● PART II Conclusion and Recommendations

1 Conclusion

The present study is designed to develop a plan to build up a stable supply system for appropriate ceramic raw materials for the purpose of promoting the ceramic industry (primarily tableware, novelty products, floor and wall tiles, and sanitary ware manufacturing industries) in Indonesia. This chapter presents the overall conclusion for the study. Further analysis, evaluation and other considerations on a variety of study items, which have led to the conclusion, are compiled in Part III (Detailed Analyses). 1.1 discusses the need for development of ceramic raw materials and planning requirements based on that development. 1.2 presents the results of technical evaluation on various minerals available in Indonesia from the viewpoint of developing an effective material development plan meeting such requirements. 1.3 presents a development plan formulated on the basis of the results and examines their financial viability and the risks involved in implementation of the plan. 1.4 discusses economic benefits expected from implementation of the development plan. Finally, 1.5 describes the results of examination of an optimum system and the process of plan implementation.

1.1 Need for Development of Ceramic Raw Materials and Basic Requirements for the Development plan

(1) Overview

The study examined the development of ceramic raw materials needed for, and basic requirements to be fulfilled by the plan to meet thc need.

The need for a ceramic raw material development plan primarily comes from the interest of securing sustainable growth of the ceramic industry. At the same time, establishing an adequate plan is needed also in view of promotion of economic activities in mining and supply of ceramic raw materials.

The necessity for establishing the material development plan, with the objective of supporting sustainable growth of the ceramic industry, has arisen from the fact that, while the ceramic industry has been growing as a modern capital-intensive industry, supply of ceramic raw materials has relied on local microenterprises and small enterprises. In fact, those engaged in mining and supply of ceramic raw materials do not use machinery or equipment except for trucks, and mining operations are mainly done manually. Also, grading of mined raw materials has been undertaken entirely on the experience of personnel engaged. Expertise and know-how related to production technology of the ceramic industry have not been provided to the upstream sector as feedback information. The technological gap between the downstream and upstream sides has impeded growth of the ceramic industry in the following areas:

1) Quality of ceramic raw materials supplied from local sources varies greatly from one supply lotto another, making quality management of products difficult. As a result, the reject rate of final products is high, increasing production costs.
2) Supply of local materials is not stable and the manufacturers need to hold sizable inventories particularly during the rainy season, to continue their stable production.
3) Some local ceramic raw materials have poor quality to cause of production problems in terms of color and moldability, giving manufacturers virtually no choise but to rely on imported materials. This further increases the production cost and forces manufacturers to hold large inventories to assure uninterrupted production.

However, from the mining and supply side of raw materials, the need for the ceramic raw material development plan is not perceived to be significant. This is due to the fact that since production of ceramic raw materials is chiefly undertaken by small enterprises, expansion of their production is not only difficult but it is also hard for them to have an interest in expansion[1]. Nevertheless, from macroeconomic viewpoints, stable operation and growth of mining and supply seem to be essential because of:

1) Economic effects created through ensuring the optimum use of available resources by improvement of mining methods. The present mining methods will exhaust resources in a short period of time while making otherwise exploitable resources unusable.
2) Economic effects brought about by substitution of imported raw materials with local ones
3) Development of local industries and creation of employment opportunities in rural areas.

At present, however, no effort is being made move to pursue common interests of the ceramic industry and the raw material supply sector. In particular, it is difficult to expect such move on the supply side, at least in the short run, given the nature of the present management structure.

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[1] For relatively large operators, there is no need to obtain external assistance to expand production.

This plan focuses on efforts to narrow the gap between the two sides in terms of technology and management, thereby contributing to stable growth of the ceramic industry, while emphasizing modernization of operation on the supply side.

For the successful implementation, however, the plan must be in line with the procurement behavior of the ceramic industry when procuring raw materials. In fact, the magnitude of the need to overcome the problems of raw material supply, as felt by the ceramic industry, varies with product types and market segments they serve. Their needs with regard to the raw materials development plan may be classified into the following four types:

1) Tile manufacturers do not necessarily demand high-grade materials. In fact, they do not want them if high quality is translated into an additional cost. Rather, they desire to have a stable supply of ceramic raw materials in terms of quantity and quality, and not to face a significant cost increase. As for development of ceramic raw materials per se, they have high expectations.

2) Sanitary ware manufacturers, particularly those of foreign affiliated companies, look for high-grade materials and are ready to accept an additional cost for beneficiation and other processes, so far as the materials can compete with currently imported materials in terms of quality and price. They are interested in the raw materials to be made available through the development plan, from the standpoint of this principle.

3) There are few tableware manufacturers who target the high-end market, and their expectation for development of ceramic raw materials has not come to light yet. At present, they manage to secure appropriate raw materials including use of imported ones.

4) Novelty product manufacturers are expecting the supply of raw material pre-mixtures which can be readily processed. Essentially, they want to manufacture products of stable quality, without the need for special blending efforts according to the quality of raw materials which varies by supply lots. It should be noted, however, that the ingredients of pre-mixtures are required to be designed to meet the characteristics of product types which vary among the producing districts.

Thus, the raw material development plan must match these needs of varying levels. The following sections analyze the needs for ceramic raw material development commonly observed among these subsectors, and difference in their needs.

(2) The need for development of ceramic raw materials by tile manufacturers

Tile manufacturers appear to feel the need for stable supply of ceramic raw materials most strongly as they wholly depend on local sources and are adversely affected financially by unstable quality of ceramic raw materials.

Their view is that, so far as stable quality is ensured, they can accept some cost increase due to the improvement of quality instability. They believe that the improvement will increase a currently low yield of first-grade products (even large manufacturers can achieve a 75% yield for wall tiles and 85% for floor tiles), leading to better profitability. Nevertheless, since the tile market is highly competitive, they will not accept any further cost increase.

Tile manufacturers are the largest consumer of ceramic raw materials, estimated to consume slightly below one million tons of clay annually compared to 1,140,000 tons for all the ceramic products, and more than 550,000 tons of feldspar (720,000 tons for all products) in 1995. Mostly they use locally produced raw materials.

As for clay, manufacturers believe that there are sufficient reserves. However, the following quality problems are identified;

1) Some generate a poor color after firing.
2) The SiO2 content is not stable.
3) The rate of firing shrinkage varies.

Since tiles are thickly glazed to conceal the body color, clay color does not present much problem. High standards are not necessarily required for other qualities also. Nevertheless, unstable quality of raw clay adversely affects yield of the first-grade product, and profitability, so that manufacturers strongly need the improvement of unstable quality.

As for feldspar, it is pointed out that the alkali content varies with supply lots. Since the feldspar is produced from tuff-based (or volcanic rock-tuff-volcanic ejecta-based) feldspar mountains on Java Island, which are feldspar-contained rocks or sediments, rather pure feldspar mines, the feldspar content varies greatly with mine locations. However, since the consumption of feldspar is smaller than clay in tile production, the need for improvement of unstable feldspar quality is not as strong as that for clay.

For stabilizing the quality, the manufacturers believe that the mining method needs to be improved significantly for both clay and feldspar. In particular, it is pointed out that the conventional mining method should be replaced with the modern method by introducing adequate mining technology and capital and establishing a long-term development plan for mining. Their opinion is that for the required improvement of feldspar quality, three stages of dressing will be sufficient on a visual basis, and no more detailed grading will be necessary.

Despite the complaint of manufacturers, no effort has been made on the supply side to improve supply conditions. Instead, manufacturers manage to utilize these ceramic raw materials by making various kinds of adjustments to compensate for unreliable quality.

(3) The need for development of ceramic raw materials by sanitary ware manufacturers

Expectations of sanitary ware manufacturers for development of ceramic raw materials are significantly different from those held by tile manufacturers. Those who manufacture export-grade products do not insist on local materials alone. They are making efforts to improve the yield and productivity, and as required, they replace ceramic raw materials of poor or unstable quality with imported ones or increase the ratio of imported materials they use. Thus, manufacturers of sanitary ware of export grade are ready to accept some cost increase so far as they can obtain local materials that meet current quality requirements.

On the other hand, manufacturers, who produce low-end products of relatively simple shape and form for the domestic market, on a small scale, will find it hard to accept a cost increase.

There are two types of base material used for sanitary ware production depending on the manufacturers. Namely, one is pottery stone-based and another is kaolin and feldspar/quartz-based. The former is mainly used by Japanese affiliated companies, and the latter by European and U.S. affiliated companies. Besides these foreign-affiliated companies, there are local enterprises only serving the domestic market.

Among manufacturers who produce sanitary ware for export-grade on a large scale, some use local materials including clay and feldspar but have been gradually replacing them with imported products due to unstable quality. In fact, the share of local materials used by these manufacturers has dropped to a range between 40% and 60%. On the other hand, those only serving the domestic market do not use imported materials, entirely relying on local sources. Annual consumption by sanitary ware production is estimated at around 23,000 tons of clay, and 12,000 tons of feldspar in 1995.

Major problems of local materials pointed out by sanitary ware manufacturers are as follows:

1) Variation in alkali content of the Lodoyo feldspar;
2) Unstable quality of the Sukabumi clay;
3) Inferior thickening to gypsum mold of the Belitung kaolin;
4) Inclusion of gibbsite in the Bangka kaolin causing unstable quality; and
5) Poor coloring of local materials after firing

There are various evaluations of the local kaolin products (Belitung and Bangka) among the manufacturers.

Sanitary ware manufacturers' expectations for raw material development include feldspar with alkali content of 10% or more, sericite-based pottery stone, and clay having characteristics close to imported kaolin or ball clay.

(4) The need for development of ceramic raw materials by tableware manufacturers

Generally, tableware manufacturers do not express serious concern about the quality problems of local materials, compared to the tile industry, and do not try to develop raw materials. Most of the foreign affiliated companies oriented to production of higher grade products use imported materials only or plan to do so in the near future. Manufacturers of medium grade products use large portions of local materials and compensate for poor coloring of body by thick glazing. They are likely to use local materials of better quality if they become available as a result of the raw material development plan.

Tableware manufacturers as a whole consume an estimated 140,000 tons of clay and feldspar each annually. Consumption of kaolin amounts to 170,000 tons. Generally, tableware produced in the country ranges from medium to high grade products for local hotels and restaurants, medium grade products sold via U.S. supermarkets and other retail outlets, and low end products for domestic supermarkets. Medium grade products for the U.S. market and low end products for the domestic market differ only in design and other minor aspects, and they are produced on the same production line using the same materials. On the other hand, medium and high grade products for hotels and restaurants are produced mostly on production lines specialized for these.

Recently, high grade ceramic manufacturers in Japan and the UK reportedly show strong interest in production in Indonesia and some companies have already decided on investment.

Tableware manufacturers are attempting to use local materials as far as possible, but in actuality, imported materials seem to be used in a fairly high percentage. In particular, many foreign-affiliated manufacturers appear to use imported materials to manufacture high grade products, attempting to maintain the same blending proportion of raw materials as they are accustomed to at their parent company, to avoid operational troubles caused by quality problems of raw materials. High grade ceramic manufacturers who have decided or plan to invest in the country are opting to import almost all of materials required.

Those who use local materials seem to use higher-grade clay (Bangka clay, etc.) compared to tile manufacturers. As for glazing feldspar, they blend feldspars of various sources, and no reliable source is established yet. Although they expect to use local feldspar, they rely on imported products in actuality due to quality problems of local raw materials.

(5) The need for development of ceramic raw materials by novelty product manufacturers

Novelty manufacturers have high expectations of the supply system for premixed body materials.

Generally, they purchase and blend such materials as clay, feldspar, kaolin, and quartz, etc. individually for novelty production. Unstable quality of these materials, however, causes characteristics of the body to vary with each blending. In some cases, various mixtures contained in ceramic raw materials adversely affect the quality of final products. Manufacturers strongly desire the improvement and stabilization of quality of these raw materials, and hope that body materials are supplied in the form of a blended blank, which are readily used for production.

Novelty products manufactured in the country are fairly diverse in raw material, quality, product type and design. Manufacturers are locally concentrated in many areas to form small clusters of microenterprises and supply a variety of products that are different in design and type between the areas.

Most popular products are folk handicraft-type earthenware or stoneware sold as souvenirs, such as relatively small flower vases and pots. Well-known products include those close to earthenware painted with pictures in Plered (terra-cotta), glazed ones in Bali, and those in Malang, considered as high-grade ceramic products. In Kiara Condong, larger pots and plates are glazed. They seem to be a ramification of porcelain originated from China, and similar products are seen in Kalimantan. In Jakarta, there are many potters who make their products without forming a cluster, by using an electric furnace and other equipment. They produce small novelty goods in a great variety, such as ashtrays, dolls, animals, and decorations, but without changing raw materials and their proportion among the products.

At present, in Malang and Plered, the governmental or regional governmental extension service organizations make and supply premixture for novelty production to individuals and companies in neighborhood. In Plered, manufacturers of premixtures are also emerging under the assistance of the extension service organization. The premixtures are made by blending a variety of materials not only of local sources but also those from elsewhere, with proportions being adjusted according to the product type. Nevertheless, the use of premixtures does not necessarily contribute to improvement of product quality.

1.2 Technical Viability and Limitations of Indigenous Minerals in Development of Ceramic Raw Materials

(1) Overview

This section examines and evaluates technically the possibility of meeting the needs for better ceramic raw materials, as identified above, by using mineral products available in the country.

