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EDITORIALS

Merry Christmas and Happy New Year 1998. In spite of monetary situation in Indonesia, which hits many news businesses, we from the Quarterly Newsletter, are proudly deliver our first issue of 1998.

In this issue, Dr. Habibie presented an article, entitled "Utilization of Natuna CO₂ and the EID Mamberamo River Project". In this article he proposed some possible utilizations of Natuna CO₂. In the second article, Dr. Suharyono discussed the prospects of steel industry in Indonesia, with PT. Krakatau Steel as his case study. In the third article, Dr. Moechtar presented some results and recommendations of the reconnaissance survey performed by Nippon Koei of Japan in November 1997. The article described the current conditions of the Mamberamo River Catchment Area, and proposed the essential measures to be conducted in the near future to prepare a more detailed overall master plan for the Mamberamo Development Project.

Finally, regular section, "BRIEFS", gives some related activities. While some sections, such as "MIC News" and "What's Next" remain.

Editor-in-Chief

Meirios Moechtar, Ph.D., P.E. ♣

UTILIZATION OF NATUNA CO₂ AND THE EID MAMBERAMO RIVER PROJECT

Introduction

Natuna Gas Field, lies $\pm$ 250 km at the North-East of Natuna Island, has a huge deposit of gas. This field is called as D-Alpha Block which is as work region owned between Pertamina (50 %) and Esso (50 %), under the Joint Operating Agreement with the Production Sharing Contract. However, the owners changed with the introduction of Mobil Oil and Japan site as new comers last year.

In 1981-1983, Pertamina and Esso formed a Joint Operating Agreement to carry out the drilling process in L-structure. The objective of the observation in L-structure is to analyze and to observe the amount of gas deposit in that structure. It was found that the gas reserve is estimated at 211 TSCF (trillion standard cubic feet) with the composition of 71 % carbon dioxide, 28 % hydrocarbon gas, 0.5 % sulfuric acid and 0.5 % nitrogen.

For the development of Natuna gas field, there are two ways to be pursued. First, the CH₄ gas for the amount of 28 % by volume is going to be used as materials for LNG plant, then it will distribute to the buyers/consumer through pipe line. This methane gas after cryogenic processing still contains CO₂ gas for the amount of 18 % and H₂S (940 ppm).

Second, the separation of gas (CO₂ and H₂S) for the amount of 71 % by volume should be processed in order not to give the side effect to the environment. Therefore the utilization and treatment of those gases are required to avoid the environmental damage affected by the gases.

Nowadays, the processing technology of CO₂ and H₂S which has an economical values and well proven is not available yet. But it is open for the utilization of those gases when required and the technology is available.

The Concept of CO₂ and H₂S Processing

To anticipate the utilization of huge amount of CO₂ and H₂S, there are several alternatives which can be taken, as follows;

1. Re-injection to the earth through stone deposit in aquifer or in D-Alpha field.

2. Injection to the sea using sparger system
3. Release to the air (global effect)
4. Utilization of gases as material for intermediate or product of petrochemicals.

