

KAOLIN

*By Ian Wilson
Ian Wilson Consultancy, UK*

Kaolin, also known as china clay, is white commercial clay consisting predominantly of the mineral kaolinite, a hydrated aluminosilicate. Other associated kaolin group minerals are halloysite, nacrite and dickite. The name 'kaolin' is derived from the village of Gaoling in Jiangxi province, China, where the white clay was mined. The nearby Jingdezhen potteries used the kaolin to create their fine white porcelain. The composition of Chinese porcelain was identified by Europeans in the eighteenth century and deposits of kaolin were sought in Europe. This led to the discovery of the kaolin deposits in Cornwall, south-west England, which were named china clay.

Deposits

Kaolin deposits are encountered throughout the world and new deposits are still being discovered. Kaolin deposits may be classified as primary or sedimentary. Primary, or residual deposits, were formed by the alteration *in situ* of the parent rocks, which may have been igneous, metamorphic or volcanic in origin, by hydrothermal and weathering processes. Sedimentary, or secondary, kaolin is derived from the erosion of pre-existing rocks and the subsequent transport and deposition of the clay.

In Cornwall and Devon, the kaolinite is derived from the late-stage magmatic or hydrothermal decomposition of feldspar within granite. It is separated from the host granite by washing it out with high-pressure water hoses, a process known as monitoring. The kaolin content rarely exceeds 20% of the altered granite, but the depth of kaolinisation extends in many places down to 300 m. In Western Australia, vast tracts of granitic rock have been weathered down to 50 m, with the kaolin content often exceeding 40%. The best known sedimentary kaolin deposits are from Georgia in the US and the Amazon Basin in Brazil. The deposits of kaolin were formed from the erosion of deeply-weathered crystalline rocks in plateau areas, which were then transported and deposited as sedimentary sequences. Here, the kaolin is found in lenses, often between 5-20 m thick, and with a high percentage of kaolinite, around 80-95%, which is dry mined.

Production

Kaolin is found in many countries but it is just the beneficiated, or refined clays that will be considered in this report. Worldwide production is estimated by the US Geological Society (USGS) to be in excess of 40 Mt/y. However, this value includes 13.5 Mt/y from Colombia and Uzbekistan, which distort the figures, as the majority of these clays is low grade, and not processed. The estimated production figures of beneficiated kaolin from 30 countries are shown in Table 1 for 2000-2002.

North America is still the most important area with 32% of production, followed by Europe with 26%. However, both the US and UK are decreasing their

production, mainly as a result of Brazilian competition. The share of South America has risen from 4% to 10% in the past five years, solely as a result of the production of high-quality coating clay from Brazil. Four countries, US, UK, Brazil and China each produce >2.0 Mt/y of kaolin (total of the four is 14 Mt/y) which accounts for 56% of the world's total.

The leading producing kaolin companies are shown in Table 2, with estimated production levels for 2002.

The 11 leading producing companies account for 56.5% of the total. Comparisons with previous years are not relevant as there has been so much restructuring of the industry by a combination of acquisitions, closure of some unprofitable plants and switching of grades from one operation to another.

Imerys

Imerys, with headquarters in France, has kaolin operations in the US, Brazil, UK, Portugal, Thailand, Australia, Ukraine and New Zealand and accounts for almost one-quarter of the world's production. In January, 2003, Imerys reorganised its business into Paper and Speciality Groups. The creation of a new global 'Pigments for Paper' Business Group was effective from January 1, 2003. This new group encompasses existing Paper Divisions in Europe, North America, Brazil and Asia. Imerys is the only kaolin company with deposits and production in the three major zones of high quality kaolin for paper coating – Brazil (Amazonas), Georgia (US) and Cornwall (UK). These deposits give the following characteristics:

- Brazil coating kaolins offer high brightness and opacity due to their range of particle size and shape.
- Georgia reserves are used for all coating applications for the North American paper industry and its calcined clays are used worldwide for their opacifying effect.
- Cornwall provides filler and coating kaolins that are well suited to the European supercalendered (SC) paper and lightweight coated (LWC) paper markets.

