



The Recession's Effect On Vanadium

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OVERVIEW

The current economic recession has had a major impact on all commodities, including vanadium. After a five-year period which saw unprecedented growth, both the demand and supply of vanadium have dropped sharply since October 2008. Because the demand has dropped more sharply than supply, prices have fallen by more than 50% since mid-2008. The sudden change in the outlook for the vanadium business is currently challenging vanadium producers worldwide.

Today, I will briefly review vanadium supply and demand in recent years but will focus particularly on the events since October 2008.

USES OF VANADIUM

- **Steelmaking - 93%**
 - **Chemical and Catalyst - 4%**
 - **Titanium - 3%**
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USES OF VANADIUM

Let me begin with a reminder that vanadium is highly dependent on steel for both consumption and supply, as shown in **Figure 1** above. More than 90% of vanadium usage is in steelmaking, with the balance evenly divided between titanium alloys and a wide range of applications in the chemical industry. This chart shows the breakdown in September 2008.

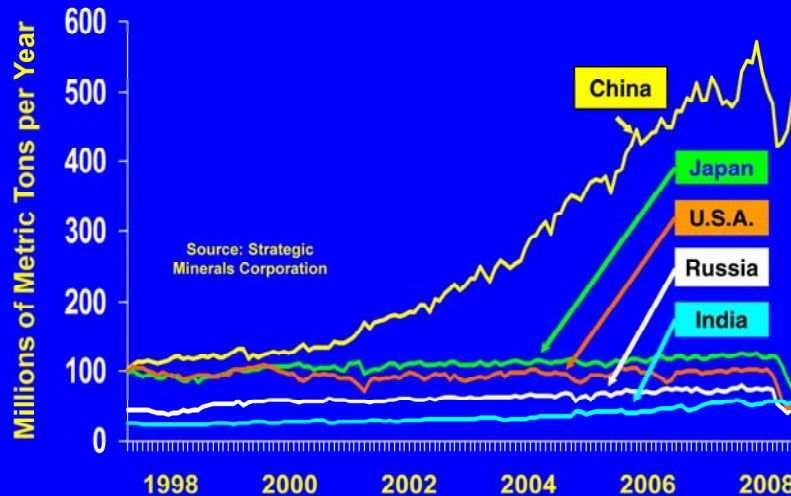


WORLDWIDE CRUDE-STEEL PRODUCTION RATE



The steel slowdown that started to appear in September and October 2008 accelerated in November and December and continues into 2009, as shown in **Figure 2**. This slump in demand puts vanadium consumption in steelmaking nearer to 90%, but I view this as a temporary situation. I expect to see steel industry accounting for more than 94% of total vanadium consumption after the recession ends---whenever that is.

CRUDE-STEEL PRODUCTION BY COUNTRY



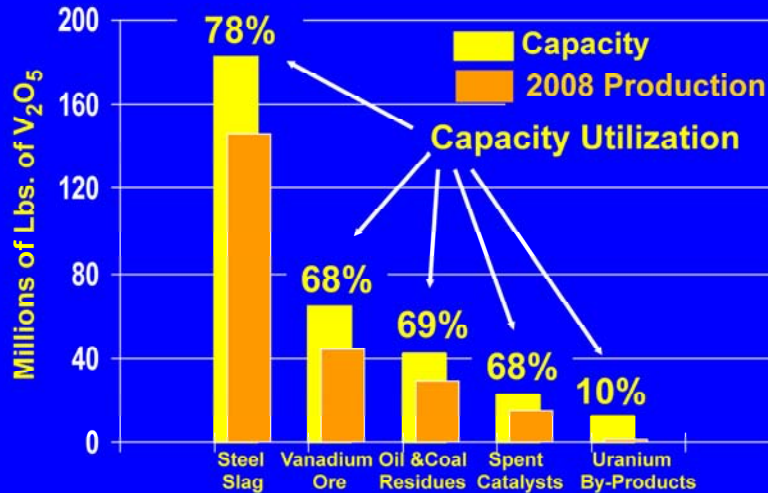
Over the last five years or so, strong growth in steel production, especially in China, led to very strong growth in vanadium demand – again most notably in China, as shown in **Figure 3**. During the same period, there has been a continuous but slower growth in steel production in India and Russia. The other two major steel-producing countries are the United States and Japan, where production has remained fairly steady until the recent recession.

