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Independence Platinum Limited (IPt)—formation and objectives

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Atomaer (Pty) Ltd is a technology-driven company with interests in Western Australian nickel. Atomaer (RSA) Pty Ltd is a process technology company operating in Southern Africa. It is a subsidiary of Atomaer Holdings Pty Limited (Atomaer), which has operating companies in Australia, Africa, South America, and Europe. In addition, Atomaer has substantial shareholdings in Braemore Resources Plc, a nickel company with interests in sulphide nickel projects in Western Australia and Southern Africa listed on the Alternative Investment Market of London Stock Exchange (AIM); Mintails Limited, a gold company with interests in gold operations in South Africa listed on the Australia Stock Exchange; and Brinkley Mining Plc, a uranium company with interests in Southern Africa listed on the AIM.

Independence Platinum Limited (IPt) has been formed by Atomaer to undertake the commercial development and exploitation of Mintek's ConRoast technology with the strategic objective of providing independent smelting and refining facilities with lower capital and operating costs for the treatment and processing of platinum concentrates, including those with high chrome and/or nickel and/or low platinum group metal values, for the development of platinum projects by junior resource companies in South Africa.

The platinum mines of South Africa have traditionally exploited the Merensky Reef of the Bushveld Complex for platinum production. However, the mining of this reef is reaching depths that require significant vertical shaft systems and costly refrigeration for access to the ore bodies at deeper levels. In the past decade, all of the platinum producers have begun to mine the UG2 reef because of its cheaper mining costs. UG2 ore usually has lower platinum group metal contents and higher chrome values. The new junior resource companies have gained access primarily to UG2 reefs. Consequently, platinum mining is becoming more UG2-based and the resulting concentrates contain high levels of chromitite. UG2 concentrates are difficult to smelt in the current six-in-line submerged arc furnaces, and this leads to increased capital and operating costs for those smelting operations.

The platinum mines of South Africa produce the majority of the world's platinum metal used in automotive catalysts and jewellery. As the platinum market is forecast to grow at a healthy rate into the future, the SA producers Anglo Platinum, Impala, Lonmin, and Northam are planning to expand mining operations in the next decade. Furthermore, a number of smaller new producers who are accessing other mineral resources are entering the buoyant market and will produce platinum concentrates for purchase or toll treatment. Hence, a shortage in both smelting and refining capacities is anticipated. Further smelting and refining facilities independent of the major platinum producers will be required in South Africa by 2010.

Mintek's ConRoast technology is best suited to fill the need to treat a high proportion of UG2 concentrates in a cost-effective and technically efficient manner. Atomaer base metals technology has been developed for rapid leaching of nickel and other base metals from alloy. Significant reductions in capital and operating costs are expected from the combination of the two advances in process technology compared with that installed at the existing smelters and refineries that were established over 20 years ago.

Independence Platinum will be listed on AIM and the Johannesburg Stock Exchange (JSE) in 2007, and developed as an independent, vertically-integrated platinum company using its independent smelting and base metals refining facilities as a strategic platform to promote the development and mining of platinum projects by junior resource companies in South Africa through technical co-operation, strategic alliances, joint ventures, off-take, toll-refining, and marketing agreements.

Introduction

Atomaer (RSA) Pty Ltd (Atomaer South Africa) is a process technology company engaged in the business of evaluating, developing, and designing processes and process units, and managing and operating processing plants for use in, firstly, the extraction and production of minerals, metals, and chemicals (metallurgical technologies) and, secondly, in the treatment of water, effluent, and gas emissions at industrial plants (environmental technologies). It has been active in Africa for more than 10 years and has used Atomaer mass transfer technology to provide solutions in the area of oxidation and leaching of minerals and metals, and the treatment of acid mine water and other liquid effluent. Atomaer Research Centre in South Africa has developed several breakthrough technologies for the Atomaer Group over recent years. They include rapid leaching of nickel and other base metals from alloy based on Atomaer's patented ILMO (Improved Leaching of Mineral Ores) process, and the rapid oxidation and leaching of gold based on Atomaer's patented Multiphase Staged Passive Reactor and related processes.