Formation of the new group underlines Imerys' commitment to serve the global paper industry with an emphasis on multinational paper customers. The new Speciality Group will cover markets for both Ceramics and Speciality Minerals (paint, rubber, plastics).

US

The main production of kaolin in the US is in Georgia and South Carolina based on a large number of deposits. It is estimated by the USGS that there are 1,400 Mt of kaolin resources remaining. The China Clay Producers Association (CCPA) of Mid-Georgia, whose members include Engelhard Corp., Imerys, J.M. Huber Corp. and Thiele Kaolin Co., announced in June 2003 that the industry posted an after tax profit of \$36 million in 2001, which represents a return of 4.2% on the net investment. "The kaolin industry has struggled in recent years, and it is gratifying to see a return to positive numbers," said Lee Lemke, executive vice president of the CCPA. "This

industry has had a dismal five years. Profitability has averaged less than 1% for the five-year period with significant losses reported in 2000 and 2001.” “The return to profitability in 2002 can be attributed to the restructuring that the kaolin companies accomplished as well as an improved market,” said Mr Lemke. The industry has continued to reduce payroll and expenses. Direct employment in the industry now stands at 2,640, down from its peak of 4,500. Restructuring has resulted in a shutdown of older unprofitable assets, which has reduced the net investment almost 30% for the four companies that remain in the kaolin business. The industry’s investment in Georgia now stands at US\$860 million. “The economy in middle Georgia is tied to the kaolin industry. While we are gratified by the 2002 results, we must continue to improve our after tax profitability to encourage our employees and shareholders and to stabilise this vital industry,” reported Mr Lemke. Imerys announced in 2001 cutbacks of its capacity in Georgia and in 2002, 30% of production was shut down and manufacturing was concentrated on higher value-added products. Also, other producers such as Engelhard have continued to concentrate on their higher value-added calcined clays and not invest more in the lower-quality commodity grades. With this policy of cutting capacity, overall sales of kaolin from the US have decreased significantly from 8.8 Mt/y in 2000 to 8.11 Mt/y in 2001, with an estimated 7.45 Mt/y for 2002. This trend is expected to continue over the next few years, with increasing imports of paper coating kaolin from the Amazon Basin in Brazil and the switch to utilising ground calcium carbonate (GCC) and precipitated calcium carbonate (PCC).

The Georgia kaolin belt continues to be an important supplier to the paper industry in the US with supplies mainly being by rail in slurry form. Calcined clay capacity is 1.1 Mt/y and is sold to the paper industry as a partial replacement for the more expensive titania dioxide in paper and paint. Some of the kaolin can also be processed dry by air flotation, and various grades of kaolin are sold to the ceramics, paint, rubber and adhesives sectors.

In Canada, where up to 1.0 Mt/y of kaolin is imported from the US and UK, investigations continue by Black Bull Resources Inc. on the kaolinised granite of the Yarmouth area, Nova Scotia. Here, the kaolin shows the potential to be delaminated and is suitable for supercalendered (SC) paper. Port Hawkesbury at present produces SC paper and imports up to 150,000 t/y from Imerys in Cornwall. However, the kaolin project has been delayed following environmental concerns.

Brazil

Over the past 20 years there has been a tremendous amount of exploration for kaolin carried out in the Amazon Basin, particularly in the vicinity of the Jari and Capim rivers. Proved reserves in the Amazon Basin are put at > 500 Mt though this is being increased with current exploration. In the Capim River Basin there are two operating mines and 15 undeveloped deposits (13 controlled by CVRD and two by CPRM). The mines exploit high-quality sedimentary seams of kaolin which exhibit high brightness, fine particle size, fine particle size distribution and particle shape, and good rheology which make the kaolin very suitable for the paper coating market. There are

currently three companies producing coating kaolin in the Amazon Basin – Cadam (Caulim da Amazonia SA) based on the Jari deposit, and PPSA (Pará Pigmentos SA) and RCC (Rio Capim Caulim SA, Imerys) based on the Capim deposits. Capacity and sales for coating kaolin for 2002 are shown in Table 3.

