DEVELOPMENT OF CYCLONE COAL BURNER FOR FUEL OIL BURNER SUBSTITUTION IN INDUSTRIES

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ABSTRACT

*The high fuel oil price forces the industries to seek cheaper alternative energy. Coal is the most promising alternative energy in Indonesia. To face this situation, R & D Centre for Mineral and Coal Technology (*tek*MIRA) has developed a cyclone burner. This burner has the combustion characteristics nearly the same as the fuel oil burner that this burner may alter the fuel oil burner in various industrial facilities, such as steam boiler, oil heater, rotary dryer, metal smelter and heat exchanger. The cyclone burner combusting coal powder of -30 mesh may match the energy output of the former altered fuel oil burner. The burning of coal emits long flame and the combustion rate may be controlled by a variable feeder. It may be shut of and then put on instantaneously as it is practiced in oil burner. Fine adjustment of the coal and air supply were performed and this burner was set up in vertical and horizontal position. In this substitution 1 litre fuel oil was substituted by 1.5 up to 1.8 kg of coal of 5700 kcal/kg.*

Keywords: coal, cyclone burner, oil burner substitution

1. INTRODUCTION

The price of fuel oil tends to be high in the last several months. The high price of fuel oil forces the industries to seek cheaper alternative energy. One of the prospective alternative energy is coal. It renders the coal price increases slowly.

Formerly Indonesia was a fuel oil exporting country, however since several years ago Indonesia has became a net fuel oil importer country. In parallel with this condition the government plans to increase the coal portion in the energy mix of energy consumption in Indonesia to become 33% in the year of 2025 (Yusgiantoro, P 2007). Some coal utilization technologies such as gasification, liquefaction, combustion and briquetting were offered in Indonesia.

In coal gasification the offered technologies are TEHA Coal Gasification System (TEHA, 2006) and Pastibara Coal Gas Producer (Pastibara 2005). In coal combustion several technologies are offered, such as chain grate boiler (Chang Zhov 2003), fluidized bed boiler (Basuki 2003), and pulverized coal burner (RMF 2003).

*tek*MIRA has developed a cyclone coal powder combustor (Sumaryono 1999), as illustrated in Figure 1. The aims are:

- To develop a coal combustor capable of burning low rank coals which often means fine coals.
- To develop a coal combustor having the combustion characteristics nearly similar with the fuel oil combustion and it may match the fuel oil burner energy output.
- The cyclone burner should be capable of altering the position of fuel oil burners in the industrial facilities such as steam boiler, oil heater, rotary dryer, smelter, heat exchanger etc.

Therefore it is a low cost process to change the industrial energy from oil into coal since the former facilities and accessories are being used again except the oil burner. This paper describes briefly the characteristics of the coal cyclone burner and its governing parameters.

Figure 1. Cyclone burner of 150 kg/hour coal combustion capacity

2. CYCLONE BURNER CHARACTERISTICS

To alter the oil burner in industrial facilities with coal burner, the coal burner should have nearly similar characteristics with the oil burner. The approach used in this paper is to determine the main characteristics required in industrial facilities and the parameters governing the performance of the cyclone combustor are described and discussed.

The main characteristics required are:
- Combustion flame characteristic;
- Energy output;
- Stability and adjustability; and
- Firing position.

2.1. Combustion Flame

The combustion of coal powder (-30 mesh) in a cyclone cylinder produces a long flame fire nearly the same as a fuel oil fire. Several factors those may enlarge the flame of coal powder combustion are:

2.1.1 Coal particle size

The rate of coal combustion increases with the decreasing of coal particle size. One of the reason is that the surface area increases with the decreasing of coal particle size, therefore the exposed surface of coal substance increases. With the increasing of surface area;
- The rate of heat transfer by radiation, convection and through the coal substance or per unit weight of coal increase.

As the rate of combustion reaction is significantly increased those coal particles are burned instantaneously in the combustion chamber or out of it in which the condition still enables the coal particles to be burned. As the result, there is a long combustion flame following the coal particles entrained by the combustion air.

2.1.2 Evolvement of volatile matter

The volatile matter evolved from a heated coal particle is controlled by coal particle size and heating rate through the coal substance.