Atomaer South Africa is a subsidiary of Atomaer Holdings Pty Limited (Atomaer), which has operating companies in Australia, Africa, South America, and Europe. Atomaer also has substantial shareholdings in Braemore Resources Plc, a nickel company with interests in sulphide nickel projects in Western Australia and Southern Africa listed on the Alternative Investment Market of London Stock Exchange (AIM); Mintails Limited, a gold company with interests in gold operations in South Africa listed on the Australia Stock Exchange; and Brinkley Mining Plc, a uranium company with interests in Southern Africa listed on AIM

Independence Platinum Limited (IPt) has been formed by Atomaer to undertake the commercial development and exploitation of Mintek's ConRoast technology[1] with the strategic objective of providing independent smelting and refining facilities with lower capital and operating costs for the treatment and processing of platinum concentrates, including those with high chrome and/or nickel and/or low platinum group metal values, for the development of platinum projects by junior resource companies in South Africa.

IPt has entered into an agreement with Mintek to fund a demonstration plant and definitive feasibility study for the commercial development and exploitation of the ConRoast process, together with other advances in process technology for the establishment of independent smelting and base metals refining facilities with long-term competitive advantages in terms of capital and operating costs and technical efficiencies, in exchange for a worldwide exclusive right and licence to use the ConRoast technology for an agreed period after a development decision.

Growth in world demand for platinum is forecast to almost double over the next 10 years. That growth is expected to be driven by consumption of platinum in automotive catalysts and other industrial uses in Asia and elsewhere. The current high prices for platinum group metals are likely to continue during that period.

Southern Africa produces more than three-quarters of the world's platinum supply and has the reserves to continue to supply most, if not all, of the growth in world demand. Major platinum producers and junior resource companies plan to fill the supply shortfall and have targeted mineral resource projects in Southern Africa. Those projects are in various stages of development, but most junior resource companies are intending to produce flotation concentrates for toll treatment or sale under off-take agreements.

Many of the new project developments planned by junior resource companies are based on mining UG2 reefs. The proportion of platinum concentrates produced from UG2 ore is expected to increase to around 70% of all concentrates by 2015. Concentrates from UG2 are typically high in chromitite.

The present smelting and base metals refining capacities in South Africa are limited and have not seen the use of significantly new advances in process technologies for many years. There are limits to the levels of chromitite that can be treated using existing furnace technology. Only the Anglo Platinum and Impala operations produce nickel as a final by-product; therefore nickel-refining capacity is severely limited.

Mintek's ConRoast technology is designed to handle high chromitite-containing concentrates, such as those produced from UG2 mining operations. It has several cost and technical benefits when compared with the traditional method of matte smelting in submerged arc electric furnaces and converting to produce a low-iron matte. Furthermore, the ConRoast process produces an alloy rather than a matte and this, together with Atomaer's ILMO process, will present cost advantages in base metals refining downstream.

This scenario has created an opportunity for an entrepreneurial company to commercially exploit advances in proven process technology to establish independent smelting and base metals refining facilities with sustainable competitive advantages in terms of capital and operating costs, and leverage that strategic platform to promote the development and mining of platinum projects by junior resource companies in South Africa.

Independence Platinum and its South African subsidiaries have been designed to fulfil this aim by 2010–2012.

The platinum market

Southern Africa is host to the greatest Platinum Group Metal (PGM) deposits known to present-day geologists: the Bushveld Igneous Complex in South Africa and the Great Dyke in Zimbabwe contain in excess of 95% of the world's known platinum reserves. In 2005, the platinum mining companies in South Africa produced concentrates that were smelted at one of four smelting operations (Anglo Platinum, Impala, Lonmin, or Northam). The majority of the resultant nickel was produced from either the Anglo Platinum or the Impala base metals refineries. Refined PGMs were produced from Anglo Platinum's, Impala's, or Lonmin's precious metals refineries, with a small amount of PGM concentrate being shipped offshore to Heraeus in Germany. This represents more than 75% of the world's platinum supply, and South African production will continue to grow to meet increased demands in the future.

