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LIME INDUSTRY IN SOUTH AFRICA, 2010

DIRECTORATE: MINERAL ECONOMICS

mineral resources

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1. INTRODUCTION

Lime with the chemical formula CaO, is sourced from calcium carbonate ($CaCO_3$), which characteristically occurs in nature as limestone ($CaCO_3$) or dolomite ($MgCO_3$). More specifically calcined or burned form of limestone is known as quicklime or calcium oxide (CaO) that form calcium hydroxide (Ca (OH_2)) or slaked lime with water. Less commonly, lime is produced from a variety of calcareous materials such as aragonite, chalk, coral, marble and shell. It is also regenerated as a by-product by paper mills, carbide plants and water treatment plants.

2. OCCURRENCES

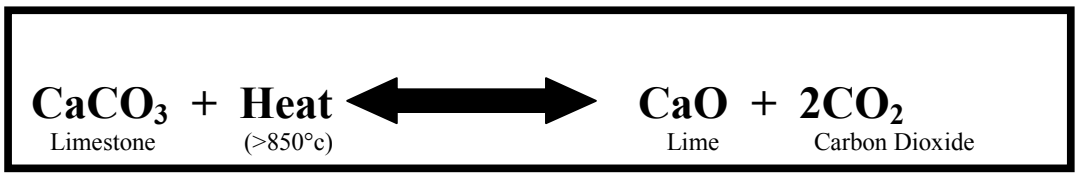
Carbonate rocks account for about 15 percent of the earth's sedimentary rocks. Limestone is composed of material derived by both chemical and biological activities. Limestone of economic importance is derived from seawater and originally deposited in relatively shallow marine environments. The environment of deposition is important because it determines the size, shape and purity of the deposit. High energy zones produce relatively pure limestone, because clay impurities are removed by high currents.

Extensive deposits of limestone are located in Brazil, China, Germany, Italy, Mexico, United Kingdom and the United States. In South Africa, the largest deposits are found in the Northern Cape Province. 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.

3. TYPES OF LIME

Quicklime

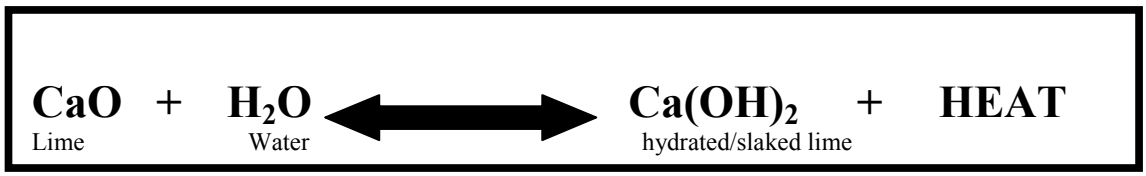
Limestone is converted to quicklime through calcining in rotary kilns. In the lime process, for every ton of saleable quicklime produced, about 2 tons of pure limestone is consumed. Limestone consumption depends on the type of product, limestone purity, and degree of calcining, water temperature and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



The bulk density of lime is 1.1g/cm^3 and 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 balance that must be achieved. The quality of lime is determined by its physical properties, reactivity of water, and the chemical composition.

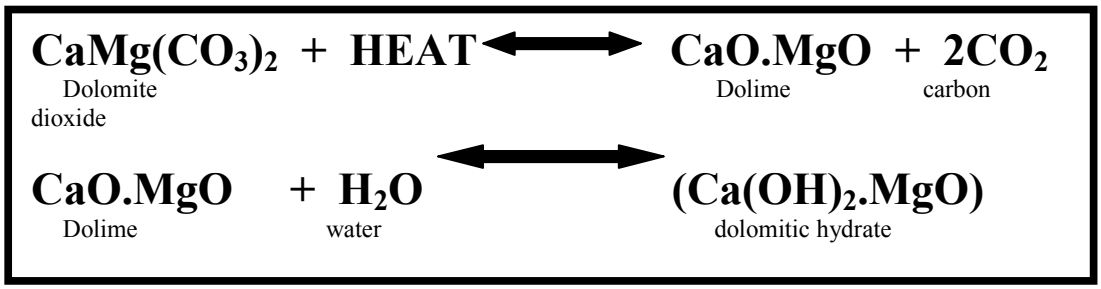
Slaked lime

Through the addition of water under controlled conditions, quicklime can be converted into slacked lime (see reaction below).



The hydration of calcium oxide occurs readily at atmospheric pressure. Magnesium oxide however requires a longer reaction time and 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). Dolomite undergoes the following chemical reaction in a heated kiln.