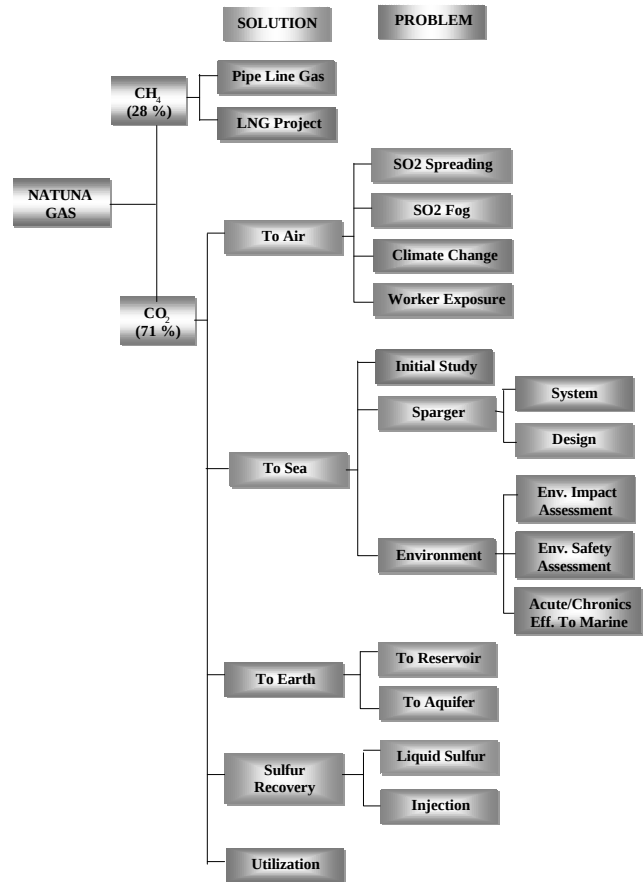


Figure 1: The Development of Natuna Gas Resources

Those four alternatives can be generally compared as follows; the re-injection method needs high investment and operating cost without any economic values. Therefore the use of this method should have concerned other alternatives. It may be used in the first step of the development of Natuna, before other alternatives are available. Whereas the two methods, the injection to the sea and the release to air, have a negative effects to the environment in short and long-term period, especially the gases produced are danger to the workers in the field. On the other hand the utilization of CO₂ probably become the best alternative which can reduce the environmental effect because the gas is used, and the products from CO₂ utilization with high added value can subsidize the cost which is spent to separate CO₂.

Utilization of CO₂ Gas

Nowadays, in the world, the CO₂ gas has been used as a raw material for urea (40 %), oil compression (35 %), refrigerator (10 %), beverage carbonation (5 %) and miscellaneous uses (10 %).

Several alternatives to utilize CO₂ can be seen as follows:

1. Urea production

Urea is chemical that is used as fertilizer in agriculture field. It can be produced as granules and easy to be transported without dangers, and dissolves in the water. In addition, urea is also used in melamine production, as an ingredient in the manufacture of resins, plastics, adhesives, textiles, and so forth.

2. Salicylic acid production in pharmacy industry

Salicylic acid production follows carboxylation process according to Schmitt method which is modified from Kolbe reaction. Caustic soda is added to phenol to produce phenolate. Then sodium phenolate is reacted with CO₂ under pressure and heat to form sodium phenyl carbonate. This form will then convert to sodium salicylate. Salicylic acid will precipitate by adding sulfuric acid. The acid is then purified by sublimation.

The derivative of salicylic acid can be used as medicine with forming methyl acetyl ester, which is known as aspirin.

3. Synthetic gasoline

The production of gasoline from methanol has been introduced by C. Itoh of Japan, and known as "methanol to gasoline" (MTG). By using this technology, methanol can be processed to become products which are relatively easy to be sold. In the reaction, gasoline (±85 %) presents as a main product, and other products are as secondary products such as: LPG (±13,6 %) and synthetic gases as methane and ethane (±1,4 %).

4. Soda ash production in chlor-alkali industry

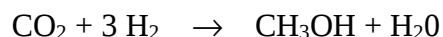
Soda ash is a solid form which is dissolved in water and contains around 99% Na₂CO₃. The industrial consumers of soda ash are glass, chemicals and soap-detergent industries.

Soda ash is manufactured throughout ammonia-soda process or Solvay process. In

this process, sodium chloride is treated with ammonia and then with carbon dioxide to produce sodium bicarbonate and ammonium chloride under strictly conditions. When heated, the sodium bicarbonate will form sodium carbonate whereas ammonium chloride is treated with lime to produce ammonia and calcium chloride.

5. Methanol production

Methanol can be produced by the reaction between carbon dioxide and hydrogen using high performance catalyst. The formation of methanol will follow the reaction below:



6. Others

Other products, which can be produced from CO₂ are formaldehyde, DMT, acetic acid, MBTE, methyl metacrylate, solvents, etc.

EID Mamberamo Project

According to the data from the Department of Mining and Energy, Irian Jaya has a huge deposit of various metallic minerals, such as nickel, copper, silver, and gold. In addition, Irian Jaya has deposit of non-metallic mineral resources, such as kaolin, mica, limestone, feldspar, zeolit, phosphate, and marble.

