The mining Industry is facing many challenges today as the demand for minerals increases; the ore bodies available are of lower quality and the ores often more complex / harder to process. Deposits are also getting more remote and more difficult to access.

Mining chemicals form a crucial part of the chain, and are absolutely fundamental to maximising recovery. The industry has both commodity and specialised chemicals – but a major issue is the level of investment required by key players to develop new and more advanced solutions, and if this will even happen to the degree necessary if the mining industry is not willing to invest in their use versus cheaper but less effective and less environmentally friendly alternatives.

Market players
The market for mining chemicals supply ranges from focussed divisions of global companies such as Clariant, GE, BASF (now owns former Cognis and Ciba chemicals businesses) and Cytec to more specialised dealers and suppliers of mining chemicals, but who also operate globally, such as SNF FloMin and Cheminova; and finally distributors, which are very numerous in local markets but may be sizeable in their own right in particular mining regions.

The global groups have the advantage of being able to provide strategically located offices in the major mining regions to provide the best possible allow local support, which may include manufacturing, testing laboratories and service personnel.

There are also the Chinese players manufacturing and exporting large volumes of mining chemicals from domestic facilities – examples include xanthate producer Qingdao Ruchang Trading and Beijing Hengju, China’s largest manufacturer of powder grade flocculants. However, most of the Chinese-made mining chemicals are not sold directly by manufacturers but almost exclusively through distributors.

As a result of the market division between lower cost product lines and more advanced chemistries, it is also true that some players have withdrawn from the market altogether, or have chosen to focus on particular areas. The downside to bulk low cost supply is a constantly changing environment at the primary feed stock supply sources, with a resulting lack of quality consistency in some cases.

Paul Gould, Global Head of Marketing and Applications, Mining at Clariant commented: “We are seeing more Chinese manufactured products available globally, either through distributors or as repackaged / resold products through some of the established brands. Over the past few years, we have seen some Chinese reagent manufactures supply ‘Building Block’ chemicals directly to customers under their own name. This trend will probably continue. This has affected the established suppliers, by causing them to withdraw from the manufacture and sale of some reagents. For example, both Cytec and Clariant have withdrawn from offering xanthates.”

Colin Cumberbatch, Marketing Director at FloMin commented: “Margins are very tight in
Commodity versus specialised

Reagent chemicals are the key to the flotation process as they actively separate the desired mineral particles from the other minerals, create the bubbles that transport them, and control the overall pH of the tank at a range where the reagents work most effectively.

The main chemical groups divided by application are collectors, which act as surfactants in the flotation cell and adsorb to the surfaces of the valuable mineral particles and make them hydrophobic (water repellent) and frothers, which have the effect of producing stable bubbles in the cell for these hydrophobic particles to attach themselves to.

Other types of chemicals used include depressants, which form a polar chemical envelope around particles and depress the effect of any hydrophobic gangue minerals in the ore that would otherwise report with the froth along with the desired metallic mineral particles. There are also differential or reverse flotation systems, where depressants are used to hold down the desired mineral while floating the undesirable gangue.

Aside from flotation reagents, the industry includes the supply of extraction chemicals such as extractants and diluents; thickeners (floculants and coagulants) used either as part of a process to thicken tailings for disposal or in the refining process; bulk acids (such as sulphuric acid) used in heap leaching; cyanide for gold processing; anti-scaling chemicals; freeze control agents; lime caustic bases; flotation dispersants and dust suppressants amongst others.

By far the most widely used reagent collector compound is the xanthate family. Xanthate remains the main chemical used in sulphide flotation with volumes of over 100,000 t/y used – and were first marketed in the US in 1928, with dithiophosphates following in 1927 and finally thionocarbamates in the 1950s by Dow. Predecessors of Clariant, Cytec and Dow were all involved in the development and sales of these pioneering chemicals in mining.

Some niche chemistries have been developed as an alternative to xanthates from Cytec and others, but they are still thought to account for less than 5% of the sulphide collector market. Colin Cumberbatch at FloMin comments: “Xanthates still dominate the flotation chemicals market due to low cost and familiarity. In some areas they have performed better than other chemistries. Even though there are quality variations among suppliers, customers view them as commodities and bargain for lower prices. The difficulties in switching are compounded by the fact that engineering companies specify xanthates to be lab tested and later used in the mine. As such, budgets do not always allow for a wider range of reagent testing for optimal performance.”