According to Johnson-Matthey, a recognised expert in PGM markets, the platinum market was in deficit for the fifth year in a row during 2005, despite a record high average price of $897 per ounce. The current price of around $1 200 per ounce bodes well for new entrants to the market. The most significant elements of this growth have been jewellery demand in China, increased use of diesel-propelled vehicles in Europe, and growth in computing systems' storage capacity. The popularity of diesel cars in Europe because of improvements in diesel engine technology, has increased demand for platinum in exhaust

catalysts. Diesel engines require a larger percentage of the traditional three-way (Pt-Pd-Rh) catalyst to be platinum based. High-density data storage discs require a platinum-cobalt alloy for the enhanced magnetic properties that allow greater data storage density. This market has become significant, with several hundred thousand ounces used annually.

In the longer term, from 2015, the use of proton-exchange-membrane (PEM) fuel cells for powering everything from cell phones to buses and hotels holds great promise. Development has been slow and depends upon the availability of a hydrogen distribution system or reformer technology that can utilize traditional hydrocarbon fuels for hydrogen production. Jewellery demand in China exploded from only 50 000 ounces of platinum in 1994 to an estimated 1 500 000 ounces in 2002, but has since contracted to 875 000 ounces per annum at the current high prices. Overall, however, jewellery acts as a market buffer, as demand strengthens immediately when prices soften, leading to a stabilizing influence on the market. Automotive catalyst growth in demand of 8.5% per annum is expected in the future, whilst jewellery and other uses are expected to grow more slowly at only 2% per annum. Thus, by 2015 (as shown in Figure 1), platinum demand is expected to be 77% higher at 11.9 million ounces per annum. A high and growing demand for platinum group metals in general is forecast for the foreseeable future. This will keep prices high and challenge the Southern African producers to invest and grow accordingly.

The projected growth in world demand for platinum will be met through exploitation of mineral resources by both the major platinum producers and junior resource companies in Southern Africa. The major mining companies have several expansion projects under development:

- Anglo Platinum—Potgietersrust North, Kroondal and Marikana PSA, Styldrift, Pandora, and others
- Impala Platinum—Everest South, Two Rivers, and Zimplats
- Lonmin—Karee and Western Platinum.

In addition, many junior resource companies are planning to develop their mineral resources and are expected to bring nearly 750 000 t/a of concentrate into the market by 2015. Some of the platinum projects under evaluation for development by junior resource companies are shown on the map in Figure 2.

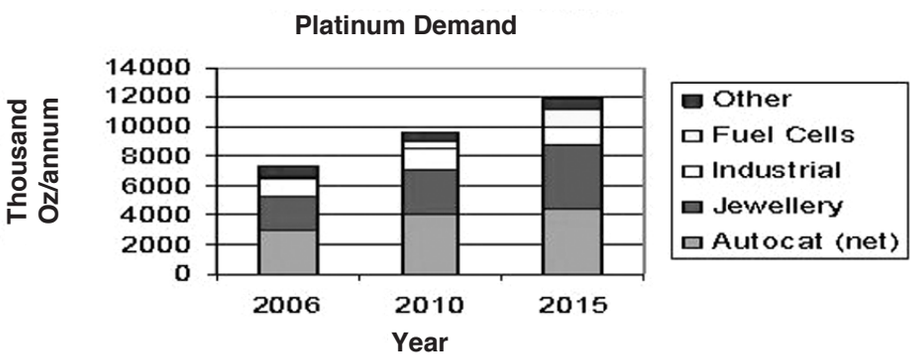

Figure 1. Growth in platinum demand from 2006–2015 (Source: R. Hochreiter)

