5 Technical and Economic Evaluation of Ceramic Raw Material Development Projects

5.1 Selection of Raw Material Sources

5.1.1 Clay materials

The Sukabumi clay was selected for the proposed development project based on the following criteria: 1) the area has good transportation access to Jakarta and West Java where file and wall tile manufacturers forming the majority of the ceramic industry in Indonesia are concentrated; 2) the clay has low grade but is sufficiently suitable for tile production; and 3) there is a mine area for large-scale commercial development although it has extensively been exploited. The clay is currently used by various ceramic manufacturers (especially tile manufacturers) in large quantities, and the current users want consistent quality and supply. However, miners and suppliers do not have management resources to meet such demand. The situation also constitutes a major factor for selection of the Sukabumi clay.

In Indonesia, clay materials for ceramic production are produced throughout the country. They are mostly suitable for production of clay tiles and red bricks, while clay materials with a low content of impurities (e.g., iron, titan) and suitable for use in china and porcelain are produced only in a few places. In particular, clay deposits in Java are not generally suitable for large-scale development due to its history of formation and complex geological structure.

At present, clay materials used by the ceramic industries including sanitary ware, tiles, and tableware are produced in Sukabumi (Gunung Guruh), Parungpanjang, and Cipeundeuy. Recently, clay materials in Monterado, Kalimantan, are developed and used by some manufacturers. Raw materials for novelty products are either locally excavated or blend different clays produced in various areas.

Clay sources evaluated under the study are described as follows.

First of all, Sukabumi is located in West Java, close to JABOTABEK where many tile manufacturers are concentrated in, requiring relatively low transportation costs. The Sukabumi clay contains large amounts of iron and other coloring impurities but has plasticity suitable for use in the production process. For these reasons, it is widely used by tile manufacturers. However, manufacturers complain about inconsistent quality of clay and strongly hope some improvements.

The test was conducted to separate clay and sandy portions of the Sukabumi clay by a water cyclone, followed by the firing test using clay samples. The test results were compared with white clay (SC-1) which was classified as high-grade clay, ball clay (CSS) used by BBK as standard clay the Sukabumi lst grade sampled upon shipment. It was identified that there were notable differences among the three clays in various indices; 0 - 0.9% in the content of mass matters larger than 2mm, 90.9% - 38.2% in the amount of clay materials, and 5.11% - 8.74% in the rate of firing shrinkage of clay portions. While this quality variation originates in complex geological structure, it can be improved to some extent (acceptable for tile production) by modifying the methods for mining, product grading, and management.

Parungpanjang is located in Tangerang, West Java, and is the closest source to the major market. Despite the locational advantage in transportation of clay products, the clay itself has excessively high plasticity to result in large firing shrinkage, so that it is not suitable for use as a principal material of tile products. Also, it has poor dispersibility in slurry due to the montmorillonite content and cannot be used for slip casting of sanitary ware and other products. Even if it is used, the amount needs to be limited. Finally, the quarrying site becomes muddy in the rainy season but it is difficult to construct drainage facilities.

Cipeundeuy is situated in the eastern part of West Java, relatively close to the market. The clay contains relatively large particles and lacks plasticity, thus not suitable for ceramic production. Because of strong heat resistance, it is mainly used in refractories. It is partially used for tile and novelty production, but not as a principal material; a limited amount is used to attain consistent baked dimensions. There is no road to accommodate trucks between the quarrying site and a main road, and crude clay produced at the site is entirely carried by workers. Both technically and economically, it is not feasible to construct a new haul road and transportation facilities.

Finally, Monterado (Capkala Mandor) produce clay which has a low content of coloring impurities and high plasticity. Deposits are even in quality and cover a wide area. As a result, the Monterado clay is used by manufacturers in Java who require high-quality clay materials. Since the quarrying site is remote from the major market to require high transportation costs, it will be continuously used by manufacturers who need high-grade clays with some price premium. The Monterado clay resources are already mined on a large scale by a private enterprise having sufficient technical and management resources, thus they were dropped from the selection process.

5.1.2 Feldspar materials

Three feldspar sources were considered, Banjarnegara and Narawita in Java, and Lampung in Sumatra. After overall evaluation, Banjarnegara was selected for commercial development under the proposed project. The Banjarnegara feldspar is relatively well graded and can be used for tableware production after some beneficiation. Also, the source has relatively good access to manufacturers throughout Java. Finally, deposits are suitable for large-scale commercial development.

In Indonesia, there are only a few places to produce feldspar suitable for ceramic production. Traditionally, the Lodoyo feldspar in East Java is widely known and is used by most ceramic manufacturers. However, high quality feldspar deposits have largely exhausted due to the mining for a long period of time, and excavation has extended to feldspar of less quality. As a result, ceramic manufacturers are rating that the Lodoyo feldspar lacks consistent quality.

Other feldspar resources include Narawita in West Java, Jepara and Banjarnegara in Central Java, and Lampung and Pangaribuan in Sumatra. Feldspar in Java is tuff-based, has a low alkali content, contains high percentages of iron and other coloring impurities, and large quality variation. As a result, ceramic manufacturers rate it unsuitable. On the other hand, feldspar in Sumatra is granite or pegmatite feldspar and is expected to have suitable quality. However, the quarrying site is remote from the market and transportation costs are too high for use in tiles and other low-cost products.

Feldspar sources examined under the study are described as follows.

Banjarnegara is located in Central Java. Although it is far from the major market in West Java, it has extensive feldspar deposits over the entire area, with estimated reserves of over 400 million tons. Generally, feldspar in this area has a low alkali content due to its history of formation. Quality is relatively consistent compared to other sources, and the Banjarnegara is already used by tile manufacturers in West Java.

In Banjarnegara, the local government is actively involved in promotion of the ceramic raw material industry by providing extension service for small- and medium-sized enterprises and other organizations, as well as individuals who are quarrying raw materials in the area, and constructing and operating a material stockyard. The local government's leadership in Banjarnegara is seen in very clean city areas as well as suburbs. In fact, it was earlier recognized for its excellence under "Clean Activity Movement" which is promoted nationwide. Strong local leadership is one of critical factors for launching a new project.

According to laboratory tests, the Banjarnegara feldspar can be easily treated to remove iron ad mica by relatively simple water washing as well as crushing and classification under grain size control, thus not required the complex and costly beneficiation process such as flotation and acid treatment. Also the alkali content can be raised to around 10%, the minimum required level for tableware and sanitary ware production, by using the flotation process. Thus, the Banjarnegara feldspar can be used as a raw material of high-grade products.

Narawita has a locational advantage in proximity to JABOTABEK. Estimated reserves total 27 million tons, but high-grade materials with a low content of impurities are sporadically present and account for only a few percents of the total, unsuitable for long-term commercial exploitation. Furthermore, with a high quartz sand content and a low alkali content, ore grade is rated low. The Narawita feldspar is used by some of tile manufacturers in the eastern part of West Java, mostly for production of roof tiles.

Pangaribuan is located near Lake Toba in North Sumatra and produces pegmatite-based potassium feldspar which is rarely available in Indonesia. The feldspar has a high alkali content (14%) and low iron and titan contents, and can be used to substitute for imported materials. However, high-grade feldspar has been mostly taken away, at least not on the surface layer of the quarrying site and mostly covered by weathered granite called country rock. The weather granite has an alkali content of 6% and can be used for low-grade products. Nevertheless, the cost for transporting it to the Java Island will be very high, and thus the mine is not suitable for commercial development.

In Lampung, there are several feldspar mines separately located at the south end of Sumatra. Geographically, Lampung is relatively close to the major market in West Java. Reserves are fairly large (32.5 million tons) and deposits contain pegmatite-based high-grade feldspar, although small grain size. However, transportation to Java relies on ferry service. Also, the mines are already developed by a private enterprise with sufficient management and technical capabilities. As a result, Lampung was dropped from the list.

According to the laboratory test, the Jepara feldspar has a high alkali content and can be used to promote vitrification of fired wares. However, it contains large amounts of coloring impurities and produces poor color. At present, a large tile manufacturer uses the feldspar, but details of the quarrying site are not known.

5.2 Sukabumi Clay Supply Project

5.2.1 Consideration of the quarrying plan

(1) Selection of quarrying areas

As the southern area has been fully exploited, several quarrying areas are established in the northern area. Assuming the mining period of 20 years, each quarrying area needs to have an area of around 40ha as follows:

300,000 (T/y) / 1.5 (T - Dry clay / m^3 /5 (m - layer thickness) / 2 x 20 (year) = 40ha

If the quarrying area is changed or expanded every five years in a planned manner, the initial area can be set at around 8ha.

(2) Consideration of quarrying method

At least three quarrying face are established and quarried by the bench cut method. Each quarrying site is bench cut after the removal of topsoil and distribution of clay resources throughout the site (quality variation) is estimated. Based on actual resource distribution, a plan is established for classification of crude clays by grade, the methods for mining and disposing poor grade and waste clays, and the mixing and homogenization methods.

Crude clays excavated are classified to 3-4 grades. As each grade is present in a very thin layer or sporadically, often intermingling with other grades, different grades of clays can be randomly mixed in the excavation process to make proper grading difficult. For this reason, the primary stockyard is provided at the quarrying site to classify each grade to a few types to ensure that the uniform mixture is produced the subsequent blending factory.

Given the complex geological structure with thin clay layers and a small working space at the quarrying site, mechanical excavation does not permit proper grading, or even leading to larger quality variation. Thus, manual excavation is recommended for quarrying at the site.

5.2.2 Grading at quarrying site

At present, the Sukabumi clay is classified into the following three grades (four if sand clay is included) for shipment:

First grade: Ball clay
Second grade: Plastic clay
Third grade: Red clay
Sand clay

This grading is primarily based on the iron content and the inclusion of quartz sand. The Sukabumi clay resources are covered with red soil layers containing a large amount of iron which has moved or entered into the clay layers to deteriorate quality. For geological reasons, the southern area often contains large amount of sandy substances.

Furthermore, mainly due to volcanic activities or geologic changes, the clay layers (sedimentary layers) extend unevenly, with frequent inclusion of different types of rocks. According to DSM's surveys, the entire clay layer is estimated to be 20m thick, but field observation and estimation of layers to be quarried suggest that useful clays can be obtained for 8m at maximum, or more likely 4-5m.

On the other hand, the results of water cyclone separation of clay and quartz sand, chemical the analysis of the separated constituents, and the firing test indicate that clays obtained from the site are deeply colored by iron and have a very high quartz sand content which varies greatly from one sample to another. Judging from the grade, it is difficult to use the Sukabumi clay for higher-grade products other than tiles.

In consideration to the above factors, is recommended to perform the grading work at the quarrying site as follows:

1) To classify excavated clays into 3-4 grades based on visual inspection. Major criteria are the inclusion of quartz sand and an iron content (color).
2) To perform excavation manually, as thin and intermingled clay layers of different grades prohibit extensive operation by using equipment, which will prevent the above grading. Note that, at the quarrying stage, first, second, and third grades will be mixed to some extend.

Prior to the start of mining, the following preparation activities are to be carried out:

1) To clearly define quality standards;
2) To conduct research on grade unification (mixing);
3) To conduct boring surveys to estimate resource distribution and reserves, based on which a basic quarrying plan is established;
4) To enforce strict mining control by limiting mining activity to a zone authorized by the local government and allowing the relocation to another area after completion of mining in the zone is officially confirmed (to ensure strict quality control and the

effective use of resources);

5) To establish a stockyard separated for different grades near the quarrying site;
6) To install testing equipment required to ensure proper grading of clays at the stockyard, e.g., the measurement of the quartz sand content; and
7) To hire a contractor to transport crude clays to the secondary stockyard, which is currently done by the miner.

5.2.3 Examination of the beneficiation and mixing processes

Major weaknesses of the Sukabumi clay are summarized as follows:

1) High iron content to produce a dark color after firing;
2) High quartz sand content; and
3) Significant variation in proportions of quartz sand and clay.

Beneficiation or homogenization of clays is usually carried out by either of the following two methods:

1) Dry mixing: Forced mixing by a feeder; or
2) Wet mixing/beneficiation: Separation and mixing by using a water cyclone or a thickner.

Another possible method is to remove iron by magnets. Theoretically, however, the method is only effective, to some extent, in removing iron mixed in the process or a magnetic iron mixture, while it rarely removes iron which inherently contained in fine particle and determine the color after firing, because they are already oxidized. In fact, the magnetic separation test on the Sukabumi clay improved the firing coloration by 5-6% in degree of whiteness and failed to accomplish complete whitening (see Table 3-28). The installation of a magnetic ferro-filter should be considered only when the Sukabumi clay can be improved in quality (tone) to a level suitable for use in tableware or sanitary ware. Clearly, the improvement confirmed during the test does not justify such investment.

On the other hand, separation of quartz sand and clay by the water cyclone or the thickner is the effective means to improve uniformity if careful selection at the quarrying site is carried out (see Table 3-29). However, the clay so beneficiated cannot be used as a principal material of porcelains, sanitary ware, insulators, and refractories which require a higher level of quality, again due to the iron content. On the other hand, the target level of quality is set for tile production, the above beneficiation process is not required.

Besides, the additional process increases the total cost above the break-even point.

In conclusion, it is recommended to use the dry mixing method which will satisfy the objective of producing clay of consistent quality acceptable by tile manufacturers.

As for timing of dry mixing, the best result can be obtained by doing so at the stockyard where crude clays are carried from the quarrying site and graded, in order to ensure that clays of different grades can be blended in appropriate proportions.

Thus, major activities at the secondary stock yard and the blending factory are as follows:

1) To classify clays brought into the stockyard by grade and quality and store them separately;
2) To blend the clays in specified proportions by using the dry blending factory;
3) To send samples of the blended clays to the laboratory for minimum required quality check (quartz sand content, water content, color after firing), which results are send back to the quarrying site and the blending factory and are reflected in mining and grading control, operation management of the blending factory (blending proportions), and product stock control; and
4) To keep the products in the sheltered stockyard which can store at least 0.5 month inventory to ensure uninterrupted supply in consideration to difficulty in work during the rainy season.

5.2.4 Examination of the transportation and shipping methods

Clays excavated in the Sukabumi quarrying site are shipped to customers generally according to the following procedures:

1) A few workers form a group to excavate one of the quarrying sites which are dotted about the mine and transport clays from the face to the outside. Generally excavation is carried out in the morning, and transportation in the afternoon.
2) Excavated clays are temporarily stored near the quarrying site.
3) Clays in temporary store are loaded to a truck (2-3 ton) manually.
4) Workers ride on the truck and move to the stockyard at the foot of the hill.
5) Clays are unloaded from the truck at the stockyard.
6) Clays brought by various groups are mixed here.
7) A large truck (20 ton) arranged by a ceramic manufacturer (customer) comes to the stockyard and the clays are loaded manually.
8) The truck carrying the clays drives to the manufacturer's factory.
9) Unloading from the truck is done manually.

There are various problems to be encountered in the above transportation and shipping processes:

1) The quarrying site is too small to receive two or more trucks at the same time.
2) Since clays excavated in the morning are transported to the stockyard in the afternoon, it is difficult to classify them properly by grade or quality, resulting in inadequate quality control.
3) While quarry workers carry clays out of the site, no excavation is carried out in the afternoon, slowing excavation work. Also, transportation work is concentrated in the afternoon to require a number of trucks which crowd the quarrying sites and the stockyard, again delaying the work.
4) It takes much time to load and unload the trucks manually, which forces them to wait idling and slows the work. Actual transport distance is 5km from the northern quarrying area and 3km from the southern area. Time required for transportation is relatively short, and loading and unloading account for most of time during which the truck is occupied.
5) A haul road from the quarrying site to the stockyard is narrow, unpaved and steep as the site is located on the top or in the middle of the hill, making it difficult to use large trucks for mass transport. Also, the road conditions are further deteriorated during the rainy season to delay transportation, partially responsible for seasonal variation in excavation and supply volumes.
6) The quarrying sites are dispersed in several locations, and the number of workers (groups) vary with seasons, prohibiting efficient transportation (truck allocation) plans.

Among them, problems in 1), 2), 3) and 6) have bee dealt with earlier when the mining method and the blending factory were considered.

Improvement measures to overcome other problems are discussed below.

Loading time can be reduced by using a wheel loader. Similarly, unloading time can be reduced by using dump trucks. However, this requires large investment and makes the existing fleet of trucks idling, so that the purchase of dump trucks is not recommendable. Considering the unloading work takes less time than loading work and is carried out at the stockyard and users' factories, it can easily be streamlined unlike the loading work carried out within the quarrying site. Thus, dump trucks will be gradually introduced to replace currently used trucks as they age and retire, and this plan assumes that unloading work will be carried out manually.

The increase in transport capacity should start from the upgrading of the haul road. Construction can be financed by collecting a type of levy on raw material price, which will be paid to the local government. Meanwhile, the plan assumes that clays will be transported from the quarrying site to the stockyard as it is done, which will be contracted out at Rp.3/kg.