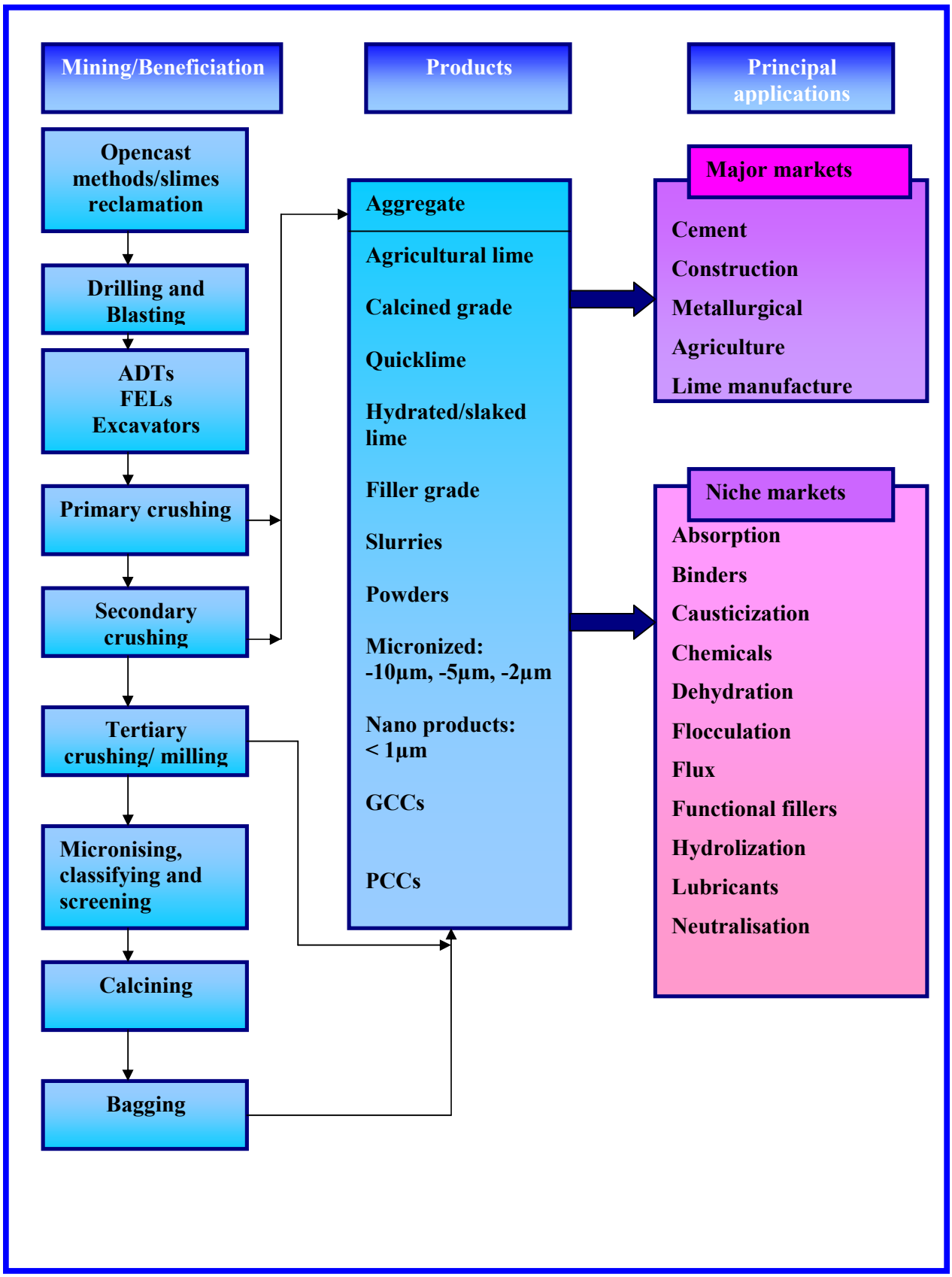


4. EXPLOITATION

Carbonates deposits are usually very shallow and extensive in nature, making opencast mining the ideal method. Three tons of overburden must be mined to obtain one ton of high purity limestone. This is due to chemical and dust losses. Limestone and dolomite are processed on site or within 50km of the mine. Processing depends on the nature of the deposit and the desired end product. Processing technologies are constantly evolving, not only to yield a cleaner product, but also to modify particular functional properties.

Limestone which includes boulders of a cubic meter in size is transported to the crushers (Fig.1), where it is reduced to less than 90 mm in size and a further 50 mm is blended on a stockpile system. Calcining or burning converts the limestone into lime. The calcining process in the rotary kiln is continuous and runs 24 hours per day throughout the year. After it is discharged from the kiln, lime passes through shaft coolers before being transferred to storage silos. In the hydrator, lime is reacted with water under closely controlled conditions to produce calcium hydroxide or hydrated lime in dry powder form.

FIGURE 1: INDUSTRY FLOWCHART



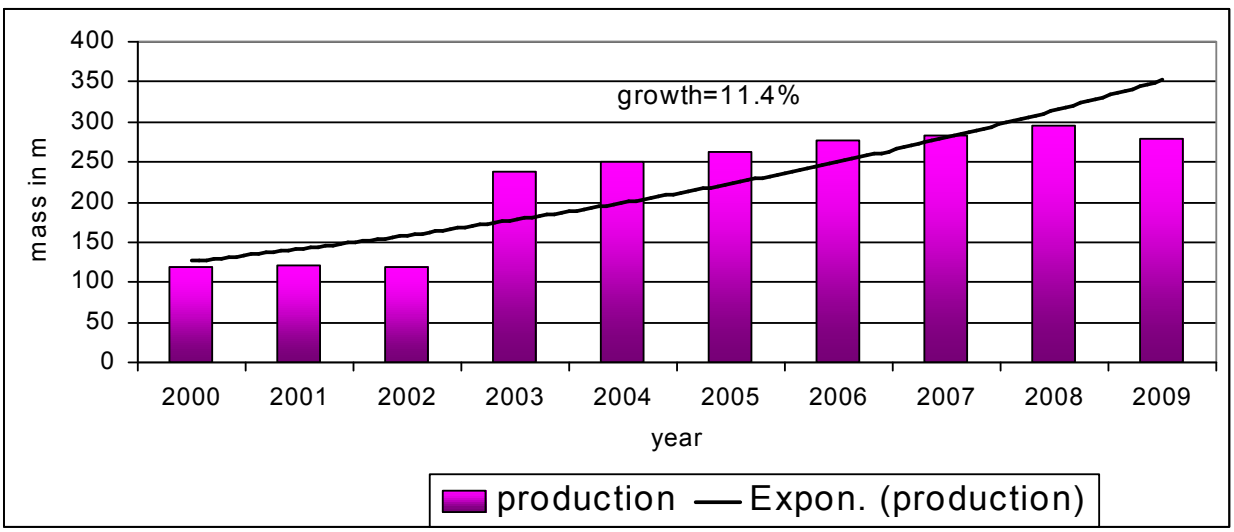
Source: DMR, Directorate Mineral Economics