Mineral products, which technical viability is examined here, are clay and feldspar which are locally available but cause problems related to availability or product quality, resulting in use of imported materials, as well as pottery stone and agalmatolite which are considered as alternatives to clay and feldspar.

Technical assessment of ceramic raw materials chiefly covers the following:

1) Viability of quarrying development and stable supply;
2) Viability to ensure stable quality; and
3) Viability to improve quality.

As the basis of technical assessment, analysis and evaluation on various minerals were conducted. The evaluation procedure and results are summarized in Figure 1-1.

For the evaluation of raw materials, coloring after firing and moldability were examined as major technical characteristics of ceramic raw materials which govern production conditions and product quality. In addition to technical characteristics of ceramic raw materials, the possibility of quality improvement by beneficiation was tested and evaluated.

Figure 1-1 Summary on Evaluation Results of Ceramic Raw Materials (1/ 4)

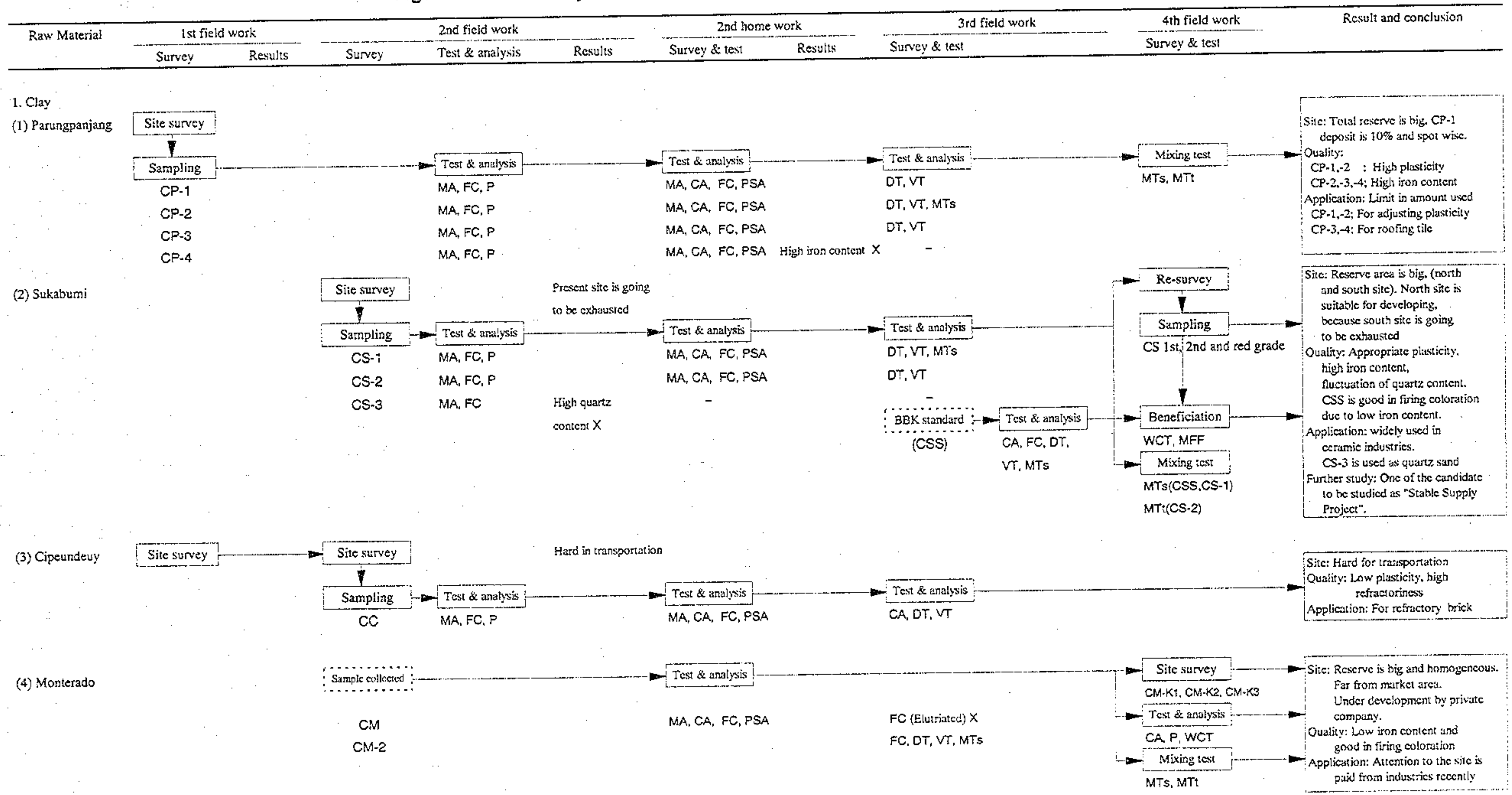

Figure 1-1 Summary on Evaluation Results of Ceramic Raw Materials (2/ 4)

Raw Material	1st field work: Survey	1st field work: Results	2nd field work: Survey	2nd field work: Test & analysis	2nd field work: Results	2nd home work: Survey & test	2nd home work: Results	3rd field work: Survey & test	4th field work: Survey & test	Result and conclusion
2. Feldspar										
(1) Pangaribuan								Site survey → Country rock		
			Sample collected →	Test & analysis →		Test & analysis →		Sampling →	Test & analysis →	Quality: FP is good quality. Country rock is the level for tile. Site: FP has been exhausted and interrupting the operation now. Far from market area
			(FP)	MA, FC		MA, CA, FC	Good in firing coloration	-	MTt	
								FP-2	-	
								FP-3	CA, FC,	
								FP-4	-	
(2) Banjarnegara			Site survey		Big reserve					
			Sampling →	Test & analysis →		Test & analysis →		Test & analysis →	Beneficiation →	Site: Reserve is big and uniform. Quality: Bad in firing coloration due to high iron & mica content. Low alkali content. Beneficiation: Firing coloration can be improved by water washing. Alkali content can be increased up to 10% by floatation separation. Application might be widened in the area of sanitary ware, table ware and glaze, if quality could be stabilized and improved by beneficiation. Application: For tile. Further study: One of the candidate to be studied as "Stable Supply and Beneficiation Project".
			(FB-1)	MA, FC		MA, CA, FC, WWT		CA	WWT, WCT, MFF, FT, AT, MTt	
			(FB-2)	MA, FC	Same as FB-1 X	-		-	FT	
			FB-3	MA, FC		MA, CA, FC	Same as FB-1 X	-	WWT, WCT, MFF, FT, AT	
			FB-4	MA, FC		MA, CA, FC	Same as FB-1 X	-	-	
			FB-5	MA, FC		MA, CA, FC	Same as FB-1 X	FC	-	
			FB-6							
(3) Lampung			Site survey					Site survey →		
			Sampling →	Test & analysis →		Test & analysis →		Sampling →	Test & analysis →	Site: Reserve is big and easy for developing. Hard for transportation to market area. Quality: Low iron content. Quality level is only for tile, due to low alkali content.
			(FL-1)	MA, FC	Bad in firing coloration X	-		- -	-	
			(FL-2)	MA, FC		MA, CA, FC		- -	-	
								FL-3	CA, FC, MFF, FT	
								FL-4	CA, FC,MFF, FT, WWT	
								FL-5		

Figure 1-1 Summary on Evaluation Results of Ceramic Raw Materials (3/ 4)

Raw Material	1st field work: Survey	1st field work: Results	2nd field work: Survey	2nd field work: Test & analysis	2nd field work: Results	2nd home work: Survey & test	2nd home work: Results	3rd field work: Survey & test	4th field work: Survey & test	Result and conclusion
(4) Narawita	Site survey →		Site survey ↓ Sampling →		FN-1 is 5-10%					Site: FN-1 is small deposit and spot wise Quality: Low alkali content FN-1; Low iron content FN-2; Bad in firing coloration due to high iron content Application: FN-1; For tile FN-2; For roofing tile
			FN-1	Test & analysis → MA, FC	Low iron and alkali content	Test & analysis → MA, CA, FC, AT		→	Mixing test → MTt	
			FN-2	MA, FC	High iron, low alkali content	MA, CA, FC, AT			-	
			FN-3/QN	MA, FC	High content of quartz X	-		-	-	
(5) Jepara			Sample collected → FJ	Test & analysis → MA, FC		Test & analysis → MA, CA, FC	High iron X Bad in firing coloration X	-	-	Site: Unknown Quality: High iron content Bad firing coloration High alkali content
(6) Lodoyo								BBK standard (FLS) → Test & analysis FC, CA →	Use as standard kaolin in the test	Site: Unknown Quality: Bad firing coloration
3. Kaolin										
(1) Belitung			Site survey ↓ BBK sample (KB) →	Test & analysis → MA, FC, P		Test & analysis MA, CA, FC, PSA		BBK standard - (KBS) → Test & analysis - FC, CA →	Mixing test → MTs, MTt Use as standard kaolin in the test	Site: Reserve is big Quality: Good firing coloration Beneficiation: Elutriation Application: For paper and ceramic industries
(2) Bangka			Information		Fluctuate in quality X	-		-	-	
(3) Bakom	Site survey	Small deposit X	-	-		-		-	-	

Figure 1-1 Summary on Evaluation Results of Ceramic Raw Materials (4/ 4)

Raw Material	1st field work		2nd field work			2nd home work		3rd field work		4th field work	Result and conclusion
	Survey	Results	Survey	Test & analysis	Results	Survey & test	Results	Survey & test		Survey & test	
4. Toseki/Pyrophyllite											
(1) Pacitan			Site survey		Far from main market area						
			Sampling →	Test & analysis →		Test & analysis →				Mixing test →	Site: Unknown in Toseki deposit reserve Far from market area Quality: Good firing coloration
			(TP-1)	MA, FC	Pyrophyllite X	-		-	-	-	
			(TP-2)	MA, FC		MA, CA, FC	Same as TP-1	-	-	-	
			TP-3	MA, FC	Pyrophyllite X	-		-	-	-	
			TP-4	MA, FC		MA, CA, FC, MTt				MTt	

Note 1. Mark under the frame of "Sampling" mean name of samples collected. The samples in parentheses are collected by BBK.

2. Mark under the frame of "Test & analysis" mean as follows.

MA: Mineral composition analysis	CA: Chemical composition analysis	FC: Firing coloration test	PSA: Particle size distribution measurement
DT: Dispersion test	VT: Viscosity evaluation test	MTs: Molding test (sanitary ware)	MTt: Molding test (table ware)
P: Plasticity evaluation test	WWT: Water Washing test	ET: Elutriation test	WCT: Water cyclone test
FT: Floatation separation test	MFF: Magnetic ferro filter test	AT: Acid treatment test	

3. Studies in dotted frames are carried out by BBK.

The evaluation of major raw materials of local sources are given in the following sections[2].

As a result of the technical assessment, Sukabumi was selected as the stable supply source of clay for development, while satisfactory results were not obtained for the viability of quality improvement. Banjarnegara was selected as the major feldspar source for development; there quality is identified technically as being eapable and in need of improvement (Table 1-1).

(2) Clay

Four sources were evaluated; Parungpanjang, Sukabumi, and Cipeundeuy on Java, which are currently used by the ceramic industry, and Monterado on Kalimantan which is under development.

On the basis of overall technical considerations, the Sukabumi clay was selected as the source best suited for development. In fact, however, the Sukabumi clay is not particularly high in grade, and is difficult to improve in terms of both technology and economy. Furthermore, many deposits have been exploited in an uncontrolled manner over a long period of time and will not be viable for further development. Nevertheless, the Sukabumi clay was selected as the source for development because of the fact that it had the following advantages which more than compensated for the above drawbacks: (1) the source is strategically located in terms of transportation of products to major consumers, namely floor and wall tile manufacturers - representing major portions of the ceramic industry - which are located in Jakarta and West Java, (2) the clay, although low in grade, is still acceptable for tile manufacturers, and (3) while uncontrolled mining is carried out extensively, large exploitable areas still remain intact.

The Monterado clay is most promising in terms of grade and scale of reserves, but it was not selected because of its remoteness to the market and also because of a fact that a foreign-affiliated company has already started commercial development to make external development support less necessary.

The clay resources in Parungpanjang and Cipeundeuy were not selected as they have unique characteristics not suitable for general purpose use, and further, their mining development seem technically difficult.

The results of technical assessment on the four clay sources are discussed in detail below.

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2 For the detail of technical evaluation results of each raw materials, in view of quarrying supply and in view of use for ceramic production, see III-2 and III-4 respectively.

