

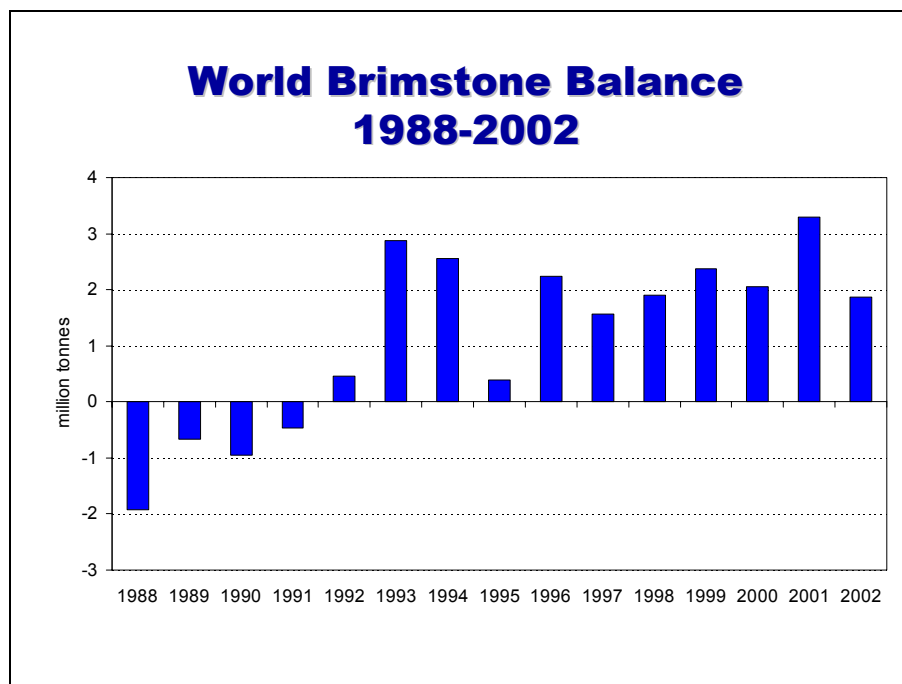
The Outlook for the Sulphur Market Balance

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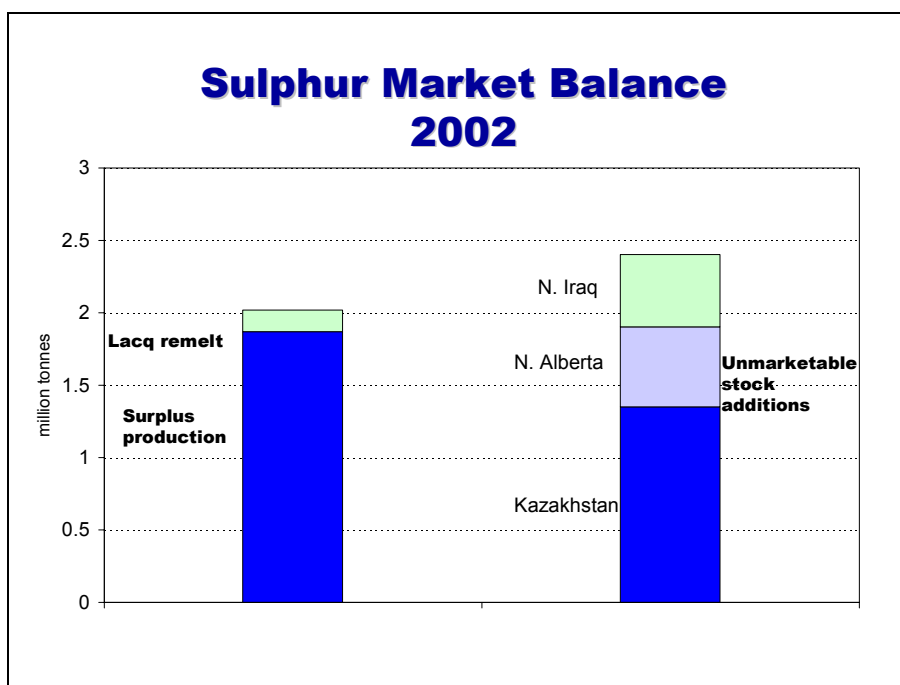
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RECENT MARKET TRENDS

The global sulphur market has been in apparent supply surplus since 1992. In 2002, we estimate that brimstone production totalled 42.9 million tonnes and that consumption was 41.1 million tonnes. These are rounded numbers, and the excess of production over consumption was close to 1.9 million tonnes. However, as the year progressed, sulphur supply became increasingly tight and the market has experienced its most robust rally in a decade, taking Vancouver export prices (in dollars-of-the-day) to their highest level since the early 1990s.



