6 Ceramic Construction Materials Industry

6.1 Ceramic Building Materials Industry in Indonesia

6.1.1 Scope of the ceramic building materials industry

Ceramics are defined as inorganic materials which are produced by burning clay and the like. The ceramic making process starts from heating of certain kind of clay whose strength increases as it dries up. As simply put, the rise in combustion temperature leads to the increase in strength of ceramic products and a decline in absorption. Ceramic products at the early stage of the manufacturing process are called "clayware," which turn into "stoneware," "earthware" then "porcelain." Ceramic products used as building materials include tiles, bricks, clay pipes, enamels, marbles, terrazzo, cement, and glass.

Ceramic construction materials selected for the present study include wall, floor and roof tiles that are produced by a large number of enterprises and seem to have various problems in terms of product quality and production technology. In addition, sanitary wares and bricks share these problems with tile products in relation to raw material and baking technology, all of which are discussed as required.

6.1.2 Industry size and structure

The ceramic construction materials industry in Indonesia has recently grown steadily over five years between 1988 and 1992. In particular, production of ceramic tiles surged at an annual average growth rate of 67.5%, while sanitary ware production 6.2% (Chart A1-6-1). Consumption of ceramic sanitary wares and ceramic tiles by application, and its trends in the past 5 years are summarized in Charts A1-6-2 and A1-6-3. The share of housing application is in the range between 62% and 64%. Growth of tile consumption is much higher compared to that of construction industry which is generally placed at about 10%, suggesting that tiles are increasingly used for residential buildings as a result of improved standards of living. Since demand will continue to grow steadily in the future, the industry seems to have high growth potential.

Housing policy of the Indonesian government is set forth in its 6th Five Year Plan (REPELITA VI) and generally consists of: a) the development of residential land and environment, and the construction of houses for low- and medium-income earners, b) the improvement of housing and residential land environment, c) relocation of residents, and d) the development of public and commercial lands (Chart A1-6-4). In particular, priority is given to the construction of low- and medium-income class housing and the

redevelopment of kampong and slum. The government plans to boost low-cost housing (RS-type houses) for low- and medium-income class built by Perum Perumnas, the housing and urban development corporation, by approximately 50% from 340,000 units under REPELITA V to 500,000 units under REPELITA VI (100,000 units/year), with an annual average growth rate of around 15%. Note that the figure only covers RS-type houses and does not include residential units supplied by the private sector. Indonesia does not subscribe to the building permit system, making it difficult to accurately estimate the number of housing units built by the private sector. Housing construction can be roughly estimated based on trends in national population and the number of persons per residential unit, assuming that housing construction keeps pace with population growth. As shown below, annual housing demand in the country is estimated at slightly less than 700,000 units, which is 6 – 7 times the number of RS-type houses to be built by the government. In fact, the rate of increase in the total number of housing construction is expected to exceed that of RS-type houses contemplated in the government plan (15%).

Estimate of Annual Housing Demand

Total population in 1992:	184.3 million
Total number of residential units:	40,540,000
Number of persons per unit:	4.5
Population at the end of 5th Five-Year Plan:	189.1 million
Estimated population at the end of 6th Five-Year Plan:	204.4 million
Required number of houses to be constructed annually:	(204.4 million-189.1 million)/ (184.3 million/ 40.54 million)/5 = Approx. 670,000 units/year

Consumption of tiles per capita in Indonesia is compared with the world average and those in selected ASEAN countries, as shown in Chart A1-6-5. Chart A1-6-6 shows the relationship between tile consumption and GNP per capita in selected countries. In Japan, wooden houses are still popular due to weather and other conditions peculiar to the country. Tatami mats or wood panels are used for flooring, and cloth or wood for wall. Plastics are also preferred as interior finish materials over tiles including bathtubs (generally unit bath) on the account of warmth, while the use of tiles is limited to exterior finish including terrace. Thus, tiles are mainly used for exterior and interior finish of commercial buildings. Similarly, in Germany and France, urban housing is dominated by apartment buildings and natural stones are widely used as building materials. In particular, high-rise buildings do not use tiles for exterior finish for safety reason. If these countries showing different tile consumption patterns are excluded from the list in Chart A1-6-6, a positive association is

observed between tile consumption and GNP per capita of the remaining countries that tend to use tiles. If this relationship is applied to Indonesia, its tile consumption is expected to grow rapidly with growth of GNP per capita in future.

More importantly, Indonesians prefer detached houses to apartments and opt for ceramic products as construction materials by virtue that these exude a refreshing sense of cleanliness. This explains to a certain extent the per capita tile consumption in the country is 0.1 – 0.2m^2/year/person above an approximate trend line shown in the chart. As of 1991, the country's GNP per capital was still low at US$ 610 and tile consumption at 0.4m^2/year/person. REPELITA VI intends to increase per capita GNP in the final year of the plan to a level emulating that of Thailand and Malaysia. Assuming that GNP per capita reaches US$ 2,000 in the target year, the country's tile consumption is expected to reach 0.9 – 1.0m^2/year/person if general popularity of tiles is considered. The pace corresponds to an annual 15% growth of housing construction targeted in REPELITA VI. Based on this assumption, tile consumption in the country up to the year 2000 is forecasted as shown in Chart A1-6-7.

Approved investment projects related to construction or expansion of production capacity for the estimated demand increase in the industry are summarized in Chart A1-6-8. The total production capacity including these new capacities is expected to increase as shown in Chart A1-6-7. In terms of supply and demand balance in the market, supply shortage in ceramic tiles is already seen in 1995.

(1) Ceramic wall/floor tile

Production of wall/floor tiles involves equipment and production techniques that are generally rendered by the process industry, and it is said that minimum production capacity of 2,000m^2/day supports a feasible production. In fact, wall/floor tile manufacturers are generally large enterprises. 40 large suppliers account for 97% of the aggregate production capacity of 150 million m^2/year in Indonesia (Chart A1-6-9). On the other hand cement tiles which compete with ceramic tiles in the market are produced by home industries using traditional technology.

Markets for the tile industry are slightly different between wall tiles and floor tiles. The former is mainly consumed for high-grade housing, while the latter is used by a wide variety of consumers. Some of high-grade wall tiles are produced on the basis of imported design and are supplied to export markets as well as in domestic markets. On the other hand, floor tiles are mostly sold in the domestic market. Ceramic floor tiles manufactured by large corporations are designed primarily for use in office buildings and high-grade houses. Those produced by small enterprises are used in kitchens, bath rooms, toilets, and terrace of ordinary houses. Another competing product are terrazzo

tiles. Both of them, however, become stained over a long period of time as cement surfaces due to aging. Ceramic tiles, priced 3 – 5 times higher than cement and terrazzo tiles, offer higher quality compensating for this price difference. As a result, ceramic tiles are increasingly used for ordinary housing, and RS-type houses. The rapid shift to ceramic tiles has reportedly caused many cement tile manufacturers located in the suburbs of Jakarta (mostly family-operated small enterprises) to go bankrupt. As of 1991, the cement tile market was one-fourth in size the ceramic tile market. On the other hand, the ceramic tile industry has been attracting many new entrants with modern, large equipment (since 1990, at least 5 large companies started commercial operation), while major capacity expansion is underway among existing manufacturers.

Ceramic tiles include high grade granite tiles with uniform quality whose price is 3 – 5 times higher than that of ordinary glazed tiles. They are mainly used for large buildings in urban areas, such as office buildings and hospitals, and have not been used for residential construction.

In future, the rise in standards of living will further spur demand for ceramic tiles, particularly high-grade products. On the other hand, demand for cement tiles will not grow much, although a certain level of consumption is expected for low-cost housing in rural areas. The sluggish demand will prompt cement tile manufacturers to shift their production focus to cement products, which will increasingly be demanded for construction of terrace for public facilities and pavement. At the same time, the products will face price pressure making the business increasingly difficult to survive.

(2) Roof tiles

Roof tiles are divided into a double-baked, glazed type and a single-baked, unglazed type. The former is used for high-grade houses, and very small portions are exported. The latter is widely used for ordinary housing. Large manufacturers mainly produce glazed tiles, partly unglazed products, by using modern production processes; whereas, small-and-medium-sized enterprises manufacture unglazed tiles based on traditional methods.

Several years ago, metal-type roof tile became popular for residential construction because it is lightweight exerting less load on buildings. However, it soon became apparent that the product had limited durability and requires a higher maintenance cost, explaining why it is not widely used today. Currently, colored cement tiles imitating high-grade products, with price being one-third that of ceramic glazed tiles, are used for ordinary housing as well as RS-type houses supplied by Perum Perumnas. However, quality problems such as water leakage during the heavy rain are being heard from users, and it is not likely that cement tiles will be used for high-grade housing.

Production of ceramic glazed roof tiles grew moderately up to 1991, as shown in Chart A1-6-1, then recorded a sharp increase in 1992, with annual production by six major manufacturers amounting to 35 million units (see Chart A1-6-10). The production capacity in 1993 is estimated at 42 million units per year. At present, an additional capacity of 48 million units/year is being constructed, and the total capacity is expected to reach 90 million by the end of 1994.

Cement roof tile production totaled 83 million units per year in 1991, as fueled by domestic demand and exports to Japan (2.4 million units per year), exceeding that of ceramic glazed roof tile. On the other hand, unglazed ceramic roof tiles are used for most of houses throughout the country, with a market size far exceeding that of glazed and cement roof tiles, amounting to 300 million units in 1991. However, unglazed roof tiles have quality problems, such as in leakage and strength, which makes them likely to be replaced with glazed or cement products.

(3) Others

There are 11 sanitary ware makers in Indonesia, with combined production capacity of 3.5 million p.c.s. per year (1993). All of them except one are large enterprises (Chart A1-6-11). 2 companies are in capital and technical agreement with foreign manufacturers and export 30% - 50% of their products. The addition of 500,000-unit capacity is planned and the total production capacity will reach 4 million units per year.

Bricks, like unglazed ceramic roof tiles, are produced by small-and-medium-sized enterprises as well as micro enterprises operating throughout the country.

6.1.3 Export and import

6.1.3.1 Past trend

According to official trade statistics during the past six years (Charts A1-6-12 and 13), both exports and imports of sanitary ware recorded growth ranging between 13% and 15%. On a volume basis, exports have been far exceeding imports, largely driven by strategy of Japanese and American joint ventures to give priority on exports. On the other hand, imports of ceramic tiles were well over exports in 1990 and 1991 as domestic production did not meet demand. Then, imports have been gradually declining with an increased domestic production capacity and the government's policy to promote the use of local products. In contrast, exports have been growing rapidly showing that the Indonesian ceramic tile industry and its products are gaining international recognition. At present, domestic demand remains strong and some companies are cutting back on exports to sell their products to the domestic market where they can enjoy a higher margin. Once the

production capacity is added to more than meet domestic demand, export drives will surge again. In FY1993, approximately 30,000 tons of ceramic tile were exported. The figure is equivalent to approximately 2 million m^2 of ordinary 30 x 30 products (15kg/m^2) and accounts for less than 2% of the total tile production capacity (approximately 100 million m^2 per year). Thus, the industry may not be considered as an export industry at present.

Breakdown of exports and imports by country shows that the U.S. accounts for the highest percentage of imports of sanitary wares, suggesting preference of high-grade products. As for exports, Italy is the largest importer, followed by Taiwan and Hong Kong. Exports to Europe (excepting Italy), the U.S. and Japan are still very small and these markets can be developed in the future (Charts A1-6-14, 15, 16 and 17).

As for tiles, major import sources are Spain, Italy, and Taiwan (in that order). The largest importer is the U.S., followed by Taiwan and Singapore. Note that Singapore is not generally a final place for consumption as it re-exports Indonesian products to other countries by using its marketing power. This provides further export opportunity for Indonesia, if it can develop its marketing power by establishing its own network to raise product quality to an internationally acceptable level and understand quality requirements of consumers in various countries, and develop products with designs based on Indonesian tradition. In 1993, exports to Singapore declined, while U.S.-bound exports with a higher margin increased rapidly. Thus, industry-wide efforts seem to produce definitive results.

6.1.3.2 Target of REPELITA VI

Trade surplus (the value of exports - the value of imports) for all ceramic products during the past five years is shown below. REPELITA VI sets target of US$ 200 million in the final year (1998) and requires export growth at an annual rate of 23%. This must be accomplished through a wide range of efforts, including capacity expansion to cover the growth rate of domestic demand (15%/year), the improvement in capacity utilization rate, productivity (cost reduction), and the strengthening of international competitiveness via quality improvement.

Year	(US$)
1989:	24,970,000
1990:	25,670,000
1991:	37,140,000
1992:	78,380,000
1993:	71,750,000
1998 (at the end of REPELITA VI):	200,000,000

6.1.4 Geographical distribution of industries

Factories producing ceramic building materials are mainly sited in industrial estates near Jakarta (Tangerang, Bekasi, and Bogor), and distributed sporadically in East Java, Central Java, Sumatra, and Kalimantan. On the other hand, manufacturers of cement tiles – a major competing product – are mostly family owned. They are located throughout the country and supply their products to low-cost houses built near the shop. Cement tile shops, previously concentrated in Jakarta City, have relocated to the suburbs in order to avoid high land cost and in response to demand shift to ceramic tiles.

Large manufacturers of glazed high-grade roof tiles are located in areas where high-quality materials and low-cost labor are available, such as Bogor, Bandung, Puruwakarta, Sukabumi, Majalengka, and Surabaya. Similarly, small-and-medium-sized enterprises as well as micro enterprises producing unglazed low-grade roof tiles are also concentrated in areas where raw materials are available. They are also located to meet demand throughout the country. Cement roof tiles are manufactured at large or medium-sized factories. They are relatively small in number and located in the suburbs of large cities such as Jakarta and Surabaya.

Sanitary ware factories are found in the suburbs of Jakarta (Bekasi, Tangerang, and Bogor), and central Java (Semarang), and eastern Java (Malang, Sidoarjo, and Tulungagung).

Brick factories are similar to unglazed roof tile factories in terms of ownership pattern and geographical distribution, located throughout the country, where raw materials are readily available.

Recently, concentration of factories in and around Jakarta raises social and environmental problems, prompting some enterprises in the ceramic industry to plan relocation, partly due to the government's guidance.

6.1.5 Raw materials

Raw materials for ceramic construction materials are roughly divided into a principal ingredient "clay," and secondary ingredients for surface treatment, "glaze" and "pigment." Clay is available abundantly throughout the country. The ceramic manufacturer obtains it from a several specialized suppliers and/or its own subsidiary. Glaze and pigment are mostly imported from various countries including Italy, Spain, and Taiwan, and three local manufacturers produce them by using technologies licensed from U.S. and Italian companies,

Since quality of the principal raw material largely affects quality of the final product, manufacturers have strong interest in securing uniform quality of clay.

Generally, clay suppliers are small-and-medium-sized enterprises and are not well organized as one industry. As a result, tile manufacturers feel difficulty in obtaining clay of reliable quality. Suppliers explore and find clay sources based on empirical know-how, and collect and send samples to ceramic manufacturers after simple analysis to examine water absorption, particle size, and other properties. Ceramic manufacturers evaluate the samples at their own facilities or often at BBK(Balai Basar Industri Keramik: Institute for Research and Development of Ceramic Industry) on a contract basis. Based on the results of evaluation, they determine blending proportions and place an order to each supplier accordingly. The supplier then mix various materials in the specified proportion at its own stockyard and deliver it to the manufacturer. While a supplier operating under a tile manufacturer can deliver the product in specified proportions, an independent supplier has to deliver products meeting different quality requirements to several manufacturers. In turn, the manufacturer evaluates raw materials delivered by several suppliers in detail and determine blending proportions and processing conditions for production. Thus, quality control of ceramic construction materials involves time-consuming efforts.

