REPORT R43/2003

A REVIEW OF

THE DOLOMITE AND LIMESTONE

INDUSTRY IN SOUTH AFRICA

DIRECTORATE: MINERAL ECONOMICS

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Department:
Minerals and Energy
REPUBLIC OF SOUTH AFRICA

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ABBREVIATIONS / NOMENCLATURE

ATH	Aluminium Trihydrate
BOF	Basic-oxygen-furnace
CaO	Quicklime / lime
$CaCO_3$	Calcium Carbonate
CHF	Swiss Francs
CO_2	Carbon Dioxide
FOB	Free on board
FOR	Free on rail
GCC	Ground calcium carbonate
GGBS	Ground-granulated blast furnace slag
H_2O	Water
kt	kiloton (1000 tons)
MgO	Magnesia
MJ	Mega Joule (1 Million Joules)
Mt	Million tons
m. tpa	Million tons per annum
PCC	Precipitated calcium carbonate
Q1, Q2	1st Quarter, 2nd Quarter
YoY	Year-on-year change
ZAR	South African Rand [currency]

Note: All local sales' prices are FOR, all exports FOB.

DOLOMITE AND LIMESTONE

Executive Summary

Limestone is defined as a calcareous material or rock with a limestone content ($CaCO_3$) of at least 70%. Lime, limestone and dolomite products are used in four principal industries in South Africa: Cement manufacturing, metallurgy (steel refining), manufacturing and agriculture (fertilizers, fungicides, animal feed), Other uses include: construction (mortar, cement, whitewash, building stone), manufacturing (glass, food processing, papermaking, leather, water purification, waste water treatment, explosives, flue gas desulphurisation, adhesives, insulation and pH control).

Prices vary considerably for carbonate products, depending on colour, purity, hardness, sizing, uniformity and degree of calcining. Limestone and dolomite are generally considered high-bulk, low value commodities, however, high-end value-added white lime, hydrated lime and some calcined limestone types command high process and are readily available in all major cities in South Africa and the SADEC region.

The South African lime industry differs in three ways from other industrialised countries: firstly, limestone deposits in North America and Europe are widespread and of good quality, whilst in South Africa, isolated high-grade deposits of limestone occur. This has resulted in lime production being limited to a few plants, with a fairly large output. Thus some South African plants are, by global standards, considered large production plants.

Secondly, South Africa's well-developed uranium and gold operations are strongly dependent on specific lime products and thirdly, South Africa's cement industry governs limestone and lime production, whilst in industrialized countries, steel-making and the aggregate industry are the market drivers for lime and limestone respectively.

Captive lime production in South Africa is relatively low and lime production has always had to meet specific customer requirements. South Africa's share of the World lime and cement output is about 0,8% and 0,7% respectively.

The South African limestone industry is dominated by 11 limestone producers (of which five are of global capacity); dolomite – three major producers; cement – four major producers, lime – two major producers and dolime, two major producers.

In view of these factors, together with coal being the only economically available kiln fuel, the rotary kiln has been the most suitable production unit for lime and cement-manufacturing in South Africa. With rising energy costs, the latest technological developments have been planned around rotary kilns fitted with preheaters, as well as the further evolving of 4 and 5 stage precalciners.

Through the investment of global cement companies in South Africa, there has been a notable improvement in quality control and safety implementation. South Africa's cement producers are all geared towards ISO 14001 compliancy, and are reinvesting their capital by further expenditure on water effluent treatment, reducing dust emissions and upgrading of kilns and milling plants to reduce energy consumption.

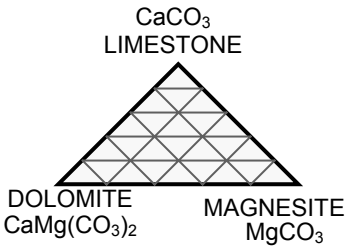
The South African markets for limestone, dolomite and cement are exceptionally competitive, and this has encouraged product expansion and price stabilities in all three industries in the last 5 years. There too has been a distinct move away from the ordinary Portland cements to blended equivalents within the CEM II and CEM III cement ranges.

In view of the infrastructural/ construction boom in the last year, markets that hold great potential are the cement and limestone markets (and associated derivative products). The dolomite industry may grow substantially due to the demand for dolomite aggregate in construction.

All three minerals, limestone, dolomite and magnesite compete/ substitute each other in similar markets and applications. Lime and limestone too, vie for similar markets. Recycling, reuse, regenerating and a greater efficiency regarding lime and limestone consumption may dampen domestic and global markets.

The overall industry risk is low (both current and future), with product market risk being low. Industry risk, related to production factors, policy, strategy and positioning is low too.

Overall growth in the local limestone and dolomite industry will mainly depend on the producer's ability to re-position themselves in an environment of increased competition to serve the customer's needs by producing a high-quality product.



Importance

Share of industrial minerals sector '02	
Revenue	20,1%
Employment	18,5%
Remuneration	21,3%
Exports	0,60%

Markets*

Limestone (14,9 Mt)	
1	Cement
2	Metallurgy
3	Manufacturing
4	Agriculture

Dolomite (2,5 Mt)	
1	Metallurgy
2	Construction
3	Agriculture

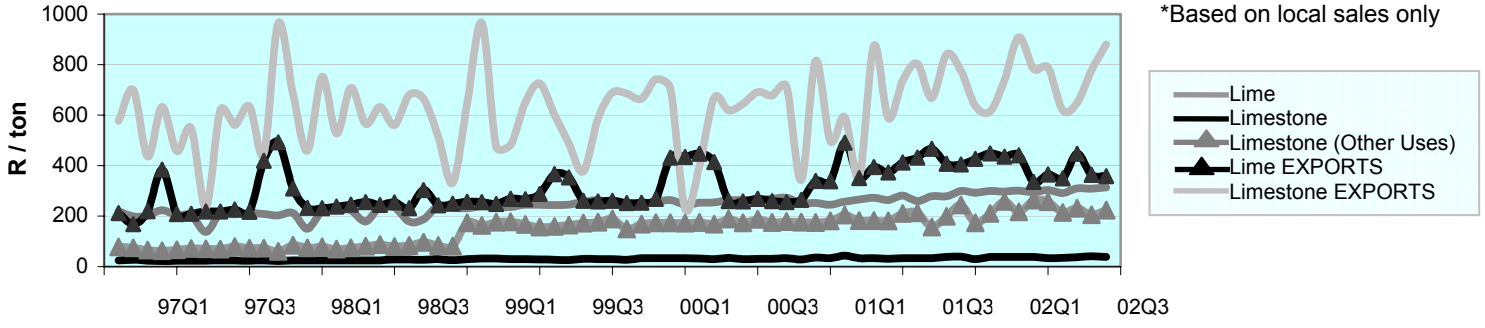
Lime (1,7 Mt)	
1	Pyrometallurgical
2	Chemical
3	Gold industry
4	Water purification
5	Effluent treatment
6	Road construction

