● PART III Detailed Discussions

1 Survey Results on Demand for Ceramic Products and the Use of Raw Materials

1.1 Ceramic Production: Estimation of Raw Material Demand

There is no statistics to allow the accurate understanding of demand for ceramic products and raw materials in Indonesia. In this section, demand for ceramic raw materials is estimated on the basis of MOIT's data and in consideration to information obtained during the field survey visiting the related industries.

As a result, principal body materials used for production of floor and wall tiles, sanitary ware, and tableware in 1995 are estimated as: 1) 1,166,000 tons of clay, 2) 702,000 tons of feldspar, and 3) 350,000 tons of kaolin.

1.1.1 Estimation process of ceramic raw material demand

(1) Basic data

Table 1-1 shows estimated demand for ceramic products in the five-year plan between 1994 and 1998, estimated actual consumption in 1994 and 1995, and demand outlook for 1996. The plan's figures and estimated consumption data were furnished by MOIT, and the 1996 outlook is based on ASAKI's data (ASAKI's estimated consumption data in 1994 and 1995 seem to use MOIT's data). The consumption estimates appear to be based on hearing from manufacturers and other sources, although no basis of estimation is indicated.

Estimated consumption data up to 1993 shown in the Table are based on MOIT's data published in 1995, with different sources from data in subsequent years.

"Industrial Statistics" are only one formal statistics on industrial production and tabulate production volumes and values by individual product item. From data on household wares made of porcelain (Code No.36111), tableware production is estimated at 105,385,000 pieces (some data are indicated in the number of sets and are converted to pieces at a rate of 1 set = 6 pieces). The figure generally agrees with MOIT's estimates. Similarly, production of ceramic floor tiles and porcelain floor tiles was estimated from Code No.36112 "Structural materials made of porcelain," totaling 46,270,000 m^2. This figure agrees with MOIT's estimates.

It should be noted that there is a large gap in floor tile and tableware production between MOIT's 1993 data and the plan's figures and estimated production. According to ASAKI, however, the latter data were estimated on the basis of estimates by the industries and information from production equipment manufacturers, suggesting that

they are relatively reliable. Thus, these data are used as the basis of estimation here.

Note that industrial statistics contain few data on sanitary ware production. Thus, the above MOIT's data are used.

As for novelty products, most of data are collected in the number of pieces and products vary greatly in size, while there is no method to estimate their weight from these data. Besides, novelty production seems to be fairly small compared to other products, so that no novelty data are included in this estimation.

(2) Demand estimation process

The basic production data are indicated in m^3 and pcs. They are multiplied by respective weight conversion factors shown in Table 1-2 to estimate production on a weight basis (Table 1-3). The weight conversion factors are estimated from ASAKI's estimates and the results of the hearing survey.

Then, raw material consumption is assumed to be equivalent to production of final products in weight basis. Theoretically, raw materials lose their weight after the firing process due to water evaporation, firing loss, and production yield. At the same time, some weight gains occur due to the addition of glaze, as well as recycled materials used in tile production. In this study, these weight loss and gain are assumed to be roughly equal.

Table 1-4 estimates production of final products (or consumption of raw materials) by region. In fact, there is no official production data on ceramic products by region. Thus, these data are estimated from regional share of production capacity which is estimated from MOIT's factory list (Tables 1-5, 1-6, and 1-7).

Then, consumption of raw materials (namely production of ceramic products) is multiplied by their proportional share in use to estimate raw material consumption by region (Table 1-8). The proportional share is based on data obtained from the interview survey for private enterprises and with reference to estimation by Mr. Robert Unaya of ASAKI (Table 1-9).

1.1.2 Estimated raw material demand

The floor and wall tile subsector is the largest consumer of ceramic raw materials. It accounts for approximately 85% of total clay consumption and 80% of feldspar consumption. The second largest subsector is tableware which accounts for 13% of clay

consumption and 19% of feldspar use.

1.2 Consumption Pattern of Ceramic Raw Materials

1.2.1 Tile materials

Most of tiles currently produced in Indonesia are floor and wall tiles, at a ratio of 70:30 according to ASAKI's data. In addition, mosaic tiles are produced in small quantities.

Specifications for raw materials vary among manufacturers who give different definitions for floor and wall tiles. For instance, a major difference between floor and wall tiles is found in coefficient of water absorption, 3-6% for floor tiles and 6-10% for wall tiles. However, some manufacturers define the coefficient of water absorption at 17% for both tiles, thus using the same materials. For them the difference between floor and wall tiles is external design. In some cases, floor tiles are defined as red body, and wall tiles as white body.

Consumption patterns of raw materials by tile manufacturers and purchase prices are summarized in Tables 1-10 through 1-12.

Generally, tile manufacturers use low cost materials. For instance, tableware manufacturers use clays priced at Rp.80/kg, whereas tile manufacturers Rp.35/kg. Tile manufacturers are not sensitive to color as products are covered with glaze. Most of tile manufacturers have their own blending facilities to use raw materials from different sources, including low-grade materials. Thus, they mostly expect the assurance of stable quality from the ceramic raw material development plan.

(1) Floor tiles

Major constituents of floor tiles are low-alkali contents of feldspar and clay. Composition of raw materials, although varying among manufacturers, is 1) 32-52% feldspar, 2) 58-48% clay, 3) 0-10% silica, and 4) 0-5% kaolin. The average composition for all the tile manufacturers is 1) 44-45% feldspar, 2) 53-55% clay, 3) 2% silica, and 4) 1% kaolin. Clay and feldspar used are tuff-based with high contents of impurities and are produced in Java.

(2) Wall tiles

Today, agalmatolite is rarely used in wall tile production, and instead, feldspar, clay, and limestone are used. Clay, kaolin, and silica in Belitung, because of relatively low iron contents, are used. According to ASAKI's data, composition of raw materials is 1) 7% feldspar (Rp.60/kg), 2) 45% clay (Rp.35/kg), 3) 10% kaolin (Rp.100/kg), 4) 15%

limestone (Rp.40/kg), 5) 20% silica (Rp.125/kg), and 6) 3% others.

(3) Mosaic tiles

There is only one mosaic tile manufacturer in Indonesia, which consumes 6,000 tons of raw materials annually. Two materials, feldspar produced in Blitar and clay in Rembang, are used at a ratio of 70:30.

1.2.2 Sanitary ware materials

Sanitary ware manufacturers in Indonesia are divided into large enterprises focusing on production of high-grade products, and small enterprises specialized in manufacture of toilets for the domestic market. Some tile manufacturers have previously produced sanitary ware, but with increasing tile demand, they have terminated sanitary ware production. Manufacturers of toilets for the domestic market use only locally available materials. However, production of high-grade products, large in size and complex in shape, involves strict requirements for slip's moldability that cannot be satisfied by local materials, so that between 50 to 60% of imported materials are used.

Tables 1-13 through 1-15 summarize specifications for sanitary ware materials. Among raw materials, 20% of feldspar, 60% of clay, and 100% of toseki are imported. While some manufacturers show interest in development of local resources, such as high-grade feldspar and ball clay, and sericite-based toseki in West Java, others have little expectation on domestic materials. The lack of expectation on domestic materials can be interpreted as the lack of confidence in quality control efforts by domestic material suppliers, rather than grade of existing materials.

1.2.3 Tableware materials

As already indicated, Table 1-13 through 1-15 summarize specifications for tableware materials. According to ASAKI, blending proportions of tableware materials are 1) 25% feldspar, 2) 25% clay, 3) 30% kaolin, and 4) 20% silica.

Manufacturers of medium-grade products want commercial availability of high-quality feldspar. On the other hand, manufacturers of high-grade products demand commercial development of high-grade ball clay and kaolin with low iron and titan contents and has expectation for use of ball clay if development of ball clay resources is undertaken in Kalimantan.

Recently, Japanese and European porcelain manufacturers show strong interest in production in Indonesia and various plans are in progress. Although they will mostly use imported raw materials, the shift to local materials is conceivable if high-grade feldspar and ball clay sources are developed. As indicated in evaluation of the Banjarnegara feldspar benefitiation project, the current level of demand does not support commercial production. As foreign manufacturers start production in the country to create larger demand for high-grade feldspar, the project will become worth consideration.

1.2.4 Materials for small novelties products and artwork

In Indonesia, there are various areas that accommodate a group of small ceramic manufacturers, including Malang, Plered, Kiara Condong, and Bali, where different types of products are manufactured. Among these clusters, government organizations in Malang and Plered supply premixed body to manufacturers in respective communities according to the type of product. In Plered, specialized body suppliers are emerging to meet growing demand.

Tables 1-16 and 1-17 show raw material consumption patterns of small-scale art ware manufacturers.

Table 1-1 Projected and Estimated Production of Ceramic Products in Volume

	Estimated actual					Projected/ Estimated					Projected			
	1989	1990	1991	1992	1993	1994	1995	% growth	1996	% growth	1997	% growth	1998	% growth
Floor/wall tile ('000 m^2)														
Plan *1)						107,051	128,243	20	153,640	20	184,077	20	220,557	20
Realization *1)						105,000	140,000	33						
Estimated (1) *2)									170,000	33				
Estimated (2) *3)	30,942	32,180	37,255	40,921	45,198									
Sanitary ware ('000 pcs.)														
Plan *1)						2,721	3,134	15	3,608	15	4,155	15	4,785	15
Realization *1)						1,800	2,500	39						
Estimated (1) *2)									2,750	39				
Estimated (2) *3)	1,647	1,898	2,183	2,510	2,887									
Roof tile ('000 pcs.)														
Plan *1)						45,936	50,530	10	55,583	10	61,141	10	67,255	10
Realization *1)						50,000	80,000	60						
Estimated (1) *2)									100,000	60				
Estimated (2) *3)	24,377	25,300	26,500	33,038	41,760									
Tableware ('000 pcs.)														
Plan *1)						773,434	840,476	9	1,025,229	22	1,180,030	15	1,358,609	15
Realization *1)						400,000	600,000	50						
Estimated (1) *2)									800,000	9				
Estimated (2) *3)	56,064	71,964	84,156	96,588	106,896									

Sources: *1) Ir. I.B. Agra Kusuma, "Pola Pengembangan Industri Keramik Nasional Dalam Nasional PELITA VI"
(1996: Paper for Seminar on Ceramic Industry in Indonesia)
*2) Ir. Robert Unaya, "Permasalahan Bahan Mentah Keramik di Indonesia" (1996: Paper for Seminar on Ceramic Indsustry in Indonesia)
*3) MOI, "Industri Keramik, 1995"

Table 1-2 Conversion Factor of each Ceramic Products in Weight

Source / Products	ASAKI[1)]	Field Survey[2)]	Assumption by Study Team[3)]
Floor/wall tile	14.9 kg/m^2	13.5 - 25 kg/m^2	*1) 14.9 kg/m^2
Sanitary	-	0.21 - 68 kg/piece	*2) 24.5 kg/piece
Roof tile	5 kg/piece	3.2 kg/piece	*3) 3.2 kg/piece
Tableware	0.5 kg/piece	0.2 - 2.4 kg/piece	*4) 0.68 kg/piece
Novelties	-	0.2 - 30 kg/piece	*5) 4.31 kg/piece

Notes: *1) Based on ASAKI's estimate. Results by the Study Team as follows:

Company	10 x 20cm	20 x 20cm	30 x 30cm	40 x 40cm
A	14.0kg	13.5kg	16.0kg	-
B	-	-	17.1kg	18.7kg
C	14.0kg	25.0kg	-	-

*2) Weight per piece of western style toilet.

*3) Estimated by the Study Team based field survey.

*4), 5) Weight per piece calculated based on production volume and quality from industry statistics.

Sources: 1) Robert Unaya, "Permasalahan Bahan Mentah Keramik Di Indonesia" (1996:Paper for Seminar on Ceramic Industry in Indonesia)

2) Based on field survey by the Study Team.

3) Based on field survey by the Study Team (Weight range from minimum to maximum).

