

From Mark's DESK



How and why do we produce gold and copper concentrates?

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On Friday 3rd March, the Ministry of Energy and Minerals issued a press release stopping the export of mineral sands on the basis that companies should be investing in building smelters in Tanzania for further processing, rather than shipping this product to other countries.

The directive has been in place for two weeks now and affects Acacia at both Bulyanhulu and Buzwagi, which produce a **concentrate** containing gold, copper and silver. North Mara is not affected.

Our CEO, Brad Gordon was in Tanzania last week to attend urgent meetings with government officials and to try and explain the impact that this ban will have on our business even while we have further dialogue on a suitable way forward to explore smelter options for Tanzania. At this stage, the ban remains in place though we remain hopeful that there will be some positive news in the near future so that normal operations can be restored.

The export of mineral sands, or in our case, the sale of gold and copper **concentrate**, is an emotive subject in every country with sovereign mineral wealth. There is a view that Tanzania is losing considerable added value by not smelting and refining **concentrates** in country, while there is another view that companies are also stealing from Tanzania by not declaring all the metals contained in the **concentrate**. These are serious issues, with serious consequences for our integrity and the sustainability and profitability of our business and the Tanzanian mining industry. For Acacia to be successful in Tanzania, we must be able to address and correct these misconceptions. Just so everyone is clear, at our mines, we generate our revenue by:

1. Producing and selling gold bars (doré) which are then refined into a more pure gold product – this accounts for 55% of revenues at Bulyanhulu, 45% of revenues at Buzwagi and 100% of revenues at North Mara
2. Producing and selling a **concentrate** which is smelted and refined to separate out the gold, copper and silver – this accounts for 45% of revenues at Bulyanhulu, 55% of revenues at Buzwagi and 0% of revenues at North Mara

Gold sales account for 95% of total revenues, with 70% coming from doré sales and 25% coming from gold contained within the **concentrate**. The remaining 5% of revenues is from copper in the **concentrate** and a very small amount of silver. On this basis, the company is currently losing 30% of its total revenue stream, and around 50% of the combined revenues of Bulyanhulu and Buzwagi. With the **concentrate** ban in place, this equates to lost revenue of more than \$1 million per day (with additional revenue lost for all of the **concentrate** sitting in Dar es Salaam waiting for shipment for which royalties have been paid).

Addressing the issue of trust

There is a perception that we do not declare everything that is in our **concentrate**. This is simply not true.

The Tanzania Minerals Audit Agency (TMAA) is present at each of our mines and even has padlocks and seals on various pieces of equipment inside the gold room so that we cannot operate them without the TMAA being physically present to verify everything that we do. Every gold bar and every shipping container of **concentrate** is sampled so that we know the content of gold, copper and silver. Four samples are taken: one for Acacia, one for the TMAA, one for the overseas smelter and one umpire sample which is kept separate and used if there is a dispute or difference between the other samples.

Further to having the TMAA on site, when it comes time to transporting the gold bars or the **concentrate**, the Tanzania Revenue Authority (TRA) is also present to observe the process. Before the containers of **concentrate** can be loaded onto trucks, we must know the value of the gold, copper and silver in the **concentrate** from the samples taken, and pay the royalty to the government. When the royalty is received in the government bank accounts, the containers are sealed by the TMAA and TRA and then trucking can commence.

What is a concentrate and why do we produce it?

How we process our ore to liberate the contained precious minerals is determined by how and why these minerals were originally formed or deposited in the rocks hundreds of millions or billions of years ago. The scientific fields of geology, mining engineering and metallurgy (mineral processing) are fascinating and require an in depth understanding of the best way to find, mine and process (extract) the payable minerals.

In general terms, when gold is the only payable mineral present (i.e. >98-99% of the value), we can process the ore on the mine site and create gold bars. At both North Mara and Geita, gold is extracted using gravity techniques for the coarse, free gold and then cyanide to leach the finer disseminated gold. Gold bars are smelted at both mines.

Bulyanhulu and Buzwagi have slightly different processes, due to the rock types at the mines which host the gold (95% of the value) and other payable metals such as copper and silver (the remaining 5% of the value). Both mines are still able to extract around half of their gold using gravity and cyanide leach techniques. However we need to use more elaborate techniques to break down the sulphide rock so that the rest of the gold, copper and silver can be liberated.

Fortunately, we can **concentrate** the sulphides using a process called 'flotation' where chemicals are added to the finely ground rock, causing the ore to float and thus separate from the waste rock. The flotation processes are very effective and allow for the gold, copper and silver to be **concentrated** into a product with much higher values and a much smaller mass than was originally mined:

- Bulyanhulu Mine can process 1.0 million tonnes of underground ore per year and, through the flotation process, remove most of the waste rock and **concentrate** the minerals into approximately 25,850 tonnes of **concentrate** containing gold and copper. That is nearly a 40 times reduction in mass which then makes the resultant **concentrate** valuable enough to sell
- Buzwagi Mine can process 4.4 million tonnes of open pit ore per year which is much lower grade and, through flotation, remove most of the waste rock and **concentrate** the minerals into approximately 25,750 tonnes of **concentrate** containing gold and copper. That is nearly a 200 times reduction in mass which then makes the resultant **concentrate** valuable enough to sell

We can never recover 100% of the gold, silver and copper from our ore. At Bulyanhulu, our gravity, cyanide leach and flotation processes are maximised to achieve the best gold recovery whilst recovering sufficient copper to make the **concentrate** worthwhile for the smelters (whose primary product is copper) to even want to purchase from us.