Dolime (331 kt)	
1	Steel making
2	Construction
3	Refractories

Magnesite (38 kt)	
1	Refractories
2	Water purification
3	Paper
4	Animal feed

*Based on local sales only

South Africa's lime and limestone prices (nominal)



Brief Industry Description

Limestone and dolomite form in similar geological environments, either by chemical or biological precipitation or by the deposition and compaction of coral animal and plant remnants on ocean and sea floors around the world. Both minerals are often closely associated in the field and are either sedimentary rock or precipitates composed of the mineral calcite (calcium carbonate) and/or the mineral dolomite (calcium-magnesium carbonate) along with small amounts of other minerals. Types of limestone are defined by their style of deposition, average grain size, micro-structures, textures, principal impurities and/or chemical constituents. The classification of limestone as defined by their magnesium carbonate content ($MgCO_3$), is as follows:

- Magnesite consists of > 46 %magnesium carbonate, < 54% calcium carbonate
- Dolomite (which includes dolomitic limestone) consists of 20 - 46% $MgCO_3$, 54 - 80% calcium carbonate
- Magnesian limestone consists of 5 - 20% $MgCO_3$, 80 - 95% calcium carbonate
- Calcitic limestone consists of < 5% $MgCO_3$, > 95% calcium carbonate

The terms lime and lime products refer to quicklime (CaO) and slaked lime ($Ca(OH)_2$). The term lime is frequently used incorrectly to describe limestone products, such as agricultural limestone. Limestone suitable for cement making needs a minimum calcium carbonate content ($CaCO_3$) of 80% and a magnesia content (MgO) of less than 5%.

In the South African limestone and dolomite industry, there are currently 24 producers and 43 quarries. Eleven limestone producers supply 80% of the South African market. Dolomite and limestone are used commercially in unprocessed, ground, air-separated, precipitated and calcined forms. Cementitious products are derived from a blend of limestone, aggregate, shale, sand and silica; these products are used as masonry cements, ready mix cements, mortars and plasters in the construction industry. In South Africa the principal use of limestone is in the manufacture of cement, followed by metallurgical applications (as a fluxing agent in steel making), the manufacture of lime and agricultural uses (Graph 1).

Industry Flowchart

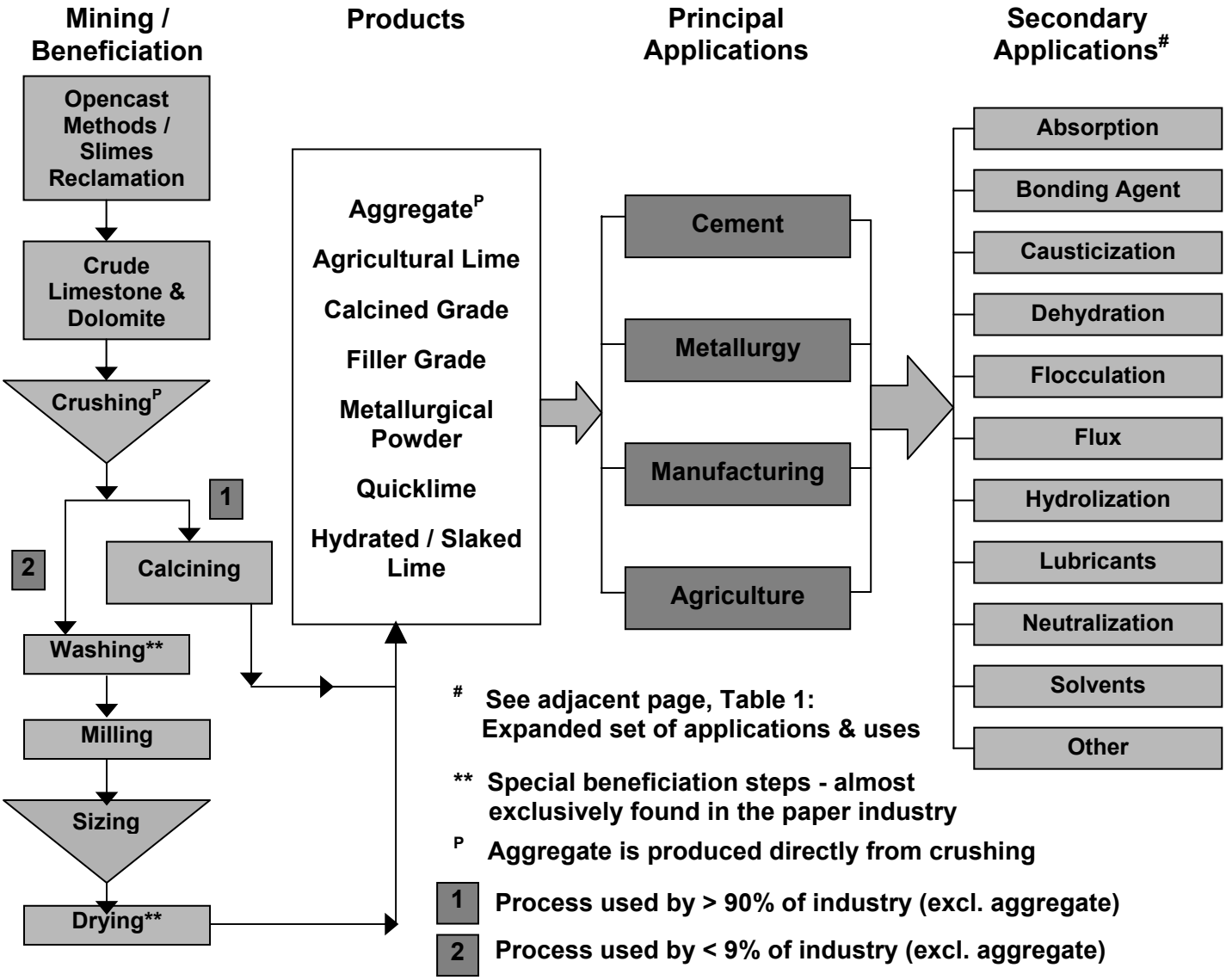


Table 1: Expanded set of secondary applications for limestone, dolomite and lime products (see Industry Flowchart)