Table 1-3 Domestic Production of Ceramic Products in Ton

Products \ Year	1994	1995	1996	1997	1998
Floor/wall tile					
Plan	1,595,000	1,911,000	2,289,000	2,743,000	3,286,000
Estimated	1,565,000	2,086,000	2,533,000	-	-
Sanitary					
Plan	67,000	77,000	88,000	102,000	117,000
Estimated	44,000	61,000	67,000	-	-
Roof tile					
Plan	147,000	162,000	178,000	196,000	215,000
Estimated	160,000	256,000	320,000	-	-
Tableware					
Plan	526,000	572,000	697,000	802,000	924,000
Estimated	272,000	408,000	544,000	-	-

Note: Converted figures using the conversion factors estimated by the Study Team

Source: Table1-1

Table 1-4 Production of Ceramic Products by Region in Ton

(Unit: ton)

	1995				1998			
	Floor/wall tile	Sanitary Ware	Roof tile	Tableware	Floor/wall tile	Sanitary Ware	Roof tile	Tableware
Total	1,911,000	77,000	162,000	572,000	3,286,000	117,000	215,000	924,000
Estimated Breakdown of Production by Region:								
Jakarta	69,000	7,000	0	8,000	118,000	11,000	0	13,000
West Java	936,000	45,000	135,000	275,000	1,610,000	69,000	179,000	444,000
Central Java	0	13,000	0	40,000	0	20,000	0	65,000
East Java	688,000	12000	27,000	69,000	1,183,000	18,000	36,000	111,000
Bali/Riau	2,000	0	0	177,000	3,000	0	0	286,000
South Sumatra	57,000	0	0	0	99,000	0	0	0
West Kalimantan	34,000	0	0	3,000	59,000	0	0	6,000
South Kalimantan	124,000	0	0	0	214,000	0	0	0

Source: Estimate by the Study Team

Table 1-5 Capacity of Floor/Wall Tile Manufacturers by Region (1994)

No.	Company	Location	Production Capacity (In m^2)	Production Capacity (In Ton)	Number of Employees
Country Total			226,785,000	3,176,000	23,000
Jakarta					
1	A	Jakarta	2,244,000	31,416	460
2	B	Jakarta	4,500,000	63,000	1143
3	C	Jakarta	240,000	3,360	105
4	D	Jakarta	36,000	504	128
5	E	Jakarta	1,200,000	16,800	152
Jakarta Total			8,220,000	115,000	1,988
Regional Capacity/Country (%)				3.6	
West Java					
1	A	Tangerang	265,000	3,710	254
2	B	Tangerang	6,160,000	86,240	1502
3	C	Tangerang	13,240,000	185,360	854
4	D	Tangerang	3,600	50	
5	E	Tangerang	4,000,000	56,000	364
6	F	Tangerang	2,100,000	29,400	302
7	G	Tangerang	12,000,000	168,000	318
8	H	Tangerang	1,700,000	23,800	352
9	I	Bogor	720,000	10,080	69
10	J	Bogor	1,220,000	17,080	473
11	K	Bogor	320,000	4,480	195
12	L	Bogor	2,100,000	29,400	396
13	M	Bogor	3,900,000	54,600	84
14	N	Bogor	1,800,000	25,200	198
15	O	Cikarang	2,750,000	38,500	375
16	P	Bekasi	8,500,000	119,000	853
17	Q	Bekasi	7,500,000	105,000	576
18	R	Bekasi	2,000,000	28,000	404
19	S	Cirebon	185,000	2,590	192
20	T	Padalarang	600,000	8,400	341
21	U	Indramayu	1,600,000	22,400	135
22	V	Serang	4,250,000	59,500	535
23	W	Majalengka	3,600,000	50,400	600
24	X	Bogor	1,000,000	14,000	234
25	Y	Serang	2,184,000	30,576	210
26	Z	Karawang	7,220,000	101,080	482
27	AA	Seran	600,000	8,400	102
28	BB	Cirebong	10,266,000	143,724	555
29	CC	Tangerang	2,880,000	40,320	402
30	DD	Tangerang	2,160,000	30,240	152
31	EE	Serang	4,368,000	61,152	310
West Java Total			111,191,600	1,557,000	11,819
Regional Capacity/Country (%)				49	
East Java					
1	A	Gresik	2,000,000	28,000	355
2	B	Gresik	32,000,000	448,000	936
3	C	Gresik	1,080,000	15,120	152
4	D	Gresik	2,220,000	31,080	310
5	E	Tulungagung	578,000	8,092	595
6	F	Tulungagung	3,770,000	52,780	787
7	G	Sidoarjo	110,000	1,540	255
8	H	Sidoarjo	35,009,999	490,140	2691
9	I	Sidoarjo	1,080,000	15,120	252
10	J	Sidoarjo	250,000	3,500	115
11	K	Surabaya	1,588,000	22,232	1514
12	L	Surabaya	600,000	8,400	
13	M	Malang	1,400,000	19,600	426
East Java Total			81,685,999	1,144,000	8,388
Regional Capacity/Country (%)				36	
Riau					
1	A	P. Batam	320,000	4,480	54
Riau Total			320,000	4,000	54
Regional Capacity/Country (%)				0.1	
South Sumatra					
1	A	Tanjung Pandan	6,700,000	93,800	
South Sumatra Total			6,700,000	94,000	
Regional Capacity/Country (%)				3	
West Kalimantan					
1	A	Pontianak	1,800,000	25,200	335
2	B	Pontianak	2,327,000	32,578	381
West Kalimantan Total			4,127,000	58,000	716
Regional Capacity/Country (%)				1.8	
South Kalimantan					
1	A	Banjar	14,540,000	203,560	48
South Kalimantan Total			14,540,000	204,000	
Regional Capacity/Country (%)				6.5	

Source: Ministry of Industry

Table 1-6 Capacity of Sanitary ware Manufacturers by Region (1994)

No.	Company	Location	Production Capacity (in m^2)	Production Capacity (in Ton)	Number of employees
Country Total			2,640,000	65,000	1,902
Jakarta					
1	A	Cengkareng	240,000	5,880	150
	Jakarta Total		240,000	5,880	150
	Regional Capacity/Country (%)			9	
West Java					
1	A	Bogor	650,000	15,925	753
2	B	Tangerang	360,000	8,820	662
3	C	Tangerang	300,000	7,350	
4	D	Bekasi	250,000	6,125	
	West Java Total		1,560,000	38,220	1,415
	Regional Capacity/Country (%)			59	
Central Java					
1	A	Semarang	120,000	2,940	337
2	B	Semarang	325,000	7,963	
	Central Java Total		445,000	10,903	337
	Regional Capacity/Country (%)			17	
East Java					
1	A	Sidoarjo	3,450	85	32
2	B	Malang	91,482	2,241	76
3	C	Tulungagung	300,000	7,350	
	East Java Total		394,932	9,676	108
	Regional Capacity/Country (%)			15	

Source: Ministry of Industry

Table 1-7 Capacity of Tableware Manufacturers by Region (1994)

No.	Company	Production Capacity (in m^2)	Production Capacity (in Ton)
Country Total		750,508,000	510,345
Jakarta			
1	A	3,240,000	2,203
2	B	7,000,000	4,760
Jakarta Total		10,240,000	6,963
Regional Capacity/Country (%)			1.4
West Java			
1	A	10,800,000	7,344
2	B	1,200,000	816
3	C	39,900,000	27,132
4	D	7,448,000	5,065
5	E	6,968,000	4,738
6	F	31,500,000	21,420
7	G	1,200,000	816
8	H	144,000	98
9	I	4,200,000	2,856
10	J	8,000,000	5,440
11	K	38,050,000	25,874
12	L	12,000,000	8,160
13	M	5,000,000	3,400
14	N	144,000,000	97,920
15	O	19,350,000	13,158
16	P	400,000	272
17	Q	24,000,000	16,320
18	R	990,000	673
19	S	2,000,000	1,360
20	T	540,000	367
21	U	6,024,000	4,096
West Java Total		363,714,000	247,326
Regional Capacity/Country (%)			48
Central Java			
1	A	24,000,000	16,320
2	B	25,950,000	17,646
Central Java Total		49,950,000	33,966
Regional Capacity/Country (%)			7
East Java			
1	A	7,500,000	5,100
2	B	6,000,000	4,080
3	C	10,000,000	6,800
4	D	24,000,000	16,320
5	E	14,556,000	9,898
6	F	1,200,000	816
7	G	25,000,000	17,000
East Java Total		88,256,000	60,014
Regional Capacity/Country (%)			12
Bali			
1	A	23,400,000	15,912
Bali Total		234,000,000	159,120
Regional Capacity/Country (%)			31
West Kalimantan			
1	A	4,348,000	2,957
West Kalimantan Total		4,348,000	2,957
Regional Capacity/Country (%)			6

Source: Ministry of Industry

Table 1-8 Consumption of Ceramic Raw Materials by Product and Region in Ton

	1995			1998		
	Floor/wall Tile	Sanitary ware	Tableware	Floor/wall Tile	Sanitary ware	Tableware
Clay Total*1)	**1,039,000**	**23,000**	**143,000**	**1,788,000**	**35,000**	**231,000**
Jakarta	37,000	2,000	2,000	64,000	3,000	3,000
West Java	509,000	14,000	69,000	876,000	21,000	111,000
Central Java	0	4,000	10,000	0	6,000	16,000
East Java	374,000	3,000	17,000	644,000	5,000	28,000
Bali/Riau	1,000	0	44,000	2,000	0	72,000
South Sumatra	31,000	0	0	54,000	0	0
West Kalimantan	19,000	0	1,000	32,000	0	1,000
South Kalimantan	68,000	0	0	116,000	0	0
Feldspar Total*1)	**602,000**	**12,000**	**143,000**	**1,035,000**	**18,000**	**231,000**
Jakarta	22,000	1,000	2,000	37,000	2,000	3,000
West Java	295,000	7,000	69,000	507,000	11,000	111,000
Central Java	0	2,000	10,000	0	3,000	16,000
East Java	217,000	2,000	17,000	373,000	3,000	28,000
Bali/Riau	1,000	0	44,000	1,000	0	72,000
South Sumatra	18,000	0	0	31,000	0	0
West Kalimantan	11,000	0	1,000	19,000	0	1,000
South Kalimantan	39,000	0	0	67,000	0	0
Kaolin Total*1)	**57,000**	**23,000**	**171,000**	**99,000**	**35,000**	**277,000**
Jakarta	2,000	2,000	2,000	4,000	3,000	4,000
West Java	28,000	14,000	82,000	49,000	21,000	133,000
Central Java	0	4,000	12,000	0	6,000	19,000
East Java	21,000	3,000	21,000	36,000	5,000	33,000
Bali/Riau	100	0	53,000	100	0	86,000
South Sumatra	2,000	0	0	3,000	0	0
West Kalimantan	1,000	0	1,000	2,000	0	2,000
South Kalimantan	4,000	0	0	6,000	0	0

Note: Sum of number of manufacturing companies do not match to the actual number announced from MOI due to rounding.

Table 1-9 Conversion Factor in Percentage[*1)]

Unit: (%)

Source / Raw Material	ASAKI[*2)]	Field Survey[*3)]	Assumption by Study Team[*4)]
Floor/wall tile			
Clay	45.0-55.0	30.0-76.0	52.0[*5)]
Feldspar	7.0-30.0	7.0-70.0	29.0[*6)]
Kaolin	10.0	5.0	8.0[*7)]
Sanitary			
Clay	30.0	24.0-36.0	30.0[*8)]
Feldspar	15.0	14.0-38.0	21.0[*9)]
Kaolin	30	26.0-41.0	34.0[*10)]
Roof tile			
Clay	99.0	-	99.0[*11)]
Feldspar	-	-	0
Kaolin	-	-	0
Tableware			
Clay	25.0	27.0	26.0[*12)]
Feldspar	25.0	21.0	23.0[*13)]
Kaolin	30.0	31.0	30.0[*14)]

Sources: *1) Ratio for use of each raw material to total use of raw material in each ceramic product.

*2) Ir. Robert Unaya, "Permasalahan Bahan Mentah Keramik Di Indonesia" (1996: Paper for Seminar on Ceramic Industry in Indonesia)

*3) Based on field interview by the Study Team.

*4) Estimated by the Study Team based on *1) and *2).
Bases of estimation as follows:
*5) and *6) are average of med-range value of ASAKI and numbers collected during the survey. *7), *12), *13) are average.
*8),*9),*10) are average of med-range value of ASAKI and numbers collected during the survey.

Table 1-10 Specifications of Raw Material (Floor/Wall tile)

Raw material and source	Factory	U-1	U-2	U-3	U-4	U-5	U-6	U-7	U-8	U-9	U-10	ASAKI*1)
	Location	Tangerang W.J.	Tangerang W.J.	Belitung	Malang C.J.	Malang C.J.	Jakarta W.J.	Gresik E.J.	Tangerang W.J.	Tangerang W.J.	Bandung C.J.	
	Products	Floor	F/W	Wall	Mosaic	Floor	F/W	Floor	Floor	F/W	F/W	F/W
Feldspar	Sukabumi	◎ 31	◎									
	Blitar				⊗	⊗						
	Banjarnegara						◎ 50			○ Average.60		
	Cipanus						◎ 32				◎ 55	
	Cikalenga											
	Lampung									○ Average.60		
	Lankasbit									○ Average.60		
	Not Announced							38	◎			◎ 50
Kaolin	Belitung		○	○ 200							○	
Clay	Sukabumi	⊗ 30	⊗				⊗ 28		◎	⊗ 35	◎ 35	
	Belitung			◎ 23			◎ 51		○			
	Rembang				◎							
	South Malang					⊗						
	Leuwilang						○ Own site					
	Parungpanjang								○	○ 53		
	Belitung											
	Not Available							27.5				◎ 35
White Clay (Sericite)	Belitung	○		◎ 10			○ 41					○
Silica Sand	Kalimantan		○									
Toseki (Pyrophyllite)	Argomulyo			◎ 90								
Lime	Padarang (Bandung)						○ 35				◎ 40	

Notes: *1) Informations obtained during the seminar on ceramic industry in Indonesia.