WORLDWIDE VANADIUM-CONSUMPTION RATE



The collapse in worldwide steel production has led to a sharp, sudden decline in vanadium consumption since October 2008 (**Figure 4**). This sudden downturn in consumption reversed an upward trend that was very steady between 1998 and mid-2008.

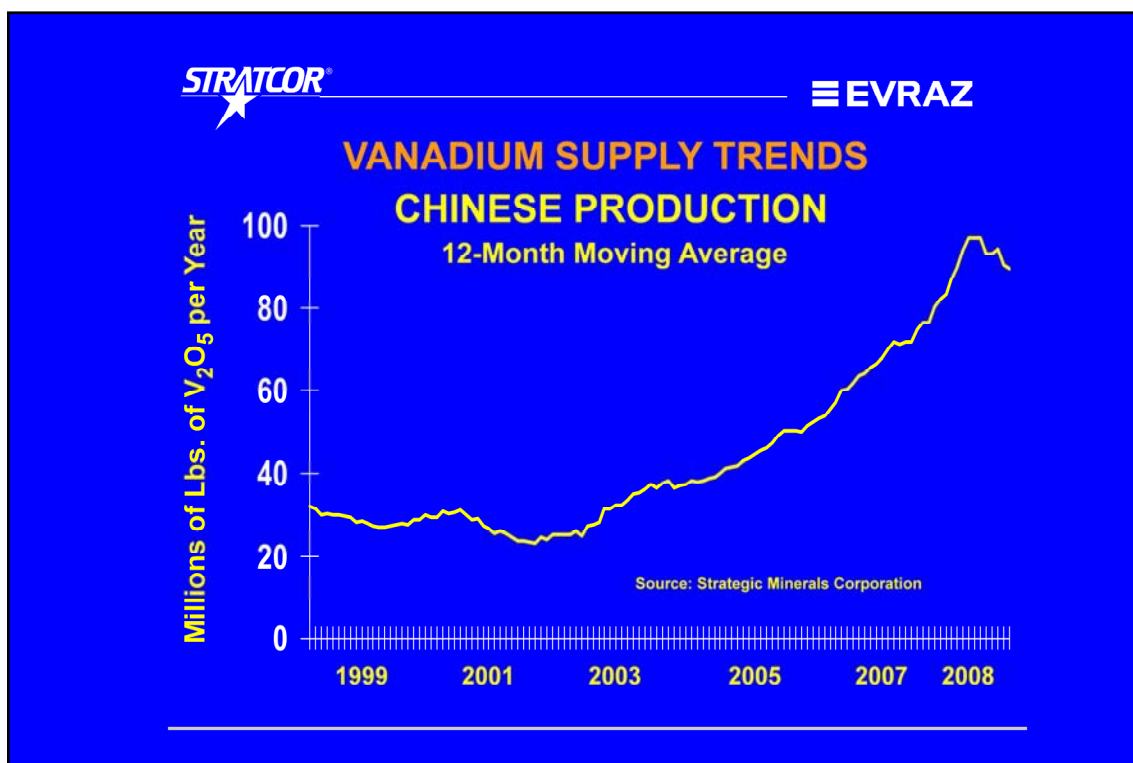
VANADIUM CAPACITY UTILIZATION



VANADIUM PRODUCTION

Vanadium is a common, widely dispersed element. It frequently occurs as a minor constituent in other ores – notably in iron ore and uranium ore. In addition, there are many ore bodies where vanadium is the major element. Vanadium also occurs in fossil fuels, such as crude oil from the Caribbean region and coal, notably in China. Burning vanadium-bearing fossil fuels creates vanadium-bearing ash from which vanadium can be extracted. Processing vanadium-bearing oil results in spent vanadium catalysts which can also be processed to extract the vanadium.

Figure 5 shows worldwide capacity for production of vanadium from these various sources, with the relative production and capacity utilization as I believe it stood in 2008. Because vanadium occurs in so many different forms, its production depends more on the comparative economics of extraction than anything else. Because there are so many sources of vanadium, it is the comparative cost of building an extraction facility and the cost of processing in that facility that determines whether or not any given source or project is viable.