The counter argument to that for continuing the status quo is that as the ores become more difficult and even the process water becomes more impure, more tailored and innovative chemical solutions will be needed. Paul Gould at Clariant comments: “There is an expression ‘the quality of today’s feed is yesterday’s tailings.’ This coupled with the pressure to mine more deposits containing polymetallic ores, and the use of poor quality water sources presents huge challenges to the industry. Investment in new reagent innovations is the key to being able to liberate and achieve economically viable recoveries in the future. There is a symbiotic relationship between the mining operations and the reagent manufacturers and needs to be recognised. If the trend towards commoditisation of mining reagents continues, the product margins that allow for new research will dry-up. This is where the mining companies can help to support their own futures.”

Cytec echoed the need for continued innovation. A spokesperson commented: “The
One opposite sides of the same mountain. Los Bronces are on the same mineral belt and an example, Codelco Andina and Anglo American use dithiophosphate collector chemistry. Ores differ widely globally and mining a similar ore type will use the same reagent blends and expertise and insights to generate consistent, quantifiable improvements in metallurgical, operational and financial performance. 

It is also true that not all xanthates are the same. Thomas Velgaard, Global Portfolio Manager – Fine Chemicals at Cheminova commented: “On a volume basis, xanthates are the largest class of sulphide mineral flotation chemicals used. However, this is not necessarily because of lower prices since the workhorse potassium amyl xanthate (PAX) has gotten quite expensive due to the dramatic rise in amyl alcohol price. Particularly due to the high PAX price and also the continual attempt to replace xanthates and there has been some success with using dithiophosphate chemistries and dithiocarbamates.”

Mine specific solutions are important, as it is by no means the case that each operation using a similar ore type will use the same suite of chemicals. Ores differ widely globally and often in small, but significant ways. But this means there is no single mechanical and chemical configuration that could be classed as “standard” for one ore type globally. For example, Codelco Andina and Anglo American Los Bronces are on the same mineral belt and one opposite sides of the same mountain.

They both are floating similar copper sulphides yet one of them uses sodium isopropyl xanthate (SIPX) and diethyl dithiophosphate (DTP) and the other is using O-isopropyl-N-ethyl thionocarbonate (IPETC) as a flotation collector.

Tailoring the right reagents for a specific ore and operation may only make a 0.5-1% difference in metal recovery, but with high metal prices this difference makes it worth finding the right one. Mining reagents cannot be treated as an ingredient in a finished product; core characteristics change which affect the composition of the feeds and may even impact the process water conditions. As a result, reagents can bring significant benefit to the performance of the mine or refinery when used wisely.

Nicole Richards, Global Marketing Director, Cytec told IM: “Simple identification of the constituent minerals in the ores is usually not enough to guide a beneficiation scheme. Each mine is unique in the type of ore and challenges in treatment. Many times advanced methods for solving increasingly difficult problems from precious, base and industrial mineral operations are needed. Treatment programs and reagents will differ depending on many factors. Although there are no generic chemical solutions that can be used to treat a particular metal or minerals due to the complex interaction of chemical, physical-mechanical and operational factors and the different needs of the operations, there are reagents that act as a good starting point such as AEROPHINE® for copper-gold ores, AERO® XD5002 for flotation of copper ores containing iron sulphides under mild alkaline conditions, and AERO MAXGOLD™ 900 as a precious metal collector. But each mining operation requires a unique optimised chemical solution.”

Colin Cumberbatch added: “Chemical reagents are specific to each type of ore even within a mine site. One customer with two operating mills uses xanthates while the other uses dithiophosphates (DTPs). Some metallurgists may also have preference to oily collectors versus water soluble ones. There may be troublesome impurities present such as clays, which require special reagents. For each ore type – mineralogy and geology – FloMin offers several reagents based on prior success. It is difficult to predict which will meet the customer’s goals. Other operating factors such as ore changes, grinding, pH, addition points, and overall plant design contribute to performance.”