Table 1-1 Summary of Raw material Evaluation by Source

Raw material	Source	Evaluation results				
		Overall evaluation results	Evaluation in view of mining conditions, and locational advantage to the markets	Evaluation of quality		
				For tile	For sanitary ware	For tableware
Clay	Sukabumi	The most advantageous in terms of development for tile use 1) Possible to use for tile 2) Proximity to the markets 3) Possible to develop in large scale However, 1) Quality is not excellent 2) Improvement of quality is technically and economically difficult	- Possible to develop in large scale development - Difficulty in mechanical quarrying - Proximity to the markets	△	X	X
	Parungpanjang	Difficult to use as a major raw material. In adequate for major development. 1) Excessive plasticity 2) Difficulty in water supply and drainage 3) Difficult to develop in large scale	- Difficult to develop in large scale - Difficulty in water supply and drainage - Proximity to the markets	X	X	X
	Cipeundeuy	Inadequate for major development due to difficulty in access and transportation. Good for use specialized in refractoriness.	- Difficult to develop in large scale - Difficulty in transportation of raw materials - Disadvantage in proximity to the markets	△	X	△
	Monterado	Inadequate for major development due to locational disadvantage to the markets for tile use. No need for further development support since under development by J/V with foreign affiliated firm	- Possible to develop in large scale - Easy to quarry - Remoteness to the markets	○	○	○

Table 1-1 Summary of Raw material Evaluation by Source

Raw material	Source	Evaluation results		Evaluation of quality		
		Overall evaluation results	Evaluation in view of mining conditions, and locational advantage to the markets	For tile	For sanitary ware	For tableware
Feldspar	Banjarnegara	The most advantageous position for major development due to consistent quality, proximity to the markets, and potentiality for large scale development. High iron contents and low alkali contents without beneficiation.	- Possible for development in large scale - Easy to quarry - Relatively advantageous location to the markets	Without beneficiation ○ With beneficiation ○	 × △	 × ○
	Pangaribuan	Inadequate for major development since it is already exploited	- Impossible for development - Remoteness to the markets	△	×	×
	Narawita	Inadequate for further development because of small scale resource and quality feldspar is already exploited	- Inadequate for development in large scale - Quality feldspar is already exploited - Disadvantage in proximity to the markets	○	×	×
	Lampung	Under development stage (No need for further development assistance)	- Potentiality for major development - Easy to quarry - Advantageous location to the markets in West Java	○	△	△
Pottery stone	Pacitan	Difficult to justify the major development due to insufficient information available on resources particularly on pottery stone.	- Difficult to develop in large scale - Difficult to quarry - Remoteness to the markets	○	△	△

○ : Possible to use as the major raw material

△ : Possible to use only as a supplementary raw material, or some limiting factors for use.

× : Not suitable for use

1) Sukabumi clay

Sukabumi is located approximately 80km southeast of Jakarta. It is directly accessible to Jakarta via highways and arterial roads, making it advantageous for transportation of output to the major market. The quarrying sites are located in Cicantayan District (northern site) and Padaraang District (southern site), and both are accessible to a main road allowing truck traffic after a few kilometers of mountain roads.

According to the DSM report, the entire mine site area is 500 ha, with thickness of 20m. However, observation at the excavated sites indicates that the deposit is a few meters thick. The Sukabumi Clay Mining Cooperative estimates the clay mine area to be 150ha with 10 million tons in reserve.

The deposit is made of three layers. The first layer is red clay lacking plasticity, 0.5 - 3 m thick (or 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 (sandstone) in mass. The third layer contains gray clay which is highly plastic. As the Gunung Walat mountain at the south end of the quarrying area is made of silica stone or sand, their contents presumably increase southward.

The existing quarrying sites are located on the mountain slope in the northern mine and on the height in the south, where veins seem to be disrupted by mountain formation activity. The southern mine has been excavated indiscriminately and it is not suitable for further development. The northern quarrying site seems to have significant reserves, but its complex vein structure makes it difficult to exploit clay of sufficient grade by simple mechanical development. Instead, mechanization should be limited to preparation work such as the removal of top soil and excavation of the working face, and truck loading and unloading, while actual quarrying operation is done manually, to allow effective grading. This way, work efficiency can be improved and product grade can be stabilized in the subsequent blending process.

In addition, clay deposits seem to be located in the flat area which has been developed as residential or agricultural land, so that a detailed reserve survey, which may open up an opportunity for large-scale development, should be conducted for the entire area.

According to geological maps, Cissat District of Sukabumi Province where the deposits are located is situated near the mid-south end of a Quaternary volcanic product zone, which is adjoined on the south side by Miocene sedimentary phases and limestone phases. Miocene sedimentary phases extend further south, and there is a nearby outcrop of Eocene strata. In addition, a fault-ridden zone of 10km wide and 30km long extends from the west side of Sukabumi City to southwest, and Cissat District located on the margin of the zone. As a result, the area shows great variation in geological structure, and the Sukabumi clay presumably originated in the Quaternary volcanic product zone.

Raw soil is composed mainly of kaolinite. It is clay containing mica minerals such as sericite, and quartz, and is rated as more or less low grade in terms of aluminum content. Plasticity is not very high, while iron content is very large but varying widely between 4% and 15%, according to mining location. It is difficult to improve the clay's grade by beneficiation processes such as elutriation and iron removal.

The cast-in test using the clay with a relatively small iron content showed good dispersibility, but plasticity (particularly, workability) and thickening are not satisfactory. Together with a high iron content (4.17%), these drawbacks make the Sukabumi clay unsuitable for sanitary ware production.

Also, it is not suitable for tableware due to the lack of plasticity and unfavorable color caused by the high iron content.

On the other hand, it can be used as plastic materials for tiles and roof tiles, as well as such red ceramic raw materials as terra-cotta.

2) Parungpanjang clay

The quarrying site is close to Jakarta, approximately 60km southwest of the city. An arterial road and a local road can be used for access, except for 25-minute drive over an unpaved road to the site. However, the road to the district is always congested and a long period of time is required for transportation compared to actual distance.

The quarrying site is located over a flat area along the road. According to DSM, the deposit is 45m thick and extends over 40ha, while quarry operators claim that it is 58m thick. As observed in the pit under excavation, top soil (red clay) is 1.2m - 1.5m deep, followed by 0.5 - 0.7 m of a clay layer with a high iron content and high plasticity, below which a mixture of various ball clays from white super ball clays to ones in varying brown color. There are no boring data available, and because of the limited data and information it is difficult to make quantitative judgment on feasibility of major development. Local conditions suggest that water drainage is required for quarrying operation to be performed during the rainy season, but installation of water supply and drainage equipment is expected to face various technical difficulties, as would be the case for the provision of elutriation and other equipment. In conclusion, the mining site is not suitable for large-scale development.

Geologically, the Parungpanjang clay mine is located near the northeast end of Pliocene sedimentary phases which extend from the southern coast at the west end of Java to northeast (10km north and south, and 25km - 50km east and west). Further east, there are Pleistocene volcanic phases, and Miocene sedimentary phases are to the south. Miocene sedimentary phases are located in midway between a volcanic zone including Mt. G.Karang on the northwest and a volcanic zone running east and west across Java. The Parungpanjang clay seems to have been produced from tuffacious rock that is made of volcanic products from these zones.

Raw soil is primarily composed of halloysite which mixes with quartz and cristobalite. It also contains montmorillonite. Plasticity is very high. It is characterized by high iron content that gives it an unsuitable color, except for those classified as super ball clay.

The very high plasticity limits the amount that can be blended as a slip material. The cast-in test using the super ball clay showed poor dispersibility due to the montmorillonite content, that prevents formation of an adequate sludge. Thus, it is not suitable for sanitary ware production.

For tile production, the clay can be used in a small amounts as a binder. However, it is not suitable as a principal material due to high plasticity and small particle size that results in large firing shrinkage and thus uncontrollable variation of product dimensions.

For tableware production, while plasticity is a favorable factor, the difficulty in slurry adjustment makes it unsuitable for such wet manufacturing process as wet crushing in a ball mill or cast-in molding, etc. Also, the high iron content is not appropriate for medium- or high-grade products due to unfavorable coloring.

3) Cipeundeuy clay

Cipeundeuy is located approximate 60km east-southeast of Bandung. The quarrying site is approximately 3km off a main road from with there is a difference in height of 300m. There is only a mountain road to the site, with enough width to allow only one person, and excavated clay is carried by workers.

According to DSM, the mine site area is 27ha, of which approximately 0.5ha has been excavated. The deposit is 18m thick and there are water springs beneath it. Judging from the state of existing pits which have been excavated for a long period of time, and that of new pits, clay's sedimentation is relatively stable, and exploitable veins seem to extend in a wide area.

However, topography makes the use of machinery difficult, and such transportation equipment as ropeways is not technically or economically feasible. Thus, the site is not suitable for major development.

According to geological maps, Cipeundeuy is located near the center of a Quaternary undifferentiated volcanic product zone which extends 150km east and west and 50km north and south, on the southeast side of Bandung. On the east side, Gabbro peridotite phases extend 5km east and west and 40km north and south.

The Cipeundeuy clay seems to originate in the undifferentiated volcanic products which have been subject to local hydrothermal and weathering actions.

The Cipeundeuy clay is mainly made of kaolinite and contains cristobalite and sericite. While plasticity is relatively low, the small iron content seems to make it suitable for tableware production. In particular, high fire resistance opens up the use for ceramic raw materials, but the cristobalite content requires special care in use.

For tile production, the clay is sufficient in terms of quality and is already used in some products.

With high fire resistance, firing at 1,250℃ turns it into cream color, which changes into gray color with further densification. Thus, the clay is suitable for refractory production and can be used to make kiln bricks for ceramic firing by converting it into chamotte.

4) Monterado clay

The quarrying site is situated approximately 80km north of Pontianak, West Kalimantan. Gentle rolling hills extend 30km north of the area and are extensively covered by white sandy top soil. Below it, high quality ball clays are reported to be present. Although there is no accurate data on reserves, according to information from a company which has started mining in this area, four companies have applied for mining licenses to develop mining sites totaling 5,000ha, and the company has already confirmed presence of veins for 200ha and has started excavation. In a proven mining site, top soil is sand (silica sand) , 1m deep, below which ball clays are present for 3m-5m in depth.

The site can be accessed by using a 6km paved side road (5-6m wide) from a main road. Products shipped to Java are carried by ship on the Kapuas river, starting from Wajok, a 30-minute drive northward from Pontianak. In Wajok, a port capable of accommodating a 5,000-ton class ship is under construction.

According to geological maps, the entire Kalimantan area on Borneo island is composed of sedimentary layers which are made of weathered Cretaceous granite deposited in Tertiary and Quaternary periods and Mesozoic plutonic and sedimentary layers. The West Kalimantan area where the clay deposits are located is dotted with Mesozoic sedimentary layers as seen in Bangka and Belting, thus forming a geological structure which suggests presence of high-grade clay for ceramic production. Compared to Java where there has been formed a complex structure caused by uplift, settlement, active faults and volcanic activities that are generated by the submerging Indian Ocean/Australian plane, the West Kalimantan area is relatively stable geologically and is expected to have uniform and extensive deposits. Unlike Java, the area is covered with white top soil, which is much less contaminated by iron and other colored impurities and suitable for production of white chinaware.

The Monterado clay is primarily composed of kaolin and quartz. In particular, kaolin has a high level of purity and contains little coloring matter such as iron. While particles are relatively coarse, the clay shows good plasticity. The cast-in test results indicate excellent dispersibility and sufficient plasticity. Thus, it can be used as a primary material for sanitary ware[3].

Also, adequate plasticity and a relatively low iron content make it suitable for tableware. The color seems to be acceptable without special treatment, and suitable for medium-grade products.

(3) Feldspar

Three feldspar sources were investigated, Banjarnegara and Narawita on Java, and Lampung on Sumatra. Based on comparative analysis, Banjarnegara was selected as the highest potential source. The Banjarnegara feldspar is rated as a relatively high grade and can be used for tableware through some beneficiation. Also, the mine site, on Java, is located conveniently for the transport of feldspar to manufacturers who are located throughout the island. Also, deposits seem to be suitable for major development.

Besides the Banjarnegara, there is another source of feldspar, Lampung, which can supply tile manufacturers in West Java. The grade of feldspar is relatively high, though the alkali content is as low as 7%. Nevertheless, the location on Sumatra requires a high transportation cost except for the area west of Java. Also, the mine site has been developed by a single mining company which is relatively well managed. For these reasons, the site was excluded from potential sources for new development under the present plan. However, it is expected to develop into a major supply source rivaling

[3] Yet, plasticity falls below that of ball clay in the UK and Gairome clay in Japan.

Banjarnegara, and if the mining company faces difficulty in development, appropriate support should be provided by the government.

1) Pangaribuan feldspar

According to the analysis and tests of the collected samples, the raw feldspar is primarily composed of nearly pure microcline, with little iron and titan content, and shows good coloring. However, the mine has been mostly excavated and only the weathered granite, which is the base rock, is left. Thus, the site is not suitable for major development.

2) Banjarnegara feldspar

The mine site is located south of Banjarnegara in the middle part of Java. It is connected to a main road via a mountain road; it takes about an hour to or from Banjarnegara. The mountain road is suitable for five-ton trucks. There are three mines in an area extending 15km east and west, and deposits seem to extend in a dike form. At present, all the mines are excavated manually, although topography allows for introduction of heavy equipment.

According to DSM, the Ds.Kalitengah mine has 495ha and 60m in depth, while the Ds.Kebon Dalem mine covers 192ha with 50m thick[4].

Judging from topographic and geological conditions, feldspar deposits can be discovered outside of the present 15km range, and are expected to become a major part of feldspar resources in Indonesia, although no detailed resource survey has been conducted.

According to geological maps, the area abounds in faults. A large fault extends east and west around 5km south of Banjarnegara City. Further south, an overthrust fault extends east and west and roughly surrounds an extrusive andesite zone extending 15km north and south and 40km east and west. The andesite accompanies basalt and diabase and develops east and west to form a few dikes.

There are several large faults extending north and south. The area has unique geological structure among other areas in Indonesia which has generally complex geological structure, indicating the history of complex diastrophism. In mineral terms, the area is generally made up of rhyolite with a relatively high feldspar content.