Therefore, in a certain condition the amount of volatile matter evolved from coal particles may be higher or lower than the volatile matter content determined in proximate analysis.

Small particle size
The evolvement of volatile matter from the core of a small coal particle size needs short time. It affects the amount of volatile produced by a coal particle significantly.

The rapid mass transfer of volatiles from the core through the particle surface, as in the case of devolatilization in a small coal particle, the opportunity of secondary reactions involving the volatile molecules is much reduced. As a result, volatiles escape from the core through-out the particle surface safely, that the maximum production of volatiles is attained. The secondary reactions undergone by the volatiles such as carbonization, recombination, cracking etc., result a lower product of volatiles and a higher product of carbon deposition. It is due to that many volatile molecules are not stable compounds, especially at an elevated temperature, as can be seen in the following case (Table 1) (Sumaryono, 1983).

Coal particles are dropped into a fluidized bed of quartz sand at 850 and 950°C. Decreasing residual char product reflects increasing of volatiles product.

Table 1. Coal particle size versus residual char product in the devolatilization of coal particle (Great Northern Coal – Australia)

Bed Temperature	Particle Diameter(mm)	Residual Char Product(%)
850°C	3.5 5.3 8.1 10	49.7 69.7 71.9 75.2
950°C	2.7 4.2 7,8 11	54.2 70.8 73.6 73.4

A clear trend may be realized from the Table 1 :

- Char deposition decreased tremendously with the decreasing of coal particle size from 10 down to 3.5 mm at 850°C and from 11 down to 2.7 mm at 950°C.
- The decrease of residual char product is accompanied with the increasing of product of volatiles especially tar product.
- The increase of char product is accompanied with the decreasing of volatiles product including the tar product. The product of pyrolitic H_2O may increase as the result of the combination of H and O, leaving C as residual char. There are competitive reactions among C, H and O in coal substance.

  In contrary, the small coal particle where char deposition is much reduced, H and O combine with C produce hydrocarbons and carbon-oxides, rather than to combine producing H_2O which renders product of residual carbon and product of volatile matter.

Cyclone burner combusts very small coal particles, the size is less than 0.5 mm. Therefore it may be expected that:

- The small coal particles entrained with the combustion air, entering the hot cyclone cylinder shall undergo suddent high rate heating at the temperature of 1150 up to 1350°C. High rate heating is provided by:
  - Radiation from the cylinder wall, hot char and combustion gases.
  - Convection from hot combustion gases and hot air.
  - Conduction from the wall and char.

- Rapid devolatilization process, nearly a condition of flash pyrolisis may occur. The volatiles escape quickly out of the particle, therefore secondary reactions of the volatiles hardly occur, rendering a high product of volatile and very low product of residual char.

- With high production of volatiles, the combustion of -30 mesh coal in a cyclone burner produces long and large volume flame.

The other advantages of the combustion of coal powder are:

- High rate of combustion, high energy output and heat intensity.
- Combustion characteristics are close to the fuel oil combustion.

2.2. The Energy Output May Match Fuel Oil Burner

The combustion of low rank coals (up to 5800 kcal/kg) in the cyclone burner, similar with the other coal combustors, it needs larger combustion space, due to the high moisture content of the coals and their low calorific value. These objections may be compensated by some superiorities of this technique:

- High turbulence combustion
  Coal combustion technique using a cyclone burner blows the coal powder into the cyclone cylinder tangentially, to form a cyclone of coal powder. This condition may facilitate a high intensity coal combustion process, that provides a high heat output. Even a low rank coal is fed, using ambient combustion air, an accumulation of heat up to 1300 – 1400°C may be attained. High rank coal with low moisture content may produce high energy output, therefore it may perform a high combustion temperature up to 1500°C.

- Coal combustion within a high radiation circumstances.
  The combustion of coal proceeds within the cyclone cylinder or the combustion process is circumferred by the cyclone wall, which temperature is equal with the maximum combustion temperature in the range of 1200 – 1400°C. This high temperature wall, has a high radiation power, that practically the coal particles receive high radiation, facilitating rapid temperature increase of the coal particle. Therefore the stability of combustion process for each coal particle is maintained to attain a high combustion efficiency.