Major clay sources in western Java are found in Parungpanjang near Serpong, Sukabumi located in south of Bogor, and Tasikmalaya southeast of Bandung. Availability of clay deposits, however, is not always favorable for stable supply of raw materials for the ceramic manufacturers. For instance, a supplier under a tile manufacturer owns a mountain in Leuwiliang, situated west of Bogor. Among various mining sites seen in the mountain, there are old abandoned sites due to black organic contents. An ongoing mining site consists of four layers, each being approximately one meter thick. The top layer contains many plant roots that should be removed for clay production. The second layer contains no root and can be used without treatment. The third layer is made up of cohesive, high quality clay. The fourth layer contains clay having different hue. Overall, the layer is relatively thin to make production of clay with stable quality difficult.

BBK under the Ministry of Industry, located in Bandung, is considering measures to stabilize the quality of raw materials under cooperation of ASAKI (Asosiasi Aneka Industri Kerakik Indonesia: Indonesian Ceramic Industries Association) through the establishment of a feed (ready mixed raw materials supplier) as seen in Japan, and standardization.

6.1.6 Production technology

Ceramic products are produced basically under the same method. Chart A1-6-18 illustrates the tile manufacturing process. Raw materials are mixed in specific proportions, wet crushed, dried, molded, coated with glaze (followed by coloring, as required), and

burned in a kiln.

Wall/floor tiles are produced in large facilities, mostly consisting of automated volume production lines. In particular, recently built modern factories computerize the materials blending process and introduce automated product inspection systems (to check flatness and size). Because of large investment required for such production facilities, wall/floor tiles are mainly produced by large enterprises which use technology and equipment imported from Italy, Germany, and Japan. However, few companies have direct ties with foreign companies in the form of joint venture or technical assistance.

Cement tiles used as floor tiles are generally produced under the traditional method heavily relying on manual labor. Facilities are locally made, and patterns are purchased from equipment makers. Color is specified by customers. Thus, own product development is rarely seen.

As for ceramic roof tiles, glazed tiles are commercially produced by using automated processes introduced from Japan on account of field-proven production technology. On the other hand, unglazed roof tiles are produced by using conventional shuttle kilns and depend upon manual work regardless of company size. Cement roof tiles are produced by using technology and equipment imported from Japan, but the process itself highly depends upon manual work and is largely unautomated.

Among sanitary ware manufacturers, 2 companies receive technical assistance from parent companies in Japan and the U.S., including advice by resident engineers. 2 companies use technology provided by Japanese companies. 7 companies mostly rely on technology Italian counterparts.

In all the subsectors, many manufacturers who receive technical assistance from foreign partners obtain technical guidance and advice from experts sent by equipment suppliers, or send their engineers and operators for training when new equipment is installed. Also, many manufacturers who do not have foreign partners – particularly, those who have newly entered the market – receive technical guidance from foreign experts including those in Italy.

6.1.7 Industrial association

In Indonesia, there is only one industrial association related to the ceramic building materials industry, Asosiasi Aneka Industri Keramik Indonesia (ASAKI), which is joined by 69 large enterprises which manufacture ceramic products. The number of related companies is accounted to be more than 7,000 enterprises including small-and-medium-sized enterprises and micro enterprises. ASAKI organizes less than 1% of them but nevertheless, represents leading companies in each product segment. ASAKI's major

activities as the industrial association are summarized as follows.

(1) Nurturing of production technology

1) Manpower development

ASAKI has established a ceramic technology course, jointly with BBK, which provides as much as 25 trainees annually involving lecture and field training, including two-week practical training and tour of factories of a few ASAKI member companies. In FY1993, 22 persons completed the course. In Indonesia, no university offers a course specializing in ceramics, making it difficult for ceramic companies to secure engineers and technicians. Thus, the course plays an important role in fostering much-needed ceramics engineers.

Other activities of ASAKI include the sending of engineers to international exhibitions related to ceramics production equipment and technology (generally held in Italy, and in 1993, Japan first hosted International Japan Ceram '93), the sending of trainees to industrial countries, the planning and sponsoring of lecture by foreign experts, and the establishment of fund for manpower development activities.

2) Support for improvement of testing and research facilities and equipment

BBK is an organization under supervision of the government. Its testing and research facilities and equipment are mostly outdated. Despite its mission to take leadership in the ceramics industry, it is unable to meet testing and research needs of companies who have recently introduced or added modern production lines. BBK plans to modernize its own testing facilities and equipment, and ASAKI provides financial assistance including the application for lending organizations.

(2) Marketing activity

ASAKI's another pillar of activity is marketing, including the sponsoring and participation in domestic and international trade shows. In 1993, ASAKI participated in the following trade shows:

1) INDOBEX '93
2) Japan International Houseware Show '93
3) CHINABEX '93

Traditionally, the country has exported its products to the world market via Singapore and Hong Kong. It has steadily established its own sales channel through international marketing activity and has successfully explored export markets, such the

U.S., which offer a high profit margin. (Chart A1-6-15)

(3) Collection and dissemination of information

ASAKI provides information related to the ceramics industry and ASAKI's activity for its member companies took the form of publications such as Bulletin ASAKI and Directory ASAKI. ASAKI also joins Ceramic Industry Club of ASEAN (CICA) and focuses on dissemination of information about the current state of the industry in Indonesia, and collection based on international trends.

During the initial period of ASAKI in the 1970s, standardization and promotion of quality control have been one of ASAKI's major activities. At present, BBK (a member of ASAKI) takes leadership in development of SNI and propagation of ISO, which are not promoted as ASAKI's activity. As discussed later, industrial standardization needs to be promoted in order to understand customer requirements accurately, and provide feedback for the ceramics industry from customers and related sectors. The process should proceed by keeping close communication with related industries, in which ASAKI is expected to play an critical role. In fact, there is high expectation for ASAKI's activity among ceramic companies.

Today, ASAKI has grown to a large organization accommodating 69 companies/organizations and covering wide industrial areas. There is criticism that its activity tends to unduly emphasize on certain areas. It is therefore important to take appropriate measures to ensure a broad range of activities, such as the establishment of special committees, so as to maintain commitment of member organizations despite their diverse interest.

6.1.8 Major issues and obstacles to further development

Following factors which have contributed to the establishment and growth of the ceramic building materials industry in Indonesia are pointed out by ASAKI:

1) Abundant supply of principal raw materials in the country;
2) Availability of abundant and low-cost labor force;
3) Low-cost energy (accounting for 30% of the production cost); and
4) A large domestic market (arising from a large number of population) that has supported the industry in establishing its foundation. (Mass production system with large scale facilities)

In consideration of the competition with imported goods, and export promotion, drive however, the ceramic construction material industry in Indonesia must overcome the following challenges (with particular emphasis on ceramic tile that needs to be developed to an internationally competitive product).

(1) Strengthening of price competitiveness

Trade statistics of Asia and Oceania regions in 1993 indicate that the country's ceramic tile exports exceeds imports by 7 times (Chart A1-6-19). Looking at 10 countries from which Indonesia imports ceramic tiles, exports are more than 5 times larger than imports. The export price (FOB) from Indonesia is US$4.96/m^2, far below the import price (CIF) of US$7.42/m^2. This clearly indicates that Indonesian products are highly competitive in Asian and Oceania markets.

Yet, the Indonesian market seems to occasionally serve as a spot market for adjustment of excess inventory by some countries. For instance, import (CIF) prices from Spain and Italy - from which relatively large amounts are imported - are US$4.41/m^2 and US$3.51/m^2, respectively, lower than the average export price (FOB) from Indonesia of US$5.38. When import tariff (40%) and value added tax (10%) are added, these prices are more or less the same as or slightly above the export price. Thus, Indonesian products are expected to compete with these products. As the country moves toward market opening, it is very important for the industry to improve international price competitiveness. The results of JICA's previous survey (Chart A1-6-20) indicate that raw material cost accounts for an estimated 36% of ceramic tiles manufactured in Indonesia, utilities cost 29%, labor cost 14%, and other fixed costs 21%. Cost reduction can be achieved in several ways. Cost saving of approximately 2% is feasible by raising capacity utilization rate from a present 80% to 90% which is near the maximum practicable level. The rejection rate remains at nearly an upper limit of the 10% - 20% range. By reducing the rate of substandard products immediately before final shipment, operating rate can be raised and energy cost can be reduced. As shown in Chart A1-6-20, cost structure varies greatly from one company to another. Comparison of fuel, labor and other costs relative to raw material cost (being set at 1.0) somewhat indicates the company's equipment condition, management policy, and financial position, and its deviation from among industries. For instance, BK, BJ, and BM which show relatively high percentages of fuel and labor costs are required to take fundamental restructuring measures, such as conversion to less costly fuel and/or modernization of old, inefficient production facilities and equipment to automated and large-scale ones. On the other hand, BA, BJ, and BG wherein other cost items weigh more than others, possible diverse measures are expected. If the high cost comes from depreciation of equipment,

operating rate should be improved. On the other hand, the high administration cost needs to be dealt with by restructuring administrative departments and other efforts on the management side.

(2) Manpower development

Owing to the relatively short history of the ceramic industry, the lack of basic scientific knowledge of employees and the shortage of ceramics engineers and technicians impede much-needed improvements in the areas of production control, including the establishment and improvement of production technology, the development of proprietary technology required for product development, the improvement and maintenance of product quality through standardization and promotion of TQC, and the improvement of productivity by an IE-based approach. This is particularly true among enterprises which have newly entered the market in response to rapid expansion of the industry. As for proprietary technology, efforts are made in the form of special education courses and seminars led by BBK and ASAKI, which are far from being satisfactory. Few companies have sufficient knowledge about production control techniques, as revealed in the result of the questionnaire survey (discussed later). Only a handful of companies make committed efforts and there are few educational organizations, both public and private. Now that the government plans to extend the period of compulsory education to 9 years, starting in 1995, for the purpose of raising the educational levels of population at large, industrial engineering courses pertaining to inorganic materials, statistics, and quality control need to be added or expanded in high school and university education. In particular, it is recommended to establish an organization which is capable of providing guidance and education for a variety of enterprises in the areas of production control, thereby helping to promote the improvement of overall production technology on a continuous basis.

(3) Establishment of raw material supply networks with assured quality

The issue of quality assurance for raw materials is shared by most enterprises and can be addressed by establishing the presence of suppliers of ready-mixed raw material as well as, promoting the standardization plan, as pointed out earlier.

(4) Reinforcement of product development capabilities

The major challenge for the industry in the past was to meet the increasing demand for ceramic tiles and glazed roof tiles. As supply capacity catches up with demand, however, the ability to meet demand for product quality will become an important issue, both in the domestic and export markets. In particular, the development of new products

that meet the changing market needs will hold the key to the sustainable growth of the industry. New products must focus on improved quality characteristics as a raw material (e.g., hardness, moisture absorption, smoothness, and workability), as well as aesthetic aspects in color and design. For instance, design features based on Indonesian culture can create value added products. Also, BBK and other organizations providing technical guidance can play an important role by training engineers who can assist manufacturers in product development, e.g., the sending of their engineers to Italy, Spain and other industrialized countries to learn about ceramic coloring techniques, the hiring of graduates from design schools, and the sending of trainees to the schools for continuous education.

(5) Streamlining of product transport

Ceramic construction materials are heavy in weight, and as a result, transportation costs account for large portions of their production costs. Also, ceramic products, either intermediate or final, are susceptible to damage within the factory or during transportation. Some tile factories are located relatively far from major highways, and access roads and site roads are not well paved. While the improvement of public roads should be set as a priority for the government, ceramic manufacturers should make their own efforts to minimize damage during transportation by improving factory layout and site roads. Once product safety in transportation is ensured, present packaging (15kg/bag) can be increased by at least 50% to save distribution costs. Factory location is another important consideration. Compared previously, there is a tendency to prefer a location where raw material or labor is readily available resulting to an increasing number of factories located near the market in order to avoid damage during transportation of products having high value added, or to reduce necessary product stock. In particular, factory relocation should be considered in the context of overall streamlining of the physical distribution system and in response to investment opportunities such as facility modernization, construction, addition, and capacity expansion.

(6) Strengthening of international marketing ability

As discussed earlier, tile exports account for less than 2% of total production and export promotion is rather a far-reaching target. The goal should be established for the industry to have the ability to maintain a certain level of operating rate and profitability by exploring worldwide market channels that can substitute for domestic demand once it slows down.

6.2 Industry's Needs and Expectations for Standardization and Quality Control

6.2.1 Current state of standardization and certification systems

(1) Use of standards

Chart A1-6-21 compares Japanese, international and Indonesian standards related to ceramic building materials. One of preliminary findings relate to the shortage of basic standards (terms) that are essential in scientific quality control.

In ceramic building materials industries in Indonesia, there is a general lack of concern about SNI (SII). Products are manufactured and supplied mainly on the basis of request from customers. SII is sometimes applied to local market-bound products, but it is not known to some small enterprises and micro enterprises. On the other hand, exporting manufacturers conduct product inspection according to respective standards (JIS for Japan, ASTM for U.S., EN for Europe, and SS for Singapore). For Asian countries, EN or SII is used for some cases.

Based on the results of the corporate questionnaire and interview surveys, the use of industrial standards in the wall/floor tile and roof tile industries is characterized as follows. (Chart A1-6-22)

1) Ceramic wall and floor tile industry

a) As for product standards, 40% of companies use SII, 30% foreign standards, and 30% their own internal standards. Among large corporations, 47% use foreign standards. As company size becomes smaller, the percentage using SII or internal standard increases. Notably, small enterprises and micro enterprises have little knowledge on SII, with field supervisors accepting or rejecting products based on their empirical judgment, which are referred to as "internal standard." Many of large enterprises export their products and use both foreign standards and SII according to their final markets.

b) Some large enterprises maintain internal standards with higher requirements than SII. In fact, they doubt about *raison d'être* of SII.

c) As for standards for raw materials, approximately 50% of all the enterprises (40% among large enterprises) use internal standards, whereas only 22% use SII. Quality control of raw materials is considered a technical know-how of each company, based on which companies struggle to establish competitiveness in technology and product quality.

d) When it comes to production equipment, 80% use foreign standards and no one adopts SII, simply because production equipment and technology originates in foreign countries (mainly Italy).

e) Technical terms in SII are not widely used because of the lack of standards for terminology, nor SII's testing methods are proliferated.

2) Roof tile industry

a) Product standards: 50% SII, 17% internal standards, and 33% foreign standards

b) Testing methods: 50% SII and 50% internal standards, with no company using foreign standards nor ISO.

c) Technical terms: No company uses SII, probably because of the lack of terminology standards and promotional activity.

d) Some large enterprises use internal standards, which are widely accepted as those for high-grade products in the country.

(2) Basis of internal standards (Chart A1-6-23)

As for the technical basis of internal standards, 26% of companies rely on SII and own technical know-how acquired through experience, followed by customer-required standards (22%). A relatively high percentage of large tile manufacturers relies on their own technology and experience.

(3) Standards to be required in future

Few opinion has been expressed in the questionnaire survey and the interview survey about the standards, both product and testing standards, to be required in future, suggesting the lack of recognition in the development of industrial standards and standardization. Nevertheless, there is an industry-wide awareness about the need for standardization of raw materials. Compared to large enterprises which can control quality of raw materials by using their own testing resources, smaller enterprises face difficulty in obtaining raw materials with reliability in terms of quality levels and thus, creating strong interest in standards for raw materials.