ABSORPTION	Apple Storage
	Adsorber Degreaser
	Bleaches
	Casen Paints
	Oil & Chemical Absorbents
	Sludge & Mud Drying Agent
	SO_2 Removal
	Strawboard
	Sulphite Pulp
	Surfactants
BONDING AGENT	Asphalt Paving
	Briquetting of Fuels
	Calcium Silicate Products
	Hydraulic Road Binders
	Insulation Materials
	Mortars
	Plasters
	Road Soil Stabilization
	Sealing Mastic & Materials
	Silica Brick
	Stuccos
CAUSTICIZATION	Caustic Soda
	Dual Alkali Scrubbing
	Semi-dry Scrubbing
	Soda and Sulphate Pulp
	Wet Scrubbing
DEHYDRATION	Air Drying
	Alcohols
	Organic Solvents
	Petroleum
FLOCCULATION	Ore Flotation
	Dust Suppressant
	Paint Pigments & Coatings
	Sewage Treatment
	Sugar Refining
	Water Purification
	Waste Treatment
FLUX	Alumina
	BOF Steel
	Electric Furnace Steel
	Non-Ferrous Metals
	Open Hearth Steel
HYDROLIZATION	Ammonia
	Lubricating Grease
	Organic Chemicals
	Pulp Cloth
LUBRICANTS	Drilling Muds
	Wire Drawing
NEUTRALIZATION	Acid Mine Drainage
	Agricultural Soils
	Calcium Phosphates
	Chrome Specials
	Citric Acid
	Dyestuffs
	Explosives Wastes
	Metal Pickling Wastes
	Radioactive Wastes
	Sewage Treatment
	Uranium Wastes
	Water Treatment
SOLVENTS	Gelatin
	Leather
OTHER	Abrasives
	Agriculture
	Animal Feed & Carriers
	Calcium Carbide
	Calcium Cyanamid
	Calcium Zirconate
	Carpet Backing
	Caulking Compounds
	Cement & Concrete
	Ceramics
	Cosmetics
	Dairy Products
	Digestion Aids
	Extenders & Fillers
	Fertilizers
	Fireworks
	Flame Retardants
	French Chalk
	Glass
	Insecticides
	Mineral Wool
	Paper & Pulp
	Plastics
	Pharmaceuticals
	Printing Inks
	Rubber
	Silica production
	Sodium Dichromate
	Toothpaste

APPLICATIONS and PRODUCT SPECIFICATIONS

Limestone and dolomite are mined by opencast methods and sold either in bulk, powder or slurry form. Several companies reclaim residual limestone 'fines' from slime dams.

Limestone is converted to quicklime through calcining in rotary or vertical kilns

Quicklime

Limestone is converted to quicklime through calcining in rotary or vertical kilns. In the lime process, for every ton of saleable quicklime produced, about 2 tons of 'pure' limestone or up to 6 tons of impure limestone is consumed. Limestone consumption depends on the type of product, limestone purity, degree of calcining, water temperature and the quantity of waste products. Further, for every part lime produced, two parts carbon dioxide are produced (see reaction below). 'Brown lime' and 'white lime' have an available lime content (CaO) of 68% and 72% respectively. Limestone undergoes the following endothermic, chemical reaction in a heated kiln:

$CaCO_3$	+	**HEAT**	⇔	CaO	+	$2CO_2$
Limestone		(> 850°C)		Lime		Carbon dioxide

The bulk density of lime is 1,1 g/cm^3. The degree of burning is described as 'soft burned', 'medium burned' or 'hard burned'. Soft burned lime is the most reactive, and is difficult to produce because of the delicate operating balance that must be achieved: sufficient heat to drive off the CO_2 without overheating and closing the pore structures. Depending on the kiln age and design, between 200 kg (new kilns) and 350 kg (old kilns) of coal is required to produce one ton of lime.

Quicklime is converted to slaked lime by the addition of water

Slaked Lime and Dolime

Through the addition of water under controlled conditions, quicklime can be converted into slaked lime. The exothermic chemical reactions is as follows:

CaO	+	H_2O	⇔	$Ca(OH)_2$	+	**HEAT**
Lime		Water		Hydrated / slaked lime		

For every ton of quicklime produced, between 1,4 and 2,2 tons of limestone is consumed

The hydration of calcium oxide occurs readily at atmospheric pressure. Magnesium oxide, however, requires a longer reaction time and/or high-pressure levels to completely hydrate. Slaked lime includes hydrated lime (dry calcium hydroxide powder), milk-of-lime or lime putty (dispersions of calcium hydroxide particles in water). **Dolomitic limestone** undergoes the following chemical reaction in a heated kiln:

$CaMg(CO_3)_2$	+	**HEAT**	⇔	$CaO{\cdot}MgO$	+	$2CO_2$
Dolomite				Dolime		Carbon dioxide

$CaO{\cdot}MgO$	+	H_2O	⇔	$(Ca(OH)_2{\cdot}MgO)$
Dolime		Water		dolomitic hydrate

Primary use of limestone is for manfacturing Portland cement

Cement

In South Africa, the most important use of limestone is for the manufacturing of Portland cement. In the manufacturing of cement, limestone must adhere to the following conditions: a $CaCO_3$ content of at least 80%, $MgCO_3$ content of below 5%, less than 1% chloride, manganese, titanium and phosphorus, and less than 0,6% combined alkalis.

Cement is produced by sintering about 78% of limestone with a mixture of various compounds or rocks, containing alumina, silica and iron oxide. Limestone and dolomite are proving to be more functional in the aggregate industry, as they tend to enhance the hydration process in concretes and produce a good cement-paste aggregate bond. For every cubic metre of concrete, 1,9 tons of aggregate (including sand) is consumed. See ***CEMENT Industry*** (pg 12).

Second largest user is the steel industry

Metallurgical Industry

The second most important use of limestone and dolomite is as a flux in the production of pig iron and non-ferrous metals. Limestone must adhere to the following prerequisites: it must be of superior grade, with a silica and alumina content totalling less than 2%, as well as low sulphur and phosphorus content. For fluxing purposes, the iron content may be high, but the material must be lumpy and finely crystallized, to avoid decrepitation ('crumbling'). In powder form, milled carbonates can be mixed with ore and pressed as self-fluxing pellets.