◎: Major material ○: Less used material ×: Problems commented

Figures: Price Rp/kg

Source: Informations obtained by Study Team through the field survey.

Table 1-11 Ratio of Raw Material Use in Percent (Floor/Wall tile)

(Unit: % of total)

Factory	U-1	U-2	U-3	U-4	U-5	U-6	U-7	U-8	U-9	U-10	Robert[*3)]	Robert[*3)]
Location	Tangerang W.J.	Tangerang W.J.	Belitung	Malang C.J.	Malang C.J.	Jakarta W.J.	Gresik E.J.	Tangerang W.J.	Tangerang W.J.	Bandung W.J.		
Products / Raw Material	Floor	F/W	Wall	Mosaic	Floor	F/W	Floor	Floor	Floor	F/W[*2)]	Wall	Floor
Feldspar	52	39		70	48	35	46		40	17	7	32
Clay	48	44	44	30	52	60[*1)]	54		55	76	46	58
Kaolin		5	5						5		10	
Silica Sand		12	23								21	10
Lime						5				7	16	
Toseki (Pyrophyllite)			24									
Sericite Clay			4									
Total	100	100	100	100	100	100	100		100	100	100	100

Notes: *1): Belitung 26%, Sukabumi 34%

*2): Water abosrption:17%

*3): Source: Ir. Robert Unaya, ASAKI

U-3: Firing temperature Wall tile: 1,200℃ ,Traditional Wall tile

U-4: Mosaic tile, water absorption 0%, Firing temperature: 1,290℃

U-10: Firing temperature: 990℃, Firing temperature during glazing process: 1,060℃, Water absorption: 17%

U-6: Producing floor and Wall tiles. Mixing ratio of raw materials are not announced. 26% use of Belitung clay considered as special case.

Source: Informations obtained by Study Team through the field survey

Table 1-12 Annual Consumption of Raw Material in Volume in Ton (Floor/Wall tile)

Raw Material	Source	U-1	U-2	U-3	U-4	U-5	U-6	U-7	U-8	U-9	U-10
Factory		U-1	U-2	U-3	U-4	U-5	U-6	U-7	U-8	U-9	U-10
Location		Tangerang W.J.	Tangerang W.J.	Belitung W.J.	Malang C.J.	Malang W.J.	Jakarta W.J.	Gresik E.J.	Tangerang W.J.	Tangerang W.J.	Bandung W.J.
Products		Floor	F/W	Wall	Mosaic	Floor	F/W	Floor	Floor	Floor	F/W
Feldspar	Sukabumi	80,000	51,000								
	Blitar				4,200	20,100					
	Banjarnegara						45,000				
	Cipanus						30,000				
	Cikalenga										3,240
	Lampung										
	Lankasbit										
	Not Announced							35,000	20,000	50,000	
Kaolin	Belitung		7,000	1,400						6,250	
Clay	Sukabumi	75,000	58,000				60,000		150,000	67,500	14,400
	Belitung			13,000			54,000				
	Rembang				1,800						
	South Malang					22,500					
	Leuwilang						15,000				
	Parungpanjang										
	Not Available							41,000			
	Belitung										
White Clay	Belitung			1,100							
Silica Sand	Kalimantan		15,000								
Silica Sand	Belitung			7,000							
Toseki (Pyrohyllite)	Argomulyo			7,200							
Lime	Bandung						9,600				1,320
Total	ton/year	155,000	131,000	29,700	6,000	42,600	213,600	76,000	170,000	123,750	18,960

Source: Informations obtained by Study Team through the field survey

Table 1-13 Specifications of Raw Material Sanitary ware and Tableware

Raw Material / Source	Factory	S-1	S-2	S-3	R-S	T-1	T-2	T-3	T-4	R-T
	Location	W.J.	C.J.	W.J.		W.J.	W.J.	C.J.	W.J.	
	Quality of Products	High	Low	High		Medium	Medium	Low	Medium	
Feldspar	Jepara			◎						
	Lodoyo	⊗		◎ 70						
	Banjarnegara		◎					◎ 35		
	Lampung					◎ 70			◎ 120	◎ 200
	India					⊗ 200				
	Australia	◎ 220								
	Malaysia			◎						
	Not Available				◎ 200					
Kaolin	Belitung		◎ 185			◎	◎	◎ 156	◎ 70	
	Bangka	⊗ 200						◎ 100		
	U.K.	◎ 200								
	Not Available				◎ 100					
Clay	Kalimantan	◎ 100								
	Belitung					◎		◎ 74		◎ 80
	Tubang		○ 40							
	Parungpanjang					⊗ 57	◎			
	Not Available				◎ 125					
Ball Clay	U.K.	◎ 300		◎						
	Thailand			◎						
Silica Sand	Belitung	60	◎ 75			◎	◎	◎ 64	◎ 100	
	Bangka									◎ 125
Toseki (Sericite)	Malaysia	◎ 300								
	Not Available				◎ 450					

Notes: S: Sanitary ware
T: Tableware
◎ :Major material
○ :Less-used raw material
⊗ :Problems commented
Numbers: Price Rp/kg
R-S: Based on information from ASAKI (Sanitary ware)
R-T: Based on information from ASAKI

Source: Informations obtained by Study Team through the field survey

Table 1-14 Annual Consumption of Raw Material (Volume in Ton) (Sanitary ware and Tableware)

Raw Material	Source	Factory	S-1	S-2	S-3	R-S*	T-1	T-2	T-3	T-4	R-T*
		Location	W.J.	C.J.	W.J.		W.J.	W.J.	C.J.	W.J.	
		Quality of Products	High	Low	High	Not available	Medium	Medium	Low	Medium	Not available
Feldspar	Jepara				2,600						
	Lodoyo										
	Banjarnegara			210					4,600	15	
	–					(10,312)					(100,000)
	India						480				
	Australia		3,200								
	Malaysia				2,600			2,000			
Kaolin	Belitung			300	3,600		720	5,500	1,600	60 – 70	
	Bangka		7,500								
	U.K.					(20,625)					(120,000)
Clay	Kalimantan		1,500								
	Belitung						550		4,800		
	Tubang			35							
	Parungpanjang						80				
	–					(20,625)					(100,000)
Ball Clay	U.K. Thailand		3,800		4,900						
	Parungpanjang							5,000			80,000
Silica Sand	Belitung		500	180	?			5,000	1,300	10	
	Bangka						480				
Toseki (Sericite)	Malaysia		6,000								
	–					(17,187)					
Total Consumption / year			22,500	725	13,700	(68,749)	2,310	7,500	12,300		(400,000)

Note: * Consumption of R-S, R-T are estimated based on annual production of the country

Source: Informations obtained by Study Team through the field survey

Table 1-15 Ratio of Raw Material Use in Percent (Sanitary ware and Tableware)

Factory / Location / Quality of Raw Material	S-1	S-2	S-3	R-S *2)	T-1	T-2	T-3	T-4	R-T *2)
Location	W.J.	C.J.	W.J.	Not Available	W.J.	W.J.	W.J.	Not Available	
Quality of Raw Material	High	Low	High		Medium	Medium	Low	Medium	
Feldspar	14	29	38	15	21	11	37	16	25
Clay	24	5	36	30	27	29	39		25
Kaolin	33	41	26	30	31	31	13	74	30
Toseki (Sericite)	27			25					
Silica Sand	2	25	? *1)		21	29	11	10	20
Total	100	100	100	100	100	100	100	100	100

Notes: *1) No replies to the questionnaire.

*2) Information obtained from Ir. Robert Unaya, ASAKI, during the seminar on ceramic industry in Indonesia.
Information on ratio of raw material use supplied from Mr. Robert Unaya are same as S-1 shown in above chart.
It seems that some problem to identify that raw material use in sanitary ware manufacturing company.
It is not clear that the ratio of the use of raw material of R-T shown in above chart is not average ratio among tableware manufactures in the country.

Source: Informations obtained by Study Team through the field survey

Table 1-16 Summary for Ready-mix Raw Material Supplier, Small Scale Manufacturers, and Specifications of their Raw Material

Raw Material	Source / Glaze	P-1	P-2	P-3	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8
	Factory	P-1	P-2	P-3	A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-8
	Location	Malang	Malang	Plered	Banjarnegara	Malang	Cakalang	Jipang	Jipang	Jipang	Mimaffa	Bage
	Product	Ready-mix	Ready-mix	Ready-mix	Art Ware	Art Ware	Others	Novelty	–		Novelty	Table Ware
	Classification	Porcelain	Porcelain	Ceramics	–	Porcelain	Ceramics		Ceramics	Ceramics	Ceramics	Porcelain
	Number of employees	–	–	–	30	42	214	10	–	4	8	25
	Production/year (Ton)	120	480	120	50	168	18					50~60
	Production process				Man. Jigger	Casting Jigger	Molding	Molding	Jigger	Jigger	Casting Jigger	Casting Man. Jigger
	Firing temperature(° C)	1,250	1,250	900	–	1,250	900	–	700~950	700	650	1,300
Feldspar	Lodoyo	○										
	Blitar		○ 75									
	Banjarnegara	○ 70										
	Lampung											
Kaolin	Belitung	○ 185	○ 250									○ 70
	Not Available											○120
Clay	Anjer			◎								
	Tubang	○ 40										
	Rembang		○ 55									
	Citeco			○								
	Banjarnegara				○ 15							
	Alluka Go Wa								○ 50			
	Not available						○		50	○ 50	○	○
Silica Sand	Alluka Go Wa											
	Not available						○ Local	○ 100	○			○
Lime				○								
Ready Mix								○ 150	○ 450	○* Local		

Note: * Shipping ready-mix material (20 water content, 250Rp/kg)
Source: Informations obtained by Study Team through the field survey

Table 1-17 Annual Consumption of Ready-mix Raw Material Manufacturer in Ton

Raw material \ Factory / Location / Product		P-1 Malang Porcelain	P-2 Malang Porcelain	P-3 Plered Porcelain
Feldspar	Blitar		340	
	Banjarnegar	35		
Kaolin	Belitung	50	140	
Clay	Tumba	5		
	Rembang		34	
	Citeco			96
Silica Sand	Belitung	30	13	
	Tumba			12
Lime				12
Total		120	527	120

Source: Informations obtained by Study Team through the field survey

2 Ceramic Raw Material Resources and Their Evaluation View of Possibility of Mining and Supply

2.1 Overview

2.1.1 Geological features[1,2]

According to the geological map, the Plutonic phases exists in the northwestern part of Sumatra, western part of Kalimantan, Bangka and Belitung, while the volcanic rock phases runs from Sumatra to Java. From these aspects, ceramic raw materials of granites origin are expected to exist in the northwestern part of Sumatra, western part of Kalimantan, Bangka, and Belitung, and the ceramic raw materials produced in the southern part of Sumatra and Java are considered to be mainly of the volcanic phases origin. Figure 2-1 shows the structure of the earth's crust around Indonesia and Figure 2-2 shows the geology of Indonesia.

Indonesia is situated in the area where the Asian plate, the Pacific plate that moves against relatively in the direction of west-north-west and the Indian Ocean-Australian plate that moves against in the direction of north, cross with one another. Therefore, the plates subsided and collided with one another repeatedly due to the interactions between these plates, while at the same time, volcanic activities and sedimentation took place forming the complex insular are based on the fragment of the earth's crust of a continent. Accordingly, the geology of this area has the basic structure that the Pretertiary phases that forms the basis is overlaid by the Tertiary sediments and volcanic rocks and further overlaid by the Quatery sediments and volcanic rocks.

To take up the Pretertiary phases, the geology in the western half of Indonesia, that is, Sumatra, Java and the western part of Kalimantan consists of the Mesozoic/Paleozoic phases and granites piercing it, while the geology in the north-eastern part of Kalimantan and Sulawesi, that are situated on the fragment of the earth's crust of a different continent, the melanges, metamorphics and ultramafics are dominant, thus showing totally different features.

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[1] Hamilton W, "Tectonics of Indonesian Area" (translated by Mr. Kazuo Hoshino), 1978, Iwanami, p399-424, "World Geology", Geoscience Lecture 14

[2] Comprehensive Development Organization of New Energy and Industrial Technology and Japan Ceramics Association, "Report of Investigation on the Circumstances of Basic Material Resources such as Ceramic Raw Material (Thailand and Indonesia)" (1991)

2.1.2 Ceramic material survey in Indonesia

The known earliest survey on ceramic materials in Indonesia was entitled "Research on Characteristic Testing and Adjustment of Ceramic Materials" that was conducted over 5 years starting in 1976. The project was implemented by the Agency of Industrial Science and Technology, the Ministry of International Trade and Industry, under International Transfer of Industrial Technology (ITIT) Project, and was conducted in the form of joint research between the Institute for Research and Development of Ceramic Industry (IRDCRI) (Balai Besar Penelitian dan Pengembangan Industri Keramik (BBK)) under the Ministry of Industry (MOI) of Indonesia (Departemen Perindustrian (DP)) and Government Industrial Research Institute Nagoya (GIRIN). The project studied major producing areas in Sumatra, Java, and Kalimantan (west part only) in detail. In addition, it successfully discovered pottery stone resources in West Java (Talang) and East Java (Pacitan), which were an important material for the ceramic industry.