5. WORLD SUPPLY

The world production of lime has been growing at an annualised compound growth rate of 11.4 percent from 2000 to 2009 (Fig.2). Lime production had a strong increase during 2003 to 2008, driven by major production increases in major consuming markets. In 2009, lime production decreased dramatically due to lack of demand from lime consuming markets, which have also reported significant decreases in their production. Lime is the fifth most commonly used chemical, after sulphuric acid, nitrogen, oxygen and ethylene.

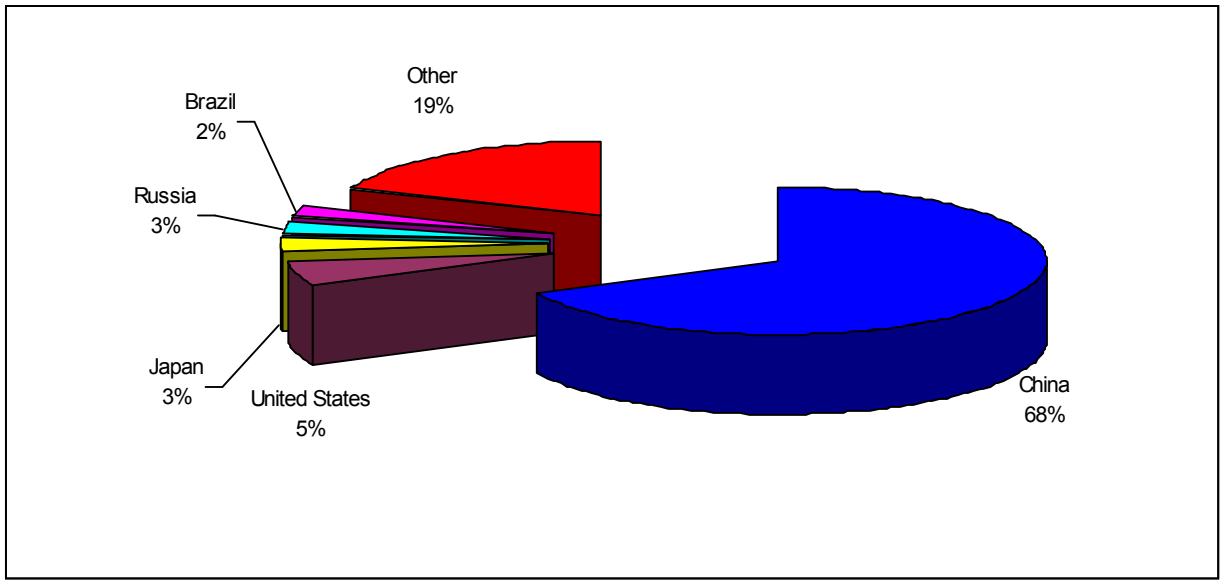
There were major drops in production in most major producing countries, except for China and Japan. In 2009, China was the world's largest producer of lime, accounting for 68 percent, followed by the United States (5%), Japan and Russia at 3 percent each (Fig.3). South Africa's contribution to the world lime production decreased by 14.8 percent to 0.46 percent in 2009 compared to 0.54 percent the previous year.