- Radiation
  It is the characteristic of coal hydrocarbons, many of which emit high luminousity flame during their combustion process, that produces high efficiency radiation, as the result of high emmissivity flame. Pulverized coal burner producing high efficiency radiation is used in a rotary kiln to calcine cement clinker. It is also used in reverberatory furnace for metal smelter where radiation heat is emitted by walls and furnace roof. It is clear that the high emmissivity coal combustion flame is used in many high temperature facilities.

  The use of coal in a reverberatory furnace:
  In a reverberatory furnace for aluminium smelter, a coal of 5500 kcal/kg is burned by a cyclone combustor using hot combustion air of 250 – 350°C. Result indicates that 18 lt/hr fuel oil consumption was substituted by 25.2 kg/hr coal of -30 mesh or 1 litre fuel oil was equivalent with 1.4 kg coal. If 1 litre fuel oil contains 9600 kcal and 1.4 kg coal contains 7700 kcal it means that by using coal, higher efficiency of 24,6% was obtained.

2.3. Stable and Adjustable

The combustion of coal powder, using a screw feeder for coal feeding enable it to control the feeding rate and fine tune up of the combustion air. A good combustion stoichiometry may be obtained, as the case in the combustion of fuel oil. The variable speed motor is controlled by an inverter as it is the air blower for combustion air. Therefore by this system, the combustion process may be controlled more accurately.

The combustion rate may be increased or reduced to produce low or high fire. The burning can be stopped suddenly and then it can be put on again easily even after stopping for 2 up to 4 hours. In only few minutes normal combustion rate may be attained. Factors those stabilize the combustion using cyclone combustor are:
- Cyclone cylinder with quartz refractory lining is a high heat capacity material.
- Insulating layer avoids the heat loss through the steel cylinder wall; and
- Accessibility of ambient air is minimized.

Those conditions above support the combustion process of the incoming coal powder. Actually the coal powder is a reactive fuel:
- Smaller coal particle means larger surface area that increase the rate of combustion reaction.
- Higher volatiles evolved, stabilizes the coal combustion.

It is clear that the coal powder combustion characteristics are nearly similar with the fuel oil combustion properties.

2.4. Firing Position: Vertical, Horizontal or Any Other Direction

The coal is fed tangentially into the cyclone cylinder, that together with the combustion air from the air blower, the coal particles move spirally within the cyclone cylinder, directed to the cyclone outlet. This motion excerts a centrifugal force which is much stronger than the gravitation force. Therefore the cyclone can be operated in any direction, vertical, horizontal or other direction. This flexibilities are required for the cyclone combustor to extend its uses in many kinds of industrial appliances and facilities.

3. APPLICATION

As a reliable furnace, the cyclone combustor may replace oil burners in many kinds of industrial facilities (Puslitbang Teknologi Mineral dan Batubara 2008).

- Steam Boiler
  Horizontal or vertical oil fired steam boiler has been modified into coal fired steam boiler using the cyclone burner which replaces the position of the fuel oil burner. The steam output ranges 1 up to 5 ton/hr and the coal consumption ranges 100 up to 750 kg/hr. Both fire tube and water tube boiler were modified.

The boilers can be operated for textile, food or chemicals industries.

- Oil Heater
  The cyclone burner has replaced the fuel oil burner in vertical and horizontal oil heaters. The capacity ranges from 600,000 up to 1,250,000 kcal at 220 up to 260°C.

- Metal Smelters
  Previously oil fired metal smelters use reverberatory furnaces to refine aluminium and tin were modified to use cyclone burners with coal powder. The cyclone burner capacity ranges from 75 up to 300 kg coal/hr.

- Rotary Dryer
  Rotary dryer for fertilizer and minerals have been modified using cyclone burners with the combustion capacity ranges from 50 up to 140 kg coal/hr.

- Other Industrial Facilities
  The other industrial facilities have been modified were lime calciner, heat exchanger, asphalt mixing plant, annealing kiln.

The figures of the modified industrial facilities are presented in the following attachment.

