Focus on Platinum

The following...

PICTORIAL PRESENTATIONS

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The 8th International Platinum Symposium

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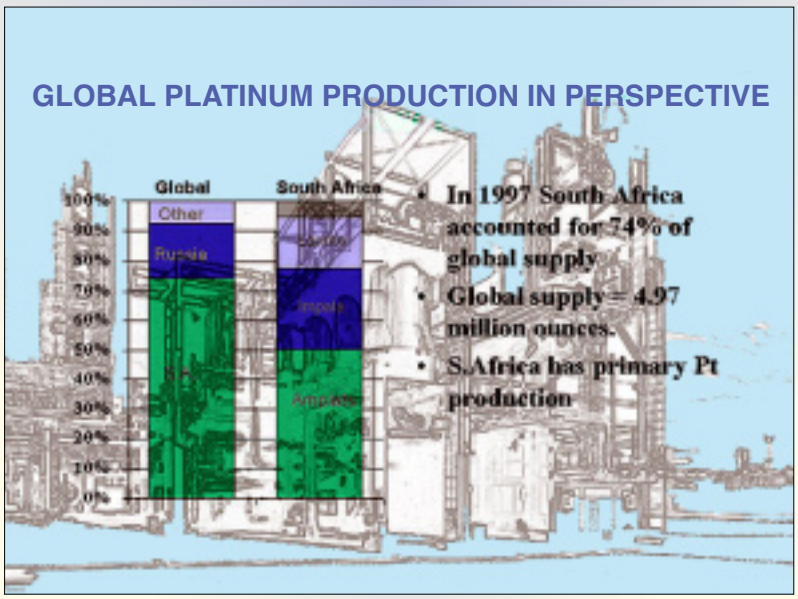
• Marketing • Mining • Metallurgy

Platinum Markets and Applications

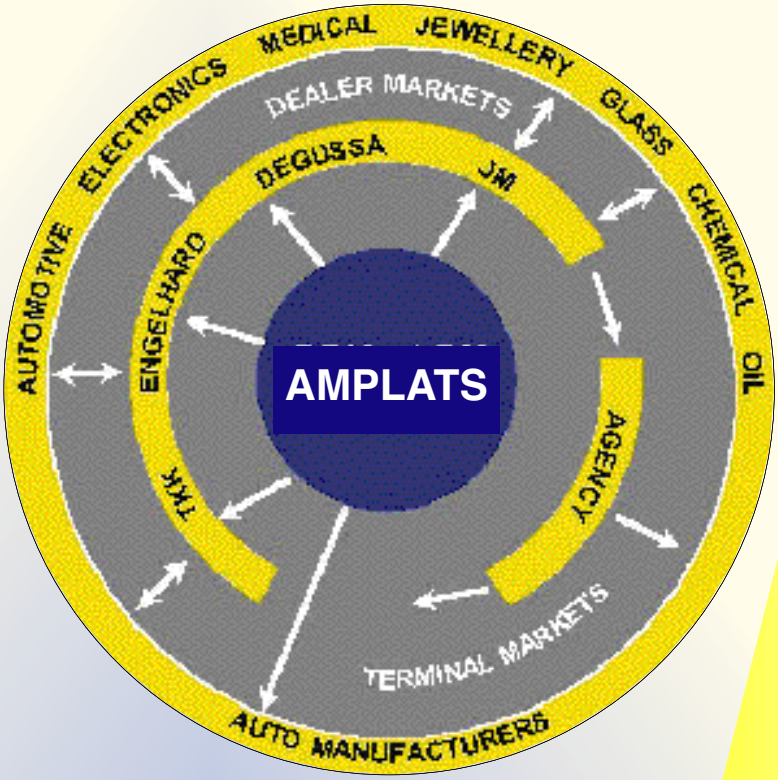
D.T.G. Emmett, *Commercial Director, Amplats*