FIGURE 2: WORLD LIME PRODUCTION, 2000 - 2009



Source: USGS, 2009

FIGURE 3: WORLD PRODUCTION OF LIME, 2008

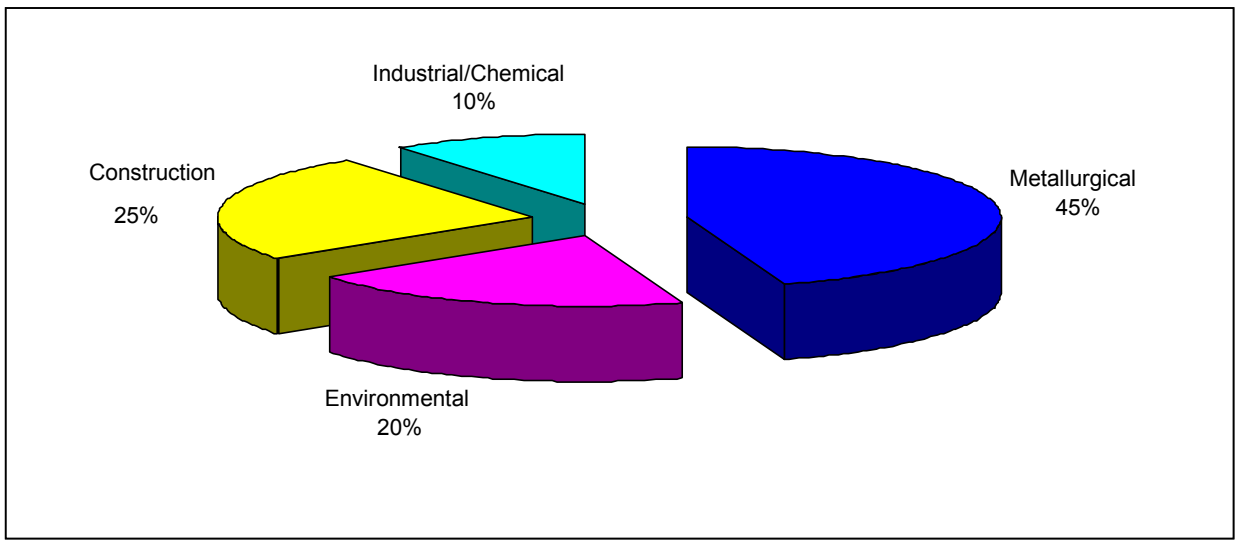


Source: USGS, 2009

6. WORLD DEMAND

World demand of lime in major markets such as steel making decreased, owing to the global financial crisis in the last quarter of 2008. Some of the severely affected areas, shutdown their lime producing plants. Metallurgical application (45%) is the largest consumers of lime, followed by construction and environmental applications accounting for 25 and 20 percent respectively (Fig.4).

FIGURE 4: USES OF LIME



Source: EuLA, 2009

7. WORLD MARKETS

7.1. Metallurgical

Quicklime is used as a flux in the production of iron and steel, to remove impurities contained in the ore and other raw material. It is also used for hot metal desulphurisation. It is an important component in the production of other metals such as copper, aluminium and magnesium.

7.2. Environmental

Uses of lime include, capturing of SO_2 and other compounds from flue gases, a method called flue gas desulphurisation (FGD), which produces gypsum as a by-product in most cases. Lime can also be used to soften or re-mineralise drinking water, sanitise and stabilise sludge and control the pH of soil and remediate contaminated soils polluted with hydrocarbons and heavy metals.

7.3. Chemical and Industrial

Lime is used in various forms in the chemical sector. Quicklime can be combined with coke to produce calcium carbide; lime is a component in the manufacture of calcium hypochlorite, citric acid and petrochemicals. In paper production, lime is used to manufacture calcium hypochlorite, a type of bleach, but may also be used to treat sodium sulphide and sodium carbonate. This treatment rejuvenates the sodium carbonate into caustic soda for reuse.

7.4. Construction

Hydrated and quicklime can be used to stabilize fine grained soils in place of poor quality clay and silty materials. It can also be used to increase the strength and consistency of aggregate products used to stabilise the base. Lime is also used in mortars and plasters. Standard cement mortars containing lime exhibit superior bond strength and lower water permeability.

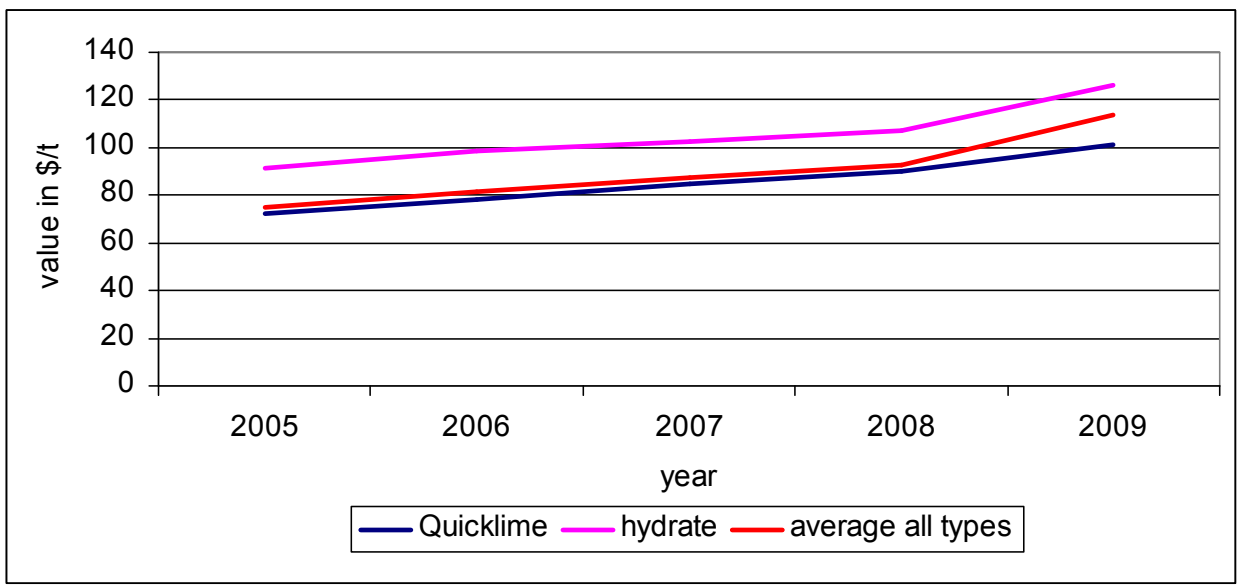
8. WORLD TRADE

In most countries, limestone and dolomite deposits are found in significant and economically viable volumes. Lime is heavy with relatively low selling prices, so transport costs control the distance at which it can be sent to on a regular basis under viable conditions. Therefore trade of lime over long distances is rare, except to areas that have no limestone resources or high-end value added products. Small percentages of the total production are exported, but mainly to neighbouring countries where potential markets are identified.

9. WORLD PRICES

Lime prices have been increasing at a rate of 7.3 percent per annum from 2005 to 2009 (Fig.6). Higher production costs are cause for the continued shift upward of lime prices. In 2008, hydrate and quicklime increased by 4.7 and 7.3 percent respectively, bringing the average price of lime to 91.7 $/t, an increase of 6.8 percent compared to 85.9 $/t the previous year. The lime industry is energy intensive, and the rise in oil and electricity prices had an impact on the cost of production. Oil in the form of diesel fuel is used by the lime industry for explosives, lubricants, mining and shipping.