(4) Availability of standards and related information (Chart A1-6-24)

Large enterprises have little difficulty in acquiring SII and foreign standards as well as related information. As company size becomes smaller, however, difficulty in obtaining such information among an increasing number of enterprises is encountered. In particular, the shortage of SII-related information seems to result from the lack of promotional activity. Also, large enterprises feel the increasing difficulty of obtaining

international standards (ISO), which nonetheless have to be effectively distributed for the benefit of future export promotion.

6.2.2 Certification system

(1) SNI (SII)

As for product certification, five large roof tile manufacturers and twelve wall/floor tile manufacturers have SII certifications (for roof tiles, SII 0022 and 0447; and for wall/floor tiles, SII 0243, 0583, 0584, and 0449). These companies account for approximately 30% of large enterprises manufacturing ceramic wall and floor tiles and roof tiles (26% of companies responding the questionnaire, as shown in Chart A1-6-25). This is very low for an official certification system. Major reasons for not obtaining SII certification are: 1) the certification does not bring any benefit; 2) there is no demand from customers; and 3) internal standards are higher than SII and can be used to maintain high quality. Furthermore, some SII certified factories responded to the questionnaire saying that they have not obtained the certification (partly due to the lack of awareness of the actual respondent). In fact, only one company responded that it affixed SII mark to its products, while some inscribe "EXPORT QUALITY" on products in an attempt to advertise high quality. Thus, there is little interest in using SII certification for the company's sales strategy.

While the government has decided to replace SII with SNI, starting in April 1994, few companies have completed the process and little is known about the procedure. This seems to come from the lack of advertising efforts on the government side, and the lack of interest in certification itself among companies.

(2) Certification under foreign standards

A tile manufacturer, a formerly joint venture with a Japanese company, has JIS certification. Also, a sanitary ware factory, a joint venture with a Japanese company, is certified under JIS reflecting the fact that sanitary wares are largely exported indicating a high level of quality awareness.

(3) Certification under international standards (ISO)

There is no company which has certification under ISO 9000 series. Ten large wall/floor tile manufacturers and one roof tile/sanitary ware manufacturer are preparing for or considering the application (Chart A1-6-27). Among them, two companies plan to obtain certification by the middle of 1995. All the companies export their products or intend to do so actively, and strongly realize that certification under ISO 9000 series will

become prerequisite to exports in the near future. This is a major difference from the attitude toward the SII certification. It should be noted, however, that there are few companies requesting raw material suppliers to obtain certification under ISO 9000 series, showing that manufacturers do not see ISO certification as a means to enforce quality control practices in the industry.

6.2.3 Quality control

6.2.3.1 Current state of quality control promotion

(1) Quality requirements by customers

Generally, the quality targeted by a product is governed by customer requirements. From the viewpoint of the basic principle of quality control, all manufacturers have to do is to manufacture products that comply with qualities required by customers. Yet, customer requirements vary in time and place. This makes quality control by manufacturers difficult. They have to make continuous efforts to quickly identify current and future quality requirements, adjust target quality standards, and develop production conditions and evaluation methods to meet quality requirements, establish control standards, and minimize production costs (which are part considerations of quality in a broad sense).

Take tile for instance, at present, ceramic tiles are increasingly recognized by customers to have better quality than cement and terrazzo tiles, and thus start to be widely used for ordinary housing, particularly in urban areas. At this stage of market acceptance, however, customers are not fully familiar with tile quality. Wall tiles are often used as floor tiles just because they have good design. Customers are currently demanding for a sufficient quantity of tile supply, rather than quality, driving unprecedented growth of the industry. At the same time, they have accumulated experience in using tiles for construction purposes and new requirements (quality, wider application, and new product development).

Complaints from customers are related to basic quality requirements, including dimensional uniformity, which becomes visible when tiles having the same product grade number are laid over a wide area then resulting to uneven patterns. Also, some tiles are returned since they warp during storage after delivery or construction.

Quality requirements by customers come to upstream manufacturers as they are conveyed in a direction opposite to product flow from retailers. Chart A1-6-28 shows a typical distribution channel of ceramic construction materials in Indonesia. They are directly sold by retailers to house owners, who call contractors (plasterers) for installation. A major difference from Japan is that contractors are not involved in the

purchase of tiles. This means, quality requirements are made by general consumers who are not familiar with product quality, and as a result, they are initially limited to product appearance. In turn, retailers who receive customer demand do not have just as much knowledge on tile quality. Thus, customer demand on quality requirements is not translated into proper technical terms and does not reach manufacturers. This constrains manufacturers from understanding customer requirements accurately. For instance, an Indonesian company boasts that their customer claim rate is below 0.01%. The company virtually receives no complaint from customers, but is not always likely the case. Rather, it is more plausible to think that customer complaint somehow fails to reach the company. In contrast to Japan, quality requirements of consumers are effectively communicated to manufacturers through contractors and wholesalers who are familiar with products. For Indonesian manufacturers, therefore, more intensive efforts are required to understand quality requirements at end users.

In Indonesia, tile manufacturers deliver their products directly to construction companies if a project is fairly large. Quality requirements are directly conveyed to manufacturers, but they are communicated as a separate rather than as a collective request to the industry. Trade organizations of the construction industry in Indonesia, including Civil Engineering Association and Architectural Engineering Association, have not held meetings with ASAKI concerning quality and standardization. To accurately understand quality requirements of customers, the ceramic tile industry should communicate with user industries through periodical meetings.

(2) Quality control in factories

Large companies have a certain level of quality control system by establishing QC organizations such as quality inspection, quality assurance, and quality control. Many companies have introduced Japanese-style quality control practices, such as posting of quality slogans to raise awareness of employees, organization of QC circles to lead improvement initiatives, announcement of quality records to spur interest among employees and education and training by using the text book of "KAIZEN". Nevertheless, the level and extent of quality control activity varies greatly among companies.

Some large enterprises either do not have or lack a sufficient QC system, but many of them are following good housekeeping and safety practices. At some shops, large storage yards for work-in-process are thoroughly cleaned and tidied up. Thus, it is highly feasible to promote quality control activity if managers have enthusiasm and take adequate efforts.

Ongoing quality control efforts of the industry, as viewed from the result of the questionnaire survey, are summarized as follows (see Charts A1-6-29 and A1-6-30):

1) Large enterprises are generally active in quality control practice by using various QC techniques, but weak in implementation of ISO 9000, use of QC consultants, promotion of QC circles, use of QC tools, and promotion of the 5S drive.
2) As the company size gets smaller, less companies promote the above five areas of activity despite knowledge of their existence.
3) Small enterprises do not know anything about QC techniques.
4) Many companies cite the lack of knowledge on QC techniques, the shortage of QC experts, and the lack of awareness of employees as major obstacles to promotion of quality control activity.

6.2.3.2 Major issues related to promotion of quality control activity

Major issues related to quality control are summarized as follows.

(1) Quality control and inspection

All the companies visited conduct visual check on every product as final inspection. The ability to find and remove defects occurring in manufacturing process by inspection often divert effort on QC promotion. In particular, the most advanced form of involves computer-aided inspection which automatically distinguish nonconforming products. This makes some field managers believe that their quality control is perfect because of the system.

Many companies are enthusiastic about obtaining certification under ISO 9000 series. It should be noted, however, that ISO is based on documentation (standardization) of the company's quality control system and top-down implementation of the system according to the documentation. Again, its basic concept involves the prevention of nonconforming product from flowing to the subsequent process by inspection. Quality improvement activity and total quality control (TQC) rely on the availability of standards for corrective actions, quality policy and other aspects, the contents and levels of which are left to discretion of each company.

It is important to understand that inspection is only a part of QC and is not an end in itself. It can be integrated with the quality control process only after continuous improvement measures, and company-wide efforts with full employee participation are ensured. Then the inspection process must be incorporated into the entire quality control system. In Japan, industries introduced the wrong idea about "QC = inspection" 30 or 40 years ago, but was later corrected giving rise to the new concept "TQC", "CWQC (Company Wide Quality Control)", and "to incorporate quality in process." Clearly, the

basic concept of QC in Indonesian industries should be reviewed and redefined as required, particularly management of the manufacturing process and the product inspection system.

Misunderstanding that "QC = Inspection"

(2) Raw material control

A major issue commonly faced by many enterprises is the stability of raw material quality. In particular, they experience difficulty in managing clay materials which affect product quality in the tile production process at the most. On the other hand, the result of the questionnaire survey, as shown in Charts A1-6-26 and A1-6-27, reveals that only 28% of enterprises use SII as standards in evaluating quality of raw materials, while 72% do not use SII or do not know that SII contains standards for raw materials. As for ISO 9000 certification, most companies have not even requested suppliers of raw materials to obtain it. Finally, as shown in Chart A1-6-31, few companies acquire quality data and information from suppliers for the acceptance of raw materials.

The raw material acceptance procedure adopted by large tile manufacturers is as follows. The manufacturers use about 7 kinds of raw materials and sub-materials, each of which is made by blending products supplied by several companies in order to prevent quality variation of raw materials from affecting quality of final products. On a daily basis, a sample is taken from each delivery lot, and the laboratory conducts various tests to analyze combustion residual, viscosity, density, particle size, and moisture content. It is often the case that quality of a raw material in the same lot varies between that delivered in one day and that delivered on the next day. When quality variation is found or a delivery lot is changed, the laboratory prepares various mixtures of raw materials in different blending proportions, shapes them in a test molding machine, and bakes them in an electrical furnace to produce sample products to be evaluated. The result, including the optimum blending proportion determined from the analysis, is reported to the production department, that applies new blending conditions. The entire process is carried out on a daily basis. Even with such elaborate quality control practice, final products are never free from quality variation due to raw materials. In fact, it frequently occurs. Manufacturers sometimes ask outside testing organizations for chemical analysis, such as composition analysis, to identify a cause for quality variation, but it takes a long period of time and does not help improve daily production activity.

The situation is more unfavorable for large enterprises of relatively small size and small-and-medium-sized enterprises, most of which do not have their own testing

facilities and equipment. While large enterprises can reject and return raw materials which do not satisfy quality requirements, small enterprises cannot. A company can dispose raw materials to a reclamation site at its own cost. Smaller enterprises with such experience are strongly interested in establishment of the ready mixed raw material suppliers for improved quality assurance.

Major issues facing the industry are summarized as follows:

- Lack of standardized raw materials
- General lack of quality awareness of raw material suppliers
- Insufficient material acceptance system by manufacturers

(3) QC managers and shop floor

In large companies, factory managers and QC managers understand various QC techniques. The result of the questionnaire survey (Chart A1-6-29) reveals that approximately 64% of QC activities (the overall average of all the responding companies in all the items) are actually performed. However, field observation does not indicate such vigor in QC activity (although some companies are very active as discussed in 6.2.3.1 (2)), there is a significant difference between perception of managers and the actual status of QC activity.

Similarly, QC managers at highly automated factories using latest equipment believe that they conduct advanced levels of QC activity by statistically processing quality data by computer and preparing control charts. Yet, activities of QC departments are not well known by production departments. Quality data and processed data can only be utilized effectively when they are supplied to production fields as feedback information and reflected in production and quality improvement activities on a daily basis, thereby achieving stabilization of quality and improvements in quality and process. This constitutes a real QC activity. Quality control is an activity in the shop floor, which by no means a desk work in the QC department. In particular, close cooperation between a department conducting testing and inspection and a production department is considered to be the root source for QC activity.

Major issues facing quality activity in the tile industry are summarized as follows:

- Perception gap between mangers and shop floor
- Lack of communication between the quality inspection/testing department and the production department

(4) QC and cost perception

At present, the Indonesian ceramic building materials industry is booming and in a strong bargaining position with customers. Customers give priority to delivery schedule and cost, and pay little regard to demand for quality. Thus, all makers do not have motivation for quality improvement. If this situation continues, the industry may lag behind the quality race for international competition calling for conscious improvement efforts.

A large company piles up a large number of defects in front of its factory. Some of smaller enterprises deliver products including an anticipated fraction defects, upon request of their customers. Many factories are not tidied up well, and a work area and service path are not clearly separated, often causing damage to products upon transportation. In the first example, the defect has occurred during the initial operating period of new equipment, causing the return of products. In the second example, the manufacturer is required to guarantee product quality by money. In the third example, the damage occurs due to insufficient enforcement of 5S. There are many examples of manufacturer's compensation for loss and damage due to poor quality control, which are really unnecessary if the manufacturer performs proper quality control and improvement activities.

– QC makes money

6.2.4 Testing and inspection

6.2.4.1 In-house testing and inspection system

(1) Large enterprises

1) Product inspection

All the large enterprises have sufficient testing and inspection resources, including laboratories and testing equipment capable of conducting tests specified in SNI (SII). Chart A1-6-32 shows test items related to floor tile, and the necessary testing equipment specified in SNI.

Large enterprises inspect their own products by using these testing equipment. Based on data obtained from testing, they accept or reject products according to standards. In addition to test items in Chart A1-6-32, some companies have colorimeters at laboratory.

2) Process control

Chart A1-6-18 shows the tile production process flow with sampling locations for process control and inspection items. Large enterprises check delivery materials at their own laboratories that have testing equipment capable of conducting physical tests such as loss on ignition, viscosity, density, particle size, and moisture content. On the other hand, few companies conduct chemical analysis (composition analysis). Some laboratories have X-ray diffraction equipment, but do not perform crystal analysis of raw materials. More importantly, suppliers do not furnish quality data on each lot of delivered materials. Thus, the current material acceptance and control systems do not meet requirements in securing product quality.

The blending proportions of raw materials are determined by preparing sample mixtures in different proportions that are shaped and baked in the electrical furnace. Determination of the optimum composition is an important factor in producing quality products on a reliable basis. In fact, large enterprises have a complete set of testing equipment at their own laboratories, better than those owned by BBK of the Ministry of Industry, including pot mills, molding machines, and high temperature electrical furnaces (1,300℃ or less).

During the process, intermediate products are sampled from the output side of the molding and drying processes to conduct simple examination covering moisture content, dimensions, and defects.

Laboratory inspection of final products after the burning process is conducted for test items shown in Chart A1-6-32. Field inspection is mostly limited to visual check on crack, warp, and other apparent defects. The latest production process is equipped with an on-line computer-based analyzer to supplement visual inspection. Since the remaking of defects or reconversion to raw materials is not possible in the tile production process, an integrated quality control system starting from acceptance of raw materials is essential.

(2) Small-and-medium-sized enterprises

Smaller enterprises do not have testing equipment covering only weight, length, and angle of SNI items shown in Chart A1-6-32. A few companies have pot mills for process control and high temperature electrical furnaces.

Medium-sized enterprises are generally busy with daily production and lack "quality" awareness. Many of them do not even know about the presence of SNI. Small enterprise do not feel the need for testing and inspection. Customer demand focuses on cost and quantity, so that the need for QC-related tests is not pondered upon.

6.2.4.2 Outside testing and inspection resources

(1) Test request to outside testing organizations

The result of the survey on testing service entrusted to outside testing organizations is shown in Charts A1-6-33, 34, 35, and 36.

Chart A1-6-33 indicates that 85% of responding enterprises entrust testing service to outside organizations. Among large enterprises, 2 companies do not entrust such service to outside testing organizations. This means, they do not regularly use outside organizations. Similarly small enterprises do not use outside testing organizations.

Chart A1-6-34 shows percentage breakdown of testing services contracted to outside organizations. Calibration of measuring instruments, including weighing machines, flow meters, and manometers, accounts for 29% of the total, mechanical testing such as the measurement of bending strength and hardness 27%, chemical analysis (chemical composition and acid resistance) 29%, and physical analysis (water absorption and dimensions) 11%. While basic measuring instruments are calibrated on a periodical basis, quality of calibration is dubious as judged from the calibration results including calibration record, indication, and the sealing of adjusted parts, as well as equipment control.