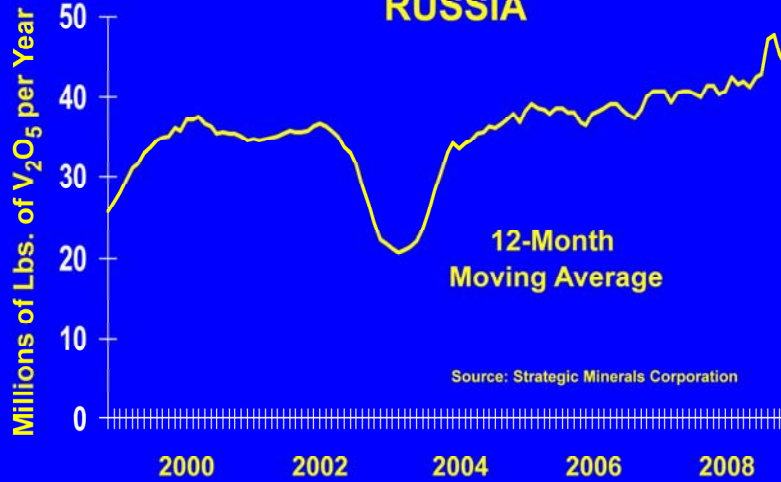
Vanadium-bearing iron ore is by far the biggest and, in general, the most economical source of vanadium. Such deposits occur in South Africa, China, Russia and New Zealand. Slag from the use of vanadium-bearing iron ore in steel production generally contains from 10% to 25% V_2O_5 . Since this slag is a by-product of steelmaking and the cost of extracting vanadium from slag is relatively low, this tends to be the lowest cost vanadium source.

Prior to the current downturn, steel production had been booming and demand for iron ore had risen strongly too. So it is not surprising that with a massive demand for steel, the Chinese industry expanded its own production of iron ore. Some of these iron ore deposits (notably at Panzhihua and Chengde) contain vanadium. As a result, Chinese production of vanadium has grown rapidly since 2002, at almost exactly the same rate as the overall demand for Chinese iron ore.

This is the main reason why Chinese vanadium production rose so sharply between 2002 and 2008, as shown in **Figure 6** above.



VANADIUM SUPPLY TRENDS RUSSIA



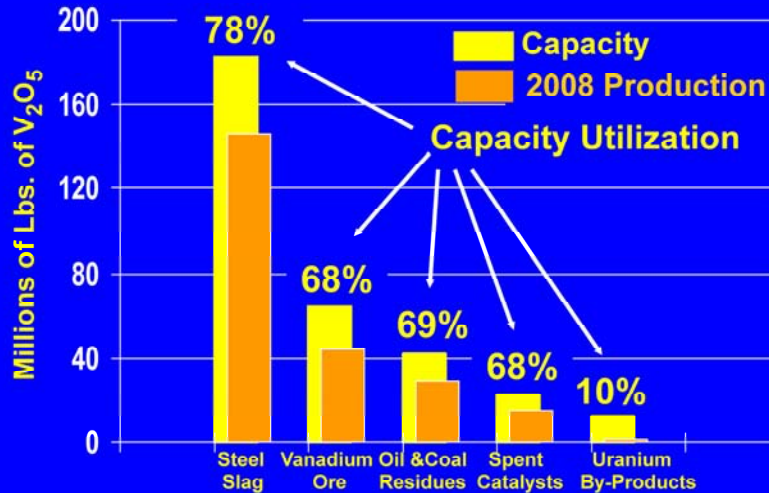
On the other hand, vanadium production in the other regions that have vanadium-bearing iron ore was relatively flat over the same period. This effect can be shown in Russia (**Figure 7**), which has seen a slight upturn in vanadium production in recent years.

VANADIUM SUPPLY TRENDS SOUTH AFRICA



At the same time, production in South Africa (**Figure 8**) has been declining since 2004.