FIGURE 6: WORLD LIME PRICES, 2005 – 2008



Source: USGS

*estimated (all types, 2009)

1. SOUTH AFRICA

10.1. OCCURRENCES

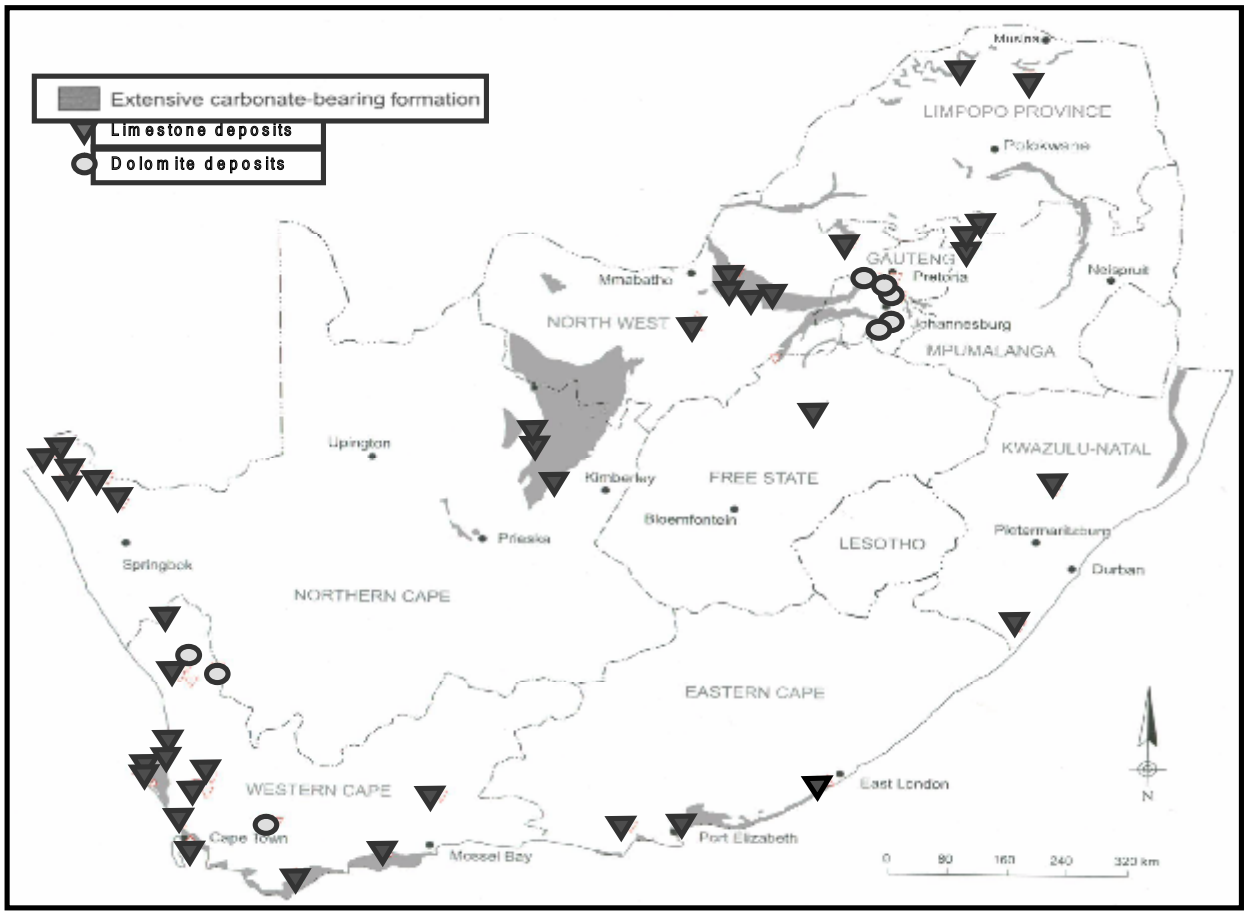
Isolated deposits of high-grade limestone in South Africa have resulted in lime production being limited to a few major plants, with fairly large outputs. Captive lime production in South Africa is relatively low; therefore lime producers have always had to meet specific customer requirements.

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, 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 1: 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.

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 concentrated in the following regions: Piketberg-Vredendal-Swellendam district (Western Cape), Pretoria-Lyttleton-Meyerton area (Gauteng) (Martini and Wilson, 1999).

FIGURE 1: LIMESTONE AND DOLOMITE DEPOSITS IN SOUTH AFRICA.