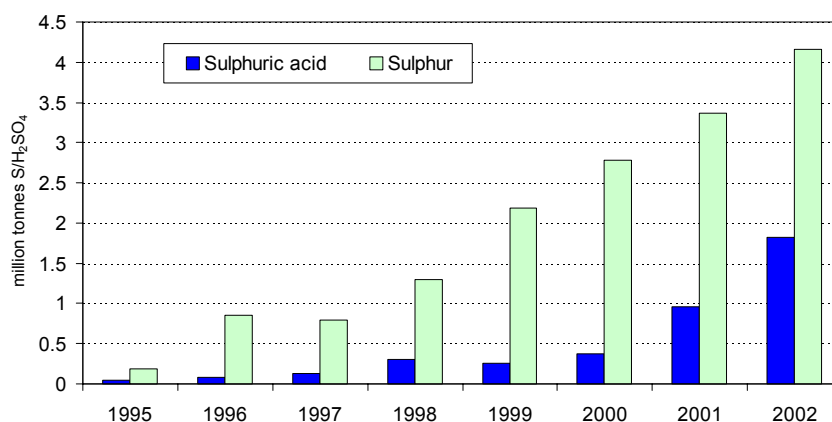
The apparent contradiction in 2002 – surplus production accompanied by rising prices - can be explained. There are some sulphur-producing plants which face very substantial costs and logistical difficulties in moving product to market, with the result that much or all of their output is stockpiled. We estimate that unmarketable stock additions at such plants in Canada, Kazakhstan and Iran totalled 2.3-2.4 million tonnes in 2002. This was clearly in excess of the volume of stockpiling required to balance the market, which was therefore in effective supply deficit.



Product had to be withdrawn from producers' stocks if a genuine physical shortage of sulphur was to be avoided. Total's routine programme of remelting at Lacq in southern France added 150,000 tonnes to supply in 2002, but this still left a global shortfall and other producers had to fill the gap. At the beginning of the year, for example, Husky had stated that it intended that all of the sulphur produced at its Ram River gas plant in Alberta would be poured to block. This policy was fairly quickly reversed, and by the end of the year the company was talking about an expansion of remelting capacity at Ram River.

On the demand side, the main feature of the market remains the phenomenal growth of brimstone import demand in China. Even though a few Chinese acid producers have reverted to pyrites use this year in response to high sulphur prices, brimstone imports through July 2003 totalled over 2.9 million tonnes, a 30% year-on-year increase. No less impressive has been the recent growth of Chinese sulphuric acid imports, which rose from around 50,000 tonnes in 1995 to above 1.8 million tonnes in 2002. This has greatly reduced distress sales of Japanese and South Korean smelter acid in remote markets, particularly the Americas.

China: Sulphur and Sulphuric Acid Imports, 1995-2002



The firming of brimstone prices has in fact been helped significantly by the tight availability of sulphuric acid from base metals smelters. The persistent weakness of metals markets has resulted in numerous production curtailments, and has forced the closure of 16 primary smelters worldwide, with a loss of acid output of around 3.8 million t/y. Further closures are to be expected, and several plants will reduce or cease acid production as a result of changes in process technology.

Table 1
Smelter Closures, 1999-2003

Region	No of plants closed	Acid loss ('000 t/y)
North America	6	2,650
Europe	7	690
Asia/Oceania	3	500
Total	16	3,840

THE MARKET OUTLOOK

In the late 1980s, there was a general feeling amongst sulphur market analysts that a supply crisis was just around the corner. There was a heavy dependence on Canadian stock remelt and there was no obvious replacement for this source of supply once stocks were exhausted, which seemed likely to occur in the early 1990s. To ward off the crisis, new sulphur mines began to be constructed in the United States and Poland.

British Sulphur Consultants did not agree with the consensus view. Early in 1987, we published an outlook for sulphur supply and demand to 1996 which began with these words: *The overriding conclusion of this report is that the sulphur supply crisis and impending exhaustion of Canadian stocks which seemed likely only two years ago are no longer indicated.* At the time, the report was greeted with disbelief, if not derision, but in 1992 the global sulphur market moved into supply surplus and Canadian stocks began to rebuild.

