

MAMBERAMO NOW



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EDITORIALS

Despite the economic difficulty due to the somehow sustained monetary crisis that most of us in Indonesia and the region have to deal with, we at the MIC have prudently sustained the deliverability of this newsletter to whom that concerned about the development of Mamberamo River Catchment Area.

In this first issue of the second year, Dr. Suharyono discussed the hydro potential in Mamberamo River Catchment Area, based on some hydrological data. In the second article, Mr. Sugiyono presented an overview of the nickel industry in Indonesia. It described the major players in the industry, included their products and rate of productions. Dr. Habibie proposed an integrated industry as an alternative model for developing industry in Mamberamo area, which consisted of copper concentrate processing plant, sulfuric acid and nickel smelting plant.

Finally, we presented some recent activities in regular section, BRIEF, followed by information on the long-awaited proceedings of Seminar and Workshop on Mamberamo in MIC NEWS.

Editor-in-Chief

Meirios Moechtar, Ph.D., P.E. ♣

HYDRO POTENTIAL IN MAMBERAMO RIVER CATCHMENT AREA

Dr. Hari Suharyono

Development of Mamberamo River Catchment Area (MRCA) is related closely with water condition in the area. The water condition is determined by the intensity of rainfall, climate of the area, water flow rate and water quality of the river. The evaluation of water condition is based on hydrological data, observation and field measurements collected by various agencies and offices.

Rainfall data of MRCA are collected from 20 posts scattered over the area and the collection is performed during 1950-1986 period. However, it should be noted that all of the data do not complete for the whole period. The data typically are recorded continuously only for about 10 years period. Furthermore, the area covered by those 20 posts is 79436.72 km² or about 3990 km² per post. A post ideally covers 250 km² or 300 posts are required to cover the whole MRCA. The rainfall frequency recorded in a post is analyzed statistically; the data show consistency with the overall rainfall in Mamberamo. Based on rainfall data during 1962-1987 period, the average rainfall in MRCA can be seen in Table 1. The table shows that the lowest rainfall is in July (193 mm per month), while the highest rainfall is in March (327 mm per month).

Table 1: The average rainfall and evaporation rate

MONTH	RAINFALL (mm/month)	EVAPORATION RATE (mm/month)
January	242	143
February	293	130
March	327	143
April	287	136
May	272	138
June	196	121
July	193	128
August	256	140
September	295	144
October	301	149
November	294	141
December	237	136

Climate data consisted of average temperature, duration of sunshine, humidity, wind speed and evaporation rate data are taken from 7 locations located in the northern part of Irian Jaya, i.e., Serui, Biak, Dok II, Wamena, Sarimi, Sentani and Nabire. In general, geographic and astronomic coordinates influence the climate of Irian Jaya; MRCA is a tropical forest, which is not influenced by dry season. During May to November, the dry wind blows from South East that leads to dry season in Northern part of Irian Jaya, while during December to April wet wind blows from North West that leads to rainy season. Due to the topography of the region, the seasons are not the same for all regions. Average temperature on the seashore is between 26 and 27 °C with maximum average temperature between 32.1 and 30 °C, and minimum average temperature between 24.4 and 21.2 °C. Duration of sunshine in Irian Jaya is about 8 hours started from 08.00 Indonesia Eastern Time (WIT), with a variation between 50 to 55 % every day for Northern part of Irian Jaya, except Sarimi region is only about 39 %. In general, humidity of Irian Jaya is high, about 70 to 90 %, due to the wind that blows from the ocean. The average evaporation rate can be seen in Table 1, which shows that the lowest evaporation rate is in June (121 mm/month) and the highest in October (149 mm/month). The rainfall and evaporation rate data are used to calculate water availability and flow rate in a dam.