5.2.5 Examination of technical specifications for the project

Based on the above considerations, technical specifications for the project are established as follows.

(1) Process concept (see Figures 5-1 and 5-2)

1) Quarrying site

As discussed in the previous chapter, The quarrying site will be excavated by workers, as continued from the past, and no excavation equipment will be used. For removal of topsoil and preparation of the quarrying site (to facilitate manual excavation and clay carrying), A dozer shovel and a power shovel will be used. For transportation from the excavation site to the primary stockyard and the loading of clays to trucks, wheel loaders will be used on account of high work efficiency.

Crude clays as excavated will be classified at the primary stockyard within the site and stockpiled separately according to the color, property, layer, and other criteria. The plan assumes that crude clays will be classified into 3-4 grades, although properties vary with excavation locations. They will be loaded to trucks by the wheel loader and will be transported to the blending factory. Transportation will be carried out on a contract basis, as currently done, and the contract price is assumed to remain unchanged at Rp.3/kg. Crude clays delivered to the blending factory will be kept at an outside stockyard, separately by grade and quality.

2) Blending factory

Three types of crude clays will be carried separately by wheel loaders to box feeders to make the mixture in specified proportions, which will be fed to a belt conveyor in a specified quantity for dry mixing.

The blended clays will be partially kept in a sheltered stockyard, amounting to approximately 10 days of supply. The remaining portions will be piled in an outside stockyard. The total stockyard capacity including the blended clays will be 15 days.

To check quality of crude and beneficiated clays, laboratory equipment will be installed in the blending factory to perform a minimum required set of tests listed below:

a) Grain size analysis (residuals on 325 mesh);
b) Water content
c) Ignition loss
d) Firing test (firing color and shrinkage)

Other tests, including chemical analysis, thermal analysis (DTA/TGA), mineral analysis (X-ray diffraction) will be conducted by BBK or other organizations on a periodical basis.

(2) Estimation of equipment capacities (Table 5-1)

1) Quarrying site

a) Quarrying volume

The amount of clay to be quarried per day is assumed to be 1,275 tons/day (670m^3/day), as calculated below:

Qtd = Qty x UC / 365 / OR

Qvd = Qtd / Db

Qty: Annual shipment volume (300,000 tons/year under the plan)

Qtd: Quarrying volume per day (tons/day)

Qvd:Quarrying volume per day (m^3/day)

UC: Unit consumption (assuming 2% loss, unit consumption is 1.02)

OR: Operating rate (assuming the number of days per year, 240/365 = 0.6575)

Db: Bulk density (1.9 tons/m^3)

b) Labor requirements and quarrying costs (clay price)

Quarrying and transportation depend much on manual labor organized in the form of a cooperative, and manpower requirements are estimated at 290 workers and labor cost Rp.2.5/kg, which are calculated as follows:

Nss = Qvd x (Ls + Lt)

Cl = Nss x Sm x Rce x 12 / Qty

Nss: Labor requirements for clay quarrying (persons)

Ls: Unit labor requirement for excavation (0.21 persons/m^3/day[1])

[1] Refer to a case in "Ordinary earth or pit earth" on Table (2), Civil Engineering Handbook, page 27.

Lt: Unit labor requirement for transportation of crude clays from the face ($0.22 \text{ persons/m}^3/\text{day}$[2])

Cl: Labor cost for clay quarrying (Rp/kg)

Sm: Wage (US$100/month)

Rce: Foreign exchange rate (Rp.2,200/US$)

The plan assumes that crude clays will be purchased from miners (cooperative) at Rp.8.5/kg including Rp.3/kg for tax and cooperating membership fee (see Chapter 2).

c) Equipment capacities

A power shovel and a dozer shovel will be used for preparation of the quarrying site, with capacities of $1.8\text{-}2.5m^3$ and $1.3\text{-}1.5m^3$, respectively, which are determined by the following equations[3]. Note that each unit will be used in two quarrying sites under the plan.

$$Wg = Qvd \times Cm / Hw / 60 / f / E$$

Wg: Equipment capacity (bucket capacity)

Cm: Time required for each work cycle

In case of the power shovel: Cm = 2.4

(In addition to 0.4 minutes for the ordinary cycle of turning, dumping, and turning, time required for transportation to a location where the shovel dozer can be used for hauling.)

In case of the dozer shovel: Cm = 0.027 x L + 0.78 = 2.13 minutes

(L denotes haul distance, which is 50m)

Hw: Working hours per day: 6

f: Bulking factor (soil conversion factor): 1.25 for clay

E: Work efficiency

Power shovel (clayey soil): 0.45

Dozer shovel (loose clayey soil with unfavorable working conditions): 0.65

Qvd: Amount of excavation per day (amount of haul)

In Sukabumi, the topsoil is approximately 1.5m deep above the clay layer of 5m, thus requiring the removal of soil in amount equivalent to 30% of that of clay to be mined.

---

[2] Refer to a case in "Transportation of earth, sand, gravel and cobble stones" on Table (3), Civil Engineering Handbook, page 27.

[3] See Basic Manuals for Quantitative Estimation of Construction Work (1995), page 116.

Thus, Qvd = 300,000 x 1.02 x 0.3 / 240 1.9 = $200m^3$ / d

The capacity of wheel loaders used for loading crude clays is assumed to be $3.3m^3$ by using the following equation[4]. Two $1.9m^3$ wheel loaders will be deployed in the two quarrying sites, with 20% of waiting time will be used for hauling clays from the site to the primary stockyard.

Wq = Qvd x Cm / Hw / 60 / f / E

Wq: Wheel loader capacity (bucket capacity, m^3)
Cm: Time required for one cycle (0.8 minutes)
Hw: Working hours per day (6 hours)
f: Bulking factor
(1.0, assuming that no soil bulking occurs as crude clays are loaded)
E: Work efficiency
(0.45, assuming Case B - loose soil and unfavorable working conditions)

2) Blending factory

a) Processing volume

Assumed to be the same as the quarrying volume, 306,000 tons per year or 1,275 tons per day ($670m^3$/day)

Annual processing capacity: 306,000 tons
Daily capacity: 1,275 tons per day ($670m^3$/day)
Hourly capacity: 106 tons/hour ($56m^3$/hour)
(Assuming that the factory is operated on two-shift, with 12 working hours/day)

b) Transportation and loading of crude and blended clays

At the factory, clay transportation takes place in the following three forms. The capacity required for wheel loaders is determined by using the equation in 1) c).

1. Transportation of crude clay from the stockyard to the blending factory
Assuming that each work cycle takes 5 minutes based on the estimated distance, with work efficiency of 0.75 as an enough work area is provided[5], the transportation capacity required for the wheel loader is $6.2m^3$.

---

[4] Equation (2) of Civil Engineering Handbook, page 31.

[5] Equation (2) of Civil Engineering Handbook, page 31.

2. Transportation of blended clays from the factory to the stockyard

   Under the same assumptions as above, the transportation capacity required for the wheel loader is $6.2m^3$.

3. Loading of blended clays to trucks for shipment

   As the hauling work is not involved in this case, one work cycle is assumed to be 0.8 minutes by using the equation in (2) 1) c) and time required for loading per day is assumed to be 6 hours, so that the capacity required for the wheel loader is $2.0m^3$.

The total capacity is $14.4m^3$. With a 20% allowance, $17.3m^3$ is desirable. Thus, three $6m^3$ wheel loaders will be introduced to improve work efficiency.

c) Box feeders

Box feeders to handle crude clays must be provided in number corresponding to the number of grades to be classified at the site. Judging from the current site conditions, classification of each grade into a few types is feasible, so that three boxes will be provided for the feeder. This allows for future unification of the current three grades, white clay, plastic clay, and red clay (not including sand clay). The capacity should set in amount equivalent to the processing capacity to ensure continuous operation during the lunch time, namely $18m^3$ (x three boxes).

The feeder is of continuous constant feed type. The capacity is set at 55 tons/hour, equivalent to 50% of the total capacity (105 tons/hour) so that, in the case of two grades, 50% of each grade can be fed. The maximum capacity is 66 tons/hour to allow a 20% allowance.

d) Belt conveyor capacity

A belt conveyor system will be used for clay transportation within the process to ensure automated and smooth flow of products within a limited space. The transport capacity is 110 tons/hour which is blending capacity.

e) Stockyard

Assuming that the storage capacity is equivalent to 0.5 months of the shipment volume, and a 3m pile can be formed by the wheel loader, with a 50% capacity allowance, the stockyard needs an area of $6,700m^2$ which can be determined as follows:

$670 (m^3 / day) \times 15 (day) / 3 (m) /0.5 = 6,700 m^2$

Of total, sheltered stockyard to keep blended clays accounts for two-third, 4,500m^2. In addition, a 20,000m^2 space (100m x 200m) will be required to accommodate the blending factory (20m x 40m =800m^2), a haul road within the stockyard (10m x 200m = 2,000m^2), auxiliary facilities such as an office and a laboratory (6m x 8m = 48m^2), and some reserves.

f) Laboratory

The laboratory should be equipped with the following testing equipment to conduct quality tests on crude and blended clays described in (1) 2).

Grain size analysis (oversize on 325 mesh): Sieves, agitator
Water content: Dryer, electronic balance
Ignition loss, firing color and shrinkage: Electric kiln (1,400℃)

(3) Workers

The plan considers direct workers only. Note that labor requirements for clay quarrying and transportation to the secondary stockyard are not considered as these operations will be contracted out.

1) Quarrying site

Vehicle operators	4 (persons)	x	1 (shift)	=	4 (persons)
Assistants	2	x	1	=	2
Total					6

2) Factory

Vehicle operators	3 (persons)	x	2 (shift)	=	6 (persons)
Blending control line	6	x	2	=	12
Laboratory	1	x	1	=	1
Office	2	x	1	=	2
Total					21

5.2.6 Estimates of required funds

Based on the above assumptions, funds required for the project are estimated as follows (general assumptions are summarized in Table 5-2).

	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) Machine & 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.

5.2.7 Project operation plan and financial analysis

Production and sales plans for the project, production costs, and cash flow projections are shown in Tables 5-3, 5-4, and 5-5, respectively.

5.3 Banjarnegara Feldspar Supply Project

5.3.1 Consideration of quarrying policy

(1) Selection of the quarrying area

Among three mine, the Kalitengah mine was selected as most suitable for the project. The mine is excavated through a small hill which is relatively remote from houses. On an adjacent hill, there are a few quarrying sites, and four mining companies are operating. It is best suited for large-scale commercial development among the three mines and has sufficient reserves for long-term exploitation (according to DSM's survey, the quarrying site is 495ha and 60m deep). On the other hand, two other mines have obstacles for large-scale development, although they have sufficient reserves. Kebon Dalem has deep topsoil coverage and quality of crude feldspar is inferior to that of 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 quality of feldspar is relatively high.

(2) Consideration of quarrying method

The Kalitengah mine is currently excavated under the following conditions:

1) It has three faces, each of which is excavated by a different company.
2) Each face is clearly bench cut in three stages.
3) Quarrying is carried out manually by an individual or a group of individuals who excavates a different location.
4) Crude feldspar excavated is stored in a bag which is carried by a sledge to a temporary stockyard below the quarrying site.
5) Bags stored are marked by different colors to identify individual miners.
6) After being weighed at the temporary site, bags are emptied to trucks and transported to the stockyard for stockpiling.
7) Raw materials from different faces are blended when being loaded to trucks for shipping.

Major problems related to the above mining procedures are summarized as follows:

1) The faces are bench cut in three stages, but all topsoil is not removed from the hill, so that quality variation and distribution of feldspar resources are not known.
2) Each face is too narrow to excavate on a large scale.
3) Quality of crude feldspar varies among the faces. As each face is excavated by small groups, and crude feldspar is classified by quality after excavation. However, it is indiscriminately blended at the primary stockyard when it is loaded to the truck. As a result, quality of feldspar varies with the increase or decrease in the number of mining workers.

To deal with these problems and ensure large-scale excavation on a stable basis, the following approach is feasible:

1) To integrate the three quarrying sites into one, which will be redeveloped into a large quarrying site to allow efficient work and will be jointly operated by the four mining companies.
2) To remove topsoil over the entire area to be quarried, and excavate it by the bench cut method to estimate quality variation and resource distribution throughout the mine.
3) To determine mining policy and method on the basis of data and information obtained. Feldspar in the mine is roughly divided into two types, white one and slightly yellowish one. To estimate reserves of each type and carry out day-to-day mining accordingly.

4) While feldspar quality slightly varies with the quarrying sites and faces, feldspar layers are relatively simple in structure and can be quarried and classified according to quality by using equipment. Dozer shovels, power shovels, and wheel loaders will be used for efficient work.

5.3.2 Grading at the quarrying site

In principle, feldspar deposits in which large amounts of iron and other impurities are included, and those with varying proportions of feldspar and quartzite should be avoided. This section focuses on the ways to attain consistent quality of feldspar. The development project assumes the use of entire feldspar deposits except for topsoil.

There are two problems related to the grading of feldspar materials to be mined from the site:

1) How should grade variation within each quarrying site be dealt with?
2) How should grade variation between the different quarrying sites be dealt with?

As for 1), quarrying limits should be set for portions where an iron content is apparently high, while quality boundaries (appearance selection criteria) should be set for portions which are suitable for higher grade products (e.g., those having a small iron content and suitable for porcelain production). Feldspar will be classified according to these standards and stored temporarily at the quarrying site.

Regarding 2), each mining company blends materials obtained from its quarrying site in its own proportions, thereby to attain a uniform grade. Thus, tile manufacturers have to purchase feldspar materials in a different blending ratio at each purpose, resulting in quality variation. The proposed plan envisages that feldspar materials of each grade, as classified at each mine, will be collected to the secondary stockyard where they are dry mixed to ensure a uniform grade and quality.

It should be noted, however, that the development of the three mines at same time will require a very large amount of initial investment, with some complication related to quality classification and the establishment of the blending ratio. Thus, it is proposed to start from one mine, and after its development reaches a full operation stage, the development of two other mines will be commenced.

5.3.3 Consideration related to beneficiation and blending

While the Banjarnegara feldspar has relatively uniform quality, careful analysis reveals some variation between the 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 designs, resulting in low yields.

In Japan, when weathered granite similar to the Banjarnegara feldspar is used as a tile material, it is always washed through rotary screens to remove undersize. This is carried out to remove clay, kaolin, and mica produced from decomposition of granite, which, together with iron compounds, are considered to be constituents harmful to ceramic production. And these minerals, compared to these useful minerals such as feldspar and quartzite, tend to break into fine particles which can be largely washed way.

This is proved by a significant difference between the undersize and oversize of feldspar after sieving, when they were heated and melted at 1,300℃ or higher; while the undersize turned into red brown and was completely vitrified, the oversize did not show a clear color and was observed to contain unmelted portions, mainly a quartzite content. The washing classification test conducted during the study shows the same result (see Table 3-16).

As mentioned earlier, in Japan, feldspar-based materials originated in granite are mostly water washed to remove obstructive materials for tile production. Then they are thoroughly blended and supplied to tile body manufacturers.

In Indonesia, feldspar ore is sent to tile manufacturers without water washing or screening. Blending is limited to ordinary mixing in the course of sweeping and stockpiling. Planned blending through a mechanical process is not carried out. Together with ineffective visual classification and discontinuous feldspar layers, the lack of proper blending causes quality variation which necessitates significant burdens on tile manufacturers.

It should be noted, however, that water sieving in Indonesia would produce 20% - 30% undersize (usually not used for tile production) which would cause the following problems:

(1) Yield declines significantly to increase costs and reduce supply.

(2) Unless a source of sufficient water supply is available in the quarrying site, an additional cost will be required.

(3) The undersize is produced in large quantities which must be properly disposed, with some pollution control measures. Again, this is another cost increase factor.

The undersize can be disposed in either of the following two ways:

1) To use it as a construction material after re-screening (to remove sludge and fine sand); or

2) To blend it, after re-screening, with the oversize to be used as a tile material. Since it contains a large amount of obstructive constituents, 10-15% of the total amount will be wasted. Additional equipment will be required for blending. If the entire amount

can be used, dry mixing will become an attractive option.

(4) The undersize has a high content of constituents with a low sintering point, which must be removed and then will likely require further adjustment in blending. In Indonesia where quick firing by roller hearth kilns is preferred, the removal of the low sintering point constituents entails the replacement with more expensive materials, resulting in cost increase.

Thus, water washing is an effective means to refine higher grade feldspar materials for use as glaze or body for porcelain, but it is not cost justifiable for the beneficiation of feldspar materials for tile production. Thus, the project assumes quality target for tile materials, and the dry mixing method is selected for the purpose of ensuring uniform quality.

The proposed blending method and plan are summarized as follows:

(1) To classify and store feldspar ores transported from the mine based on their quality;

(2) To blend different feldspar ores in a specified blending ratio at the dry mixing factory to attain uniform quality.