Source: Council f or Geoscience

TABLE 1: LIST OF EXTENSIVE RESOURCES OF LIMESTONE IN SOUTH AFRICA, BY PROVINCE

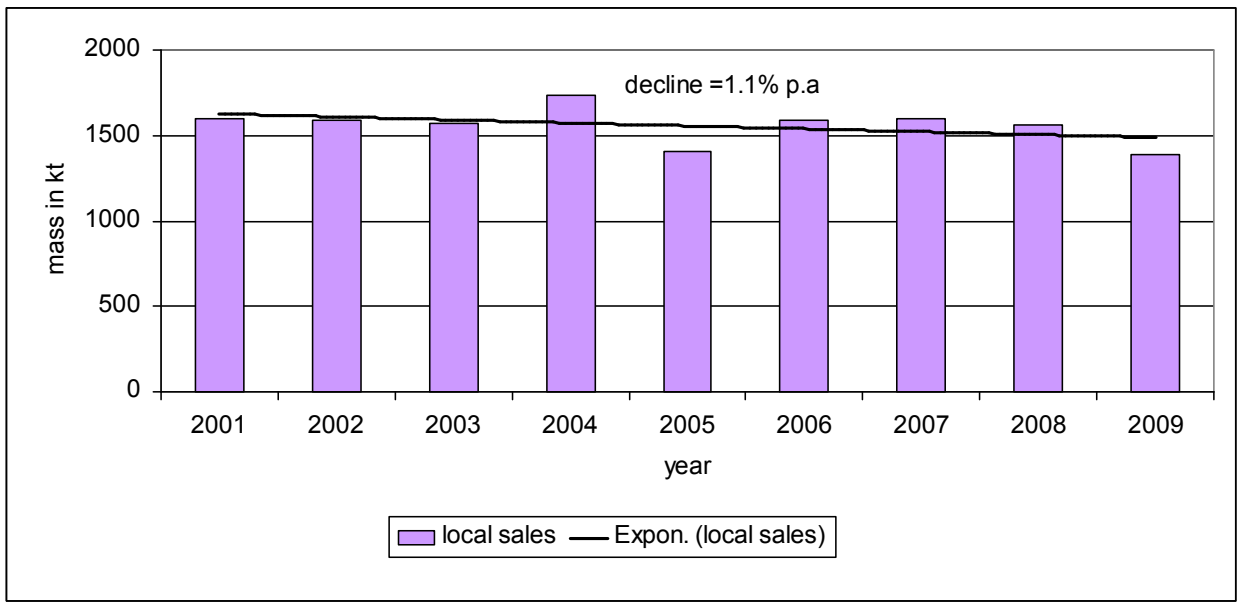
Province	**District / City / Town**
Eastern Cape	Port Elizabeth-East London
Free State	Kroonstad, Welkom, Warden
Gauteng	Lyttleton-Pretoria
Kwazulu-Natal	Marble Delta
Limpopo	Potgietersrus, Mopane, Syferfontein
Mpumalanga	Marble Hall, Groblersdal
North West	Lichtenburg-Lothlane, Slurry, Dwaalboom, Zebedelia-Pilansberg,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

Source: Council for Geoscience

1.2. SUPPLY AND DEMAND

South Africa's local volumes of lime have been decreasing at an annual average of one percent since 2001. Lime substitution, better efficiencies and the shrinking markets contribute to the decline in lime sales. During 2006 the local steel industry, which is the largest consumer of lime boomed. Steel consumption hit a record of 5.7 Mt beating previous records of 5.3 Mt in 1981. The lime industry is directly linked to developments and investments in the steel and metallurgical industries.

FIGURE 3: SOUTH AFRICAN LOCAL SALES VOLUMES OF LIME, 2001 – 2008



Source: DMR, Directorate Mineral Economics

1.3. MARKETS

The market for quicklime is divided into pyrometallurgical and chemical components. Hydrated lime comprises three sectors: the chemical, water purification and 'other' sectors (Table2). Quicklime and hydrated lime contributed an average of 92 and 8 percent respectively to total local sales of lime over the last five years. Local sales for pyrometallurgical quicklime are on the increase, whilst demand for quicklime in the chemical industry seems to be tapering off.

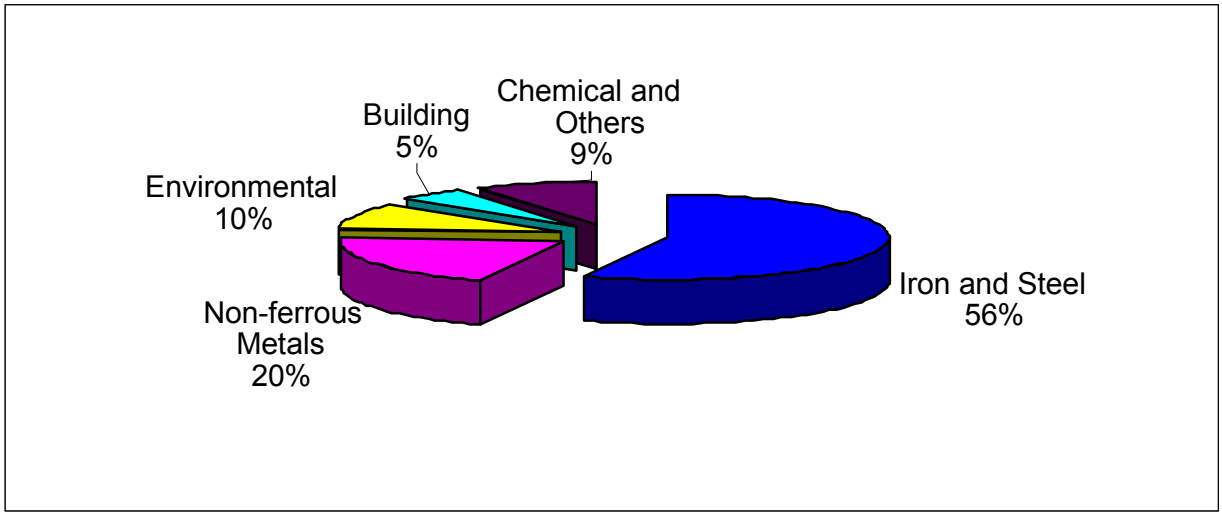
TABLE 2: SOUTH AFRICA'S LOCAL SALES OF LIME BY SECTOR, 2005-2009

Year	2005	2006	2007	2008	*2009
Quicklime	Mass kt	Mass kt	Mass kt	Mass kt	Mass kt
Pyrometallurgical	733	880	819	785	699
Chemical	556	593	655	635	577
sub-total	1 289	1 473	1 475	1 420	1 276
hydrated lime	Mass kt	Mass kt	Mass kt	Mass kt	Mass kt
Water purificatication	37	32	36	48	51
Chemical	43	33	45	51	35
Other	49	47	43	44	25
sub-total	129	112	124	143	111.2
TOTAL	**1417**	**1585**	**1599**	**1563**	**1387**