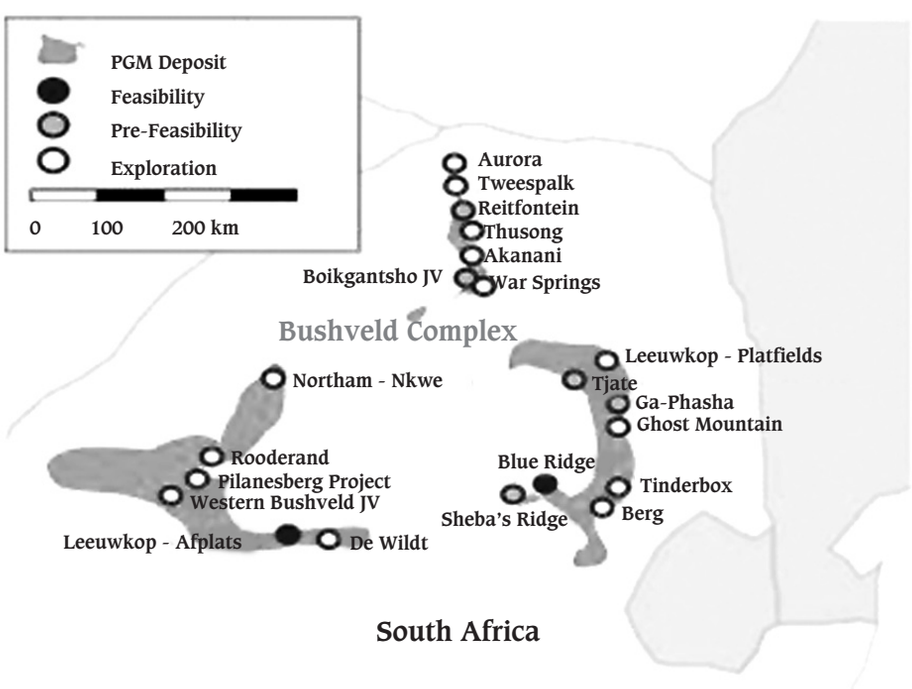

Figure 2. Location of junior resource company projects (Source: Environex)

The combined effect of the expansion projects of major platinum producers and the development of new projects by junior resource companies is estimated as likely to increase concentrate production for smelting by some 1 500 000 t/a by 2015. Capacity for this level of concentrates is not currently available, and will require new investment in either conventional smelting or advances in process technology (such as the ConRoast process discussed below). Most of this increase in concentrate will be derived from UG2 ores that are high in chromitite, with the industry mining nearly 70% UG2 ores by 2015. Current furnace technology used by the major platinum producers has limits in terms of the level of chromitite in platinum concentrates. Mintek's ConRoast technology is very well suited to the treatment of high chromitite concentrates.

The plans announced by the major platinum producers in South Africa to increase smelting and refining capacity are primarily designed to capture growth in production and demand by improving the treatment and refining of concentrates arising from expansion projects.

Some industry rationalization can be expected. Junior resource companies will require off-take agreements for platinum concentrates, to procure finance for the development of underground and open-cast mines and associated platinum concentrators. Major platinum producers are unlikely to make capacity available for low-grade platinum concentrates from junior resource companies. Concentrates with high chrome values will encounter significant penalties even if capacity is available; and those with high nickel values may attract high charges owing to the need for increased base metal refining capacity.

Several junior resource companies have recently announced that they are evaluating the establishment of smelting facilities using conventional technology as a part their total project development. However, those companies will inevitably confront the same challenges as the major platinum producers in terms of the limits imposed by conventional smelting technology and base metals refining capacity as well as the negative effects of economies of scale for small operations.

Moreover, it will be difficult, if not impossible, for most junior resource companies to raise sufficient capital for smelting and refining facilities in addition to the development of underground and/or open-cast platinum mines and associated concentrators. Not surprisingly, most large financial institutions are sceptical when junior mining and resources companies propose this approach.