The recent survey was conducted in 1990 as part of "Comprehensive Development Planning Survey (Basic Study on Formation of Research and Development Foundation in Asian Countries)" entrusted by the MITI of Japan. It was conducted jointly by New Energy Development Organization (NEDO) and Ceramic Society of Japan, covering Thailand and Indonesia and entitled "Study on Current State of Basic Materials for Ceramic and Other Industries."

Research projects by the Indonesian government have been carried out under the leadership of the Directorate of Mineral Resources (DMR) (Direktorat Sumberdaya Mineral (DSM)) of the Department of Mines and Energy (DOME) (Departemen Pertambangan dan Energi (DPE)). The latest report entitled "Industrial Minerals in Indonesia (Bahan Galian Industri di Indonesia)" was published in 1990.

DSM, The Mineral Technology Research and Development Center (MTRDC), and BBK have jointly established a system to compile and update a data base on ceramic materials in Indonesia.

2.1.3 General description of mineral resources for ceramic materials by mineral type[3]

(1) Kaolin

Kaolin is made from weathering and decomposition of feldspar contained in granite. Kaolin deposits are divided into residual deposits as weathered and dissolved, and

[3] Latest data on raw materials under this study (kaolin, clay, feldspar, pottery stone, and agalmatolite) are shown in Table 2-1.

sedimentary deposits made in rivers after washed away from residual deposits. Residual deposits generally include color minerals, so that pure white kaolin is rarely found with relatively coarse particles. Sedimentary deposits generally have good quality due to natural water washing, and are large in quantity.

In Indonesia, kaolin is widely available in Sumatra and Kalimantan. Major producing areas are located in Bangka and Belitung. Deposit size is large, proven to total 7 million and 6 million tons. Because of good quality, it is favored by Southeastern Asian countries and Japan and has been exported from early times. Kaolin is also available in Java, but its deposits are relatively small compared to Bangka and Belitung. Deposits in Narawita and Bakom have been all exploited.

(2) Clay

Clay is produced throughout the country. In particular, clay in Java was made from weathering and decomposition of tuff-based feldspar. Since bedrock is volcanic origin, clay includes halloysite and sericite, in addition to kaolinite. Particle size is small and plasticity is large. However, high contents of color substances produce very poor color after baking. Reserves are generally large in amount.

Best known and most widely used clay sources in Indonesia are Parungpanjang and Sukabumi, but their quality is not always satisfactory. To ensure high quality clay, some companies have their own deposits and develop new sources in West Kalimantan (Monterado).

(3) Feldspar

Feldspar is classified into pegmatite-based (granite-base) feldspar and volcanic feldspar. The former is made from large crystallization differentiation of feldspar, silica stone, and mica in granite. In a good feldspar mine, feldspar and silica stone are completed separated to form a lens shape, and without inclusion of mica, to generally produce good color after firing. However, reserves are generally small and there are a limited number of production areas. Deposits in North Sumatra (Pangaribuan) are classified as granite-based feldspar and are expected to have good quality by an observation of small sample.

The latter is basically rhyolite or andesite with relatively high alkaline contents. Thus, it should be called sub-feldspar or feldspar-like material. As tuff-based feldspar, high contents of color impurities are found to result in very poor color after firing. Also, low alkaline contents increase high refractoriness. Reserves are generally very large, and production is carried out in various locations in Java to widely supply feldspar materials. Narawita and Banjarnegara feldspar is classified into this category.

(4) Agalmatolite and toseki

Agalmatolite and toseki are made from hydrothermal decomposition of tuff-based (rhyolite or andesite) feldspar. Toseki has high sericite content and agalmatolite high pyrophyllite content. Either toseki or agalmatolite is produced according to hydrothermal property (acidity or alkalinity) and temperature. Since hydrothermal solution changes in chemical composition over a long period of time, both toseki and agalmatolite are often present in a mixed form. Color impurities dissolve into hydrothermal solution to produce relatively good color after firing. However, high quality toseki or agalmatolite with high levels of purity accounts for only 10% - 20% of total. Reserves are mainly large.

Toseki and agalmatolite are widely available in Sumatra, Kalimantan, and Java. Large deposits are seen in East Java, and Pacitan is used from early times. Recently, some companies use agalmatolite in Argomulyo near Malang because of stable quality. Talang toseki in West Java had small reserves and has been fully exploited.

2.2 Resource Distribution of Individual Raw Material Mine and Evaluation from the Viewpoint of Mining and Utilization

2.2.1 Sukabumi clay

2.2.1.1 General topographic and geological features

According to the geological map (Figure 2-3), Cisaat area in Sukabumi prefecture where the deposits exist is situated close to the southern end of the middle part of quaternary volcanic products zone that extends over approx. 100km from east to west, and approx. 40km from south to north and Miocene sedimentary phases and Miocene lime stone phases lie immediately to the south. Further to the south, Miocene sedimentary phases spreads out and outcrop of Eocene stratum can be found near by. In addition, there is an area of approx. 10km in width and approx. 30km in length where a number of faults take place extends from the part to the west of Sukabumi city to the direction of south-west. Since Cisaat is situated in their peripheral region, the strata of Cisaat varies greatly. It is presumed that, given the geological feature above. Sukabumi clay resulted from the transformation of the quaternary volcanic products.

Sukabumi is located approx. 80km to the south of Jakarta and 80km to the west of Bandung. The clay mountain is called Gunung Guruh (Mountain Guruh) and is situated approx. 8km to the west from the downtown center of Sukabumi straddling over three

counties (Kecamatan Cibadak, Cisaat, and Cikembar). Topography is fairly mountainous as mountain ranges and valleys extend east and west, with mountain slopes ranging between 5 and 45 degrees (10 - 25 degrees on average). Actual quarrying sites are roughly divided into two locations, Kampung Citohet Desa Cicantayan on north and Kp.Padaraang, Desa Sirnaresmi (Gunung Guruh), Kec.Cisaat, Kab. Sukabumi on south. Sukabumi prefecture (Kabupaten Sukabumi) has many mountains over a considerably extensive area and its name is renowned as the producing areas of other raw materials for ceramics except for Gunung Guruh, a clay producing area, described here.

Express ways and paved trunk roads link Jakarta and Sukabumi, therefore, you can reach a village at the foot of the mountain in approx. 3 hours by car. From the aspect of transportation of raw materials to surrounding areas of Jakarta, the region with the largest demand in Indonesia, it is extremely favorably located (Figures 2-4, 5).

The northern excavation site is located in Cicantayan District, located along a paved road from Cisaat to Bojong near Cikembar. Quarrying sites are located on undulating mountains along the road. A few red brick factories are seen sporadically along the road, from which dirt roads run up the mountain slope to quarrying sites, and small quarrying sites are seen on the mountain or valley side of the road. In Cicantayan, there is a district office organized by surrounding four villages, and a stock pile facility for the excavated clay is 2km from the office toward Cisaat. The area is assessable to a main road which allows trucks, which constitutes a major advantage for quarrying operation. On the other hand, the mountainous terrain necessitates decentralized quarrying operations .

The southern quarrying site can be reached by using a paved main road from Sukabumi City to Cikembar and turning north on a branch road before Pangleseran you climb the unpaved mountain road for approx. 2km, for about 10 minutes. You will come to a point near the summit of a sort of a plateau that consists of several small mountains linked together. The difference in altitude with the village at the foot of the mountain is approx. 300m. From the height, a mountain having the northern quarrying site can be seen a few kilometers away on north. There are two mountain climbing road to the quarrying site and the width of the roads is secured sufficiently, and therefore, truck as large as 5-ton trucks can pass the road. In addition, of the two routes, one route is used for carrying out to the stock pile. Taking into consideration the possible slippage in the rain and the actual situation of the quarrying sites that the small scale digging spots are distributed in many places over an extensive area as is described later, 2-ton trucks are mostly used to carry out the clay to the stock pile.

2.2.1.2 Distribution of resources

See Picture 2-1. According to the DSM report, the mine site area in entire Gunung

Guruh is 500 ha, with thickness of 20m (Table 2-2). However, observation at the excavated site indicates that the deposit is a few meters thick. The quarrying site is made of three layers. The first layer is red clay without plasticity, 0.5 -3 m thick (more in some places). The second layer is made of brownish gray clay having relatively high plasticity, and its thickness varies greatly, containing silica stone or sand (sand stone) in mass. The third layer contains gray clay which is highly plastic. According to BBK's geologists, mountains at the south end of Gunung Walat are made of silica stone or sand, so that their contents increase in the south. The area containing clay deposits, as known by the Clay Mining Cooperative of Sukabumi Prefecture, is 150 ha and has estimated reserves of 10 million tons.

The current quarrying sites are located on the mountain slope (northern quarrying site) and on the height (southern), where veins are disrupted by mountain building activity. However, clay deposits suitable for large-scale development are located on the flat area, so that detailed reserve survey should be conducted for flat areas including those developed as residential or agricultural land, and a comprehensive development plan should be established in coordination with regional development.

(1) Northern quarrying site (Cicantayan area)

In the northern quarrying area, small quarrying sites are dotted along a haul road for clay transportation which runs on the mountainsides. Distribution of clay resources varies greatly from quarrying site to another. For instance, while one quarrying site produces clay with large sand content, clay-dominant materials are excavated from other quarrying site, only 50m away in distance. It is presumed that the ore vein is complicated in this area, because the clay with much different quality are reserved in such a close place. This indicates a complex structure of veins in the area and a major obstacle for large-scale development.

(2) Southern quarrying site (Padaraang area)

The quarrying field consists of the peaks of several small mountains and depressed ground between small mountains. It is not a flat land, but a ridge commanding a considerable good view extends several hundred meters. There are small rigged rock mountains (matrices) dotted here and there on the ridge, and between these rock mountains there are depressed grounds that is considered as former quarrying sites and the removed surface soil is accumulated around the depressed portions. The periphery of the current quarrying site is full of the sites being currently exploited or already exhausted. The valley across from the northern mine site, however, is still covered with trees and plants. Judging from these conditions comprehensively, there is a large

possibility that clay exists in this area including the valley between mountains. Of the total clay sedimentation of 24 ha in the area, government's exploitation license has been issued for 8 ha.

The condition the clay sediments is not in the shape of a pocket but it is presumed, from the condition of the digging parts, that it forms a deposited stratum of 10-12m in depth. It is not possible to determine the causes of the formation of the deposited clay accurately, because at the current stage, the geological investigation is not yet carried out. Judging from the section of digging part, the level of the deposits varies greatly. There are rock veins which should be horizontal originally but part of which is completely vertical. It is presumed, therefore, that this area is affected by considerable degree of diastrophism. It is considered that this will cause the decline in the efficiency of quarrying when a large scale exploitation is to be carried out in the future. In addition, the steep slope toward the valley remains to be grassy fields and left untouched.

2.2.1.3 Current state of quarrying, beneficiation, and utilization

The sedimentation area in the north is mainly owned by national government, and Cicantayan, present quarrying site is owned privately, whereas that in the south is mainly owned by local government. At present, nearby villages have organized Clay Mining Cooperative of Sukabumi Prefecture (Koperasi Penambang Tanah Liat Kabupaten Sukabumi) and are commercially exploiting clay under license of the local government. The cooperative has approximately 700 members including private enterprises and workers of mining companies. Since the cooperative prohibits non-members to sell the excavated clay under its regulation, clay suppliers having land and exploitation license encourage their workers to join the cooperative. Executive officers of the cooperative are elected every three year by members.

The cooperative collects levy on clay sales, some of which are used for its operation. The levy is Rp.3/kg and is divided as follows:

Rp.1.00 /kg	APTALI (explained later)
0.60	Prefectural Government of Sukabumi
0.30	Provincial Government of West Java
0.75	Clay Mining Cooperative (operating expenses)
0.10	Environmental protection measures (cleaning, health, and safety)
0.10	Land reuse cost
0.15	Insurance cost for members

In Sukabumi District as a whole, there are 17 clay suppliers (owners of leading suppliers: Mr. Parmin, Mr. Dibyo, Mr. M. Ahmad Dasuki, and Mr. Aben), some of which

collect or purchase clay from individual miners and sell it to ceramic manufacturers. Several suppliers have their own land and exploitation license. All the suppliers have organized the Association of Clay Suppliers (APTALI) to avoid unfair treatment or undue competition.

The excavated clay is widely used by ceramic manufacturers (mainly floor tile companies) in Tangerang, Bekasi, Cileungsi, Bogor, and Cirebon (roof tile manufacturers). It should be noted, however, that the Padaraang clay in the south is mostly depleted in the quarrying site on the mountain top and is mainly shipped to small manufacturers, such as novelty product manufacturers in Bandung. On the other hand, the Cicantayan clay in the north is shipped to large tile manufacturers in Tangerang and other areas.

Total production of the Sukabumi clay is estimated in the range between 1,000 and 2,000 tons/day, and the cooperative does not have accurate data, partly because production volume varies with seasons (dry and rainy) to prohibit accurate estimation. More importantly, this indicates the lack of efforts on the cooperative side to collect basic production and shipment data.