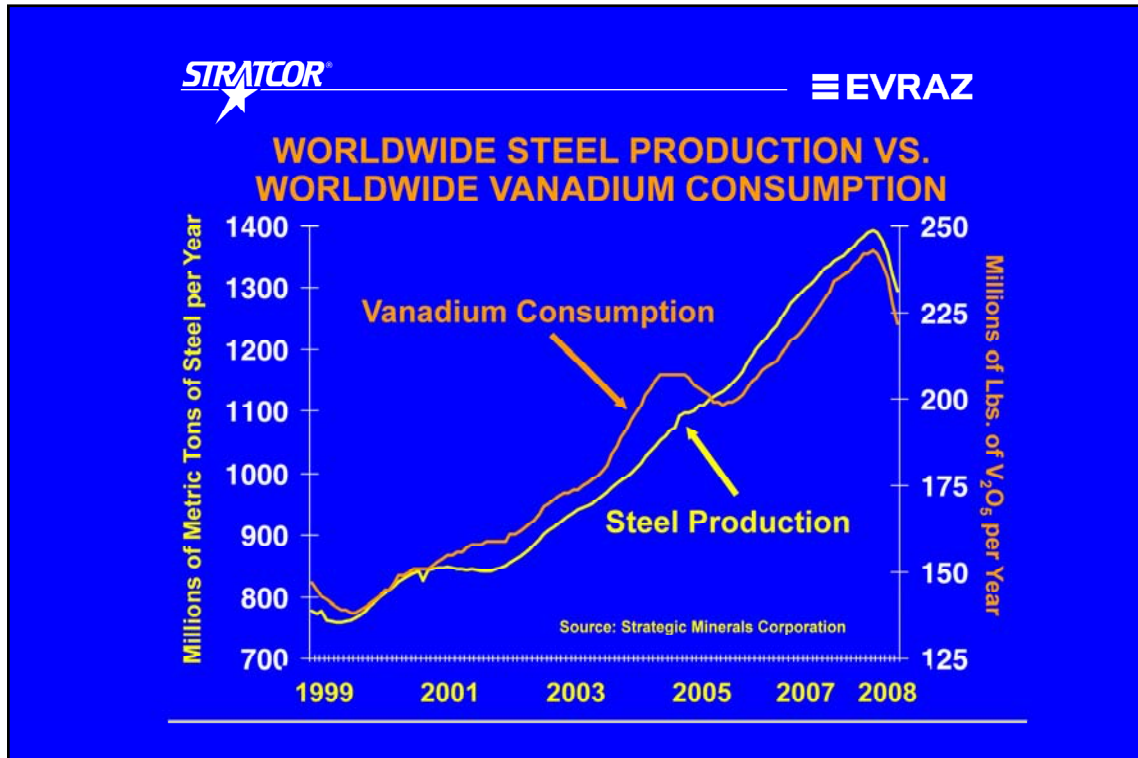
VANADIUM CAPACITY UTILIZATION



Looking at the other sources of vanadium (**Figure 9**), we can see that the next significant source is vanadium ore. Most of this ore is currently produced in South Africa while a smaller amount is produced in China. Many other vanadium ore bodies exist in Russia, China, Canada, Australia and South Africa. However, the high capital costs of a new plant as well as high operating costs for most ore sources make production from ore less viable unless vanadium demand resumes the steep growth seen up to October 2008. At some point, that will happen – but “when” is really the question.

Oil and coal residues and spent catalysts make up most of the balance of current vanadium production. These sources provide most of the vanadium produced in the United States.

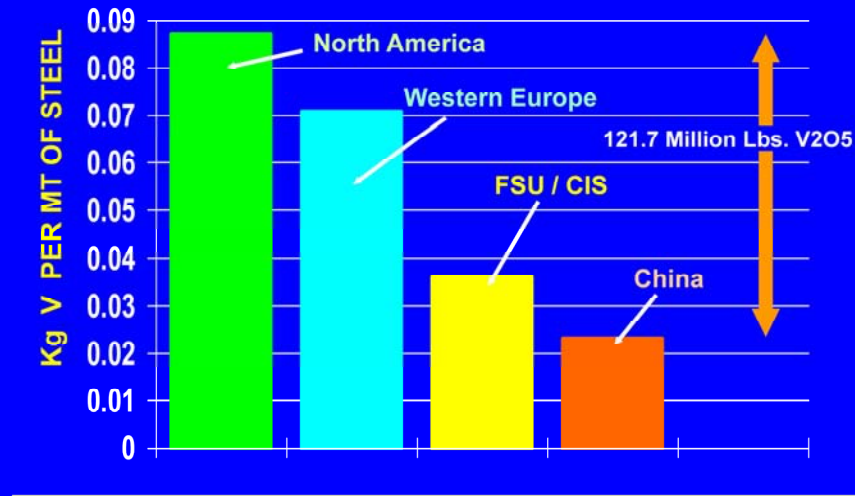
Finally, rising uranium prices stimulated the resumption of uranium mining with the result that a significant amount of vanadium was produced from uranium/vanadium ores in 2008, particularly in the U.S.A. This source of by-product vanadium is expected to continue to grow steadily over the next few years.