4. CONCLUSION

From the discussion above it can be concluded that:

1. Cyclone coal burner with its excellence characteristics is a reliable combustor.
   - The combustion chamber is enclosed within a high radiative quartz refractory at high temperature, therefore a high heat transfer rate is experienced by coal praticles dropped into this chamber.
   - High heat transfer and high turbulence in the combustion chamber increase the coal combustion rate and combustion efficiency.
   - High turbulence and high combustion rate enhance the combustion intensity that it may match the oil burner combustion intensity easily.
   - High heating rate into coal particles enhances the volatiles product, that makes a long and voluminous combustion flame.

Its reliability is proven by its capabilities to alter fuel oil burner positions in various industrial facilities.

2. Other advantages of coal cyclone burner are:
   - Combustion process is stable and easily controllable.
   - It may be positioned horizontal or vertical that makes the burner more flexible.
   - It is a simple and low cost alternative for industry to change its energy from fuel oil into coal.

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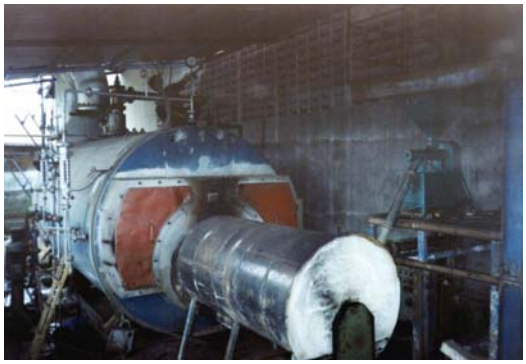
ATTACHMENT

Application of Cyclone Burner to Alter Oil Burner in Industries

Cyclone Burner for Aluminium Smelter



Cyclone Burner for Steam Boiler 2.5 ton steam/hr

Cyclone Burner for Steam Boiler 5 ton/hr Steam

Cyclone Burner for Rotary Dryer

Cyclone Burner for Vertical Oil Heater

Cyclone Burner for Asphalt Mixing Plant (AMP)

ECONOMIC IMPACTS OF CABOTAGE LAW IMPLEMENTATION IN INDONESIA COAL TRANSPORTATION

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ABSTRACT

Presidential Decree No. 5 year 2005 followed by Shipping Law No. 17 on May 7 in 2008 has been declared by Indonesian government to start implementing cabotage law. Under new law, by 2010, all domestic shipments of 13 specified commodities including coal will have to be conducted by national vessels.

Coal, as the largest energy resource in Indonesia had contributed significant value to state revenue and can be utilized more. In 2006, coal transportation cost mostly earned by foreign-flagged ships by US$ 3.07 billion compared to Indonesia-flagged ships which only can earn US$ 0.5 billion. This study conducted to analyze the economic impact to Indonesia based on the implementation of cabotage law in 2010. From the analysis, it can be concluded that cabotage law implementation on coal transportation will give economic impacts :
1. US$ 935 million per year on foreign exchange saving;
2. Utilization of shipping industry by investment of US$ 1.25 billion;
3. Increase on government income from tax to US$ 0.2 billion per year;
4. More than 30,000 new direct employment opportunities and ;
5. Improvement of investment and business climate.

Keywords : cabotage law, coal transportation, economic impact

1. BACKGROUND

In March 2005, Presidential Decree (Inpres) No. 5 has been signed by Indonesian President. The Inpres order ministers and regional governments to implement the cabotage law. The word cabotage is taken from the Spanish word “cabotaje” and refers to “sailing from cape to cape”. In the context of maritime law, the cabotage principle grants rights to a country to trade and navigate within its own coastal territories, and to operate and regulate the traffic inside its territorial waters. Imitating the cabotage laws of industrial nations (such as the Jones Act in the United States and cabotage laws in Japan and Australia), the Shipping Law will limit domestic trade to vessels flying the Indonesian flag including restrictions on foreign ships participating in the domestic maritime trade. The implementation of cabotage law also reaffirmed by New Shipping Law no. 17 on May 7 in 2008.

Under the new law by 2010, all domestic shipments of 13 specified commodities (including rice, crude palm oil (CPO), coal, oil, wood products, fresh produce, fertilizer and cement) will have to be conducted by national vessels. According to regulations, all of the trade by state-owned companies such as Pertamina, PLN, TB Bukit Asam, must be carried by Indonesian-flagged vessels. The

precise schedule to implement cabotage law can be seen in table 1.