Current plans are for Cadam to increase its capacity to 1.2 Mt/y, PPSA to 1.0 Mt/y in the next few years while RCC (Imerys) is just completing its expansion to 850,000 t/y. This will increase the overall capacity to 3.05 Mt/y.

Coating kaolin demand in the world is at present around 8.0 Mt/y split between North America (31%), Europe (35%), Asia (9%), Japan (15%), South America (3%) and others (8%). Coating kaolin production capacity is now 10 Mt/y with Brazil accounting for 22%. With the majority of Brazilian coating kaolin destined for the export market its share of the world trade is an impressive 43% of global exports with 21% of global sales. The Brazilian producers are extremely competitive based on their high quality ore deposits and good mine-to-port logistics. The Jari deposit and plant is adjacent to the ocean-going port of Munguba, whilst both of the Capim plants (PPSA and RCC) send their processed ore by a 180 km pipeline to Barcarena (near Belem) where the slurry is spray dried and loaded directly onto ocean-going vessels. Imerys Rio Capim Caulim commissioned its 160 km pipeline from the mine site to Baracena in May 2002. Following the capacity increase from 450,000 t/y to 600,000 t/y in 2001, a further expansion from 600,000 t/y - 850,000 t/y was begun at the plant in 2002 and will be completed in the first quarter of 2002. The spray-dried kaolin, at just 4 – 6% moisture is delivered to specially-designed facilities in ports such as Antwerp where further processing (slurrying, bagging) takes place.

Imerys, as the world's largest kaolin producer now controls Rio Capim Caulim (RCC) with 99.86% of the shares, the remaining 0.14% held by Sumitomo. CVRD, the world's leading exporter of iron ore from Brazil, is currently negotiating to acquire Caemi. Contingent on approval by regulatory authorities CVRD stand to control 100% of Caemi which in turn will control 100% of Cadam and 80% of the voting shares of PPSA and, importantly, 100% of the Capim mineral rights. This will establish CVRD as a major player in the kaolin market, second only to Imerys.

UK

The main producing country in Europe remains the UK, with the French group Imerys now controlling the majority of deposits in Cornwall and Devon. Sales have remained fairly static for the past few years at 2.3 – 2.4 Mt/y, way below the heights reached in the late 1980s when up to 3.3 Mt/y was produced. Apart from Imerys, other producers are Goonvean, a privately-owned company with a capacity of 250,000 t/y (sales currently at 200,000 t/y) based on the St Austell granite, and WBB Minerals (was Watts Blake & Bearne, now renamed WBB Minerals and fully owned by Sibelco, the Belgium group) with 150,000 t/y.

Goonvean is thus the only remaining English china-clay producer and specialises in the filler and ceramic markets. Kaolin from Devon and Cornwall

is characterised by very low titania which makes it suitable for high-quality ceramics, particularly porcelain and tableware. The iron level is also of importance and this can be controlled by selective mining and by utilising superconducting magnets. Goonvean has developed new products for high-quality ceramics over the past four years. A new product called Diamond Star is now being sold for use in high-quality tableware and porcelain, and is competing with Imerys' Super Standard Porcelain and New Zealand's China Clay 'Premium'. Diamond Star has low iron and titania which gives rise to good fired whiteness and translucency in tableware (in both oxidative and reductive firing conditions). WBB Minerals mines the Dartmoor Granite at Lee Moor where it has two pits, Shaugh and Headon, and a plant at Headon. The markets served by WBB Minerals are paper (20%), ceramics (70%) and others (10%). WBB installed an Eriez magnet in 2002 to improve the brightness of the clay by reducing the iron levels. Over 87% of the kaolin from Devon and Cornwall is exported.