Mamberamo River is the main river system in MRCA. The river is established by the flow of two rivers, i.e., Tariku and Taritatu rivers. Mamberamo river flows from the south to the north and empties into the Pacific ocean. Tariku river flows from Sudirman mountains in the west to the east and combines with Taritatu river in the middle of MRCA. Taritatu river flows from Jayawijaya mountains in the west to the east. Mamberamo river has a length about 1300 km with an average width of 250 m. Average rainfall is about 2000 to 3000 mm in Mamberamo valley, up to 5000 mm in Jayawijaya and Sudirman mountains, the amount of water evaporates 1400 mm and the rest is going to the land surface. The river flow rate is about 4525 m³/sec. Field

observations show that season fluctuation of water surface in the river is about 1.5 to 2 m in the middle part (Kasonaweja) and 4-5 m in the upstream part (Pagai), particularly in Taritatu river. The season fluctuation of water surface suggests that the level of flow stability in Mamberamo River is low. There is a possibility that some of branches of the river are dry. A large quantity of water flow rate in Mamberamo river may be caused by a large catchment area, a high rainfall, a step river bank slope that leads to a high surface flow. Some parts of the river estuary become smaller and restrict the flow of water. This situation leads to flood and to inundate of the riverbank.

The water pH of the river is about 7.4-7.8. It means that the impacts of ore materials and plantation types are compensated by a large water flow of the river. Based on laboratory analysis, several physical and chemical characteristics are above the threshold limit i.e., dissolving material, electric conductivity and chloride. The analysis of the dissolve material is 2480 mg/liter that is above the threshold limit of group B drinking water (1000 mg/liter) and agriculture (2000 mg/liter). The electric conductivity of the water is 3108 μ mhos/cm, while the threshold limit of water for agriculture purposes is 2250 μ mhos/cm. The chloride of the water is 650 mg/liter, while the maximum allowable is 600 mg/liter. In general, the water quality of Mamberamo River is in the normal range for drinking water and agriculture purposes. Furthermore, it is recommended that the water used for fishery purposes should be treated in a settlement pond prior to its utilization.



OVERVIEW OF NICKEL INDUSTRY IN INDONESIA

Agus Sugiyono, M.Eng

Nickel reserve in Indonesia is estimated at around 881.3 million tonnes with Ni contents range from 1.3 % to 3.0 %. The reserves are located in a spread out and vast

areas in Sulawesi, Maluku, Kalimantan and Irian Jaya. Of those, only some reserves in Sulawesi and Maluku have been developed by PT Aneka Tambang (state-owned company) and PT INCO (a subsidiary of International Nickel Co., Ltd., Canada). The government of Indonesia (GOI) has granted some exploration concessions to the former, that is an area of 6,200 hectares Pomalaa, Sulawesi, 13,100 hectares in Gebe Island, Maluku, and 183,200 hectares in the islands of Obi and Halmahera. While the latter has been granted by the GOI an exploration concession area of about 218,500 hectares in Soroako, Sulawesi.

PT Aneka Tambang produced about 2.3 million tonnes of nickel ore in 1994, which is a 16.9 % increase of its production in 1993. The major parts of the production were for export purposes. The export of nickel ore with high Ni content from Pomalaa and Gebe Island is about 818,700 tonnes, while of low Ni content originated from Gebe Island is about 1 million tonnes. The rest of the production was processed in Pomalaa to become ferronickel (22 - 25 % Ni content). The annual capacity of this ferronickel processing plant in Pomalaa is about 20,000 tonnes. PT Aneka Tambang exported about 26,500 tonnes of ferronickel (block and shots) in 1994 to Japan, Germany and Switzerland.

PT INCO produced about 2.5 million tonnes of nickel ore in 1994 and processed to become nickel matte (78 % Ni, 1 % Co, 20 % S, and less than 0.7 % Fe) in Soroako. The annual capacity of this nickel matte processing plant in Soroako is around 45,400 tonnes. The total production of nickel matte in 1994 is around 45,300 tonnes and 80 % of those were exported for INCO Ltd. and affiliation company in Japan. The rest of 20 % production was exported to Sumitomo Metal Mining Co. Ltd. in Japan. Figure 1 is shown type of nickel products exported from Indonesia.