Third largest user is the manufacturing industry

As a flux, quicklime removes impurities such as phosphorus, silica and sulphur. In the beneficiation of non-ferrous metals, lime is used to control pH in the flotation process, to neutralize iron sulphides and to extract and recover metals through precipitation or leaching processes. Calcite is the preferred calcium carbonate for the flux coating of electric welding rods. In BOF steelworks about 40-65kg of lime per ton of steel is consumed, whilst in electric arc steel-making works, 30-45kg of lime per ton of steel is used.

Fourth largest user is the agricultural industry

Agriculture

The fourth most important use of limestone and dolomite is in the agricultural industry, where it is used in an unburned, pulverised form, primarily as a fertilizer/soil conditioner to neutralize acid soils. When burned, calcitic limestone forms a calcium oxide product, which is more soluble and reactive. Dolomitic material is more suited for the treatment of acidic soils, whereas calcitic limestone is used on alkaline soils.

Construction

In construction, depending on the application, strength/hardness, particle shape, sizing, purity, colour (reflectance) and a lack of dusts and fines are important parameters. Hydrated lime is used for plastering, due to its exceptional bright white colour. Hydrated lime and quicklime are used in subgrade stabilization to stabilize fine-grained soils. In base stabilization, lime improves the strength and consistency of aggregates. In road paving, hydrated lime is used in hot mix asphalt to act as an anti-stripping agent. In asphalt mixes, lime improves adhesion and binding proper-ties, reduces brittleness at low temperatures, improves resistance to fatigue and acts as an anti-oxidant.

Autoclaved aerated concrete (AAC) and sand-lime bricks are made from a mixture of sand and lime, which are moulded under high pressure of at least 11 atmospheres. Sand-lime bricks require high purity quicklime with a low MgO content, a combined silica and alumina content of less than 5%, and combined CO_2 of less than 7%. Sand-lime bricks provide good sound insulation and have high compressive strength. AAC and cellular concrete are made in a similar manner, but the former requires the addition of an aerating agent, alumina powder, to the mixture. AAC is strong, lightweight and has good thermal insulation. Quicklime can also be used as a drying agent for damp soils.

Paper Industry

Lime is used by the pulp and paper industry in the basic Kraft pulping process. Lime is often used to produce calcium hypochlorite bleach for bleaching paper pulp. In the Kraft process, slaked lime is used to recausticize sodium sulphide and sodium carbonate for recycling, and in the treatment of plant process water. Other lime applications include precipitated calcium carbonate (PCC), a speciality filler used in premium-quality coated and uncoated papers, paints and plastics. PCC is formed by the bubbling of carbon dioxide through milk-of-lime, which forms a precipitate of $CaCO_3$ and water. Ground calcium carbonate (GCC), a finely ground pure calcium carbonate, is used as a filler or whitening agent.

Ca-Supplement

As a mineral supplement in cattle feed, carbonates must be low in silica and alumina, extremely low in fluorine and contain no arsenic.

Chemical Industry

In the chemical industry, lime is used in the manufacturing of alkalies. Quicklime is combined with coke to produce calcium carbide, which is used to make acetylene and calcium cyanide. Lime is also used to make calcium hypochlorite, citric acid, petrochemicals, and other chemicals.

Environmental Uses

Lime is used for the softening and clarification of municipal water, the removal of harmful bacteria, as an odour reductant and is a neutralizing agent in acid-mine and industrial discharges. In water treatment processes, brown lime is used in the ‘prelime’ stage, whilst white lime is used in the ‘postlime’ stage. Suitable limestones must have 85-95% $CaCO_3$ and less than 5% MgO and insolubles.

Glass

In the manufacture of glass, limestone or dolomite is combined with soda ash and silica sand, and heated to temperatures above 1 500°C. Carbonate prerequisites include calcium values of at least 54% and 29% CaO for limestone and dolomite respectively. Furthermore, an iron content of less than 0,2%, alumina content of less than 0,4% and nickel, cobalt, chrome, manganese and titanium in less than traceable amounts is required for glass manufacturing.

Refractory Bricks

Dead-burned dolomite, also known as refractory lime, is an important component in tar-bonded refractory bricks. The dolomitic raw material must be of high grade, 36-42% MgO, 58-62% $CaCO_3$, with less than 2% combined silica, alumina and iron. Hydrated lime is used to produce silica refractory bricks for the lining of industrial furnaces.

Sugar Refining

In the first sage of sugar refining, milk-of-lime is used to raise the pH of the product stream, so as to precipitate colloidal impurities. Residual lime is then precipitated out of the solution through a reaction with carbon dioxide. In the second stage of purification/ sugar refining, carbon dioxide is bubbled through brown sugar. In South Africa, about 6,3 kg of lime is consumed for every ton of white sugar produced.

PRODUCTION

Globally

Lime ranks among the top 5 industrial minerals in the world

In almost all countries, limestone is found in significant, economically viable volumes. Due to the high bulk, low value of limestone and dolomite, little trade is done internationally, except in the high-end, value-added product range. It is estimated that World production of limestone is of the order of 5 billion tons per year. This figure includes limestone used as dimension stone and as aggregate, as well as that used in the cement, chemical and agricultural industries. World lime production is estimated at greater than 200 Mt per annum, whilst World cement production is estimated to be 1.5 billion tons. Lime ranks as the fifth most commonly used chemical, after sulphuric acid, nitrogen, oxygen and ethylene. South Africa's share of the World lime and cement output is about 0,8% and 0,7% respectively.

South Africa

The bulk of sales in South Africa are in the form of inter-company transfers

In 2002, limestone and dolomite production in South Africa remained unchanged compared with the previous year (Graph 2), while local sales, by mass, increased by 5,0% (Graph 3). Domestic consumption of limestone is currently on an upward trend after a five-year slump in demand (lowest trough: 1st Quarter 2001). The average sales value of limestone has little significance, other than as an indication of cost of production, as the bulk of sales are in the form of inter-company transfers to the two principal users, namely cement or lime plants (Graph 4). In 2002, local sales of limestone (by mass) for the manufacture of cement increased by 0,5%, whilst sales of cement (by mass) increased by 5,9%.

In 2002, cement exports increased by 39,0% to 595 kt

Over a two year period, exports of lime and limestone products (by mass) have decreased by a phenomenal 72,1% to a new low of 12 kt – this is attributed to the low ferrochrome production at Zimbabwe Alloys, a major importer of these products (Graph 5, 6). Other export markets, such as the sugar, gold and copper industries, which require lime products, have been similarly negatively affected by the political instability in Zimbabwe. This was partly compensated for by the improvement in regional and export cement sales. Regional sales of cement to Botswana (which accounts for almost half of regional consumption) increased strongly, but those to Lesotho, Namibia and Swaziland declined. In 2002, exports of cement increased by 39% to 595 kt, representing 5,8% of total cement sales.