Current state of the northern and southern quarrying sites, including operating conditions is described as follows.

(1) Northern quarrying site

In the site, excavation is carried out on the outcropped slopes along the haul road and at the bottom of slope below houses. Small quarrying sites are widely seen along the road. A group of 4-5 persons manually excavate each quarrying site at a rate of 5 tons per day. While sandy clay is excavated and sieved in some places. This type of clay seems to be formed into blocks for lining of lime kilns. Further efforts are needed to ensure the effective use of resources and control environmental pollution by reducing the amount of waste materials generated, including research and study on productive use.

Excavation is carried out in the morning, and the excavated clay is loaded manually to a small truck (4-5 tons) and is transported to a stock pile. The haul road from the mine to the foot of the mountain has many steep slopes, and small trucks drive down as if they fell down from the top. Quarrying sites are spread out throughout the country, resulting in inefficient and tedious work to collect clay in the stock pile.

Clay collected at the stock pile is transshipped to large trucks (10 tons). Again, unloading from small trucks and loading to large trucks are carried out manually, resulting in long waiting time on either side and poor productivity in terms of excavation and transportation (judging from working conditions, daily production is around 2 tons/person/day).

(2) Southern quarrying site

Land in the southern quarrying site is owned by the Indonesian government, but the quarrying right (quarrying concessions) are owned by the respective villages of Ds. Sirnaresmi, Ds. Kebonmanggu, Ds. Kartaraharja and Ds. Pasakahlima. Exploitation is carried out by the residents of the area, in an individual capacity, who select the location as they desire, and no organized exploitation has been made. The individual diggers dig at random from the place where it is easy to dig, giving no considerations to the quality and the residual amount of the deposit, partly due to the lack of general and dependable selection criteria, and partly due to the absence of uniform sediments, though they also classify the clay into red clay, 1st grade clay, and 2nd grade clay, etc.. Furthermore, they are also allowed to dig the ore mines belonging to other villages. The number of workers vary considerably depending on the season, but decreases to about 100 at the time of farmers' busy season that is in the rainy season.

As the digging is done by hand using a square spade, it is often the case that the digging spots form a conical shape and a considerable amount of clay is left undug at the bottom or at the periphery of the digging spots as it was not possible to dig it out completely with this method. The surface soil (red clay) covering the clay layer is 0.5-2m in depth, and removed using a shovel car at the expense of the village. A part of the surface soil is diverted to the local roof tile manufacturer of a small size.

Regarding the quality of the clay, it has appropriate plasticity and appears to be easy to use, but the firing coloration seems to be considerably poor. The clay here is overlaid by the red clay of the surface layer containing a large amount of iron. Therefore, closer to the surface, the more reddish color it develops due to permeation of iron. In this reddish portion, a fine particle of quartz sand is contained and the quality varies depending of the degree of the inclusion of the particles. At the current stage, the clay here is classified into three types (or four types); red (plastic) clay, white (plastic or ball) clay (further classified into first and second grades in some cases) and sand stone at the time of digging and carrying out, and the thickness of the layer is not constant and varies depending on the location.

In addition, 2-3m below the level where the white clay is being dug currently (that is, the location at the depth of 5-6m from the ground surface where the surface soil is removed), the white clay of a better quality (called super white clay) exists, but since the amount of the reserve is extremely small and a minimal amount of production prohibits it from being sold as a separate grade, this is shipped mixed with the white clay.

After digging, the clay is carried out to the stock pile at the foot of the mountain mainly using 2-ton trucks, using the road installed for transportation up to quite close to

the actual quarrying site, with 10 to 15 times of shuttle services a day (100 tons/day). There are two stock pile, one of them, owned by an individual, has a square of about 8,000m^2, and is located at the foot of the mountain, 2-3km below the quarrying site located at the summit of the mountain, and is used as a temporary storing place before shipment. Most of the stock pile has no roof and the floor is just the trodden dirt, and one side of it is used as the platform for loading the clay on board the truck using the difference in ground height. At the platform, 5-6 units of 20-ton trucks can be stopped at the same time, and the loading work is done dependent on manpower. White clay and super white clay are mixed together randomly. Apart from it, there is another stock yard with the area of approx. 1,600m^2, part of which is installed with a shed (300m^2), and is owned by the representative (individual) of the union of miners.

Clay prices traded at this stock pile are as follows:

First grade (CHU)	Rp. 13.5/kg
Second grade (CP)	Rp. 12.5/kg
Red clay (PRU)	Rp. 10.0/kg

Of total, the transportation cost from the quarrying site to the stock pile (2-3 km in distance) is Rp.6,000/m^3 =Rp.3/kg. The transportation cost from the stock pile to users (ceramic manufacturers) ranges between Rp.8 - 11/kg. Thus, the average clay price at factory ranges between Rp.22 - 25/kg (1.05 - 1.20 yen/kg).

The retribution fee paid to the village is Rp.10,000 per truck of 6m^3 in size. When calculated using the specific gravity of 1.4 (approx. 8.5 ton/truck), it is approx. Rp.1.2/kg. These fee is paid to the village via the owner.

The usage of the clay is mainly tiles, and part of the clay products is mixed into the raw materials for sanitary ware. The destination to be delivered and the volume of shipment is as follows.

Destination to be delivered:

Ikad, Super Itali, KIA, Novelty product manufacturers in Bandung

Volume of shipment:

In the peak season: 10-20 times /day with a 20-ton truck

During rainy season and in the year the production declined: 5 times / day with a 20-ton truck on average year (200 tons/day on average)

2.2.1.4 Important considerations in development

(1) Quarrying

With the current situation that the digging worker individually dig by hand at random from the spot easy to dig and where the clay's quality is good as it were to dig pocket

wise, the efficiency in terms of the amount that can be dug is considerably low. Assuming, for instance, that the depth (thickness) of the layer is 10m, the amount of the existing clay is 19 tons per $1m^2$, (converted at nominal density of 1.9 and moisture content of 20%) and the ratio of the clay that is exploitable in this manner is 50%, 9.5 tons is still left unexploited. Therefore, a considerable amount of resources will remain unused, and then the resources available for exploitation will be depleted in time in an early stage.

Also, for the purpose of realizing more efficient use of the resources, it is necessary to take measures promptly to improve the quarrying method. It is necessary to give the extensive quarrying right to a firm which has a large capital or otherwise to set up a public corporation for exploitation and let it exploit the clay in a rationalized way through introduction of machinery, such as backhoe, and jointly with hand-digging. In particular, it is recommended to remove topsoil over an entire quarrying site in a selected quarrying site to expose the entire excavation site (working face), collect data and information of clay distribution (by quality grade), and then determine the methods for excavation, quality grading, blending, and shipment before excavation. In terms of ground configuration, there is a slope, and therefore, it is easy to dispose the waste soil as well as to install water drainage. Introduction of heavy machinery would make stable supply and quality control possible without reducing the amount of quarrying during rainy seasons.

(2) Stabilizing the quality

To stabilize the quality, both measures to counter the situation at the above mentioned mountain quarrying sites and at the stock pile are required. At the quarrying site, a sub stock pile should be provided to classify and store the excavated clay according to quality grade. It is advisable to make the stock pile as a body run by the village, and then, if a stock pile at least with a roof is set up, it is possible to store a large quantity of clay there regardless of the season whether it is in the rainy season or dry season. In addition, if a power shovel is introduced to perform force it is possible to stabilize the quality further more than it is now, and because it will enable the shipment with a constant pace, which would lead to stable provision, expansion of shares and increase in profit. To use the clay for the high quality product, beneficiation is required, but beneficiation is not profitable because it contains a large quantity of fine particle sand. Therefore, the destinations of shipment are mostly tile manufacturers, and it is considered that we cannot but use the portion where the quality in no good for the manufacturers of roof tiles and bricks.

2.2.2 Parungpanjang clay

2.2.2.1 General topographic and geological features

According to the geological map (Figure 2-3), the Parungpanjang clay mine is situated close to the north-eastern edge of the Pliocene sedimentary phases (approx. 10km from south to north, approx. 25 -50km from east to west) that extends broadly from the southern coast of the western edge of Java to the north-east, and furthermore, the Pleistocene volcanic phases spreads further to the east and the Miocene sedimentary phases spreads over to the south. These Pleistocene sedimentary phases are situated in the midst of the volcanic belt of Mount Karang (Gunung Karang) in the north-west and the volcanic belt runs across Java from east to west. It is presumed that Parungpanjang clay are composed of the clay transformed from tuffacious rock consisting of the volcanic products erupted from the volcanoes in this volcanic belt.

Namely, Parungpanjang clay has halloysite formed due to the weathering of tuffacious rocks as its major component and further contains montmorillonite, therefore, it has high plasticity.

The quarrying site is located in approx. 60km west of Jakarta, in Bogor prefecture, and the configuration of the ground surrounding it is that of alluvium. It is located along the mountains in the undulating farm land with relatively gentle rise and fall (Figures 2-6, 7, 8).

It takes 2 hours to go to the quarrying site by car from Jakarta. The roads on its way to the site is in no good condition with 50 minutes' ride on the paved main roads, 40 minutes' ride on the local roads and the 25 minutes' ride on the unpaved narrow roads with deep depression and high protrusions, and furthermore, the roads are jammed with cars. Therefore, for its distance, it takes a long time to reach the site. It is possible, however, to get access to the site with an 8 ton-truck. It is considered, therefore, that there is no problem if only the roads are arranged and maintained well.

2.2.2.2 Reserves

The current quarrying site is located in the flat land, immediately close to the road. The red clay covering the surface is 1.2 - 1.5m deep, and subsequently, lies the clay layer of 0.5 - 0.7m, which is rich in iron and has high plasticity, and the next layer beneath it is the mixture of white super ball clay and a variety of ball clays of different degree of brownishness.

According to the owner of the quarrying site, the depth of the layer is 58m based on the

result of boring tests. According to DSM[4], however, the depth (thickness) of the layer is 45m and the ore mine extends over 40ha.

It is presumed that the amount of the deposit is large if the above clay layer exists evenly over the whole mine area. There has been no record of boring so far.

2.2.2.3 Quarrying, beneficiation and utilization

Around the current quarrying site (20ha), there are about 100 small firms that utilize the red clay of the surface soil to manufactures red bricks. But these firms quarry the clay just for their own use and do not quarry to sell the clay. There is only firm (individual) that is currently carrying out exploration and the firm owns another quarrying fields of 20ha and 3.5km apart. The land property right is owned by the owner of the firm. The firm, employing 200 workers for the two quarrying fields, has been exploiting since 25 years ago.

(1) Type of products, production, and market

Main products here are plastic clay and sand stone. Plastic clay is classified in following 4 types.

1) Super Ball Clay (White)
2) Ball Clay (Bluish White)
3) Plastic Clay (Reddish White)
4) Roof Tile Clay (Red)

The output of ball clay and plastic clay altogether is 200 tons/day. This does not include the sand stone quarried from different sites.

The destination of shipment are tile manufacturers and refractory manufacturers.

For tiles: KIA, IKAD, Bermis and Union Keramik, etc.

For refractories: Indoporlen

2) Quarrying method and stockpile

The quarrying method adopted here is hand quarrying, and the bench cut method is not adopted nor machinery such as a power shovel are introduced. The digging spot moves around from one place to another in search of the site easy to quarry, and strip quarrying method dependent on manpower is adopted and the sites are dug as if they were

[4] See Table 2-2.

pocket wise. At a digging spot, about 5-6 workers, forming a group and using the hand tools such as shovels and scoops, dig out and carry out the clay using baskets. The surface soil around the quarrying sites has become awfully muddy with puddles in the former digging holes. There is a problem with respect to drainage and safety.

5-6 natural drying facilities with roofs that are used both as the stock yard and drying yard are distributed here and there, but the number of the facilities of this kind is few compared with the amount quarried, falling short of sufficient space. In addition, these facilities have roofs but have only dirt floors that are not paved with concrete nor are these shields. Therefore, the clay quarried out are placed according to the grade only. These facilities could be compared to temporary storing yard.

3) Beneficiation

The ball clay to be shipped is just dried in natural condition on the drying shelf with a roof, which is performed in response to the request by the customers, and no special beneficiation, like elutriation and crushing is performed.

4) Quality control

The owner and the personnel instructed by the owner direct to classify the clay and the clay is stored in 4 types according to the color of the clay. The refractoriness is not measured. Quality control is hardly carried out except visual checking.

5) Product prices and transportation costs

The price of the products is determined through negotiations with the customers at the actual quarrying site using the color, etc., as the criteria. The clay is classified more in detail in actuality, but the followings is the standard for classification.

1) Super Ball Clay: Rp.50 - 100/kg
2) Ball Clay: Rp.50 - 100/kg

The price of the products when transported to Jakarta is Rp.120-250/kg, these prices varies depending on the drying condition of the clay.

