Going for garnet

The industrial garnet market in North America and Europe is a niche, but not insignificant, sector. In recent years, demand for garnet in waterjet applications has shown particular promise. The following article is based on a presentation given at the 16th Annual Canadian Conference on Industrial Minerals in Toronto, 19-20 October 2004. It was prepared by Washington, USA-based mineral consultant, Jim Hansink, on behalf of Freeport Resources Inc., a junior exploration company, with garnet interests in Labrador, eastern Canada.

Garnet supply in North America

Garnet has been mined and used for various abrasive applications in the USA and Canada for nearly 150 years. The discovery of garnet-rich rocks in the eroded core of the folded metamorphic rocks of northern New York state created a local industry that survives to this day. Barton Mines Company LLC. operates a mine and mill complex in the area. It continues to serve markets it helped establish in past decades.

In more recent years, alluvial garnet has been produced from stream and river gravel deposits in the mountains of northern Idaho. Here, WGI Heavy Minerals Inc. operates the Emerald Creek Mine Co., which helped establish the initial US market for garnet in both the blast cleaning and filtration business sectors.

Other garnet production facilities and garnet imported into North America from India and Australia have combined to meet the demand as it has developed. Deposits of quality garnet that may or may not come onto the market in the near future are known to exist in Canada, Mexico, and in the USA. Similar deposits are known in China and Sri Lanka. These later deposits, together with current producers in India, suffer from uncertain ocean freight rates to North America; rates that may far exceed the FOB cost of the mineral.

Abrasive waterjet cutting

Perhaps the most exciting market for garnet is the waterjet cutting industry. Patented in the early 1980s, this emerging computer-based technology uses ultra-high pressure water forced through very small nozzles to cut a wide range of materials. If fine garnet is introduced into the flow, precision cuts become possible in a wide range of materials, from titanium metal to glass.

In comparison to lasers, which operate at high temperatures and are limited to cutting 1.3-2cm thick material, abrasive jets are more versatile and more cost-effective. Commonly used on 10cm thick metal, waterjets can cut up to 25cm steel and 60cm glass at slow speeds, or surface etch for decorative purposes. Any complex two-dimensional shape may be machined with high precision and excellent quality finish. Some waterjet machines cut with a tolerance of +/- 0.005 cm. For these reasons, the aerospace industry makes extensive use of this technology.

Abrasive waterjet cutting is less than twenty years old and already has an American trade association and benefits from US government-funded research. Total demand for this sector is difficult to estimate, and published figures range from as low as 15,000 to over 30,000tpa. The market has a historic growth rate of over 12% annually; a rate that, although flattened during the recent recession, has remained positive. Future growth rates are expected to be in the 5-7% range. Presently, waterjet is most popular in North America and Europe and is a relatively recent technology in the Far East.

Waterjets utilise garnet in the 0.30-0.15mm size range. Users require a high degree of product cleanliness and processing consistency. Although large users exist, most abrasive waterjets are owned by small "jobbers" or machine tool shops. As a result, sales are made in small lots.

As waterjet demand continues to grow, the shift in emphasis from coarser to finer grains will cause suppliers and mining companies to restructure operations to meet the new demand. Emerald Creek Garnet Co. already crushes some of its very coarse material to make finer waterjet material. Ernst Flow Industries Inc., the leading waterjet equipment manufacturer, purchases garnet from WGI Heavy Minerals Inc. in India and markets it worldwide as #80 Paser Plus for use in waterjets. GMA Garnet Ltd., with a relatively large percentage of its mine-run material in the finer size ranges, is in a good position to benefit from growth in this market.

Barton Mines has positioned its garnet at the high end of the quality spectrum and commands a price premium. Other suppliers try to approach the perceived Barton quality as closely as possible, but price their material to attract new customers in the shortest possible time. This has led to a 'stratified' market.

Fig 1: North American supply statistics (estimated)

SUPPLIER	LIMIT(tonnes)	COMMENTS
Barton Mines, New York	23,000	Competes with others only in waterjet cutting; angular grains (crushed)
Emerald Creek, Idaho	23,000	Pushing into waterjet sector; sub-round ed grains (alluvial)
China and India	28,000	Sold in Europe, Asia, N. America; sub-rounded grains (alluvial)
GMA imports, Australia	23,000	Currently about 15,000; sub-rounded grains (alluvial)
Others	3,000	Few potential new suppliers
TOTAL	100,000	

Abrasive blast media

At this time, the largest North American market for industrial garnet is in abrasive blast cleaning which is commonly known as sandblasting. In abrasive blasting, a grain of material is held in a pressurised steel pot until released through a system of hoses and a nozzle to impact a surface. The grain, often traveling at velocities approaching the speed of sound, cleans the surface through a combination of "cutting" through layers of dirt

Fig 2: North American demand for abrasive blast media

ABRASIVES	TONNES	COMMENTS
Silica sand	1,500,000	Slowly being restricted by OSHA
Coal slag	600,000	Future supply in doubt
Copper slag	60,000	Limited supply; environmental risk
MINERALS		
Staurolite	80,000	Very fine grained; limited future
Olivine	30,000	Limited availability; dusty
Garnet	35,000	High perceived cost; regionally limited availability
Steel abrasives	300,000	High related capital cost
TOTAL	2,605,000	

and paint, and through a mechanical action of disrupting the surface through shock impact. Nearly any material of the proper size to pass through the pneumatic system with sufficient mass to carry energy can be used as a blasting abrasive.