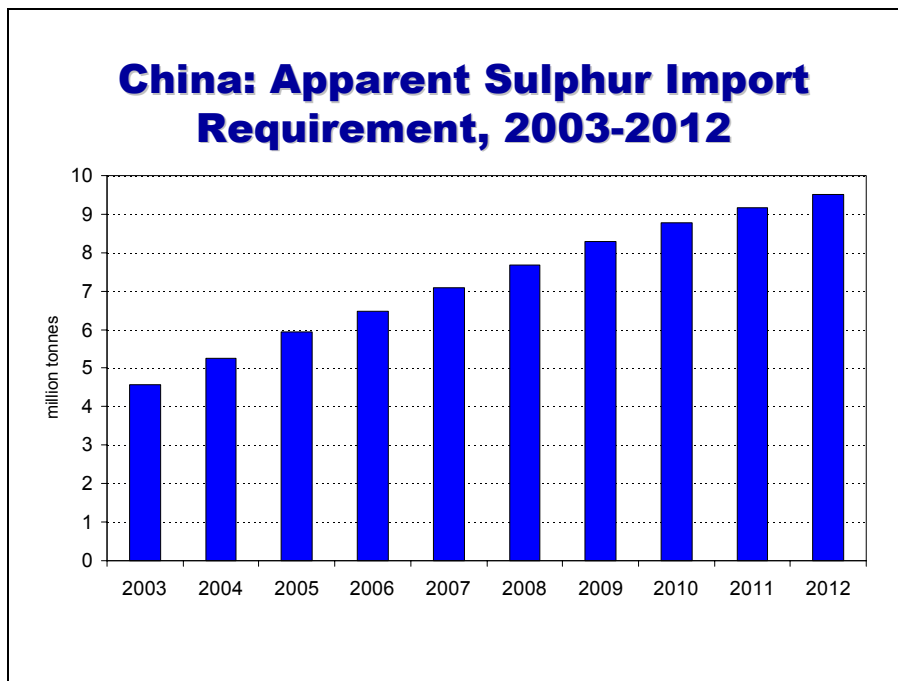
After a decade of annual surpluses, a different mind-set now prevails: Sulphur production will exceed consumption for ever – and by ever-larger amounts. Once again, our analysis suggests otherwise. Based on what we believe to be supportable supply-side and demand-side assumptions, we conclude that the balance of the market could swing back to supply deficit as early as 2009. The key assumptions supporting this view are briefly outlined below.

On the supply side, we take the view that increasing use will be made of **gas re-injection technology** at sour gas operations. Sulphur recovery from sour gas will continue to grow and to represent the largest single source of output, but re-injection will mean that the rate of growth is relatively slow. It is true that some of the proposed projects are to be applied on a scale and in conditions which are unprecedented, but there are huge incentives to ensure that the technology works.

The Kashagan oil and associated gas field in the Kazakh sector of the Caspian Sea provides a good example. The reservoir pressure is so high that compressors do not currently exist which would be capable of re-injecting gas. However, operating company Agip KCO estimates that with conventional sulphur recovery, output could be in the region of 7 million t/y at peak oil production. With maximum re-injection, though, it may be possible to reduce this to as “little” as 2 million t/y. Given that the Kazakhstan government classifies sulphur as a hazardous industrial waste and effectively bans conventional block storage, every effort will be made to attain the lower level.

Table 2				
Sulphur Recovery from Gas				
Historical and Forecast Growth				
	1992-1997	1997-2002	2002-2007	2007-2012
Increment (MMt)	3.59	3.60	3.98	2.19
Compound growth	4.1% pa	3.4% pa	3.2% pa	1.6% pa

On the demand side, we assume that brimstone will meet the bulk of incremental demand for sulphur-in-all-forms in **China**. The prospects for strong overall demand growth are high. From 1990 to 2002, production of sulphuric acid in China rose from 12.0 million t/y H_2SO_4 to 30.5 million t/y H_2SO_4 , an increase of 18.5 million t/y at a compound growth rate of 7.8% per year. China has vast remaining reserves of pyrites but the material is generally of poor quality and there are significant environmental benefits associated with the use of elemental sulphur. A recent reclassification of sulphur as a bulk commodity rather than a hazardous chemical has removed the need to bag the product, reducing costs and easing logistics.



We also foresee strong sulphur demand growth for use in **nickel-cobalt leaching** operations. It is true that the 3 pressure acid leach plants which came on stream in Western Australia in the late 1990s have experienced severe operational and financial difficulties, but the leach plant at Moa Bay in Cuba has operated successfully for decades, and there are two pressing reasons why the problems associated with nickel-cobalt leaching technology must be overcome:

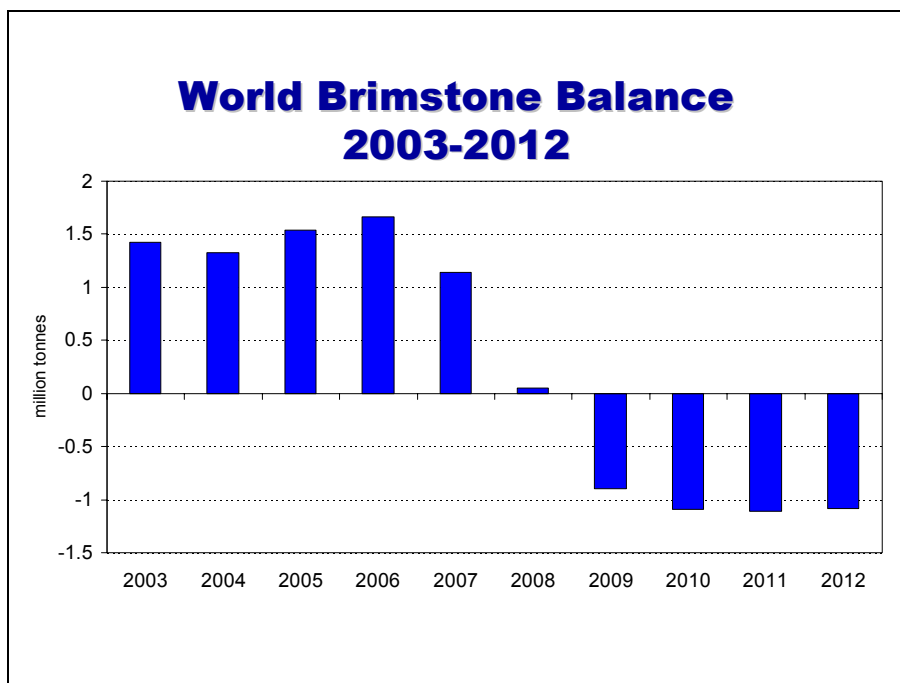
- Unlike many other base metals, the most abundant reserves of nickel and cobalt are oxide ores known as laterites. According to one major nickel producer, laterite ore contains approximately 84% of the world's nickel resources and a greater proportion of cobalt. Laterite ore deposits are commonly found close to the surface, meaning that they can be mined by open pit methods. Many laterite deposits but few sulphide deposits have been identified with potential for commercial exploitation. The nickel and cobalt metal in low-magnesium laterites can be extracted only by means of sulphuric acid leaching.

- Demand growth for nickel is running at 5-6% per year, driven primarily by rising consumption of stainless steel, particularly in China, which has very limited indigenous nickel reserves. There is nothing to indicate a significant slowdown in the rate of stainless steel demand growth for the foreseeable future, other than a shortage of nickel supply.

Nickel leach plants consume large quantities of sulphuric acid. As with all leaching operations, consumption will vary according to the specific characteristics of the ore, but the Australian plants suggest an average of around 30 tonnes of sulphuric acid per tonne of nickel metal. The energy requirements of the process are high, and all larger operations are likely to incorporate sulphur-burning sulphuric acid plants equipped with advanced heat recovery systems. We believe that nickel-cobalt leaching will be the next really major area of sulphur and sulphuric acid demand growth, but it remains very difficult to predict the timing and location of this new demand.

Table 3 Identified Unexploited Nickel-Cobalt Deposits		
Type of deposit	No of deposits	Contained Ni (MMt)
Sulphide	4	3.3
Laterite	28	43.1

Based on these key assumptions, we forecast that the sulphur market will move into equilibrium in 2008, with deficits of around 1 million t/y arising in following years. In the interim, annual surpluses of 1.1-1.7 million t/y are foreseen. These should be manageable, but it should be remembered that both Tengizchevroil in Kazakhstan and Gas Corporation of Khorasan in Iran are making strenuous efforts to move more sulphur to market, with the result that the gap between the apparent and effective supply surpluses should narrow.



If our assumptions regarding acid gas re-injection are correct, there are interesting implications. Most of the large sour gas operations where gas is to be re-injected will also have sulphur recovery capacity. This raises the prospect that, within limits, some of the operators will be able to vary the amount of sour gas which they re-inject or send to the sulphur recovery units. These sour gas producers could therefore become the new swing suppliers of sulphur, fulfilling the role previously taken on by the Frasch sulphur miners.

Much will depend on the sulphur price, though. Back in 2001, prices hit such extremely low levels that virtually every significant sour gas producer was looking at re-injection, but at today's prices, interest has probably diminished to an extent. On the demand side, though, high sulphur prices could slow the rate of Chinese import growth. Regardless of the drawbacks associated with pyrites, we believe that there would be a significant return to the use of this feedstock if the economics of using sulphur became sufficiently unfavourable. And new nickel-cobalt leach projects could be deferred if sulphur prices remain high, as sulphur is a major component of the overall production cost. We assume that everything – supply, demand and price – will move towards an equilibrium level, but we would be the first to admit that this is a speculative assumption in this curious and unpredictable market.