(3) To collect blended feldspar samples, evaluate minimum quality requirements (firing color and fire refractoriness) at the laboratory, and send the results to the mine and the blending factory as feedback, which will be reflected in quarrying and grading control, operation of the blending factory (control of blending ratio), and product stock control.

(4) To stored feldspar products at the stockyard which should keep at least a 0.5-month inventory to ensure stable supply to customers. The stockyard needs not be sheltered. Its floor can be covered with feldspar products, not necessarily protected by concrete.

5.3.4 Examination of transportation and shipping methods

At present, feldspar produced in the Kalitengah mine, Banjarnegara, is shipped to customers according to the following procedures:

(1) Feldspar excavated is packed into 100kg bags at the face.

(2) Four bags are loaded on a sledge which is pulled down to the primary stockyard.

(3) After weighing, feldspar is taken out of the bags and is loaded to five-ton trucks manually. In the process, feldspar ores of different grades are randomly mixed.

(4) The trucks drive approximately 15km to the secondary stockyard managed by the prefectural government.

(5) Feldspar is unloaded by workers at the stockyard.

(6) A large truck (20 ton) arranged by a customer comes to the stockyard and feldspar is loaded manually.

(7) The truck carrying feldspar drives on public roads to the manufacturer's factory.
(8) Unloading from the truck is done manually.

There are problems related to transportation from the face to the primary stockyard in (2), and loading and unloading in (3), (5), (6), and (8). All of them are carried out manually and are inefficient. In addition, transportation in (2) involves a high risk of accident. Finally, feldspar ores of different qualities are randomly mixed as they are loaded to the trucks, as explained in (3).

Proposed improvement measures are summarized as follows:

(1) An entire amount of feldspar quarried on the same day is loaded to the trucks, without any separation according to quality. As a result, feldspar ores of different qualities are randomly mixed to cause quality variation at the customer. The primary stockyard should be provided at the quarrying site, large enough to classify the ores according to quality and allow separate transportation to the secondary stockyard.

(2) Transportation of feldspar from the face to the primary stockyard and loading to the trucks should be carried out by aid of wheel loaders to improve productivity and safety. An alternative method is to install a hopper system along the slope, which can feed feldspar to the truck. This also requires any means of transporting feldspar from the face to the hopper system. The wheel loaders will also be used to load feldspar products at the secondary stockyard for shipment.

(3) Transportation from the primary stockyard to the secondary stockyard as well as unloading from the trucks will be done manually as done at present.

(4) There is a log bridge on the haul road between the secondary stockyard (operated by the prefectural government) and the quarrying site, which may become impassable under heavy rain. A new bridge and other facilities to allow the passing of large trucks are required.

5.3.5 Designing of project specifications

Based on the above considerations, project definitions are established as follows.

(1) Project concept (see Figures 5-3 and 5-4)

1) Quarrying site

The Kalitengah mine was selected as the quarrying site from the three mines under operation. Within the site, two faces will be selected for excavation. Three types of equipment will be used, power shovels, dozer shovels, and wheel loaders (also used for topsoil removal and site preparation work). They will be useful for efficient mining operation and will not cause the mixing of materials with different qualities as the ore bed is relatively simple in structure, although feldspar ores available in the site are generally brittle with sandy properties and can be excavated manually.

Crude feldspar excavated will be transported to the blending factory and will be classified and stacked in piles according to appearance and property. Transportation from the quarrying site to the factory will be carried out on a contract basis.

2) Blending factory

In the blending process, two types of feldspar are fed from discharging hoppers, are carried by belt conveyors, and are screened and blended through vibrating screens. Since the feldspar ore is brittle due to its volcanic origin, feldspar materials are mixed with impurities such as clay and mica if they are pulverized. This affects a fine particulate recovery plant if beneficiation is carried out in a separate process. Thus, the process should be designed to avoid pulverization of crude feldspar and allow the mixture to be formed in size passing a 10mm screen. The oversize is crushed by a jaw crusher and is returned to the blending line. Feldspar after blending is stockpiled in an outside stockyard.

At the blending factory, feldspar should be tested for the following items:

a) Grain size analysis

b) Melting test

c) Ignition loss

Other tests, including chemical analysis, X-ray diffraction analysis, and blending test, will be conducted by BBK or other organizations on a periodical basis.

(2) Estimation of equipment capacities (Table 5-6)

1) Quarrying site

a) Quarrying volume

The amount of feldspar to be quarried per day is assumed to be 525 tons/day (275m^3/day), (excluding ore consumption of 125,000 tons/year under the feldspar beneficiation project) by using the following equation:

Qtd = Qty x UC / 365 / OR

Qvd = Qtd / Db

Qty: Annual shipment volume (123,000 tons/day)

Qtd: Quarrying volume per day (tons/day)

Qvd: Quarrying volume per day (m^3/day)

UC: Unit consumption (assuming 2% loss, unit consumption is 1.02)

OR: Operating rate (assumed to operate for 240 days, 240/365 = 0.6575)

Db: Bulk density (1.9 tons/m^3)

Thus, mining capacities are assumed as follows.

Annual mining volume:	125,500 tons/year
Annual operating rate:	240 days/year
Quarrying volume per day:	525 tons/day (275m^3/day)
Actual operating hours per day:	6 hours/day (single sift)
Quarrying volume per hour:	90 tons/hour (50m^3/hour)

b) Equipment capacities

The capacity of the power shovel used for mining is assumed to be approximately 9.8m^3. Since two faces will be excavated and the power shovel will be used for site preparation purposes including the removal of topsoil, two 5m^3 power shovels will be used.

Pq = Qvd x Cm / Hw / 60 / f / E

Pq: Power shovel capacity (bucket volume, m^3)

Cm: Time required per cycle (8 minutes, including the time required for transportation to a location where the shovel dozer can be used for hauling)

Hw: Working hours per day (6 hors)

f: Rate of change in earth volume (assumed to be 1.25 of the standard value for ordinary soil[6])

E: Work efficiency (0.5 for soil containing gravel/cobble stone[7])

For site preparation, dozer shovels and power shovels (discussed above) will be used. Two 1.3-1.5m^3 dozer shovels will be used to cover the two faces.

For loading to trucks, the wheel loader capacity is assumed to be 1.4m^3 by using the following equation. Two 1m^3 loaders will be used to cover the two pits.

Wq = Qvd x Cm / Hw / 60 / f / E

Wq: Wheel loader capacity (bucket capacity, m^3)

Cm: Time required for one cycle (0.8 minutes)

Hw: Working hours per day (6 hours)

f: Bulking factor (1.0, assuming that no soil bulking occurs as crude feldspar is loaded)

E: Work efficiency (0.45, assuming Case B - loose soil and unfavorable working conditions)

---

[6] Note 1 of Civil Engineering Handbook, page 31 (Standard Earth Work Volume)

[7] See table on Em value, Civil Engineering Handbook, page 32

2) Blending factory

a) Blending volume

The blending volume is assumed to be same as the mining volume, 125,500 tons per year or 525 tons per day (275m^3/day). The blending factory is operated on a two-shift basis and for 12 hours per day. Thus, the processing volume per hour is 45 tons.

b) Stockyard

Assuming that the storage capacity is equivalent to 0.5 months of the shipment volume, and a 3m pile can be formed by the wheel loader, with a 50% capacity allowance, the stockyard needs an area of 2,750m^2 which can be determined as follows:

$$275\ (m^3/day) \times 15\ (days) / 3\ (m) / 0.5 = 2{,}750m^2$$

In addition, a 15,000m^2 space (150m x 100m) will be required to accommodate the blending factory (12m x 46m = 550m^2), auxiliary facilities such as an office and a laboratory (6m x 8m = 48m^2), the site for the beneficiation factory discussed in the next chapter (30m x 40m = 1,200m^2), the beneficiated feldspar stockyard (20m x 25m = 500m^2), and some reserves.

c) Crude feldspar discharging hoppers

Judging from feldspar resources observed in the quarrying site, feldspar excavated from can be divided into two types; those having a higher iron content and a lower iron content. Accordingly, two hoppers will be installed. Each hopper will have the same capacity as the two types of feldspar are present in more or less equal proportions. The total capacity is assumed to be 25m^3, equivalent to one hour processing volume, and each hopper has a 15m^3 capacity to provide some allowance.

d) Classification and crushing equipment for coarse feldspar

For efficient classification of coarse feldspar (rock) contained in the ore, a bar screen capable of removing coarse grains of 10-15mm or larger will be installed, followed by a vibrating screen to remove 10mm or larger particles. Each capacity is set at 50 tons/hour to treat the entire amount of blended feldspar by one unit, with an allowance rate of 10%.

Coarse grains are crushed by a jaw crusher. As the percentage of coarse constituents is estimated at 5% of total, the capacity of the jaw crusher is assumed to be 3 tons/hour.

e) Transportation of feldspar between the stockyard to the factory, and loading of blended feldspar for shipment

Transportation of crude and blended feldspar ores between the stockyard and the blending factory, and loading of blended feldspar to trucks for shipment will be carried out by wheel loaders. Based on the equation presented in 5.2.5 (2) 1), c), the total wheel loader capacity is $6.1m^3$. To ensure work efficiency, two $3.5m^3$ loaders are proposed.

1. Transportation of crude feldspar from the stockyard to the blending factory
   Assuming 12 hours of work per day (Hw), 10 minutes required for each cycle time (Cm), and work efficiency (E) of 0.75 under favorable working conditions, the total wheel loader capacity required for transportation of feldspar is $5.1m^3$ for round trip.
2. Loading of blended feldspar for shipment
   Product shipment will be carried out during the daytime (6 hours). When Cm is assumed to be 0.8 minutes, the wheel loader capacity required for loading is $1m^3$.

f) Transportation of feldspar in the process

In the blending process, crude and blended feldspar will be transported by belt conveyors which capacities will be 45 tons/hour and 5 tons/hour respectively.

g) Testing equipment

For quality tests on crude and blended feldspar discussed in 2) of (1), the following testing equipment is required:

Grain size analysis and test: Standard sieves and electronic balance

Firing color and sintering tests: Electric kiln (1,400℃), pot mill, and others

(2) Workers

1) Quarrying site

Manpower requirements at the quarrying site are estimated as follows:

Vehicle operators	6 persons	x	1 shift	=	6 persons
Assistants	2	x	1	=	2
Total					8

2) Factory

Manpower requirements at the factory are estimated as follows:

Vehicle operators	2 persons	x	2 shift	=	4 persons
Blending control line	2	x	2	=	4
Laboratory and office	2	x	1	=	2
Total					10

5.3.6 Estimates of required funds

Based on the above assumptions, funds required for the project are estimated as follows.

	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.

5.3.7 Project operation plan and financial analysis

Production and sales plans for the project, production costs, and cash flow projections are shown in Tables 5-7, 5-8, and 5-9, respectively.

5.4 Banjarnegara feldspar beneficiation and supply project

5.4.1 Consideration of beneficiation methods

A primary purpose of the project, denoted as quality target, is to improve firing color of the Banjarnegara feldspar by raising the alkali content (K_2O + Na_2O) and removing the iron content (Fe_2O_3) to make it suitable for use as a material for high-grade porcelains, such as sanitary ware and table ware, or for glaze.

As a ceramic material, the Banjarnegara feldspar has disadvantages in the following three respects:

(1) The alkali content ($K_2O + Na_2O$) ranges between 6% and 8% (see Table 3-7), below 10% required for ceramic production.
(2) The content of iron (Fe_2O_3) - a discoloring agent - ranges between 1.0% - 1.6% (see Table 3-7), higher than a generally accepted standard (0.3% or less). In particular, mica is deeply incorporated into the ore.
(3) Quality varies with the mines, quarrying sites, and faces.

The project in the previous section attempts to supply feldspar with consistent quality by blending the ores evenly. The project is designed to improve quality through the beneficiation process.

Since the contents and distribution of feldspar, quartzite, mica, and iron compounds which compose weathered granite, vary with the quarrying areas, a higher efficiency in the treatment process can be accomplished by crushing and dry screening feldspar ores as pretreatment before water washing.

Possible methods of beneficiating feldspar materials include water washing and screening as the pretreatment process (removal of iron compounds and mica), floatation, acid iron separation, and magnetic iron separation.

In consideration to properties of the Banjarnegara feldspar and the purpose of beneficiation, and under the condition that there are less problems inherent in the treatment process, several candidate beneficiation methods were selected as follows:

1) Water washing - floatation
2) Water washing - Magnetic iron separation
3) Water washing - acid treatment

Note that water washing, acid iron separation, and magnetic iron separation are designed to remove an iron content, and only floatation raises alkaline concentration.

Laboratory test results indicate that, by selectively crushing optimum particle sizes and separating mica from feldspar and quartzite, followed by water washing, the iron content can be reduced to around 0.2%, and firing color can be improved to a level equivalent to the general grade of the Masuda feldspar in Japan. However, the method inevitably crushes relatively soft feldspar, which is then removed as the undersize in the classification process, resulting in lower sinterability. Thus, crushing and water washing are not sufficient to achieve the target quality levels. Also, the method is inferior to acid treatment and magnetic iron separation in terms of improvement in firing color.

Secondly the magnetic iron separation test reveals that the use of strong magnets (25,000 Gs) can reduce the iron content to 0.15% or less and the firing color is improved to a level emulating that of the Masuda feldspar. However, the method requires large investment and is not capable of raising the alkali concentration.

Acid iron separation is another effective method for reducing the iron content, and the results of the test conducted during the study indicate possibility of improving the iron removing effect and firing color. However, problems remain in long duration of acid treatment and high costs, making it difficult to adopt the method unless it is applied to feldspar materials for high-grade products. Furthermore, neutralization or recovery of acid after treatment is difficult. For these reasons, the method was dropped from further consideration.

Finally, it has been confirmed that floatation can increase the alkali concentration to nearly 10%. Thus, by combination with techniques to remove iron and mica contents, it can help feldspar quality improve to the target levels.

In overall consideration to the above factors, the project adopts a beneficiation process which combines crushing, water washing, classification, magnetic iron separation, and floatation. The process flow is summarized as follows:

(1) To use feldspar which has consistent quality by means of dry mixing to be performed under the feldspar beneficiation and supply project;

(2) To crush it in a drum washer, while washing away impurities such as clay and iron contents;

(3) To pulverize the washed feldspar and quartzite (150 -200 meshes);

(4) To remove an iron content from the pulverized feldspar and quartzite by strong magnets;

(5) To increase the feldspar content in the slurry after iron separation through the floatation process;

(6) To settle and separate the slurry including feldspar in a pit, and recover feldspar;

(7) To collect small samples from products and evaluate quality (firing color, feasibility, and refractoriness; and

(8) To store products which have passed the test in a sheltered stockyard (concrete floor).

5.4.2 Consideration of project specifications

(1) Process concept (see Figures 5-5 and 5-6)

1) Pretreatment process (crushing, water washing, and iron separation)

Feldspar for pretreatment should be blended under the previous project to attain uniform quality. It is first transported from the stockyard to the factory by a wheel loader, and is crushed and water washed in a 5mm mesh drum washer. The process is designed to remove mica and clay minerals concentrating on fine grain portions by water washing. Less than 5mm feldspar particles, which have been washed away and settled, are continuously raked by a spiral classifier. They are then mixed with 5mm or larger particles and are carried by belt conveyors to the tube mill where they are pulverized continuously to 150-200 mesh. During the pulverization process, impurities trapped inside feldspar and quartzite particles are separated. Coarse particles in the pulverized mixture are raked by the spiral classifier and pulverized in the tube mill. Pulverized portions are sent to the magnetic separation process by a sand pump. In the magnetic iron separation process, magnetic materials are removed by the strong magnetic iron separation (2,000 Gs), and the fluid mixture is sent to the floatation process.

2) Floatation process

The floatation process first removes mica, then feldspar floats while quartz sand settles and is recovered. Feldspar and quartz sand so separated are sent by the sand pump to settlement tanks where they settle and are removed of excess water. Finally, they are raked by a power shovel and are transported by the wheel loader to the stockyard for storage.

The floatation process uses an acid liquid which corrodes equipment and piping. Thus, all the equipment handling the acid liquid will be lined with rubber which has high acid resistance and corrosion resistance.

Since the process's ability to recover feldspar depends largely upon various conditions such as grain size (whether it allows separation of mica), the type of chemical agent used and the conditions of its application, optimum conditions for floatation must be identified in advance through preliminary and intermediate tests, and modification of equipment design and other adjustments may become necessary.

3) Stockyard

The stockyard should be sheltered, with concrete floor sloping at five or six degrees to ensure water drainage.