Table 1. Cabotage law implementation schedule

No	Type of cargo	Examples	Due date
1	General cargo	Furniture, pulp & paper, packagedproducts, tobacco etc	Immediately
2	Wood and Plywood	Logs, timber, wooden products, plywood, wood chips.	Immediately
3	Rice	All types of rice	Immediately
4	Fertilizers	All types of fertilizers	Immediately
5	Cement	All types of cement	Immediately
6	CPO	Palm-oil, coconut oil	1 Jan '08
7	Mining and quarrying	Ores, sand/gravel, other quarryingproducts	1 Jan '08
8	Other grains	Cocoa, wheat, coffee, other non-agricultural & mining cargo	1 Jan '08
9	Fresh products	Fish, meat, fruits, vegetables, liveanimals	1 Jan '08
10	Liquid and chemical	Chemicals, cooking oil	1 Jan '09
11	Agricultural products	Soybean, copra, pulses/legumes	1 Jan '09
12	Oil and gas	Crude oil, fuel, gas, LNG, LPG,asphalt, other liquid petroleum	1 Jan '10
13	Coal	All types of coal	1 Jan '10
14	Up stream-downstream oiland gas products		1 Jan '11

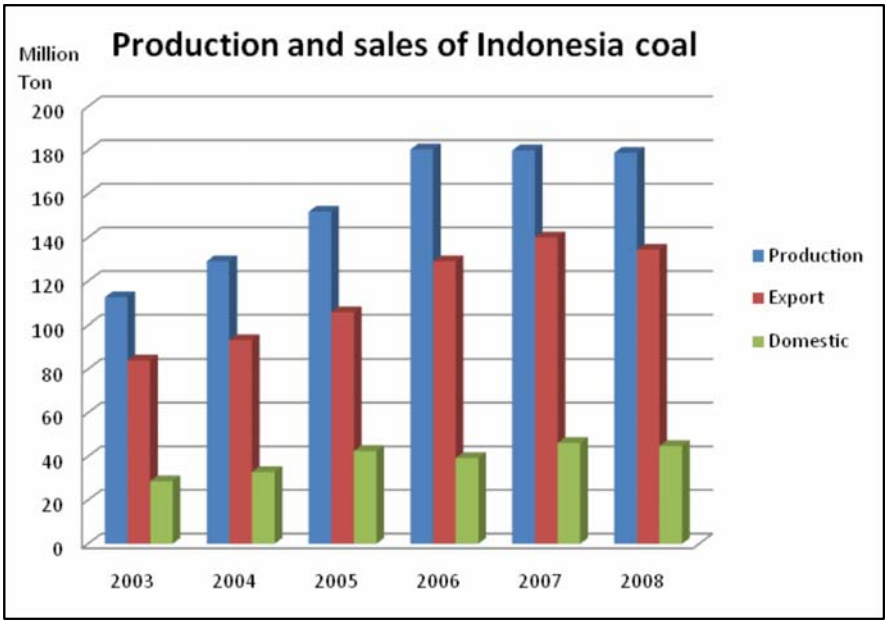
Source : Ministry of Transportation, 2008

It is an ironic that Indonesia which has a lot of natural resources, has only small portion of the maritime trade that carry its natural resources. Foreign-flagged ships dominates the country's maritime trade with 77% portion of combined domestic and foreign trade (export-import), 39% of domestic trade and 94% of foreign trade. In the end of 2007, the 7,463 domestic vessels in operation carried only 65.3 percent of the total domestic cargo, or about 148.7 million tons (thejakartapost, April 2008). The same scenario also happened with coal. In domestic trade, only 60% uses Indonesia-flagged ships (Bisnis Indonesia, April 2007) and in international trade or export, Indonesia-flagged ships shares is only 10% (Tempo Interaktif, July 2008).

However, the full implementation of Inpres No 5 and Shipping Law No 17 can increase the state revenue from maritime trade and at the end will increase the economic of Indonesia. This study will analyze the economic impact from full implementation of cabotage law especially in coal transportation to the economic of Indonesia after 2010.