Weight machines account for approximately 80% of calibration services conducted, and a principal calibration organization is DOM.

Looking at the breakdown of inspection items, bending strength accounts for 80% of mechanical testing and is mainly done by BBK. No testing is done for electrical areas. As for chemical analysis, composition analysis account for approximately 80% of the total. 60% are handled by private testing organizations, led by PT.Sucofindo. Also, private testing companies receiving technical assistance from Italy, Japan, and other countries conduct service. A majority of services entrusted to government testing organizations is handled by BBK. BBK dominates in the share of physical tests.

Chart A1-6-35 indicates that testing services entrusted to outside organizations are divided between government and private organizations at a ratio of 60:40.

Chart A1-6-36 summarizes the frequency of entrustment. Two-third of respondents entrusts calibration once per year, and one-third as required. Chemical composition analysis and physical test are not contracted on a periodical basis. Many responses cite twice - five times per year, suggesting that they request testing service whenever a problem arises, rather than for daily quality control purposes.

(2) Request to outside testing organizations

Major complaints felt about outside testing organizations are listed in Chart A1-6-37. "No problem" responses and no answers account for 80% of the total. During the

interview survey of selected companies, no request to outside testing organizations has been heard, including the installation of new equipment. This seems to show that enterprises do not feel the need for making use of outside testing organizations as they do not depend much on these organizations. In fact, BBK's testing equipment is older than those owned by tile manufacturers, and it does not posses testing equipment capable of evaluating raw materials in a simulated production environment. Thus, it fails to meet demand of manufacturers. It is a serious problem for the government research organization which is expected to take leadership in development of the industry.

6.3 Japanese and International Standards and SNI in Indonesia

Chart A1-6-21 compares SNI, ISO, and JIS standards for ceramic construction materials.

Looking at recent trends in international standardization related to ceramic materials, TC206 has been added to ISO in the field of new materials, and standardization of technical terms and symbols and testing and evaluation methods has recently started. As for ceramic materials including construction materials, various standards have been established or are being established, including TC33 (refractories), TC48 (glass devices and tools for scientific experiment), TC74 (cement and lime), TC160 (building glass), TC22/SC11 (grating materials), TC29/SC5 (grind stone), and TC61/SC13 (composite materials and reinforce fiber). However, no ISO standard is available for tiles under the present study. JIS has two standards related to tiles, A5208 (clay roof tiles) and A5209 (porcelain tiles), which have been reviewed very recently. The following sections describe the current status of SNI standards related to tiles, in comparison to JIS.

6.3.1 Standards related to raw materials

SNI standards related to raw materials for tiles cover water contents of clay and pottery stone, and clay test. JIS does not comprise of standards for raw materials, but standards listed in Chart A1-6-38 subject to the review process for JIS certification. Under JIS, the method for chemical analysis of raw materials is specified according to minerals, including silica stone, feldspar, refractory clay, pyrophyllite, lime stone, and dolomite. On the other hand, SNI does not have standards for testing methods except for feldspar and clay. Standards for raw materials vary between mines and uniform standards are difficult to be established, leaving suppliers and buyers to agree on a separate standard for each deal. However, testing methods should be discussed under the same criteria and must be unified for all raw materials used.

6.3.2 Product standards

(1) SNI has two standards related to floor tiles, 03-2096 (Testing Method) and 03-0106 (Quality Standard). JIS accommodates testing methods and grade standards related to porcelain tiles within a single standard, A5209. Similarly, SNI 03-2095 for roof tiles contains testing methods and quality standards. SNI lacks such unification in relation to ceramic construction materials.

(2) The floor tile standard (SNI 03-0106) mainly covers materials as seen in European standards. Compared to JIS, it contains less installation standards. Contents of such standards are closely related to tile's distribution system. The distribution channel of tiles in Indonesia is illustrated in Chart A1-6-28. Since construction firms are not involved in the distribution process, their quality requirements are not reflected in actual standards. Since tiles are used by consumers after installation, their quality and value are recognized only after they are laid in accordance with reliable standards, so that installation standards essential.

(3) Standardization of tiles is meaningless unless it extends to related industries, e.g., standardization of dimensions of the entire house including wall, floor, and window. Opinions in the industry suggest that the task is beyond the ability of the government and should be accomplished through industry-wide efforts involving the entire construction industry.

(4) Test items in SNI covering floor tiles are listed in Chart A1-6-32. Major differences from JIS are as follows:

- Items covered in SNI, not in JIS: Weight, angle, and volume
- Items covered in JIS, not in SNI: Warp, "bachi (unevenness of size of sides)", "uraashi (shape and size of groove in back face)", wearing resistance, frost resistance, and acceptance and rejection

Test items and standard values covered by industrial standards vary across countries. "Uraashi" and frost resistance are standards unique to JIS. "Uraashi" is a safety standard of maintaining peel strength after installation at a specific level, while frost resistance is designed to prevent tiles from being damaged due to the freezing of moisture inside the tile in a cold area. (Note that such standard is not seen in Europe where the use of tiles on exterior walls of 4-story or higher buildings is governed by the building code.) If Indonesian tiles are to target export markets requiring the above specifications, SNI should incorporate JIS or equivalent standards.

6.4 Need for Standardization and Quality Control, and Their Direction

6.4.1 Development of standards

To promote standardization, the development of standards is essential. Based on the result of the survey on use of standards (see 6.2.1), the following recommendations are made as a desirable direction for the future development of standards.

(1) Compared to product and testing standards, other standards including technical terms are not widely used. This primarily comes from a small number of such standards in SNI, for which their urgent development is called. Without them, the difference in interpretation of technical terms may hinder smooth commercial transaction.

(2) SNI related to ceramic construction materials is divided into standards specifying testing methods and standard values separately (floor tiles) and those unifying the two elements (roof tiles). From the user's viewpoint, it is desirable to have testing methods and standard values within the same standard.

(3) General access to SNI and foreign standards needs to be improved, in particular, information service should be provided for small-and-medium-sized enterprises who feel difficulty in obtaining such information.

(4) Some companies believe that quality of their products exceeds requirements specified in SII and the use of SII mark does not make any sense. Clearly, SII has failed to keep up with current quality requirements and technological levels and has become "legacy" standards. Any standards including SII must be reviewed, replaced and/or updated on a periodical basis, the responsibility for which rests upon the industry association, ASAKI.

(5) SII is rarely used for acceptance of raw materials. Although stabilization of quality is strongly recognized as an important issue, the need for standardization is not felt widely. One feasible way to achieve the purpose is to establish the raw material supply corporation (association) that is currently considered by BBK and ASAKI, which can spearhead promotional activity for standardization. Nevertheless, opinions of the industry on the establishment of such organization vary widely, including some skepticism, so that the plan should be carefully proceeded in consideration to the following factors:

1) The association will not generate much benefits for large companies that have their own procurement systems, but will give some impact on them, e.g., if the association is very large in size, large companies will not be able to reject raw materials as long as they conform to standards, even if they present some quality problems.

2) Data and information related to the mixture of raw materials belong to proprietary know-how of each manufacturer and are not likely to be made available for

standardization of quality of raw materials.

3) The new company will have negative impact on existing suppliers, mostly small–and–medium–sized enterprises.

(6) The development of standards is the responsibility of the standardization promotion center, PUSTAN, under the Ministry of Industry. BBK is responsible for preparing and reviewing draft standards. Since BBK is a member of the ceramic industry association (ASAKI), the development process takes the form of joint efforts by the government and the industry association. In practice, however, BBK takes sole leadership. Standards are to be fully utilized by the industry, and such standards must be developed by reflecting opinions of affected individuals, companies and organizations. At least a draft proposal for a standard should be developed and submitted by the industry to strike the balance between current quality requirements and technological levels. As a result, ASAKA, rather BBK, should play a central role in the process. To this end, it is recommended to strengthen ASAKA's technical committees and encourage active participation of companies in the drafting process.

6.4.2 Certification system

The certification system of SNI (SII) is theoretically an important institution from the interest of quality assurance to customers. Yet, the result of the questionnaire survey reveals that only 30% of large companies have obtained SII certification. Further promotion of the certification system seems to hold the key to the improved industry–wide recognition of product quality.

(1) In many cases, customers do not demand products having SII certification, simply because they are not aware of SII. When an industry grows rapidly, it is often the case that the market be deluged with new companies and inferior products, which in turn have adverse effects on general consumers. In Indonesia where monitoring of inferior products by consumer organizations is not very active, the government research organization is expected to monitor business activities and give guidance to companies. It is also the interest of the industry to exclude inferior products from the market, and the SII market can be used as part of product differentiation strategy. At the same time, the industry is expected to make efforts to advertise SII and raise awareness of product quality among customers.

(2) No company has obtained certification under ISO 9000 series, which will soon become essential for export industries. At present, 10 companies or more are

considering application, but they do not have necessary information nor access to proper information sources. Companies intending to obtain the certification are expected to increase rapidly in the near future, and a private organization to support application and certification procedures seems to be required.

6.4.3 Quality control practice and standardization

From the questionnaire survey, an estimated 60% of enterprises conducts quality control activity. The remaining 40% including those who plan some quality control initiatives do not practice quality control. Although 60% is a fairly high rate of acceptance, many companies consider inspection as QC activity and are not aware of in-process quality control and the concept of "kaizen." The situation may become a major obstacle to efforts of stabilizing product quality and reduce incidence of defects. Similarly, standardization is often limited to the manager level. Managers keep documentation including work standards and instruction sheets that do not reach a shop floor. With the increasingly intensified competition being anticipated in export markets, the current QC system is apparently not capable of meeting quality requirements. To improve quality control practice of individual companies, the following recommendations are proposed:

(1) Education of business owners

Business owners tend to become highly profit-oriented and leave quality behind as long as products are sold. There is general belief that quality control consumes time and money and does not produce immediate benefits. It should be noted, however, that much-publicized growth of the Japanese industry has been partly fueled by vigorous quality control and improvement activity. Japan is full of examples that prove "QC makes money." By combining tile production technology imported from Italy (basic technology) with quality control techniques of the Japanese industry (control technology), the Indonesian tile industry will be able to become more competitive in the international market. As the first step, the government and the industry organization should educate business owners to realize the true value of quality control.

(2) Education of managers and workers

In addition to employers, employees must have quality awareness. Quality control initiatives can start from the 3S or 5S activity. Factories visited by the study team have been poorly lit and are not clean nor tidied up, making it difficult to identify what is done well and what is not. Enforcement of the 5S activity helps separate acceptable products from defective ones clearly, improve work efficiency, and visualize how many

defects are actually produced. In doing so, awareness of all employees is a prerequisite to company-wide improvement activity through education and training. In particular, managers and workers should receive different levels of guidance and instruction according to their roles in quality control efforts.

(3) Control of raw materials

In Indonesia, raw materials for ceramic tiles are contained in a very thin layer making it difficult to obtain high-grade materials only. In addition, manufacturers use the mixture of various raw materials collected from different sources, so that proper control of raw materials is very important. To ensure reliable supply, BBK and ASAKA are considering the establishment of a company that will produce ready-mixed raw material combine with standardization efforts, both of which should be vigorously supported by the government.

(4) QC and inspection

Many companies misunderstood equating inspection with quality control. Such misconception is unavoidable at the initial stage of introducing QC activity. It is entirely wrong to believe that quality can be assured solely through inspection and testing. Even large companies are content by performing a variety of tests routinely without realizing their objective. This leads to waste of resources, which can only be avoided by adopting the new and true concept of quality control.

(5) QC manager and shop floor

There is lack of communication and understanding between the QC manager and shop floor. QC managers are not familiar with what is going on in production departments, and simply collect data without understanding their purpose and how these relate to quality control. In short, QC managers need to be reeducated.

(6) Use of QC consultant

At present, QC consultants are employed at a minimum level. If a qualified consultant is not available within the country, it is important to hire experienced consultants from foreign countries to receive guidance. This will enable the concept of quality control to take root in the entire organization, and eventually contribute greatly to improved profitability.

(7) Market study and development

Product quality is governed by customer need, and should be properly understood in

establishment of SNI. Market study and development should be led by the industrial association, and results should be communicated to enterprises. Market information so obtained can be used effectively as basis of updating SNI's standard values.

6.4.4 Testing and inspection

Testing and inspection resources are divided into those of in-house and outside organizations, as described below.

6.4.4.1 In-house testing and inspection resources

Large enterprises have testing equipment and data that meet certain levels of testing and inspection service requirements. On the other hand, smaller enterprises are capable of conducting only simple tests. More importantly, all the enterprises have the misconception that "quality control = inspection" and mostly conduct tests to collect data used for product inspection. They should understand that inspection is the process of accepting or rejecting a product or a lot containing products, and strict inspection is not equal to enforcement of quality control. Bearing these points in mind, the following recommendations are proposed:

(1) To prepare testing manuals for product inspection by type of product, covering 1) sampling methods, and 2) acceptance and rejection methods and criteria: While testing methods are specified in SNI and foreign standards including JIS, EN, and DIN, the two items need to be documented by each company. In particular, acceptability criteria shall serve as yardsticks for testing and inspection and should ensure effective use of testing resources.

(2) To automate product tests measuring critical characteristic values as far as possible: At present, tests to measure important characteristics values, such as dimensions, damage and crack, are conducted visually by all the manufacturers on products of varying size. At ceramics shops operated around the clock, variation in inspection accuracy and product quality present a problem, and misjudgment increases during nighttime inspection. Some factories have automated dimensional measurement by using computers. It is desirable to automate all the tests related to critical characteristic values.

(3) To establish tests for process control: Raw materials are the most important factors influencing quality of ceramic products. Unlike other chemical process industries, ceramics use "soil" as a raw material that is obtained from mountains. In principle,

quality of the raw material must be controlled at the source by producers, which is currently done by manufacturers upon acceptance. More importantly, chemical analysis of the raw material is not conducted by manufacturers, not even by large companies. Instead, they blend raw materials from different sources and find the best mixture on a trial and error basis. As a result, they are running a risk of producing a large number of defects if something goes wrong.

There are various types of chemical analyzers available to tile manufacturers. Wet analyzers are a low-cost device analyzing chemical composition of raw materials. Fluorescent X ray analyzers are affordable to large companies. Chemical analysis of raw materials allows "forward control" of quality by determining mixture design in advance, contributing greatly to the ease of process control and quality improvement. In fact, forward control becomes useful when raw materials are less available to necessitate the blending of diverse materials.

Fineness of raw materials is currently tested manually by sieving a sample at a laboratory. It is recommended to use an automatic particle analyzer in order to obtain data quickly and accurately, thereby permitting efficient control of the crusher.

The burning process is automated for continuous kilns, whereas single kilns including shuttle kilns are equipped with few instruments. Obviously, thermometers and other basic instruments should be installed to facilitate process control.

Finally, it is important to determine when, where and how process control tests should be performed according to factory size and equipment availability, and establish the optimum process control system accordingly.

6.4.4.2 Outside testing and inspection resources

At present, approximately 85% of manufacturers rely on testing service provided by outside organizations, particularly tests requiring expensive testing equipment, such as the measurement of bending strength and hardness. Also, calibration of testing equipment is mainly entrusted to a government testing organization, DOM.

Ordinary tests are mainly entrusted to BBK, with some being contracted to private testing organizations such as Sucofindo. Although some complain that testing service takes a long period of time and/or charges fees are high, small-and-medium-sized enterprises who cannot own expensive testing equipment have to rely on those outside organizations.

The following recommendations are made for possible improvements in testing service by outside organizations.