4) Quality tests

Testing equipment for the feldspar supply project will be used to conduct the following tests, while other tests will be performed by BBK and other public organizations:

a) Grain size analysis

b) Melting test

(2) Estimation of equipment capacities (see Table 5-10)

1) Overall process capacity

The project's overall process capacity is established on the basis of the following assumptions:

a) Shipment of beneficiated feldspar: 30,000 tons/year (from project definition)

b) Yield of the feldspar beneficiation process: Cleaning process 80% (from test results)

Floatation process 30% (from test results)

c) No. of operating days: 240 days/year (5 days/week)

d) Daily working hours: 12 hours (two-shift, 6 hours/shift)

e) Bulk density of crude and blended feldspar: 1.9 tons/m^3

Thus, process capacities are estimated as follows:

a) Processing volume of crude feldspar: 125,000 tons/year (66,000 m^3/year)
520 tons/day (275 m^3/day)
45 tons/hours (23m^3/hours)

b) Processing volume in the pretreatment process: 125,000 tons/year

Feldspar and quartzite:	100,000 tons/year
Loss (clay portions):	25,000 tons/year (104 tons/day, 55m^3/day)

c) Processing volume in the floatation process: 100,000 tons/year (53,000 m^3/year)
420 tons/day (220 m^3/day)
35 tons/hours (18 m^3/hours)

Feldspar:	30,000 tons/year (16,000 m^3/year) 125 tons/day (66 m^3/day) 10 tons/hour (5.5 m^3/hours)
Quartzite:	60,000 tons/year (32,000 m^3/year) 250 tons/day (130 m^3/day) 21 tons/day (11 m^3/hour)
Loss (iron and mica):	10,000 tons/year (42 tons/day, 22 m^3/day)

According to laboratory test results, impurities contained in fine particles of crude feldspar, such as clay, iron, and mica, are assumed to represent approximately 20% of total. Thus, crude feldspar processing capacity which allows for them is 520 tons (45 tons/hour). Based on the same test results, beneficiated feldspar obtained from the floatation process is estimated to account for 30%, so that the processing capacity totals 125 tons per day (30,000 tons annually).

Assuming that fine particles are removed in the crushing and water washing processes, the following equipment capacities are determined on the basis of 12 working hours per day (two shift).

2) Equipment capacities by process

a) Crude feldspar supply, water washing and crushing processes: 45 tons/hour

- Wheel loaders to transport feldspar ores: Four units (1.9m^3 each)
- Discharging hoppers: Two 12m^3 units (one hour capacity to allow continuous operation during lunch time)
- Constant feeders: Two units, vibrating type, and 30 tons/hour each
- Transportation of feldspar within the process: Belt conveyors with 45 tons/hour capacity
- Crushing and water washing equipment: A drum washer widely used for this purpose, with capacity of 45 tons/hour to allow for an entire amount of ore received
- Washed feldspar recovery: To recover sandy portions from the slurry, eight spiral classifiers (6 tons/hour) will be used in consideration to their high efficient.
- Pulverizing equipment: This is used to crush washed feldspar ore into fine particles in order to separate it to iron, mica, feldspar, quartzite before floatation. Tube mills will be used to meet design requirements (crushed grain size (150-200 mesh) and continuous operation). The total capacity is 35 tons/hour to allow for 20% impurities removed in the water washing process. To avoid excess load, two units (18 tons/hour each) will be provided.
- Iron separator: Used to remove iron and mica contents present in ore and iron mixed in the crushing process. Magnetic ferro-filter will be used because of field-proven performance. Two units (20,000 Gs, 18 tons/hour each) will be used to meet requirements.

b) Floatation process: 35 tons/hour

It is not feasible to install one unit having the processing capacity of 35 tons/hour, partly because of capacity limitation in dispersing equipment, and partly because of no design experience in Japan and very large investment to be involved. Instead, equipment having 1-2 tons/hour capacity, which is widely used for high efficiency, will be used. 16 units will be installed to meet the 35 tons/hour requirements, 2.25 tons/hour each.

c) Recovery of beneficiated feldspar

- Settling tanks: Three tanks for feldspar and three tanks for quartzite will be installed and used alternatively to complete three work cycles (each consisting of receiving, settlement, and recovery). Assuming slurry concentration of approximately 10%, feldspar yield of 30%, and one-hour settlement time, tank capacity is determined at $15m^3$ from the following equation:

Tank capacity = 35 (tons/hour) x 0.3 x 1 (hour) / 1.9 (tons/m^3) / 0.1 = $55m^3$ for 3 tanks
Settlement tanks have the total capacity of $130m^3$ for 3 tanks.

- Product recovery: Feldspar sediments will be recovered by power shovel. To handle 35 tons/hour of ore supply, small equipment (1.3 - $1.5m^3$) will be used.

d) Product transportation and storage

- Transportation: Recovered products (feldspar and quartzite) will be transported by four $1.9m^3$ wheel loaders (also used to transport ores).
- Storage: Beneficiated feldspar is stored in a sheltered stockyard, concrete floor with a five-degree slope to allow for smooth water drainage (Note: quartzite will be stored outside). The required stockyard area is $120m^2$ (40m x 30m) to keep a ten-day inventory, calculated by using the following equation:

Required stockyard area = Production (125 tons/day) x Inventory (10 days)/bulk density (1.9)/pile height (3m)/allowance factor (0.5) = $450m^2$

(3) Workers

Vehicle operators	5 persons	x	2 shift	=	10 persons
Factory workers	10	x	2	=	20
Total					30

5.4.3 Estimates of required funds

Based on the above assumptions, funds required for the project are estimated as follows.

	Rp. million	US$ 000
(1) Land acquisition & preparation	560.5	240.6
(2) Building & warehouse	435.0	186.7
(3) Facilities	67,333.5	28,898.5
1) Machine & equipment	64,917.7	27,861.7
2) Vehicles	2,415.8	1,036.8
(4) Others (*)	81.2	34.8
Total	68,410.2	29,360.6

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

5.4.4 Project operation plan and financial analysis

Production and sales plans for the project, production costs, and cash flow projections are shown in Tables 5-11, 5-12, and 5-13, respectively.

5.5 Small-Scale Body and Glaze Premixing Project

5.5.1 Consideration of project specifications

(1) Process concept (Figures 5-7 and 5-8)

The body premixing method is to feed raw materials (kaolin, plastic clay, feldspar, quartz sand, etc.) in a specific blending ratio into a ball mill, where the materials are crushed and blended in wet conditions for around 20 hours.

The slip after blending is sent through 150 - 180 mesh screens to remove uncrushed substances, followed by iron separation. Finally, it is dehydrated through a filter press and turns into a cake.

The cake is sent through a deairing extruder, as required, to remove the air from the body. In fact, the body is shipped either in the cake or deairated form according to the usage.

The cake may be stored at the factory, in which case it must be covered by a plastic sheet to prevent drying and promote aging.

The preparation of the glaze, on the other hand, takes longer hours (40 - 60 hours) since large amounts of primary materials (feldspar and quartz sand) are used, and they must be more pulverized than the body. For this reason, the project assumes that the factory is operated on a three-day/cycle basis.

The crushed and blended glaze passes through a 200 mesh screen, and after iron separation, it is kept in a plastic container (30 liter) before shipment.

The factory is enclosed only around the body stockyard to prevent drying.

Body and glaze products are subject to the minimum-required tests as follows:

a) Grain size analysis and measurement of water content;

b) Reaction test on the body and glaze and firing test.

(2) Estimation of equipment capacities (Table 5-14)

1) Body blending line

a) Overall capacity

Annual blending capacity: 700 tons/year

Blending capacity per day: 3 tons

(700 tons/240 days)

b) Ball mill

The time required for crushing and blending by the ball mill varies with the property of material and the property of the required body. The maximum duration of crushing operation is 20 hours, and the ball mill is operated in a one day/cycle including the charging and discharge of raw materials.

The ball mill needs to have capacity of 3 tons/unit. 2 units will be provided to allow the blending of two types of body. Since the amount of the body is same among different grades, a two-ton unit and a one-ton unit will be provided to ensure efficient operation.

c) Slip tank

Three tanks will be provided, two tanks to store the slip after crushing by the ball mill and one tank to keep the slip after iron separation. The storage capacity is $5m^3$ under the assumption that the slip concentration is 50% and the amount of inventory is one day.

d) Magnetic ferro-filter

The magnetic ferro-filter (1kw) will be used to remove the iron content which has mixed with body materials in the transportation or production process, not concerned about the removal of iron contained in the raw material.

e) Diaphragm pump

The high-head diaphragm pump (around 200m head) will be used to send the slip to the filter press.

f) Filter press

The filter press's capacity must correspond to that of the ball mill and should be one ton/batch. Production volume is 3 tons/day, with 12 operating hours, thus three cycles/day or four hours/cycle.

g) De-airing extruder

The de-airing extruder will be installed to remove gas from the blended body, as required. The capacity is 400 - 500kg/hour.

2) Glaze blending line

a) Overall capacity

Annual blending capacity: 70 tons/year

Blending capacity per day: 300kg/day

b) Ball mill

The time required for crushing and blending of the glaze by the ball mill ranges between 40 and 60 hours, resulting in the blending cycle of 3 days. As a result, the ball mill capacity is tripled from that for the body, 900kg/unit. Two 500kg ball mills will be installed to produce two grades of glaze.

c) Slip tank

Three tanks will be installed, two tanks to store the slip after crushing by the ball mill and one tank to keep the slip after iron separation. The storage capacity is $1m^3$ under the assumption that the slip concentration is 50% and the amount of inventory should cover the amount equivalent to one blending by the ball mill.

d) Magnetic ferro-filter

The magnetic ferro-filter (1kw) will be used to remove the iron content which has mixed with body materials in the transportation or production process, not concerned about the removal of iron contained in the raw material.

3) Testing equipment

Testing equipment should be able to cover the following tests:

Grain size analysis: Standard sieves

Measurement of water content: Dryer and electronic balance

Firing test: Electric kiln

Reaction test on body and glaze: Pot mill and others

Other tests will be carried out by BBK or other public organizations on a contract basis.

Other equipment will have minimum-required capacities which match body and glaze blending capacities and do not adversely affect properties of products.

(3) Workers

Factory workers	3 persons	x	2 shift	=	6 persons
Office and laboratory workers	2	x	1	=	2
Total					8

5.5.2 Estimates of required funds

Based on the above assumptions, funds required for the project are estimated as follows.

	Rp. million	US$ 000
(1) Land acquisition & preparation	97.9	42.0
(2) Building & warehouse	27.0	11.6
(3) Facilities	1,149.0	493.1
1) Machine & equipment	1,149.0	493.1
2) Vehicles	-	-
(4) Others (*)	29.8	12.8
Total	1,303.7	559.5

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

5.5.3 Project operation plan and the financial analysis

Production and sales plans for the project, production costs, and cash flow projections are shown in Tables 5-15, 5-16, and 5-17, respectively.

5.6 Assessing the Effect of the Plan

5.6.1 Assessment of economic internal rate of return

Economic benefits and costs expected from the plan are assessed from national economic standpoints of Indonesia in the form of economic internal rate of return on investment.

Projects which constitute the plan are divided into three types. The first type consists of the Sukabumi clay supply project and the Banjarnegara feldspar project, where present mining and supply operations will continue even if they are not implemented. Thus, these projects are considered as one type of rehabilitation project.

The second type consists of the Banjarnegara feldspar beneficiation and supply project and the small-scale premixed body and glaze supply project, which are entirely new projects.

The third type is the technical support capability build-up project, from which direct benefits cannot be expected.

5.6.1.1 Economic benefits

Economic benefits and costs are evaluated in different manners according to the type of project. Note that indirect benefits are difficult to be quantified in an objective and accurate manner, and if included in the EIRR calculation, they could cause overestimation of the project's effect. Thus, they are separately accounted for and evaluated in 1.4.2.

Direct benefits expected from the first type projects are characterized as an economic value which will increase as projects producing economic goods, namely clay and feldspar, are implemented. To determine the increase in the economic value, the economic value produced when the project is not implemented must be deducted from the gross economic value. Prices of clay and feldspar produced from the new projects, as determined in the financial analysis, are based on prices of local clay and feldspar currently available and in consideration to advantages obtainable by users, so that these prices are considered to represent the economic value contemplated here. On the other hand, market prices of currently produced clay and feldspar, which will be replaced with those produced under the project, can determined through competition with imported and domestic products in markets where the products can be freely imported. Thus, the differences between prices of clay and feldspar with quality variation, which are currently available in the market, and those of clay and feldspar to be produced under projects, are considered to represent an increase in economic value created by the project.

As for the second type project (new projects), the entire economic value of raw materials to be produced is assessed. For instance, the beneficiated feldspar production project will replace imported products in the same quantity and thus will not reduce other economic value produced in the country. On the other hand, the body supplied in the small-scale premixed body and glaze supply project replaces blended materials which are currently used. Thus, a decline in economic value occurs due to the decrease in production of the materials. At the same time, the production of body materials in amount more or less equal to the blended materials occurs. Finally, the decline in economic value is set off by the same amount of increase, so that the net increase in economic value created by body production is equivalent to the entire economic value of the body to be produced.

Then, glaze produced from the project replaces the imported one. As a result, the entire economic value produced by the project is subject to evaluation.

Prices of these goods assumed in the financial analysis are assessed and established by assuming that they compete with international products (imports) at prices delivered to the user (by taking into account the difference in qualitative value), and they are considered to represent the economic value. Therefore, prices adopted in the financial analysis are used as the basis of determining the economic value obtained from the plan. Noted that prices of imported goods are used, a 5% import duty and a 10% value added tax are deducted. Finally, the price of quartz sand recovered as the by-product of the feldspar beneficiation process is established through competition with prices of other quartz sand products available in the market, and thus it is considered to represent its economic value.

5.6.1.2 Economic costs

(1) Equipment cost

In either case, equipment cost is considered as the cost newly incurred upon implementation of the respective project.

Since domestic and foreign currency portions for the equipment cost are not clear at this stage, they are equally divided. From foreign currency portions, the 5% import duty and the 10% value added tax are deducted. From domestic currency portions, the 10% value added tax is deducted. Note that the economic value represented by domestic current portions of goods and services procured are difficult to measure, so that prices used in the financial analysis are used without any adjustment.

(2) Land acquisition cost

Land to be used for all the projects, except for the small-scale premixed body and glaze production project, is unlikely used for any other purposes and its value is considered to be null if not used for the project. The small-scale premixed body and glaze production project will use the land which has a commercial value and the land value used in the financial analysis are used without any adjustment.

Finally, the site preparation cost is directly borrowed from the financial analysis.

(3) Labor cost

In any of the projects, the labor cost is considered as a new input under each project.

The total unemployment rate in the recent ten or so years was in the range between 2-3%, with the 1994 figure being 1.6% [8]. On the other hand, the underemployment rate (the percentage of persons working for less than 35 hours) is high at 36.6% and the percentage of employees in total jobholders is only 32.7%. Thus, the wage of unskilled workers is assumed to be 75% of that adopted in the financial analysis.

As for salaries of managers and engineers, the true economic value is difficult to measure and those in the financial analysis are used without any adjustment.

(4) Raw earth price

The economic value of raw earth used in the Banjarnegara feldspar supply project and the Sukabumi clay supply project is the difference between the economic value of raw earth used for the project and that for other purpose.

The both projects will blend high-grade materials which are traditionally used with low-grade materials which are currently disposed. Here the percentage of the previously disposed material is assumed to be 30% of the total. The economic value of the traditionally used material is its current price. On the other hand, the economic value of the previously disposed material is considered to be zero because it will not be used for any other purpose.

The price of the currently used material is assessed as zero in the financial analysis for the Banjarnegara project. The Sukabumi clay is assessed at Rp.8.5/kg. The financial prices of these materials have been established through competition with imported and domestic products (in consideration to the difference in grade) and are considered to represent their economic values.

On the other hand, in the beneficiated feldspar supply project, the economic value of raw materials is considered as the cost. However, beneficiated feldspar is imported and will not be used for any purpose other than the project, its economic value is assumed to be zero.

---

[8] Preliminary value published by IMF, International Financial Statistics, Feb. 1996

The input cost of raw materials in the small-scale premixed body and glaze production project is assessed as the economic value of each material. As prices of kaolin and feldspar are determined through competition with imported products, and their economic values are determined by deducting the 5% import duty and the 10% value added tax from the financial prices. Economic values of other materials equal to corresponding domestic market prices.

(5) Other costs

Other costs including the building cost and utilities costs will newly arise upon implementation of the projects. Since their true economic values are difficult to ascertain, prices assumed in the financial analysis are used without any adjustment.

5.6.1.3 Economic internal rate of return

Economic internal rate of return (EIRR) for the projects summarized as follows.

(1) Sukabumi clay supply project

EIRR is 24.3%, which is sufficiently high to indicate that the project will produce a significant economic effect.

(2) Banjarnegara feldspar supply project

EIRR is 4.6%, which represents a very small economic effect from the project. This is because the cost for required equipment is relatively large while additional costs for raw materials are considered to be zero (negative for the Sukabumi clay), whereas the increase in economic value obtained from the project is relatively small. On the other hand, FIRR for the project is high at 32.7%, because the price of raw earth is considered as zero at the mining stage, and the feldspar price is high at Rp.43/kg.