Major components are white feldspar, quartz, and microcline, and their alkali content

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[4] Data on the Ds. Kebutuh Jurang mine are not available.

is low at 7-8%. Iron content is high and adversely affects coloring unless some beneficiation is carried out.

There is only a small variation in quality among samples collected in the large mine site. Iron can be removed by beneficiation treatments.

The Banjarnegara feldspar can be used for sanitary ware production where kaolin, feldspar, and quartz are used as the base materials, if it is refined. Also, it can be used for tile production without special beneficiation.

The possibility to use this for tableware production depends on the possibility of removal of mica that causes pour coloring. If the mica can be successfully removed, in terms of other quality aspects, the Banjarnegara feldspar can be used even for high-grade products.

3) Narawita feldspar

The mine site is located 40km east of Bandung. From the main road, it takes more than one hour rough drive on a unpaved mountain road to the site. Then another 15-minute drive is required to reach Narawita Hill. The road manages to accommodate five-ton trucks. Narawita Hill consists of a 20ha feldspar mountain and a 20ha quartz mountain. The existing mine is located on a 30m cliff, from which veins extend 1-2km in all directions. Boring surveys have confirmed that the ore bed extends 40m downward from the current excavation face. The excavation face (vertical section of the cliff) shows the presence of faults that run in all directions, together with brown color layers of rock containing corroded iron on its surface, white or light gray color layers containing high-grade feldspar, intermediate light brown color layers, and others, forming complex texture and structure. Many sections around the better-grade feldspar layer have been manually excavated, while low-grade portions are left intact. Field observation indicates that better-grade feldspar represents only 5% to 10% of the total.

In addition to the fact that the reserves are small, and located remote from the market, the available good color layers are already limited due to the progress of excavation. The apparently white surface also includes poor color portions, being a sign of unstable quality. Therefore, the site is unsuitable for major development.

Geological maps indicate that the Narawita mine is located near the center but slightly westward of a Quaternary undifferentiated volcanic product zone that extends approximately 150km east and west and 50km north and south, located southeast of Bandung City. On the west side, Gabbro peridotite phases extend from the city, approximately 15km wide. The Narawita mine belongs to a part of the undifferentiated volcanic product zone that is characterized by a high alkali content and a low iron content, and mainly consists of partially weathered volcanic cataclasite. Mineral composition includes sanidine, tridymite, cristobalite, and quartz, with partial inclusion of sericite.

Alkali content is low at 6%, an unsuitable level for sanitary ware production.

Although the iron content is relatively low, 0.5% in white portions and 1.5% in colored portions, the low alkali content makes the material unsuited for tableware production. In terms of color alone, this feldspar is relatively favorable and acceptable for medium-grade products. However, if porcelain is assumed to be the type of ceramic products to be made, a large amount of other complementary materials and feldspar would have to be added, making it difficult to use Narawita feldspar by itself.

It is acceptable for tile production in terms of quality.

4) Lampung feldspar

After a 30km drive north on a main road from the Bandar Lampung Airport (at the southwest end of Sumatra) and a 50km drive westward from Gunung Sugih, the mine site is reached by driving an additional 3km on a side road. The side road is not paved, and in some sections, the maximum speed of a jeep is limited to around 10km/h. It is, however, generally flat and 7-8m wide to allow large trucks (20-ton class) to carry mined mineral products.

According to geological maps, the southern part of Sumatra where the Lampung feldspar mine is located is founded upon early Tertiary formation formations consisting of Paleozoic and Mesozoic layers as well as granite, which are covered by Tertiary and Quaternary sedimentary and volcanic rocks. Top soil has the whitish color peculiar to granite zones, making a sharp contrast to the reddish color found in Java, which indicates a high iron content.

The entire mine site is located within this granite zone where weathered granite can be observed everywhere and feldspar is seen at the bottom of a river flowing nearby. The mine site covers 30ha, and feldspar resources are present over a distance of 1km around the mine and reach 30m in depth. According to DSM, feldspar reserves in this area are estimated at 12.5 million m^2 and constitute major deposits.

Sandy portions which account for approximately 70% of top soil, contain 7% alkali and 0.35% iron.

Sandy layers on top, that are currently, being excavated, are relatively poor in feldspar and alkali content. If the alkali content can be increased, the Lampung feldspar seems to be suitable for tableware production because of the low iron content. The mass portions are already used for tile production.

As for sanitary ware, it can be used for composition of kaolin, feldspar and quartz. However, the low alkali content and a long distance to the market are clear disadvantages. Beneficiation treatment is necessary to increase the alkali content to more than 10% for expansion of the demand.

(4) Pottery stone

- Pacitan pottery stone

The mine site in Pacitan is located in eastern Java (Kabupaten Pacitan) and can be reached by driving around 200km (3 hours and 40 minutes) from Yogyakarta via Surakarta (Solo) City. The mountain road is paved (low-grade) and is extensively damaged. Its width allows two passenger cars to pass each other. There are many steep slopes. It is difficult for five-ton or larger vehicles to be operated on the road.

Geologically, the Pacitan area is located on Miocene sedimentary formations which extend 100km east and west and 50km north and south. On the north side is bounded by Quaternary volcanic rocks and on the south side by Miocene limestone. Overall, geological structure is relatively simple. As a result, uniform and extensive veins are expected without inclusion of other rocks.

Judging from the excavation face, the ore bed appears to be relatively uniform. It presumably extends vertically as there is a vertical distance of 50m from the mountain top where pyrophyllite is excavated to the outcrop of pottery stone.

The area was investigated by a land survey company under contract to the East Java government. Test pits were excavated at 40m-60m intervals over an area of 1km east-west and 500m north-south, and presence of rich pyrophyllite resources was confirmed. DSM also surveyed the area and estimated 5,188,000 m^3 of pottery stone reserves (according to Bahan Galian Industri di Indonesia).

Major components are quartz and sericite. It is considered to be low-grade pottery stone as the sericite content is low. As is evident from the color, iron (Fe_2O_3) and titan (TiO_2) contents are very low, 0.08% and 0.28% respectively. Plasticity is sufficient to mold small products. For sanitary ware, it can be used as a supplemental ingredient.

For tile production, it can be used as a primary material. In fact, it has previously been used for the purpose, but use was terminated due to unfavorable mining and transport conditions as well as the long distance to the market.

As for tableware, it may be used for medium-grade tableware products, since the low iron content makes for good coloring, though the quality is not high due to the low sericite content. Further, it needs to be used with clay having high plasticity and a favorable color because its plasticity is not high enough as required for pottery stone.

1.3 Ceramic Raw Material Development Plan

1.3.1 Planning concepts

(1) Selection of planning concepts

In consideration to the needs and requirements for ceramic raw material development, and technical potential and limitations of resources, which were identified and evaluated in the previous sections, three planning concepts as a basic framework for the contemplated plan are established as follows:

1) Supply ceramic raw materials having stable quality, not necessarily high grade, to the tile industry, which is the largest sub-sector of the ceramic industry in the country, as the plan's primary target.
2) Develop a system to refine the above raw materials and supply them to tableware and sanitary ware manufacturers.
3) Develop small-scale ready-mix body supply facilities near clusters of small ceramic producers that are located throughout the country, and supply one or a few clusters nearby with the premixed body, haring preparing it according to the requirements in each cluster.

In establishing the above planning concepts, the following factors were taken into account:

1) Supply of premixed body

At present, only small novelty manufacturers want supply of premixed body and demand has not reached a critical level to justify the development of a major system. Other manufacturers are reluctant to disclose their own blending know-how, and further, they have their own blending facilities and testing facilities for self-protection against the unstable quality. Thus, development of the supply system of premixed body should be considered after establishing manufacturers' confidence in external supply sources through operation of supply system of raw materials of stable quality, and the establishing of close linkage between suppliers and ceramic manufacturers.

However, the small-scale community-based premixed body supply facility is a possible concept in that the novelty manufacturers supply products of uniform materials and product levels in each cluster.

2) Improvement of quality of ceramic raw materials

The need for quality improvement is particularly high among sanitary ware manufacturers. Tile manufacturers, strongly hoping for the supply of raw materials with stable quality, cannot not absorb much cost increase. Tableware manufacturers do not have any particular expectation for quality improvement, but they are likely to use improved raw materials if it is technically and economically feasible to do so. Meanwhile, quality improvements of currently available raw materials require accepting significant additional costs. Thus, quality improvement efforts must be limited to the scope that is technically and economically viable, and in particular, the first step should focus on stabilizing quality.

3) Possible blending of raw materials from different sources

Transportation costs account for major portions of clay and feldspar prices in the country, and blending these materials from different sources has additional cost impact. For instance, typically the price of clay at a mining site ranges between Rp.8 - 10/kg, while the price of clay from other sources exceeds Rp.20/kg. Thus, the first step of quality improvement should be limited to the use of raw materials available at a particular site.

4) Use of sources outside Java

The Monterado clay and the Lampung feldspar available outside Java have high development potential because of the large scale of reserves. In consideration to the following unfavorable factors, however, they are not considered in the plan:

a) the plan primarily serves tile manufacturers on Java, for whom high transportation costs will be a major bottleneck; and
b) the two sources are currently operated by companies having sound technical and management bases, who do not require outside support for new development.

So far as these sources are commercially available, development of sources in Java should be limited to those that are technically and economically viable. In addition, development projects should be planned and implemented in consideration of possible use of sources outside Java, e.g., blending them with materials produced in Java.

(2) Operationalization of the planning concepts

The following sections give shape to the above planning concepts. The process is shown in Figure 1-2 and summarized in Table 1-2.

The first planning concept mandates the ability to supply raw materials of adequate quality to tile manufacturers in Java, particularly West Java, where demand is concentrated, without significant cost increase required for beneficiation and transportation. Also, the following restrictions need to be considered:

1) the transportation cost dictates the use of raw materials which are available in Java, particularly the western or central region;
2) the transportation cost represents 40% - 50% of the prices of currently used clay and feldspar, as delivered to users, so that transportation of raw material from one source to another for blending purpose, followed by transportation to customers, is cost prohibitive.

As a result, stable quality is to be achieved by using raw materials from a single source and by careful grading at the mining site, blending, and quality control. Mining sites were selected in Sukabumi for clay and in Banjarnegara for feldspar, as they are relatively close to buyers, products are acceptable in terms of grade, and resources are commercially exploitable in terms of reserve scale and accessibility. No other candidate site meets these requirements.

The second planning concept (supply of refined materials) is difficult to implement if raw materials available in Java are to be used; there is a technical difficulty for clay and a cost obstacle for feldspar. As a result, imported materials should be used instead, and for future options:

1) as for feldspar, possibilities should be assessed after demand grows sufficiently to justify a large beneficiation plant.
2) as for clay, further resource surveys should be continued in an attempt to discover new prospective sources.

It should be noted that the Monterado (Kalimantan) clay and the Lampung (Sumatra) feldspar are commercially exploitable in terms of product grade. Further, it is difficult to find high-grade materials in Java, as judged from its geological conditions. In considering the above two options, therefore, the blending of these materials with those available in Java seems to be a realistic strategy.

Figure 1-2 Needs and Limiting Factors of Ceramic Raw Material Development Plan, and Selection Process of Plan Concept (1)

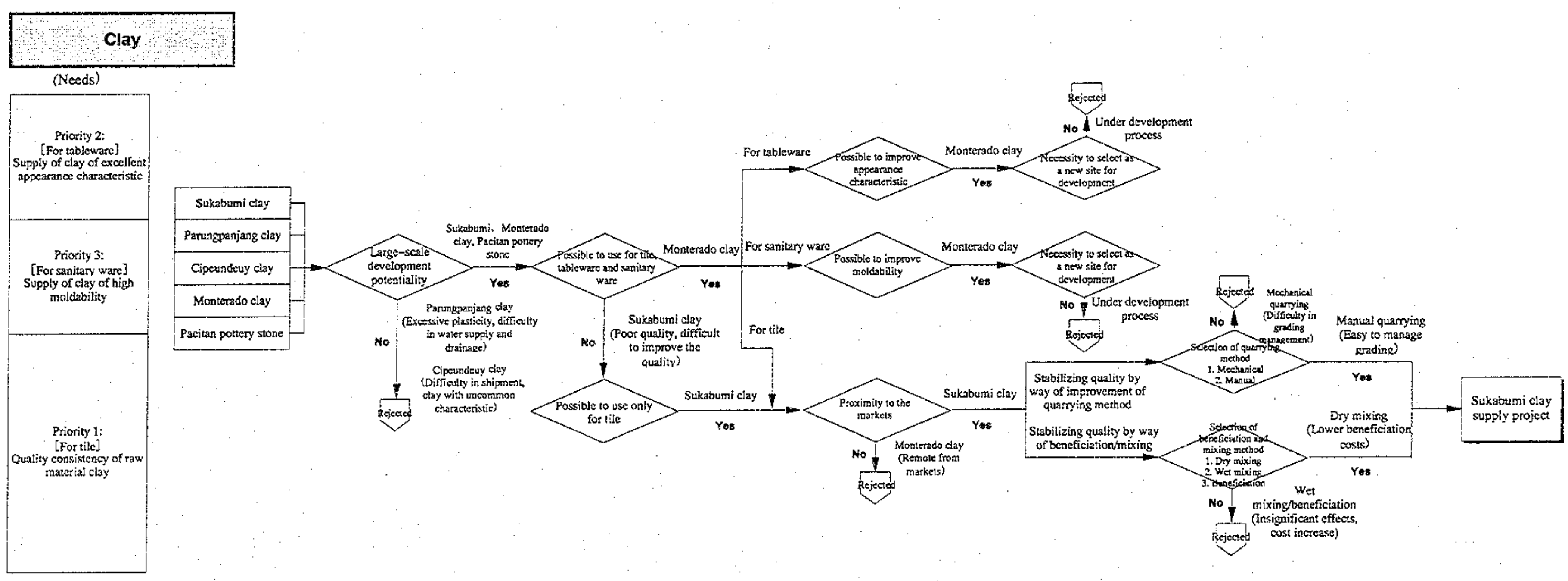


Figure 1-2 Needs and Limiting Factors of Ceramic Raw Material Development Plan, and Selection Process of Plan Concept (2)

