What are Industrial Minerals? Published on LinkedIn 29th April, 2019. Andrew Scogings

Is this your perception of the Industrial Minerals space? Think again!

Industrial minerals – we can't live without them – but what are they?

Although industrial minerals are often viewed as "*unglamorous, mundane or rubble*" to quote Mike O'Driscoll of IMFORMED www.imformed.com, we are surrounded by a huge number of everyday domestic and industrial products that would not exist were it not for industrial minerals. For example, a home and contents might have industrial minerals incorporated into, or consumed in the manufacture of a range of products:

- Plastics such as garden furniture, and Paint (kaolin, talc, mica, calcium carbonate, mica, wollastonite)
- Glass e.g. windows and glassware (silica sand, soda ash, limestone, dolomite, feldspar, lithium minerals and borate, in addition to refractory minerals like alumina and graphite used in furnaces to melt the glass)
- Ceramics including crockery, toilets, basins and tiles (silica, kaolin, feldspar, talc, zirconia, refractory minerals)
- Counter tops (dimension stone)
- Plasterboard walls and ceilings (gypsum)
- Bricks (clays, pigments, refractory minerals)
- Steel and aluminium (refractory minerals, bentonite for pelletising iron ore)
- Salt (halite)
- Beverages e.g. wine, beer and fruit juice (diatomite, bentonite, perlite)
- Cooking oil (bentonite)
- Cat litter (attapulgite, bentonite, sepiolite)

- Smart phone and EV / car (lithium minerals and compounds, graphite, plastic and paint fillers, glass-making minerals).

The Industrial Minerals Association of Europe www.ima-europe.eu estimates that ~150 tonnes of industrial minerals may be used to build an average house, while a car may consume ~100 to150 kg.

So, the question is – just what are industrial minerals?

Industrial minerals have traditionally been defined as minerals and rocks mined and processed for the value of their non-metallurgical properties. They have also been defined as being non-metallic, non-fuel minerals.

Industrial minerals may be incorporated into products (e.g. as fillers in plastics and paint) or consumed in the manufacture of items (e.g. bentonite and sand in foundry moulds into which molten metal is poured). The use of industrial minerals can be traced back to the Stone Age (literally) with some products and markets listed below:

- Stone Tools - flint (Stone age)
- Amphorae / Pithoi – clay (Neolithic, Bronze Age)
- Pyramids / temples – marble cladding, structural stone
- Wool cleaning - bentonite, attapulgite (Fuller's Earth, several thousand years ago)
- Edible oil clarification - clays (1800s)
- Metal casting ('green sand' moulds) - bentonite, silica sand (early 1900s)
- Oil drilling muds - bentonite, barite and other minerals (early 1900s)
- Hydraulic fracturing (also known as 'fracking') - silica sand (mid 1900s)
- Geosynthetic Clay Liners (GCL) - bentonite and geotextiles (1980s)
- Clumping cat litter - bentonite (late 1900s)
- Li ion batteries – natural and synthetic graphite (~1990 commercial production).

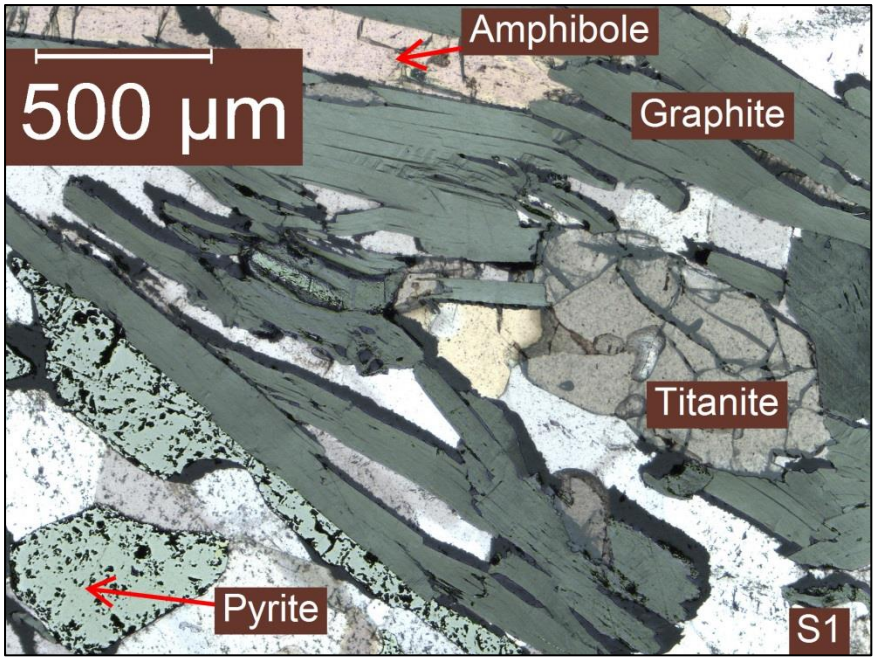
Geosynthetic Clay Liner being installed at a waste landfill site

Minerals and rocks mined and converted into industrial mineral products may be classified as **NATURAL** products and include clays, graphite, halite (salt), silica sand, stone aggregate, talc, limestone, gypsum, feldspar and mica to name but a few. Some 'ores' that are traditionally smelted to produce metals may also be used as a source of industrial minerals, including chromite which can be used as a natural pigment for glass or as sand for metal-casting, or manganese and iron ores that are natural pigments for bricks and cement.