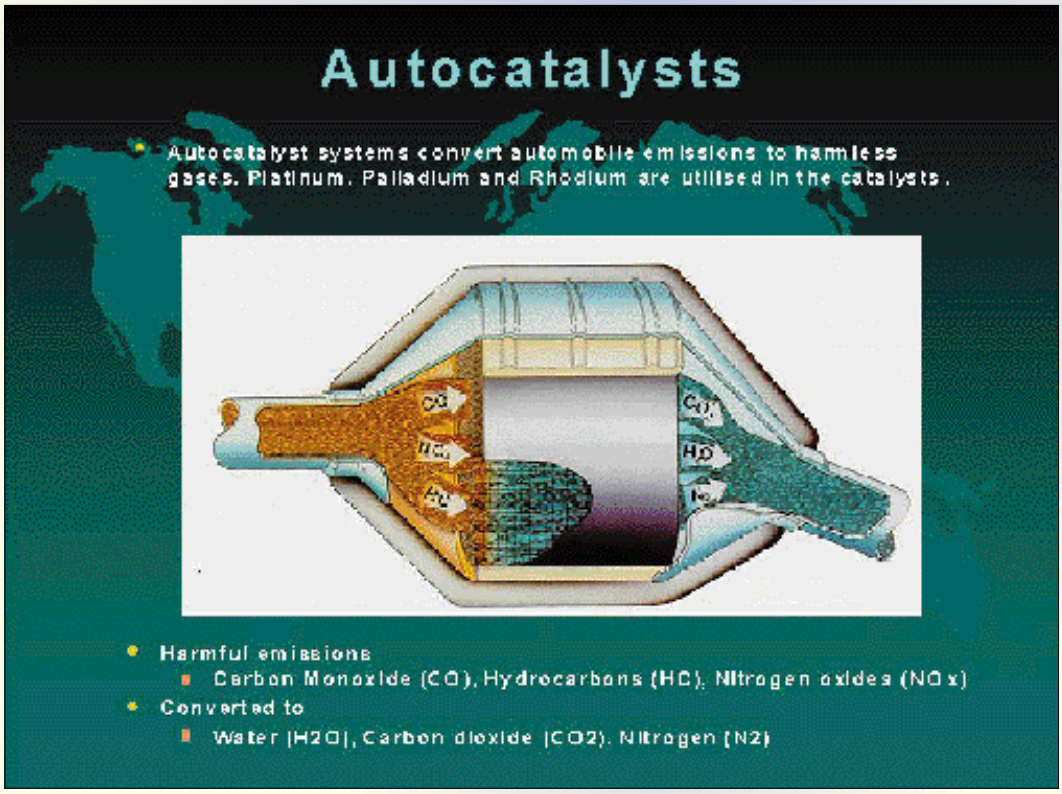
South Africa, by a wide margin, is blessed with the largest known world reserves of platinum. The optimal use of these resources for the benefit of all South Africa's peoples is a goal shared by industry, government and all South Africans. The challenge is to grow the industry in accordance with demand growth and thus to manage a long-term stable growth pattern for PGM usage world-wide. Amplats and the South African producers are well able to meet this challenge.



South Africa plays a critical role in the provision of Platinum Group Metals for world markets. In fact no other country has the productive capacity nor the geological reserves to supply the world's platinum needs. The world required some 5 million ounces of Platinum in 1997 and South Africa supplied a full 74% thereof. The second major supplier, Russia provided a further 18% of world demand, primarily as a by-product of nickel production. Amplats satisfied about 37% of total world demand followed by Impala 20% and Lonhro at 12%.

The flow of PGM's from the South African producers is primarily from their respective refineries to the world's major precious metal traders, secondary refiners and fabricators like TKK (Tanaka Kikinzoku Kogyo) in Japan, Degussa and Hereaus in Germany, Johnson Matthey in England and Engelhard in the USA. These companies fabricate for and supply to the more varied and diverse markets in electronics, jewelry, chemicals, dental, and medical applications. In addition, significant amounts of pure metals are sold directly to the large motor manufacturers in Japan and the USA for their use in autocatalyst manufacture.





The autocatalyst market fuelled a rapid growth in platinum demand. The recycle of metal from scrap catalysts is increasing. Net platinum demand in this segment has fallen with the increased substitution of platinum by its sister metal palladium. Platinum usage is sustained by increased demand in diesel and lean burn applications where platinum is preferred, and in the developing world, where platinum is more tolerant of less pure fuels. The use of palladium in autocatalysts has grown more than six-fold in the past five years. This tremendous shift by the large automobile manufacturers into palladium use has given rise to serious imbalances between the natural occurring ratios of PGMs and the world's current demand ratios.

The jewelry market is highly competitive. Platinum must compete not only with gold and silver but also with many other luxury consumer items that attract disposable income. This market dynamic means that platinum jewelry needs constant promotional support. Amplats has been the major contributor to the Platinum Guild International, an organisation that facilitates the promotion of jewelry around the world in order to increase demand. Other South African producers also contribute to jewelry promotional activity, as do certain of the industry fabricators.

