OPTIMIZATION OF ENVIRONMENTAL CONTROL USING INDUSTRIAL MINERALS FOR UPSTREAM OIL AND GAS ACTIVITIES

by
Djoko Sunarjanto, Supriyatno and **Azizah**

ABSTRACT

Industrial minerals are useful as drilling materials support such as; limestone ($MgCaCO_3$) for filler, bentonite and barite for drilling mud and quartz sand for propping agent. Until now the benefit of them has not been optimized because it is only as building material, and still the mining which cause environmental damage.

Concerning the environmental care and to support the movement of using national products of oil and gas activities need innovations and creativities in taking the benefit of those minerals. The alternative that has been chosen such as the effort of the balancing between the national products and big investment in oil and gas.

To make condition of bentonite as drilling mud was needed activation and change it to sodium bentonite to improve those mineral suspension by polymer added. Meanwhile industrial development of silica sand as gravel packing and propping agent, have been better within mining activity in Bangka Area. Average quality of silica sand consist SiO_2 up of 90 % to satisfy the requirements, but still was quality improved. In few regions in Indonesia overall industrial mineral can be used to support oil and gas activities.

Key words: environmental, industrial minerals, upstream oil and gas activities.

I. BACKGROUND

From the point view of Exploration and Production of Oil and Gas, some regions in Indonesia are potentially industrial minerals area which for the time has not been an optimally exploited. At least there are industrial mineral locations within oil and gas production region, where in every province there is the limestone, quartz sand of Bangka Island in South Sumatra oil and gas region and bentonite in Central Java and Nusa Tenggara. In general, the benefit only upon which mines industrial faction become sand and stone or building materials, the foundation of stone, as construction materials which low value and the mining is environmental damaged.

To support of domestic product usage, improved the local component and use of domestic raw material for the gas and oil activities needed innovation and creation of domestic product. The best alternative for create the balance between domestic product usage and the important investment (oil and gas investment). So the exploitation of quartz sand as early improvement of local component, beside the other industrial minerals, example ; limestone (specially $MgCaCO_3$) as the filler or mixture of drilling process and also bentonite and barite as drilling mud.

Eco-Industrial Park (EIP) approach in Surna T. Djajadiningrat and Melia Famiola (2004) to combine two prominent concept, that is how to develop an area of industry which environment concern, but also own ability to be able to yield self product with excellence marketing competitive. EIP concept to try and develop view as industrial cluster, by using approach of excellence competitiveness developed by Michael Porter (1990).

II. ENVIRONMENTAL CONTROL

A new paradigm of development a mining industrial area have own properly care about environment

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level, those the attention for industrial minerals exploiting and development also become governmental pre-eminent priority and investor.

Other side of oil and gas drilling activities need of rock material as oil and gas support for drilling until producing. The case, quartz sand, beside serve the purpose of gravel packing also serve the purpose of propping agent. Gravel packing is material to prevent sand flow which as follower material come from unconsolidated formation. Propping agent is material to close and prevent after stopped operating or to covered a fracturing impact.

As support of oil and gas upstream activities can created between industrial minerals mining company and oil and gas industrial. Beside can created a larger efficiency, strenghtenedly prospect improvement of added value the industrial minerals as environmental control and improve of local fund.

Based on an existing condition need policies determination as a mean to push domestic product improvement with qualify local content. Besides campaign of environment or sustainable development and domestic product affection, the other way is priority domestic product by State Owned Companies (Badan Usaha Milik Negara) and private sector, its context for example PERTAMINA and oil and gas national companies to start for industrial mineral which made available around activities area all at once and also preserve of environment.

III. LIMESTONE

1. Compositions

Limestone (and dolomite) is primary carbonate type rock which the composition dominant of calcite mineral ($CaCo_3$), formed through sedimentation process, structure of crystal system is hexagonal. The other carbonate mineral which association to main mineral carbonate is siderite ($FeCO_3$), ankerite ($CaMgFe(CO_3)_4$) and magnesite.

Dolomite belonging to carbonate mineral cluster, pure dolomite mineral theoretically contain $MgCO_3$, MgO and $CaCO_3$ or CaO. The chemistry formula of dolomite mineral become $CaCO_3.MgCO_3$. Dolomite clasification in industrial mineral commerce based for magnesium element content, Mg (chemistry), dolomite (mineralogy), calcium element (Ca) and magnesium (Mg).