Furthermore, exportation of high-grade concentrates for extraction and production of base metals and precious metals outside South Africa is not seen as a viable long-term solution in the context of government policy to increase the level of beneficiation in South Africa, especially in precious metals.

Formation of Independence Platinum

Independence Base Metals Refiners (Pty) Ltd (IBMR), Independence Platinum Resources (Pty) Ltd (IPR) and Independence Precious Metals Refiners (Pty) Ltd (IPMR) have been formed for the purposes of undertaking the business activities of IPt in South Africa.

IPt and IBMR have entered into an agreement with Mintek for the commercial development and exploitation of ConRoast Technology (ConRoast Technology Agreement). Under that agreement, IBMR has been established for the purposes of evaluating, developing, and operating independent smelting and refining facilities for the treatment and processing of metal sulphide concentrates containing platinum group metals and base metals, primarily for the platinum industry in South Africa, with the following objectives:

- to demonstrate and introduce more efficient process technology with a lower cost structure in terms of capital and operating costs in the smelting and refining of metal sulphide concentrates containing platinum group metals and base metals
- to meet the projected shortage in smelting and refining capacity emerging from the development of platinum projects by junior resource companies in the platinum industry in South Africa, especially those of historically disadvantaged South Africans
- to provide smelting and refining facilities and capacity for the treatment and processing of metal sulphide concentrates containing platinum group metals and high chrome values which would not be amenable to treatment and processing at existing smelters and refining complexes in South Africa
- to provide for participation in the ownership of IBMR and the Independent Base Metals Refinery by and for the benefit and economic empowerment of historically disadvantaged South Africans.

IPR has been established for the purposes of facilitating and participating in the development and mining of mineral resources containing platinum and associated metals owned by junior resource companies in South Africa that require access to independent smelting and refining facilities for the development and mining of their mineral resources, and to procure platinum concentrates as feedstock for the Independent Base Metals Refinery.

IPMR has been established for the purposes of extracting, separating and producing platinum group metals and precious metals from the refining of final high-grade IBMR platinum concentrate through toll-refining and other arrangements for the international marketing and sales of those metals; and providing for the ownership of IPMR by and for the benefit and economic empowerment of historically disadvantaged South Africans.

The ConRoast Technology Agreement provides for evaluation of the establishment and operation of independent smelting and base metals refining facilities with an initial capacity to process up to 360 000 metric tons of platinum concentrates to extract and produce up to 30 000 tons of nickel metal, 15 000 tons of copper metal, and 1 800 000 ounces of platinum group metals in the form of a high-grade concentrate for separation and refining of platinum group metals at a precious metals refinery under technical co-operation, strategic alliances, toll refining, and marketing agreements.

Mintek has demonstrated the effectiveness of the ConRoast process in numerous pilot-scale studies in the past few years. Most recently it has smelted 20 000 tons of low-grade PGM materials for one of the existing PGM producers at a significant scale and over a long period (more than two years). Only two key process areas require further work for process definition and optimization: first, the roasting step prior to DC arc smelting; and secondly, the alloy leaching step—in particular, the removal of iron from the leach solutions. Whilst all of these steps have been well proven at a laboratory scale, and have demonstrated the technological benefits expected, both process steps will be proven at a greater scale on a variety of concentrate feedstocks and for a wider range of operating conditions.

Under the ConRoast Technology Agreement, IPt has agreed to expend US$15 million (about ZAR100 million) on a Development Programme including a demonstration plant, optimization studies, and the definitive feasibility study for a development decision within three years. IPt is aiming to complete the Development Programme so that commissioning of the independent smelting and base metals refining facilities can commence in the second half of 2010.

IPt is currently a private company, the major shareholders of which are Atomaer and institutional investors in Europe and North America. IPt plans to proceed with an initial public offering and listing on the AIM of the London Stock Exchange and the JSE in 2007 to provide opportunities for investment by South Africans. IPt has commenced the process of identifying appropriate entities for the broad-based economic empowerment of historically disadvantaged South Africans.