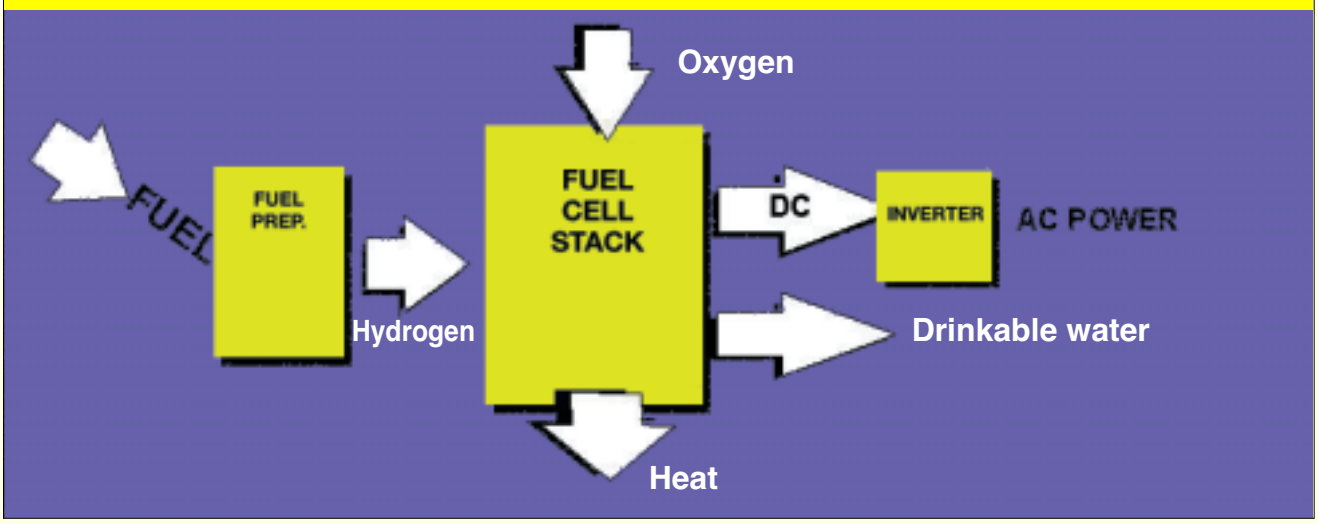
Through the efforts of PGI, the jewelry market has grown continuously for 14 years and almost tripled its share of the world jewelry market over that period. Average growth rates of some 7%/annum have been achieved. In China the average Pt jewelry demand growth rate for the past six years has been a phenomenal 60%/annum. The Chinese market is now the second largest national market for platinum jewelry after Japan.

MARKETING

The industrial market for platinum relies upon the very unique physical and chemical properties of the metal. Platinum has excellent corrosion characteristics, high strength, good creep resistance, and a wide range of catalytic uses that make it the metal of choice in a myriad of industrial applications. Hence the use of platinum in industry tends to be very specific and technologically based, requiring continued R&D expenditure to find new uses and expand consumption. Many of these uses are catalytic in nature but also range from coating the tip of long life spark plugs to cancer treating drugs. Several areas of the market are nearing maturity, such as the petroleum catalyst market. Others are growing with the general world advance in technology, such as the computer revolution and its electrical and glass applications.

FUEL CELLS

- Alternative to fossil fuels / Nuclear power stations
- Most environmentally friendly
- Compact size, silent, variety of fuels suitable
- On-site installation-no transmission wires
- Can be used in stationary or transportation applications



The greatest longer term growth in industrial demand is expected to come from the development of the PEM (proton exchange membrane or solid polymer) fuel cell which uses platinum as a catalyst. Fuel cells came into use during the NASA space program but only with the advent of the PEM cell was a power density sufficient to economically power a motor vehicle possible. In 1997, Daimler-Benz and Ballard Power Systems, formed a joint venture to produce a commercially available fuel cell powered vehicle by 2004.

Deep mining technology in platinum mines

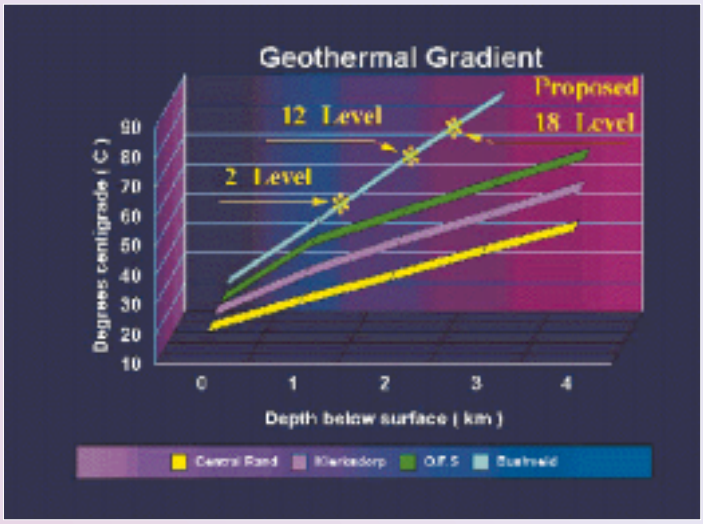
R.G. Viring, *Mine Services Manager, Northam Platinum Limited*

What makes deep platinum mining different?