In the following, we briefly discussed the nickel matte processing plant of PT INCO in Soroako, Sulawesi. The schematic diagram of the plant is as illustrated in Figure 2 below. This processing is capable of producing around 45,400 tonnes of nickel matte per year of 5.5 million tonnes of wet ore.

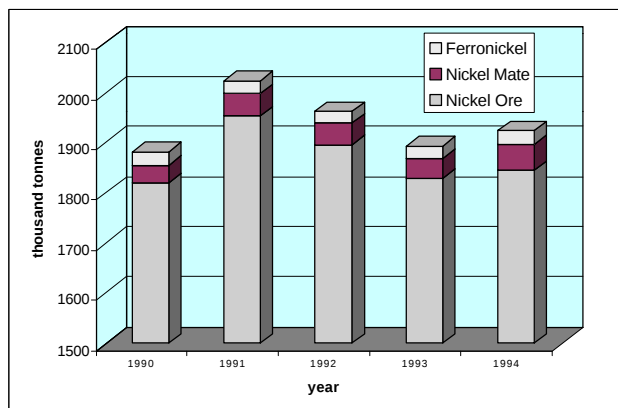


Figure 1: Nickel Export from Indonesia

Processing begins at the dryer unit that removes barren rock to produce a dried ore with the average content of around 2 % Ni. The dried ore is then reduced in rotary kiln units and smelted in electric furnaces where nickel matte and waste slag are separated. The iron in the furnace matte is removed in Pierce Smith and Top Blown Rotary Converter unit. Finally, the product is granulated and packaged, ready for shipment. Processing plant facilities consist of:

- **Rotary Dryers**

There are two units, each with length of 50 m. One of the units has diameter of around 5 m and the another is around 5.5 m.

- **Reduction Kiln**

There are four units of reduction kiln and three of them have length of 100 m and diameter of 5.5 m. The other unit has length of 115 m and diameter of 6 m. The larger reduction kiln capacity is approximately 195 tonnes of wet ore feed per hour and the other three reduction kilns have capacity of around 130 tonnes of wet ore.

- **Electric Furnace**

The smelting process is performed in three electric furnace units. The diameter of the furnace is around 18 m. The first unit of electric furnace is powered by a 3-phase, 60 MVA transformer, while the other two units are powered by two 3-phase, 65 MVA transformers.

- **Converter**

There are two units of Pierce Smith Converter and Top Blown Rotary Converter.

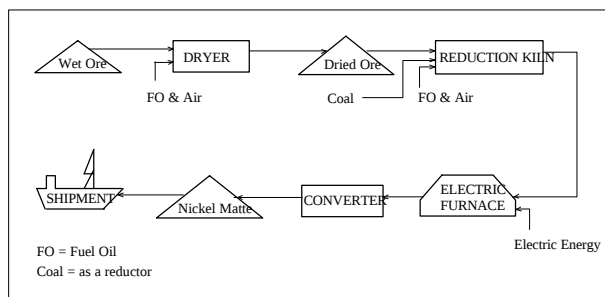


Figure 2: Diagram of the Processing Plant

Electric power for the processing plant is produced by Larona hydropower plant, oil fired power plant, and diesel power plant. The capacity of each power plant is shown in Table 2. The hydropower installation consists of a rockfill dam, a 7-km concrete surface canal, steel penstocks and the power plant. The dam built across the Larona River and creates a large reservoir. The water debit in the canal is up to 150 m³/s.

Table 2: Power Plant in PT INCO

	Hydro	Oil Fired	Diesel	
			MBDG- Mirless	For Emergency
Capacity (MW)	55	28	8	0,75
Unit	3	1	3	5
Total Capacity (MW)	165	28	24	4,5
Start operation	1978	1976	1993	1975
Life time (years)	100	30	25	25



INTEGRATED INDUSTRY AS A MODEL FOR DEVELOPING INDUSTRY IN MAMBERAMO RCA

Dr. Ir. Sudirman Habibie MSc.