2. COAL

Coal is the largest energy resource in Indonesia followed by natural gas, crude oil, hydropower and geothermal, respectively. The coal resources in Indonesia is 104,7 billion tons (esdm, January 2009) and mostly located in Sumatera and Kalimantan islands. Among this commercial energy used, the contribution of coal increases significantly. In the year of 1985, contribution of coal was only 8% of the total energy mixed and increased up to 17% in 2006 and it is expected to increase at least 33% in 2025. In the power sector, the share of coal is also expected to grow very significantly. In 2006 the requirement of coal for power generation was 35.5 million tons and will be increased since the acceleration program of constructing the 10,000 MW power plant. Therefore, coal has played a significant role in meeting the growing energy demand as well as enhancing the security of energy supply in the country. Statistics of coal production and sales can be seen in Figure 1.



Source : Ministry of Energy and Mineral Resources, 2009

Figure 1. Production and sales of Indonesia coal

3. METHODOLOGY

The methodology of this research includes : study literature; facts finding from corporate and government websites, and looking for opinion from experts in coal or shipping that recorded in news websites.

4. RESULTS AND EVALUATION

The *resource curse* or paradox of plenty is refers to the country with abundant of natural resources but, particularly non-renewable resources like minerals, coals and fuels, tend to have poor economic growth and worse development outcomes than countries with fewer natural resources. Indonesia could be one of the country suffering the *resource curse* if Indonesia can't utilize its natural resources with maximum result for the Indonesia's interest. Coal has been giving significant revenue to Indonesia for the last decade but it will give more when Indonesia coal transportation had utilized fully. The Inpres No. 5 year 2005 was the starting point for government to gain optimum benefit from coal transportation.

Economic impacts for Indonesia-flagged ships from cabotage law implementation can be count by calculating the opportunity that lies in the future after year 2010. In prediction, at 2010 Indonesia will produce coal about 240 million ton (korantempo, Desember 2007). Based on those prediction and other information, we can calculate the impacts :

1. Domestic coal trade
   In 2006, 40 million ton of coal traded domestically. Only 60% or 24 million ton was shipping by Indonesian-flagged ships. The rate, using the rate of coal shipment from Kertapati, Palembang to Suralaya as reference (Annual Report 2007 PT Bukit Asam Tbk), then assumed Rp 73,480/ton or US$ 8/ton if 1 US$=Rp 9,200. Based on that rate, total shipping cost of coal in 2006 was US$ 8 X 40 million = US$ 320 million which US$ 192 million earned by Indonesia-flagged ships.

   In 2010, 70 million ton of coal predicted will be traded domestically (kontan, November 2008). If Indonesia implements the Inpres No. 5 year 2005 completely, then Indonesian-flagged ships will earn US$ 560 million of coal shipping cost or about three-times (3x) of 2006.

2. International coal trade
   In 2006, 130 million ton of coal exported. Only 10% or 13 million ton was shipping by Indonesia-flagged shipss. The rate of coal shipment

for export to Asia-Pacific is between US$ 20-30/ton (Republika, September 2008) and if the rate of US$ 25/ton used as reference then the total turnover was US$ 3.25 billion which US$ 2.925 billion earned by foreign-flagged ships and only US$ 325 million earned by Indonesia-flagged ships.

In prediction of 2010, more than 150 million ton of coal will be exported. Therefore, there will be total turnover around US$ 3.75 billion in coal shipment. Hopefully, Indonesia-flagged ships will get more shares of that than 10% in year 2006.

Based on the predictions and assumptions above, there are economic impacts for Indonesia by implementing the cabotage law. The economic impacts are :

1. Foreign exchange saving
   There is US$ 128 million from coal shipment cost in the year of 2006 went to foreign country because Indonesian ships could only have 60% portion of the coal domestic trade. After 2010, foreign exchange could be saved because only Indonesian-flagged ships will deliver coal in domestic area. The net foreign exchanges saving will be US$ 560 million per year. The increase is US$ 368 million compared with that in the year 2006.