VANADIUM CONSUMPTION

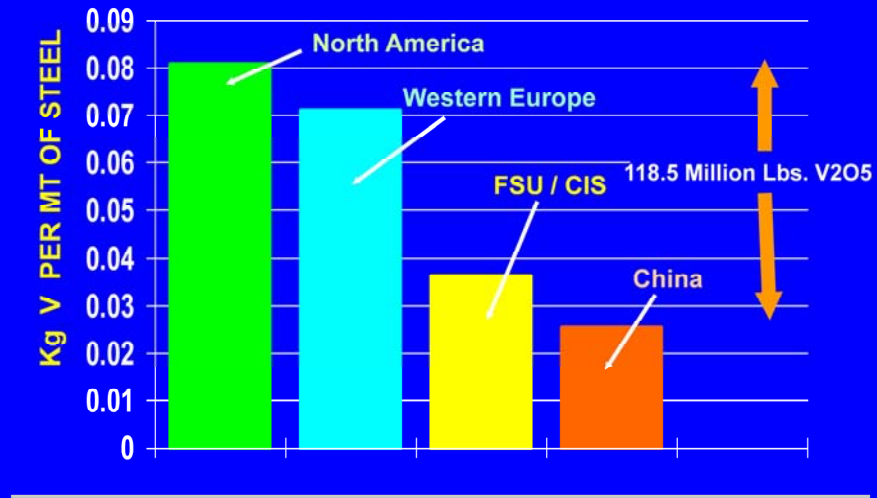
Until September 2008, worldwide steel production had risen very sharply for about six years, as shown in **Figure 10**. In line with this, vanadium consumption also rose sharply – notably in China. Since then, as steel production worldwide has collapsed, so has vanadium consumption. In addition to steel being the main driver of vanadium consumption, a shift to the production of steels with higher strength has further increased the growth in vanadium consumption when compared with the volume of steel produced. But, since October, this growth in usage per ton of steel has not been nearly enough to offset the vanadium consumption lost due to the sheer size in the downturn in steel production.

