Public reporting of industrial minerals resources according to JORC 2012
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THE current edition of the Australasian Joint Ore Reserves Committee (JORC) Code was published in 2012 and after a transition period, it became mandatory from December 2013. There are some changes between JORC 2004 and 2012 for the reporting of industrial mineral resources, which should be addressed by industry players. By Andrew Scogings

Recent interest in industrial minerals

Industrial minerals such as graphite and spodumene have recently become the focus of much attention for listed exploration and mining companies, partly due to developments in battery technologies related to the emerging electric vehicle market. Consequently the race has been on to report larger tonnage exploration targets and resources, with certain projects being described for example as the biggest or second biggest in the world, perhaps hundreds of millions of tonnes containing a certain percentage of a particular mineral. However, being the biggest doesn’t necessarily mean being the best and the author’s intention is to highlight the need to report resources by market-related specification.

As noted on the website of Industrial Minerals Magazine: “Without a market, an industrial mineral deposit is merely a geological curiosity.” Too many industrial minerals explorers forget the significance of this, which is a bit like the geochemical anomaly in metals exploration that remains a geochemical anomaly and never becomes a mineable resource.

JORC 2012 – Reporting resources and reserves according to specifications

The fundamental difference between JORC 2004 and 2012 is contained in an all-important new paragraph in Clause 49, which requires that mineral resources or reserves must be reported in terms of mineral specifications:

‘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.’

Further references to specifications are found in the JORC 2012 guidelines, of which excerpts are listed below:

It may be necessary, prior to the reporting of a mineral resource or ore reserve, to take particular account of certain key characteristics or qualities such as likely product specifications, proximity to markets and general product marketability.

Some industrial mineral deposits may be capable of yielding products suitable for more than one application and/or specification. If considered material by the reporting company, such multiple products should be quantified either separately or as a percentage of the bulk deposit.

It is worth noting that the word ‘specification’ is referred to no less than four times in Clause 49, demonstrating its importance in reporting according to JORC 2012.
Examples of industrial mineral specifications

Industrial minerals which are commonly defined according to size and/or purity specifications include andalusite, chromite, graphite, kaolin, limestone, magnesite and vermiculite. Other minerals and clays such as attapulgite and bentonite may be specified according to final product sizing but more importantly according to performance in particular markets and applications such as oil well drilling, cat litter, metal casting and iron ore pelletising.

A quick glance at the ‘Price Briefing’ pages in Industrial Minerals Magazine (March 2014, pages 72-74) highlights that different specifications and markets very likely command a range of prices. For example crystalline graphite may range from $US700 per tonne (medium flake +100-80 mesh, minimum 85% C, FCL European port) to as much as $1300/t (large flake +80 mesh, minimum 94% C, FCL European port). It is clear that such price variations could have an impact on the economics of an industrial minerals project.

Similarly chromite varies in price according to specification and markets, from circa $300/t for chemical grade to circa $500/t for refractory grade FOB South Africa. The chromite price is generally directly related to specifications such as particle size, silica content and Cr/Fe ratio.

From these examples, it is obvious that when publicly reporting an industrial mineral resource it is insufficient to simply report a tonnage and the contained percentage of the mineral. Not only is this contrary to JORC 2012 requirements but it could be misleading to investors. Let us take the case of a hypothetical graphite resource reported as 200 million tonnes at 10% graphite. Essentially all this tells us that the resource contains 10% in situ flake graphite, but it tells us nothing about i) the size range of graphite flakes, ii) the likely purity of extracted graphite flakes, iii) impurities such as sulphides that may impact on mineral extraction, nor iv) possible markets.

The same would apply to a vermiculite deposit, where flake size and exfoliation characteristics are required to be reported. In the case of clay such as bentonite, simply reporting a tonnage based on purity measurement (e.g. Cation Exchange Capacity or XRD mineralogy indicative of montmorillonite content) conveys no meaningful information as to possible market applications – if any. Individual bentonite deposits may have similar montmorillonite content, but perform entirely differently in markets as diverse as paper manufacture, metal casting or oil well drilling. Bentonite quality may also be affected by depth of weathering, whereby “blue” bentonite is oxidised to a yellow colour at shallow depths and may have improved performance in drilling products, despite having identical CEC and montmorillonite content (Figure 1).

Appropriate quality tests (assays)

The responsibility falls on the competent person to ensure that exploration samples are tested for appropriate parameters in addition to basic tests for mineral content.

- Individual or appropriate composite samples should be evaluated according to size, purity of extracted minerals and/or market performance specifications.
- It may be difficult to find a commercial
higher viscosity in drilling mud applications. Source: AMCOL Minerals Europe.

Methods will have to be developed internally.

- Some test methods are industry standards, such as bentonite slurry viscosity and are available from bodies like the American Petroleum Institute.

For example, bentonite may be characterised by a number of metrics such as purity, chemistry and exchangeable cations:

- Moisture in situ and “as tested”
- Purity – montmorillonite vs inert minerals (Cation Exchange Capacity in meq/100g)
- Ca, Mg and Na Exchangeable Cations
- XRF (chemistry)
- XRD (mineralogy)
- Swelling in water
- pH

However these measures don’t necessarily indicate how the clay might perform in various applications; therefore a range of tests may be required to determine market opportunities including:

- Water absorption (iron ore and chromite pelletising)
- Viscosity (drilling mud)
- Fluid loss (drilling mud)
- Thermo gravimetric analysis (metal casting) - refer to Figure 2
- Green, dry and wet tensile strength (metal casting)
- Clump strength (cat litter)

Conclusions

When publicly reporting industrial mineral resource or reserve estimations according to JORC 2012, which has taken effect from December 2013:

- It is no longer sufficient to simply report a resource of contained industrial mineral.
- The estimation must include the specification of those minerals if those minerals are defined by a specification.
- If multiple products are possible from a deposit, such multiple products should be quantified either separately or as a percentage of the bulk deposit. A typical example could be a bentonite deposit that yields metal casting and drilling products from different parts of the deposit based on weathering domains.
- Proximity to markets and general product marketability should be taken into account.
- Specific market-related testing and/or metallurgical testwork are very likely to be required for industrial minerals deposits. It is not good enough to rely on traditional mineralogical or chemical purity (assay grade) tests as commonly used in metals exploration.

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Figure 2. TGA analysis of an Australian bentonite. Dehydroxylation peak at 695°C suggests high thermal durability. Source: AMCOL International