In 2002, sales of metallurgical grade carbonates decreased by 3,7% compared with 2001; this is attributed to depressed steel production during the year. Agricultural limestone and dolomite sales of 964 kt for 2002 were realised – a significant year-on-year increase of 20,7%.

The market for quicklime is divided into pyrometallurgical and chemical components; sales for each of the sectors were 967 kt and 537 kt, respectively in 2001. Hydrated lime comprises three sectors: the chemical, water purification and 'other' sectors – sales by mass were 47 kt, 36 kt and 29 kt respectively in 2001 (Graphs 7-12). Over the last two years, quicklime prices have stabilised, whilst hydrated lime prices have increased strongly (the exception being products sold to the chemical industry). Local sales for pyrometallurgical quicklime are on the increase (in both mass and value), whilst demand for quicklime in the chemical industry seems to be tapering off.

MARKET COMPARISON

Global Lime

Trend towards consolidation in the global industry

The two largest global lime producers, both Belgium-based companies, are the Carmeuse Group and the Lhoist Group. The iron and steel industry is estimated to consume almost 40% of European lime production. North America produces about 20 million tons per annum (m. tpa), Mexico 6m. tpa and Europe 30-35m, tpa. In Europe, lime is produced by small- to medium-sized companies, which cater for local industries. However, over the past decade, there has been a trend towards consolidation of the industry by a small number of large international companies. Due to the hydrating nature of lime, packaging and transportation costs contribute significantly to the high export prices charged.

Example: USA

In 2001, there were 108 lime and hydrate producers in the USA. However, five companies, operating 38 lime plants and 6 hydrating plants, accounted for about 70% of the total output. Lime production totalled 18,7 million tons in 2001. In 2000, the USA lime market was split into the following five segments (with market share in brackets): metallurgical purposes (38%), environmental uses (26%), chemical and industrial uses (24%), construction (11%) and refractory dolomite (1%).

Global Cement

China is the greatest cement-producing country in the world

China is the greatest cement-producing country in the world, accounting for more than a third of world output, with an estimated production of about 583,2 Mt for 2000. The other four major cement-producing countries are India, the USA, Japan and South Korea. At present, several industrialized countries' cement facilities are foreign owned, e.g. 79% of USA Portland cement output and 85% of

its production capacity were foreign owned (year-end 2000). Worldwide, there's been strong growth in the use of natural and synthetic pozzolans** as partial or complete replacements for Portland cement. During production, pozzolan-manufacture is less energy-intensive and has fewer environ-mental complications. The top three cement producers worldwide are Holcim, Lafarge and Cemex.

Example: Holcim and Cemex
Holcim operates through 80 countries worldwide, and has a production capacity of 121,2 Mt. In 2001, cement-, aggregates- and ready-mix concrete sales increased to 84,3 Mt, 89,5 Mt and 25.5 million m^3 respectively. In 2001, Holcim personnel totalled 47 362 and operating profit grossed CHF 1,945 billion. In 2001, most of Cemex' products were sold in Mexico (38%), the USA (29%) and Spain (12%). Cemex' domestic success relies on its strong brands which command prices of up to 20% above its nearest competitors – a result of a long history and numerous marketing campaigns emphasizing quality.

** Pozzolans – materials that, in the presence of free lime, have hydraulic cementitious properties, these include volcanic ashes, GGBS, fly ash, silica fume and calcined kaolin.

Two markets for cementitious products: civil engineering and building sectors

South Africa

South Africa has many large, isolated, high -grade deposits

Captive lime production in South Africa is low

The South African lime industry differs significantly from the lime industries of the main industrialised countries. Firstly, the magnitude of the gold and uranium operations in this country adds a significant segment to the lime market. Secondly, limestone deposits in North America, Europe and Japan are widespread and of good quality, allowing for numerous lime producing operations to be set up in these countries. Isolated deposits of high-grade limestone in South Africa have resulted in lime production being limited to a few major plants, with fairly large outputs. By global standards, some of these plants are considered large production plants (e.g. PPC Lime Acres has a production capacity of 2 Mt per annum). Captive lime production in South Africa is relatively low; therefore lime producers have always had to meet specific customer requirements.

Major markets for cementitious products in South Africa: civil engineering and building sectors

The market for cementitious products in South Africa is divided into civil engineering and building sectors. In the civils sector, an 18% increase in turnover for 2001 (up on the previous year's 14% increase) offers a glimmer of hope of things to come. The undertaking of highway projects (N4 Bakwena Platinum Project, N3 to Durban), dam projects (Baviaanspoort Sewage Works, Mohale Dam which is part of the Lesotho Highlands Water Scheme, Maguga Dam in Swaziland) and building projects (the Dimension Data Head Office complex, Melrose Arch, Cape Town Convention Centre and Johannesburg International Airport extensions, Blue IQ initiatives) point to renewed short-term investment in infrastructural activity within the country. Limestone and dolomite are not as widely used in South Africa for aggregate or dimension stone as elsewhere in the World.

South African companies are now focusing on contracts in other African countries and overseas

Sector-by-sector analysis shows that the South African construction industry is characterised by both stagnation and recovery – this has led to some South African construction companies focusing on lucrative contracts offered in other African countries and overseas, claiming that up to 60% of their income has been generated from foreign sources. About half of these contracts were secured in African countries, notably Angola, Botswana, Nigeria and Mozambique, with harbour, mining, and low-cost housing developments featuring strongly. Several large cement-manufacturing companies have acquired production facilities in other African countries to cut transport and export overheads (e.g. PPC Cement's acquisition of Portland Holdings in Zimbabwe). Some cement companies have reported increases of up to 10% in exports.

Two major quicklime markets: chemical and pyrometallurgical

Due to the hydrating nature of quicklime, lime producers' focus on high instant capacities, low production capacities (50-80% of installed capacity) and keep storage capacities to a minimum. Cape Lime and P&B Limeworks are the only two producers of 'white lime' in South Africa. Due to a current shortage of white lime in South Africa, burnt limestone is imported from countries as distant as Spain and France. Several municipal water treatment plants have resorted to soda ash, calcium hydrate and partial brown lime substitution to limit their exposure to white lime price hikes and scarcities.