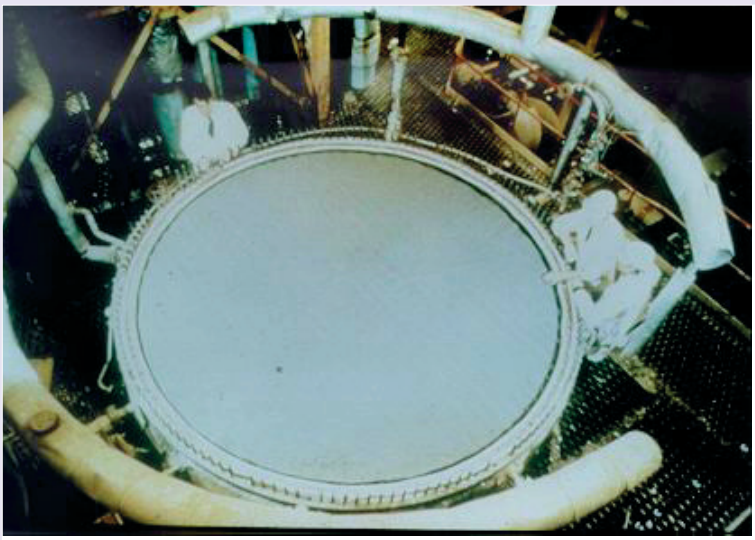
Two aspects being

- Temperature
- Rock Engineering

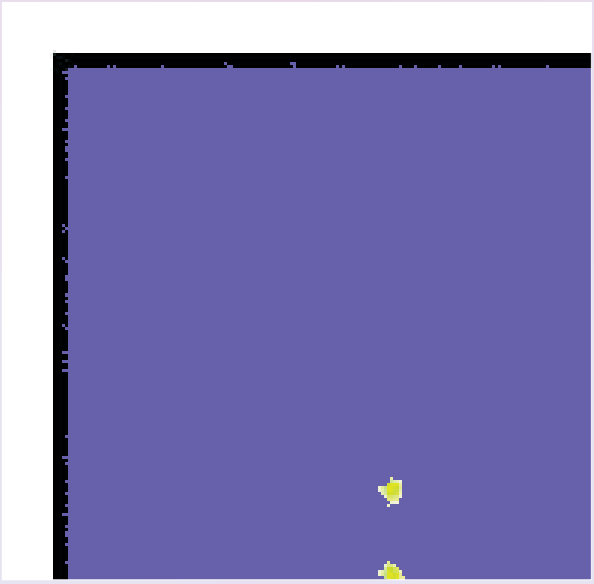
The increase in temperature is 2.13°C per 100 m depth resulting in virgin rock temperatures of 50°C at 1200 m below surface and 65°C at 2000 m below surface. By resolving the high underground heat problem, Northam simultaneously resolves the rock engineering problem. The heat problem was addressed by using chilled Hydropower. This cold Hydropower water is used to power all equipment underground. The use of the cold water then cools the local environment creating a **Cold Micro Climatic Zone.**



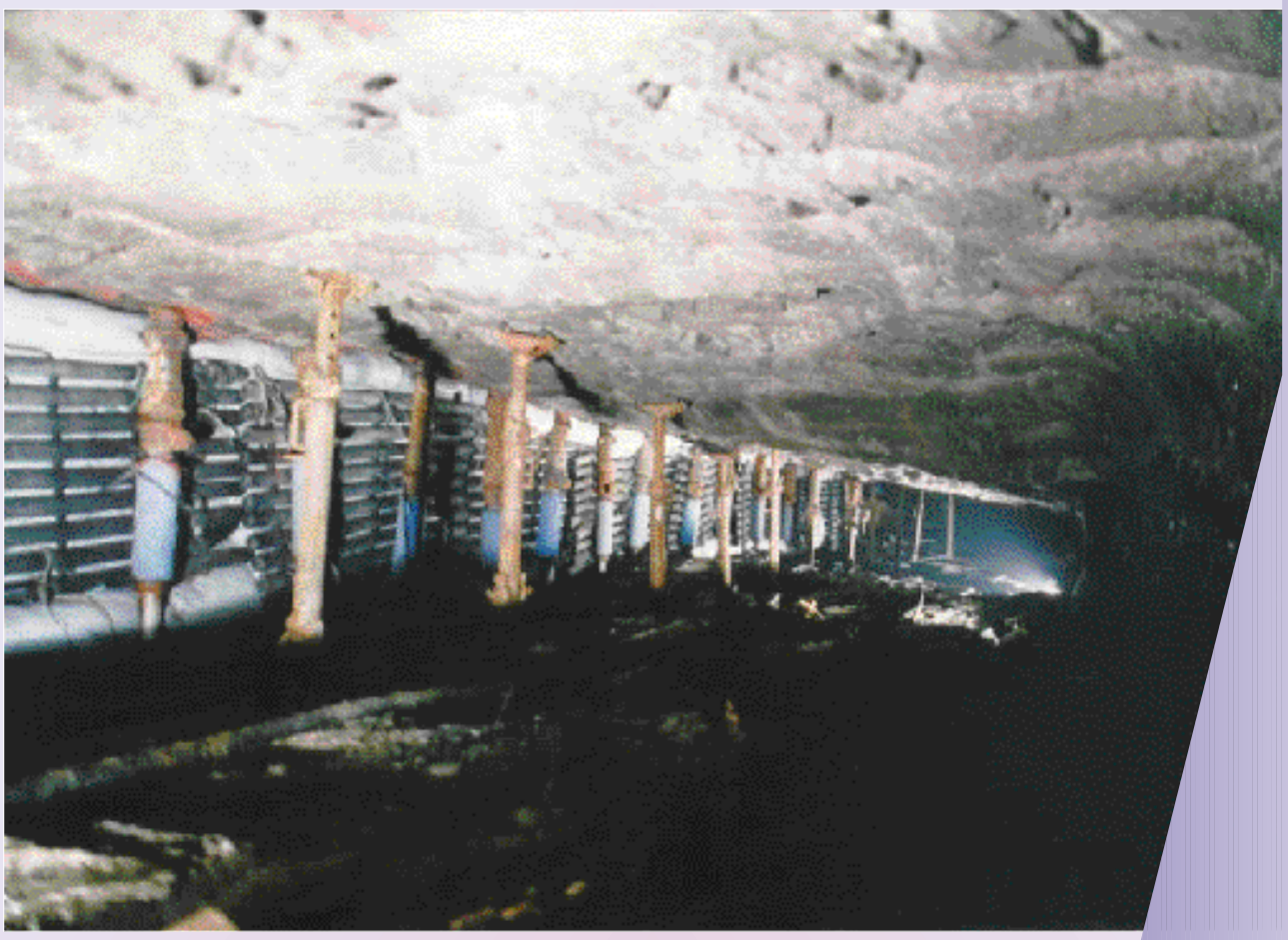
The prime example is the Three Boom drill rig, developed on mine at Northam Platinum Limited for the use in narrow tabular ore bodies which drops the air temperature by half a degree per drill ie. one and a half degrees when using the Three Boom drill rig. This drill rig allows a single operator to drill three holes in 4 minutes or a 25 m face in four hours with the assurance that each hole is accurately drilled with a constant burden and a constant direction.