Natural graphite is an example of a truly multi-functional industrial mineral. It has specific physical properties such as flexibility (to roll into tiny spheres for battery anodes), it's soft and hence a lubricant, it conducts electricity, is stable at high temperatures and it can be expanded and made into foil for heat sinks in computers - this list is almost endless as are the specifications for individual markets.

SYNTHETIC industrial minerals are manufactured from natural minerals and are often produced due to inferior characteristics and / or rarity of their natural counterparts. Synthetic minerals include precipitated calcium carbonate (PCC), graphite, soda ash, fused alumina and mullite. Perhaps halite derived from sea water or brine evaporation, rather than being mined, is also a synthetic industrial mineral?

Then we get to the question of industrial minerals being defined as **NON-FUEL** minerals – are fuels ever used as industrial minerals? My contention is that coal may be classified as an industrial mineral in certain circumstances, for example when it is milled into powder and incorporated into foundry sand to generate lustrous carbon which improves the surface finish of the casting. Are there other examples? Yes, lignite-based products are used in foundry sand and oil drilling mud applications, while milled anthracite can be used as a filler in plastics or polymers.



Flake graphite from Norway in thin section under the microscope. Plane polarised reflected and transmitted light

Industrial Mineral Specifications

Industrial Minerals are a lot more complex than they appear at face value, as there are a diverse (and sometimes bewildering) number of specifications for industrial mineral products. These may include: moisture, chemical purity, mineralogy, particle size distribution, particle shape, mechanical strength, colour, density, water absorption, thermal resistance, rheology, fluid loss and insulating properties.

For example:

- Drilling grade barite may be specified around SG (density), chemical and particle size parameters.
- Cat litter might have to meet moisture, particle size and colour specifications.
- Flake graphite may be specified according to moisture, particle size distribution, carbon content (purity) and bulk density.

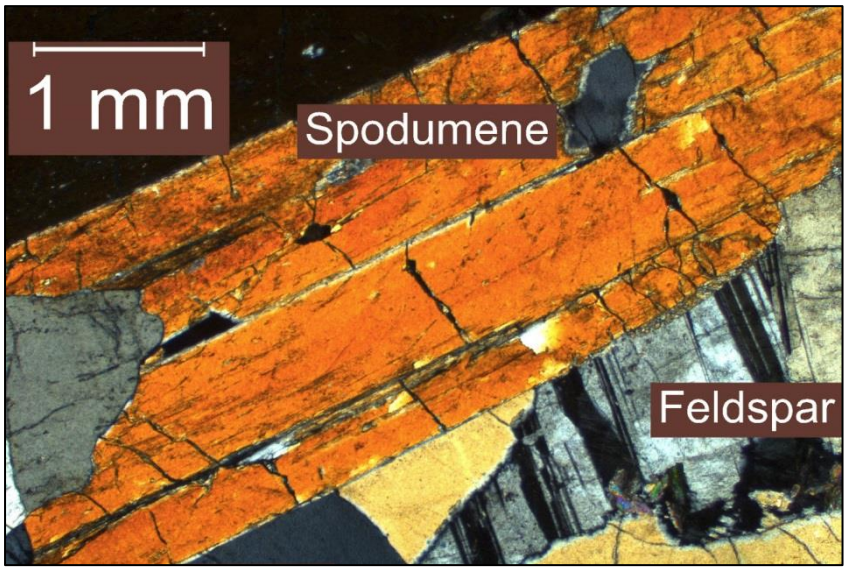
These specifications are a primary reason that Clause 49 was introduced to the JORC Code in 2012. This clause requires that: "For minerals that are defined by a specification, the Mineral Resource or Ore Reserve estimation must be reported in terms of the mineral or minerals on which the project is to be based and must include the specification of those minerals."

Laboratory filter press for measuring fluid loss of drilling fluids

So, based on the above discussion, should spodumene and petalite be classified as industrial minerals?

The lithium-bearing minerals spodumene and petalite are used as 'traditional' industrial minerals in glass and ceramic applications, but spodumene in particular is the main hard-rock source of lithium chemicals such as lithium carbonate and lithium hydroxide. Perhaps these minerals are hybrids?

Interestingly, chemical specifications apply to concentrates supplied to both the industrial mineral and chemical markets; therefore require reporting according to Clause 49.



Spodumene in thin section under the microscope. Transmitted light, crossed polars

Does it really matter which minerals or rocks are classified as industrial minerals, or what type of industrial mineral they are?

- Yes, seeing that industrial minerals could be of natural or synthetic origin and may include some of fuel origin
- Yes, especially as there are some 'hybrid' minerals which serve both traditional industrial mineral markets and chemicals / compounds markets - these are potentially a confusing 'grey area' for investors
- Yes, considering that all industrial minerals are produced and sold according to technical specifications
- Yes, seeing that industrial minerals are required to be publicly reported by ASX and NZX listed companies in accordance with Clause 49 of the JORC Code.

Bibliography

Harben P.W. (1999). *The industrial minerals handbook,* 3rd edition. Industrial Minerals Information Ltd, London.

IMA-Europe (2018). Industrial minerals sector contribution to circular economy. Pp. 1-44.

Joint Ore Reserves Committee (2012). *Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves. The JORC Code, 2012 Edition*. Available from http://www.jorc.org

O'Driscoll, M. (2019). Industrial Minerals Basics Executive Primer. IMFORMED Rendezvous, Paris, 8-10 April 2019.