Imerys still produces around 2.0 – 2.1 Mt/y with sales destined mainly for the paper filler and paper coating markets (Table 4).

Whilst Devon and Cornwall produce a wide range of products for paper, based on the ability to offer a range of delaminated engineered clays, the competition from the Amazon Basin for the higher brightness coating pigments resulted in Imerys deciding to switch 150,000 t/y of such products to its Brazilian operation, RCC (Rio Capim Caulim). High brightness engineered pigments from the UK, such as Suprastar and Suprapint, will be replaced by engineered pigments from Brazil such as Capim DG and GP.

Imerys are currently preparing a blueprint to map out the industry in Cornwall and Devon for the next 40 – 50 years based on the remaining estimated >100 Mt of mineable reserves. Despite facing significant competition since the early 1980s from other kaolin deposits, and other pigments such as PCC and GCC, it is envisaged that mining will continue at the 2 Mt/y level for the foreseeable future, and investment continues to ensure an efficiently run business. Traditionally, mining of kaolin in Cornwall has been a wet process. However, some dry mining is now being carried out in some pits for a tighter quality control of selected products. Investment over the past few years has been at the US\$60 million level, being spent on the completion of a flash-calciner for 'Opacilite' (a new extender for paint), streamlining refining facilities with pipework replacement and upgrading centrifuges. Pit development has taken place, with new schemes for Blackpool and Wheal Martyn and expanding the Littlejohns and Melbur Pits. A further US\$30 million will be spent in 2003 in developing the 'super-pits' (over the years smaller pits have been amalgamated to form larger pits, generally covering >125 ha) and completing the introduction of fluidised bed dryers.

Importantly, the problem of the waste rock and sand is being addressed (1 t of kaolin gives 9 t of waste, a mixture of hard rock and sand). From 500,000 t/y in 1999 it is anticipated that 1.6 Mt/y will be sold in 2002 rising to 2.5 Mt/y in 2003. Imerys, local authorities and independent aggregate companies are currently exploring the important transport issues, including improving facilities

at the Port of Par to export secondary aggregates to both UK and European markets.

China

The market for kaolin continues to grow in China, with an estimated 2.1 M in 2002. Major markets of processed kaolin are ceramics (75%) and paper, paint and others (25%). Kaolin deposits are found in a wide range of geological settings both in the coastal and the inland provinces of southern China. The largest primary resources have been derived from the alteration of granitic rocks and their extrusive equivalents.

A high-quality kaolin at Longyan in Fujian Province suitable for high-quality tableware has attracted much interest from international kaolin companies but to date there is no joint venture. With large international paper companies now investing in China, imports of coating kaolin from the US and Brazil will continue to grow. Local Chinese companies are also being developed to compete in this market.

The Maoming Basin in southwest Guangdong Province, consists mainly of arkosic sediments which have been deposited and subsequently kaolinised. Kaolin from Maoming is euhedral (aspect ratios of 10 - 15), has a high brightness of up to 90 ISO and good rheology, all suitable properties for paper coating. To date two companies, Maoming Kaolin Co. and Yangdong International Kaolin Co., have established mining and processing facilities with good-quality coating products. The search for high-quality coating kaolin continues in China as the market is expected to increase from present levels of 200,000 t/y to 500,000 t/y within the next five years.

Also well known in China are the so-called hard kaolins which are greyish clays, often with low iron and titania, associated with coal measures in northern China. On calcination, these grey clays produce a high-quality, high-brightness calcined product suitable for paper and speciality markets.

Engelhard of the US is the first major foreign kaolin company to invest in China acquiring in December the Shuozhou Anpeak Kaolin Co. of Shanxi Province. Anpeak has a processing plant that was constructed in 2001 and is expected to have a capacity of 30,000 t/y of calcined clay by mid-2003.