(3) Beneficiated Banjarnegara feldspar supply project

EIRR for the project is -3.5%, and no economic effect is expected.

(4) Small-scale premixed body and glaze production project

EIRR for the project is 11.5%. FIRR is 7.5% if it is implemented as an individual project, and 15.5% if government assistance is obtained. Thus, in consideration to indirect benefits and other economic contribution to be expected from the project, it will bring positive value to the national economy.

5.6.2 Indirect benefits and other economic contributions

5.6.2.1 Indirect benefits

Major indirect benefits created by the projects are estimated as follows:

1) Increase in employment opportunity

The increase in employment opportunity created by construction and operation of the projects after completion:

1. Sukabumi clay supply project: 30 persons
2. Banjarnegara feldspar supply project: 21 persons
3. Beneficiated Banjarnegara feldspar production project: 30 persons
4. Small-scale premixed body and glaze production project: 8 persons

(Note that the multiplier effect is not considered)

2) Trickle-down effect on related industries

The effect includes increased consumption of construction materials, such as steel materials and cement, and other materials used for commercial operation.

3) Contribution to the development of regional economy

Construction activities and commercial operation after completion of the projects will stimulate transportation and commerce sectors, contributing to regional development.

Note that these indirect benefits are difficult to quantify in objective and accurate manners.

5.6.2.2 Other economic contributions

Other economic contributions include the savings in foreign currency reserves expected for the Banjarnegara feldspar beneficiation and supply project. Based on the previous assumption of domestic and foreign currency portions, the balance of payments resulting from projects over 20 years is estimated as follows;

(Unit: US$'000)

Year	Inflow (A)	Outflow (B)		Balance (A)-(B)
		Cost for Machine & Equipment	Substitution of Imported Feldspar	
-1	0.0	14,449.2	0.0	-14,449.2
1	0.0	0.0	-951.3	951.3
2	0.0	0.0	-1,550.0	1,550.0
3	0.0	0.0	-1,596.6	1,596.6
4-20	0.0	0.0	-1,596.6	1,596.6
Total	0.0	14,449.2	-31,240.1	16,790.9

In addition, all of projects will create an opportunity for new project development through stable supply of better raw materials, which will indirectly generate foreign currency revenues, e.g., the tableware industry may be able to enter the medium- and high-grade product markets, and the novelty product industry can develop export-oriented products.

At the quarrying sites, excavated materials which are currently disposed as waste will be used and thus will alleviate environmental damage.

Table 5-1 Equipment List of Sukabumi Clay Supply Project

No.	Description	Q'ty	Remarks
(A)	Mining Site		
1.	Wheel Loader	2 sets	Bucket Capacity: 1.9 m^3
2.	Power Shovel	1 set	Bucket Capacity: 1.3～1.5 m^3
3.	Dozer Shovel	1set	Bucket Capacity: 1.8～2.5 m^3
(B)	Factory		
1.	Wheel Loader	3 sets	Bucket Capacity: 6.2 m^3
2.	Box Feeder with 11 kw motor x 1 set and 3.7 kw x motor x 2 sets	3 sets	Bucket Capacity: Approx. 18 m^3
3.	Belt Conveyor with 7.5 kw motor	1set	Length: Approx. 18m
4.	Belt Conveyor with 7.5 kw motor	1set	Length: Approx. 15m
5.	Reversible Conveyor with 7.5 kw motor	1set	Length: Approx. 10m
(C)	Testing Equipment	1 lot	
	– Electric furnace		
	– Air Oven		
	– Standard Screen		
	– Electronic balance		
	– Agitator		
	– Others		
(D)	Others	1 lot	
1.	Electric Equipment	1 lot	
	– Receiving and Distribution Panel with Accessories		
	– Motor Control Panel with Accessories		
	– Operation panel with Accessories		
	– Wiring Materials	1 lot	
2.	Miscellaneous Materials	1 lot	
(E)	Spare Parts		

Table 5-2 (1): Assumptions to be used for financial projection and evaluation of the plan

1. Assumptions on financial conditions and cost factors

(1) Exchange Rates

- US$ 1.00 = Rp. 2,330
- US$ 1.00 = JPY 105

(JPY 1 = Rp. 22.19)

(2) Interest rates

- 20% /year

(3) Product/raw material prices

1) Ceramic raw materials

- Clay: Rp. 24/kg at Sukabumi (or Rp. 41/kg at W. Java or Jakarta)
- Feldspar: Rp. 43/kg at Banjarnegara (or Rp. 65/kg at W. Java or Jakarta)
- Refined feldspar: Rp. 124/kg at Banjarnegara (or Rp. 146/kg at W. Java or Jakarta)
- Silica: Rp. 18/kg at Banjarnegara (or Rp. 40/kg at W. Java or Jakarta)
- Premixture: Rp. 450/kg at the plant

2) Glaze

- Glaze: Rp. 840/kg at the plant

(4) Corporate income tax

- 15% if the income is less than Rp. 10,000,000/year
- 25% if the income exceeds 10,000,000/year, but less than Rp. 50,000,000/year
- 35% if the income exceeds Rp. 50,000,000/year

(5) Depreciation

- Vehicles: 25% fixed percentage
- Machinery/ facility: 10% fixed percentage
- Building: 5% straight line

(6) Labor cost

- Manager: Rp. 8,500,000/year
- Engineer: Rp. 6,500,000/year
- Worker: Rp. 2,500,000/year

(...to be continued on the next page)

Table 5-2 (2): Assumptions to be used for financial projection and evaluation of the plan

(7) Costs for land acquisition, preparation and construction work

1) Land acquisition: Rp. 65,000/m^2
2) Land preparation
   - Ground works: Rp. 1,050/m^2
   - Foundation works: Rp. 49,000/m^3
   - Concrete works: Rp. 305,000/m^3
3) Construction of open warehouse for raw material: Rp. 75,000/m^2
4) Construction of office/laboratory: Rp. 225,000/m^2

(8) Utility cost

1) Electricity: Rp. 104.3/kwh
2) Diesel oil: Rp. 380/liter

(9) Assumptions on other cost factors

1) Sales expenses: 1% of direct manufacturing costs (total of variable costs and fixed costs)
2) Maintenance costs: 1% of total facility costs in the 1st year, 2% in the 2nd year, and 3% thereafter.
3) Overhead cost: 80% of direct labor costs
4) Account receivable: equivalent to 3 months' sales value
5) Product inventory: equivalent to 1 month total production costs
6) Material inventory: equivalent to 0.8 month variable costs
7) Account payable: equivalent to 3 months' variable costs
8) Debt/equity ratio: 0.7:0.3
9) Project life: 20 years

(...to be continued on the next page)

Table 5-2 (3): Assumptions to be used for financial projection and evaluation of the plan

2. Assumptions on project scope

2.1 Sukabumi clay supply project

1) Annual production: 300,000 tons of clay (with processing loss 2%)
2) Raw clay: the project will buy the raw clay at the quarrying site at Rp. 8.5/kg. The transportation of raw clay from the quarrying site to the processing plant is contracted out at Rp. 3/kg.
3) The project includes:

   - Vehicles required for preparation of quarrying (removal of surface soil), and loading to truck at the quarrying site

   - Stockyard of raw clay at the quarrying site

   - Processing (mixing) facilities of raw clay including vehicles for unloading, feeding and loading

   - Stockyard of processed clay

   - Quality testing facility and equipment
4) The processed clay (blended clay) will be sold at the site with loading to the trucks of users

2.2 Banjarnegara feldspar supply project

1) Annual production: 123,000 tons of feldspar (with 2% of processing loss)
2) Raw feldspar: The transportation of raw feldspar from the quarrying site to the processing plant is contracted out at Rp. 3/kg.
3) The project includes:

   - Vehicles required for preparation of quarrying (removal of surface soil), and loading to truck at the quarrying site

   - Stockyard of raw feldspar at the quarrying site

   - Processing (blending) facilities of raw feldspar including vehicles for unloading, feeding and loading

   - Stockyard of processed clay

   - Quality testing facility and equipment
4) The processed feldspar (blended feldspar) will be sold at the site with loading to the trucks of users

(...to be continued on the next page)

Table 5-2 (4): Assumptions to be used for financial projection and evaluation of the plan

2.3 Banjarnegara refined feldspar supply project

1) Annual production: 30,000 tons of refined feldspar and 70,000 tons of silica
2) Raw feldspar: The transportation of raw feldspar from the quarrying site to the processing plant is contracted out at Rp. 3/kg.
3) The project includes:
   - Processing (refining) facilities of raw feldspar including vehicles for unloading, feeding and loading
   - Stockyard of processed feldspar, and silica
4) The processed feldspar (refined feldspar) and fine silica will be sold at the site with loading to the trucks of users

2.4 Small scale premixture supply project

1) Annual production: 700 tons of premixture and 70 tons of glaze (with processing loss 2%)
2) The project includes:
   - Processing (mixing) facilities
   - Quality testing facility and equipment
3) The processed premixture and glaze will be sold at the site

(Completed)

Table 5-3 Sukabumi Clay Supply Project
- Production & Sales Plan -

(Unit: ton)

Year of operation	Clay			
	Production	Operation rate (%)	Sales	Inventory(*)
1st	195,000	65	180,000	15,000
2nd	300,000	100	290,000	25,000
3rd	300,000	100	300,000	25,000
4th and onwards	300,000	100	300,000	25,000

(*) 1 month equivalent of production.

Table 5-4 Production Cost Statement - Sukabumi Clay Supply Project

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Variable Cost	Raw clay	1,690,650	2,601,000	2,601,000	2,601,000	2,601,000	2,601,000	2,601,000	2,601,000	2,601,000	2,601,000	2,601,000	2,601,000	2,601,000	2,601,000	2,601,000	2,601,000	2,601,000	2,601,000	2,601,000	2,601,000
	On-site transport	596,700	918,000	918,000	918,000	918,000	918,000	918,000	918,000	918,000	918,000	918,000	918,000	918,000	918,000	918,000	918,000	918,000	918,000	918,000	918,000
	Total Variable Cost	2,287,350	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000
Direct Fixed Cost	Direct Labor Cost	84,990	84,990	84,990	84,990	84,990	84,990	84,990	84,990	84,990	84,990	84,990	84,990	84,990	84,990	84,990	84,990	84,990	84,990	84,990	84,990
	Over Head	67,992	67,992	67,992	67,992	67,992	67,992	67,992	67,992	67,992	67,992	67,992	67,992	67,992	67,992	67,992	67,992	67,992	67,992	67,992	67,992
	Maintenance Cost	82,143	164,286	246,429	246,429	246,429	246,429	246,429	246,429	246,429	246,429	246,429	246,429	246,429	246,429	246,429	246,429	246,429	246,429	246,429	246,429
	Tax/Insurance	101,143	78,961	64,595	53,330	44,413	37,274	32,629	29,011	26,177	25,528	24,944	24,417	23,943	23,515	23,130	22,783	22,470	22,188	21,934	21,705
	Utility Cost	230,365	230,365	230,365	230,365	230,365	230,365	230,365	230,365	230,365	230,365	230,365	230,365	230,365	230,365	230,365	230,365	230,365	230,365	230,365	230,365
	Total	566,633	626,595	694,371	683,107	674,189	667,050	662,405	658,788	655,954	655,305	654,720	654,193	653,719	653,291	652,906	652,559	652,246	651,964	651,710	651,482
Direct Factory Cost		2,853,983	4,145,595	4,213,371	4,202,107	4,193,189	4,186,050	4,181,405	4,177,788	4,174,954	4,174,305	4,173,720	4,173,193	4,172,719	4,172,291	4,171,906	4,171,559	4,171,246	4,170,964	4,170,710	4,170,482
Depreciation	Machinery	149,396	134,606	121,280	109,273	98,455	88,708	79,926	72,013	64,884	58,460	52,673	47,458	42,760	38,527	34,713	31,276	28,180	25,390	22,876	20,612
	Vehicles	1,583,614	1,187,711	890,783	668,087	501,065	375,799	281,849	211,387	0	0	0	0	0	0	0	0	0	0	0	0
	Buildings	370,800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pre-Operating Cost	114,368	114,368	114,368	114,368	114,368	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	IDC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	2,218,178	1,436,684	1,126,430	891,728	713,888	464,507	361,775	283,400	64,884	58,460	52,673	47,458	42,760	38,527	34,713	31,276	28,180	25,390	22,876	20,612
Total Factory Cost		5,072,161	5,582,279	5,339,801	5,093,835	4,907,077	4,650,558	4,543,181	4,461,188	4,239,838	4,232,765	4,226,393	4,220,652	4,215,479	4,210,818	4,206,618	4,202,835	4,199,426	4,196,354	4,193,587	4,191,093
Operating Expenses	Sales Expenses	28,540	41,456	42,134	42,021	41,932	41,861	41,814	41,778	41,750	41,743	41,737	41,732	41,727	41,723	41,719	41,716	41,712	41,710	41,707	41,705
	General & Admin. Expenses																				
	Total	28,540	41,456	42,134	42,021	41,932	41,861	41,814	41,778	41,750	41,743	41,737	41,732	41,727	41,723	41,719	41,716	41,712	41,710	41,707	41,705
Paid Interest	LTD	1,370,546	1,226,278	1,082,010	937,742	793,474	649,206	504,938	360,670	216,402	72,134	0	0	0	0	0	0	0	0	0	0
	STD	0	338,328	308,647	164,620	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	1,370,546	1,564,606	1,390,657	1,102,362	793,474	649,206	504,938	360,670	216,402	72,134	0	0	0	0	0	0	0	0	0	0
Other Non-Operating Expenses																					
Total Production Cost		6,471,247	7,188,341	6,772,592	6,238,218	5,742,483	5,341,624	5,089,933	4,863,656	4,497,989	4,346,642	4,268,130	4,262,384	4,257,206	4,252,541	4,248,338	4,244,550	4,241,138	4,238,064	4,235,294	4,232,798

Table 5-5 Income Statement - Sukabumi Clay Supply Project

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1 Operating Income	4,320,000	6,960,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000
Sales Revenue	4,320,000	6,960,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000	7,200,000
Other Revenue																				
2 Cost of Sales	4,533,106	5,522,545	5,374,433	5,138,348	4,948,372	4,683,949	4,564,147	4,480,038	4,270,296	4,245,372	4,232,933	4,221,130	4,215,910	4,211,207	4,206,969	4,203,150	4,199,710	4,196,610	4,193,817	4,191,301
Variable Cost	2,287,350	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000	3,519,000
Direct Fixed Cost	566,633	626,595	694,371	683,107	674,189	667,050	662,405	658,788	655,954	655,305	654,720	654,193	653,719	653,291	652,906	652,559	652,246	651,964	651,710	651,482
Depreciating	2,218,178	1,436,684	1,126,430	891,728	713,888	464,507	361,775	283,400	64,884	58,460	52,673	47,458	42,760	38,527	34,713	31,276	28,180	25,390	22,876	20,612
Change in Inventory	539,055	59,734	-34,632	-44,513	-41,295	-33,392	-20,966	-18,851	-30,458	-12,607	-6,540	-479	-431	-389	-350	-315	-284	-256	-231	-208
3 Sales Revenue	-213,106	1,437,455	1,825,567	2,061,652	2,251,628	2,516,051	2,635,853	2,719,962	2,929,704	2,954,628	2,967,067	2,978,870	2,984,090	2,988,793	2,993,031	2,996,850	3,000,290	3,003,390	3,006,183	3,008,699
Sales Expenses	28,540	41,456	42,134	42,021	41,932	41,861	41,814	41,778	41,750	41,743	41,737	41,732	41,727	41,723	41,719	41,716	41,712	41,710	41,707	41,705
General & Addm.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4 Operating Profit	-241,646	1,395,999	1,783,433	2,019,631	2,209,696	2,474,190	2,594,039	2,678,184	2,887,955	2,912,885	2,925,330	2,937,138	2,942,363	2,947,071	2,951,312	2,955,134	2,958,578	2,961,680	2,964,475	2,966,994
Non Operating Income																				
Interest	1,370,546	1,564,606	1,390,657	1,102,362	793,474	649,206	504,938	360,670	216,402	72,134	0	0	0	0	0	0	0	0	0	0
Other Non-Operating Income																				
5 Revenue before Tax	-1,612,192	-168,607	392,776	917,269	1,416,222	1,824,984	2,089,101	2,317,514	2,671,552	2,840,751	2,925,330	2,937,138	2,942,363	2,947,071	2,951,312	2,955,134	2,958,578	2,961,680	2,964,475	2,966,994
Income Tax	0	0	117,833	275,181	424,867	547,495	626,730	695,254	801,466	852,225	877,599	881,141	882,709	884,121	885,394	886,540	887,573	888,504	889,343	890,098
Tax-free Income																				
6 Revenue after Tax	-1,612,192	-168,607	274,943	642,088	991,355	1,277,489	1,462,371	1,622,260	1,870,087	1,988,525	2,047,731	2,055,996	2,059,654	2,062,949	2,065,919	2,068,594	2,071,004	2,073,176	2,075,133	2,076,896
Dividend																				
7 Excess Cash	-1,612,192	-168,607	274,943	642,088	991,355	1,277,489	1,462,371	1,622,260	1,870,087	1,988,525	2,047,731	2,055,996	2,059,654	2,062,949	2,065,919	2,068,594	2,071,004	2,073,176	2,075,133	2,076,896