Mamberamo River Catchment Area (RCA) has an energy potency which is predicted at around 15 to 20 Giga Watts (GW). This can be used as energy resources for industries particularly energy intensive industries. Energy intensive industries (EII) and integrated industries (II) become the choices for developing this area. EII is addressed to absorb large amount of energy and II is for

increasing the utilization of natural resources, diversification and reducing environmental problem caused by industry.

PT. Freeport Indonesia has produced copper concentrates since 1972 from Bijih Mountain (Erlzberg) mining area in Irian Jaya. Currently the copper concentrates produced by PT. Freeport are mostly exported to Japan to be further processed. In the mean time a copper smelting plant project in Gresik (East Java) which has already been in construction stage, is planned to process about 500,000 tonnes per year of copper concentrates originated from PT. Freeport Indonesia. In year 2000, the capacity of the processing plant will be increased to be 600,000-700,000 tonnes per annum. This is approximately 25% of the total production of PT. Freeport Indonesia, which will reach 2,600,000 tonnes per annum by that year. Therefore, at least about 75% of copper concentrate production still have to be exported for further processing.

In this conjunction, it is very reasonable to develop a copper smelting plant in the Mamberamo area, so that the 75% of the remaining copper concentrates for export can be processed domestically.

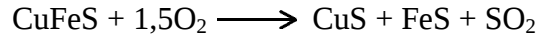
By assuming that processing technology will be similar to the one that used in Gresik smelting plant, electricity energy requirement in electrolytic refining stage to process 500.000 tonnes of concentrates per year by utilizing electric furnace will be 6 MVA. Suppose Mamberamo copper smelting has capacity of 3 times of Gresik capacity, then total electric energy consumption will reach around 20 MVA.

The by-product of a copper concentrate smelter plant is mainly sulfuric acid. By assuming that the capacity of the copper smelter is 2 million tonnes per year of copper concentrates, then it will by-produce sulfuric acid of around 1.5 million tonnes per year. While this sulfuric acid Gresik is used for Petrochemical industry in Gresik, it may also be used in the processing plant of low-grade nickel laterite ore from the cycloop area of Irian Jaya, to be developed in Mamberamo area. Furthermore, the establishment of copper smelting plant in Mamberamo area can be expected to develop other copper downstream

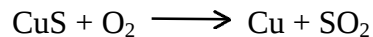
industries, such as electric and telecommunication cables, electronics, pipes and household items.

Copper concentrates generally contain main mineral of chalcopyrite (CuFeS_2) and small amount of other minerals. So copper smelter process is based on two step reaction processes, those are:

- Separation between copper and ferro (smelting)



- Conversion of copper sulfide into copper (conversion)



Anode copper produced at smelter process has a copper content of 99.4 - 99.8%. However this product doesn't still meet quality standard for using in electricity yet. This anode copper should be purified by electrolysis process (electrorefined) to produce high-grade copper precipitated at cathode, so it is called cathode copper.

At electrolysis process, anode slime is produced at anode. Anode slime contains small amount of several high values mineral metals, such as gold, silver, selenium, tellurium, etc. At copper smelter plant in Gresik, anode slime is not processed but exported. A SO_2 gas produced from copper smelter process is flown into sulfuric acid plant. The integrated plant of copper smelter and sulfuric acid plants is very important in term of economic point of view and environmental protection scheme.

Some huge nickel ore resources are available in many islands in northern part of Maluku Province, such as Halmahera, Gebe, Gag, Obi, Waigeo and cycloop. Mining concession (Kusa Pertambangan/KP) in some areas, such as Gebe, Gag and Obi are owned by PT. Aneka Tambang (state-owned company), while Waigeo and cycloop are belong to other companies. Among those resources only Gebe Island has been mined by PT. Aneka Tambang through an exploitation

concession granted by the Government of Indonesia (GOI).