3) Plastic Clay: Rp.50/kg
4) Roof Tile Clay: Rp.35/kg

With respect to the package style during transportation, it is packed in a bag only when requested by the customers (Same is true for the dried products). Usually, the raw clay is shipped in bulk style put on the trucks. Shipment is always carried out by the

truck. The firm owns 14 trucks of 8-tons and it is possible rent another 10 trucks when shipment is large. The amount of shipment is approx. 800 tons / week (8 tons / truck x 100 times / week) for ball clay and plastic clay.

The breakdown of the shipment by the quality, roughly speaking in terms of proportion, is two trucks for super clay, 5-7 trucks for ball slay, 4-5 trucks for plastic clay and 6-7 trucks for roofing tile clay.

2.2.2.4 Important considerations in development

(1) Grasping the amount of the deposit of the clay

The accurate amount of the clay deposit is unknown since the result of boring test is not yet confirmed. The existing amount of the deposit, judging firm the condition of the actual field and information obtained from the owner, however, is considered as sufficient for the time being. Upon exploitation, it is necessary to reconfirm the amount of the deposit accurately. In particular, to grasp the amount of the reserve by the type is essential.

(2) Quality

As for the quality, its plasticity is too high and its iron contents is slightly high, and therefore, it is presumed that it has a problem when it is to be used, as it is, as the raw materials for ceramics. To expand the usage, beneficiation of some kind such as elutriation is required. When elutriation process is installed in the local area, it is necessary to study of water supply and water drainage since the actual site is located on a flat land.

(3) Transportation of raw materials

The condition of transportation is considered as one of good ones since the location, in terms of distance, is close to the capital, Jakarta, although there is a problem that the part of the road to the site remains unpaved and it takes a long time to get to the site due to the traffic congestion. It is desirable that the road near the site should be paved. It is, however, necessary to take measures to cope with the shortage of the number of trucks available for transportation.

(4) Situation in the quarrying site

It is difficult to deal with the order of a large amount since the quarrying is carried out by hand-digging dependent on manpower. To counter the situation, it is necessary to arrange and expand the stock yard. Quarrying at the present stage is by hand-digging

dependent on manpower, and therefore there is a limit in the quarrying capacity. It is possible to introduce machinery, and there is still sufficient rooms for streamlining. In addition, it is necessary, during rainy seasons, to take measures against the mud of the surface soil and to take measures for water drainage at the digging site is also required from the viewpoint of safety.

2.2.3 Cipeundeuy clay

2.2.3.1 General topographic and geological features

According to the geological map (Figure 2-9), the geology of Cipeundeuy is the center of Quaternary undifferentiated volcanic products zone of approx. 150km from east to west and approx. 50km from south to north that spreads to the east-south of Bandung city, and to the east lies the Gabbro, peridotite phases of approx. 5km from east to west and approx. 40km from south to north.

It is presumed that Cipeundeuy clay, located in the midst of undifferentiated volcanic products zone, is resulted from the transformation of part of this volcanic products in some regions into clay due to continuous hydrothermal action and weathering.

Clay mountain in Cipeundeuy is located approx. 65km east-south-east of Bandung, and its address is Kp. Cipeundeuy, Desa Cikarang, Kota Malangbong (Figures 2-4, 10, 11). After driving a car for about 3 hours on the paved trunk road from Bandung, you would arrive at small village nestling in the ravine at the foot of the mountain via Cipeundeuy. The office and a stock pile of the exploiting firm which owns the concession for the Cipeundeuy clay are located along the trunk road running through this village. The clay mountain can be reached by going from Cipeundeuy station for about 40 minutes on foot through the footpath between rice fields on the slope of the two mountains of 500m and 350m in height, respectively, and through a mountain road in a wood in the gorge and climb up by about 300m. The path from this quarrying site to the stock yard at the foot of the mountain is a mountain road which is as narrow as only a person can walk. Considering the topography (the configuration of the ground) and the situation of the surrounding area, it is difficult to install the road for carrying out the clay as the land lying in between is utilized as rice fields or ploughed land.

2.2.3.2 Reserves

As for the topography (configuration of the ground), the quarrying site is located near to the highest point of rice paddies which has been cultivated in steps in the valley between two mountains and spreads upwards from half way up the slope of a high mountain.

According to the DSM data, the area of deposit is 27ha, and the area of the quarrying site that has been quarried since (about 35 years ago) is approx. 0.5ha. The depth (thickness) of the clay layer is 18m, and water flows out from beneath.

There are two quarrying sites, the old site that has been in use since old time and the new site that has been quarried since October, 1995. These two sites are closely situated with the distance of approx. 100m and the difference in height is approx. 10m. When the depth (thickness) of the clay layer is estimated based on the condition of these two sites, the condition of the sedimentation is relatively stable, therefore, the size of the expansion of the clay vein that can be exploited is considerably promising. Although it is possible to exploit the field, the only method available for transport the clay for about 3.3km down to the stock pile at the foot of the mountain is dependent on workers who carry clay on their back. This unfavorable situation has been the bottleneck in exploiting this mine. The general condition of the ore veins for both the old and new sites are shown in Figures 2-12 and 13.

2.2.3.3 Quarrying, beneficiation and utilization

Digging is performed by shaving off the clay layer, as if a tunnel were dug, which appears in the form of a standing wall at the place where the surface soil of the slope of a mountain was removed. Two to 4 workers carry out hand digging using a square spade at the 2 current quarrying sites. The size of the clay layer wall being dug is 4m in breadth x 3m in height for the new mine and 5m in breadth x 3m in height for the older mine heretofore in use. The new mine is dug out as long as 5m only in the horizontal direction, but there is an indication that the older mine heretofore in use was dug out as much as 80m in breadth x 60m in the horizontal direction (approx. 5,000m^2). However, by now, it is not possible to confirm how much clay layer existed and how much could have been dug in the expanse of the wall surface of 80m in width, except in the part with 5m in width that are being dug, since this site has been exploited from old time, and also because red clay might have fallen from the above, or otherwise, the hole was buried with the waste soil. In addition, the outcrop that appears to be the white clay layer is faintly observed at the present time as shown in Figures 2-12 and 13, but it is not possible to confirm whether this is linked to the ore vein of the clay layer that is exploitable. Currently, water comes out from underneath of both mines. It is said that there exists the clay of a good quality beneath them, but the situation is such that digging is not possible as water is collected in the depressions.

The clay is dried and stored while being divided into 2 types, bluish clay and grayish white clay, but both of them are dealt with as the products of the same quality when sold. The customers the clay is delivered to do not consider this practice as problematic.

The clay being dug has no plasticity even though water is added and the refractoriness is high for both cases, therefore, is mainly delivered to refractory manufacturers. It is hard to apply this to other usages, and therefore, this usage will be the major application of this clay in the future, also.

The method of transport after quarrying, the amount and cost of the clay are described as in the following. The clay is carried out on the mountain road of 3.3km down to the stock pile at the foot of the mountain by laborers put on their back.

Number of workers required for carrying out:	50 persons (farmers' busy season/rainy season) ~ 300 (at the maximum)
Amount of clay to be carried:	320 kg /(man/day) [80 kg / travel x 4 times /(man/day)]
Transport expense:	Rp.1,500 / 100 kg

There is no cottage nor square around the quarrying site, and therefore, the clay quarried out is temporarily put on a flat potion of land at hand, and immediately after that, carried to the stock pile at the foot of the mountain. Classification, as a whole, is done visually.

There are two stock piles, that also serves as drying yards, having a roof and with the area of 195m^2 (15 x 13m) and 72m^2 (6 x 12m), respectively. As the emphasis is put on drying, it is not possible to store the clay in a large quantity. Currently, however, the demand for the clay is brick and there is no need to store over a long period of time, and therefore the current space in those stock piles is sufficient. In addition, the clay is dried in the natural condition under the sun at a place like courtyard or using the field at the back while spreading out the clay scrupulously. This is due to the customers' request that is made because, when the crushing work is performed at the site of the customers, the clay needs to be dry to perform the work with efficiency.

Major destinations to be delivered and the amount to be delivered are as follows:

	trucks/week (12--14ton/truck)	ton/week
Indoporlen Co., Ltd. (refractory brick)	6 ~ 8	78 ~ 108
Super Itali Co., Ltd. (tile)	3 ~ 4	39 ~ 52
KIA (tile)	3 ~ 4	39 ~ 52
PT. Jarifu (refractory brick)	2	26
	Total	182 ~ 238

The prices are as follows:

Dried clay	(water content: 15%)	Rp.60/kg
Undried clay	(water content: 20 ~ 25%)	Rp.40 ~ 45/kg

2.2.3.4 Important considerations in development

Currently, digging is wholly dependent on manpower and the situation is such that it is not possible to introduce heavy machinery. The current situation of the mine heretofore in use is that the clay of a good quality exists at the bottom as shown in Figure 2-14, but that it is not possible to dig because water is gathered in depressions. To improve the situation, it is considered that, if the ground configuration can be changed as shown in Figure 2-15, digging will become possible as the improved configuration would prevent water from being collected in depressions. The proposal made to improve the situation, however, has problems in actuality regarding how to dispose of the waste soil unnecessarily came out and that it is difficult to introduce machinery. But, already, in the mine heretofore in use, a large clod of clay that is not usable fell from the top, burying the quarrying site. If this quarrying site is continued to be quarried, it will become impossible to remove surface soil, thus resulting in the situation that eventually a new get away stopgap have to be made just to meet the situation as in the case of the new mine.

Under this circumstance, it is feared that the stable supply of clay may not be possible in the future. With respect to the improvement of the carrying out method from the site in the mountain, it is possible to consider to construct a road or install transport facilities such as ropeway, but it will be indeed hard to carry out these plans from the viewpoint of cost as well as from technological aspect.

Future exploitation seems to be considerably difficult when we take into account the facts as follows: 1. There are serious problems, as described above, in terms of quarrying as well as transportation. 2. It is necessary from the viewpoint of quality, to choose the fields of application so that they meet the characteristics of the clay here that has high refractoriness and a low plasticity compared with the clays produced in other areas.

2.2.4 Monterado

2.2.4.1 General location, and topographic and geological conditions

According to a geological map (Figure 2-16), the Kalimantan area (Borneo) is made of sedimentary layers formed by weathered granite which deposited during the Tertiary and Quaternary periods, and plutonic layers formed in the Mesozoic period and their

sedimentary layers. The West Kalimantan area which has the deposits visited by the Study Team is dotted with Mesozoic sedimentary layers, similar to those seen in the Bangka and Belitung islands, representing geological structure where availability of high quality clay as a good ceramic material can be expected. The area's relatively stable geological structure suggests presence of homogeneous and large deposits, making a sharp contrast to Java Island which forms a new, complex structure due to uplift, subsidence, active faulting, and volcanic activities caused by the creeping of the Australian Plate on the Indian Ocean. Also, unlike Java Island, the entire area is covered with white soil and is less contaminated by color impurities such as iron, promising availability of materials suitable for production of white porcelain.

In West Kalimantan, clay is commercially produced in Kp. Capkala, Ds. Mandor, Kec. Sungai Duri, Kab. Sambas, located approximately 80km north of Pontianak. The site is reached by driving on a paved arterial road from Pontianak for three hours (driving distance of approximately 120km), and after Sungai Pankalan, further driving on a branch road eastward for approximately 6km (Figure 2-17). The branch road is 5-6m wide and seems to allow five-ton cars at maximum. Nevertheless, it is paved and does not have any steep slope seen in Java, so that it can be used for transportation of products throughout the year including the rainy season.

Ds. Monterado can be reached by driving on the road northeastward for around 15km. Since Monterado has been well known in Indonesia from early times for gold, uranium, and bauxite mines, clay produced in Capkala Mandor is generally called the Monterado clay. (Note: According to a local guide, the name "Mandor" is not used to avoid confusion with Kec. Mandor which is located approximately 40km north of Pontianak.)

The clay quarrying site in Capkala Mandor is located along the branch road on the south side and is surrounded by gentle hills. The hills extend to Singkawang, located approximately 30km north, and are densely and extensively covered with white, sandy top soil. According to the local guide, high-quality ball clay is present below the topsoil, and if this is true, the area has huge clay reserves.

2.2.4.2 Resource distribution

See Picture 2-2. Clay resource distribution in West Kalimantan is shown in Table 2-3 and Figure 2-18. Ten mining companies and ceramic manufacturers have filed application for exploration with the local government or a district office of the Ministry of Mine and Energy. So far, only one company (PT. Clay and Minerals Indonesia) has obtained an exploitation license for an 1,000 ha area in the quarrying site (Capkala Mandor) which is commercially mined (details later). The company has excavated test quarrying sites in a few dozen locations and has confirmed, within a 200 ha area, presence

of high-quality ball clay at 3-5m depth from ground (6m in some places) below topsoil of 1m deep made of sand (silica sand). Originally, the company obtained the exploration license for a 300 ha area which is closer to Monterado and discovered that good clay was present only in an 165 ha area. Then it started commercial operation at the present quarrying site. Furthermore, the company obtained an exploration license for an 1,000 ha area in Sungai Pinyuh, 40km south of Capkala Mandor, and started its development.