VANADIUM USAGE PER MT OF STEEL 2007

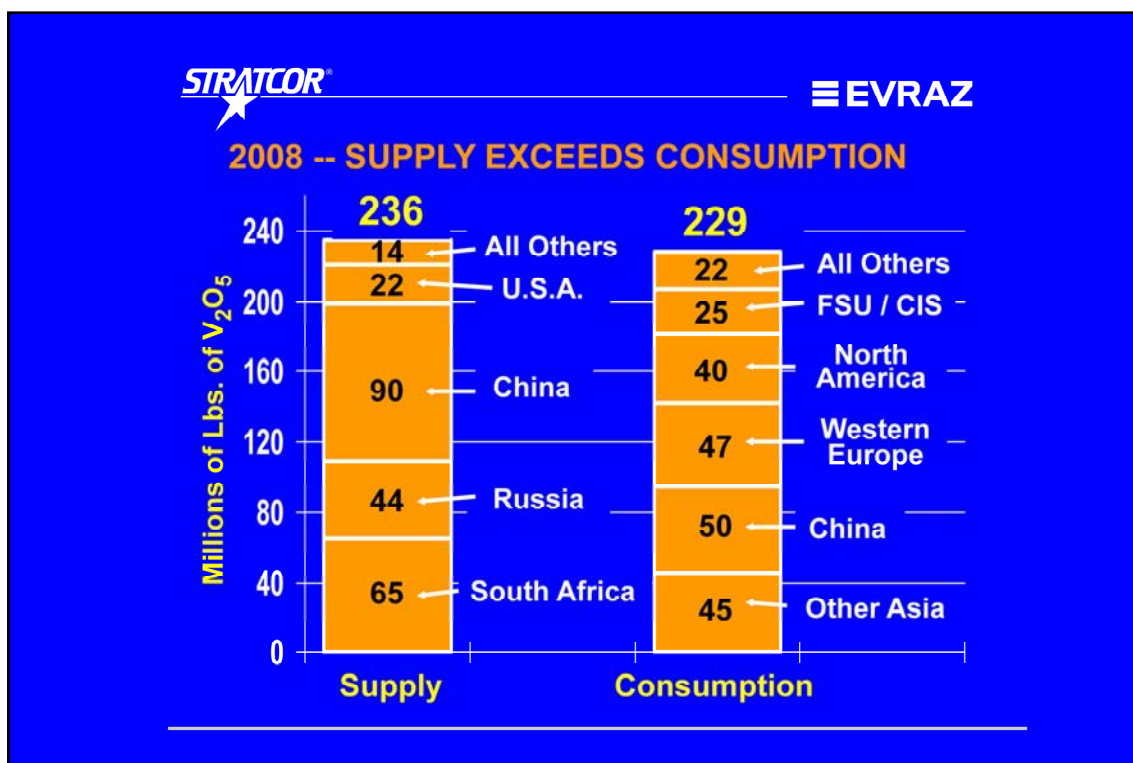


On the bright side, China has seen – uniquely – a rebound in steel production since December 2008. With China’s increased production of higher strength (Grade 3) rebar, there is some possibility that this will create at least some offset to the big drop in vanadium consumption in the rest of the world. In fact, if China’s use of vanadium per ton of steel matched that of the rest of the world, the vanadium market would expand dramatically. This effect is shown in **Figure 11** above for 2007.

VANADIUM USAGE PER MT OF STEEL 2008



In fact, this effect was taking hold in 2008, as shown in **Figure 12**, when China increased its usage of vanadium per metric ton of steel from 0.023 kg in 2007 to 0.025 kg in 2008.



VANADIUM SUPPLY

During 2008 (**Figure 13**), China overtook South Africa to become the world's largest vanadium-producing country. I estimate that in 2008, China produced 90 million pounds of V₂O₅, peaking in the second quarter at an annualized rate of 115 million pounds V₂O₅. Looking at the turbulent second half of 2008, it appears as though China's vanadium production fell to an annualized rate of 75 million pounds V₂O₅ – based on Chinese net exports and apparent internal consumption. What is not clear, however, is whether Chinese production of vanadium-bearing slag continued to be generated at the level reached in the second quarter. That might suggest a large buildup of unprocessed slag or a buildup in unshipped vanadium inventory. Alternatively, it might indicate an even more rapid growth in usage per ton of steel in China than I have assumed in my calculations to date.

South African production in 2008 was around 65 million pounds of V₂O₅ (oxide equivalent units after processing), and Russia's production was around 44 million pounds of V₂O₅ (oxide equivalent).

LAST QUARTER 2008 -- SUPPLY INCREASES

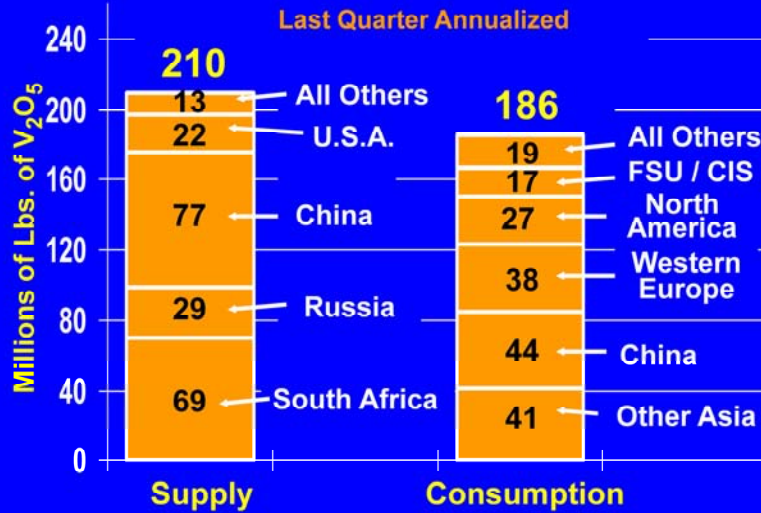
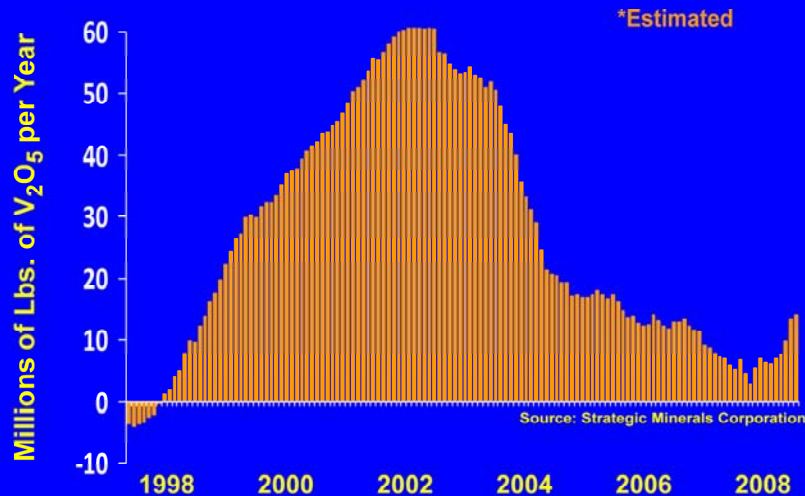