Source: DMR, Mineral Economics
*preliminary statistics

The iron and steel industry is the largest consumer of lime in South Africa accounting for 56 percent of total consumption followed by non-ferrous and environmental accounting for 20 and 10 percent respectively (Fig.5.).

FIGURE 5: THE LIME INDUSTRY MARKETS



Source: DMR, Directorate Mineral Economics

1.4. TRADE

According to the South African Revenue Services, lime in South Africa is mostly imported from France as well as Morocco, Malaysia and England. More than 90 percent of lime imported is quicklime. Lime imports have drastically increased in 2007 due to increased demand in the iron and steel industry (Table 2).

South African lime exports were mostly to Zimbabwe. The political instability in Zimbabwe has led to declining sales volumes of lime exports. Lime markets such as sugar, gold and copper industries have also been negatively affected.

TABLE 3: SOUTH AFRICAN EXPORT SALES AND IMPORTS OF LIME, 2001-2009

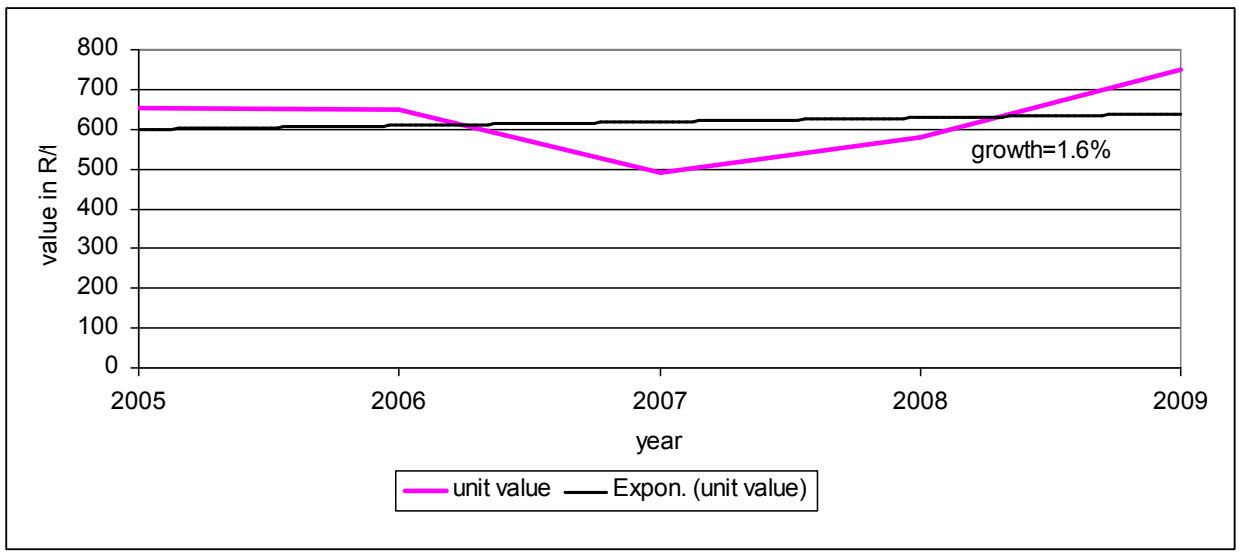
year	Exports sales		Imports[#]	
	mass(kt)	Revenue (R'mil)	mass(kt)	Revenue (R'mil)
2001	13.3	5.5	7.7	8.2
2002	9.0	3.4	9.4	12.6
2003	10.8	4.9	10.2	11.8
2004	9.4	4.8	0.2	1.0
2005	8.9	5.1	0.1	0.4
2006	10.9	6.9	0.6	50.4
2007	12.2	8.8	71	75.6
2008	8.8	1.6	59	94.2
2009	8.5	7.5	*	*

Source: DMR, Directorate Mineral Economics
#SARS
* Not available at the time of print

1.5. PRICES

South African lime prices have been increasing at an annual average rate of 1.6 percent since 2005 (Fig.6), due to high input cost. Over the last two years, quicklime prices have stabilised, whilst hydrated lime prices have robustly increased. During 2005, several lime producers have negotiated for long-term contract prices with major consumers, as rail tariffs, wage increases and energy prices continue on an upward spiral.

FIGURE 6: SOUTH AFRICAN LIME PRICES



Source: DMR, Directorate Mineral Economics

11. ENVIRONMENTAL IMPACTS

Lime production generates large volumes of carbon-dioxide, which cannot be economically recovered. The lime industry is continuously challenged to reduce air, water and noise pollution. Lime production produces a lot of by-products, in the form of lime kiln dust (LKD), primarily from operations of rotary kilns. Lime kilns produce large quantities of exhaust gases at temperatures ranging from 100°C to 1000°C. The dust concentration can be quite high depending on the design of the kiln and the feed-stone.