Table 5-6 Equipment List of Banjarnegara Feldspar Supply Project

No.	Description	Q'ty	Remarks	
(A)	Mining Site			
1.	Wheel Loader	2 sets	Bucket Capacity:	3.7 m^3
2.	Dozer Shovel	2 sets	Bucket Capacity:	1.8～2.5 m^3
3.	Power Shovel	2 sets	Bucket Capacity:	5～6 m^3
(B)	Factory			
1.	Charging Hopper	2 sets	Capacity:	8～10 m^3
2.	Vibration Feeder with 2.2 kw motor	2 sets	Capacity:	Max. 50 t/hr
3.	Belt Conveyor with 0.75 kw motor	1set	Length:	Approx. 4 m
4.	Belt Conveyor with 2.2 kw motor	1set	Length:	Approx. 16 m
5.	Belt Conveyor with 1.5 kw motor	1set	Length:	Approx. 12 m
6.	Reversible Conveyor with 0.75 kw motor	1set	Length:	Approx. 5 m
7.	Vibration Screen with 7.5 kw motor	1set	Capacity:	−10 m/m, 45 t/hr
8.	Receiving Hopper	1set	Capacity:	Approx. 8～10 m^3
9.	Belt Feeder with 2.2 kw motor	1set	Capacity:	Max. 50 t/hr
10.	Belt Conveyor with 0.75 kw motor	1set	Length:	Approx. 4 m
11.	Belt Conveyor with 1.5 kw motor	1set	Length:	Approx. 10 m
12.	Wheel Loader	2 sets	Bucket Capacity:	3.7 m^3
13.	Jaw Crusher with 7.5 kw motor	1set	Outlet clearance:	15 mm
14.	Steel Materials for Support and Others	1 lot		
(C)	Testing Equipment	1 lot		
	– Electric Kiln			
	– Standard Screen			
	– Electric Balance			
	– Pot Mill Set			
	– Other Equipment			
(D)	Others			
1.	Electric Equipment	1 lot	For motor power only	
	– Receiving and Distribution Panel with Accessories			
	– Motor Control Panel with Accessories			
	– Operation panel with Accessories			
	– Wiring Materials			
2.	Miscellaneous Materials	1 lot		
(E)	Spare Parts	1 lot		

Table 5-7 Banjarnegara Feldspar Supply Project
- Production & Sales Plan -

(Unit: ton)

Year of operation	Feldspar			
	Production	Operation rate (%)	Sales	Inventory(*)
1st	79,950	65	73,300	6,650
2nd	123,000	100	119,400	10,250
3rd	123,000	100	119,400	10,250
4th and onwards	123,000	100	119,400	10,250

(*) 1 month equivalent of production.

Table 5-8 Production Cost Statement - Banjarnegara Feldspar Supply Project

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Variable Cost	On-site transport	244,647	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380
	Total Variable Cost	244,647	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380
Direct Fixed Cost	Direct Labor Cost	62,496	62,496	62,496	62,496	62,496	62,496	62,496	62,496	62,496	62,496	62,496	62,496	62,496	62,496	62,496	62,496	62,496	62,496	62,496	62,496
	Over Head	49,997	49,997	49,997	49,997	49,997	49,997	49,997	49,997	49,997	49,997	49,997	49,997	49,997	49,997	49,997	49,997	49,997	49,997	49,997	49,997
	Maintenance Cost	94,816	189,632	284,449	284,449	284,449	284,449	284,449	284,449	284,449	284,449	284,449	284,449	284,449	284,449	284,449	284,449	284,449	284,449	284,449	284,449
	Tax/Insurance	105,822	82,959	66,039	53,197	43,426	35,969	30,258	25,986	22,711	22,325	21,977	21,664	21,382	21,128	20,898	20,692	20,506	20,338	20,187	20,051
	Utility Cost	219,995	219,995	219,995	219,995	219,995	219,995	219,995	219,995	219,995	219,995	219,995	219,995	219,995	219,995	219,995	219,995	219,995	219,995	219,995	219,995
	Total	533,126	605,079	682,975	670,133	660,363	652,906	647,194	642,923	639,647	639,261	638,914	638,601	638,318	638,064	637,835	637,629	637,443	637,275	637,124	636,988
Direct Factory Cost		777,773	981,459	1,059,355	1,046,513	1,036,743	1,029,286	1,023,574	1,019,303	1,016,027	1,015,641	1,015,294	1,014,981	1,014,698	1,014,444	1,014,215	1,014,009	1,013,823	1,013,655	1,013,504	1,013,368
Depreciation	Machinery	88,842	80,046	72,122	64,982	58,548	52,752	47,530	42,824	38,585	34,765	31,323	28,222	25,428	22,911	20,643	18,599	16,758	15,099	13,604	12,257
	Vehicles	2,133,008	1,599,756	1,199,817	899,863	674,897	506,173	379,630	284,722	0	0	0	0	0	0	0	0	0	0	0	0
	Buildings	52,200	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pre-Operating Cost	12,232	12,232	12,232	12,232	12,232	12,232	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	IDC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	2,286,282	1,692,035	1,284,171	977,077	745,678	571,157	427,159	327,547	38,585	34,765	31,323	28,222	25,428	22,911	20,643	18,599	16,758	15,099	13,604	12,257
Total Factory Cost		3,064,055	2,673,494	2,343,526	2,023,590	1,782,421	1,600,443	1,450,734	1,346,849	1,054,612	1,050,406	1,046,617	1,043,203	1,040,126	1,037,355	1,034,857	1,032,607	1,030,580	1,028,754	1,027,108	1,025,625
Operating Expenses	Sales Expenses	7,778	9,815	10,594	10,465	10,367	10,293	10,236	10,193	10,160	10,156	10,153	10,150	10,147	10,144	10,142	10,140	10,138	10,137	10,135	10,134
	General & Admin. Expenses																				
	Total	7,778	9,815	10,594	10,465	10,367	10,293	10,236	10,193	10,160	10,156	10,153	10,150	10,147	10,144	10,142	10,140	10,138	10,137	10,135	10,134
Paid Interest	LTD	1,410,141	1,261,705	1,113,269	964,833	816,397	667,962	519,526	371,090	222,654	74,218	0	0	0	0	0	0	0	0	0	0
	STD	0	121,643	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	1,410,141	1,383,348	1,113,269	964,833	816,397	667,962	519,526	371,090	222,654	74,218	0	0	0	0	0	0	0	0	0	0
Other Non-Operating Expenses																					
Total Production Cost		4,481,974	4,066,657	3,467,389	2,998,889	2,609,185	2,278,698	1,980,495	1,728,132	1,287,426	1,134,781	1,056,770	1,053,352	1,050,273	1,047,499	1,045,000	1,042,748	1,040,718	1,038,890	1,037,243	1,035,759

Table 5-9 Income Statement - Banjarnegara Feldspar Supply Project

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1 Operating Income	3,151,900	5,134,200	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000
Sales Revenue	3,151,900	5,134,200	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000	5,289,000
Other Revenue																				
2 Cost of Sales	2,690,707	2,708,090	2,393,445	2,062,616	1,814,883	1,627,973	1,475,574	1,367,871	1,091,323	1,063,122	1,053,115	1,043,487	1,040,383	1,037,586	1,035,066	1,032,795	1,030,749	1,028,906	1,027,245	1,025,749
Variable Cost	244,647	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380	376,380
Direct Fixed Cost	533,126	605,079	682,975	670,133	660,363	652,906	647,194	642,923	639,647	639,261	638,914	638,601	638,318	638,064	637,835	637,629	637,443	637,275	637,124	636,988
Depreciating	2,286,282	1,692,035	1,284,171	977,077	745,678	571,157	427,159	327,547	38,585	34,765	31,323	28,222	25,428	22,911	20,643	18,599	16,758	15,099	13,604	12,257
Change in Inventory	373,348	-34,596	-49,919	-39,026	-32,462	-27,530	-24,840	-21,022	-36,711	-12,715	-6,498	-285	-256	-231	-208	-188	-169	-152	-137	-124
3 Sales Revenue	461,193	2,426,110	2,895,555	3,226,384	3,474,117	3,661,027	3,813,426	3,921,129	4,197,677	4,225,878	4,235,885	4,245,513	4,248,617	4,251,414	4,253,934	4,256,205	4,258,251	4,260,094	4,261,755	4,263,251
Sales Expenses	7,778	9,815	10,594	10,465	10,367	10,293	10,236	10,193	10,160	10,156	10,153	10,150	10,147	10,144	10,142	10,140	10,138	10,137	10,135	10,134
General & Addm.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4 Operating Profit	453,416	2,416,295	2,884,961	3,215,918	3,463,750	3,650,734	3,803,190	3,910,936	4,187,517	4,215,722	4,225,732	4,235,363	4,238,470	4,241,270	4,243,792	4,246,065	4,248,113	4,249,958	4,251,620	4,253,118
Non Operating Income																				
Interest	1,410,141	1,383,348	1,113,269	964,853	816,397	667,962	519,526	371,090	222,654	74,218	0	0	0	0	0	0	0	0	0	0
Other Non-Operating Income																				
5 Revenue before Tax	-956,725	1,032,947	1,771,692	2,251,085	2,647,352	2,982,773	3,283,665	3,539,846	3,964,863	4,141,504	4,225,732	4,235,363	4,238,470	4,241,270	4,243,792	4,246,065	4,248,113	4,249,958	4,251,620	4,253,118
Income Tax	0	309,884	531,508	675,326	794,206	894,832	985,099	1,061,954	1,189,459	1,242,451	1,267,720	1,270,609	1,271,541	1,272,381	1,273,138	1,273,819	1,274,434	1,274,987	1,275,486	1,275,935
Tax-free Income																				
6 Revenue after Tax	-956,725	723,063	1,240,184	1,575,760	1,853,147	2,087,941	2,298,565	2,477,892	2,775,404	2,899,053	2,958,012	2,964,754	2,966,929	2,968,889	2,970,654	2,972,245	2,973,679	2,974,970	2,976,134	2,977,182
Dividend																				
7 Excess Cash	-956,725	723,063	1,240,184	1,575,760	1,853,147	2,087,941	2,298,565	2,477,892	2,775,404	2,899,053	2,958,012	2,964,754	2,966,929	2,968,889	2,970,654	2,972,245	2,973,679	2,974,970	2,976,134	2,977,182

Table 5-10 Equipment List of Banjarnegara Feldspar Beneficiation and Supply Project

No.	Description	Q'ty	Remarks	
1.	Wheel loader	1 set	Bucket Capacity:	1.9 m^3
2.	Charging Hopper	1 set		
3.	Vibration Feeder with 0.75 kw motor	1 set	Capacity:	Max. 15 t/hr
4.	Belt Conveyor with 0.75 kw motor	1 set	Length:	Approx. 7m
5.	Drum Washer with Screen and 45 kw motor	1 set		
6.	Belt Conveyor with 2.2 kw motor	1 set	Capacity:	13 t/hr
7.	Tube Mill with 190 kw motor	3 sets	Length:	Approx. 8 m
8.	Agitator with 5.5 kw motor and Spiral Classifier with 5.5 kw motor	1 set	Capacity:	12~13 t/hr
9.	Drum Screen with 2.2 kw motor	2 sets		
10.	Magnetic Separator with 15.5 kw power	1set	High Power type	
11.	Agitator with 11 kw motor	2 sets		
12.	Sand pump with 5.5 kw motor	3 sets	Capacity:	0.7~1.0 m^3/min.
13.	Floatation Facilities Rubber lining tank Rubber lining pump Rubber lining agitator Other equipment	4 units	Capacity:	2.25 t/hr/unit
14.	Water Pump with 1.5 kw motor	5 sets		
15.	Power Shovel	1 set	Bucket capacity:	1.3~1.5 m^3
16.	Dump Truck	1 set	Capacity:	6~8 t
17.	Electric equipment – Receiving and Distribution Panel with Accessories – Motor Control Panel with Accessories – Operating Panel with Accessories – Wiring Materials	1 lot		
18.	Others – Water Supply, Facilities – Piping Materials – Steel Materials – Air Compressor – Screen – Other miscellaneous materials	1 lot		
19.	Spare Parts	1 lot		

Table 5-11 Banjarnegara Feldspar Beneficiation & Supply Project
- Production & Sales Plan -

(Unit: ton)

Year of operation	Refined Feldspar			
	Production	Operation rate (%)	Sales	Inventory(*)
1st	4,875	65	4,470	405
2nd	7,500	100	7,280	625
3rd	7,500	100	7,500	625
4th and onwards	7,500	100	7,500	625

(*) 1 month equivalent of production.

(Unit: ton)

Year of operation	Silica			
	Production	Operation rate (%)	Sales	Inventory(*)
1st	11,375	65	10,425	950
2nd	17,500	100	16,990	1,460
3rd	17,500	100	17,500	1,460
4th and onwards	17,500	100	17,500	1,460

(*) 1 month equivalent of production.

Table 5-12 Production Cost Statement - Banjarnegara Feldspar Beneficiation and Supply Project

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Variable Cost	On-site transport	14,918	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950
	Total Variable Cost	14,918	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950
Direct Fixed Cost	Direct Labor Cost	45,900	45,900	45,900	45,900	45,900	45,900	45,900	45,900	45,900	45,900	45,900	45,900	45,900	45,900	45,900	45,900	45,900	45,900	45,900	45,900
	Over Head	36,720	36,720	36,720	36,720	36,720	36,720	36,720	36,720	36,720	36,720	36,720	36,720	36,720	36,720	36,720	36,720	36,720	36,720	36,720	36,720
	Maintenance Cost	224,775	449,549	674,324	674,324	674,324	674,324	674,324	674,324	674,324	674,324	674,324	674,324	674,324	674,324	674,324	674,324	674,324	674,324	674,324	674,324
	Tax/Insurance	226,455	201,566	180,658	162,098	145,582	130,857	117,713	105,959	95,434	86,246	77,967	70,509	63,788	57,733	52,277	47,362	42,933	38,942	35,347	32,107
	Utility Cost	229,160	229,160	229,160	229,160	229,160	229,160	229,160	229,160	229,160	229,160	229,160	229,160	229,160	229,160	229,160	229,160	229,160	229,160	229,160	229,160
	Total	763,010	962,895	1,166,763	1,148,202	1,131,686	1,116,961	1,103,818	1,092,063	1,081,538	1,072,350	1,064,072	1,056,613	1,049,892	1,043,837	1,038,381	1,033,466	1,029,037	1,025,046	1,021,451	1,018,211
Direct Factory Cost		777,927	985,845	1,189,713	1,171,152	1,154,636	1,139,911	1,126,768	1,115,013	1,104,488	1,095,300	1,087,022	1,079,563	1,072,842	1,066,787	1,061,331	1,056,416	1,051,987	1,047,996	1,044,401	1,041,161
Depreciation	Machinery	2,115,577	1,906,135	1,717,427	1,547,402	1,394,209	1,256,183	1,131,820	1,019,770	918,813	827,851	745,893	672,050	605,517	545,571	491,559	442,895	399,048	359,543	323,948	291,877
	Vehicles	245,128	183,846	137,884	103,413	77,560	58,170	43,627	32,721	0	0	0	0	0	0	0	0	0	0	0	0
	Buildings	127,500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pre-Operating Cost	746	746	746	746	746	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	IDC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	2,488,950	2,090,726	1,856,057	1,651,561	1,472,515	1,314,352	1,175,448	1,052,491	918,813	827,851	745,893	672,050	605,517	545,571	491,559	442,895	399,048	359,543	323,948	291,877
Total Factory Cost		3,266,878	3,076,571	3,045,770	2,822,713	2,627,151	2,454,264	2,302,216	2,167,504	2,023,301	1,923,151	1,832,915	1,751,613	1,678,359	1,612,358	1,552,891	1,499,311	1,451,035	1,407,539	1,368,349	1,333,038
Operating Expenses	Sales Expenses	7,779	9,858	11,897	11,712	11,546	11,399	11,268	11,150	11,045	10,953	10,870	10,796	10,728	10,668	10,613	10,564	10,520	10,480	10,444	10,412
	General & Admin. Expenses																				
	Total	7,779	9,858	11,897	11,712	11,546	11,399	11,268	11,150	11,045	10,953	10,870	10,796	10,728	10,668	10,613	10,564	10,520	10,480	10,444	10,412
Paid Interest	LTD	3,012,018	2,694,964	2,377,909	2,060,855	1,743,800	1,426,746	1,109,691	792,636	475,582	158,527	0	0	0	0	0	0	0	0	0	0
	STD	0	1,064,509	2,224,539	3,584,849	5,168,594	7,027,341	9,221,988	11,826,785	14,932,274	18,648,880	23,111,345	28,170,077	34,340,073	41,865,974	51,046,229	62,244,927	75,906,247	92,572,072	112,903,493	137,707,028
	Total	3,012,018	3,759,473	4,602,449	5,645,704	6,912,394	8,454,086	10,331,679	12,619,422	15,407,856	18,807,407	23,111,345	28,170,077	34,340,073	41,865,974	51,046,229	62,244,927	75,906,247	92,572,072	112,903,493	137,707,028
Other Non-Operating Expenses																					
Total Production Cost		6,286,675	6,845,903	7,660,116	8,480,128	9,551,092	10,919,749	12,645,162	14,798,076	17,442,202	20,741,511	24,955,130	29,932,485	36,029,160	43,489,000	52,609,733	63,754,802	77,367,802	93,990,091	114,282,286	139,050,478