Figure 14 shows the annualized balance between production and consumption in the fourth quarter of 2008. Production in both South Africa and in Russia dropped sharply during this period due to the high correlation between steel production and vanadium slag generation. Overall, even though vanadium production dropped quite sharply in the last three months of 2008, the drop in consumption was even more pronounced, causing an inventory build-up of approximately 8 million pounds of V_2O_5 .

In addition, in common to all commodity markets, a reduced level of consumption releases inventory from the supply pipeline. For example, if vanadium consumers typically hold one month of inventory and their consumption suddenly drops to fifty percent, then they instantly have two months of inventory. So if vanadium producers attempt to cut production to maintain a market balance, they need to halt all production for a month and then resume production at only 50% of the previous level. Furthermore, this only addresses maintaining a balance in vanadium stocks held by consumers. One must also consider producer and “pipeline” inventories in the same way.

EXCESS VANADIUM-OXIDE INVENTORY*



So it is quite possible that producers would have to halt all production for, perhaps, three months, before resuming production at 50% of the previous level --- just to maintain a market balance. This, of course, never happens in vanadium or any other commodity – so markets become oversupplied instantaneously whenever there is a sharp drop in consumption.

Vanadium suffers from a further problem. Since such a high proportion is sourced from some form of by-product (steel slag, ashes, spent catalyst, uranium ore etc.), any reduction of oxide or ferrovanadium production would not necessarily coincide with a reduction in the generation of the vanadium-bearing raw material – the inventory of which might continue to build and overhang the market.

Figure 15 above shows how vanadium inventory has moved over the last eleven years. In the next slide . . .

EXCESS VANADIUM-OXIDE INVENTORY

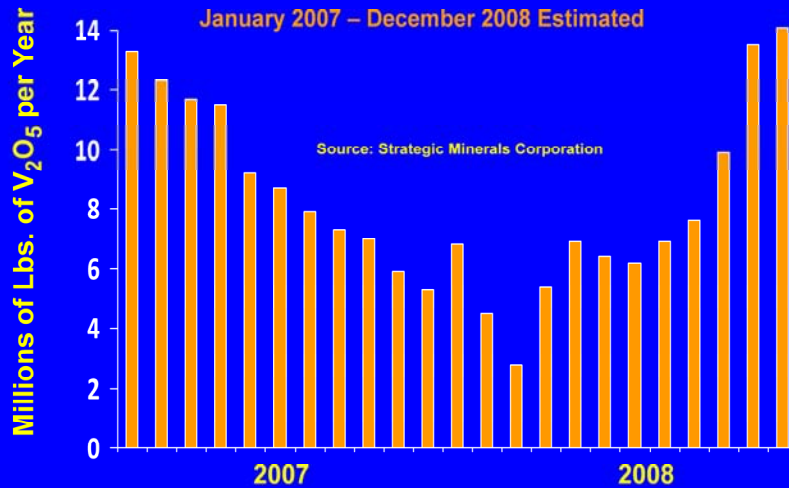


Figure 16 shows the extent to which I believe vanadium inventories (in the form of oxide and downstream products) have built up during the fourth quarter of 2008. About half of this inventory build came from reduced consumption, while the balance came from the “pipeline” effect described above.