(1) Strengthening of testing resources by government organizations

At present, ceramic construction materials are tested by a government testing organization, BBK. Only that it has outdated testing equipment and is poorly staffed. As a result, it has been receiving complaints about the lengthy time involved in testing. While delay in product performance tests such as bending strength does not affect manufacturing operation, that involving chemical analysis of raw materials may seriously affect process control. BBK is therefore expected to perform analysis related to process control and report the result promptly.

1) As for chemical analysis of raw materials, addition, updating and improvement of testing facilities and equipment are recommended in the following areas:
   a) While wet analyzers are available in sufficient quantities, analytical techniques are obviously behind those of private testing organizations. Reeducation of laboratory staff is recommended.
   b) A fluorescent X-ray analyzer should be procured to speed up analysis.
   c) A chemical laboratory should be modernized.
2) As for physical testing, the existing X-ray diffraction analyzer used to identify mineral composition is very old and unsuitable for requirements. Purchase of a new X-ray diffraction analyzer is recommended to ensure accurate and speedy crystal analysis of minerals.

(2) Improvement of service by private testing organizations

Sucofindo has branch offices in various locations conducing a wide range of analytical and testing services. As for chemical analysis of raw materials, the laboratory in Jakarta has latest equipment and performs effective analysis. As the number of requests has been rapidly increasing year after year, Sucofindo's business becomes financially viable.

In the future, in addition to Sucofindo, the use of private testing organizations specializing in certain fields is expected to be on the rise, including the ceramics industry, particularly small-and-medium-sized enterprises.

While government organizations are subject to budgetary and other restraints, private organizations can expand their scope and level of service relatively freely as long as it make business viable. To encourage the improvement of services by private testing organizations, the government and the industry are expected to fulfill the following roles:

1) Research on testing capabilities of the existing private testing organizations and their

promotion to related industries and companies

2) Support for the establishment and development of new private testing organizations (e.g., low-interest rate loans, and favorable tariff rates on imported testing equipment)

Chart A1-6-1 Production Development of Ceramic Sanitary, Floor Tile and Roof Tile (1988-1992)

Year	Ceramic Sanitary		Ceramic Floor Tile		Ceramic Roof Tile	
	Production 000 p.c.s.	Growth (%)	Production 000 m^2	Growth (%)	Production 000 p.c.s.	Growth (%)
1988	1,114	-	14,851	-	21,300	-
1989	1,129	1.3	15,618	5.2	24,400	14.6
1990	1,291	14.3	39,196	151	25,300	3.7
1991	1,375	6.5	69,471	77.2	26,500	4.7
1992	1,413	2.8	94,976	36.7	35,000	32.1
Average Growth Rate		6.2		67.5		13.8

Sources: MOI, BBK, FL-UI and ASAKI

Chart A1-6-2 Estimated Consumption of Ceramic Sanitary and Tile, by Sector (1992)

Sector	Ceramic Sanitary		Ceramic Tile	
	000 p.c.s.	% of Total	000 m^2	% of Total
Housing	652	64	59,340	62
Office Building	183	18	17,228	18
Hotel/Apartment	132	13	11,485	12
Commercial Building	52	5	5,742	6
Others			1,914	2
Total	1,019	100	95,709	100

Sources: MOI, BBK, FL-UI and ASAKI

Chart A1-6-3 Estimated Consumption of Ceramic Sanitary and Tile (1988-1992)

Year	Ceramic Sanitary		Ceramic tile	
	000 p.c.s.	Growth (%)	000 m^2	Growth (%)
1988	883	–	15,526	–
1989	695	-21.3	19,450	25.3
1990	932	34.1	40,844	110.0
1991	827	-11.3	72,158	76.7
1992	1,019	23.2	95,709	32.6
Average Growth		6.2		61.1

Sources: MOI, BBK, FL-UI and ASAKI

Chart A1-6-4 Supply & Renovation Plan of Houses & Housing Land

Items	Unit	Actual (projected) in 1993	Repelita-VI 1994	1995	1996	1997	1998	Total
A.Supply of houses & land								
1.Housing land environment								
a.Development of housing land environment								
Number of regions[1]	Number	–	–	1	1	1	1	1
Area	ha	–	–	100	200	400	500	1,200
b.Selected regions for village development[2]	Number	–	200	300	450	500	550	2,000
2.House construction for low/middle income people	Number	339,700	70,000	90,000	110,000	110,000	120,000	500,000
B.Renovation of houses & lands								
1.Development of urban housing land environment	ha	260	100	100	150	200	250	800
2.Renovation of urban housing land environment								
a.Area	ha	37,000	2,000	3,000	4,500	5,500	6,250	21,250
b.Number of urban citys[3]	Number	470	40	60	90	110	125	425
3.Renovation of houses & lands in undeveloped villages								
a.Infra renovation[4]	Number	20,000	2,300	3,400	4,000	4,600	5,700	20,000
b.House renovation	Number	240,000	30,000	50,000	60,000	70,000	90,000	300,000
C.Target of number of inland house movements								
1.General movement & self movement with official expense	Number	247,560	50,000	60,000	70,000	80,000	90,000	350,000
2.Self movement with private expense	Number	–	15,000	35,000	45,000	65,000	90,000	250,000
D.Target of land development for public, business and migrate								
1.House lands for migrates	Number	543	170	210	240	280	300	1,200
2.Land development	ha	164,423	71,853	86,224	100,595	114,965	129,338	502,975
a.For public	ha	84,028	23,832	28,596	33,365	38,131	42,899	166,823
b.For business	ha	80,395	48,021	57,626	67,230	76,834	86,439	336,150

Note: 1)Pilot project in Repelita-VI
2)First Trial of development in Repelita-VI
3)Urban cities which have more than 100,000 population in Repelita-VI
4)To have been carried out in "Environment Improvement Program of House & Village" in Repelita-V

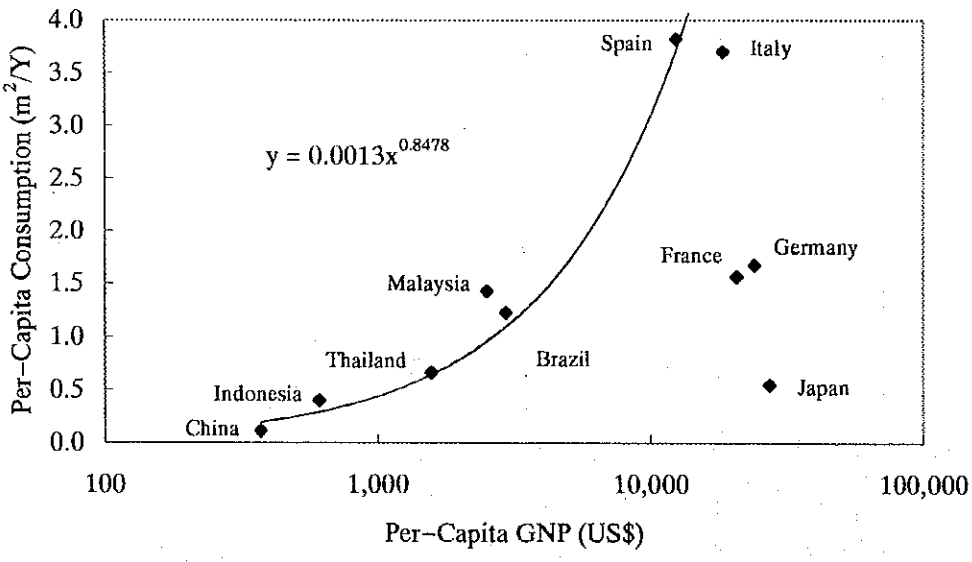
Sourse: The Republic of Indonesia, Sixth Five Years Development Plan (Data), 1994-1998, REPELITA VI (Published by Indonesia-Japan Business Services)

Chart A1-6-5 Per-Capita Consumption of Ceramic Wall/Floor Tile

Countries	Consumption ($000m^2$)	Population (million)	Per-Capita Consumption (m^2/person)	Per-Capita GNP(US$)
China	123,000	1149.5	0.1	370
Indonesia	72,000	181.3	0.4	610
Thailand	38,000	57.2	0.7	1,570
Malaysia	26,000	18.2	1.4	2,520
Brazil	186,000	151.4	1.2	2,940
Spain	149,000	39.0	3.8	12,450
Italy	214,000	57.8	3.7	18,520
France	93,000	57.0	1.6	20,380
Germany	139,000	80.1	1.7	23,650
Japan	84,000	123.9	0.7	26,930

Compiled by The Study Team from various sources

Chart A1-6-6 Per-Capita Consumption of Ceramic Tile vs. Per-Capita GNP



Note: The data on Japan, France and Germany are excluded in estimating the above regression curve.

Chart A1-6-7 Projected Supply and Demand of Ceramic Tile and Sanitary (1993-2000)

Description	1993	1994	1995	1996	1997	1998	2000
1 Ceramic tile(million m²/y)							
1) Consumption	110.7	126.6	145.6	167.4	192.5	221.4	292.8
2) Max. Process Capacity	147.0	153.2	155.9	155.9	155.9	155.9	155.9
A. Existing	147.0	147.0	147.0	147.0	147.0	147.0	147.0
B. Expansion		2.5	2.9	2.9	2.9	2.9	2.9
(a) PT.Asia V.		2.5	2.5	2.5	2.5	2.5	2.5
(b) PT.Keramika DI			0.5	0.5	0.5	0.5	0.5
C. New Plant		3.8	6.0	6.0	6.0	6.0	6.0
(a) PT.Aneka		2.3	2.3	2.3	2.3	2.3	2.3
(b) PT.Rama Mulia		1.5	1.5	1.5	1.5	1.5	1.5
(c) PT.Bumiraksa P			2.3	2.3	2.3	2.3	2.3
3) Estimated Production	117.6	137.9	140.3	140.3	140.3	140.3	140.3
4) Balance	6.9	11.3	-5.3	-27.1	-52.2	-81.1	-152.5
2 Ceramic Sanitary(000pcs/y)							
1) Consumption	1,172	1,348	1,550	1,782	2,050	2,357	3,117
2) Max. process capacity	2,990	3,490	3,990	3,990	3,990	3,990	3,990
A. Existing	2,990	2,990	2,990	2,990	2,990	2,990	2,990
B. Expansion		500	1,000	1,000	1,000	1,000	1,000
3) Estimated Production (for domestic)	1,794	2,356	2,691	2,691	2,691	2,691	2,691
4) Balance	622	1,008	1,141	909	641	334	-426

Estimated by The Study Team on the basis of data and information obtained from various sources including interviews to MOI, BBK, FE-UI and ASAKI.

Chart A1-6-8 Approval of New and Expansion Projects on Ceramic Tile and Roof Tile by BKMP, 1992-1994

No.	Name of Company	Status	Location	Production Capacity	Investment
A. New Investment					
1	PT. Bumirakaksa Prosperind	PMDN	Tangerang	Tile: 2.25 m.m^2 Brick: 3.0 m.pcs	Rp 2.3 b.
2	PT. Aneka Keramik Indo	PMDN	Purwakarta	Tile: 2.25 m.m^2 Brick: 3.01 m.pcs	Rp 47.1 b.
3	PT. Rama Mulia Jaya Aneka Ind.	PMDN	Pasuruan	Tile: 1.50 m.m^2	Rp 12.3 b.
4	PT. Catra Parama Keramika	PMDN	Purwakarta	Rf tile: 12.0 m.pcs	Rp 26.8 b.
5	PT.Radian Ceramica Indonesia	PMDN	Bekasi	Rf tile: 20.0 m.pcs	
6	PT.Raya Keramik Indah	PMDN	Majalenka	Rf tile: 24.0 m.pcs	
7	PT.Selo Ciri Krida	PMDN	Banjar Baru	Rf tile: 24.0 m.pcs	
8	PT.Terra Cota Nusantara	PMDN		Rf tile: 4.0 m.pcs	
9	PT. Atap Keramika Khatulistiwa	PMDN	Pontianak	Rf tile: 12.6 m.pcs	Rp 39.0 b.
B. Expansion Project					
6	PT. Asia Victory Industry	PMDN	Surabaya	Tile: 2.47 m.m^2	Rp 32.7 b.
7	PT. Keramik Indah Perkasa	PMDN	Citeurep	Rf tile: 6.3 m.pcs	Rp 2.5 b.
8	PT. Keramik Diamond Indah	PMDN	Gresik	Tile: 0.45 m.m^2	Rp 1.5 b.

Note: PMDN: Domestic Investment Scheme

Source: The Investment Coordinating Board (BKPM)

Chart A1-6-9 Estimated Production Capacity of Ceramic Tile Companies as of 1992

No.	Name of Company	Status	Location	Production Capacity ($000m^2$/Year)
1	PT.Porsmo	PMDN	Tangerang	12,000
2	PT.Keramika Indonesia Asosiasi (KIA)	PMDN	Bogor,Padan	10,600
3	PT.Intan Keramika	PMDN	Cirebon	10,266
4	PT.Mulia Keramik Indah R.	PMDN	Bekasi	8,500
5	PT.Masterina Keramik Pratama	PMDN	Tangerang	8,400
6	PT.Radian Caramika Indonesia	Non-fac.	Bekasi	7,500
7	PT.Floorindo Supermitra	PMDN	Karawang	7,220
8	PT.Angsa Daya (IKAD)	PMDN	Tangerang	6,160
9	PT.Serinco Djaya Marmer	PMDN	Tangerang	4,500
10	PT.Aneka Pola Esterika	PMDN	Serang	4,368
11	PT.Citra Mandiri Cakrawala	PMDN	Serang	4,250
12	PT.Jaya Industri Prakasa Utama	PMDN	Tangerang	4,000
13	PT. Metropole Megah	PMDN	East Java	3,770
14	PT.Raja Keramik Indah	PMDN	Majalengka	3,600
15	PT.Satya Raya Keramindo Indah	PMDN	Tangerang	3,600
16	PT.Citra Prima Keramindo	PMDN	Tangerang	2,880
17	PT.Cikarang Indah	Non-fac.	Cikarang	2,750
18	PT.Banua Batusari	PMDN	Pontianak	2,327
19	PT.Union Ceramic Utama	PMDN	Jakarta	2,244
20	PT.Asia Buana Persada	PMDN	Gresik	2,220
21	PT.Gaya Reksa	PMDN	Serang	2,184
22	PT.Intan Keramik Alam Sri Indonesia	PMDN	Tangerang	2,160
23	PT.Keramika Indah Sejati	PMDN	Bogor	2,100
24	PT.Tjigombang Nusantra Perkasa	PMDN	Tangerang	2,100
25	PT.Wahyunusa Wahana	PMDN	Bekasi	2,000
26	PT. Ubin Kimas Mutiara	PMDN	East Java	2,000
27	PT.Keramic Diamond Indah	PMDN	East Java	2,000
28	PT.Indopenta Sakti Teguh	PMDN	Bogor	1,800
29	PT.Karya Kalindah	Non-fac.	West Kalimantan	1,800
30	PT.Perkasa Primarindo	PMDN	Tangerang	1,700
31	PT.Bermis Sarana Wisma	Non-fac.	Indramayu	1,600
32	PT.Asia Victory Industry	PMDN	East Java	1,558
33	PT.Sumber Raya Kendimasindo	Non-fac.	Malang	1,400
34	PT.Serpih Mas	PMDN	West Java	1,220
35	PT.Duta Megah Mutiara	PMDN	Jakarta	1,200
36	PT.Lumbung Industri Keramik	PMDN	Gresik	1,080
37	PT.Kuali Mas	PMDN	Sidoarjo	1,080
38	PT.Elokin Tegelindo	PMDN	Bogor	1,000
39	PT.Suryaragam Prima (Danto)	PMDN	West Java	863
40	PT.Gunung Raharja	Non-fac.	Bogor	720
41	PT.Keramik Pangrango Permai	PMDN	Padalarang	600
42	PT.Malkatama Persada	PMDN	Serang	600
43	PT.Jatismah Indah Keramik	PMDN	Surabaya	600
44	PT.Perusda Sarana Bangunan	Non-fac.	East Java	578
45	PT.Keramik Indah Perkasa	PMDN	Bogor	320
46	PT.Sinar Pulung	PMDN	P.Batam	320
47	PT.Jatisuma Tile Fac	PMDN	Sidoarjo	250
48	PT.Aristika Inkernas	Non-fac.	Jakarta	240
49	PT.Tera Cota Indonesia	Non-fac.	Cirebon	185
50	PT.Kuda Laut Mas	PMDN	Sidoarjo	170
51	PT.Selo Giri Krida	PMDN	Banjar	145
52	PT.Maspion	PMDN	Sidoarjo	110
53	PT.Sanggar Kurnia Alam	PMDN	Jakarta	36
54	Others	–	–	87
	Total			146,961