The types of nickel deposit above mentioned is lateritic nickel ores, which consist of limonitic in upper layer and saprolitic in lower layer. Each type requires different process. Limonitic ores usually are processed in hydrometallurgical plant such as sulfuric acid leaching or ammoniacal leaching. Meanwhile saprolitic ores, which have higher nickel contents, are processed by pyrometallurgy. Availability of electrical power supplied by Mamberamo hydroelectric plant will be more beneficial by using Rotary Kiln - ELKEM process or Plasma Furnace Plant. In the mean time the development of hydrometallurgical plant for processing of limonitic nickel ore will take advantage of the availability of sulfuric acid or ammonia gas in Mamberamo area. Consider that the price of sulfuric acid agent is a determining factor in selection of nickel leaching process.

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BRIEFS

Meirios Moechtar, Ph.D., P.E.

Acquisition of PEM Fuel Cell

In order to get the first hand experience in operating a fuel cell power system, the Mamberamo Energy Study Team of BPPT recently acquired 2 units of Polymer Electrolyte Membrane Fuel Cell (PEMFC) from ElectroChem, Inc., USA. The team decided to do so as there is no such a unit available in Indonesia. Therefore, we may say that these units are the first of its kind in Indonesia. Some research institutes have been conducting experiments on this new and emerging energy conversion technology, but it is limited to small-scale and impractical unit.

Although these PEMFC units are very small in capacity (each unit is only 50 W), yet we may consider this acquisition as a breakthrough in fuel cell technology in Indonesia. This PEMFC unit is as shown in Figure 3 below and its specifications are summarized in Table 3.

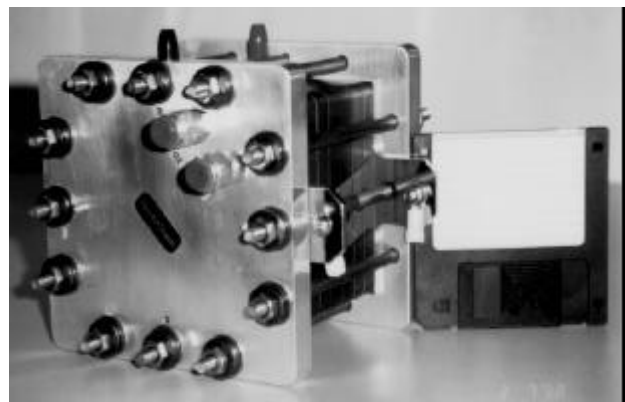


Figure 3: PEM Fuel Cell

Table 3: Specifications of PEM Fuel Cell Unit

Specifications	
Effective area	50 sq.-cm
Graphite plates	6 bipolar and 2 side
MEA*	7 x 43 sq.-cm
Net weight	4 kg
Operating temperature	80 deg.C
Pre-heater	8 x (20 W, 110 V)
Current collectors	Copper plates

* MEA = membrane electrolyte assembly

We originally planned to drive a small electric utility car powered by PEMFC units. However, due to the limitation in our budgetary, we have to slightly modify our plan. We finally decided to use the units to charge lead-acid batteries, which in turn are used to drive a DC motor on a small go-kart. However, in order to get a better public awareness on the bright prospect of this technology, a more significant capacity of PEMFC system is imperative. Since we still do not know yet when we will be able to recover from this limited budgetary situation, any support on this matter is highly expected and appreciated. Any favorable offers from any parties interested in cooperating with us in disseminating this technology in Indonesia are absolutely welcome.

Visit to Industries in Germany

As a realization of the long-time cooperation between BPPT and BMBF (State Ministry for Education, Science, Research and Technology, Germany), some members of the Mamberamo Study Team were invited to visit

some industries in Germany from February 22 to March 2, 1998.