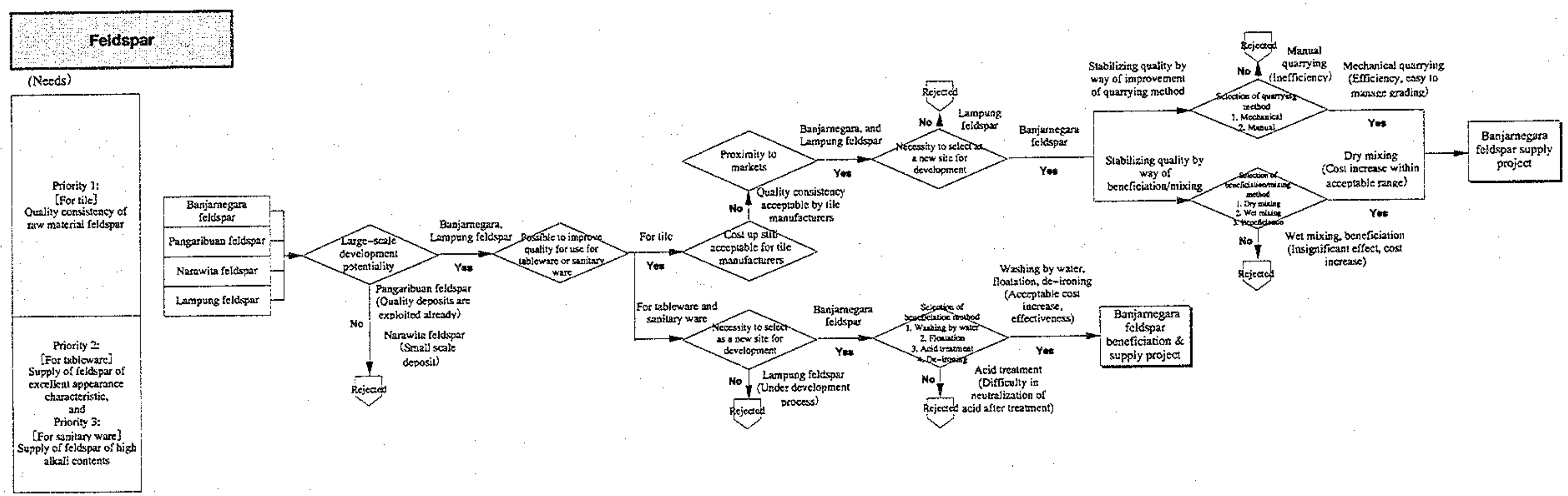


Figure 1-2 Needs and Limiting Factors of Ceramic Raw Material Development Plan, and Selection Process of Plan Concept (3)

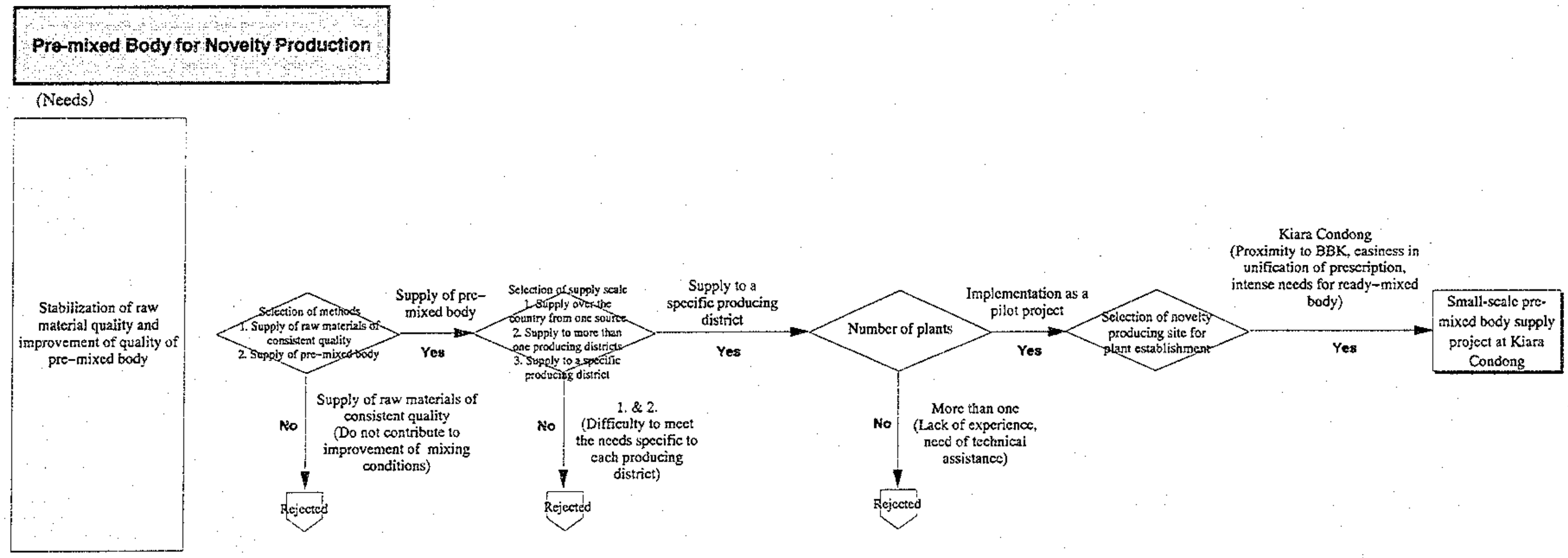


Table 1-2 Selection of Planning Concept ◎:Great expectation, ○:Implementation expected, △: Probable to use if implemented, X:Expectation insignificant

Needs for development plan	Extent of expectation for the projects: Tile	Tableware	Sanitary ware	Novelty goods	Sources of minerals of technical potentiality	Limiting factors	Plan concept selected
Clay							
Quality consistency of raw material clay	◎	△	X	X	Sukabumi	Possible to use for tile, but inadequate for tableware and sanitary ware	Supply of clay of consistent quality focusing on tile manufacturers
					Monterado	No need to select as a site for development since it is already under development stage. Inadequate to use for tile because of prohibitive transportation costs.	Plan rejected
					Bangka (Kaolin)		
					Belitung (Kaolin)		
					Quality stabilization with mixing of materials from more than one sources	Increase in transportation costs.	
					Supply as pre-mixed body	Increase in transportation costs. Difficulty in disclosing mixing technology to the public.	
Supply of clay of excellent appearance characteristic	△	△	○	X	Monterado	No need to select as a site for development since it is already under development stage.	Plan rejected
					Bangka (Kaolin)		
					Belitung (Kaolin)		
Supply of clay of high moldability	X	△	○	X	Monterado	No need to select as a site for development since it is already under development stage.	Plan rejected
					Pacitan (Toseki)	Impossible to define the size of deposit. Remoteness to the markets.	

Table 1-2 Selection of Planning Concept

◎:Great expectation, ○:Implementation expected, △: Probable to use if implemented, X:Expectation insignificant

Needs for development plan	Extent of expectation for the projects: Tile	Tableware	Sanitary ware	Novelty goods	Sources of minerals of technical potentiality	Limiting factors	Plan concept selected
Feldspar							
Quality consistency of raw material feldspar	◎	△	X	X	Pangaribuan	Quality deposits are already exploited. Remoteness to the markets.	Plan rejected
					Narawita	Small scale deposit. Quality deposits are mostly exploited. Remoteness to the markets.	
					Lampung	No need to select as a site for development since it is already under development stage.	
					Banjarnegara		Supply of feldspar of consistent quality focused on tile manufacturers
					Quality stabilization with mixing of materials from more than one sources	Increase in transportation costs.	Plan rejected
					Supply as pre–mixed body	Increase in transportation costs. Difficulty in disclosing mixing technology to the public.	
Supply of feldspar of excellent appearance characteristic	△	○	△	X	Pangaribuan	Quality deposits are already exploited. Remoteness to the markets.	Plan rejected
					Narawita	Small scale deposit. Quality deposits are mostly exploited. Remoteness to the markets.	
					Lampung	No need to select as a site for development since it is already under development stage.	
					Banjarnegara	Not viable due to low yield rate of feldspar	
					Quality stabilization with mixing of materials from more than one sources	Increase in transportation costs.	

Table 1-2 Selection of Planning Concept

◎:Great expectation, ○:Implementation expected, △: Probable to use if implemented, X:Expectation insignificant

Needs for development plan	Extent of expectation for the projects: Tile	Tableware	Sanitary ware	Novelty goods	Sources of minerals of technical potentiality	Limiting factors	Plan concept selected
Feldspar (continued)							
Supply of feldspar of high alkali contents	X	○	○	X	Pangaribuan	Quality deposits are already exploited. Remoteness to the markets.	Plan rejected
					Narawita	Small scale deposit. Quality deposits are mostly exploited. Remoteness to the markets.	
					Lampung	No need to select as a site for development since it is already under development stage.	
					Banjarnegara	Not viable due to low yield rate of feldspar	
					Quality stabilization with mixing of materials from more than one sources	Increase in transportation costs.	
Pre-mixed Body for Novelty Production							
Stabilization of raw material quality and improvement of quality of pre-mixed body	X	X	X	◎	Supply of pre-mixed body	Difficulty to meet the needs specific to each producing district. Lack of experience.	Supply to a specific producing district.

The third planning concept must take into account the following factors:

1) an organization to provide technical assistance is required near a cluster of producers in order to meet the needs peculiar to each locality; and
2) it is difficult to deploy the facilities to supply premixed body near all the clusters of producers because of difficulty in establishing an implementation body in each locality and due to the lack of experience in such an undertaking.

Instead, it is viable to start a pilot project in a production area that already has high demand for premixed body, as it will serve as a model for the rest of the country as a result of subsequent specialized publicity efforts, and diffusing the experience and know-how gained. Kiara Condong was selected as the best suited production area. Other areas include those which are already served by public organizations or private enterprises to supply premixed body, such as Malang and Plered, and those where relatively simple products are manufactured and quality of raw materials is not a major concern. These areas can be dealt with on the basis of experience in the pilot project.

1.3.2 Plan outline

The selected projects comprising the ceramic raw material development plan, and the relationships among projects as well as between projects and major users, are shown in Figure 1-3 and Table 1-3.

Six potential projects have been selected, as summarized below. However, as a result of the detailed evaluation of each project, 4 projects, namely, (1), (3), (5), (6), are recommended for implementation would fare. Detailed evaluation of the project (2) was not undertaken, since it has technical difficulty in implementation.

(1) Sukabumi clay supply project

The primary purpose of the project is to supply clay of stable quality to the tile industry which is the largest sub-sector of the ceramic industry in the country. No beneficiation to improve clay quality will be conducted.