Other areas

Europe

The Czech Republic is an important kaolin producer based on the sedimentary kaolinitic sands of Horni Briza and Kasnejov. Keramika Horni Briza (formerly ZKZ) is now controlled by the Austrian group, Lasselsberger. These clays are naturally platy and some are exported to Germany where they are blended with local clays for use on lightweight coated paper (magazine paper). Lasselsberger also now controls the Chlumcany deposit and plant. The kaolinised granites of the Karlovy Vary area produce the famous Zettlitz range of products for use in porcelain and tableware. WBB Minerals now controls the Hlubany plant and nearby kaolin pits for ceramic grades.

In France, Denain Anzin Minéraux (DAM), a subsidiary of the Swiss-based group Harwanne, controls all of the kaolin deposits, apart from those of Société Kaolinière Américaine (SOKA). AGS, the Dordogne-based chamotte producer used to be owned 40% by Imetal (now Imerys). As part of the acquisition of ECC it was necessary for Imerys to divest its share in AGS and they have now formed a partnership with SOKA, leaving DAM and AGS/SOKA as the sole kaolin producers in France. Ironically, Imerys, the largest kaolin-producing company in the world has no kaolin operations in France, but has plastic ball clays, ceramics clays and a body plant in Limoges.

In Germany, the main producer is AKW with an estimated 900,000 t/y of capacity. Dorfner is another important producer with production of 150,000 t/y of kaolin. Imerys Tableware recently acquired the body preparation plant in Kirchenlamitz, Germany from German ceramics producer Winterling Porzellan AG. The ten-year-old plant is a modern facility with capacity to produce 10,000 t/y.

Production from Ukraine remains low at 350,000 t/y, compared with 750,000 t/y prior to the breakdown of the former Soviet Union. High-quality kaolin exists in many areas but investment has not been forthcoming. The joint venture to produce coating clays between Proskanaya and Engelhard, Dnipro Kaolin, has now been discontinued following difficulties. The plant in the Glukovsky area, near Kiev is undergoing some modernisation but production is still way down. Imerys (Speciality Minerals) have acquired a majority stake (51%) in Donbasskeramika (Ukraine) which will give access to high quality kaolin for ceramics.

Asia

In 2002, Imerys acquired the kiln furniture business of Siam Refractory Industry Co. Ltd in Thailand. It also increased its stake in the Thai joint venture MRD-ECC (ball clays in Lampang) from 49% to 57.19%, simultaneously acquiring a 70% interest in Mineral Resources Development's (MRD) kaolin operation in Ranong. The Ranong kaolin operation produces 50,000 t/y mainly for use in sanitaryware as the clays shows good casting properties.

The Skardon River project in Queensland, now under the ownership of Minerals Corp., is poised to enter the market with both hydrous and calcined grades of clay for non-paper markets to be followed by paper grades. However, the build-up to sales has been sluggish owing to production problems which are now said to be solved. Minerals Corp. acquired Skardon for A\$6.5 million from the receivers.

In Western Australia, the deposits evaluated in great detail by Rio Tinto in the Wickepin area, 180 km southeast of Perth, have been acquired by W.A. Holdings Pty Ltd. Detailed characterisation studies of the deposit have been carried out in UK and US laboratories, and the potential for high brightness coating clay and calcined grades has been identified. Full-scale pilot-plant trials are expected to be carried out in 2003 leading to a decision on whether

a plant will be constructed. Resources of kaolin in Western Australia are reported to be >300 Mt.

In India, the main kaolin-producing company is English Indian Clays (EIC). This was originally a joint venture with English China Clays but the latter withdrew from the venture in the early 1990s. Over the past 10 years EIC has developed into a major kaolin-producing company with a capacity of 120,000 t/y of coating and filler grades for paper and non-paper uses, and also produces calcined grades. The kaolin is mined from local sedimentary sequences in the Trivandrum area of Kerala State, southern India.