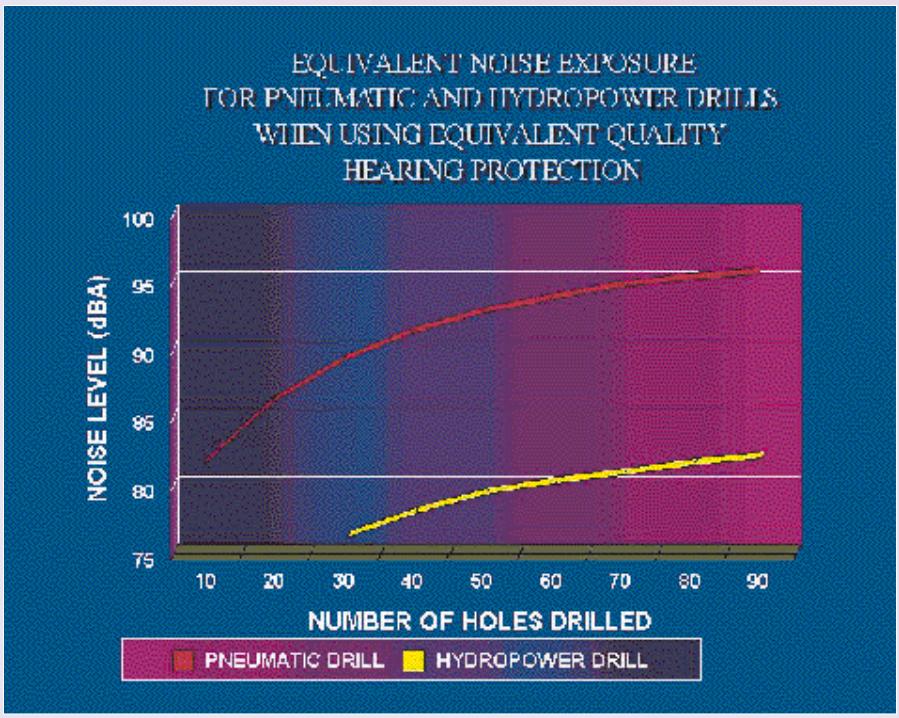
Cleaning of stopes is completed by a single operator using the on mine developed Ekscalibur Water Cannon in a single cleaning shift. The Ekscalibur has a 120 RW nominal power output. It is safe and light to handle and keeps the operator at a safe distance away from the face. Continual hydropower barring of the face and hanging, adds to the safety of the operator.



In areas of poorer ventilation, Venturi spot coolers are used. These cause a two degree drop in temperature whenever it is required.