A number of collection systems that are used to cope with these conditions, include cyclones, fabric filters, electrostatic precipitators, wet scrubbers and gravel bed filters. Emissions of volatile organic compounds (VOC) are generally very low, with the rare exception of those kilns that produce dark smoke, or which are fed with limestone containing exceptionally high levels of organic matter. Emissions of heavy metals are insignificant, because of the high purity of most limestone used for the production of lime. LKDs are collected by dust control systems and used as supplements of calcium for Portland cement manufacture.

Lime manufacturing produces carbon-dioxide emissions resulting from the mineralogical transformation process used as well as from the use of energy. Production of lime is energy intensive; hence the industry has every incentive to reduce its energy consumption, because environmental issues are of significant importance. Lime industry falls within the scope of several environmental legislations, such as the Directives on emissions trading, IPPC (Integrated Pollution Prevention and Control), the incentive on waste, management of waste from the extraction processes, Registration, Evaluation and Authorisation of Chemicals(REACH), sewage sludge and the conservation of natural habitats and of wild fauna and flora.

Consistent with the Mineral Petroleum Resources Development Act, 2002(MPRDA), as much access to raw material and land use management are important for continued extraction. Soil management is also very important to the industry, since soil has to be removed as a primary step to the quarrying of limestone, but is usually saved for use in quarry restitution.

South Africa was one of the countries that agreed to reduce the emission of green-house gases, under the guidelines of the Kyoto protocol, although only developed countries are

required to fully commit to this protocol. The Kyoto Protocol is an international treaty of the United Nation Framework Convention on Climate Change (UNFCCC). This treaty aims to stabilize the concentrations of 4 greenhouse gases (carbon dioxide, methane, nitrous oxide and sulphur hexafluoride) and 2 groups of gases (hydrofluorocarbons and perfluorocarbons) that are produced by industrialised countries. South African has been adopting ways to reduce emissions below the level adopted as of Kyoto Protocol.

12. SMALL SCALE MINING POTENTIAL

Small-scale is commonly associated with informal, unregulated, undercapitalised and under-equipped operations, where there are lacking technical management skills. These operations produce limited amounts of minerals from uncertain reserves. Small-scale mining is labour intensive and thus provides employment to a large number of people, who generally lack skills, and live in remote areas where there are limited opportunities for formal employment.

In remote areas of South Africa, where agriculture is crucial for survival, lime is often difficult to obtain. Lime is used to reduce the acidity of the soil in agriculture. The scarcity of production sites and high transport costs are the major reasons for lack of agricultural lime. It was estimated that small-scale production using manual methods could produce agricultural lime for approximately R210-R250 per ton. Higher yields of maize can be achieved with a relatively low input cost of lime. Due to the higher maize prices, the total financial returns can be considerably increased.

The major problems facing small scale miners range from marketing, land ownership, information planning and lack of finance. It is difficult for these miners to acquire bank loans due to lack of collateral. There have been increasing attempts by the government to facilitate the development of the sector through the Department of Mineral Resources Small Scale Mining Directorate.

13. IMPACT OF THE RECESSION ON THE LIME MARKET

Similar to most industries, the lime industry declined as a result of the global economic recession. Major producers had to decrease consumption, due to decreased production in the iron and steel industry, which is a major consumer of lime. Output had to be reduced to more appropriate levels of demand, in an effort to stop declining prices.

The building and construction sector was one of the first sectors to feel the impact of the recession, with declining sales in the residential sector. However, the support from the government through its infrastructure projects and the 2010 world cup preparations, the impact of the financial down-turn was marginal in this sector.

14. OUTLOOK

This study indicates that world lime production has been steadily increasing over the last decade, with China contributing almost 70 percent to the total production. With the world economic downturn which started in the last quarter of 2008, demand for lime has decreased. Consequently, suppliers adjusted production downwards to sustain the market tightness which kept prices high. Metallurgical applications are the largest consumer of lime accounting for approximately 45 percent.

In South Africa, local sales have been steadily decreasing since 2001, due to lower demand resulting from lime substitution. Quicklime contributes more than 90 percent to local sales. Local sales contribute an average of 99 percent to the total lime sales, exports contribute the balance. Imports have increased by 235 percent since 2006, owing to the increased demand in the iron and steel industry.

Approximately fifty six percent of lime is consumed in the iron and steel industry; hence demand for lime will be dependent on iron and steel production. Demand for hydrated lime has grown over the last couple of years; growth will continue to increase as demand for lime for water purification increases. Lime imports are expected to continue increasing to meet demand in the South African construction industry in the next few years. South African prices will also continue spiralling upwards in response to higher input costs.

Carbonate markets generally show moderate growth, in line with the GDP and to a lesser extent, forecasts of the manufacturing and construction industry. However demand will increase steadily, as a result of increasing production in major sectors, as the world recovers from the global financial crisis.

The South African economy is expected to increase by 2.3 percent in 2010, rising to 3.6 percent by 2012. As a result growth in the lime industry is expected, supported by the government plans to spend R846 billion on its infrastructure programs in the next 3 years, as well as R52 billion for various expanded public works projects for the next 3 years. These initiatives will sustain the need for raw materials required by the steel and building sectors, which accounts for 56 and 5 percent of South African sales of lime, respectively.

Lime consumption is expected to grow in the gold and uranium sector, iron and steel, and in ferrochrome processing. Growth in the local lime industry is small; producers are hopeful that sustainable consumption will continue. The demand for lime has been shrinking over the last two decades, but local markets are expected to experience some growth in the next few years. However, the production of lime is energy intensive and growth might be affected by the increasing electricity prices.

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