   Another huge saving will be achieved if the portion of Indonesian-flagged ship in export coal shipment increase. In 2010, every 10% portion of export coal shipment worth US$ 375 million. If Indonesia can increase the portion from 10% (2006) to 20% (2010) the net foreign saving from export will be (US$ 3,75 billion X 20%) = US$ 750 million, increased US$ 425 million compared to that in the year of 2006. If the portion will not increase then the saving will be US$ 375 million, only increase US$ 50 million from that in the year of 2006.

   Total foreign exchange saving will be US$ 560 million + US$ 375 million = US$ 935 million in 2010 or increase US$ 418 million compared to that in the year of 2006.

2. Utilization of ship industry
   Coal transportation in 2010 will need a lot of ships. There will be 37 unit of Handymax ships and 55 unit sea trains needed (ministry of industry, October 2006) to support coal transportation in 2010. The cost will be US$ 1,25 billion. PT PAL Indonesia (PAL) as a leader in Indonesia ships industry could only earn revenue of US$ 130 million in 2007. It indicates that for coal transportation only, it will require almost US$ 1.25 billion/ US$ 130 million = 10 companies like PAL to build all coal ships. In the future, all new ships will also need maintenance and repairs. The utilization of ship industry will increase a lot and need to expand the capacity.

3. The government income from tax
   Every companies who earned profit from their business in Indonesia have to pay corporate tax. More business means more tax revenue, Shipping company like PT Berlian Laju Tanker Tbk in the year of 2007 earned revenue of US$ 400 million and pay tax to government of US$ 41 million (www.blt.co.id). If Indonesia-flagged ships company can increase their revenue like point no. 1 = US$ 368 million + US$ 425 million = US$ 793 million, then the government income from tax will increase almost double : US$ 793/US$ 400 X US$ 41 = US$ 81 million/year since the year of 2010.

   The expansion of ship industry will also gives contribution to government income. Based on point 2, the tax revenue can be calculated from ship-build company like PAL. In 2002, PAL earned revenue US$ 100 million and paid tax to government US$ 9 million (radarbanjar, July 2003). If all ships will be built in Indonesia, then with revenue of US$ 1,25 billion will give tax revenue of US$ 112,5 million. Then the total government income from tax in the year of 2010 will increase to US$ 81 million + US$ 112,5 million = US$ 193,5 million.

4. Employment opportunities
   All of the project in shipping company and ship industry will create new employment opportunities, both direct and indirect. PT Arpeni Pratama Ocean Line Tbk (APOL), big shipping company, with revenue in 2007 of US$ 173 million have 1,655 employees (www.apol.co.id). According to point no. 1, it was predicted that the revenue for Indonesia-flagged ships will increase to US$ 418 million. Compared to APOL, the new direct employment available in 2010 is about US$ 418 million/US$ 173 million X 1,655 = 4,022 direct employees. The same comparison can be used to measure the direct employee created

in ship industry. PAL, with revenue US$ 130 million, currently hired 2,685 direct employees (www.pal.co.id). Total new direct employment created in ship industry until 2010 is 26,850 direct employees if all of the ships will be built in Indonesia. Total employment opportunities will be created in shipping and ship industries are about 4,022 + 26,850 = 30,872 direct employees.

5. Improvement of investment and business climate
   The implementation of cabotage law will improve the Indonesia investment climate. It will serve as a proven for both domestic and foreign investors as well as prospective lenders, that Indonesia has great opportunities for shipping and ship industry investment and business.

5. CONCLUSION

The economic impact for Indonesia of cabotage law implementation in coal transportation are :

1. **Foreign exchange saving**, since the year of 2010 Indonesia can save US$ 935 million per year from coal domestic and export transportation.

2. **Utilization of ship industry**, until the year of 2010 Indonesia requires 92 ships and if all ships will be built in Indonesia, the investment needed is US$ 1,25 billion.

3. **Increase government income from tax,** since the year of 2010 Indonesia-flagged ships company will contribute additional income of US$ 81 million per year. Beside that, the ship industry also can contribute of US$ 112,5 million until all ships built.

4. **Employment opportunities**, there will be more than 30,000 new direct employment opportunities for supporting the cabotage law implementation.

5. **Improvement of investment and business climate**.

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