Thomas Velgaard commented: “The appropriate and optimum flotation collector(s) for a specific sulphide mineral deposit is not only impacted by the targeted mineral values being recovered, but also the gangue minerals, liberation size, mineral deportment, morphology, associations etc. Further, the flowsheet employed, operating strategies, metallurgical targets and goals, equipment, water chemistries and other factors have a great impact on optimum collector selection. Even with the same ores, if the system is changed, often the collector must be changed to accommodate and optimise the overall process system. As another example for two different sulphide copper mineral ores, tetrathedite minerals are usually best floated with thionocarbonate chemistries while a chalcopyrite ore typically optimally collected with a dithiophosphate collector chemistry.”

**Transportation and environment**

The market is already very competitive. Logistics are a key driver in the prices of mining chemicals and it often accounts for...
20% or more of the overall cost especially for overseas shipments. The suppliers have to constantly evaluate all transportation possibilities that provide the best economy of scale but that also deliver products in a manner that customers expect and on time.

Xanthates are supplied as powders and pellets in plywood covered bulk bags or drums, but for environmental and safety reasons, pellets are preferred. Dithiophosphates are supplied as liquids, while thionocarbamates as liquid and oxide collectors as liquids or pastes. Frothers are all supplied as liquids.

Paul Gould at Clariant comments: “As I explain to people who are not familiar with the mining business, our customers are often not only located at the ‘end of the earth’, but ‘down a hole at the end of the earth.’ At Clariant we understand that you cannot run a mineral processing operation without security of supply and so, Clariant Mining Solutions is a global company with strategically located resources in the major mining regions to the best possible allow local support. Local infrastructure includes manufacturing, testing laboratories and service personnel. The ability to manage inventories in a disciplined way as well as providing additional or different products a short notice due to unexpected demands helps customers’ maintain high operational uptime.”

Nicole Richards at Cytec told IM: “Transportation and logistics in the mining industry are certainly a key factor in ensuring reliable delivery and service for any supplier. Each year presents different challenges including availability, costs and reliability of transportation carriers particularly to remote and undeveloped geographies. It is important to understand and manage each situation to ensure quality service is not compromised.”

Colin Cumberbatch at FloMin adds: “Logistics are very important. Most of the mines are located in remote regions of continents and most mining reagents like xanthates are hazardous cargo. More shipping lines are making it difficult to ship xanthates by sea. Customers are also requesting pricing based on delivery to the minesite including warehousing. This is also a major challenge for global suppliers.”

Thomas Velgaard at Cheminova stated: “Transportation is not critical as in basic commodities, but because the specialty reagents are transported globally and can represent a significant cost as a percentage of the delivered cost on a per kg basis. That said, however, the reagent’s performance is significant and is differentiated typically from competitor offerings. Consequently, if a particular reagent provides improved metallurgical results versus the competitive product, that can represent a significant improvement in mining company profits, often higher than the actual cost of the reagent. So a mine will often times pay more for a superior performing product because it makes great economic sense.”

In the formulation of chemicals solutions, minimisation of environmental impact is also always taken into account. Over the last few years, requests for more environmentally sensitive reagents have become more common from the mining companies. This is change and is ahead of government regulations. Projects have even held-up due specifically to environmental concerns. Also, while ores are becoming increasingly difficult to treat, environmental regulations are becoming more stringent. Water use (or more importantly water conservation) is becoming a major concern. The industry is looking to the mining chemical manufacturers to develop specialty reagents that can meet their needs in treating difficult ores and to allow them to address the environmental and resource challenges.

Innovative chemistries are being introduced that allow regulations on waste water discharge and emission to be met and are cost effective from a total treatment cost perspective. Just as increasing metal prices now make the extraction of ‘dead deposits’ more economic, the industry foresees a similar impact from new chemistries enabling effective operation under new environmental regulations.

Clariant
Clariant has a long history of providing collectors (Flotinor, Hostaflot), depressants (Flotol) and frothers (Flotanol, Montanol) for the mining flotation process. It also supplies
the Arkomon range of products for dust control. The company describes its expertise as focusing on meeting the specific needs of customers wherever they are located, which includes iron ore in Brazil, sulphide copper ores in Chile and Peru, tin in Australia and rare earths in North America. However, whatever the ore demands, Clariant states that it is able to provide local support and expertise wherever the customer is located.