ConRoast technology

Conventional sulphide matte smelting[2] has worked well for ore concentrates derived from the Merensky Reef, although there has been much concern about the emissions of SO_2 from these smelters. However, with the increased use of UG2 ores (containing much higher levels of chromite), a number of new challenges have arisen. Significantly higher temperatures are required in order to prevent the build-up of high-melting chrome spinels in the furnace. Unfortunately, the resulting matte becomes highly superheated, which makes the problem of containment that much more challenging. Water-cooled copper has been used in the construction of a number of new furnaces, but these have faced serious challenges because of corrosion of the copper by sulphur and volatile halogen compounds, leading to significantly reduced cooler life, and, in extreme cases, cooler failure. Existing smelters place restrictions on the quantity of chromite in the concentrates that they are willing to accept as furnace feed. This, in turn, places constraints on the operations of the concentrators and mines. There are significant opportunities for improvement if these constraints can be relaxed.

An alternative process has been devised for the smelting of PGMs. This process, known as ConRoast, is centred on the smelting of low-sulphur feed materials in a DC arc furnace, resulting in the production of an iron-based alloy. A simplified flowsheet is shown in Figure 3.

The problem of SO_2 emissions (and especially the fugitive emissions from Peirce-Smith converters) is to be addressed by dead roasting the sulphide concentrates in a well-contained continuous fluidized bed roaster (essentially removing all of the sulphur by oxidation). Depending on the quantity of sulphur present, the SO_2 can either be used as a feed to a sulphuric acid plant or can be scrubbed.

The collection of PGMs in an iron alloy removes the restriction on the quantity of base metal sulphides that need to be present to provide for sufficient collection of the PGMs. Furthermore, the PGMs have an even greater affinity for iron than they do for matte. This ensures very good recoveries of PGMs in smelting. The DC arc furnace has been successfully applied to the smelting of chromite on industrial scale, so there is no restriction on the amount of chromite in the feed to the furnace. Pilot-plant smelting of UG2 concentrates containing up to 5% Cr_2O_3 has been successfully demonstrated at Mintek[3]. The iron-based alloy has a liquidus temperature close to that of the slag, and therefore does not become significantly superheated. The furnace is therefore much more reliable, and does not have the same stringent cooling requirements as matte smelting does when treating UG2 ore concentrates.

It is possible to remove much of the iron from the alloy product pyrometallurgically (by converting). However, the alternative is to subject the liquid alloy stream to water atomization. This industrially proven process[4] generates particles that are small enough to leach very rapidly. In this case, the alloy product can have the iron removed hydrometallurgically (by oxidative leaching and pressure precipitation of hematite) before further treatment in a base metals refinery and precious metals refinery.

Atomaer ILMO technology

IPt and IBMR have also entered into an agreement to license Atomaer technology for the rapid oxidation and leaching of base metals based on the ILMO (Improved Leaching of Mineral Ores) process developed by Atomaer (Atomaer Technology Agreement). The Atomaer leaching technology incorporates, among other things, a multi-phase staged passive reactor in which liquid or slurry, together with oxygen, is passed through the reactor at a controlled pressure difference. Under these conditions, interaction between solid, liquid, and gas phases occurs, resulting in enhanced mass transfer and leach kinetics. This technology was initially applied in the oxidation of ferrous ions to ferric ions. Further development of this technology has shown benefit in precious metal (e.g. gold) and base metal (e.g. nickel) leaching. Subsequently, successful development work has been carried out on pilot scale at various nickel refineries using the technology to enhance the leach kinetics in the atmospheric oxidative leaching of mattes and alloys.