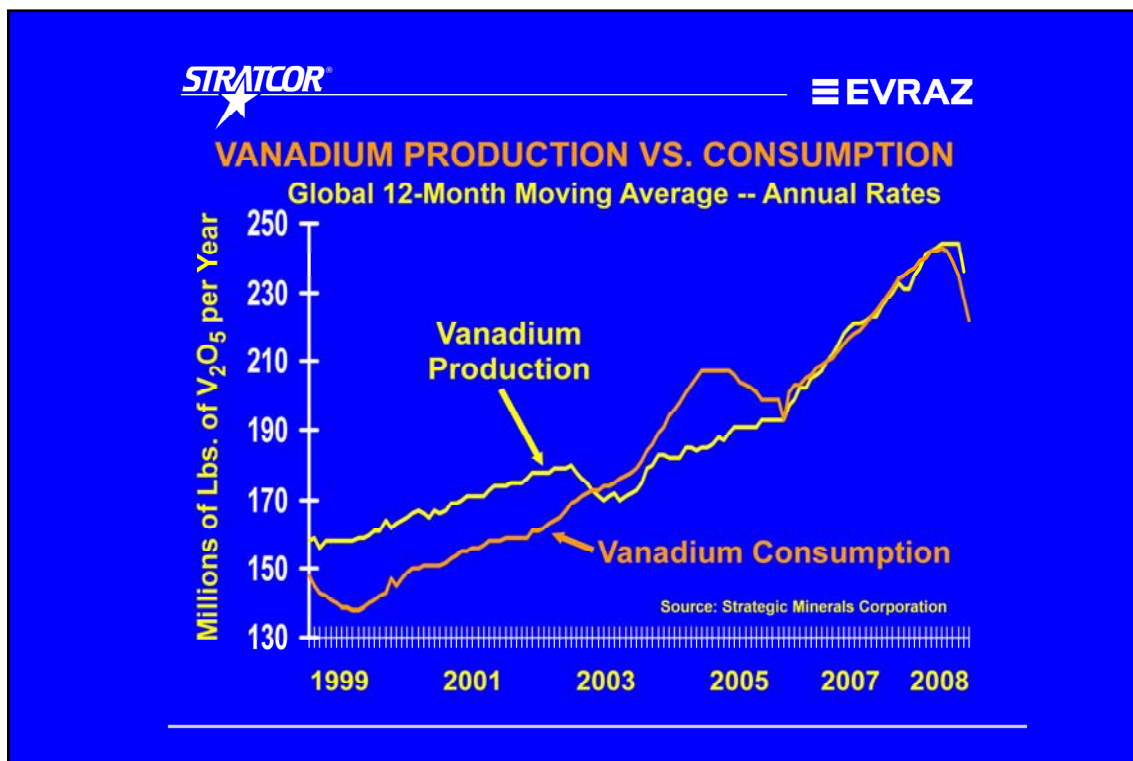


Figure 17 shows vanadium production and consumption over the past eleven years – stocks building in the early years, correcting in the 2004 to 2006 period, and production chasing consumption down in the last quarter of 2008 – but not quite successfully!

The good news is that when consumption resumes, as one day it will, this effect will be reversed and the combined “demand” from consumers and the pipeline will create a substantial surge in demand which producers of vanadium and other commodities will be hard-pressed to meet.

SUMMARY

- **Vanadium Market Has Become Oversupplied Because of Collapsing Steel Demand**
 - **Production Cutbacks Have Not Arrested Growing Product Stocks**
 - **Recovery of Worldwide Steel Production Is Key to Future Health of Vanadium**
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SUMMARY

The vanadium market has been oversupplied since October 2008 due to collapsing demand from its dominant consumer – the steel industry. Vanadium producers have responded by cutting production – but cuts in production have not (to date) been deep enough to arrest the growth in worldwide vanadium-product stocks (oxide and ferrovandium). A further question exists over whether or not Chinese producers of vanadium-bearing slag have accumulated stocks of slag – which would represent an additional build-up of vanadium units that are not included in the vanadium stock build up described in this presentation.

The timing of a hoped for recovery in worldwide steel production remains the key to the future health of the vanadium industry.