To prevent this air picking up heat in the old workings, the mine uses classified tailings as backfill in the worked out areas. The mine has a backfill standard where the distance between the face and the backfill is 4.4 m after the blast. The total area covered by backfill is in the order of sixty five percent.



Technological Spin-offs.

A number of technicological spin-offs have evolved from using hydropower. A reduction in noise levels is of special note. The international standard for noise levels is eighty five decibels. As seen in the graph an operator can drill in excess of 90 holes using a hydropower drill opposed to 17 holes using pneumatic drill before reaching the limit.

Simple but important developments have been the use of the Sample Cutter. All face and raise sampling is executed using a Hydropowered Sample Cutter. Channels are cut allowing for a consistent accurate sample.

A most cost effective explosive is Anfex. The granulated explosive is loaded into a dry, clean hole using air. A standard 'Lategan Loader' has been converted using Hydropower to load Anfex with air.

Processing of Platinum Ores

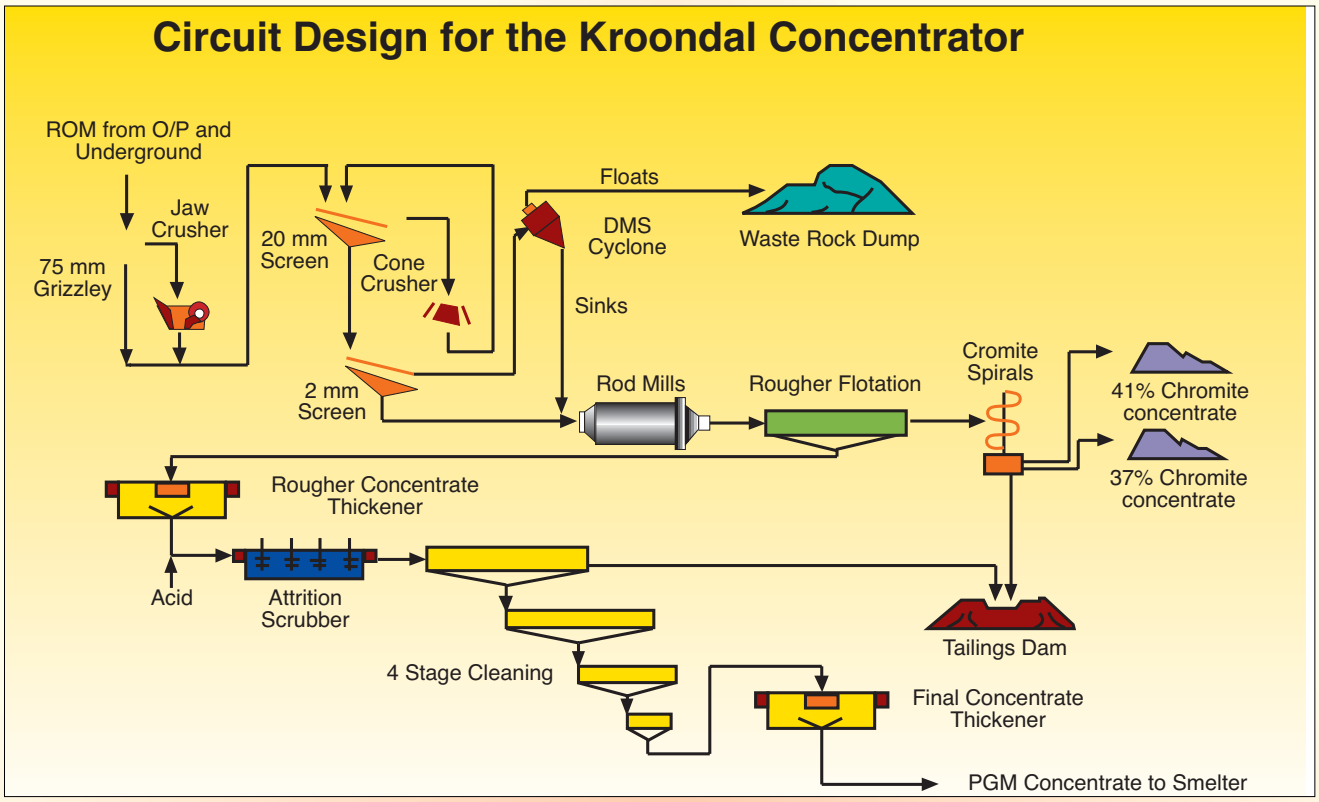
R.L. Paul, *General Manager, Engineering Research and Services, Mintek*

All the platinum producers are involved constantly in technical and financial optimization of their operations. At times their development is kept secret or the work is short term, being aimed at 'trouble shooting' problems that are specific to their feed material and/or circuit configuration. Either way these results do not find their way into the public domain. I have identified those broad based directions that are generic to the industry and that have an impact or potential impact that is likely to be industry wide.