Three major hydrated lime markets: water purification, chemical and 'other' sectors

South Africa still trails behind other countries regarding the use of dolomite and limestone as an aggregate

In the aggregate industry, consumer patterns are changing regarding dolomite as an aggregate in the construction industry. E.g. Kumba Resources' Glen Douglas dolomite mine entered the aggregate industry in 1991 and currently accounts for 50-60% of the total aggregate demand in the Vaal area. However, South Africa still trails behind foreign countries regarding the use of dolomite and limestone as an aggregate. Currently there is a change in product focus amongst most carbonate producers: products are tailored to suit the needs of consumers – this often entails steering away from certain markets, e.g. reducing metallurgical grade limestone stocks and moving towards products that are geared for the construction industry. Limestone and dolomite producers favour fixed/long-term contracts and would therefore choose consumers that are similarly aligned. Should demand fall in one particular market, producers have countered this by stepping up production in their other product ranges.

In 2001, the number of people employed in limestone and dolomite quarries decreased by 4,4% compared with 2000, and total remuneration increased by 4,9%. The replacement of labour intensive

processes through technological advancements and company downsizing has been attributed to necessary staff reductions (Graph 13,14).

RESERVES AND RESOURCES

Figure1: Main occurrences of limestone and dolomite in South Africa

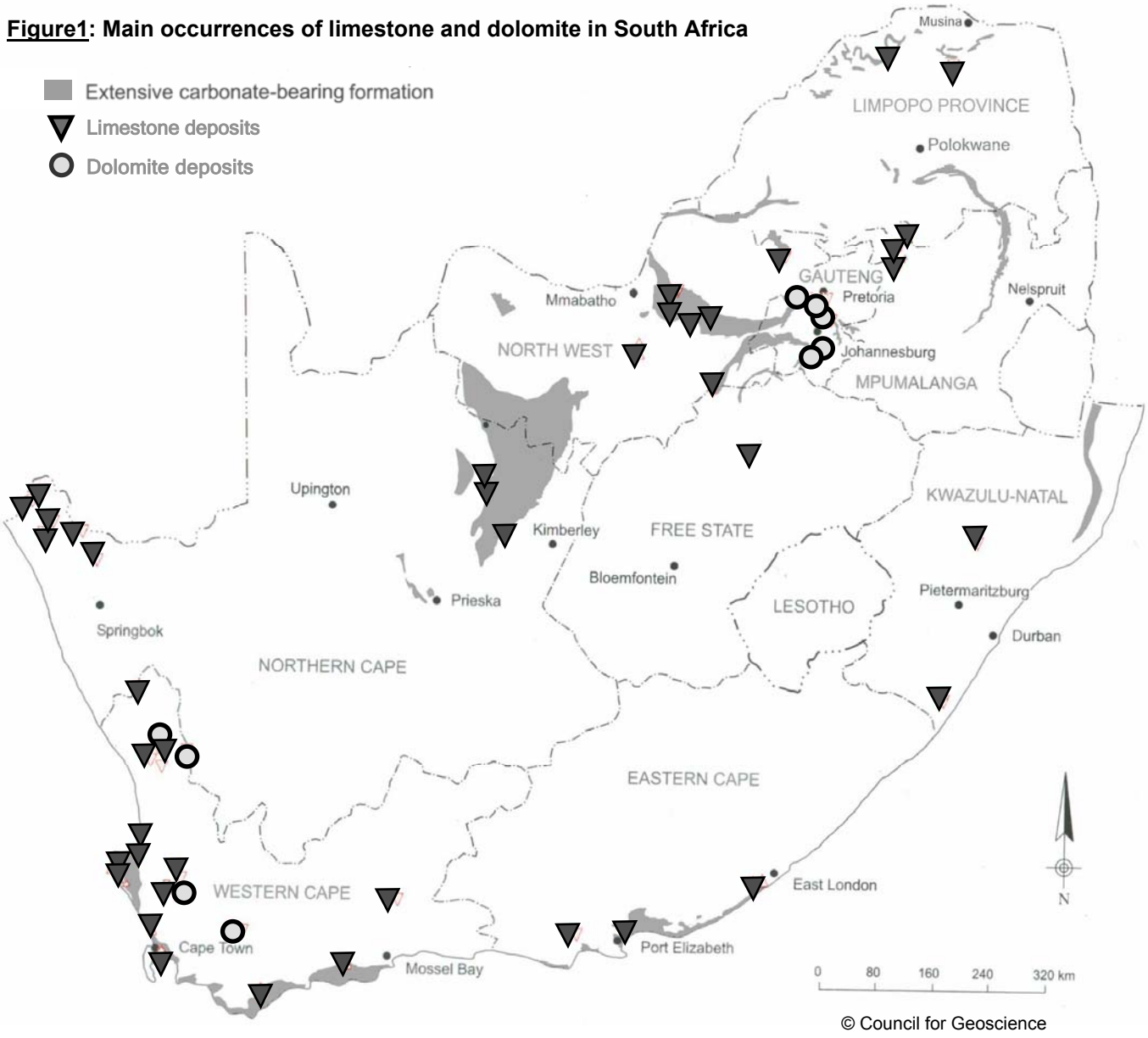


Table 2: List of extensive resources of limestone in South Africa, by province

Province	District / City / Town
Eastern Cape	Port Elizabeth-East London
Free State	Kroonstad, Welkom, Warden
Gauteng	Lyttleton-Pretoria
Kwazulu-Natal	Marble Delta
Limpopo	Potgietersrus, Mopane, Syferfontein
Mpumalanga	Marble Hall, Groblersdal
North West	Lichtenburg-Lothlane, Slurry, Dwaalboom, Zebedelia-Pilansberg, Rietfontein
Northern Cape	Ulco, Richtersveld
Western Cape	Vanrhynsdorp, Piketburg-Swellendam, Hermanus-Mosselbay

Sedimentary carbonates are South Africa's major resource of limestone and dolomite

Despite its highly variable ore grade, sedimentary carbonates, constitute South Africa's major resource of limestone and dolomite (Figure 1). Deposits of economic significance are hosted in five sedimentary units: (1) the Campbell Rand Subgroup and the Malmani Subgroup, the former in the Northern Cape Province, and the latter in the Gauteng, Limpopo, Mpumalanga and North West provinces, (2) the Mapumulo Group, outcropping at Marble Delta in southern KwaZulu-Natal, (3) the Nama Group in the Vanrhynsdorp area of the Western Cape, (4) the Malmesbury Group in the Western and Eastern Cape, (5) and the Tertiary and Quaternary coastal limestones along the Cape coast (Table 2: Limestone resources). Calcrete and dolocrete deposits are located in the arid regions of the country and provide important resources of low-grade material for both the cement manufacturing and agriculture industries. Travertine deposits are generally small, the exception being the deposit at Ulco in the Northern Cape Province.