PMDN ; Domestic Investment Scheme

Non-fac. ; Non-facility

PMA ; Foreign Investment Scheme

Sources : Various sources includeing interview survey to MOI, BBK, FE-UI and ASAKI

Chart A1-6-10 Estimated Production Capacity of Glazed Ceramic Roof Tile Companies as of 1992

No.	Name of Company	Status	Location	Production Capacity (millionPCS/Year)
1	PT.Lantai Keramik Mas	PMDN	Bogor	8.8
2	PT.Keramikatama Intirona Persada	PMDN	Bogor	6.0
3	PT.Abadi Genteng Jatiwangi	PMDN	Jatiwangi	6.0
4	PT.Bermis Sarana Wisma	PMDN	Padalarang Sukabumi	6.0
5	PT.Keramik Indah Perkasa	PMDN	Bogor	4.5
6	PT.Deco Plafonta Utama	PMDN	Medan	2.4
7	Others	PMDN	-	1.3
	Total			35.0

PMDN ; Domestic Investment Scheme

Sources : Various sources including interview survey to MOI, BBK, FL-UI and ASAKI

Chart A1-6-11 Estimated Production Capacity of Ceramic Sanitary Company as of 1992

No.	Name of Company	Status	Location	Production Capacity(PCS/Year)
1	PT.Indo American Ceramic	PMA	Bogor	650,000
2	PT.Surya Toto Indonesia	PMA	Tangerang	360,000
3	PT.Sorento Nusantra	PMDN	Lambung	350,000
4	PT.Inax International	PMDN	Semarang	325,000
5	PT.Satya Raya Keramindo	PMDN	Tangerang	300,000
6	PT.Metropole Megah	PMDN	Tulunganung	300,000
7	PT.Radia Ceramika	PMDN	Bekasi	250,000
8	PT.Serinco Djaya Marmer	PMDN	Tangerang	240,000
9	PT.Ina to Indonesia	Non-fac.	Semarang	120,000
10	PT. Pinda Aneka Group	Non-fac.	East Java	91,500
11	PT.Sarana Purna Cipta	Non-fac.	East Java	3,444
	Total			2,989,950

PMA ; Foreign Investment Scheme

PMDN ; Domestic Investment Scheme

Non-fac. ; Non-facility

Sources : Various sources including interview survey to MOI, BBK, FL-UI and ASAKI

Chart A1-6-12 Import of Ceramic Sanitary and Tile (1988-1993)

Year	Ceramic Sanitary			Ceramic Tile		
	Volume (ton)	Value (US $ '000)	Growth (%)	Volume (ton)	Value (US $ '000)	Growth (%)
1988	161	304	-	4,000	1,677	-
1989	157	609	-2.5	8,199	1,718	105.0
1990	241	713	53.5	38,710	12,695	372.1
1991	267	524	10.8	53,953	13,620	39.4
1992	300	1,572	12.4	46,432	11,973	-13.9
1993	299	714	-0.3	21,978	7,458	-52.7
Average of Growth			14.8			90.0

Source : Central Bureau of Statistic (CBS)

Import Trend of Ceramic Tile

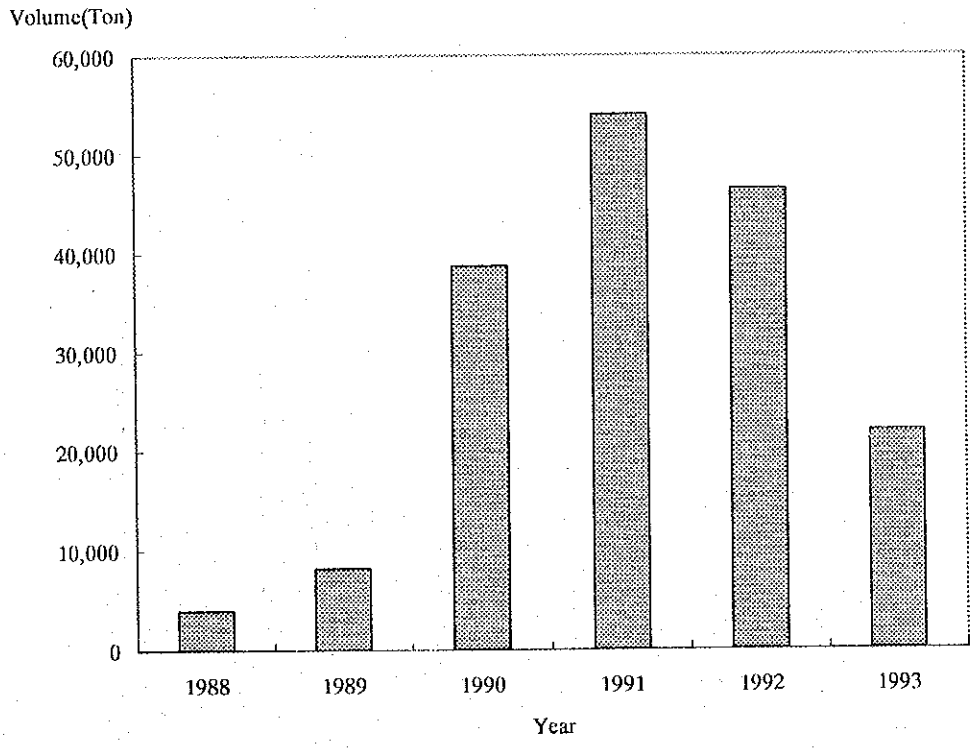


Chart A1-6-13 Export of Ceramic Sanitary and Tile (1988-1993)

Year	Ceramic Sanitary			Ceramic Tile		
	Volume (ton)	Value (US $ '000)	Growth (%)	Volume (ton)	Value (US $ '000)	Growth (%)
1988	5,642	6,922	-	7,484	2,344	-
1989	5,889	7,562	4.4	14,795	5,034	97.7
1990	5,621	7,867	-4.6	9,046	2,942	-38.9
1991	8,491	13,687	51.1	5,580	1,884	-38.3
1992	6,214	9,170	-26.8	33,244	11,973	495.8
1993	8,683	13,272	39.7	31,369	11,247	-5.6
Average of Growth			12.8			102.1

Source : Central Bureau of Statistic (CBS)

Export Trend of Ceramic Tile

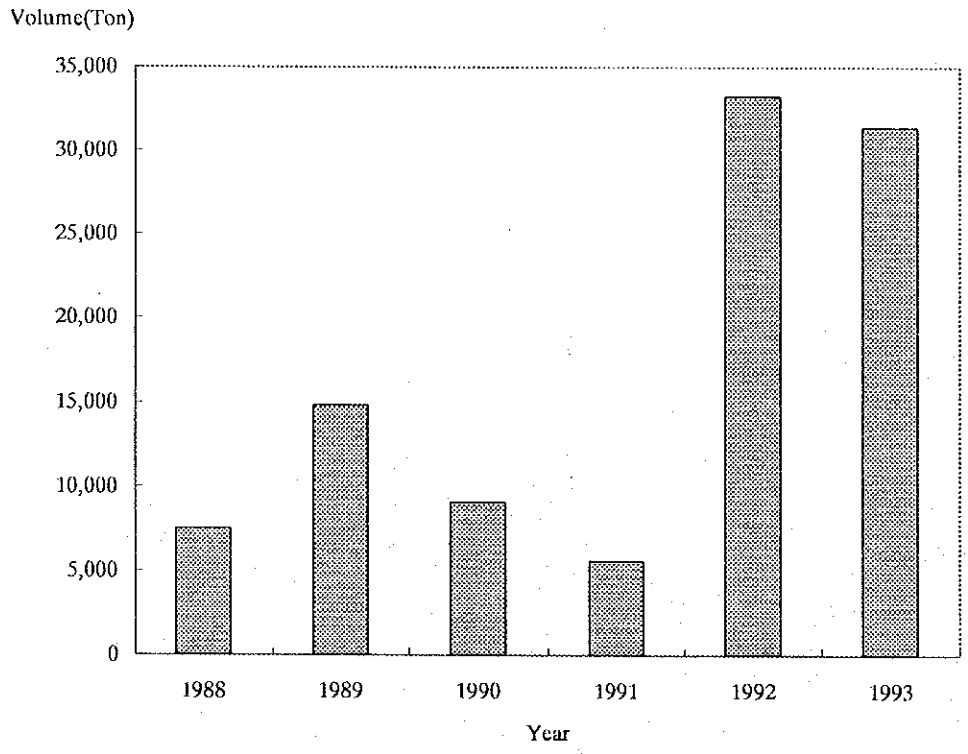


Chart A1-6-14 Import of Ceramic Tile by Country of Origin (1988-1993)

Tons

US $ ' 000

No.	Country of Origin	1988	1989	1990	1991	1992	1993
1	Spain	774	810	12,588	22,704	28,797	13,887 (US$/m^2)
		212	65	2,187	5,354	6,995	4,097 (4.43)
2	Italy	2,075	4,468	15,377	9,963	8,760	4,314
		1,006	864	7,592	2,352	2,286	1,010 (3.51)
3	Taiwan	136	117	5,184	15,790	4,254	1,881
		44	63	1,224	4,149	956	530 (4.23)
4	Australia	0	161	1,218	509	992	580
		0	68	328	267	388	445 (11.51)
5	Singapore	381	2,376	3,098	1,212	960	358
		19	461	927	273	223	153 (6.41)
6	Others	634	267	1,245	3,775	2,670	958
		396	197	437	1,225	1,127	1,224 (19.16)
	Total	4,000	8,199	38,710	53,953	46,433	21,978
		1,677	1,718	12,695	13,620	11,975	7,459 (5.09)

Source : Central Bureau of Statistics

Trend of Import from Top 3 Countries of Origin

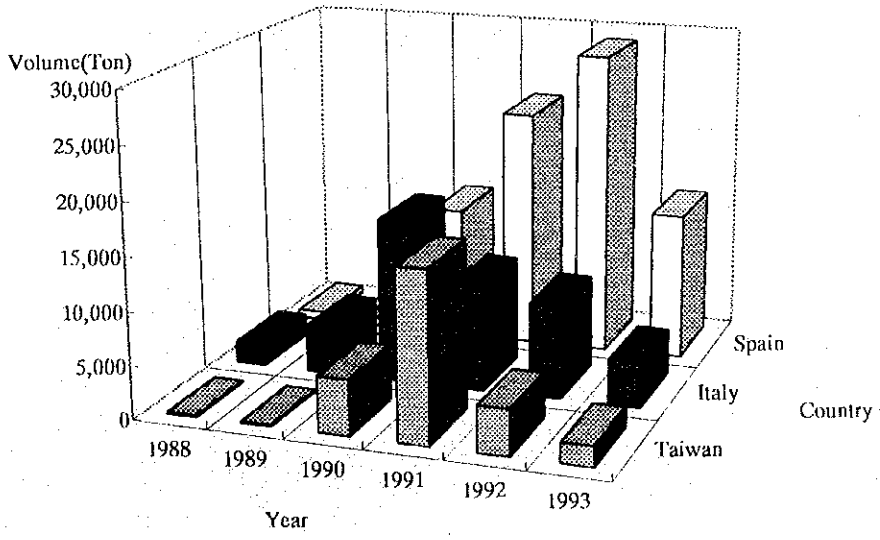


Chart A1-6-15 Export of Ceramic Tile, by Country of Destination (1988-1993)

Tons

US$ '000

No.	Country of Destination	1988	1989	1990	1991	1992	1993
1	USA	811	55	504	421	2,413	7,935 (US$/m^2)
		338	15	286	304	1,598	3,632 (6.87)
2	Taiwan	245	137	766	190	645	4,474
		97	50	276	88	170	1,139 (3.82)
3	Singapore	2,018	3,096	1,824	2,128	11,350	4,417
		619	930	1,017	738	4,786	1,668 (5.66)
4	Australia		2,659	1,267	1,070	2,846	3,737
			860	414	738	1,144	1,449 (5.82)
5	Brunei	10	206	0	20	443	2,625
		6	125	0	8	141	646 (3.69)
6	Hong Kong	2,332	1,648	767	235	1,998	490
		675	473	228	69	566	196 (6.00)
7	South Korea	93	1,606	2,113	1,396	7,968	0
		32	407	494	269	1,372	0
8	Others	1,975	5,388	1,805	120	5,581	7,691
		577	2,174	227	40	2,196	2,517 (4.91)
	Total	7,484	14,795	9,046	5,580	33,244	31,369
		2,344	5,034	2,942	2,254	11,973	11,247 (5.38)

Source : Central Bureau of Statistics

Trend of Export to Top 3 Countries of Destination

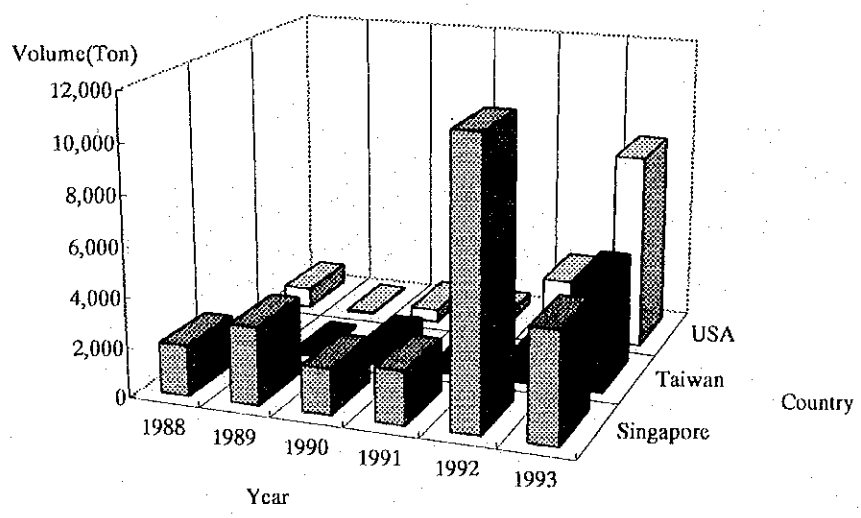


Chart A1-6-16 Import of Ceramic Sanitary, by Country of Origin (1988-1993)

Tons
US $ ' 000

Country of Origin	1988	1989	1990	1991	1992	1993
Singapore	35	45	64	24	46	62
	83	129	138	53	31	48
Japan	13	5	8	22	17	47
	84	5	63	145	60	168
USA	4	17	70	50	128	45
	17	53	284	89	1,338	164
Italy	57	22	30	24	35	44
	89	58	19	12	17	15
RP.China	1	2	19	1	17	2
	2	3	10	11	9	6
Others	51	66	50	146	96	99
	29	361	199	214	169	313
Total	161	157	241	267	339	299
	304	609	713	524	1,624	714