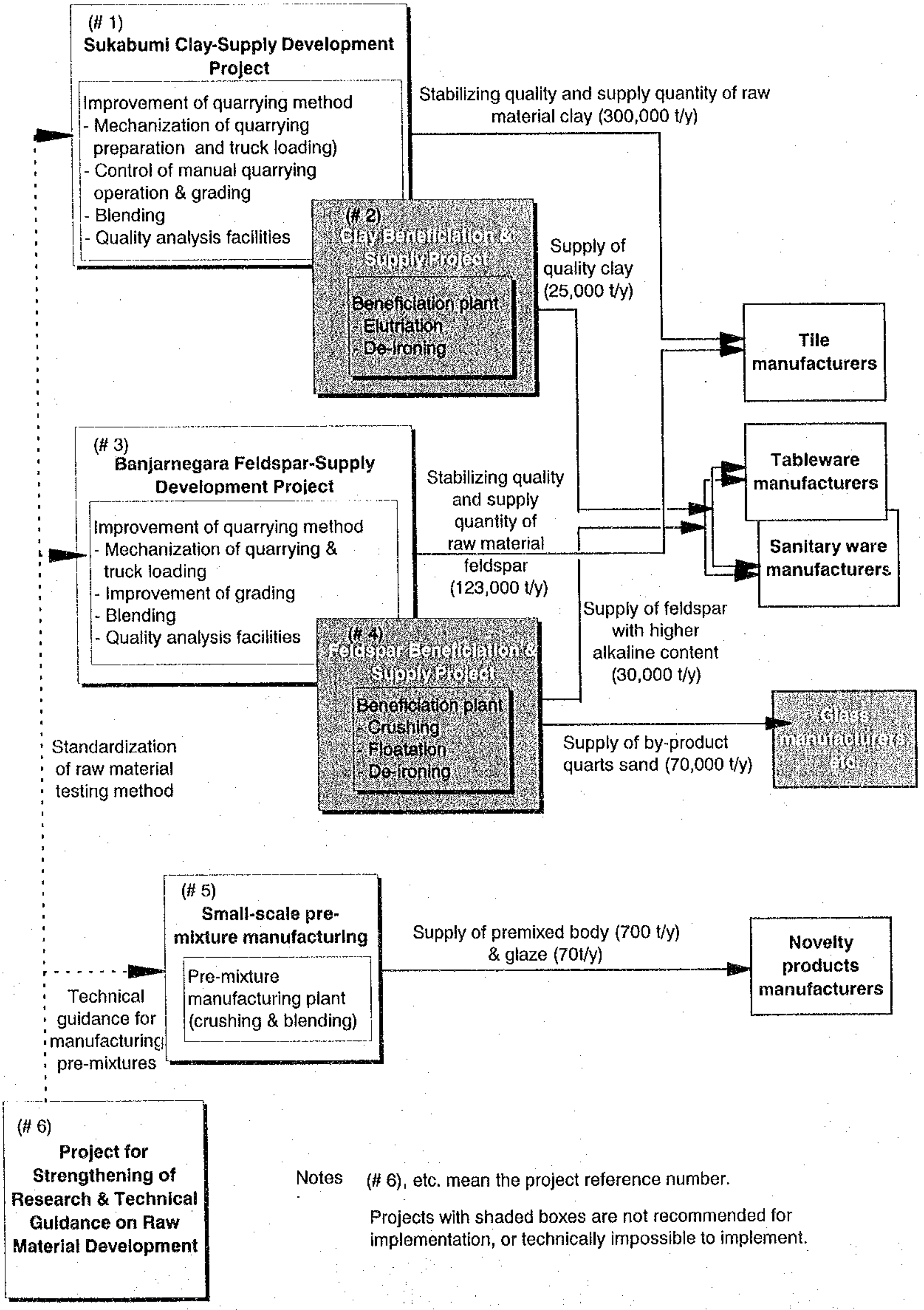
(2) Sukabumi clay beneficiation and supply project

The project aims to supply clay suitable for use by tableware and sanitary ware manufacturers by beneficiation of the Sukabumi clay.

(3) Banjarnegara feldspar supply project

The primary purpose of the project is to supply feldspar of stable quality to the tile industry which is the largest sub-sector of the ceramic industry in the country. No beneficiation for quality improvement will be conducted.

Figure 1-3 Outline of Ceramic Raw Materials Development Plan



Notes (# 6), etc. mean the project reference number.

Projects with shaded boxes are not recommended for implementation, or technically impossible to implement.

Table 1-3 Summary of Ceramic Raw Materials Development Plan

No.	Project	Objectives	Project Description	Evaluation Results	Estimated Initial Fund Requirement
(1)	Sukabumi Clay Supply Development Project	Stabilize quality and supply quantity of raw material clay	Location: Sukabumi (Land under ownership of National Gov't) Contents: 1) Large-scale quarrying development 2) Efficient quarrying development with mechanization of quarrying preparation and truck loading 3) Cotrol of manual quarrying operation & grading 4) Construction of stockyard for grading 5) Construction of blending facilities 6) Installation of equipment for quality analysis Beneficiaries: Tile manufacturers in West ant Central Java Capacity: Shipment capacity: 300,000 tons/year Implementation: Private operation	Implementation recommended (High technical effects anticipated; Reasonable profitability; High economic effects) - FIRR: 23.2% - EIRR: 24.3%	Rp. 10,304.9 million (US$ 4,422.6 thousand)
(2)	Refined Clay Supply Project	Supply of quality clay	Location: Sukabumi (Land owned by the National Gov't) Contents: Construction of refining plant - Beneficiation (elutriation) - De-ironing Beneficiaries: Sanitary ware manufacturers in West Java Capacity: Shipment capacity: 25,000 tons/year	Impossible for implementation (De-ironing is technically impossible)	
(3)	Banjarnegara Feldspar-Supply Development Project	Stabilize quality and supply quantity of feldspar	Location: Banjarnegara (Land owned by provincial Gov't) Contents: 1) Improvement of quarrying development 2) Efficient quarrying development with mechanization of quarrying preparation and truck loading 3) Cotrol of manual quarrying operation & grading 4) Construction of blending facilities 5) Construction of beneficiation plant 6) Installation of equipment for quality analysis Beneficiaries: Tile manufacturers in Java Capacity: Shipment capacity: 123,000 tons/year Implementation: Private operation	Implementation by private initiatives recommended (High technical effects anticipated; Reasonable profitability; Low economic effects) - FIRR: 32.7% - EIRR: 4.6%	Rp. 10,602 million (US$ 4,550.5 thousand)

Table 1-3 Summary of Ceramic Raw Materials Development Plan

No.	Project	Objectives	Project Description	Evaluation Results	Estimated Initial Fund Requirement
(4)	Refined Feldspar Supply Project	Supply of feldspar with higher alkaline content	Location: Banjarnegara (Land owned by the Provincial Gov't) Contents: Construction of beneficiation plant - Crushing facilities - Floatation facilities - De-ironing Beneficiaries: Sanitary ware and tableware manufacturers in Java, Glaze manufacturers Capacity: Shipment capacity: Refined feldspar 30,000 tons/year, Quartz sand 70,000 tons/year Implementation: Private operation	Implementation not recommended (Technical effects are expected; but profitability not expected because of small in size, and low yield rate of feldspar) - FIRR: -3.2% - EIRR: -3.5%	Rp. 68,410.2 million (US$ 29,360.6 thousand)
(5)	Small-scale Premixed Body & Glaze Manufacturing Project	Supply of premixed body & glaze to the local small scale novelty mfrs.	Location: Bandung (at BBK) Contents: 1) Construction of premixed body & glaze manufacturing plants 2) Procurement of raw materials, and manufacturing and supply of pre-mixtures and glaze 3) Installation of equipment for quality analysis Beneficiaries: Novelty manufacturers in Kiara Condong Capacity: Shipment capacity: 700 t/y of body & 70t/y of glaze Implementation: UPT/BBK Others: Model project for dissemination in other producing districts	Implementation by government sector recommended (Profitability is improved with implementation by government sector; Recommend implementation because of expected economic contribution to the development of local industry, national economic effects, and role played as a pilot project) - FIRR: 7.5% (Implementation by government sector: 15.5%) - EIRR: 11.5%	Rp. 1,303.7 million (US$ 559.5 thousand)

Table 1-3 Summary of Ceramic Raw Materials Development Plan

No.	Project	Objectives	Project Description	Evaluation Results	Estimated Initial Fund Requirement
(6)	Project for Strengthening of Research & Technical Guidance on Raw Material Development	Strengthening of technical support system for the above raw material development projects	Contents: 1) Supplementary technical study - Boring survey for Sukabumi and Banjarnegara - Sample raw material evaluation at users' plants 2) Strengthening of functions of BBK in providing continuous assistance, including; - Standardization of raw material testing method - Research on manufacturing conditions of premixed body and its improvement - Product development research taking into account the limitation of local raw materials 3) Establishment of international training courses in BBK on raw material development Beneficiaries: The above projects and ceramic industries Implementation: BBK	Implementation recommended	1) Supplementary boring survey - Sukabumi US$ 1,050,000 (US$ 270,000 for the sites required for the 1st 5 years only) - Banjarnegara US$ 370,000 2) Additional testing equipment US$ 124,000 3) Other expenses

(4) Feldspar beneficiation and supply project

The project aims to supply feldspar suitable for use by tableware and sanitary ware manufacturers by beneficiation of the Banjarnegara feldspar. It will also supply feldspar for production of glaze.

(5) Small-scale premixed body and glaze supply project

The project constructors a facility to supply premixed body and glaze to clusters of small-scale novelty manufacturers in Kiara Condong. It serves as a pilot plant to collect data and information to be supplied to similar facilities serving other clusters.

(6) Project to build up capabilities for ceramic raw material research and development and technical assistance

The project is designed to build up resources and organizational efforts in the areas of ceramic raw material R&D and technical assistance under the leadership of BBK.

1.3.3 Sukabumi clay supply project[5]

1.3.3.1 Project concept

To improve the quarrying management and grading to ensure supply of the Sukabumi clay with stable quality. A blending facility of different grade clays will be constructed. Instead of selectively quarrying and shipping higher-grade products only, lower-grade products which are currently discarded will be mixed with higher-grade ones to improve mining yield. Target quality levels are those suitable for use by tile manufacturers.

To facilitate quarrying work and transportation of excavated materials, heavy equipment will be introduced.

To control clay quality at a certain level, analytical instruments will be introduced to trace clay quality during mining and before and after the mixing operation.

1.3.3.2 Project outline

(1) Project site

The project site is located in the Sukabumi clay mountain. As the southern pit has been excavated indiscriminately and is not suitable for new development, the new development will focus on the northern pit. A primary stockyard will be provided at the quarrying site to grade and store clay as excavated.

A secondary stockyard and a mixing plant will be provided near the main road to receive and blend clays excavated from the mine above the mountain. Primary

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[5] For the detail of technical and financial/economic evaluation of each project, see III-5.

candidate sites for the stockyard and the mixing plant are existing stockyards in the northern and southern areas, which will be expanded to accommodate the facilities.

(2) Quarrying

Prior to quarrying, top soil will be removed by using an earthmover, and site preparation will be done to make the excavation face widely visible and facilitate quarrying planning.

As clay layers in the site form a complex structure, mechanical excavation causes the mixing of clays of different grades, making planned blending in the subsequent stage difficult. Excavation will therefore be carried out manually. At the primary stockyard to be provided in the site, excavated clay will be visually classified (based on content of quartz sand and iron [or color]) into 3 to 4 grades and will be stockpiled.

Clay stocked at the primary stockyard will be loaded onto trucks by using the above equipment for transportation to the secondary yard.

(3) Blending and shipping

At the secondary stockyard and the mixing plant, graded clays will be mixed to produce and store clay of specified quality.

Crude clay transported from the site will be classified according to the grade and stored temporarily. Clay of each grade will be carried by a wheel loader to a box feeder, in an amount determined according to the preset blending ratio. From the box feeder, clay will be batched and fed to belt conveyors for dry mixing. Mixed clay will mostly be stockpiled outside, while part will be kept under a shelter prior shipment during periods of rain. Finally, it will be loaded to users' trucks by the equipment provided for the purpose (Figure 1-4).

1.3.3.3 Project definition

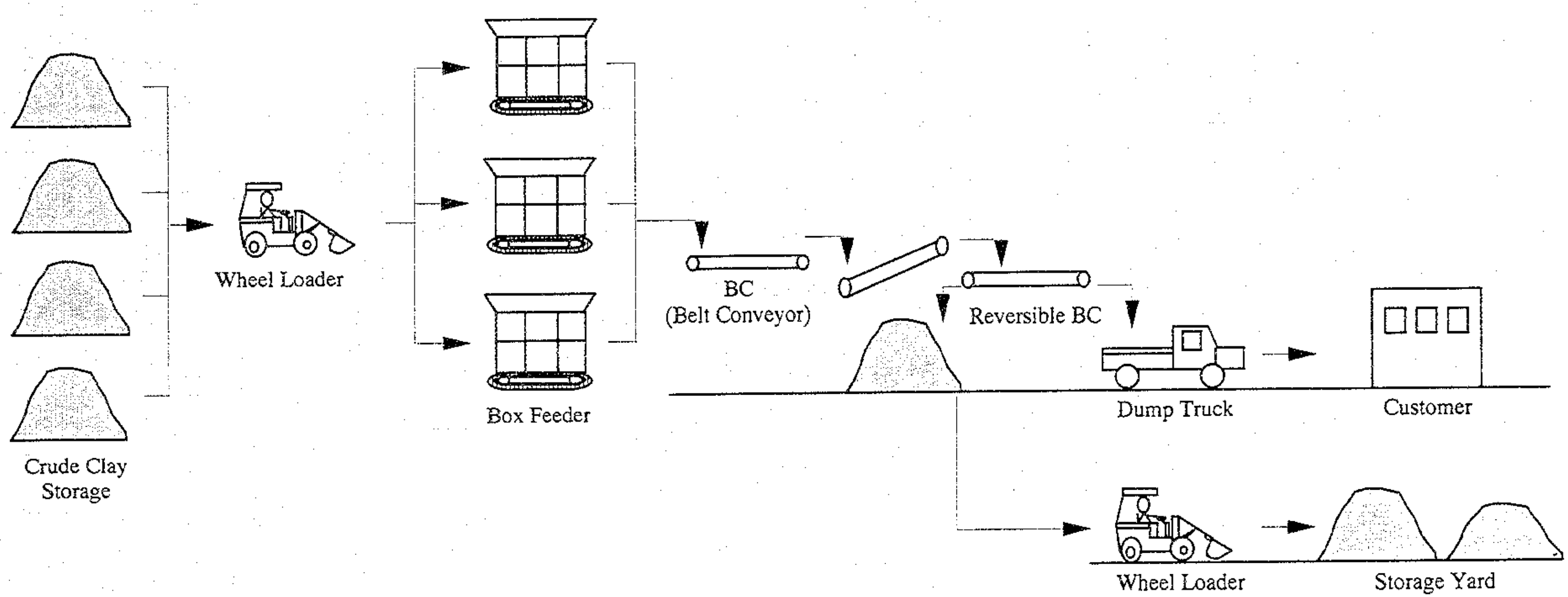
(1) Production capacity

The annual production capacity is assumed to be 300,000 tons. The basis of the assumption is as follows:

Major customers are floor and wall tile manufacturers in West Java. Judging from the grade of clay currently produced at the mine, it is unlikely to be usable for production of tableware and sanitary ware. It is difficult to ship the clay to central and eastern parts of Java because of high transportation cost.