As for other projects, a company (Bumi Borneo Kreasi) carried out exploration work and market development for a 600 ha area located a few km away from Capkala Mandor, which has not started commercial operation. In Pajintan near Singkawang, two companies obtained exploration licenses for a combined total of approximately 800 ha in area. All these areas under exploration amount to over 5,000 ha. If 50% of the entire area are endowed with good clay deposits, which are assumed to be, say, 4m deep, gross reserves total impressive 250 million tons.

Geological distribution of clay deposits observed in the Capkala Mandor quarrying site is quite different from that in clay mountains found in Java. In Java, uniform distribution is hard to find, e.g., good clay layers are separated by faults or are present in between silica sand and rock layers, making mechanical excavation very difficult. On the other hand, in Capkala Mandor, topsoil (silica sand) is relatively thin (approx. 1m) and although its lower part forms vertical layers, each layer is fairly homogeneous and extends widely to allow mechanical excavation.

2.2.4.3 Current situation of exploitation, beneficiation, and utilization

(1) Quarrying site and current operation

As mentioned earlier, there is only one company that produces clay in West Kalimantan under an exploitation license, PT. Clay and Minerals Indonesia (Clayindo) which is a joint venture of Watts Blake Bearne & Co. PLC (WBB), a leading ceramic material supplier in the UK. Other nine companies (Table 2-3) are applying for exploration license and need to obtain the exploitation license from the local government after test excavation, market evaluation, and environmental study.

Clayindo has obtained the exploitation license for an 1,000 ha area that extends north and south in Capkala Mandor, including a paved road from Sungai Pangkalan to Monterado. At present, a 200 ha area on the south side of the road is being excavated. Operation was commenced in 1989, and 150 tons are excavated daily. Prior to commercial excavation, a 3 x 3m test quarrying site having 5m in depth is excavated by using excavators and labor force (maximum 120 persons) to collect samples from each layer, which are send to WBB's headquarters in the UK for quality evaluation and product grading. Product grading is based on content of 120-mesh or more coarse

particles (silica sand), with three grades of CK-1, CK-2, and CK-3 from the top layer to the bottom. CK-2 has the highest quality (small silica sand content and high plasticity) and is largest in quantity to be a major product from the quarrying site.

Samples are taken during excavation and are checked for quality at a laboratory provided at the entrance to the quarrying site. The laboratory is equipped with an electrical kiln (maximum 1,000℃), a dryer, sieves, and a small agitator to evaluate loss on ignition, moisture content, and residue after 120-mesh sieving. Excavated clay is stored in various locations according to grade. After quality analysis, it is packed in 50kg bags which are kept in a roofed stock pile for shipment. The quarrying site does not beneficiate products, such as elutriation, and ensures stable quality through strict product grading and control as well as blending according to use.

The quarrying site seems to have sufficient environmental protection measures, including drainage channels to discharge water (including rainwater) and backfilling of excavated quarrying sites with topsoil obtained from new quarrying sites.

(2) Shipment

Most of clay currently produced (150 tons/day, or 50,000 tons/year) are shipped for tile production, with 10% for sanitary ware. According to Clayindo, the Capkala Mandor clay is supplied to tile manufacturers in East Java. The company intends to expand the market for sanitary ware production which requires higher quality than clay used for tile production and plans to double production (100,000 tons/year).

At present, the company is building two stock pile facilities along the road before the quarrying site. Also, a wharf (60m long) accommodating a 5,000-ton ship is being constructed in Wajok, along the Kapuas River, a 30-minute drive from Pontianak. At the wharf, an office and a stock pile (10 x 50m) are being constructed and loading equipment has been delivered. In addition, blending and palletizing equipment will be installed to enable the blending of excavated clay materials to supply clay products in quality according to the use. Test production has been completed and the equipment is reportedly being manufactured.

2.2.4.4 Major considerations required in resource development

(1) Product transportation cost

According to Clayindo, transportation from the clay quarrying site to the wharf can only be done by 5-ton trucks due to the relatively narrow branch road (5-6m) before the arterial road. When costs for ship transport to the major market, the Java Island, and truck transport within the island are added, the total transportation cost reportedly accounts for 75% of clay's ex-factory price. According to a local carrier in Pontianak,

ocean transport between Pontianak Port and Jakarta Port takes about 45 hours at a cost of Rp.25,000/Fios-ton (free in out system) with the minimum quantity of 1,000 tons. While 50kg bags are currently used, 1-ton bags can be used. No bulk transport service is available. Cost reduction efforts by improving transportation methods will become important as demand grows.

(2) Development of applications

As mentioned earlier, Clayindo designs its own clay products under technical assistance of WBB and has been successfully supplying products to meet customer needs through product grading and blending.

On the other hand, there is an unsuccessful case. A mining company (PT. Bumi Borneo Kreasi) excavated test quarrying sites in an area 4-5km north of Capkala Mandor in around 1993 and brought samples to BBK for evaluation on their use as insulation materials. Since then, no commercial production has been carried out. The test quarrying sites were extensively excavated on the east and west sides of the road. Topsoil with high contents of organic matters (1-1.5m deep) and a sandy layer below it were excavated to 3-4m in part (along the road). Bags containing clay having relatively high plasticity were left around them.

It is presumed that the company conducting exploration failed to relate clay resources to commercialization due to the lack of quality knowledge (particular major applications and their quality requirements). This indicates that even if high quality clay is found, sufficient knowledge on its quality as well as quality requirements by customers, together with a certain evaluation period, will be required before commercial production.

Finally, Clayindo is actively exploring the market for the sanitary ware material, but it does not develop clay materials for high-grade tableware.

(3) Ceramic industry in West Kalimantan

The ceramic industry in West Kalimantan is fairly small. Five small- and medium-sized manufacturers are operating in Desau near Singkawang to produce novelty products and refractories. The largest manufacturer has around 80 employees. Using local clay and the Capkala Mandor clay, it forms relatively large bowls and pots by means of foot kneading and kick wheels, which are fired in ascending kilns burning firewood. The firing process in the kilns takes 4-5 days per each cycle and is repeated 4 times per month. The firing temperature, as judged from appearance of final products, is not very high and is estimated at around 1,150℃. It is interesting to note that the manufacturer does not use compound pigments for glaze, and instead, it uses natural materials, such as rice hulls, ash, and shells, to produce a variety of colors including blue, purple, brown, and green.

The factory started operation in 1933 by using techniques brought from China. Other than the five enterprises, there is one enterprise near Pontianak Airport mainly producing insulating firebricks and refractories (1,000 pieces of ordinary type per month), together with novelty products. It has kilns made in Taiwan, which burn kerosene and attain a higher temperature of 1,240℃. It also has modern equipment compared to the enterprises in Singkawang, such as powered wheels and clay crushers.

It should be noted that there is no tile and no roof tile factory in the area, unlike Java Island. Also, except for modern public buildings and high-grade houses, many houses use iron or tree bark/leave for roofing and tiles do not seem to be widely used. As seen in northern Sumatra (Medan), there is little ceramic demand as roof tiles are not used in the area due to the custom not to place earthware on roof. More important, the lack of fuel (gas) source and unstable electricity supply (power outage occurs three or four times per day) prevent the emergence of the industry.

On the other hand, West Kalimantan has 3.5 million population, of which 500,000 live in Pontianak, so that the industry has growth potential once they start to use ceramic products. Furthermore, natural gas is being developed in Natuna Island located northwest of Kalimantan, and once commercial production starts, a large ceramic factory can be sited (although the electricity supply problem is to be solved), making the area attractive for the industry.

2.2.5 Banjarnegara feldspar

2.2.5.1 General topographic and geological features

According to the geographical map (Figure 2-19) of this region, there is a large fault that extends from east to west at around 5km to the south of Banjarnegara city, and moreover, there is an overthrust fault that extends from east to west to the south of the city. Circumscribed by these faults, erupted Andesite covers the area of 15km from south to north and 40km from east to west. The andesite, that includes basalt and diabase, develops in the form of several ore veins running from east to west.

In addition, large faults running from south to north at several locations are found. In Indonesia that has a complex geological structure, this region especially has a unique geological structure exhibiting the complexity of diastrophism. From the aspect of mineralogy, this region is based on rhyolite that contains relatively a large content of feldspar. The feldspar found in this region have defects such as high refractoriness due to smaller content of alkaline substances (about a half as much as the content in feldspar) and poor coloration after firing attributable to a large content of colored impurities. However, having a very large amount of deposit, this area is very promising as an area with

prospective mines to be exploited.

The feldspar mountain of Banjarnegara is located in the mountain district in the south of Banjarnegara city in the central part of Java island, and can be reached in about an hour from the center of the city via main roads and passing through a mountain road. There are several quarrying sites. It is possible to make an access to any one of these sites by 5-ton truck, therefore, these sites are situated comparably conveniently in terms of securing the roads to carry out the products. The entire region constitutes a feldspar mountain (mine)[5], and exploitation has begun from the place which is convenient from the viewpoint of transportation.

In addition, this region produces clay, talc as well as ceramic raw materials, and these resources have been already exploited.

2.2.5.2 Reserves

There are 3 operating feldspar mines in Banjarnegara, Kalitengah, Kebon Dalem, and Kebutuh Jurang (Figures 2-20, 21).

As for the locations of the 3 mines, these mines are aligned, with Kebon Dalem mine being located 5km away from Kalitengah mine, and Kebutuh Jurang mine being located further 10km away from Kebon Dalem mine. The feldspar vein is extended 15km from east to west.

1) Other 2 ore mines can be seen in the direction of the extension of the feldspar layer of Kebutuh Jurang mine.
2) The personnel of the Prefecture as well as those of ore mines involved has a recognition that these 3 ore mines are linked together.
3) Judging from the condition of 3 ore mines and the appearance of the ore rocks, the ores of the 3 mines are of the same quality.

Judging from the above facts, these 3 mines are not independent ore deposits, but linked with each other forming a ore vein. In addition, if they are connected in a form of a ore vein, the amount of deposits here is expected to be huge to the extent it is beyond anybody's estimation.

According to DSM, Ds. Kalitengah mine spreads over the area of 495ha with the layer of 60m in depth, and Ds. Kebon Dalem mine covers the area of 192ha with the layer of 50km in depth (thickness)[6].

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[5] Information from Banjarnegara prefecture.

[6] The data on Ds. Kebutuh Jurang ore mine is uncertain.

Judging from both topographical as well as geological conditions, there is a possibility that feldspar may be discovered outside the area of 15km described above, and therefore, this ore deposit is considered to form a major pillar of Indonesian feldspar resources. The condition of the resources and the amount of the deposit here has not been investigated in detail.

2.2.5.3 Quarrying, beneficiation and utilization

This ore mine has been exploited actively supported by Banjarnegara prefectural government. Guidance as well as supervision have been done by the prefectural government to prevent a wicked customer or a vicious distributor from purchasing the materials at an unduly cheap price. Also, the guidance concerning the health and safety of workers has been made. Furthermore, the province has been making effort actively to arrange the roads and also to install a joint stock pile of feldspar.

(1) Removal of the surface soil

The depth of the surface soil differs from one place to another. To remove the surface soil, heavy machinery has not been introduced, therefore, it's removal is dependent on manpower. Some ore mine has no place to throw away and dispose the removed surface soil.

(2) Quarrying

All digging is done by hand-digging dependent on manpower. Each ore mine has faces distributed over several locations from the consideration of how to place workers. The number of faces varies from the case when many worker are available for digging to the case when a small number of workers available. The quality of the ore product from each face differs slightly. But, in spite of this, no countermeasures has been taken such as classifying the products to stabilize the quality or mixing the products with a certain ratio, and the products dug from the faces have been shipped as they are. Therefore, the quality of the product varies greatly from the time when many workers are available for digging to the time when only a small number of workers are available.

(3) Destination of shipment

The whole amount of the product is shipped to the locations outside the province. Most of it is directed for tiles, but only a small part of it is shipped for the manufactures of the table ware. The method as described above is considered as sufficient for the application of tiles, but it is necessary to consider washing the products with water when required since feldspar contains mica and clay and often includes the portion contaminated with surface soil (red colored portion).

2.2.5.4 Important considerations in development

(1) Introduction of Heavy Machinery

Judging from the condition of the ore mine, it will be easy to increase the amount of the quarried product and stabilize the amount of supply, etc. by introducing heavy machinery. It is, however, to early to do so when considering the amount of supply at the present time. It is considered that introduction of the machinery should be carried out according to the increase in the amount of demand. There are some mines which are facing the limit in terms of the disposal of the waste soil, therefore, it is necessary to study the possibility that the public organization or all ore mines jointly introduce a small power shovel and that all mines altogether dispose the waste soil jointly.

(2) Quarrying method and stabilization quality

The quality of the product can be stabilized by placing workers so that the proportion among the amount of quarried ore of all faces becomes constant, or though shipping the product after mixing all products from all faces with a certain proportion for shipment. In this case, at least 3 faces are necessary.

It is necessary to educate the owner of the mine and the workers that it is the responsibility as well as the duty of the exploitation firm to maintain the stable quality and stable supply as well as to instruct the quarrying method. As the workers are diligent and hard-working as well as efficient competent, the quality of products will certainly be stabilized if only the work is standardized and an appropriate instruction is given.