Through water electrolysis process, the hydrogen can be produced. This can be used as renewable energy with environmental friendly, also the hydrogen may be used in the iron reduction process.

With the utilization of CO₂ from Natuna and hydrogen from Mamberamo, those two big projects will be connected each other.

Water electrolysis process

Electrolysis method can be used to produce hydrogen. The process is based on an electrical energy which flows through electrode to water. Water is immediately separated to become hydrogen and oxygen gases. There are three types of conventional water electrolysis cell, those are tank cell, press filter cell and high pressure cell.

The material normally used for electrode is platinum to avoid a corrosive problem, but it is expensive. Therefore people had developed the new materials. A combination of anode covered by nickel and other precious metal is

used to strengthen the speed of oxygen formation, whereas cathode is covered by nickel.

The Development of Chemical and Petrochemical Industries in Mamberamo

The hydrogen produced from water electrolysis process can then be used to produce petrochemicals, such as urea, gasoline, and methanol, by combining it with CO₂ in chemical processing. The CO₂ used is originated from Natuna gas field or Wiriagar. As mentioned above that the Natuna CO₂ may be transported to Mamberamo and then processed further to produce petrochemicals by combining it with hydrogen (H₂). Beside that the LNG field in Wiriagar-Bintuni ($\pm$ 400 km from Mamberamo) which has gas deposit about 100 TSCP and contains 18 % CO₂, can be used as resources of CO₂ too. So Wiriagar CO₂ can guarantee the long-term supply of CO₂ for petrochemical industry in Mamberamo. In other word, the combination of these two big projects can create a synergy between them. Transportation and storage systems for CO₂ may be quite interesting for potential businesses.

Dr. Sudirman Habibie ♣

STEEL INDUSTRY

A complete steel plant consists of an iron making, steel making and steel construction product. The iron making converts iron ore pellets, which contain 65% of iron, to pig or sponge iron, which contains about 94.3% of iron, 4.5% of carbon and some impurities such as manganese, silicon, phosphate and sulfur. There are two major processes that can be used to produce iron from the ore, i.e. blast furnace and direct reduced iron (DRI). Blast furnace is done in a large vertical cylinder charged with a mixture of metal ore, coke and limestone. Air is blasted from the bottom to promote combustion of the coke to carbon monoxide. It reacts with iron ore to produce pig iron. In this process, the coke becomes a reductor and provides energy for the reduction process. The limestone reacts with waste mineral to produce

slag. Pig iron liquid is separated from the slag and is accumulated at the bottom of the furnace. The iron liquid is drawn off the furnace for further processing. In DRI, iron ore is reduced to metal without actually melting. The ore is reacted by carbon monoxide and hydrogen made from natural gas or coal. In this process, natural gas or coal becomes a reductor and energy. The product of DRI is known as sponge iron. In addition, H-Iron and Nu-Iron processes are two known iron smelting processes using hydrogen as a reductor and electricity as energy.

In general, the iron making unit that produces pig or sponge iron from iron ore generates small revenue. Therefore, the cheapest energy and reductor are chosen. There is an over supply of sponge iron product in the world now. It is supplied by the East Europe countries that need foreign currency. In Indonesia, PT Krakatau Steel (PTKS) is the only plan that produces sponge iron with a total capacity of 2.55 million ton per year. Currently, the plan uses natural gas as reductor and energy. An increase of natural gas price from US \$ 0.65 per MMBTU to US \$ 2.0 per MMBTU leads to the changing of reductor from natural gas to coal in 1998. A blast furnace, which uses coal is under construction.

The steel making converts pig or sponge iron to steel which contains carbon no more than 2 %. The process is carried out in steel furnace. There are two major processes to produce steel from iron, i.e. basic oxygen furnace (BOF) and electric arc furnace (EAF). The BOF utilizes oxygen as reductor and energy sources. The oxygen is blown through a charge of molten iron with about 30 % scrap iron. The process is causing the carbon, silicon, mangan and phosphorous impurities to oxidize. The EAF needs electricity as the source of energy and can melt charge up to 100 % scrap. The output from steel furnace is rolled into bars, plates or rods, cast into ingots, or poured into continuous-casting machines that can shape it before it cools. In general, the steel making unit that produces bars, plates, rods or ingots from pig or sponge iron generates bigger revenue than iron making.