An alternative supply source of clay to tile manufacturers in West Java is Parungpanjang other than Sukabumi. This clay, however, can satisfy part of their clay requirement (less than 10% of total clay use), due to its special technical feature. Kaolin

Figure 1-4 Sukabumi Clay Supply Process Flow Chart (300,000 t/y)



and ball clay from Belitung is also used in some cases as an alternative source of clay, but the price is too high for tile manufacturers. A few tile manufacturers have clay deposits of their own. These clay sources are estimated to satisfy around 40% of the clay requirement of the tile manufacturers. The Sukabumi clay, on the other hand, is estimated to have supplied the remaining 60%, in that Sukabumi quarries 1,000 tons a day (or 300,000 tons a year) of clay. However, these are very rough estimates based indirect and individual information such as quarrying capacity of a worker per day, etc. Thus, the size of designed production capacity was decided at the safe side as 300,000 tons a year. Since the demand for clay in 1998 projected by MOIT is around 950,000 tons, the project is to supply 30% of the requirement. The sales volume with the assumed production capacity, therefore, seems to be suitable under the competitive situation stated above.

The internal rate of return (IRR; before tax unless otherwise specified) for the project is 23.2%, high enough to indicate that the project is feasible. As shown in Table 1-4, an increase in production capacity improves profitability further. However, the expected sales amount, 300,000 tons, is based on a relatively high market share (30% or slightly more based on the 1998 outlook, and slightly less than 60% based on the 1995 figure [520,000 tons]). To allow for a risk of lower sales, it is undesirable to increase the production capacity above the assumed level. On the other hand, a lower capacity will decrease profitability.

Table 1-4 Change in IRR with Change in Production Capacity and Operation Rate (Sukabumi Clay Supply Project)

		Production Capacity (ton/year)			
		420,000	360,000	300,000	240,000
Operation Rate(*1)	100%	27.4%	25.5%	23.2%	18.6%
	Low case(*2)	15.4%	16.8%	18.4%	

(*1) Operation rate in the 2nd year. The operation rates are 65% for the 1st year in both cases.

(*2) The maximum saleable volume is assumed at 240,000tons.

(2) Quarrying

1) Quarrying area

A few quarrying sites will be selected in the northern mine. Assuming that deposits are 5m thick and production will last 20 years for two sites, each site requires 40ha.

2) Quarrying plan

Quarrying will be carried out at three or more cutting points by using the bench method. After removing top soil, a face is bench cut to identify distribution of clay resources and quality variation throughout the mine. Then, a quarrying plan is established according to resource distribution, including grade classification standards, excavation and disposal methods and the methods of utilization and mixing of clay including poor grade clay to be disposed. The work will be carried out by an adequate earthmover.

Crude clay will be classified into 3 to 4 grades. However, as each grade is present in a very thin layer or sporadically, often intermingling with other grades, different grades of clay will be randomly mixed in the excavation process, making proper grading difficult. For this reason, each grade will be further sub-graded into two to three at the primary stockyard in the quarrying site for proper control.

Given the complex geological structure at the quarrying site, resulting in thin and narrow clay layers, mechanical excavation does not permit detailed quality grading, or may even lead to wider quality variation. Thus, manual excavation is recommended for quarrying at the site.

(3) Transportation of crude clay to the secondary stockyard

Crude clay is assumed to be transported to the secondary stockyard by a contractor who is currently engaged in excavation and transportation. The contractor seems to be able to meet requirements as they transport 1,000 - 2,000 tons per day, depending upon the season. However, loading equipment needs to be added to avoid congestion at the shipping area of quarrying site. While the use of dump trucks is the most effective means for streamlining the unloading work at the secondary stockyard, it requires large investment and would make existing trucks idle. Thus, the acquisition of dump trucks should be considered in connection with the gradual replacement of existing older trucks.

(4) Homogenization of crude clay

The crude clay is mixed using a mixer to be homogenized.

The Sukabumi clay has the following disadvantages:

1) High iron content to produce color deeply after firing;
2) High quartz sand content; and
3) Large variation of quartz sand and clay ratio.

According to results of the magnetic de-ironing test conducted in the study, iron removal was not significant as the color after firing improved only 5 to 6% in the degree of whiteness. Generally it is believed that the iron contaminant can be removed to some degree, in the treatment process, or contaminant can be reduced in an iron mixture having strong magnetism , but when there is a small amount of iron inherently contained in clay, which governs the color after firing, it can rarely be removed by use of magnetic force since it is already oxidized. Thus, use of the de-ironing process is not assumed for the present project.

Beneficiation or homogenization of clay is generally carried out by either of the following methods:

1) Dry mixing: mixing using a mixer
2) Wet mixing/beneficiation: Separation and mixing by using a water cyclone or a thickener

To improve quality uniformity of the Sukabumi clay, the most effective way is to control grading of clay strictly in the quarrying process and to separate quartz sand from clay by using a water cyclone or a thickener. However, this method requires a large investment and is not justifiable to tile manufacturers in terms of cost . Further, according to the evaluation tests conducted, clay refined by this method still contains a high percentage of iron, disqualifying it for use as a principal ingredient for porcelain, sanitary ware, insulators, and refractories which require a higher level of quality. For the present project, therefore, dry mixing, rather than wet mixing/beneficiation, is assumed.

(5) Quality control equipment

Testing and inspection equipment for quality control will be installed.

To effectively evaluate and control the quartz sand/clay ratio and color after firing, which are the most important factors in quality control, it is recommended to facilitate work by acquiring sieves, a dryer, an electrical furnace for firing, some small devices, balance, and molds for firing work pieces.

1.3.3.4 Required funds, profitability, and risk related to the project

(1) Estimated initial fund requirements

The estimated initial funds required for the project are summarized in Table 1-5.

Table 1-5 Estimated Initial Fund Requirement
(Sukabumi Clay Supply Project)

	Rp. million	US$ 000
(1) Land acquisition & preparation	1,328.2	570.0
(2) Building & warehouse	370.8	159.1
(3) Facilities	7,843.5	3,366.3
1) Machinery & equipment	1,509.1	647.7
2) Vehicles	6,334.4	2,718.6
(4) Others (*)	762.4	327.2
Total	10,304.9	4,422.6

(*) Including pre-operating expenses, initial working capital, etc.

(2) Profitability

Projected revenue and expenditure for the project up to the seventh year of operation are summarized in Table 1-6. Except for the first year, revenues will exceed total production costs. Accordingly, profitability measured by IRR is high at 23.2% for before tax and 20.1% for after tax, high enough to attract private investment.

Table 1-6 Sales Revenue and Production Costs
(Sukabumi Clay Supply Project)

(Unit: Rp. 000)

Year of operation:	1st	3rd	5th	7th
Sales revenue total	4,320,000	7,200,000	7,200,000	7,200,000
Production costs				
Variable costs	2,287,350	3,519,000	3,519,000	3,519,000
Labor costs	84,990	84,990	84,990	84,990
Overhead costs	67,992	67,992	67,992	67,992
Maintenance costs	82,143	246,429	246,429	246,429
Tax & insurance	101,143	64,595	44,413	32,629
Other fixed costs	230,365	230,365	230,365	230,365
Fixed costs	566,633	694,371	674,189	662,405
Direct manufacturing costs	2,853,983	4,213,371	4,193,189	4,181,405
Depreciation	2,218,178	1,126,430	713,888	361,775
Total manufacturing costs	5,072,161	5,339,801	4,907,077	4,543,180

(3) Risks

Changes in profitability due to variation of major influencing factors are summarized in Table 1-7. As discussed later, there is a relatively small risk that the project's profitability falls below a level that makes private investment viable.

Table 1-7 Change in IRR with Change in Major Factors Affecting Profitability (Sukabumi Clay Supply Project)

Change in Sales Price			Change in Operational rate		Change in costs of vehicles and facilities		Change in Project Life	
Sales Price (Rp./kg)	Deviation from the base case (%)	IRR before tax (%)	Operational rate(*) (%)	IRR before tax (%)	Deviation from the base case (%)	IRR before tax (%)	Project Life (years)	IRR before tax (%)
28.8	+20	33.5			-20	27.3		
26.4	+10	28.5			-10	25.1		
24.0	0	23.2	100	23.2	0	23.2	20	23.2
21.6	-10	17.6	90	20.9	+10	21.5	15	22.6
19.2	-20	11.5	80	18.4	+20	20.0		
16.8	-30	4.3	70	15.8				

Note: (*) Operational rate in the 2nd year and onwards. The operational rates in the 1st year are 65% for all the cases.

As seen in the table, the effect of sales price on profitability is fairly large, while the risk of price decline is very small. The sales price assumed here (Rp.24/kg) is 17% higher than the lowest current price for delivery to customers[6]. The assumed price takes into account benefits from the project enjoyed by customers; the stable quality of clay allows them to manufacture tile products at a lower rejection rate as well as a lower percentage of low-grade products. The price level can therefore be justified and possibility of an 10% decline in this price is very small (in this case, since the price delivered to customers is at a level 10% above the lowest price currently seen, a further decline is almost unlikely). Even if the 10% decline occurs, IRR can still be maintained at 17.6%, which can be compensated for by the factors discussed later. Thus, the project faces a small risk of deteriorated profitability caused by price declines.

The effect of change in crude clay prices on profitability is considered to be the same level as the case of sales price, since unit consumption of crude clay in clay production is assumed at 1.02. Further, the purchase price of crude clay is assumed on the basis of the current price which includes manual work for quarrying and loading on truck, and it will not likely increase significantly. Rather, the use of equipment by the project will reduce workload, increase production volume per worker, and thus cause the crude clay price to decline.

Another risk is lower clay demand than expected, which results in a lower operating

[6] The current sales price of ceramic tile is Rp.1,007,000/ton on the average, and the present yield of tile is 75%. If the yield is improved to 90% with use of raw materials of stable quality, the revenue of manufacturers will increase by 20% (or Rp.151,050) from the present revenue of Rp.755,250 (or 75% of Rp.1,007,000). With the cost of clay accounting for 2.4% of unit sales price, the contribution of 1kg of clay to this revenue increase is Rp.7.0/kg (or 2.4% of Rp.151,050/520kg). Thus, Rp.6.0/kg of the sales price increase of clay of stable quality may be justified.

rate. IRR falls to 20.9% at the operating rate of 90% and 18.4% at 80%. Again, this risk is not serious in terms of project viability. Further, since the 80% operating rate is translated to annual sales of 240,000 tons, which accounts for approximately 27% of expected demand in 1998 (for tile manufacturers in West Java) and 45% of the 1995 demand. Since there is no other major clay source in Java, potentially competing sources are limited to the Monterado (Kalimantan) clay or imports from China, etc., and the project is considered to be able to ensure the demand expected in the above.

The effect of change in equipment costs on profitability is also very small, as IRR will remain at 20% even if the equipment cost increases 20%. In reality, the equipment cost is expected to decline below the present estimates, since these estimates are based on the assumption that most of equipment will be procured in Japan and will be transported to Indonesia for installation. However, for some of equipment listed high performance is not required (e.g., regarding dimensional accuracy or strength) and may be locally available. In this case, the cost is 30 to 40% lower than that when equipment is procured in Japan[7]. Also, construction vehicles that represent a large portion of the equipment cost can be procured locally at a lower price than the present estimates, not to mention the cost saving possible it second-hand equipment or vehicles are bought. Therefore, it is unlikely that the equipment cost rises above the present estimate, and it is rather realistic to assume that it will decline. If the actual equipment cost is 10% lower than the estimate, IRR will become 25.1%, and 27.3% in the case of a 20% decline. Thus, this undertaking will be viable even if there is a decline in price.

The project life is assumed to be 20 years. Even if it is shortened to 15 years, the effect on profitability will be very weak.

1.3.4 Banjarnegara feldspar supply project

1.3.4.1 Project concept

The project's primary purpose is to streamline quarrying and transportation of the Banjarnegara feldspar through mechanization, and ensure stable supply in volume.

In order to ensure supply of the feldspar having stable quality, the project will improve the quarrying management and grading. A facility for blending different grades of feldspars will be constructed. Instead of selectively quarrying and shipping higher-grade products only, lower-grade products which are currently disposed will be mixed with

[7] According to information furnished by a local ceramic manufacturer.

higher-grade ones to improve mining recovery. Target quality levels are those suitable for use by tile manufacturers.

To control feldspar quality at a certain level, analytical instruments will be introduced to trace feldspar quality during mining and before and after mixing operation.

1.3.4.2 Project outline

(1) Project site

The project site is the Kalitengah mine which is best suited for large-scale development among three mines under operation and has sufficient reserves for long-term exploitation (according to DSM's survey, the mine site is 495ha and 60m deep). The working face is located on a small hill which is relatively remote from houses, and a few more working faces are on an adjacent hill.

