   a) CWS has high combustion efficiency (above 95%-98%)
   b) CWS combustion is easy to control and its waste is low

4. Providing new manner in coal transportation: CWS can be transported through pipelines and stored in storage tanks:
   i. Less construction investment in railway and highways and rolling stocks
   ii. Less land indemnification for right of ways
   iii. Less environmental pollution
iv. Easier in handling and operation
v. Low running costs and high reliability

5. Burning CWS replacing loose coal and improves regional environment
CWS can be manufactured in the mine mouth to supply several power plants by using ships and pipelines. It’s just like distribution system from oil refinery to power plants.

6. Replacing diesel oil
Through special processing CWS can be produced to improve its quality to replace diesel oil

II.5 Favorable Economic Effects

It is difficult to compare the relative costs of using a CWS against traditional coal or oil firing because the price of the CWS itself varies according to the coal price, the location of the plant, and/or the plant capacity etc. The economic advantage compared to pulverized coal is however indicated by significant reduction in handling cost by simplifying facilities required for loading and unloading activities.

In general,
Å\ 2 tons of coal water slurry (costs - US$ 200) can replace 1 ton of heavy oil (costs US$ 298), a significant saving of production cost.
Å\ Users can save - 70% fuel cost for per ton of fuel oil (heavy oil).
Å\ Coal water slurry can replace heavy oil fuel and brings tremendous economic benefits as an oil substitute fuel, as shown in table 1 beside.

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<thead>
<tr>
<th>Item</th>
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<tr>
<td>Steam Produced</td>
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<tr>
<td>Residual Oil Burning</td>
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<td>CWS Burning</td>
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<td>Residual Oil Unit Price</td>
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<td>CWS to Resid Oil Ratio</td>
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<tr>
<td>Saving Realized</td>
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II.6 CWS Production Process

1. Crusher
2. Surge Tank
3. Ball Mill
4. SLURRY Tank
5. Filter Tank
6. Stirring Tank
7. Tank for Oversize Particles
8. Storage Tank

CRUSHED COAL send to SURGE TANK then BALL MILL (add right amount of water and additive) then to SLURRY TANK send to FILTER TANK for separation by filtration, send to STIRRING TANK (add stabilizer) then store at STORAGE TANK before off take
III. CURRENT END USERS OF THE PRODUCT AND ITS MARKET POTENTIAL

At present, there are more than 20 processing plants, producing coal water slurry with the total production capacity of more than 4 million tons in China; there are more than 5,000 oil burning boilers, available to be converted to CWS fuel, with the annual oil burning amount of over 39 million tons and the demand of coal water slurry about 78 million tons, if the ratio of calorific value of oil to CWS is 2 to 1.

Meanwhile, with the increase of petroleum price and strengthening of environmental protection, more and more coal burning boilers and petroleum burning boilers will be reformed to coal water slurry burning boilers. So, this product is in large demand and its marketplace is wide as well.

Coal-liquid mixtures are most likely to be used in boilers that were designed for coal but have changed over to oil, or in oil boilers that can burn coal-liquid mixtures without serious loss of output (de-rating). Other suggested uses have been in diesel engines, for blast-furnace injection, in process heating, and in rotary kilns.

CWS Application In China
CWS in Maoming Power, 125 MW Steam Plant
Maoming city, Province Guangdong modification from oil burner to 100% CWM

- Boiler Capacity: 220 T/h × 2, 410 T/h × 2
- CWM Consumption: 1 MMTPa (produced by own plant)
- Total Conversion Cost: ± USD 25 Mio from oil to CWM
- Modification Period: 4 Months per unit
- Boiler Capacity: 410 T/h (2 sets)
IV. CONCLUSION

Â Coal Water Slurry (CWS) is a new type of liquid fuel, environmentally friendly fuel that can replace petroleum as fuel in the energy conversion and process industries.

Â CWS consists of 65% - 70% coal, 30% - 35% water and small quantities of chemical additives.

Â CWS has oil like appearance, can be handled like liquid, burns like oil and coal, the cost is just slightly higher than coal.

Â It resembles Heavy Fuel Oil with good fluidity; therefore stable during storage and can be transported conveniently like liquid, through pipes and by pumps.

Â The capital investment costs is very low relative to coal gasification and liquefaction processes, which can be more than US$6.5 billion for a 100,000 BPSD complex, as compared to US$150 million for CWS of the same size.

Â It has high combustion efficiency and low in pollution discharge.

Â The successful introduction of CWS technology into the industries, in China, to replace heavy fuel oil has a very significant impact in the utilization of low rank coal, for new
thermal power plant. The simultaneous and parallel development of advanced coal cleaning technologies as in the case of CWS could allow Indonesia to make a fast transition, economically, away from our limited resource of oil and natural gas to our most abundant resource of coal. Coal based CWS will be the fuel of this century and beyond

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