To sum up, the perfect blast media are: heavy and hard enough to be effective; durable enough to resist breakdown on impact (low dusting); angular enough to cut through paint and to roughen the surface; free of toxic substances that are harmful to man or the environment; available from local stocks to minimize delivery problems; and low in purchase cost.

Silica sand, still widely used in North America, has nearly all these attributes, but carries serious health risks. Smelter slags are safer but often contain heavy metals perceived to present other health or environmental risks. Steel abrasives eliminate many of these risks, but are quite costly, requiring purchase of recycling and related equipment to justify their use. Other minerals such as garnet offer alternatives that meet some, but not all, of the listed attributes.

In abrasive blasting, nearly any sizing shown to be effective can find a market niche. Garnet sizes used for blast cleaning range from very coarse material (about 2.0mm) used in some specialized recycling applications to fine grained (0.15mm) material used to clean aluminum and thin steel. Most blasting is done with material in the 0.8 x 0.5mm and a slightly finer 0.6 x 0.2 mm size range.

The growth rate of demand for garnet blasting abrasives is about 5% per year. As governments continue to stress the importance of eliminating silica from the workplace, it is reasonable to expect growth rates exceeding 10% per year in coming years. In the USA, the Occupational Safety and Health Administration (OSHA) is currently evaluating new regulations that would significantly restrict the use of silica sand as a blast media.

All producers offering garnet to the US market must meet the minimum standards set forth in International Standards Organization (ISO) and Steel Structures Painting Council (SSPC) specifications. The most important of these are shown in fig 3:

Current prices for abrasive blasting products are from $380-760/tonne, just slightly lower than waterjet-grade material. In some areas, such as India, increased waterjet production has created excess supplies of coarser blasting grades, resulting in short-term reductions in pricing for blast media.

Water filtration

The third major market for garnet grains is in single or multi-media, high-density sand filters. The use of garnet as a high-density layer under the sand and anthracite layers can increase the efficiency of the filtering process in some areas.

The technology for this application was patented in the early 1980's using WGI Heavy Minerals' Idaho material as the standard. The technology and the patents are now in the public domain. Much of the original design work using garnet was done with WGI Heavy Minerals' #8/12, #3040, and #50 materials.

Fig 3: ISO and SSPC Specifications

ITEM	LIMIT
Free Silica	Less than 1.0%
Soluble Chlorides	Less than 25 ppm
Toxic Metals	Within Environmental Protection Agency limits (EPA)
Friability	California Air Resources Board (CARB)

Fig 4: Garnet demand in North America (000 tonnes)

Demand Sector	2002 Demand	% of Demand	——2007 Demand——	
			Low	High
Abrasive Blasting	26	41%	35	60
Waterjet Cutting	18	29%	37	50
Filtration	09	14%	12	15
Other (powders, etc.)	10	16%	12	15
TOTALS	63	100	96	140

Other sizes are rarely used in the filtering process.

The total North American market for garnet filtration sands is estimated at about 9,000tpa. It is not clear whether this market is growing or if it is static. The demand is highly dependent on the decision of contracted engineering firms as to size and filter type to be employed.

Other markets

Garnet is occasionally used in other markets. None of these, however, present important short-term investment opportunities. Use of garnet as an anti-skid additive to paints and floor tiles is well established, but the market is so highly segmented that no suppliers have made an effort to control it. It offers a good future application as garnet is significantly less expensive than aluminum oxide.

Garnet is also ideal as a substitute for higher cost aluminum oxide used in blast cabinets, but sales to individual users are small and are best done by a dedicated distributor. An opportunity may exist to form a business alliance with one or more manufacturers to introduce a branded cabinet media.

Future demand in North America

Fig 4 illustrates current and possible future demand, as both a high and low case, based largely on further restrictions on the use of silica sand as a blast media. "Other" uses include powders and special markets presently served exclusively by Barton Mines.

Although there is excess overall capacity in the system at the current time, the imbalance of particle sizes needed to meet specific market demand will influence the availability (and therefore the prices) of many current products.

It is also worth remembering that not all potential supply tonnage is available for each separate market. For example, GMA cannot compete for medium/coarse blast product for heavy maintenance painting demand, and Barton's crushed garnet from its hard rock mine is far too expensive to attract buyers in abrasive blasting or filtration.

Added to this, there are regional distribution patterns. For example, Los Angeles is now oversupplied with garnet, but some cities in the east suffer from shortages in some sizes. Waterjet garnet is reportedly in high demand in the east and northeastern USA. Canadian statistics are not as reliable, but high demand is known in the south eastern region. Producers have attempted to resolve availability issues by establishing regional warehouses and by creating new distributors.

These signals suggest that future markets for garnet remain very bright.