Source : Central Bureau of Statistics

Trend of Ceramic Sanitary Import from Top 3 Countries of Origin

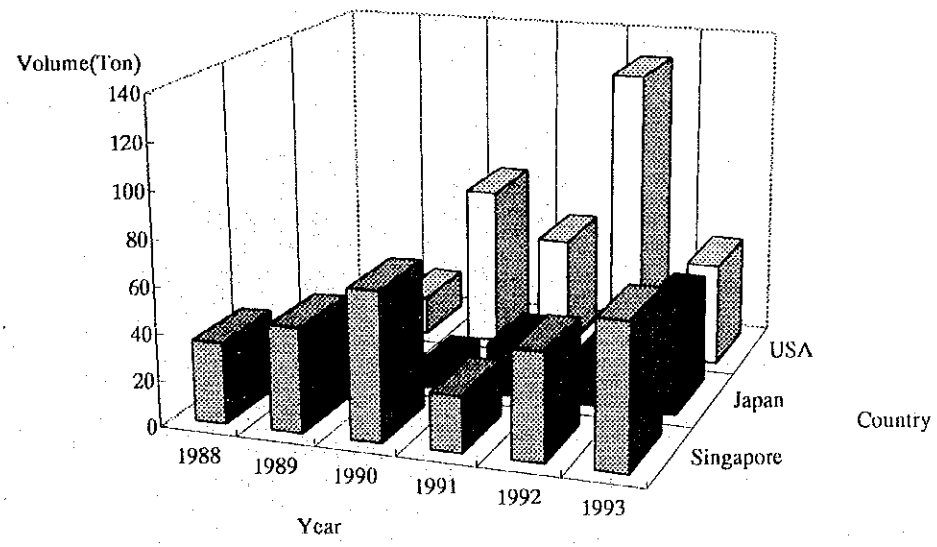


Chart A1-6-17 Export of Ceramic Sanitary, by Country of Destination (1988-1993)

Tons
US $ ' 000

Country of Destination	1988	1989	1990	1991	1992	1993
Taiwan	1,019	743	782	871	782	2,492
	1,218	1,210	1,278	1,667	1,266	4,016
Italy	2,816	3,156	1,870	2,691	2,921	2,225
	3,236	3,889	2,165	3,979	3,665	2,376
Hong Kong	255	165	440	448	655	988
	413	230	685	713	1,047	1,537
Japan	389	355	503	170	257	760
	572	424	607	530	330	1,100
Malaysia	43	62	158	334	365	511
	71	129	318	674	709	925
Singapore	68	82	175	542	239	500
	195	131	359	673	571	1,178
USA	86	390	951	1,533	272	353
	156	481	1,322	2,152	388	638
South Korea	145	323	522	556	197	106
	157	357	680	838	286	153
Others	821	613	220	1,346	526	748
	974	711	453	2,461	908	1,349
Total	5,642	5,889	5,621	8,491	6,214	8,683
	6,992	7,562	7,867	13,687	9,170	13,272

Source : Central Bureau of Statistics

Trend of Ceramic Sanitary Export To Top 3 Countries of Destination

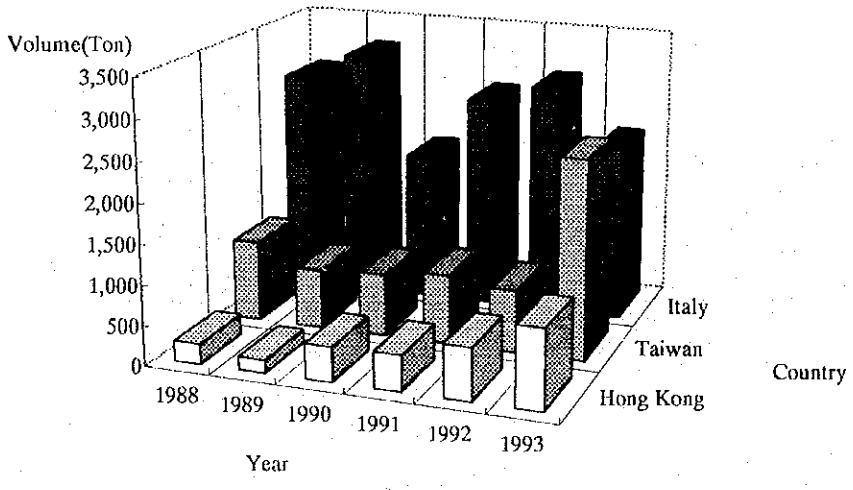


Chart A1-6-18 Process Flow Sheet of Tile Manufacturing

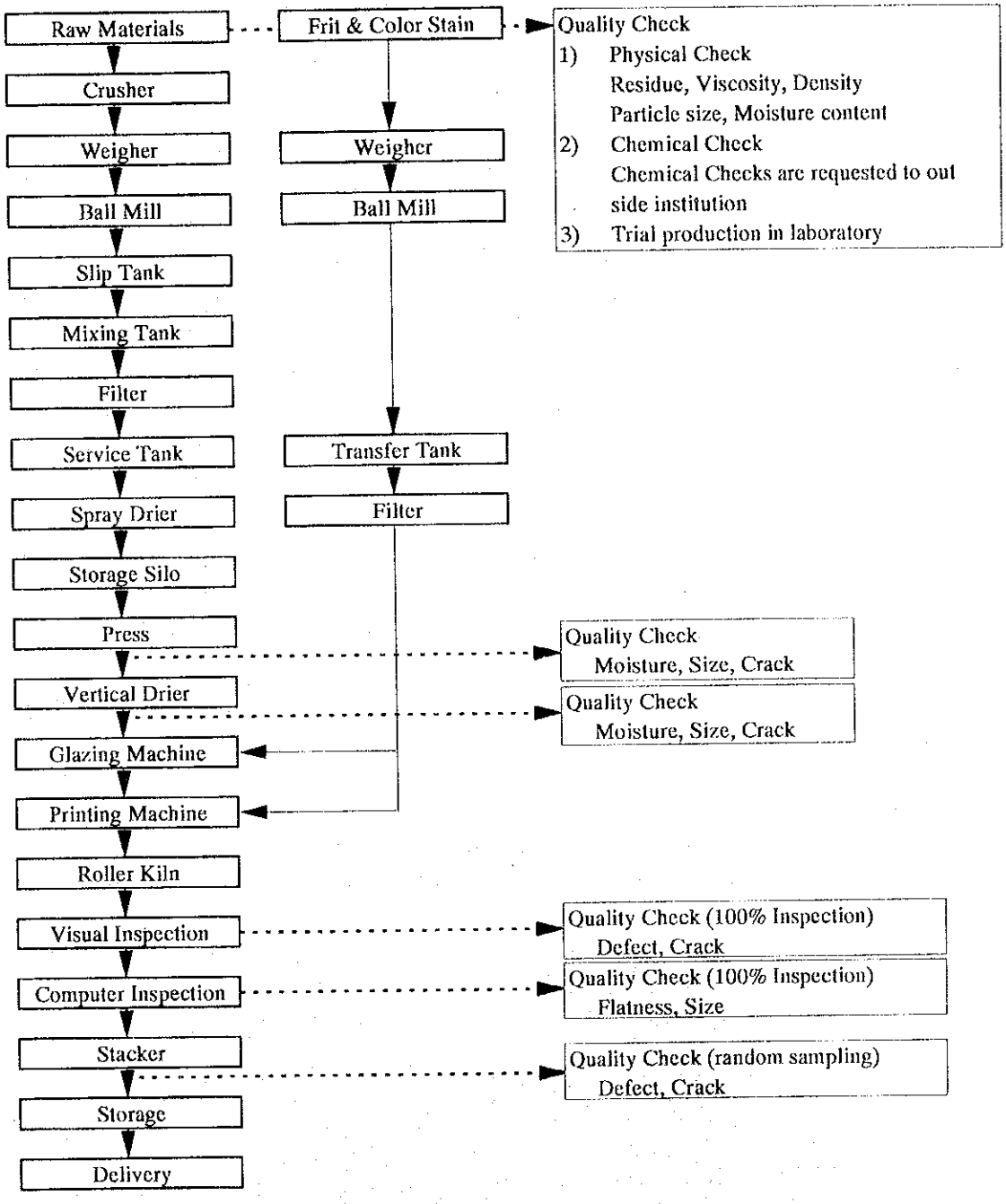


Chart A1-6-19 Import/Export of Ceramic Tiles from/to Asian & Oceanian Countries, 1993

No.	Countries	Import			Export		
		Quantity(kg)	Value(CIF US$)	US$/$m^2$	Quantity(kg)	Value(CIF US$)	US$/$m^2$
1	Taiwan	1,880,695	530,089	4.23	4,473,894	1,138,730	3.82
2	Australia	579,651	444,850	11.51	3,736,515	1,449,411	5.82
3	Singapore	357,625	152,586	6.40	4,417,497	1,668,166	5.66
4	China	119,165	33,008	4.15	78,050	17,516	3.37
5	Malaysia	104,231	55,397	7.97	152,615	67,330	6.62
6	Japan	96,886	338,324	52.38	56,402	36,367	9.67
7	Hong Kong	18,364	5,528	4.52	489,747	196,200	6.01
8	Brunei	9,675	2,747	4.26	2,624,868	646,116	3.69
9	Korea	237	4,352	275.44	0	0	
10	Thailand	22	30	20.45	0	0	
(	Sub-Total	3,166,551	1,566,911	7.42	16,029,588	5,219,836)	4.88
11	Philippines	0	0		1,385,927	578,763	6.26
12	Vietnam	0	0		1,366,889	482,256	5.29
13	Burma	0	0		1,271,926	297,043	3.50
14	Cambodia	0	0		964,895	351,616	5.47
15	New Guinea	0	0		210,044	87,650	6.26
	Total	3,166,551	1,566,911	7.42	21,229,269	7,017,164	4.96

Source : Central Bureau of Statistics

Import/Export Trend of Ceramic Tile from/to Asian & Oceanian Countries

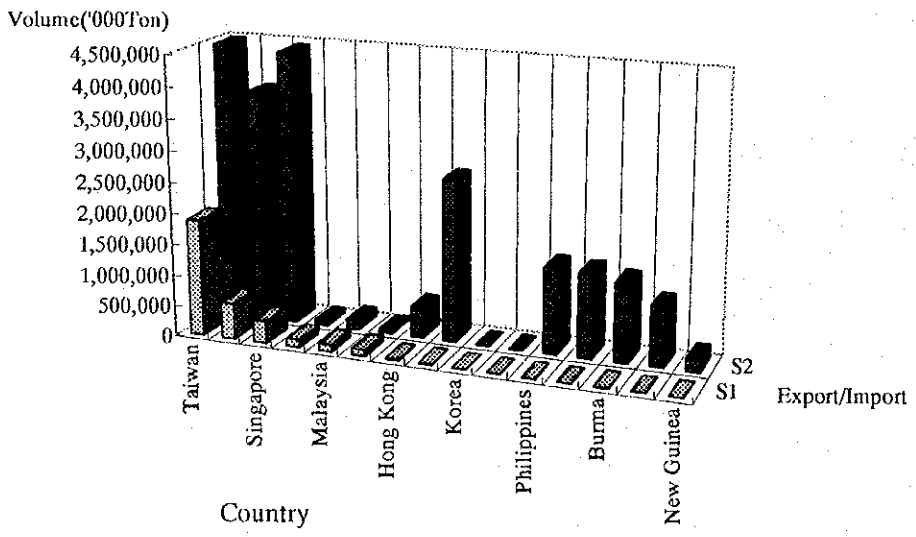


Chart A1-6-20 Evaluation of Ceramic Tile Producers by Production Cost Component

Companies	Production cost Component(%)				
	Valuable Cost		Fixed Cost		Total Cost
	Raw Materials	Utilities	Labor	Others	
BA	37 (1.00)	22 (0.59)	9 (0.24)	32 (0.86)	100
BB	39 (1.00)	29 (0.74)	17 (0.44)	15 (0.38)	100
BD	40 (1.00)	31 (0.78)	6 (0.15)	23 (0.58)	100
BG	37 (1.00)	19 (0.51)	17 (0.46)	25 (0.68)	100
BH	44 (1.00)	30 (0.68)	10 (0.23)	16 (0.36)	100
BJ	30 (1.00)	30 (1.00)	20 (0.67)	20 (0.67)	100
BK	34 (1.00)	48 (1.41)	6 (0.18)	12 (0.35)	100
BM	31 (1.00)	23 (0.74)	26 (0.83)	20 (0.65)	100
Average	36 (1.00)	29 (0.81)	14 (0.39)	21 (0.58)	100

Compiled by The Study Team from "Study on Master Plan for Promotion of Industrial Sectors in The Republic Of Indonesia"

Note : Figures in the parenthesis show the index number of each cost with raw material cost being 1.0.

Chart A1-6-21 List of SNI, ISO, and JIS in Ceramic Building Materials (1/4)

	SNI		ISO		JIS	
Vocabulary	15-1328	Massive red bricks, Term of acceptance	R 836	Vocabulary for the refractories industry. Trilingual edition	R 2001	Glossary of terms used in refractory
Test method	15-0254	Test method of ceramic raw materials for determination of formation water	8656-1	Refractory products - Sampling of raw materials and unshaped products - Part 1.Sampling scheme	M 8100	Particulate materials - general rules for methods of sampling
	15-0255	Determination of drying/burning shrinkage of ceramic raw material			M 8850	Methods for chemical analysis of limestone
	15-0256	Determination of bending strength condition after burning the ceramic raw material			M 8851	Methods for chemical analysis of dolomite
	15-0257	Test method of ceramic raw materials for determination of pyrometric cones equivalent by using seger cones,			M 8852	Methods for chemical analysis of silicastone
	15-0258	Test method of ceramic raw materials for determination of grain size distribution by sieving and precipitating			M 8853	Methods for chemical analysis of feldspar
	15-0449	Chemical test method of clay and feldspar (wet method)			M 8854	Methods for chemical analysis of refractory clay
	15-1145	Glazing and ceramic body. Test method for conformation			M 8855	Methods for chemical analysis of roseki
	15-1572	Test method for detergent resistance of glaze				
	03-2096	Ceramic floor tiles. Specification and test method				

Chart A1-6-21 List of SNI, ISO, and JIS in Ceramic Building Materials (2/4)

	SNI		ISO		JIS	
Test method	15-0350	Clay fire resistance for fire resistance brick	528	Refractory products – determination of pyrometric cone equivalent(refractories)	M 8512	Testing method for refractoriness of refractory raw materials
			1146	Pyrometric reference cones for laboratory use – Specification	R 8101	Seger cone
			2477	Shaped insulating refractory products – Determination of permanent change in dimensions on heating.	R 2207	Test method for the rate of linear change of refractory brick on heating
			2478	Dense shaped refractory products – Determination of permanent change in dimensions on heating	R 2202	Method of measuring dimensions of refractory bricks
			5014	Refractory products – Determination of modulus of rupture at ambient temperature	R 2213	Test method for modulus of rupture refractory bricks
			5016	Shaped insulating refractory products – Determination of bulk density and true porosity	R 2203	Method of measuring warpage of refractory bricks
			5017	Dense shaped refractory products – Determination of bulk density, apparent porosity and true materials	R 2205	Test method for apparent porosity, water absorption specific gravity of refractory bricks
			5019-1	Refractory bricks – Determinations – Part 1. Rectangular bricks	R 2150	Method of inspection for dimension of refractory bricks
Products	15-0926	Feldspar for bodymaking of fine ceramic				
	15-2948	Clay for solid ceramic				

Chart A1-6-21 List of SNI, ISO, and JIS in Ceramic Building Materials (3/4)