2. Reserves

Indonesia have a big reserve of limestone, dispersed in Sumatra Island, Java, Nusa Tenggara, Sulewasi, Papua, and also in other Islands. Reserve (in million ton) is: Nanggroe Aceh Darussalam (101), North Sumatra (6), West Sumatra (23.273), Riau (7), South Sumatra (49), Bengkulu (3), Lampung (3), West Java (673), Central Java & DIY (125), East Java (416), South Borneo (1.007), Center Borneo (543), West Nusa Tenggara (1.917), East Nusa Tenggara (230), North Sulawesi (66), South Sulawesi (20), Papua (240). In South Sulawesi limestone potency along at hilly of Tonassa - Pare-Pare (Figure 1**)** until Enrekang and Tana Toraja.

The spreading of dolomite there are in Province of Nangroe Aceh Darussalam, North Sumatra, West Sumatra, Central Java, East Java and Papua (Madiapoera, T., 1990).

IV. BENTONITE

1. Compositions

The composition or content of mineralogy sodium bentonite as following;

SiO_2 = 65,73 – 67,77
Al_2O_3 = 15,07 – 15,87
Fe_2O_3 = 2,02 – 2,07
CaO = 2,03 – 2,36

Bentonite is term for a clay contain monmorillonite in the world of commerce name. Bentonite be divided two groups from the content of alumunium silicate hydrous, that is activated clay and fuller's earth. From the type divided to be two, i.e: the first is Wyoming type (Na-Bentonit–Swelling Bentonite). Sodium

Figure 1
The potential of limestone on Allajeng, Tonassa, South Sulawesi

bentonite have own swell energy till eight times if plunged into water, and the ratio of soda and high lime, pH of colloid suspension : 8,5-9,8, cannot be activated and exchange position occupied by ion sodium (Na+).

The second type is calcium bentonite (Ca-bentonite–Non Swelling bentonite) this bentonite not enough good swell if packed into a water and persistent dispersion underwater, but naturally or after activated can have the good absorbted.

2. Reserves

As clay mineral with approximately reserve 500 million ton, applicable to absorber (calcium bentonite) and as drilling mud (natrium bentonite). Ca-bentonite relatively a lot of dispersed in Indonesia, specificaly for sodium bentonite dispersed on Pangkalan Brandan (North Sumatra), Sarolangun (Jambi), Boyolali (Central Java), Central Timor (East Nusa Tenggara).

V. QUARTZ SAND

1. Compositions

Quartz sand is make up one of mine material which extensive purposed on every industry. Indonesia quartz sand have composition as follow :

SiO_2	:	55.30	-	99.87 %
Fe_2O_3	:	0.01	-	9.14 %
Al_2O_3	:	0.01	-	18.00 %
TiO_2	:	0.01	-	0.49 %
CaO	:	0.01	-	3.24 %
MgO	:	0.01	-	0.26 %
K_2O	:	0.01	-	17.00 %

The physical charateristic of quartz sand:

- White transparent colored, but sometime have another colour, depending pollutant oxide. Example, yellow (Fe - oxide), red (Cu - oxide) etc.
- Hardness : 7 (Mohs scale)
- Specific gravity : 2.65
- Melting point : ± 1,715 °C
- Conductivity : 12 - 100 °C
- Crystal shape : hexagonal.

2. Reserves

Quartz sand potential in Indonesia occuring abundantly is precisely big and dispersed on 56 locations, the reserve estimated not less than 5.2 billion ton. Mostly on West Sumatra Province (72.76 %), North Sumatera (11.91 %), West Kalimantan (9.23 %), and the others regions not less than 2.60 %. Quartz sand quality reserve in Indonesia is a good, SiO_2 value in East Borneo is the best on Indonesia (SiO_2 value 98.7 - 99.9 %). Utilizing to support oil and gas upstream activities, the quartz sand get involved because the grain and shape is finely pounded. The location at urban development Balikpapan region – Penajam, increasing development the region means make sand mining activity still used for construction material, uncontrol and damaged environment (Figure 2).

Figure 2
Quartz sand mining activities as material construction disposed environmental damaged on North Penajam Paser, East Kalimantan

Figure 3
The potential of quartz sand as industrial minerals on Blora, Central Java.

At East Java quartz sand is make up of Ngrayong Formation member, as reservoar. From the exploration history, 75 % of hydrocarbon resulting on onshore East Java Basin source from Ngrayong For-

mation (Sri Budiyani and Abdul Mukmen, 1994). Some potential quartz sand location which disclosed at Central Java, Blora and Tuban region East Java, some years exploited for construction material.

Quartz sand Bangka and Belitung with rate of SiO_2 97.6 - 98.53 % and 87.05 - 99.3 %, laterlly has been mining and processing for oil and gas drilling activity.