The mining business is centred on Clariant Mining Solutions, headquartered in Woodlands, Texas. This site only deals with mining and does not support other businesses. Clariant Mining Solutions was founded in 1980 and is a business unit of Clariant AG; which is the direct descendant of the multinational chemical companies, Sandoz and Hoechst. Paul Gould comments: “While Clariant Mining Solutions is global in reach, it has structured its resources to enable them to focus on local customer needs through strategically located centres of excellence, where Clariant provides regional development, service and manufacturing.”

With the more complex requirements of polymetallic ores, rare earths and lower grade deposits, Clariant states that it is continuing to develop chemistries to meet these challenges. This includes expanding its operational reach, broadening and deepening its product portfolio and enhancing technical and service offerings through the addition of skilled and knowledgeable personnel who are experts in their fields. Under the byline, “Performance and Value Delivered”, Clariant Mining Chemicals states that it now seeks to partner with its customers to help them meet the challenges of harder to process and lower quality ores through investment and innovation.

Gould is very upbeat on the current market. He comments: “Before joining Clariant, I held mining marketing roles for both Nalco and Cytec, and right now the mining industry is the hottest it has ever been. Chemical companies who formerly had no or little mining products are adding flotation and/or solvent extraction reagents to their portfolio the hope of cashing in. However, the familiar ‘family values’ of mining reagents remain as important to our customers as they have ever been. These are performance, value, service and security of supply.”

Cheminova

Cheminova manufactures high quality dithiophosphate sulphide mineral flotation collectors under the Danafloat brand. Thomas Velgaard commented: “Our product line is augmented with a number of other specific sulphide collector chemistries to ensure that a sulphide mineral flotation technologist has the reagent tools needed to capture the flotation opportunities and to resolve issues that are presented.” On a segment basis, Cheminova’s primary sales are to copper, lead-zinc, and gold-silver mines but have collector sales to other sulphide mineral applications. The company believes that its key advantage is its ability to leverage its organo-phosphorus chemical manufacturing expertise and size to produce the best quality sulphide reagents. The products are produced with state of the art reactor trains that are fully monitored and controlled. The mining chemistries are actually manufactured starting from base elemental phosphorous and sulphur raw materials so Cheminova has complete control on quality as well as the production efficiencies this provides.

Cytec

Cytec Industries is a global leader in specialty mining reagents and has been supplying the mining industry for nearly 100 years. Nicole Richards comments: “Cytec has been
redefining the boundaries of mineral processing, enabling our customers to achieve optimal productivity while meeting complex economic, environmental and metallurgical challenges. Our expertise is in three main areas of mining: alumina processing, mineral processing and solvent extraction. In our main products we are the global leader both in terms of application expertise and market share with on-site technical assistance provided on a global basis. Our customers expect and receive application support as an included element of the Cytec offering.

In minerals processing, Cytec offers specialty collectors, frothers and modifiers, dewatering agents and antiscalants. Other proprietary tools include diagnostic software, statistical process analysis and design, as well as specifically developed laboratory and field tests; many of which have become industry standards.

Solvent extraction of metals remains a core part of Cytec’s business, and the company provides highly selective reagents primarily for copper, cobalt, nickel and several rare metals. These extractants provide plants with enhanced kinetics, productivity and throughput. Cytec currently has two distinct product families in this area: organophosphine based-extractants offered under the trademark CYANEX®, and its hydroxoxime extractants offered under the trademark ACORGA®.

In alumina processing, its products range from bauxite handling aids to hydrate dewatering. Cytec technologies bring new efficiency to all aspects of the Bayer process used in alumina production.

GE Water & Process Technologies

As stated, water is becoming an increasing important resource, and management of water resources (covered in-depth in IM’s forthcoming July issue). Mining and minerals processing companies are turning to advanced water reuse and conservation solutions as they need reliable supplies of clean water for extracting and processing ore and other materials. GE is one group that is able to offer a complete set of chemical and equipment solutions to help companies improve how they manage their water resources for mining and mineral processing activities. This includes integrated discharge water management/reuse solutions for water recovery, treatment and recycling; and dust control technologies including underground ramp, mine service, haul road and materials handling treatments that are engineered to help reduce water usage and operating costs.