Table 5-13 Income Statement - Banjarnegara Feldspar Beneficiation and Supply Project

	1	2	3	4	5	6	7	8	9	10
1 Operating Income	724,050	1,179,420	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000
Sales Revenue	724,050	1,179,420	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000
Other Revenue										
2 Cost of Sales	2,743,198	3,029,988	2,977,946	2,754,406	2,537,940	2,340,255	2,158,489	1,988,166	1,803,046	1,648,318
Variable Cost	14,918	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950
Direct Fixed Cost	763,010	962,895	1,166,763	1,148,202	1,131,686	1,116,961	1,103,818	1,092,063	1,081,538	1,072,350
Depreciating	2,488,950	2,090,726	1,856,057	1,651,561	1,472,515	1,314,352	1,175,448	1,052,491	918,813	827,851
Change in Inventory	523,680	46,584	67,824	68,307	89,211	114,009	143,727	179,338	220,256	274,832
3 Sales Revenue	-2,019,148	-1,850,568	-1,762,946	-1,539,406	-1,322,940	-1,125,255	-943,489	-773,166	-588,046	-433,318
Sales Expenses	7,779	9,858	11,397	11,712	11,546	11,399	11,268	11,150	11,045	10,953
General & Addm.	0	0	0	0	0	0	0	0	0	0
4 Operating Profit	-2,026,927	-1,860,426	-1,774,843	-1,551,118	-1,334,486	-1,136,654	-954,756	-784,316	-599,090	-444,271
Non Operating Income										
Interest	3,012,018	3,759,473	4,602,449	5,645,704	6,912,394	8,454,086	10,331,679	12,619,422	15,407,856	18,807,407
Other Non-Operating Income										
5 Revenue before Tax	-5,038,945	-5,619,899	-6,377,292	-7,196,821	-8,246,881	-9,590,740	-11,286,435	-13,403,738	-16,006,946	-19,251,678
Income Tax	0	0	0	0	0	0	0	0	0	0
Tax-free Income										
6 Revenue after Tax	-5,038,945	-5,619,899	-6,377,292	-7,196,821	-8,246,881	-9,590,740	-11,286,435	-13,403,738	-16,006,946	-19,251,678
Dividend										
7 Excess Cash	-5,038,945	-5,619,899	-6,377,292	-7,196,821	-8,246,881	-9,590,740	-11,286,435	-13,403,738	-16,006,946	-19,251,678

	11	12	13	14	15	16	17	18	19	20
1 Operating Income	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000
Sales Revenue	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000	1,215,000
Other Revenue										
2 Cost of Sales	1,481,920	1,336,999	1,170,506	990,953	793,134	570,926	317,072	22,902	-321,991	-730,152
Variable Cost	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950	22,950
Direct Fixed Cost	1,064,072	1,056,613	1,049,892	1,043,837	1,038,381	1,033,466	1,029,037	1,025,046	1,021,451	1,018,211
Depreciating	745,893	672,050	605,517	545,571	491,559	442,895	399,048	359,543	323,948	291,877
Change in Inventory	350,995	414,614	507,853	621,405	759,757	928,384	1,133,963	1,384,637	1,690,340	2,063,190
3 Sales Revenue	-266,920	-121,999	44,494	224,047	421,866	644,074	897,928	1,192,098	1,536,991	1,945,152
Sales Expenses	10,870	10,796	10,728	10,668	10,613	10,564	10,520	10,480	10,444	10,412
General & Addm.	0	0	0	0	0	0	0	0	0	0
4 Operating Profit	-277,791	-132,795	33,765	213,379	411,253	633,509	887,408	1,181,618	1,526,547	1,934,740
Non Operating Income										
Interest	23,111,345	28,170,077	34,340,073	41,865,974	51,046,229	62,244,927	75,906,247	92,572,072	112,903,493	137,707,028
Other Non-Operating Income										
5 Revenue before Tax	-23,389,136	-28,302,872	-34,306,307	-41,652,596	-50,634,976	-61,611,418	-75,018,839	-91,390,455	-111,376,946	-135,772,287
Income Tax	0	0	0	0	0	0	0	0	0	0
Tax-free Income										
6 Revenue after Tax	-23,389,136	-28,302,872	-34,306,307	-41,652,596	-50,634,976	-61,611,418	-75,018,839	-91,390,455	-111,376,946	-135,772,287
Dividend										
7 Excess Cash	-23,389,136	-28,302,872	-34,306,307	-41,652,596	-50,634,976	-61,611,418	-75,018,839	-91,390,455	-111,376,946	-135,772,287

Table 5-14 Equipment List of Small-scale Body and Glaze Premixing Project

No.	Description	Q'ty	Remarks
(A)	Body Preparation Section		
1.	Ball Mill with 11 kw motor	1 set	Capacity: 2,000 kg/Batch
2.	Ball Mill with 7.5 kw motor	1 set	Capacity: 1,000 kg/Batch
3.	Agitator for Slop tank with 1.5 kw motor	3 sets	Slip tank: Concrete made
4.	Vibration Screen with 0.2 kw motor	1 set	
5.	Magnetic Ferro-filter, magnetic power 1 kw	1 set	with silicon rectifier
6.	Slip Pump with 1.5 kw motor	1 set	
7.	Diaphragm Pump with 2.2 kw motor	1 set	
8.	Filter Press with Hydraulic pump (1.5 kw)	1 set	Capacity: 1 t/Batch
9.	De-airing Extruder with 1.5 kw motor	1 set	Capacity: 400~500 kg/Batch
(B)	Glaze Preparation Section		
1.	Ball Mill with 5.5 kw motor	2 sets	Capacity: 500 kg/Batch
2.	Agitator with 0.75 kw motor	3 sets	Glaze tank: Concrete made
3.	Slip pump with 0.25 kw motor	1 set	
4.	Vibration Screen with 0.2 kw motor	1 set	
5.	Magnetic Ferro-filter magnetic power 1 kw	1 set	with Silicon rectifier
6.	Portable Agitator with 0.57 kw motor	1 set	
(C)	Testing Equipment	1 lot	
	Electric Kiln		
	Standard Screen		
	Electronic balance		
	Pot Mill		
	Air Oven		
	Others		
(D)	Others		
1.	Hand Cart	2 sets	Capacity: 300~500 kg/Batch
2.	Weighing Balance	2 sets	1,000 kg x 1 set 100 kg x 1 set
3.	PV-Tank	30 pcs	Capacity: 30 L
4.	Miscellaneous	1 lot	
	Shovel		
	Bag		
	Wooden Pallet		
	Hose		
	Others		
5.	Electric Equipment		
	Receiving and Distribution panel with Accessories	1 lot	For motor power only
	Motor Control Panel with Accessories		
	Operation Panel with Accessories		
	Wiring Materials		
(E)	Spare Parts	1 lot	

Table 5-15 Small-scale Body and Glaze Premixing Project

- Production & Sales Plan -

(Unit: ton)

Year of operation	Pre-mixture			
	Production	Operation rate (%)	Sales	Inventory(*)
1st	455	65	417	38
2nd	700	100	680	58
3rd	700	100	700	58
4th and onwards	700	100	700	58

(*) 1 month equivalent of production.

(Unit: ton)

Year of operation	Glaze			
	Production	Operation rate (%)	Sales	Inventory(*)
1st	46	65	42	4
2nd	70	100	68	6
3rd	70	100	70	6
4th and onwards	70	100	70	6

(*) 1 month equivalent of production.

Table 5-16 Production Cost Statement - Small-scale Body and Glaze Premixing Project

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Variable Cost	Kaolin	40,784	62,734	62,734	62,734	62,734	62,734	62,734	62,734	62,734	62,734	62,734	62,734	62,734	62,734	62,734	62,734	62,734	62,734	62,734	62,734
	Feldspar	31,883	48,977	48,977	48,977	48,977	48,977	48,977	48,977	48,977	48,977	48,977	48,977	48,977	48,977	48,977	48,977	48,977	48,977	48,977	48,977
	Quartz	8,507	13,078	13,078	13,078	13,078	13,078	13,078	13,078	13,078	13,078	13,078	13,078	13,078	13,078	13,078	13,078	13,078	13,078	13,078	13,078
	Clay	2,673	4,109	4,109	4,109	4,109	4,109	4,109	4,109	4,109	4,109	4,109	4,109	4,109	4,109	4,109	4,109	4,109	4,109	4,109	4,109
	Others	5,423	8,253	8,253	8,253	8,253	8,253	8,253	8,253	8,253	8,253	8,253	8,253	8,253	8,253	8,253	8,253	8,253	8,253	8,253	8,253
	Total Variable Cost	89,271	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150
Direct Fixed Cost	Direct Labor Cost	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000	24,000
	Over Head	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200	19,200
	Maintenance Cost	11,760	23,521	35,281	35,281	35,281	35,281	35,281	35,281	35,281	35,281	35,281	35,281	35,281	35,281	35,281	35,281	35,281	35,281	35,281	35,281
	Tax/Insurance	12,963	11,511	10,441	9,473	8,596	7,802	7,127	6,518	5,970	5,476	5,031	4,630	4,268	3,943	3,649	3,385	3,147	2,932	2,739	2,565
	Utility Cost	13,017	13,017	13,017	13,017	13,017	13,017	13,017	13,017	13,017	13,017	13,017	13,017	13,017	13,017	13,017	13,017	13,017	13,017	13,017	13,017
	Total	80,940	91,249	101,940	100,972	100,095	99,301	98,625	98,016	97,468	96,974	96,529	96,128	95,767	95,441	95,148	94,883	94,645	94,431	94,237	94,063
Direct Factory Cost		170,211	228,399	239,090	238,121	237,245	236,450	235,775	235,166	234,618	234,124	233,679	233,278	232,916	232,591	232,298	232,033	231,795	231,581	231,387	231,213
Depreciation	Machinery	113,755	102,494	92,347	83,204	74,967	67,545	60,858	54,833	49,405	44,514	40,107	36,136	32,559	29,336	26,431	23,815	21,457	19,333	17,419	15,694
	Vehicles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Buildings	27,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Pre-Operating Cost	4,464	4,464	4,464	4,464	4,464	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	IDC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Total	145,219	106,957	96,810	87,668	79,431	67,545	60,858	54,833	49,405	44,514	40,107	36,136	32,559	29,336	26,431	23,815	21,457	19,333	17,419	15,694
Total Factory Cost		315,430	335,356	335,900	325,789	316,676	303,996	296,633	290,000	284,023	278,638	273,786	269,414	265,475	261,926	258,729	255,848	253,252	250,913	248,806	246,907
Operating Expenses	Sales Expenses	1,702	2,284	2,391	2,381	2,372	2,365	2,358	2,352	2,346	2,341	2,337	2,333	2,329	2,326	2,323	2,320	2,318	2,316	2,314	2,312
	General & Admin. Expenses																				
	Total	1,702	2,284	2,391	2,381	2,372	2,365	2,358	2,352	2,346	2,341	2,337	2,333	2,329	2,326	2,323	2,320	2,318	2,316	2,314	2,312
Paid Interest	LTD	173,397	155,145	136,893	118,640	100,388	82,136	63,883	45,631	27,379	9,126	0	0	0	0	0	0	0	0	0	0
	STD	0	57,569	100,384	144,140	192,703	247,741	310,694	383,332	467,800	566,713	683,261	803,266	949,583	1,128,009	1,345,617	1,611,033	1,934,782	2,329,703	2,811,459	3,399,158
	Total	173,397	212,714	237,277	262,780	293,091	329,876	374,578	428,963	495,178	575,839	683,261	803,266	949,583	1,128,009	1,345,617	1,611,033	1,934,782	2,329,703	2,811,459	3,399,158
Other Non-Operating Expenses																					
Total Production Cost		490,530	550,353	575,567	590,950	612,139	636,237	673,569	721,315	781,547	856,818	959,384	1,075,013	1,217,387	1,392,261	1,606,669	1,869,201	2,190,352	2,582,932	3,062,578	3,648,377

Table 5-17 Income Statement - Small-scale Body and Glaze Premixing Project

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1 Operating Income	222,930	363,120	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800
Sales Revenue	222,930	363,120	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800	373,800
Other Revenue																				
2 Cost of Sales	274,569	330,373	335,800	324,508	314,911	301,989	293,524	286,023	279,006	272,368	265,242	259,782	253,616	247,359	240,869	233,979	226,500	218,211	208,851	198,110
Variable Cost	89,271	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150	137,150
Direct Fixed Cost	80,940	91,249	101,940	100,972	100,095	99,301	98,625	98,016	97,468	96,974	96,529	96,128	95,767	95,441	95,148	94,883	94,645	94,431	94,237	94,063
Depreciating	145,219	106,957	96,810	87,668	79,431	67,545	60,858	54,833	49,405	44,514	40,107	36,136	32,559	29,336	26,431	23,815	21,457	19,333	17,419	15,694
Change in Inventory	40,861	4,983	2,100	1,281	1,765	2,007	3,110	3,977	5,017	6,270	8,544	9,632	11,860	14,567	17,860	21,869	26,752	32,702	39,955	48,797
3 Sales Revenue	-51,639	32,747	40,000	49,292	58,889	71,811	80,276	87,777	94,794	101,432	108,558	114,018	120,184	126,441	132,931	139,821	147,300	155,589	164,949	175,690
Sales Expenses	1,702	2,284	2,391	2,381	2,372	2,365	2,358	2,352	2,346	2,341	2,337	2,333	2,329	2,326	2,323	2,320	2,318	2,316	2,314	2,312
General & Addm.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4 Operating Profit	-53,341	30,463	37,610	46,911	56,517	69,447	77,919	85,426	92,448	99,091	106,221	111,685	117,855	124,115	130,608	137,501	144,982	153,273	162,635	173,378
Non Operating Income																				
Interest	173,397	212,714	237,277	262,780	293,091	329,876	374,578	428,963	495,178	575,839	683,261	803,266	949,583	1,128,009	1,345,617	1,611,033	1,934,782	2,329,703	2,811,459	3,399,158
Other Non-Operating Income																				
5 Revenue before Tax	-226,739	-182,250	-199,667	-215,869	-236,574	-260,429	-296,659	-343,537	-402,730	-476,748	-577,040	-691,581	-831,728	-1,003,894	-1,215,008	-1,473,532	-1,789,800	-2,176,430	-2,648,824	-3,225,780
Income Tax	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tax-free Income																				
6 Revenue after Tax	-226,739	-182,250	-199,667	-215,869	-236,574	-260,429	-296,659	-343,537	-402,730	-476,748	-577,040	-691,581	-831,728	-1,003,894	-1,215,008	-1,473,532	-1,789,800	-2,176,430	-2,648,824	-3,225,780
Dividend																				
7 Excess Cash	-226,739	-182,250	-199,667	-215,869	-236,574	-260,429	-296,659	-343,537	-402,730	-476,748	-577,040	-691,581	-831,728	-1,003,894	-1,215,008	-1,473,532	-1,789,800	-2,176,430	-2,648,824	-3,225,780