In Indonesia, steel product is produced from PTKS and several other private companies

with a total production of 2.74 million ton in 1996. A study made by PTKS estimates that the total demand of steel flat product in Indonesia is about 2.9 million and 5.6 million ton in 1996 and 2004 respectively. The steel demand is about 58% in the form of hot rolled product and the rest is in the form of cold rolled product. Based on the current production capacity only about a half of the steel demand will be supplied domestically in 2004, if there is no new steel making plan in operation by that year.

A comparison of energy used in iron making and steel making can be seen in Table 1. The table is based on the average of energy intensity in PTKS. It shows that the total energy intensity for the iron making is bigger than the steel making. The iron making with DRI process requires more natural gas than the steel making; while the steel making with EAF process requires more electricity than the iron making. Based on the type and the amount of energy required as well as the revenue generated, Mamberamo area that has an abundant inexpensive electric power is more attractive to build steel making unit. In this case, the sponge or pig iron can be imported from Australia. It should be noted that the current iron making unit of PTKS also imports the iron ore pellet from Brazil, Sweden and India.

Table 1: The energy intensity average of PTKS in 1995

	IRON MAKING	STEEL MAKING
Total (Gcal/ton)	3.75	2.87
Natural gas (Nm ³ /ton)	444.58	23.94
Electric (KWh/ton)	59.98	902.06

Dr. Hari Suharyono ♣

RECONNAISSANCE SURVEY OF MAMBERAMO

From November 14 to 24, 1998, a team from Nippon Koei, Japan, accompanied by a team from PT. Tata Guna Patria, Indonesia, performed a reconnaissance survey of Irian Jaya, included the Mamberamo River

Catchment Area. The latter is the main topic of this report.

Some Results of the Survey

Based on the survey, we may briefly describe the following general features and conditions of the Mamberamo Area:

- The forest in the South-Eastern upstream areas is covered by not so much dense and small size (in diameter) but tall trees. Most of them are iron trees. In this area, there is a bridge over the Mamberamo River. This bridge is a section of Trans Jayapura-Wamena Highway, which was just inaugurated by the President of Indonesia on January 19, 1998.
- Toward West of this inland area is a vast swamp areas with bushes and shrubbery. These vast swamp areas cover almost all the middle reaches of the Mamberamo River Area. This area is said to be inundated during the rainy season in a very huge and wide area. The swampy condition of this area may cause the furious meandering of the Mamberamo River (see Figure 2 below).



Figure 2: Mamberamo River with furious meanderings

- The meandering may subsequently cause the riverbank erosion, which can be seen from the visual heavy sedimentation on the water flows in the river. However, the mountainous area has little landslide and erosion. It implies that the riverbank erosion can be eliminated by constructing

the dam(s) along the river. Therefore, sedimentation might not be a so big problem anymore.

- The industrial development of the Mamberamo Areas will heavily depend on its huge hydropower potential. It may have a huge hydropower potential as big as 100 GW. According to the nationwide hydropower potential study, which is now undertaken by Nippon Koei, Japan, the economically prospective hydropower potential in the Mamberamo is approximately 20 GW with identified power development schemes, and cost of electricity would be around 4-5 cent/kWH. It may be suggested that the prospective resources and driving force for Irian Jaya development in general, is the hydropower development.
- Toward North of these middle reaches of the river, the downstream area forms a narrow gorge, which seems to be suitable for dam site(s) in terms of topographic features. However, further geological investigation is prerequisite.
- Several agencies has conducted preliminary studies on the Mamberamo development. However, most of those studies provided only the ideas for development but not sound development plan since basic data such as hydrological, topographical, geological and geotechnical data are not available yet. A more comprehensive and overall master plan for the Mamberamo development needs to be conducted by taking into consideration of hydropower development, along with the demand for water supply and irrigation, based on the sound data. To successfully prepare the master plan, hydrological observation and topographic mappings are mandatory and prerequisite. It is also noted that from the observation that the river water in the small tributaries looks like very clean. It implies that it has good potential of hydropower generation, water supply and irrigation.
- There are many and wide land reclamation plots for transmigration, including lower reaches of the Mamberamo River Catchment Area to the Northern Coastal