MINERAL PROCESSING - GENERIC PROBLEMS & DEVELOPMENTS

PROBLEM	DEVELOPMENTS
Early rejection of non- PGM waste	Dense media separation; jigging
PGM liberation without overgrinding	Ore specific circuit designs
Recovery of fine particles	Circular flotation cells?
Flexibility for changing ore mineralogy	Fast off-line mineral quantification
Increased concentrate grades	Chemical treatment before cleaning
Increased recoveries	Attritionery; scrubbers; computer control

Many of these developments have been incorporated in the design of the Kroondal concentrator.



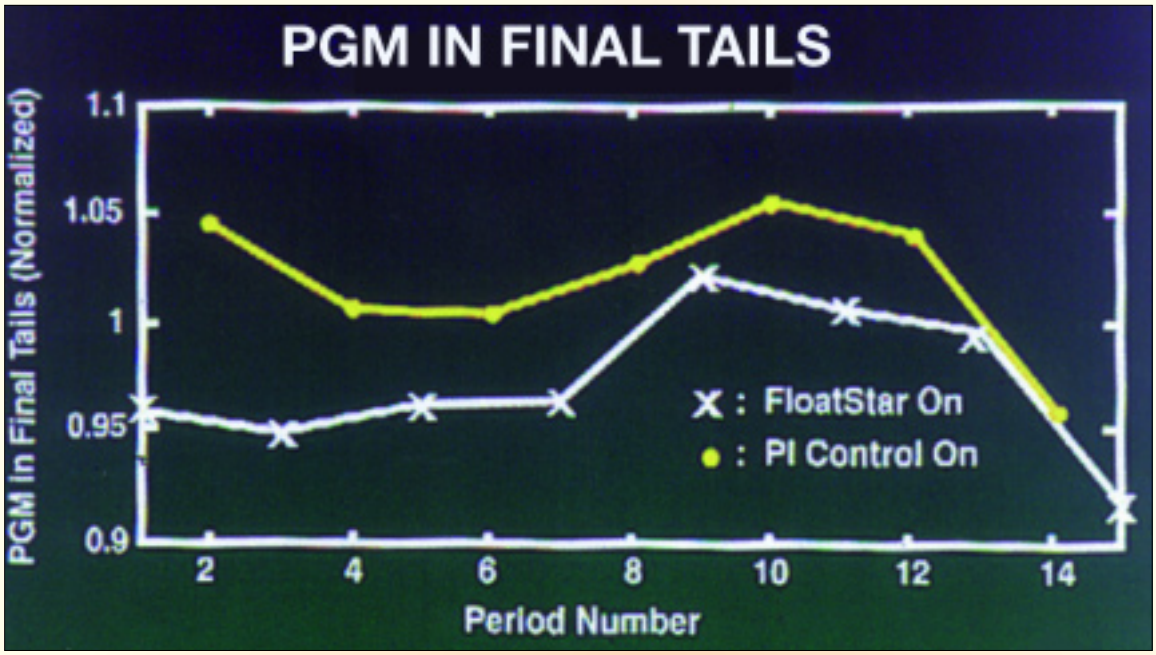
The following innovations have been incorporated:

- crushing followed by DMS on the +2 mm material: rejection of pyroxenites equivalent to 20 - 30% of the feed mass
- rod milling is used to restrict fines formation
- chromite recovery using spirals which will be sold for the production of ferrochrome by pelleting and blending with +6 mm lumpy chromite
- no second stage milling and flotation of the spiral tails (economic reasons)
- rougher concentrate cleaned chemically (acid) and physically (attritioner)
- cleaner tailings open-circuited

EIMCO Smart Cell

Advantages for the circular cell are

- better mixing, no dead corners, better aeration and higher rate of particles bubble collision
- overflow launder goes around the rim giving faster froth removal due to use of froth crowders
- small footprint areas
- fewer large cells—lower maintenance
- improved metallurgical performance



Float Star level control

Advanced level stabilization giving improved metallurgy

- Float Star used on four PGM plants, one Ni plant and one Au plant PGM's in tails are reduced by 0.05g/t giving 1% increase in recoveries