South Africa's largest limestone resources occur in a 150 km belt along the Northern Cape boundary

The largest limestone resources in South Africa occur in a relatively narrow 150-km long belt along the Northern Cape boundary. Along this belt, most quarries are proximally located to the Kimberley-Postmasburg railway line. Large resources of high-grade limestone and dolomite occur in the Richtersveld (Northern Cape Province), but have not been exploited because of their remote location.

Economically viable dolomite deposits are located in Gauteng and the Western Cape

Economically viable dolomite deposits are concentrated in the following regions: Piketberg-Vredendal-Swellendam district (Western Cape), Pretoria-Lyttleton-Meyerton area (Gauteng).

TECHNOLOGICAL and PRODUCT DEVELOPMENTS

Most lime producers in South Africa use rotary kilns

Since coal is the only economically available kiln fuel in South Africa, lime producers have been constrained to using rotary kilns. With rising energy costs, the latest developments have been planned around rotary kilns fitted with preheaters (this includes new technologies in 4 and 5 stage precalciners). New kiln technologies incorporate the use of grate coolers, tertiary air ducts and in-line precalciners, as well as software programs which independently control thermodynamic conditions that occur in a kiln, based on various matrices and parameters (E.g. the 'multivariable predictive control systems' and the *Cement Perfecter* in 2000). The PPC Cement Dwaalboom factory (Limpopo Province), as at July 2002, was rated the most technologically advanced cement factory in the world.

A new technique for calcining limestone is fluidised bed calcination, whereby limestone is suspended on upward-blowing jets of air during the combustion process - the result is a turbulent mixing of gas and solids. Current research includes the use of absorbents to reduce SO_2 emissions in rotary lime kilns in several ways: a) by the injecting of finely divided or hydrated lime into the combustion air, and b) the injecting of hydrated lime into the exhaust gases of rotary kilns. The use of finely pulverised limestone fed into a flash calciner with adjoining short rotary kiln, too, is currently being researched.

In South Africa the following extraction and beneficiation methods are being researched: (1) electrostatic and/or electromagnetic techniques to improve physical properties of low-grade carbonates and/or oxides; (2) the production of precipitated calcium carbonate (PCC) from impure CaO using the Calcitech method; and (3) the production of PCC and magnesia from dolomite using the Magnepro method.

Most of South Africa's cement producers are focusing on ISO 14001 compliancy

Most of South Africa's cement producers are focusing on ISO 14001 compliancy, which entails: a) further expenditure on water effluent treatment, b) upgrading of kilns and milling plants to reduce energy consumption and c) the reduction of dust emissions and toxic air particulates, which includes kiln dust, free silica particles, CO_2, SO_2 and NO_X emissions.

New electrostatic and electromagnetic separation techniques are being developed in South Africa

Recent developments include the launching of textile concretes (woven fabrics embedded in a cementitious matrix) which can replace fibreglass applications; the use of concrete inlays on certain sections of asphalt roads; fibre-reinforced shotcrete (a cement/ aggregate mix with added metal fibres); and the dry mortar system initiated by some of the cement companies. Future developments in the construction industry include plastic reinforcement for concrete (using polypropylene fibres) as well as corrosion-resistant steel in concrete structures.

SUBSTITUTES

Much inter-substitution exists between lime, limestone, magnesite and dolomite

All three minerals, limestone, dolomite and magnesite compete/ substitute each other in similar markets and applications. Lime and limestone too, vie for similar markets. Magnesium-based products, magnesite, seawater or brine magnesia and brucite, compete in the following industries – steel, refractory bricks, agricultural and environmental applications. As a filler, ATH, barite, feldspar, kaolin, mica, nepheline syenite, perlite, pyrophyllite, talc, flour silica and synthetic silica are feasible replacements for limestone and dolomite. In the aggregate industry, basalt, chert, gneiss, granite, slag, sandstone, sand and gravel are likely substitutes. Globally, new technologies that promote the recycling of glass, paper, PVC, asphalt and plastics are affecting demand for limestone and lime products.

Future threats include recycling and regenerating of lime, plastics, glass, PVC and paper

Potential future threats for lime and limestone producers include recycling/regenerating of lime by paper mills, as well as municipal water treatment plants, which can rework lime from softening sludge.

Quicklime produced by the recycling of waste hydrated lime (a waste product of the carbide industry) may also prove threatening to the industry. In Europe, burnt gypsum and gypsum substitutes have caused a decline in demand for lime in the construction market. Other substitutes of Portland cement and concrete include clay brick, glass, aluminium, steel, fibreglass, wood, stone and asphalt.

Substitution of cement structures for steel in the construction industry is fast becoming a new trend in South Africa. Although only about 5% of buildings in South Africa have been built using steel structures, proactive marketing by steel producers and merchants are improving steel sales at the expense of cement's market share.

SPHERE OF INFLUENCE

The average cost of agricultural limestone and -dolomite in South Africa is dependant on three important constraints:

1) Frequency of deposits
2) Ore grade (purity, sizing, pricing)
3) Transport (logistics, road conditions, terrain)

It is important to note that, over long distances, cost efficiencies improve for beneficiated, lime products (Table 3). In 2002, limestone, for agricultural purposes, was sold at an average price of between R36-47 per ton throughout South Africa. Impure carbonates sold for less than R36/ton, with a sphere of influence of less than 200 km. Brown lime, white lime and high-grade carbonaceous products are readily available in all major cities throughout South Africa and the SADEC region, including Windhoek (Namibia) and Gabarone (Botswana), up to a range of about 1900 kilometres.

Table 3: Sphere of influence regarding agricultural limestone and dolomite.

Province	Sphere of influence (in km)	Average range (in km)	Average cents per ton per km (Cents/ t/ km)
Gauteng	250 – 350	100 – 200	50
Western Cape	140 – 160	80 – 120	55-88
Mpumalanga	220 – 250	100 – 150	28-35
Limpopo	350 – 600	120 – 200	40

Quality-grade dolomite is a scarce commodity in South Africa, as most dolomites are too calcitic. High- quality dolomite-producing quarries and plants are relatively far from their end-user markets in South Africa, however, consumers are prepared to have these products shipped over vast distances (up to 1700 kilometres). Where agricultural dolomite is not available, limestone is often used as a substitute soil-conditioner.