VI. QUARTZ SAND ANALYSIS

As industrial minerals, quartz sand is potential for developed supporting oil and gas activities. Appropriate Eco-Industrial Park (EIP) concept which develop industry area with more care about environment and production of products capability with excellent competitive and increasingly value all at once. Quartz sand has develop on Bangka Island, specifically for quartz sand for support oil and gas production and drilling activities has been research on Drilling Material Laboratory of PPPTMGB "LEMIGAS".

The quartz sand characteristic and quality which fulfill international standard (API Standard), analysis conducting on quartz sand Bangka Island, in means creating prosperity product which have competitive excellent market, LEMIGAS have done specifically for research quartz sand at Bangka Island in 2005. Bangka Island have good quality quartz sand sediment, from have own producer conducted sample product analysis with dimension 12/20 and 20/40 mesh. In this short paper taken one 20/40 mesh

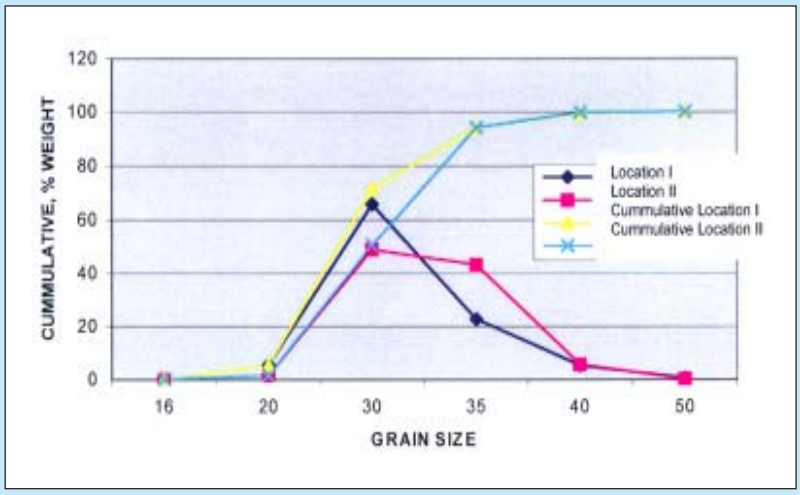

Figure 4
Curve of grain size sand distribution of Bangka Island (20/40)

Table 1
Grain size distribution raw material

Sieve size, mesh	Sample		
	I	II	III
8	3,5	0,4	6,7
12	6,05	1,2	15,25
16	14,68	3,6	29,7
18	11,75	2,7	16,05
20	12,69	3,5	11,3
25	15,66	13,4	11,5
30	15,35	333	3,4
35	13,37	28	2,2

Table 2
Grain size distribution local processing sand (size 20/40)

Sieve size, mesh	Sample	
	I	II
16	0	0,13
20	5,46	1,58
30	65,93	48,99
35	22,77	43,41
40	5,3	5,74
50	0,59	0,22
PAN	0	0

analysis, the sample tested with prerequirement standard for proppant (RP 56) procedure. Laboratory analysis shown silica sand quality generally fulfill prerequirement as gravel packing and propping agent for support oil and gas production and drilling which during the time still import.

1. Grain size/Sieve Analysis, is grain size distribution appropriate with API RP 56 for base sand material, size 20/40, the result as the Table 1.
2. Grain shape; Sphericity and Roundness is sand grain shape percentage refer from Krumbein dan Sloss **(**Figure 5**).**

From the data can made or repairing sand grain shape until fulfill API prerequirement which percentage 0.6 above, the assessment to compare visually with chart or figure.

Table 3
Grain shape assessment based on Krumbein and Sloss Sand processing with size 20/40

Grain shape	Location I	Location II
Roundness	0.71	0.62
Sphericity	0.72	0.71

Table 4
Crush resistance quartz sand

Stress on sand	Location I, % wt fines	Location II, % wt fines
1500 psi	20/40	20/40
3000 psi	0.575	2.375
4000 psi	15.175	12.9

Table 5
Acid solubility of quartz sand

	Location I	Location II
Acid solubility, heavy %	0.32	0.26

3. Crush resistance, is sand endure capacity toward surface pressure on sand, result at the Table 4.

Sand with existing processing still not yet fulfill API prerequirement, every grain sand in sight cracked line which if incurred by sufficient pressure the sand will break. In a good composition of grain size possibility to improve the problem, because crush resistance effected by grain size.