Market

The consumption of kaolin is mainly for paper filler and coating, with paint, rubber, plastics, sealants, ceramics, refractories and fibreglass being of importance as shown in Table 5.

Kaolin competes with ground and precipitated calcium carbonate and talc in the paper, paint and plastics industries. In 1980, approximately 87% of the pigment use in paper was kaolin and this has reduced to 40% by 2002. Ground calcium carbonate (GCC) which was 9% of the market in 1980 has increased its share to 37%, and precipitated calcium carbonate (PCC), virtually unused in 1980, now has a 15% market share. This trend towards calcium carbonate has mainly been as a result of an alkaline paper-making system being introduced, and also because of the requirements of higher brightness pigments for woodfree pulp. Kaolin brightness for coating grades is between 86-90 ISO, whilst GCC and PCC can achieve >95 ISO brightness.

However, kaolin has a platy morphology that is still required for a large number of paper applications, particularly in LWC (light-weight coated) papers. The trend in recent years has been for a combination of different minerals being used in the same coating formulation. GCC can be mixed with kaolin, GCC with PCC and more recently talc with GCC to obtain improved performance. Kaolin is widely used in paint as an extender and the calcined grades give higher opacity than a hydrous type. There are regional trends, with the US still relying dominantly on kaolin for coating, followed by PCC and GCC. In Europe and Asia the trend has been more towards the use of GCC, no doubt due to the proximity of high-quality marble deposits. It is necessary to use a crystalline limestone (marble) for high brightness as chalk and limestone rarely achieve brightness greater than 85-90 ISO.

Ceramics remains an important market for kaolin, with various grades for porcelain (low iron and titania), sanitaryware (good casting properties) and in refractories (controlled alkali levels).

Prices

List prices for various grades of kaolin produced in the US and UK are regularly quoted in *Industrial Minerals*, with *Chemical Marketing Reporter* quoting prices for US grades. The price of kaolin varies, depending on the degree of processing and in some cases the scarcity of a particular grade. The price of one grade can vary tremendously depending on the size of the

order. Large papermakers taking bulk-delivery of 20,000 t in one shipment can expect to receive the same grade much more cheaply than a smaller customer.

Throughout the 1990s there was price stagnation, mainly due to the negotiating strength of the papermakers and the competition from GCC and PCC. As mentioned, the Georgia producers showed little financial return on their vast production capacities and this led them to cut capacities for unprofitable grades and attempting to get realistic price increases to remain viable. Following some increases in 2000, further price increases were announced in December 2001 for 2002. Imerys, in North America, raised its prices for all paper grades of, kaolin and calcium carbonate by 6-8%, and Engelhard Corp. and Thiele followed suit by raising their prices by an average 5-7%. The Thiele price increase on selected kaolin products to the paper industry has been set at 5% to offset higher mining and processing costs, resulting from increases in energy, chemical and transportation costs. In December 2002, Imerys announced price increases on all paper grade kaolin by an average of 2% to 7% effective January 1, 2003. In February 2003, Imerys, Pigments for Paper Americas Division announced that due to the significant increase in natural gas costs a temporary energy surcharge would be implemented. Natural gas prices increased by up to 40% in early 2003, trading at prices as high as US\$10 per million Btu. From March 1, 2003, Imerys implemented surcharges of US\$4, US\$6, and US\$18 per dry short ton for hydrous slurry, hydrous clay and all calcined products, respectively. These surcharges will be reviewed monthly and will be based on the previous three months rolling average of the NYMEX for natural gas. They will remain in effect as long as the average quarterly price for natural gas remains above US\$4.50 per million Btu.