Area, span from the estuary of Mamberamo to Sarmi and to the East to Jayapura. However, the team didn't get the chance to perform the reconnaissance survey on the proposed industrial estate in the Waren of the district of Waropen Atas. This is located in the Western part of Mamberamo to the Cenderawasih Bay.

- The needs for infrastructures such as irrigation system, road, drinking water, electricity, etc. must be fulfilled in order to promote transmigration program. The transmigrates, in turn, will satisfy the need for human resources when the Mamberamo Project could be realized. Therefore, a more precise planning of transmigration would be prerequisite.

Basic Approach to the Mamberamo Development

Based on the current situations, that is limitation on available data, many problems in transmigration, and there are huge potentials of natural resources, three basic approach are recommended for the development of Mamberamo Project, and Irian Jaya in general:

- Establishing database, which includes the topographical, geophysical, geotechnical and hydrological data. Supporting data will include social-economic, human resources, natural resources, infrastructures, land use, meteorological and others. These data are essential for preparing a more precise planning of each sector of development. Among the above, meteorological, hydrological, topographic and geological database should be established with a highest priority, since it needs much time for site survey and observation. However, this effort will need huge financial resources and expertise. The Government of Indonesia may consider it as a heavy burden for its state budgetary. Therefore, any support, either bilateral or multilateral is essential in conducting and realizing this essential database.
- Fulfilling of basic human needs, especially for the implementation of transmigration and isolated areas. The development of these human resources is potential and essential in developing the industrial sector

in Mamberamo, and Irian Jaya. This is also essential for political issues. The basic human needs should include water supply, foodstuff, electricity, education, medical treatment facilities, and others as needed according to the situation.

- Improving economy with natural resources development together with hydropower development. There are huge potential of resources for development such as land, mineral, water, fisheries, forest, tourism and others. Among these resources, land, mineral, water and fisheries resources are most attractive ones. While the forest and tourism resources seem to be limited, and need further detailed analysis in master plan level, which is a long-term target of development.

Basic Policy of Development

In accordance with the government policy toward Eastern Indonesia Development, the basic concepts of development for the area may be summarized as follows:

- To promote Mamberamo development, and Irian Jaya in general, by means of mineral, water, tourism, fisheries and forest resources development.
- To promote industrial development in the Central Northern areas, which covers KAPET Biak (inaugurated in Jan. 19, 1998) in the North, Cenderawasih Bay in the West, Nabire and Jayawijaya mountain range in the South, and Trans Jayapura-Wamena Highway in the East, by utilizing huge hydropower potential of Mamberamo River in the East-Central area of Irian Jaya.
- To promote human resources development through vocational training and education of local people along with the transmigrates.
- To establish transportation network to connect isolated areas by roadway as first priority, and railroad, river transportation, and coastal & ferry in order to promote development of Irian Jaya.

The human resources development needs to be put on high priority due to the following conditions:

- Irian Jaya is very limited in human resources. Deficit of population is one of

possible causes of failure of implementing development activities. For a land area of about 414,800 km², but a population of 2.0-2.5 million people, Irian Jaya needs to increase its population to support its economic development.

- Transmigration is one of the ways to increase population and human resources development. Integrated with indigenous local people and their good cooperation, human resources development should be promoted.

Hydropower Development

The Mamberamo River has a catchment area of about 79,000 km², and annual average rainfall in the basin is assumed at 2,800 mm. The vast catchment areas and a high rate of annual precipitation may cause the hydropower potential of the Mamberamo is quite huge. It is said that its potential is more than 100 GW, of which about 20 GW would be possible to be economically developed, if the power demand exists. Two of the most prospective sites are Mamberamo No.1 (5,700 MW) and No.2 (930 MW), based on the study so far made.