4. Acid solubility, is heavy percent solubility sand on mixture acid solubility HCI and HF with consederation 12 : 3 during one hour, Table 5;

Figure 5
Grain shape processing sand with size 20/40 of Location I

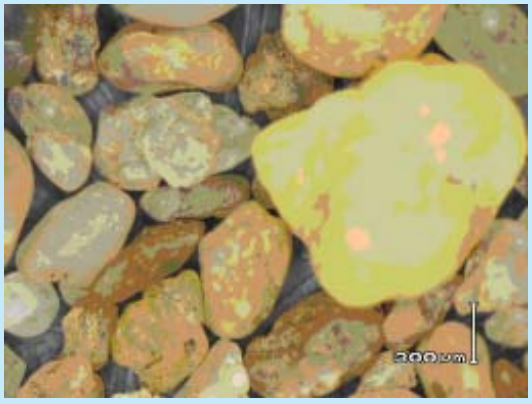

Figure 6
Raw material of Location II

5. Turbidity, all sand industry processing in Bangka Island have earned to wash the fickle, proven by means of turbidity experiment result : Location I : 60 FTU and Location II : 70 FTU.
6. Conductivity is permeability which made by sand along the crack, laboratory test appliance analysis only can give the maximum pressure closure 1710 psi.

From the table and curve, sand with measure 20/40 relatively not change, not permeability derivation at high pressure closure (1710 psi) and at this temperature increase appropriate sand ability in crush resistance. *Notice* : Pressure gradient of crack approximately 0.6 - 0.8 psi/ft and gradient of formation fluid 0.45 psi/ft. Then overbourden pressure will acceptance by proppant about 0.15 - 0.35 psi/ft. From total dissolved proppant can be visible the quartz sand Bangka Island can detain 2000 psi pressure. Therefore the proppant able to weared for well with deepness 5,714.28 ft or 1,904.76 metre.

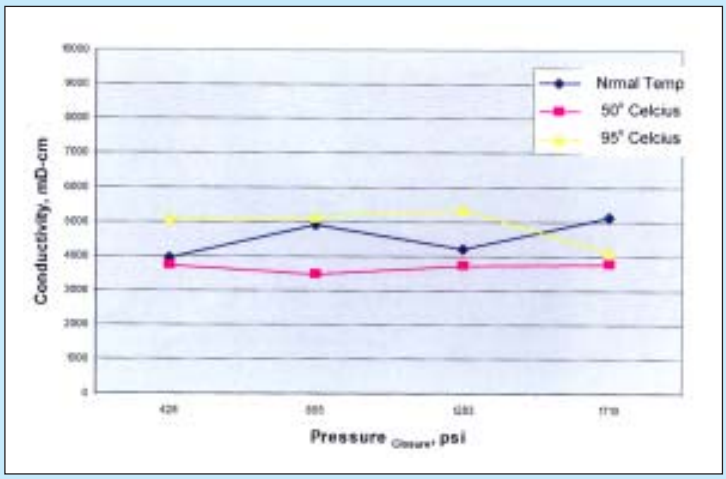

Figure 7
Conductivity on constant rate chart curve, sample 20/40

VII. TO INCREASE LOCAL CONTENT

Mining of industrial minerals/construction material at some regions disposed to less about environment watch. In means avoiding environment damage and optimally benefit the potential by using for necessity of upstream oil and gas activities, this step also for means to push domestic product and to increase local content. As the first step still needed focused implementation ;

a. To make available requirement of raw material appropriate with exploration and exploitation of oil and gas requirement. Generally, the industrial minerals in some regions can be purpose for oil and gas activities support.
b. To improve the price of success and added value, for example claystone as construction material but by processing be obtained as mud logging or propping agent.
c. To increase effectual and efficiently for raw material available in Indonesia conducted to process, the subtitute import product and increased its local content materials.
d. In means increase competitive product, pushedly non oil and gas commodity and keep improvement competitive.
d. Effort for participation all party, include national entrepreneur/investor of industrial minerals to support oil and gas upstream activities requirement.
f. Increase to handles environment problems.
g. Willingness of mineworker and local government earnstness.

More important matter its pushed to develop of innovations industrial material profit which available around oil and gas activities, by means fulfill requirements of oil and gas industry while still importing.

VIII. CONCLUSIONS

Bentonite in order to reach prerequirement as appropriate mud logging standard specification needed activation to be Na-bentonite until increased reology characteristic from the mineral suspension with polymer addition. Meanwhile, the industrial quartz sand developed as gravel packing and propping agent, more progressive with quartz sand processing and mining activity existence in Bangka. Analysis of silica sand, average content of SiO_2 above 90% up to standard, from API RP 56 and RP 61 rules and regulations analysis the quartz sand has not yet up to prerequirement. For quality improvement can the increasing number of resistance and in general the quartz sand Bangka Island can be used in well deepness up to 2,000 metre.

The special effort all people work to help for optimization of environmental control using industrial minerals for upstream oil and gas activities, specifically for oil and gas drilling which still import, those to created a better environment manage and increase added value for community and local government. All has envolved into an integrated minerals and oil and gas company with a significant share of the Indonesian or domestic products.

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