OUTLOOK

Global Lime/ Limestone

Environmental applications are currently the major global growth market

Environmental applications are currently the major growth market – this market will continue growing as more emission targets are proposed. However, the following factors will have an effect on lime and limestone output:

a) Construction industry, which depends on short term projects, interest rates and recessions;
b) Steel industry, which depends on steel total output, fluxing materials, refractory bricks, transition between BOF to mini-mills;
c) Environmental applications and 'clean air' legislation – the treatment of sewage sludge, animal waste neutralization and flue gas desulphurisation.

The iron and steel industry is still the global market driver, and will remain so for the foreseeable future. Worldwide, there is a trend to substitute lime-based fluxes in the steel industry with magnesium oxide products. The further recycling of PVC may have a negative effect on limestone fillers in the plastics industry.

The new lime and 'clean air' legislation (especially in Europe) has a positive and negative effect on the industry – positive aspects include the growth of lime-based flue gas desulphurisation systems, negative effects include lime producers having to meet new CO_2, SO_2 and NO_X emission targets as well as lower cement kiln dust levels. There has been a slow growth, internationally, regarding PCC as a substitute for kaolin in the alkaline paper market – minimal growth is expected as kaolin substitution is fast approaching saturation levels. GCC, a cheaper alternative to PCC, has shown steady growth in the paper and building industry, as well as in other applications. Further consolidation is expected in the limestone/ lime industry – large international companies, which already dominate the industry, will continue to grow and expand into new markets and regions.

Global Cement

Worldwide demand for cement is projected to rise by 4% annually through to 2006.

Worldwide demand for cement is projected to rise by 4% annually through to 2006, with a ceiling of about 2 billion tons. The Asia/Pacific, Africa/Middle East, Latin America and Eastern Europe regions – which accounted for three-quarters of all cement demand in 2001 – should grow the fastest. Sales gains in these areas will be fuelled by an acceleration of infrastructural and building activities. Turkey, India, Brazil and Thailand are expected to record some of the strongest increases in percentage terms. China will continue with its dominance in total number of tons of cement sold, as construction projects – such as preparations for the 2008 Olympic Games commence.

In the USA, Japan and Western Europe, infrastructure is well developed, such that growth will be centred on maintenance and repair construction through to 2006. However, rising construction expenditures in nations such as Greece, Ireland and Portugal will contribute to overall market increases. Other leading cement producers include India, Japan, the USA and South Korea. The greatest growth in cement output will be in 'industrializing countries', supported by both healthy domestic market conditions and stepped-up investment by multinational manufacturers.

Demand for pozzolanic and blended cements is expected to increase substantially in the next 4 years.

Demand for non-blended pozzolanic cements, masonry cement and other cement types will record the strongest gains through 2006. Sales of these products will be stimulated by the cost, environmental and performance benefits they offer. Demand for blended cements will also climb at an above-average pace through 2006, driven by their superior performance in selected applications and success in marketing these products as a more environmentally friendly alternative to straight Portland cement. It is important to note that the market for straight Portland cement currently accounts for about 80% of all cement demand worldwide; however, this may change soon, due to blending and pozzolanic substitution.

The consumer market for cement is expected to be the fastest growing end-use segment. Suppliers will benefit from rising personal income levels in industrializing countries, where consumer sales can account for half or more of total cement demand, and by new product introductions in mature markets. Demand for cement used in the manufacture of concrete products will also climb at above-average rates, stimulated by a) the growing popularity of pre-cast concrete products among construction contractors and b) the expected acceleration in non-building and non-residential construction activities, which are the largest markets for pre-cast concrete products.

South Africa

Limestone and dolomite production is strongly influenced by local demand

In South Africa, limestone and dolomite production is influenced more by local demand than by the availability of resources. Interest rate and cement price increases in the near future could reduce consumer confidence and affect cement demand negatively. Cement sales should, however, increase with renewed fiscal spending on infrastructure development by Government. Government has proposed infrastructural spending of R57 billion, or 5,2% of GDP, in 2002/3, an increase of 16% over that of the previous financial year, whilst a spending target of R76 million has been proposed for 2004/ 5. In the private sector, positive developments include large new investment programmes by the platinum industry and Sasol, as well as highly localised up-market developments of residential dwellings, hotels, casinos, convention centres, shopping centres, and office parks.

GFCF has improved significantly in the last three years, due to larger projects and increased Government spending

A positive indicator in the civil engineering sector was a sharp increase in turnover, in real terms, in the last two years; from a 15% decrease in 1999 to 14% growth in 2000 and an 18% increase in 2001. Furthermore, the number of projects postponed or potentially cancelled has declined from 40% in 1999 to 12,7% in 2001. In addition, real gross fixed capital formation (GFCF), comprising residential and non-residential building and construction works has improved significantly from a year-on-year decline of 10,4% in 1999 to an increase of 4,2% in 2001. In 2002, GFCF remained at similar levels to that of 2001, at approximately R18 billion.

GFCF in South Africa represents 16,6% of GDP, which is considerably lower than the internationally accepted average of 25%. Further, fixed investment in S.A. has not been more than 18% of GDP since the beginning of the nineties. The residential building sector, especially upper income housing developments, has shown definite signs of growth, while non-residential investments are reaching

saturation levels after a mini-boom in high-growth localities such as Midrand, Sandton, and Roodepoort.

Growth of about 2,5% has been forecast for the industry as a whole for 2003.

Over the last two years, real investment in the overall building sector has fallen to levels 20% below that achieved in the mid-1970s. Further consolidation of operations is expected in the construction industry, with fewer contracts awarded, although the value of some larger contracts will increase significantly. Maintenance and improvement of South Africa's infrastructure, especially low cost housing, is the key to sustained growth in the local construction industry (and the cement industry). Given the positive index ratings of 2002, a strong growth of about 2,5% has been forecast for the industry as a whole for 2003 – see Table 5: Macro-economic indicators, Table 6: GFCF in Real terms and Table 7: Real percentage change in main indicators.

Agricultural consumption of dolomite and limestone is generally unpredictable, as evidenced by erratic sales over the last 3 years. It is expected that sales in 2003 will increase marginally, provided that drought or floods do not occur. With the steel sector showing little sign of improvement, no significant increase in sales of metallurgical grade carbonates is likely till mid-2003.

Upliftment programmes that could have an impact on limestone demand include the concrete blockyard manufacturing initiative taken on by the Kwazulu-Natal public enterprises department.

Regenerating, recycling and a more efficient use of limestone and dolomite products will dampen national and global markets.