A range of chemical treatment solutions are offered to control fugitive dust emissions while achieving water reductions of up to 90%. GE’s dust control approach combines water with an environmentally friendly chemical treatment. Once the product is applied, it renders road surfaces hard, dust-free and non-slippery for an extended period.

GE has a mobile water treatment fleet – the largest in the world – which meets the demand for on-site water treatment through emergency and short-term leases and long-term outsourcing. A complete range of membrane and filtration technologies also provides influent treatment for a diverse variety of non-potable water sources. The group also offers Zero Liquid Discharge (ZLD) systems use advanced evaporation and crystallisation technologies that eliminate wastewater discharge and enable recovery of valuable by-products. Other GE technologies enable heavy metal removal to improve wastewater quality and water treatment systems to provide deposit and corrosion control in mining process systems.

Distinct chemical solutions include boiler, cooling and industrial process chemicals — and monitoring to improve plant productivity while safeguarding assets to ensure environmental protection.

Umit Turunc, Global Product Manager, Mining Chemicals at GE told IM “GE offers water and process technology solutions to help operators address calcium carbonate fouling and various scaling issues associated with the cyanide leach process, which requires vast amounts of water. Fouling restricts flow in piping, pumps and in distribution emitters. It also causes scaling on the activated carbon and all system hardware. In the gold leach process, calcium in the solution may be the result of calcium ions already present in the water or from the addition of lime for pH adjustment. Carbonate can be contributed by freshwater addition or by adsorption from the air. Increasing the pH, temperature, conductivity, alkalinity, or any ionic species concentration, will increase the scaling potential by moving the equation equilibrium to the right. Suspended solids in the system will also promote calcium carbonate precipitation.”

Not all system fouling is attributed to scale deposits. It may be the result of mud transported into the system, sludge pumped from the ponds, carbon fines or other foreign debris. Also, not all scales are composed of calcium carbonate; however, in the cyanide leach circuit, a very large percentage of scale is calcium carbonate. Scale that is made up of other species usually will not deposit if calcium carbonate is controlled.

An examination of the deposit will reveal which type of fouling is present. Controlling the negative effects of scale formation requires strict management control of operations. Understanding that most gold leach circuits are carbonate-limited more often than calcium-limited also helps. When adding a reagent that increases the carbonate or bicarbonate concentration or elevates pH, it must be done at a location that will permit harmless precipitation to occur.

GE offers water and process technology solutions to help operators address calcium carbonate fouling and various scaling issues associated with the cyanide leach process, which requires vast amounts of water. Fouling restricts flow in piping, pumps and in distribution emitters. It also causes scaling on the activated carbon and all system hardware. In the gold leach process, calcium in the solution may be the result of calcium ions already present in the water or from the addition of lime for pH adjustment. Carbonate can be contributed by freshwater addition or by adsorption from the air. increasing the pH, temperature, conductivity, alkalinity, or any ionic species concentration, will increase the scaling potential by moving the equation equilibrium to the right. Suspended solids in the system will also promote calcium carbonate precipitation.”

Not all system fouling is attributed to scale deposits. It may be the result of mud transported into the system, sludge pumped from the ponds, carbon fines or other foreign debris. Also, not all scales are composed of calcium carbonate; however, in the cyanide leach circuit, a very large percentage of scale is calcium carbonate. Scale that is made up of other species usually will not deposit if calcium carbonate is controlled.

An examination of the deposit will reveal which type of fouling is present. Controlling the negative effects of scale formation requires strict management control of operations. Understanding that most gold leach circuits are carbonate-limited more often than calcium-limited also helps. When adding a reagent that increases the carbonate or bicarbonate concentration or elevates pH, it must be done at a location that will permit harmless precipitation to occur.

GE offers water and process technology solutions to help operators address calcium carbonate fouling and various scaling issues associated with the cyanide leach process, which requires vast amounts of water. Fouling restricts flow in piping, pumps and in distribution emitters. It also causes scaling on the activated carbon and all system hardware. In the gold leach process, calcium in the solution may be the result of calcium ions already present in the water or from the addition of lime for pH adjustment. Carbonate can be contributed by freshwater addition or by adsorption from the air. Increasing the pH, temperature, conductivity, alkalinity, or any ionic species concentration, will increase the scaling potential by moving the equation equilibrium to the right. Suspended solids in the system will also promote calcium carbonate precipitation.”