	SNI		ISO	JIS	
Products	15-1782	Feldspar for glazing			
	03-0028	Cement floor tiles		A 6505	Building materials(Concrete floor panel)
	03-0054	Glazed ceramic wall tiles. Specification and test method		A 5209	Ceramic tiles
	03-0106	Ceramic floor tiles. Specification and test method		A 5534	Enamel tiles
	03-0136	Terrazzo tiles		A 5411	Pre-cast terrazzo
	03-0536	Unglazed acid fastness ceramic floor tile. Specification and test method			
	03-1331	Ceramic mosaic floor tiles			
	03-2095	Ceramic roof tile		A 5208	Clay roof tiles
	03-2134	Glazed ceramic roof tile			
	03-0579	Chinese vitreous type ceramic washing table			
	03-0680	Chinese vitreous squatting toilet		A 5105	Trap-less water toilet bowls
	03-0797	Chinese vitreous sitted toilet		A 5207	Sanitary wares
	03-1148	Chinese vitreous man urinoir		A 4410	Sanitary unit for housing
	03-2947	Urinoir vitreous china type		A 4417	Toilet unit for housing
	03-2998	Chinese vitreous mono-block sitted toilet			
	15-0686	Performed red bricks		R 1250	Common bricks
	15-0553	Perforated red brick			
	15-0054	Red brick for liner			
	15-1328	Massive red bricks. Term of acceptance		A 5210	Ceramic masonry units for buildings

Chart A1-6-21 List of SNI, ISO, and JIS in Ceramic Building Materials (4/4)

	SNI		ISO	JIS	
Products	15-2094	Red brick for building material		A 5213	Red brick for building material
	15-0236	Refractory brick, chammote type		R 2101	Shape and dimension of refractory bricks
	03-0687	Straight line clay pipes for un-pressured water supply		R 1201	Clay pipes
	03-0688	Gooseneck type clay pipes for un-pressured water supply			

Chart A1-6-22 Usage of Standard in Ceramic Building Materials Industry

(Unit : %)

Sector		Wall/Floor Tile Makers															Roof Tile Makers				
Co. scale		LL					L					S					L				
Standard		SII	In-house standard	Foreign standard	International standard	Total	SII	In-house standard	Foreign standard	International standard	Total	SII	In-house standard	Foreign standard	International standard	Total	SII	In-house standard	Foreign standard	International standard	Total
Products	Product	33	20	47	0	100	40	50	10	0	100	0	100	0	0	100	50	17	33	0	100
	Test Method	40	0	50	10	100	44	56	0	0	100	0	100	0	0	100	50	17	33	0	100
	Term	42	0	50	8	100	44	44	0	12	100	0	100	0	0	100	50	17	33	0	100
	Sub Total	38	8	49	5	100	43	50	3	4	100	0	100	0	0	100	50	17	33	0	100
Raw Materials	Product	36	36	28	0	100	25	63	12	0	100	0	100	0	0	100	67	33	0	0	100
	Test Method	10	50	40	0	100	25	63	12	0	100	0	100	0	0	100	67	33	0	0	100
	Term	9	36	55	0	100	25	63	12	0	100	0	100	0	0	100	67	33	0	0	100
	Sub Total	20	40	40	0	100	25	63	12	0	100	0	100	0	0	100	67	33	0	0	100
Machinaries	Product	0	0	100	0	100	0	33	67	0	100	0	100	0	0	100	0	0	50	50	100
	Test Method	0	0	100	0	100	0	33	67	0	100	0	100	0	0	100	0	0	50	50	100
	Term	0	0	100	0	100	0	33	67	0	100	0	100	0	0	100	0	0	50	50	100
	Sub Total	0	0	100	0	100	0	33	67	0	100	0	100	0	0	100	0	0	50	50	100

Definition : LL ; Big Co. in Large Scale Industries
L ; Large Scale Industries
M ; Middle Scale Industries
S ; Small Scale Industries

Source : Questionnare Survey

Chart A1-6-23 Base of In-house Standard in Ceramic Building Materials Industries

(Unit : %)

Sector	Wall/Floor Tile			Roof tile	Total
Co. scale	LL	L	S	L	
SNI (SII)	22	27	0	33	26
International standard	0	13	0	0	7
Customer standard	22	27	0	0	22
Foreign standard	11	20	0	33	19
Own experience	44	13	100	33	26
Others	0	0	0	0	0
Total	100	100	100	100	100

Definition & source : Same as Chart A1-6-22

Chart A1-6-24 Obtaining of Standards and Relating Information

(Unit : %)

Co. Scale	LL			L		
	Easy	Difficult	No need	Easy	Difficult	No need
SII						
Standards	90	0	11	58	33	9
Information	78	11	11	60	30	10
Sub Total	84	5	11	59	32	9
Foreign Standards						
Standards	100	0	0	50	25	25
Information	83	17	0	45	33	22
Sub Total	92	8	0	47	29	24
International Standards						
Standards	100	0	0	0	67	33
Information	50	50	0	0	100	0
Sub Total	67	33	0	0	83	17
Total	85	9	6	47	38	15

Definition & source : Same as Chart A1-6-22

Chart A1-6-25 SII Certification

(Unit : %)

Item	Question D1				Question D2			
Co.'s Scale	LL	L	S	Total	LL	L	S	Total
YES	75	46	0	55	11	45	0	26
NO	0	18	100	15	89	33	100	63
Don't Know	25	36	0	30	0	22	0	11
Total	100	100	100	100	100	100	100	100

Question D1 ; Do you have any products applicable to SII mark certification?

Question D2 ; Are you a certified manufacturer of the SII mark certified product(s)?

Definition & source : Same as Chart A1-6-22

Chart A1-6-26 SII Certification for Raw Materials

(Unit : %)

Items	Question D4			Question D5		
Co.'s Scale	LL	L	Total	LL	L	Total
YES	22	33	28	22	20	21
NO	56	22	39	67	60	63
Don't Know	22	45	33	11	20	16
Total	100	100	100	100	100	100

Question D4; Do you have any raw materials, components, or auxiliary materials which are applicable to the SII mark?

Question D5 ; Have you requested your suppliers to apply for SII mark?

Definition & source : Same as Chart A1-6-22

Chart A1-6-27 ISO 9000 Certification

(Unit : %)

Items	Question D61	Question D63
YES	0	14
NO	86	86
Don't Know	14	0
Total	100	100

Question D61; Are you a registered firm for the ISO 9000 series certification?

Question D63 ; Have you requested your suppliers to apply for ISO 9000?

Definition & source : Same as Chart A1-6-22

Chart A1-6-28 Distribution Flow of Ceramic Tiles

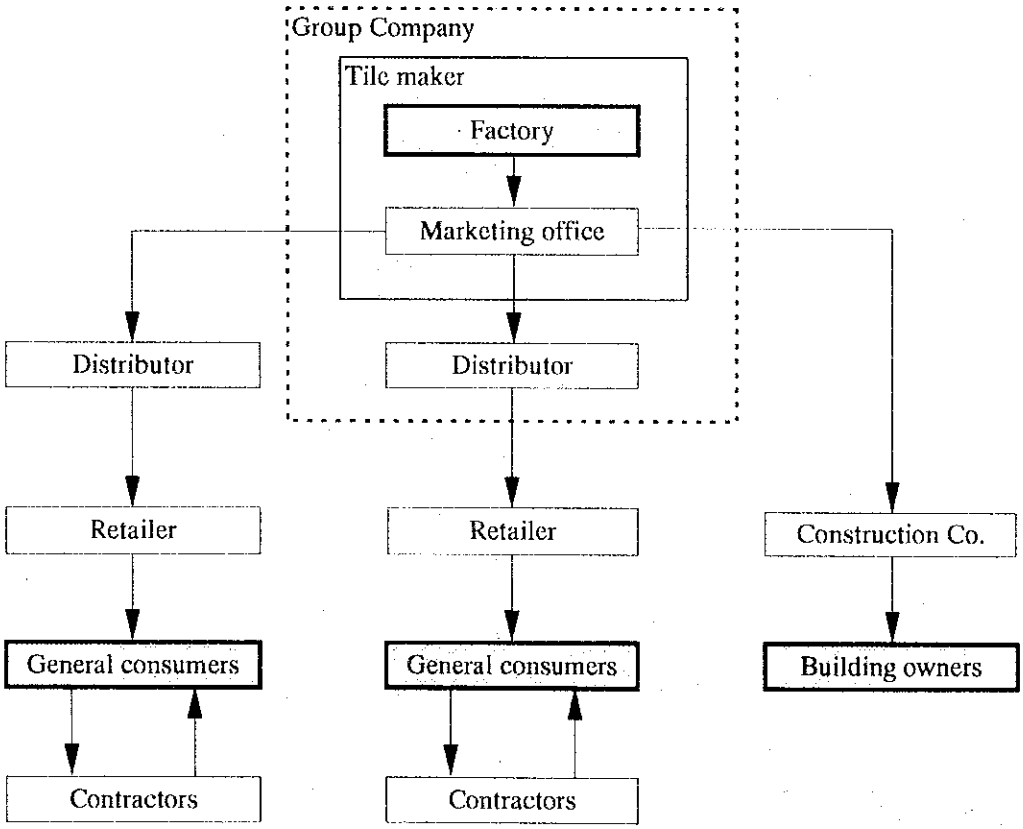


Chart A1-6-29 Activities for Quality Control

(Unit : %)

Sector / Co.' scale	Wall/Floor Tile					
	LL			L		
	Implemented	Planned	Don't know	Implemented	Planned	Don't know
Product inspection	100	0	0	100	0	0
Inspection in process	100	0	0	100	0	0
SQC(Statistical QC)	60	20	20	71	29	0
QC department	80	0	20	71	29	0
Documentation for QC	67	22	11	86	14	0
ISO 9000 series	0	78	22	0	43	57
Using QC consultant	25	63	12	33	0	67
Developing in-company STD	67	22	11	100	0	0
QC circle	56	44	0	33	45	22
Employee Suggestion system	75	25	0	100	0	0
Seven tools for QC	50	38	12	40	20	40
5S activities	38	38	24	33	33	33
QC training	75	25	0	57	29	14

Sector / Co.' scale	Wall/Floor Tile			Roof Tile		
	S			L		
	Implemented	Planned	Don't know	Implemented	Planned	Don't know
Product inspection	0	0	100	100	0	0
Inspection in process	0	0	100	100	0	0
SQC(Statistical QC)	0	0	100	75	25	0
QC department	0	0	100	75	25	0
Documentation for QC	0	0	100	100	0	0
ISO 9000 series	0	0	100	0	0	100
Using QC consultant	0	0	100	0	0	100
Developing in-company STD	0	0	100	75	0	25
QC circle	0	0	100	25	50	25
Employee Suggestion system	0	0	100	100	0	0
Seven tools for QC	0	0	100	60	0	40
5S activities	0	0	100	75	0	25
QC training	0	0	100	100	0	0

Definition & source : Same as Chart A1-6-22

Chart A1-6-30 Major Reasons of Quality Problems

(Unit : %)

Co.' scale	LL	L	S	Total
Ignorance by management	1			1
Apathy of employees	4	4		8
Lack of knowledge in QC method	5	5	1	11
Lack of staff to introduce QC	5	3	1	9
Lack of time to carry out QC activity	3	1	1	5
Unconcern of customers	1			1
Cost increase	1			1
Job hopping	1			1
Others	1	4		5
Total	22	17	3	42

Definition & source : Same as Chart A1-6-22

Chart A1-6-31 Quality Inspection in Receiving Raw Materials

No. of answer

Co.'s scale	LL	L	S	Total
Inspection by your Co. on all items	5	4		9
Sampling inspection by your Co.	8	8		16
Using supplier's data and information	1	1		2
Using 3rd party's data and information		1		1
No(or no need) inspection			1	1
Others		1		1
Total	14	15	1	30

Definition & source : Same as Chart A1-6-22

Chart A1-6-32 Test Items and Facilities/Equipment for Ceramic Floor Tiles (SNI 03-2096)

Test Items	Facilities/Equipment
Weight	Dryer (150℃<) 、Weighing balance (g)
Length	Galipas (0.1mm)
Angle	Galipas (0.1mm) 、Angle measure (0.3mm)
Water absorption	Dryer (150℃<) 、Weighing balance (0.1g)
Volume/Weight	Dryer (150℃<) 、Weighing balance (0.2g) 、Galipas (0.1mm)
Bending strength	Bending strength tester
Resistance	Autoclave (2-3atom)
Anti Chemicals	Sieve tray (1mm、0.5mm) 、Heater、Dryer、H2SO4、HNO3、HCl、NaOH

Note : The figure in ( ) are accuracy or units

Chart A1-6-33 Request to Outside Inspections

(Unit : %)

Size of Co.	LL	L	S	Co. Total
Yes	89	90	0	85
No	11	10	100	15
Total	100	100	100	100

Definition & source : Same as Chart A1-6-22

Chart A1-6-34 Test Items and Institutes Requested, In %

Division	Test items	%	Institutes
Calibration	Weighing balance	29	DOM、LIPI、B4T、
	Flow meter、Flatness、Manometer		Private institutes
Mechanical	Bending strength、Hardness	27	BBK、Private Inst.
Electrical	-	0	
Chemical	Component、Acid alkali resistant	29	LIPI、Sucofindo
			BBK、Over sea inst.
Physical	Water absorption、Length、	11	BBK、Over sea inst.
			Private institutes
Others		4	BBK、Private Inst.
Total		100	

Source : Same as Chart A1-6-22

Chart A1-6-35 No. of Test Request to Government and Private Institutes, In %

Government Institutions		Private Institutions	
Name	%	Name	%
BBK	31	Domestic	28
DOM	26	Over sea	9
LIPI	4		
B4T	2		
Total	63		17

Source : Same as Chart A1-6-22

Chart A1-6-36 Frequency of Test Request to Out-side Laboratories

Frequency(time/year)	(%)
1	33
2—5	17
Anytime needed	50
Total	100

Chart A1-6-37 Unsatisfactory to Out-side Laboratories

Items	(%)
No problem	55
Testing period to long	12
Expensive test cost	8
No answer	25
Total	100

Chart A1-6-38 Particular Examination Items for JIS A5209

2. Control of materials and raw materials

Qualities, inspection methods and storage methods of materials and raw materials listed in table below shall be prescribed in detail based on company standard which satisfy the conditions described in the table. These shall be implemented properly according to standard set.

Name of materials	Quality of materials	Inspection method in receiving	Storage method
1. Non-plastic raw materials such as pottery stone, feldspar and silica stone	for items 1 to 3 (1) Appearance (to be compared with standard sample) (2) Color after firing (to be compared with standard sample, excluding limestone)	for items 1 to 6 To receive after inspection of quality items in left column, or confirmation of following items. (1) Quality report submitted by supplier (2) Type of grade when the quality is consistent for long period in past	for items 1 to 5 To be stored without contamination of foreign matters
2. Plastic raw materials such as clay and kaolin			
3. Coloring raw materials such as limestone and oxidized metal			
4. Ready mixed raw materials and clays	(1) Particle size after crashing (in case of mill preparation) (2) Particle size (in case of purchasing as particle situation) (3) Water content (4) Color after firing (to be compared with standard sample)		
5. Glaze	(1) Concentration or specific gravity (2) Particle size after crashing (3) Color after firing (to be compared with standard sample) (4) State at melting (to be compared with standard sample)		
6. Paper	(1) Material (2) Size (3) Opening ratio (in case of back adhesive type of unit tile)		To be stored properly

Note : 1. Necessary materials in above table shall be prescribed in company standard in accordance with products manufactured by the relevant factory, production method and so on.
2. The materials used in subcontract factories or associated factories may be purchased by those factories

Source : Agency of Industrial Science & Technology of MITI, Japan