(3) Transportation, etc.

It takes a considerable time to load and unload the raw materials. Many trucks are kept waiting for their turn to come. It is necessary to study the possibility of introducing dump trucks for transportation and improving the loading work through the introduction of a shovel car. The condition of the mines should be improved so that one driver can load the quarried raw materials that are stored in a hopper. In addition, operation efficiency will be raised by loading the stored products with a power shovel and thus reducing the time required for loading, and further making it unnecessary for dump trucks to wait for their turn to come.

In addition, to use a truck that also can be used as a dump truck should be considered.

(4) Improvement of the quality

In terms of quality, feldspar produced in this mine has a disadvantage of poor firing coloration and having high refractoriness as this feldspar is of tuff origin, but this feldspar

is good enough for the manufacture of the product that requires only lower quality than that for tiles. Also, because this is of tuff origin, this feldspar has an advantage that the amount of deposit is large. When a force is applied slightly, the ore gets disintegrated into the state that silica, feldspar and mica are separated from one another and mixed together with this condition, Therefore, there is a high possibility to improve the quality through beneficiation. It is necessary to carry out a basic research from various angles.

(5) Reserves

It is necessary to carry out detailed survey on situation of feldspar deposit and its amount of reserves by mine expert, so that the basic exploitation of these mines should be planned by the government. These area has enough value to be exploited as feldspar mines.

2.2.5.5 Banjarnegara Kalitengah mine

(1) General topographic and geological features

The mountain exploitation site can be reached in about an hour from Banjarnegara city via main roads, half-paved roads and through mountain roads. The mountain roads here are broad enough that a 5-ton truck can easily pass.

The exploitation site is located in the mountain behind a small settlement. There are many small mountains set closely with each other, and feldspar is obtained from the area covering from the mid-slope of the mountains to the summits. Four mining companies are operating in Kalitengah on the left side of a small valley seen from here lies Pursahaan Daera mining company (the largest of all), and other mining companies having 3 ore mines of Banjar Utama, Sari Alam and Gunung Mas are situated on the right side of the valley. See Figure 2-22.

(2) Reserves

1) Condition of the ore mine

See Picture 2-3 (1). Digging surface is divided into 3 stage, upper, middle and lower, height difference of which is about 10m. The feldspar from these 3 stage are in the form of bluish gray homogenous rock plate, and although its surface is hard, it is crumbly and easily crushed. Weathering has advanced to considerably lower part. We presume that rhyolite volcanic rocks has gone through natural weathering and affected slightly by metamorphosis due to heat, and consequently, has become friable.

Reddish brown powdery deposit stratum which is contaminated with surface soil is observed in a part of the deposit. The amount of the powdery ore is small with the percentage of below 20% of total. The surface soil is not so thick with the thickness

of approx. 0.5 - 1.5m. According to DSM, the field of the deposit covers the area of 495ha with the depth of 60m, and the amount of deposit is large.

At the lower part of the feldspar stratum, the black rocks (basalt or serpentine) are observed, and these black rocks are commonly observed not only in Kalitengah mine but also in other 2 mines.

2) Quality

On the whole, fine particles of mica are included to a considerable extent, and moreover, a trace amount of clay adhered to it is observed. Except for the powdery portion of the deposit, there is not a large difference in the quality of the deposit as a whole. The powdery portion contains a large amount of clay and contaminated with iron (contamination due to surface soil), and has a high refractoriness and shows poor firing coloration. As a whole, the difference in quality is small and the quality is stable.

(3) Quarrying, beneficiation and utilization

1) Quarrying

Digging is done by hand-digging using iron bars and rake spades, and the product is carried out packed in a bag. As the surface of the ore is hard, therefore, it is indeed a hard work to dig it by hand. Due to hand-digging, the faces tend to stand up, and the height of the face has already become as high as 4m. Therefore, the digging is performed as the digging on the inclined slope, and the work has become rather hard to perform. Fortunately, as rocks are not mixed in the deposit, there is no danger of rock slides, but if the working site goes up higher than it is now, the working site will become narrow and will be dangerous.

2) Unloading, weighing and temporary storing

The product packed in 4 bags is carried down the steep slope on board a cart (a sledge with wheels at its sides) drawn by man to temporally stock pile. On the way down, bags sometimes falls off to the bottom of the valley. This process is indeed very dangerous.

Ores are packed in the bags classified by the quarrying site, and carried out to the temporary stock pile. After checking the amount, the bags are opened and ores are mixed together at that stage. The color and the shape of the ore differs depending on the quarrying site, but packing work is not done to classify the product by the quarrying site or whether it is from the powdery deposit or lump deposit, but to check the amount dug and amount carried out by workers. Accordingly, neither strict classification of

quality nor stringent quality control has been performed.

3) Production quantity price and market

Production quantity price and market are as follows;

Production quantity	:	60 ton/day (50 workers) in the rainy season 150 ton/day (125 workers) in the dry season (According to DSM, however, 15 -20 ton/day)
Price	:	Rp.17/kg when delivered at the exploitation site, in it, Rp.4/kg is for carrying out
Market	:	floor tile manufacturer

(4) Important considerations in development

1) Improvement in quarrying efficiency

It is necessary to improve the digging tools. By using a small electric pig hammer, for example, the digging efficiency increases. The mine has a slope and less surface soil, therefore, the disposal of the waste soil is easy. If the exploitation is not carried out by one company, Pursahaan Daera, but is carried out systematically incorporating other 3 mining companies on the right side together, and using heavy machinery, this mine will make a good mine with high efficiency.

2) Stabilization of the quality

To stabilize the quality, it is necessary to carry out thorough work management at the actual quarrying site as follows : To have more than 3 faces and dig the ore by placing workers at each site so that the amount of the dug ore at each site becomes constant. And the shipment is carried out by mixing all of the ores dug out with an constant ratio.

In particular, when the quality of the product dug from one face is poor, it is important to perform digging so that, for example, the amount of the reddish part with poor quality constitutes below 20% of the total amount of the dug ore and try to ship the product from that face mixing with shipped products and not ship it independently.

Currently, washing with water is not performed, but washing with water enables the removal of the clay that contains a large quantity of colored substances, and therefore, slightly improves the coloration after firing[7], but the refractoriness becomes slightly higher. The removal of mica, however, is difficult.

When the request for the improvement of quality is made by the clients, it is possible to improve the quality to a certain degree if only washing with water is performed when

[7] The color of powder ore fired after washing became better than that of unwashed.

necessary. It is required, however, to test the method of washing with water in advance to confirm its actual effect.

3) Safety control

The current carrying out method by a cart (sledge) is an extremely dangerous transport method. Since there is a sufficient difference in height between the digging site and the place of amount checking and the distance of a line connecting these two points is not so large, installment of a simple equipment such as a chute or a ropeway will be effective as the measure for the safety.

2.2.5.6 Banjarnegara Kebon Dalem mine

(1) General topographic and geological features

You can reach the ore mine in approx. 50 min. from the joint stock pile organized by the province, via main roads and going through semi-paved ordinary roads. Turning into the road installed for exploitation of the mine from this road, and going 40 - 50m further, you can arrive at the quarrying site. This ore mine is situated very conveniently from the aspect of transportation.

(2) Reserves

1) The condition of the ore mine

See Picture 2-3 (1). At the front side face, the digging face is approx. 20m in height and the deep surface soil is covering the face, therefore, digging is temporally suspended for the time being. Currently, digging has newly started near the foot of the mountain (closer to the ordinary road) where the surface soil is thin. Even at that site, there is a surface soil layer of 2-6m in thickness, and further the site is dug on, the thicker the surface soil tends to be accumulated. In the surrounding area, the folk houses are densely situated, and there are abundant rice fields and farm lands, therefore, it is hard to find the place to dispose the waste soil here given this sort of the ground configuration.

According to the data by DSM, the mine field covers the area of 192ha with the thickness of the stratum 50m, therefore, the amount of the deposit here is large.

The condition of the ore mine is as shown in Figure 2-23.

2) Quality

Looking at the feldspar, the characteristics of the ores here is the same with that of the feldspar of Kalitengah mine, but micas are large and contained with a large amount. Also, clay is mixed together in the ore. As a whole, the quality of feldspar here is

inferior to that of Kalitengah mine. As its coloration after firing is poor and its refractoriness is high, a complaint is sometimes made from the customers.

On the right hand side of the front side of the site, black rocks as are observed in Kalitengah mine are also found.

(3) Quarrying, beneficiation and utilization

1) Quarrying

The ore mine is owned by an individual and has been exploited since 4-5 years ago. The exploitation is carried out by hand-digging at the relatively gentle slope of the site.

2) Beneficiation

Washing with water and other beneficiation measures are not taken in this mine, too.

3) Production quantity, price and market

Production quantity, price and market are as follows.

Amount of diggings:	20-25 ton/day in the dry season, less in the rainy season
Number of workers for quarrying:	10-15 workers
Price when delivered at the quarrying site:	Rp.15/kg
Fare up to Jakarta:	Rp.25-30/kg (distance: 400km)
Market:	floor tile manufacturers

(4) Important considerations in development

The largest problem here is the disposal of the waste soil. There is no place to dispose the waste soil in the surrounding area, and therefore, it is not possible to dispose the waste soil by manual in the current situation. Introduction of heavy machinery is required.

As for the improvement of the quality, it is necessary to examine to what extent the quality can be improved through washing with water as in the case of Kalitengah mine.

2.2.5.7 Banjarnegara Kebutuh Jurang mine

(1) General topographic and geological features

This ore mine can be reached in approx. 40 min. by car from Banjarnegara city by driving along the main roads, on the plainly paved roads and unpaved roads. The unpaved road runs in the mid-slope of the undulating mountain relatively with gentle

rises and falls, linking small settlements. Exactly, at the location of the quarrying site, this unpaved road runs at the ridge of the mountain, and feldspar is exploited upto around 10m from the road. This unpaved road is constructed by the prefecture for exploitation and transportation of feldspar and for other industrial development, and still now, is under construction work or improvement. The road is broad enough for 5 ton-truck to pass.

(2) Reserves

1) Quality

See Picture 2-3 (2). It appears the ore contains only a small amount of mica, but actually a considerable amount of small pieces of mica is contained. Also, kaolin is seen to have adhered to the surface of the ore. Judging from the appearance, the ore here belongs to the same type of feldspar as was found in both of the Kalitengah, Kebon Dalem mines mentioned above. Among the 3 mines, the quality of feldspar obtained here is the best, but the ore here is slightly hard compared with those of other 2 mines.

2) Condition of quarrying site (see Figure 2-24)

The digging face at the front side is dug upto 10m beneath the road. The height of the digging face is standing as high as about 30m, therefore, in the current situation, it is hardly possible to continue to dig further. There is a huge feldspar block at the center of the front side, it is kept as it exists because it has a good quality, and currently, digging is done at the place located deep on the left side of the ore mine where the quality of the ore is inferior.

Underneath the quarrying site, lies the feldspar stratum , the considerable amount of which are left unquarried. It appears that there is a deposit rich in feldspar immediately under the road, and in the direction of this feldspar vein, other 2 mines are seen. At the lower part of the right hand side of the front, black colored rocks as was found in other 2 mines exist.

(3) Quarrying, beneficiation and utilization

CV. Purwogiri has been operating in this mine.

1) Quarrying

As in other mines, digging is done dependent on manpower in this mine. The dug ores are put in the basket and carried down to the temporary storing yard by workers using a carrying pole. Output is checked by the number of the used bamboo baskets. At the present stage, the portion located deep on the left side where the quality of the

ores is poor, but the feldspar at the center of the front side is kept as it is as described above. This is because the clients prefer to get the ore with cheaper price.

Loading place to the truck is made one step lower so that the truck can park alongside this loading platform, therefore, the loading work is easy.

This ore mine is under the guidance and instruction by the provincial government, and pays Rp.2/kg to the province for the instruction fee.

2) Production quantity, price and market

Production quantity, price and market are as follows:

Production quantity:	20 ton/day (in the dry season when the condition is good). The number of workers is about 20.
Price:	Rp.16/kg (poor quality ores) If it is possible to sell the ore at Rp.20/kg, the mine intends to ship the better quality ores. But currently, no demand exists for it.
Market:	The ores are sold to the distributors, therefore, the end-user is unknown.

(4) Important considerations in development

1) Stabilizing the quality

It is recommended that the ore with good quality should not be kept as it is but should be used as an ingredient to improve the quality as a whole. Through the shipment of a mixture of a certain proportion, the quality of the products as a whole is kept stable, and thus, it becomes possible to gain the confidence from the customers. Also, it enables the mine to utilize the ores with poor quality even partly.

The condition of the feldspar existing here has not been investigated. It is necessary to investigate the condition it exists and review the method of exploitation including the possibility of shifting the location of the road there.

2) Improvement of the quality

As a consequence of firing the white clay accumulated in the depressions where high quality ore exists after removing the impurities, it exhibited the coloration of exactly as red bricks. This shows that the coloration of the feldspar here will be slightly improved if only the clay contained in it is removed by washing the feldspar with water.