Those schemes, even one scheme among two, are too big for one stage development, since huge power demand are not expected under the present economic conditions and near future development planning in Irian Jaya. Conceivable development scenarios are hydropower development for mineral resources development such as copper smelter, aluminum smelter, and steel making processing. Others are the implementation of fuel cell power transportation system (by using hydrogen produced from water electrolysis), and stage-wise development as demanded.

Scenario of the hydropower development would be prospective if private sector's investment can be arranged since huge mineral resources are available in Irian Jaya. Scenario of hydrogen-based fuel cell power for transportation system is still subject to further technology development on fuel cell itself and water electrolysis as well. This is essential in order to achieve cheaper production cost and/or more effective heat generating system by hydrogen, and the fuel cell power system as

well, but both would be prospective in future. For fuel cell technology development, the Mamberamo Development Team recently acquired two units of 50-W PEM fuel cell power supply from ElectroChem, Inc., USA. The main purpose of this acquisition is to familiarize the researchers at BPPT and other related institutions with this new and emerging technology. Please note that these PEM fuel cell units are the first of its kind in Indonesia.

The stage-wise development scenario is the most conventional thought. However, from topographical point of view, this scenario is also conceivable. But since most of the study on the hydropower potential is based on the many assumptions, due to the limited available data (only 9 runoff observation stations exist along the river of 650-km long). Rainfall data is also limited, and actual observation condition should be confirmed first. Therefore, it is recommended to perform hydrological observation as soon as possible.

Topographic maps which cover the Mamberamo River Catchment Area are available of piecemeal and small scale as 1/250,000 incomplete contour lines only. Therefore, a complete topographic maps with 1/50,000 scale covering the entire basin area of Mamberamo are essential. Subsequently, it is recommended to prepare such maps by means of aerialphoto-mapping including ground control survey.

Our further measure with regard to this matter is seeking for the financial aid from the Japanese government in establishing the required database for the project.

Meirios Moechtar, Ph.D., P.E. ♣

BRIEFS

On Oct. 22, 1997, the Mamberamo Project Development Team invited the parties from the German Embassy and industries, and KADIN to discuss the basic concept of Master Plan of the Mamberamo Project. The meeting was chaired by the Vice-Chairman of BPPT, and is mainly intended to anticipate the GIF III in Berlin on Dec. 2, 1997. One of the results of

the meeting is the inclusion of the Mamberamo Project in the Forum's agenda.

As a result of the visit of H.E. Prime Minister Prodi of Italy, the Mamberamo Project Development Team discussed the prospects of the steel industry development in Mamberamo, with Demag Italimpianti, a worldwide leader in steel industry from Italy.

In order to obtain more information about the prospect of aluminum smelter industry in Mamberamo, the Team contacted Mr. Thierry Berthoud of Pechiney, France, the world leader in aluminum industry. He kindly commented on our conceptual master plan. His main point to be considered is about the cost of electricity for the smelter plant, which should be in the range of 1.8 – 3.72 US¢/kWh.

On request by PT. Muskat Prima, consultant to the BAPPEDA Irian Jaya, we conducted a meeting in Nov. 1997. We agreed to assign Waren in District of Waropen Atas as the center of the Industrial Estate for the EID Mamberamo RCA. PT. Muskat Prima will inform and discuss this matter to BAPPEDA Irian Jaya.

MIC NEWS

Due to the internet restructuring in BPPT office, we regretfully inform our subscribers that either the homepage and the e-mail will not be accessible for the time being. Any change will be posted in the further notice.

WHAT'S NEXT

As a result of the meeting on last October with the German industries, Dr. Keune of German Embassy, along with German industries and Mamberamo team members of BPPT will perform the reconnaissance survey of the Mamberamo River Catchment Area.

The Faculty of Agriculture, University of Cenderawasih, Jayapura, Irian Jaya, will organize the second Seminar & Workshop on the Mamberamo RCA in Jayapura in June 1998. More details about this event will be posted in the coming issue of this newsletter.