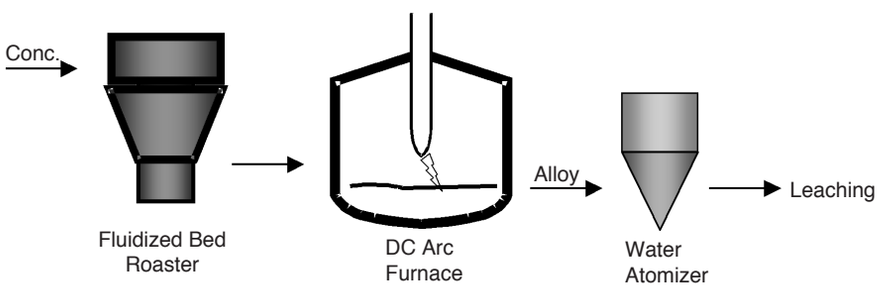

Figure 3. Simplified flowsheet of the ConRoast process

IPt will be licensed to utilize this technology in the envisaged base metals refinery, and this will lead to significant reductions in leaching times and capital investment. As part of the development programme, this technology will be integrated at a pilot scale with the ConRoast technology, to form a seamless treatment concept from concentrate to final PGM concentrates and base metals.

Combined technology benefits

The combined effect of using Mintek's ConRoast Technology and Atomaer's ILMO Technology will lead to several benefits in the process. In brief these are as follows:

Capital costs

Capital costs for the process can be reduced through the possible combining of the drying and roasting steps for concentrates, through the single-source production of good strength SO_2 gases, through the simplicity of acid plant design, through the removal of the converting operation, through the removal of matte handling equipment, through the removal of slag cleaning furnaces and mill and flotation plants, through the reduction in leach times for the PGM-containing alloy, and through the absence of a sulphur removal step within the base metals refinery. The additional capital for iron removal within the leaching facility is not expected to add significant capital in light of the savings mentioned above.

Operating costs

Operating costs for the process chain follow a similar pattern to that established with capital costs. Simplified gas cleaning and acid production facilities will lead to lower opex. No fugitive gases beyond the roasting operation are expected because essentially all of the sulphur is removed in that single early operational step. Drying costs are integrated with roasting costs and lead to a saving owing to the elimination of another handling step. Because no intermediate furnace matte is produced, and does not require handling (whether in hot or granulated form) or storage before converting, significant cost savings are expected. In the current matte smelting process, slags are produced (furnace and converter) and these are high enough in PGMs to require further cleaning in a separate furnace, or by milling and flotation, or both. The much greater partition coefficients for base and precious metals between slag and an alloy, as opposed to between slag and a matte, will allow a clean slag to be discarded from the ConRoast smelting operation. The entire converting operation is removed from the process, as essentially all of the incoming sulphur is eliminated in the roaster: thus significant cost savings are expected. Furthermore there are no sulphur removal costs in the base metals refining operation, giving very significant operating cost savings. Slightly higher furnace operating costs (if applicable) and the added cost for iron removal in the base metals refinery are not expected to be significant in light of the above cost savings.

Technical benefits

There are several other expected technical benefits associated with the ConRoast process and subsequent alloy leaching. As already mentioned, the ConRoast process readily accepts high chrome-containing concentrates such that tolling penalties would not be required for such concentrates. This may be expected to relax concentrator operating conditions and result in increased PGM recoveries from some of the primary ores. Roasting the concentrates at the required temperatures has shown that the deleterious light metals are more effectively removed in the roaster off-gases. The lower levels of Se, Te, Sb, As, Bi, Zn, Pb, etc. in the downstream processes will lead to some simplification of those impurity removal steps and also to improved final metal qualities. The significantly greater partition coefficients for metals into an alloy will give improved recoveries across the smelting unit for all valuable metals, and particularly so for cobalt. Cobalt recoveries are expected to be double those currently experienced in the industry. Environmental compliance will be easier to achieve because of the single-source production and collection of SO_2; and, because furnace and converter mattes are not produced, the risk posed from the carcinogenic nickel sub-sulphide will not be incurred.

Conclusions

Independence Platinum, in conjunction with Mintek, has the vision, the technical strength, and the financial backing to achieve its objective of becoming a significant platinum industry player by 2010–2015.

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