Two other candidate mines have clear obstacles for large-scale development, although they have sufficient reserves. Kebon Dalem has deep topsoil and the quality of crude feldspar is inferior to that of the other two mines. The site is surrounded by densely populated houses. On the other hand, Kebutuh Jurang has small cutting faces which have advanced to a few meters away from a nearby road, although the quality of feldspar is relatively high.

The secondary stockyard will be established at a stockyard operated by the prefectural government, after some expansion. The blending plant will also be accommodated within the same site.

(2) Quarrying

Prior to the start of quarrying at the Kalitengah mine, top soil will be entirely removed from the quarrying site, followed by bench cut excavation to allow the understanding and estimation of resource distribution and quality. An earthmover will be used to quarry and transport crude feldspar to the primary stockyard, as well as truck loading for transportation to the secondary stockyard. Trucks will be used for transportation from the primary stockyard to the secondary stockyard.

At other quarrying sites, ongoing quarrying operation will be continued and crude feldspar will be received by the secondary stockyard.

(3) Blending and shipping

The secondary stockyard operated by the prefectural government will be expanded, and the blending plant will be constructed within the site.

Crude feldspar transported from the site will be classified according to the grade and stockpiled. Feldspar of each grade will be carried by a wheel loader to a box feeder, in an amount determined according to the preset blending ratio. From the box feeder, feldspar will be batched and fed to belt conveyors for dry mixing. Mixed feldspar will mostly be stockpiled outside, but part will be kept under a shelter for shipment during periods of rain. Finally, it will be loaded to users' trucks by an earthmover for shipping (Figure 1-5).

1.3.4.3 Project definition

(1) Production capacity

Annual production capacity is assumed to be 123,000 tons. The basis of this judgment is as follows:

Judging from the grade of feldspar currently produced at the mine, it is difficult to expect that it will be used by tableware and sanitary ware manufacturers.

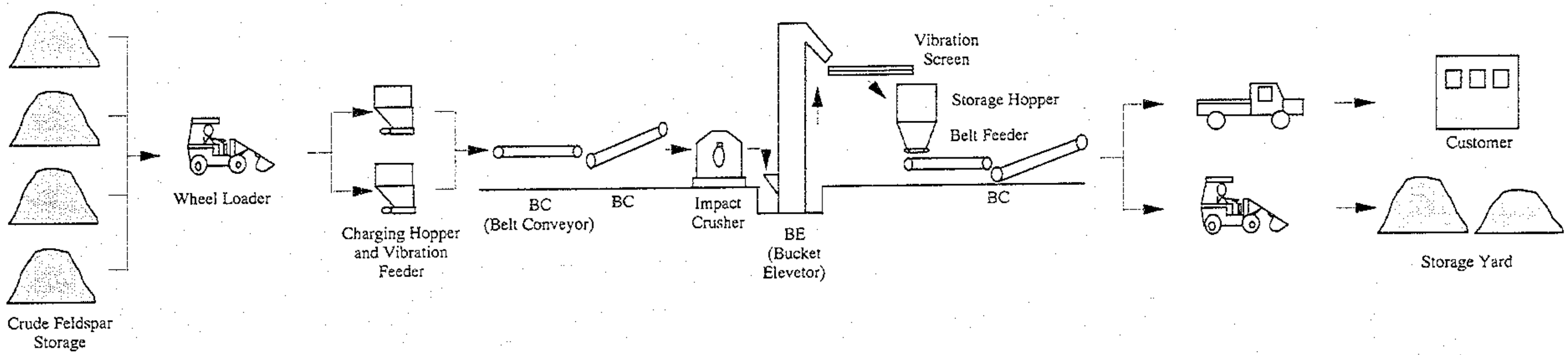
The feldspar deposits are still under development at Lampung in Sumatra and Argomulyo in East Java. Further, according to a manufacturer survey conducted as part of the present study, some tile manufacturers mentioned as other supply sources of feldspar Narawita, Cipanas, and other unknown sources as their alternatives. As a result, the present share of the feldspar from Banjarnegara is 13.5% of the volume totaled in the survey. The production capacity of the present project assumes to supply the equivalent of the present share (14%) against the expanded demand in 1998. The supplied volume this assumed is equivalent to the share of 23% of the estimated demand size in 1995.

The quality grade of feldspar from the present project is expected to be superior compared to the other existing sources. Assuming that the feldspar supplied from the new sources such as Lampung and Argomulyo account for one-fourth of total demand in West Java and East Java respectively, and that those from other sources account for a half in each region, the present project may supply the remaining one-fourth of total demand. The market share of 25% of total estimated consumption of 536,000 tons in 1995, is not an overestimate under such conditions. This amount is equivalent to the market share of around 14% of projected demand, 894,000 tons, in 1998. The share is the same percent as that of present share, and no difficulty should be expected in attaining that level.

The internal rate of return (IRR; before tax unless otherwise specified) for the project is 32.7%, high enough to indicate that the project is feasible.

The assumed production capacity is fairly conservative in that profitability can be maintained at a 140% higher capacity.

Figure 1-5 Banjarnegara Feldspar Supply Process Flow Chart (123,000 t/y)



As indicated in Table 1-8, the larger capacity continues to improve profitability. Further, the profitability is high enough even at an 80% of the assumed capacity (98,400 tons/year). If the production capacity increases by 40% (172,000 tons) and actual sales remains at 98,400 tons, IRR will be 23.9%. In other words, the production capacity can be set between 80% and 140% of the assumed level and profitability will be maintained.

In Indonesia, new feldspar development projects are under way in Lampung (Sumatra) and East Java (Argomulyo). Although the markets for these projects are geographically limited, their grade is high enough to be used for medium-grade tableware production. On the other hand, the project's proposed annual sales of 123,000 tons account for 13% of the 1998 outlook (or 22% based on the 1995 sales of 520,000 tons). Thus, the project will be able to secure expected sales under conditions of the potential competition. For these reasons, the production capacity assumed under the project can achieve profitability with high possibility even if the risk of a sales decline is taken into account. In fact, if future demand growth is fairly certain and potential feldspar resources do not show significant problems, the production capacity can be further increased.

Table 1-8 Change in IRR with Change in Production Capacity and Operation Rate (Banjarnegara Feldspar Supply Project)

		Production Capacity (ton/year)			
		172,000	147,000	123,000	98,400
Operation Rate(*1)	100%	39.3%	36.2%	32.7%	28.5%
	Low case(*2)	23.9%	25.4%	26.8%	

(*1) Operation rate in the 2nd year. The operation rates are 65% for the 1st year in both cases.

(*2) The maximum saleable volume is assumed at 98,400tons.

(2) Quarrying

1) Quarrying area

The project site is the Kalitengah mine.

2) Quarrying plan

Topsoil will be removed over the entire mining site, followed by bench cut excavation to estimate general quality, resource distribution, and scale of reserves. Based on data and information obtained from the exploratory survey, a quarrying plan and excavation methods will be determined. Feldspars in the mine can be roughly divided into white and slightly yellowish ones. Based on estimated reserves of the two types by proportion, daily excavation will be carried out.

Although feldspar quality varies slightly among mining pits and cutting points, the ore bed is relatively simple in structure, and mechanization will result in effective control of quarrying and grading according to quality, e.g., bulldozers, power shovels, and wheel loaders will be used for efficient quarrying operations.

(3) Transportation of crude feldspar to the secondary stockyard

Transportation of crude feldspar to the secondary stockyard will be carried out by a contractor who is currently engaged in excavation and transportation. Loading equipment will be introduced to replace manual work. In addition, the use of dump trucks is the most effective means for streamlining the work, but this requires large investment and makes existing trucks idle. Thus, acquisition of dump trucks should be done in keeping with the gradual replacement of existing trucks, and loading and unloading at the secondary stockyard is assumed to be carried out manually for a while.

(4) Homogenization of crude feldspar

The homogenization is assumed to be accomplished by dry mixing.

While the Banjarnegara feldspar has relatively uniform quality, careful analysis reveals variation among cutting faces, i.e., the difference in tone due to the content of iron compounds, and the differences in fluxing and sinter points due to content variation of quartz and feldspar. All these factors cause product (tile) dimensions, tone, and sintering temperature to deviate from design values, and lower the yield.

In Japan, when weathered granite, which is similar to the Banjarnegara feldspar, is used as a tile material, it is standard practice to wash it through a rotary screen to remove undersize. The washing classification test conducted on the Banjarnegara feldspar also showed that the same procedure can be expected to be useful.

However, water sieving produces 30% to 40% undersize, which is usually not used for tile production, and thus, lowers yield significantly and increases costs. Also, a large amount of undersize must be treated by re-sieving to remove sludge and fine sand before it can be used for construction or to remove detrimental constituents for blending with over size for use as tile materials. This further increases cost .

Thus, the dry mixing method is assumed for homogenization in the present project, since the major quality target is for tile materials.

(5) Quality control equipment

Testing and inspection equipment for quality control is assumed to be installed.

Using this equipment, such minimum quality characteristics as color after firing and refractoriness will be tested for the samples collected from mixed feldspar, and the results will be fed back to quarrying site and the blending plant for better grading control, mixing ratio control of the blending plant and product stock control.

1.3.4.4 Required fund, profitability, and risk related to the project

(1) Preliminary estimates of initial fund requirements

The estimated initial funds required for the project are summarized in Table 1-9.

Table 1-9 Estimated Initial Fund Requirement
(Banjarnegara Feldspar Supply Project)

	Rp. million	US$ 000
(1) Land acquisition & preparation	1,039.4	446.1
(2) Building & warehouse	52.2	22.4
(3) Facilities	9,429.4	4,047.0
1) Machine & equipment	897.4	385.2
2) Vehicles	8,532.0	3,661.8
(4) Others (*)	81.5	35.0
Total	10,602.5	4,550.5

(*) Including pre-operating expenses, initial working capital, etc.

(2) Profitability

Projected revenue and expenditure for the project up to the seventh year of operation are summarized in Table 1-10. Revenues will exceed total production costs from the first year. Accordingly, profitability measured by IRR is high at 32.7% before tax and 28.0% after tax, high enough to attract private investment.

Table 1-10 Sales Revenue and Production Costs
(Banjarnegara Feldspar Supply Project)

(Unit: Rp. 000)

Year of operation:	1st	3rd	5th	7th
Sales revenue total	3,151,900	5,289,000	5,289,000	5,289,000
Production costs				
Variable costs	244,647	376,380	376,380	376,380
Labor costs	62,496	62,496	62,496	62,496
Overhead costs	49,996	49,997	49,997	49,997
Maintenance costs	94,816	284,449	284,449	284,449
Tax & insurance	105,822	66,039	43,426	30,258
Other fixed costs	219,995	219,995	219,995	219,995
Fixed costs	533,125	682,976	660,363	647,195
Direct manufacturing costs	777,772	1,059,356	1,036,743	1,023,575
Depreciation	2,286,282	1,284,171	745,678	427,159
Total manufacturing costs	3,064,054	2,343,527	1,782,421	1,450,734

(3) Risks

Changes in profitability due to variation of major influencing factors are summarized in Table 1-11. As discussed later, there are a few factors that adversely affect profitability, so as to threaten the project's viability.

Table 1-11 Change in IRR with Change in Major Factors Affecting Profitability
(Banjarnegara Feldspar Supply Project)

Change in Sales Price			Change in Operational rate		Change in costs of vehicles and facilities		Change in Project Life	
Sales Price (Rp./kg)	Deviation from the base case (%)	IRR before tax (%)	Operational rate(*) (%)	IRR before tax (%)	Deviation from the base case (%)	IRR before tax (%)	Project Life (years)	IRR before tax (%)
51.6	+20	39.9			-20	39.3		
47.3	+10	36.3			-10	35.7		
43.0	0	32.7	100	32.7	0	32.7	20	32.7
38.7	-10	29.0	90	29.9	+10	30.1	15	32.4
34.4	-20	25.2	80	26.8	+20	27.9		
30.1	-30	21.2	70	23.6				

Note: (*) Operational rate in the 2nd year and onwards. The operational rates in the 1st year are 65% for all the cases.

A decline in sales price of feldspar is only one factor which may deteriorate the project's profitability. If the sales price decreases 30% from the assumed price[8] (Rp.43/kg), IRR will drop to 21.2% which is the minimum level to maintain the project's feasibility. However, the lowered price, Rp.30/kg, is lower than the lowest case currently seen. This means, the decline in sale price is a minor risk factor with a very low probability of occurrence.

Demand may fall below the forecast level, resulting in decline in the operating rate. If the operating rate drops to 90%, IRR will be 29.9%, and 23.6% at the 70% level. Again, this seems to be a very small risk factor.

The impact of equipment cost change on profitability is very small, as IRR will remain at 27.9% even if the equipment cost increases 20%. In addition, it is reasonable to expect that the equipment cost will decline below the present estimates. These estimates are based on the assumption that most of equipment will be procured in Japan and will be transported to Indonesia for installation. However, high performance for some of equipment listed is not require (e.g., dimensional accuracy, strength) and this equipment

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8 The sales price was estimated by applying the same assumption as that of Sukabumi clay sales price. Namely, the consumption of feldspar in one ton of tile manufacturing is 290kgs. The feldspar cost accounts for 2.4% of the product price. Therefore, the contribution of 1kg of feldspar of stable quality to improvement of yield rate is equivalent to Rp.10.9 (or 2.1% of Rp.151,050/ton per 330kg). Thus, the Rp.10/kg of price increase of feldspar from the current Rp.33/kg will be acceptable for the tile manufacturers.