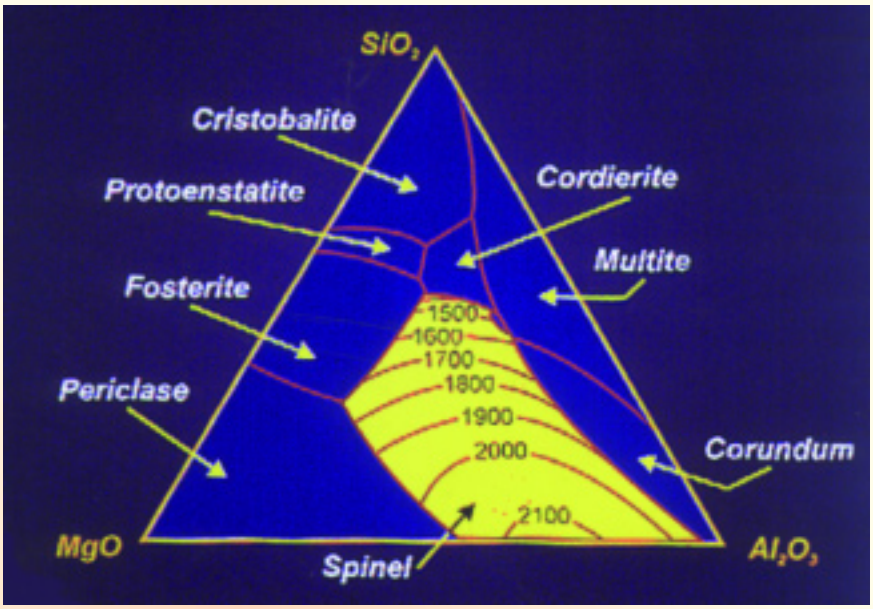
SMELTER AND CONVERTER DEVELOPMENTS

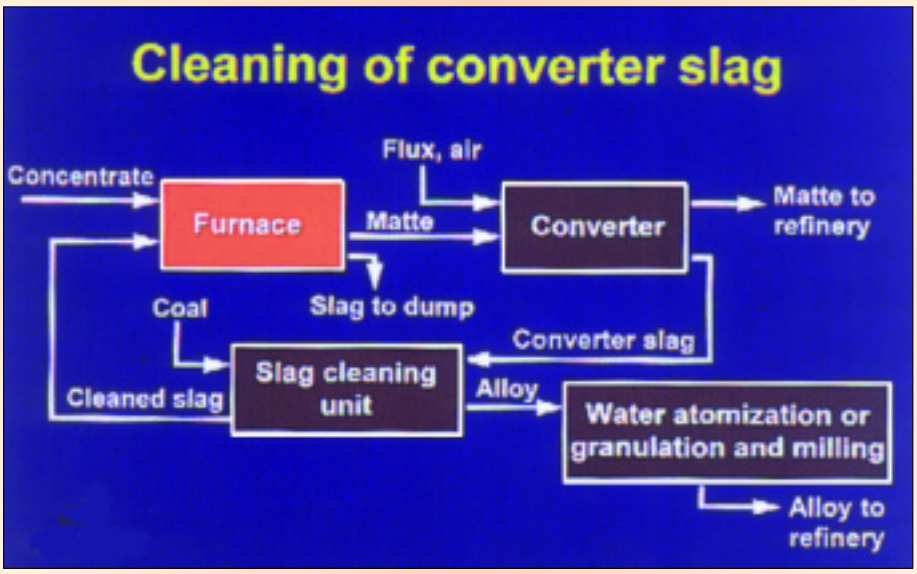
Developments currently being studied for the smelting of high chromite concentrates

- adding carbon to increase chromium solubility
- continuous converting
- cleaning of converter slag

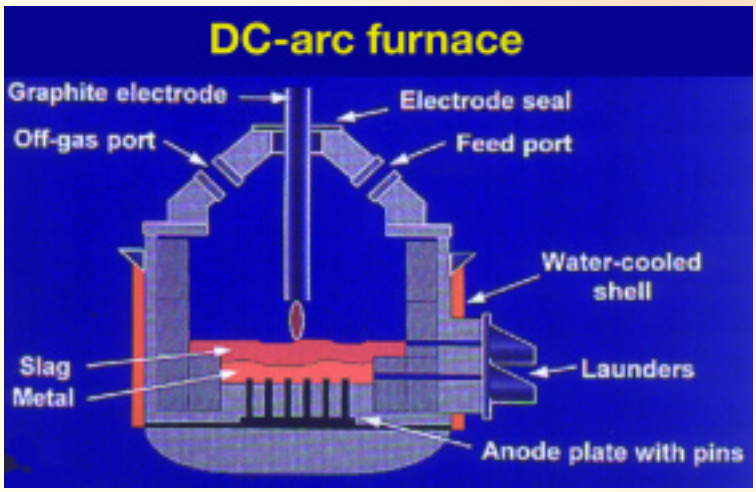
SPINEL PHASE DIAGRAM

Smelting of slags containing in excess of 2% Cr_2O_3 is difficult due to crystalization of spinels in the furnace. As little as 1% of Cr has an effect on the size of the spinel phase field and the viscocity of the slag increases dramatically. This increases the extent of matte entrained in the slag and the PGM recovery is reduced. Carbon addition reduces the trivalent to divalent chromium which is much more soluble in the slag





Recovery of copper, nickel, and cobalt from the converter slag can be achieved by the addition of carbon to the slag in a DC are plasma furmace. The base metal alloy is an excellent collector for the PGMs.



A DC arc furnace is the best unit for slag cleaning as it is for smelting UG2 chromite fines to ferrochrome. The reducing environment in this furnace is readily controllable.