The prices quoted by *Mineral Price Watch* in March 2003 for kaolin, ex-Georgia plant per short ton were US\$80-100 for bulk filler, US\$85-185 for paper coating grade, US\$320-375 for calcined bulk, US\$65-75 for sanitaryware grade (bagged) and US\$125 for tableware grade (bagged). In Asia, the delivered price (cif basis) for kaolin varies from country to country but average prices are US\$210/t for #1 coating clay, US\$190/t for #2 coating clay and US\$450/t for calcined clay. The delivered price for #1 coating clay from Brazil is around the US\$200 - 210/t level. Filler clay from Indonesia is delivered in Asia for approximately US\$80 -100/t.

For Cornwall, UK, free-on-truck prices quoted in July 2002 (per tonne), were £47-58 for filler, £63-90 for paper coating, £35-90 for ceramic grade and £80-130 for porcelain grade. In New Zealand, the ex-works price of Premium, the high-quality clay for use in porcelain was around US\$400/t ex-works, with a delivered price in the Asian region of around US\$500/t.

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Table 1

World Production of Kaolin ('000 t)¹			
	2000	2001	2002^e
Europe			
Austria	50	50	40
Bulgaria	110	110	110
Czech Republic	750	750	800
France	320	320	320
Germany	1,800	1,800	1,800
Poland	100	130	130
Portugal	170	170	170
Spain	300	300	300
Ukraine	250	300	350
UK ² (sales dry wt)	2,376	2,400	2,350
Uzbekistan	200	200	200
<i>Europe</i>			(26%)
Asia/Oceania			
Australia	240	230	230
China	1,900	2,000	2,100
India	500	500	600
Indonesia	400	500	500
Pakistan	70	70	70
South Korea	1,850	1,800	1,800
Malaysia	310	210	250
New Zealand	15	15	15
Thailand	350	250	260
<i>Asia/Oceania</i>			(23%)
South America			
Argentina	100	100	100
Brazil	1,500	1,800	2,100
Colombia	100	100	100
<i>South America</i>			(10%)
North America			
Mexico	490	400	400
US (sales)	8,800	8,110	7,450
<i>North America</i>			(32%)
Africa/Middle East			
Egypt	290	260	260
Iran	500	500	500
Nigeria	110	110	110
South Africa	120	140	140
Turkey	400	400	450
<i>Africa/Middle East</i>			(6%)
Others	854	870	880
			(3%)
Total	25,325	24,895	24,885

^e Estimated.¹ Sources: US Geological Survey and industry comments.² UK production figures, NERC and industry comments.

Table 2
Leading Producers, 2002

Company	Kt/y	%
Imerys, France	5,900	24.0
Engelhard, US	1,800	7.0
Huber, US	1,400	6.0
Thiele US	1,200	5.0
Cadam, Brazil	1,000	4.0
AKW, Germany	900	3.5
Pará Pigmentos SA. Brazil	600	2.5
Keramika Horni Briza, Czech Rep	400	1.5
Alter Abadi, Indonesia	300	1.0
DAM, France	270	1.0
Goonvean, UK	250	1.0
Others	10,865	43.5
Total	24,885	100

Table 3
Brazilian Coating Kaolin 2002 (000't)

Company	Installed Capacity	Sales	Exports
Cadam	1,000	720	650
RCC (Imerys)	600	510	490
PPSA	600	420	310
Total	2,200	1,650	1,450

Source: PPSA/CADAM

Table 4
Markets Served by Imerys UK Kaolin Products

Paper filler	37%
Paper coating	33%
<i>Paper</i>	<i>(70%)</i>
Sanitaryware	12%
Tableware	6%
Tiles	1%
Refractories	3%
<i>Ceramics</i>	<i>(22%)</i>
Paint	4%
Rubber	1.5%
Adhesives & Sealants	1.5%
Plastics	1%
<i>Performance Minerals</i>	<i>8%</i>

Table 5
Consumption of Kaolin

Industry	Share (%)
Paper	45
Paint, rubber, plastics, sealants	10
Ceramics	16
Refractories	15
Fibreglass	6
Others	8
Total	100