This visit is a fact findings mission with its main purpose is to get a better comprehension on the latest status of some energy related technologies in Germany. The team visited some industries deal with water electrolysis technology, fuel cell power system and clean coal technology. However, we only presented the first two technologies since they are related to the development scenario of Mamberamo RCA. As you may recall that the Mamberamo Study Team proposed 12 studies to support the preparation of the Master Plan for Mamberamo RCA, and two of them are the studies on the water electrolysis and on the potential application of hydrogen-based fuel cell for transportation system.

After a fruitful discussion on some new and renewable energy technologies at the energy technology office of BMBF, then the visit was followed by some trips to industries and research institute.

On the trip to Daimler-Benz AG (DB) in Stuttgart, the team had a chance to share the ride on the famous NECAR 2. This minivan run on PEMFC, and used hydrogen as fuel and air as oxidant. During this test drive, we could tell that fuel cell powered car is technologically ready. The main obstacle is the unit price of fuel cell. However, according to Mr. Johannes Ebner, vice president of the facility, it can be overcome through mass-production of fuel cell. He said that it would be achieved in the next 4 years. By that time, fuel cell powered cars will be as common as the ICE car these days. More strict regulations on air quality in the upcoming years, will be of benefits for this kind of vehicles. Besides of NECAR 2, DB is also making NEBUS (bus version) and NECAR 3, the latest generation, which will run on methanol as fuel.

DLR (German Aerospace and Aeronautics Agency) mainly focused on the technological advancement on fuel cell and water electrolysis. They deal with only PEMFC and Molten Carbonate Fuel Cell (MCFC). They don't deal with the Phosphoric Acid Fuel Cell (PAFC), the most advance fuel cell type that is ready for commercialization, as both the American and Japanese are already ahead of

them. Siemens AG also focused their fuel cell activity on the PEMFC and Solid Oxide Fuel Cell (SOFC). The former is as a joint effort with MAN (heavy-duty vehicle manufacturer) and Linde AG (leader in petrochemical industry) to develop public bus powered by PEMFC. While for the latter, they cooperate with DLR. However, Siemens are still on their R&D stage for both types of fuel cell. The last trip on fuel cell technology is to visit (Motoren-und-Turbinen Union) in Ottobrun, Munich, which emphasized their effort on MCFC. Their main result is the modification of the MCFC technology obtained from the Energy Research Corp. (ERC), USA.

On water electrolysis technology, the team visited DLR and SWB (Solar-Wasserstoff-Bayern), MTU and Bayernwerk AG, where these three are located in the suburb of greater Munich. The progress on this technology is not as significant as the one on fuel cell technology. Even the Federal Government of Germany may cut some research budget on this technology due to its lack of progress.

Finally, the team would like to acknowledge their appreciation to Dr. H. Keune, Counselor for Science, Technology and Environment at the German Embassy in Jakarta and to Dr. Ingmar Schmidt of DLR/BMBF in Bonn. Without their relentless efforts, this visit would never be realized.

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MIC NEWS

BPPT has published the English version of the proceedings of Seminar and Workshop on Mamberamo River Catchment Area Development: As a Growth Area in Eastern Part of Indonesia, which was held in Jakarta in April 7-8, 1997. The proceedings divided into two sections. Section one is a seminar that covers the discussion on the government policy and regulation on the development of Mamberamo RCA. Section two is a workshop that covers discussion on six topics, that is:

- a. Metal and mining industries;
- b. Petrochemical industries and utilization of Natuna CO₂;
- c. Dam and construction of hydroelectric power plants;

- d. Agriculture and forestry industries;
- e. Development of infrastructure and utilities;
- f. Assessments of environmental impact, and social-economic-cultural aspects.

The proceedings consist of 427 black & white pages. For whom interested to get involved in the project development should have a copy of the proceedings as they cover almost every aspect of the project. They also cover many and various ideas, thoughts and concepts, which are very helpful in preparing a better master plan for the project development. Discussion of every commission in the workshop is also included in the proceedings.

Now, they are available from the Secretariat of MIC at a reasonable price to cover some expenses in the preparation of the proceedings. The price for each copy is:

- Member: US\$ 20
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- allover Indonesia: US\$ 2
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