Not all system fouling is attributed to scale deposits. It may be the result of mud transported into the system, sludge pumped from the ponds, carbon fines or other foreign debris. Also, not all scales are composed of calcium carbonate; however, in the cyanide leach circuit, a very large percentage of scale is calcium carbonate. Scale that is made up of other species usually will not deposit if calcium carbonate is controlled.

An examination of the deposit will reveal which type of fouling is present. Controlling the negative effects of scale formation requires strict management control of operations. Understanding that most gold leach circuits are carbonate-limited more often than calcium-limited also helps. When adding a reagent that increases the carbonate or bicarbonate concentration or elevates pH, it must be done at a location that will permit harmless precipitation to occur.
One area of progress has been in xanthate alternatives. Richards comments: “There are limitations with the use of xanthates and other technologies are now being used within the industry. In addition, there are safety, health, and environmental issues related to the usage of xanthates; they are combustible, self-ignite /explode, and release toxic gases such as CS₂, COS, etc during storage, shipment and usage. Based on a desire to provide the industry with sustainable solutions, Cytec has developed the XR Series of xanthate replacement products that exhibit a metallurgical profile very similar to that of the xanthates while mitigating the Safety Health and Environmental (SHE) concerns. In addition, this new series of products is cost competitive compared to xanthates. Solving customer needs with novel technology does not necessarily mean higher cost reagents. Cytec focuses on solving our customer needs while offering an attractive value proposition.”

SNF FloMin
Based in Baytown, Texas, FloMin produces a complete range of xanthates (it is the second largest exporter from China), liquid collectors, promoters and depressants for the mining industry. It maintains an inventory of a wide range of frothers from MIBCs to glycol ethers to specialty alcohol blends. For solvent extraction the company offers several modified aldoximes, DEHPA and Ionquest 290 extractants. Industrial minerals markets are supplied with fatty acids, petroleum sulfonates, surfactants, dust control agents, defoamers, and dewatering aids. The parent company SNF is the largest producer of water soluble polymers worldwide including flocculants, dispersants and coagulants as well as feed equipment.

In terms of new product development at the group Colin Cumberbatch comments: “There have not been many entirely new chemistries in the market, though there are variations to existing thionocarbamates, dithiophosphates and dithiocarbamates. FloMin has employed some novel approaches to blending existing chemistries have yielded some very impressive products. A large impact has been made by customising frothers rather than using standard MIBC or glycol ethers. Also, there is an emphasis on placing alternative collectors inside of xanthate pellets. We expect to see growth in this area.”

The company also stated that it is benefitting from a more broad approach by mining chemical customers: “More customers are open to test reagents from multiple suppliers. In the past it was perceived that only a handful of companies were the only credible global supplier of specialty promoters. Successful implementation of FloMin reagents in new mines and switched sourcing from some large mines has given us invitations from others.”

ArrMaz
ArrMaz Custom Chemicals is an interesting player, as it supplies mining chemicals mainly for the phosphate mining and industrial mineral sectors. This includes anionic collectors, cationic collectors, frothers, pH modifiers, defoamers, polymers, rheology modifiers and depressants. In this niche, it is the market-leader. These industrial minerals also require customised chemical suite solutions. Guoxin Wang, Director, Flotation Technology, at ArrMaz comments: “All our flotation collectors are custom-made based on the ore-body characteristics including geological formation and mineralogical composition. For example for phosphate ores, Florida phosphate is sedimentary with silica and clay as main gangue minerals, for which we use anionic collector to float the phosphate, then use cationic collector to further lower the silica content from the rougher concentrate. Even for the phosphate mines in central Florida, we have to formulate the collectors specifically to meet the needs due to difference of ore bodies. For some phosphate deposits in China, the main gangue mineral is dolomite with minor silicate, for
which reverse-flotation scheme is applied. We use custom-made anionic collector to float carbonate minerals out to lower MgO and concentrate the P₂O₅. For our craft, it truly is orebody specific, which is also affected by processing scheme at each location which can also vary significantly.”