Figure 5-1 Process Flow for Sukabumi Clay

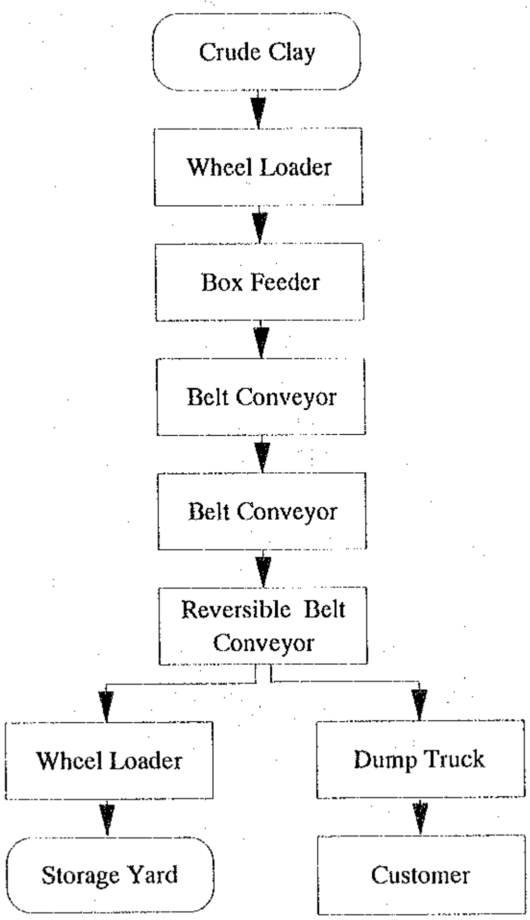

Figure 5-2 Sukabumi Clay Supply Process Flow Chart (300,000 t/y)

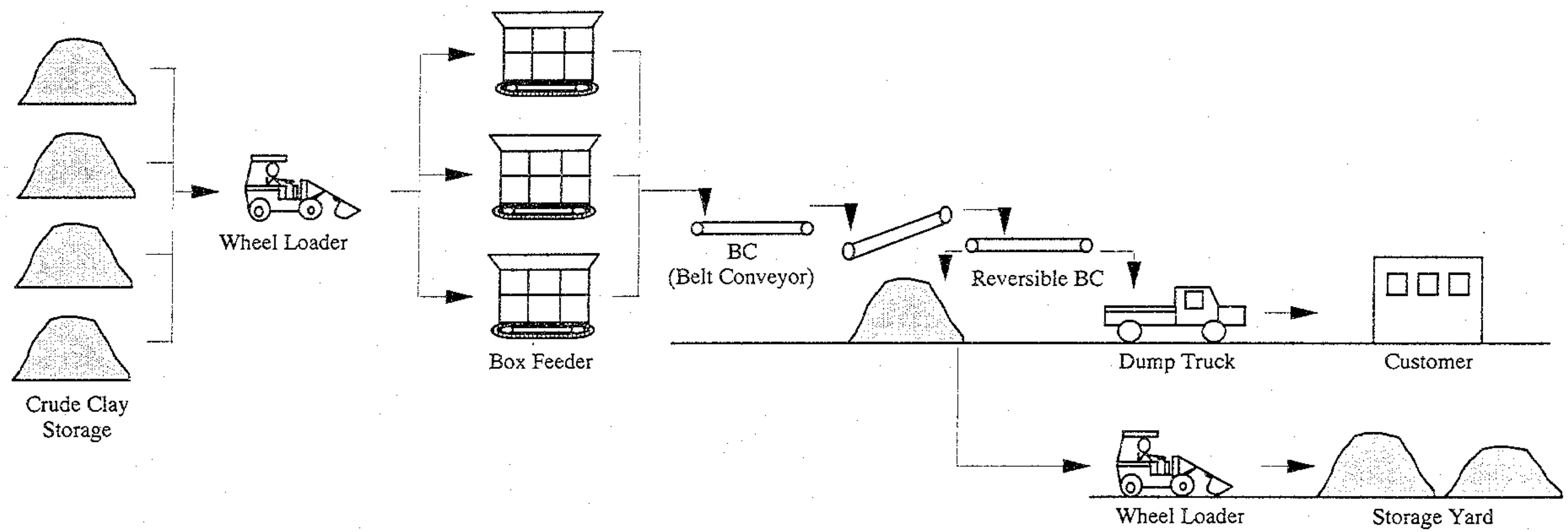

Figure 5-3 Process Flow for Banjarnegara Feldspar Supply

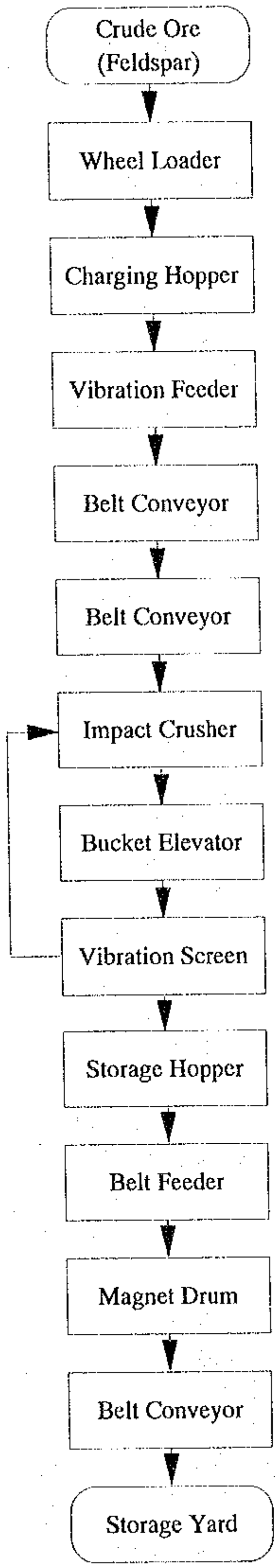

Figure 5-4 Banjarnegara Feldspar Supply Process Flow Chart (123,000 t/y)

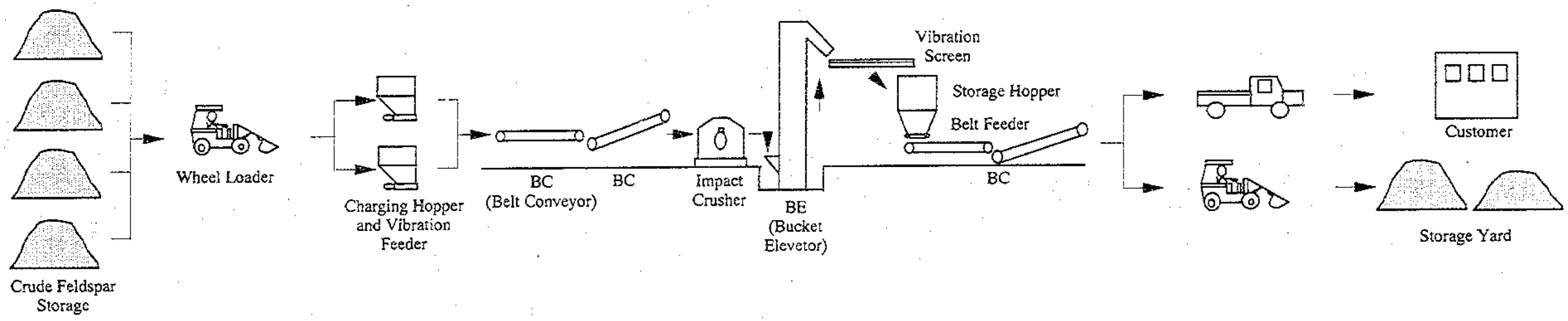

Figure 5-5 Process Flow for Banjarnegara Feldspar Refining

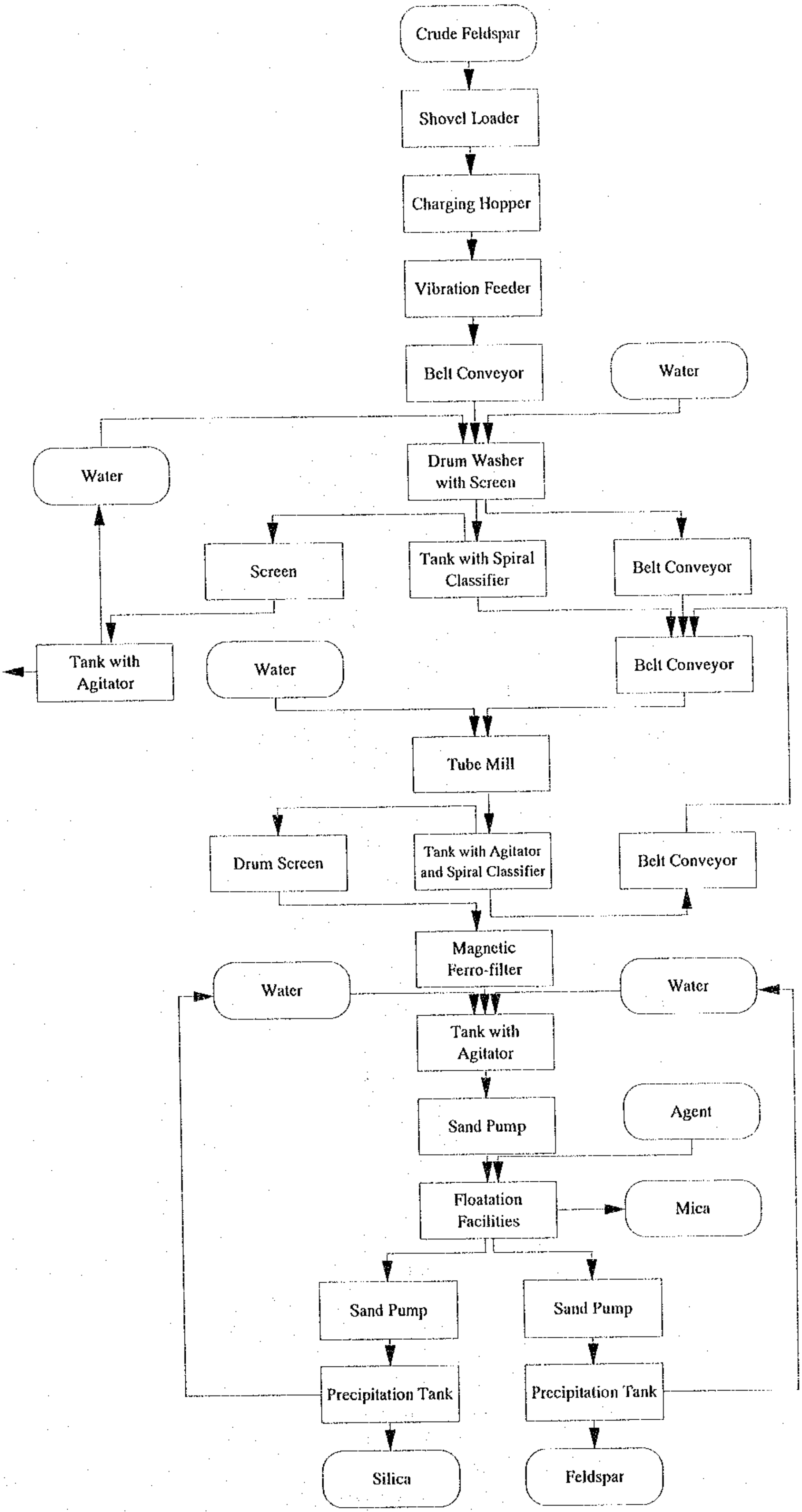

Figure 5-6 Banjarnegara Feldspar Refining Process Flow Chart (25,000 t/y)

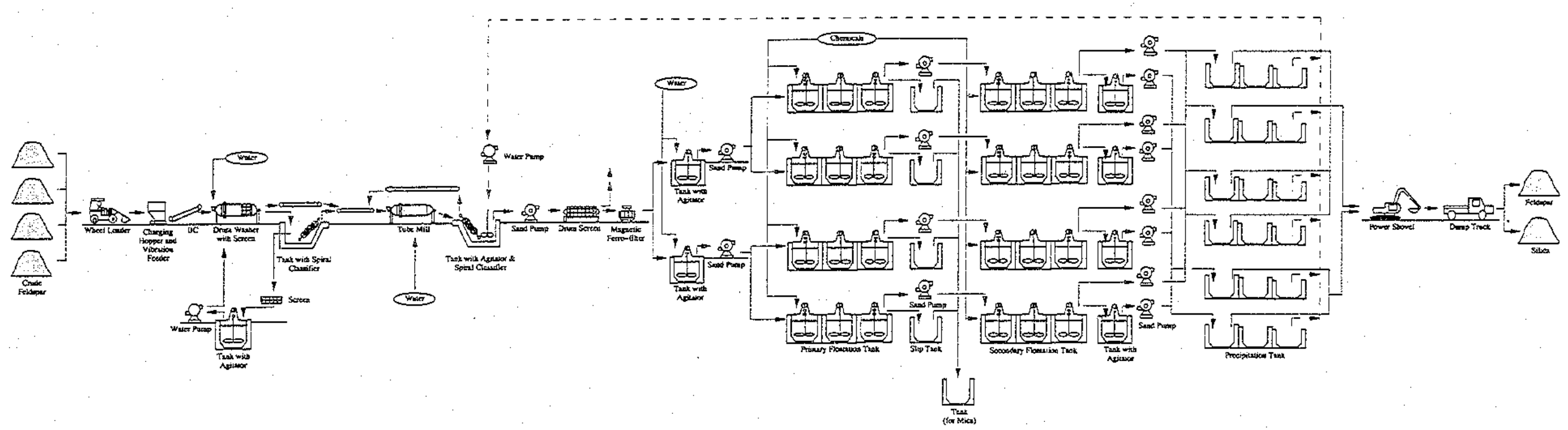

Figure 5-7 Process Flow for Prepared Body and Glaze

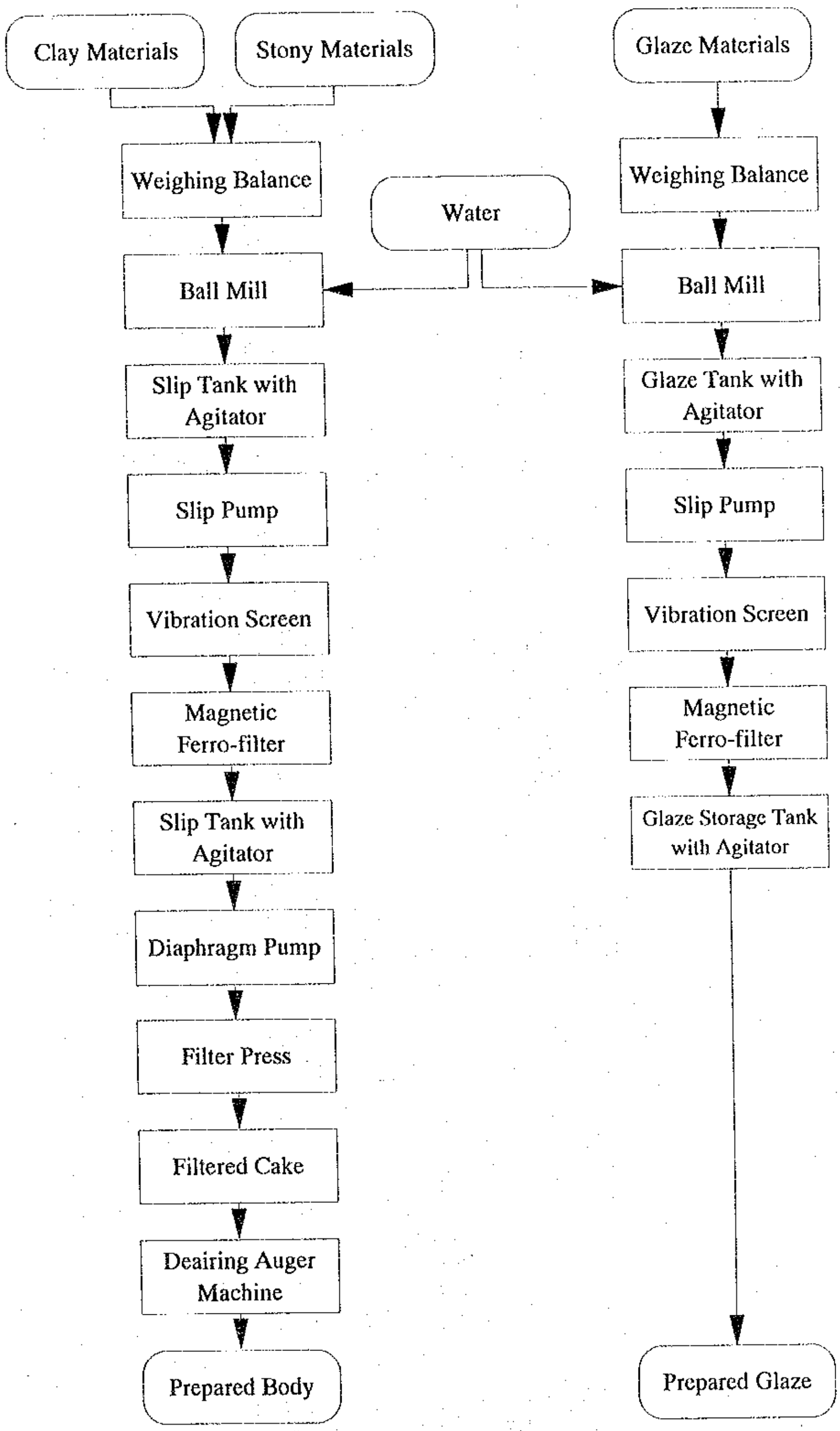

Figure 5-8 Body and Glaze Preparation Process Flow Chart (Body 700t/y, Glaze 70t/y)