The group states that some phosphate flotation customers are looking for alternative products from ArrMaz from their traditional suppliers due to short supply and pricing. In terms of new development, the company states that it is constantly working on maximising its reagent performance and cost.

For example, it has developed a series of carbonate flotation collectors which can be used extensively for carbonate minerals flotation from phosphate ores worldwide. ArrMaz has also discovered a surfactant to strengthen anionic collectors for silica sand flotation.

Unlike other mining chemical markets, so far China has not supplied any chemicals similar to those ArrMaz specialises in for phosphates and industrial minerals out of China. Conversely, the group is trying to enter China market to meet China’s needs for chemical solutions in these non-metallic minerals areas. ArrMaz is also introducing its flotation collectors to other industrial minerals industries such as calcium carbonate to help raise customer product standards.

**BASF**

BASF’s Mining Solutions business unit operates globally offering a diverse range of mineral processing chemicals and has grown significantly with the acquisitions of Cognis in 2010 and Ciba in 2008. It describes its current strengths as lying in solid liquid separation and solvent extraction; however, the group also has reagents that support other mineral processing applications, such as flotation, grinding and agglomeration.
Martin Neale, Global Marketing Industry & Strategy Manager at BASF comments: “Within this industry over the last few years, there has been an increased focus by customers to maximise recovery of water/valuable minerals utilising reagents to improve process efficiencies and minimise waste. BASF as the world’s leading chemical company has therefore aligned its offering to meet the challenges faced by the industry through performance improvements of existing offerings and via new innovative and sustainable solutions. Improvements in this respect potentially yield massive savings to mine operators, both in operational costs and reduced capital investment requirements.”

BASF also recognises that the mining industry faces many challenges and issues relating to the use of water and the impact of exploration, extraction and residue management on the environment. In order to address this, the company has developed the Rheomax DR (Density & Rheology) range of advanced flocculants. In addition, Rheomax ETD (Enhanced Tailings Disposal) is a patented, novel method of tailings management in which technology is used to change and control the structure and drainage properties of mineral processing residues.

In terms of the commodity versus specialised debate, Neale tells IM: “Commodity offerings are generally considered to be low priced due to the large volumes and high market saturation of suppliers. Specialty offerings, particularly those that are linked back to crude oil as a key raw material are usually confined to a limited number of specialist producers. For specialty chemicals no new suppliers have really developed in recent years. It is felt this is due to customers requiring a high level of process/application service support coupled with global reach, which new entrants find difficult to meet.” He adds: “Many chemicals that are used in the industry can be considered to be mature and whilst they may still be defined as “fit for purpose” they are not necessarily the most effective offering from either an environmental or performance perspective. As a leading chemical supplier BASF continue to invest in innovation and sustainable solutions to solve the industries issues.”

Axis House
South Africa-based Axis House supplies a full range of mining reagents to mineral processors. The range includes flotation reagents such as collectors, depressants, froth modifiers and flocculants; leaching reagents would include pH modifiers, acids, flocculants, solvent extractants and diluents. Axis House is known for the pioneering work that has been done in its in-house laboratories in Cape Town and Sydney developing specifically tailor-made oxide mineral flotation agents, the co-development of a low flash-point diluent, as well as being involved in the development of higher performing precipitation agents in copper and cobalt circuits.

In 2008, Axis House acquired the chemical business from ASX-listed Ausmelt. This broadened the company’s oxide flotation offering of sulphidisation reagents (and their successful application); modified fatty acids and amines (Rinkalore range) to also include the Ausmelt range of hydroxamate oxide collectors. This move enabled Axis to offer a full range of oxide flotation reagents. Trevor McLean-Anderson, Managing Director commented: “Owning the technology also allows us to improve it, something we do in conjunction with our clients and AECI group company Industrial Oleochemical Products.”

In the flotation of oxides it used to be thought that sulphidisation was the only commercial route available to plant metallurgists, but Axis House has been supplying modified fatty acids and amines for this purpose since its inception - and Ausmelt flotation reagents have now been used commercially on more than eight plants internationally. IM