I trust that people understand from this brief description, that it is the type of orebody that dictates the processing options that we use. In some respects, North Mara and Geita are actually lucky because they are able to do all of their processing on site and only produce gold bars. For the Bulyanhulu and Buzwagi **concentrates**, gold is still the most important product as the copper and silver is only 10-15% of the value of the **concentrate**.

Downstream Processing

It appears that one of the main concerns causing the ban on our selling **concentrates** for export is that we should be doing **all** of the downstream processing in Tanzania because otherwise the country doesn't potentially get full benefit for its minerals. It is important to note that our gold/copper/silver **concentrates** are already a highly processed and beneficiated product.

Whilst the smelters do charge to process our **concentrate**, on average for the contract terms that we have agreed with the overseas smelters, we receive 97% of the total value of gold, silver and copper. That is because with any smelting or other chemical process, getting 100% recovery is impossible and these terms pass the risk to the overseas smelters to ensure that they can actually achieve above these recovery rates (or they will lose money). In Tanzania (if a smelter

were built), the smelter operator would need to offer competitive terms, not just on price but also on recovery of the various metals, therefore their margins would depend on their own processing costs and efficiency.

There are generally two different types of downstream treatment options to extract the gold, copper and silver from the **concentrate**: smelting and oxidation. There are three types of oxidation process: roasting, pressure oxidation and bio-oxidation. The type of process used will depend on a number of variables including the types of ore, size of facility and access to cheap power.

- 1) Smelting: involves heating the **concentrate** to 1,200°C to melt the valuable metals (gold, copper and silver)
- 2) Roasting: essentially 'cooking' the **concentrate** at 750°C and isolating the gold, copper and silver by converting the sulphur in the sulphide minerals into sulphur dioxide gas (which then produces large volumes of sulphuric acid)
- 3) Pressure oxidation: an autoclave (massive oven) operating at temperatures of 190 - 225°C and high pressures of 1.9 - 3.2 MPa (many components constructed from titanium due to the aggressive conditions)
- 4) Bio-oxidation: use bacteria in a liquid wash at 42°C, which literally 'eat' the sulphide away from the contained gold, copper and silver

There is a lot more detail which can be provided to explain these various processing techniques, though in each case the copper is first separated from the gold and silver and these are treated separately to get the final metal product.

If our mines were able to build dedicated downstream processing facilities, they would be tiny compared to the large commercial smelters. Furthermore, power costs in Tanzania are high compared to other countries with developed smelting industry. When the mines were being built (Bulyanhulu in 1999-2000 and Buzwagi in 2007-2008), studies showed that it was far more cost effective to sell the concentrates to large commercial toll smelters with access to cheap power rather than build our own. We currently sell our **concentrate** to smelters in Germany, China and Japan.

Based on the current mine plan, Buzwagi will only produce **concentrate** for another 18 months, after which time, when it is processing the low grade oxide stockpiles, it will not recover any copper and all gold will be recovered by gravity and cyanide leach. This will leave Bulyanhulu as the only large scale mine in Tanzania which produces a **concentrate**.

What do you think?

As employees of Acacia, or contractors working at the Acacia mines, or family and friends, you will no doubt wonder why there is no smelting facility for our gold, copper and silver **concentrates** in Tanzania.

Ultimately, if it made economic sense to do so – for the country and for the company – then such facilities would have been built. In the south of the DRC and in northern Zambia (all part of the same copper belt, where copper is the primary product), there are sufficient mines producing copper **concentrate** to warrant constructing large smelters and refineries in country to serve a number of mines which can share the cost. In South America, some of the copper mines – such as Chuquibambilla in Chile – are so large that they do their own downstream processing (with a capacity of 855,000 tonnes per year, compared to the Bulyanhulu requirement of just 25-30,000 tonnes per year).

The TMAA conducted an independent study into the construction of a smelter for copper and gold in Tanzania which was updated in early 2011 and which concluded that it was not viable to do so. Acacia has offered to fund the Government conducting an update of this study (though we would not be involved in the study itself), to see whether the situation has changed.

It is important that we all understand more about this **concentrate** ban so that when it is discussed in different circles, more informed comments and discussions can be had. This issue really is affecting all of us. Please do provide feedback so that we can help to make this matter easier to understand, build trust and explain. With the current approach, we believe we are doing the best for Tanzania and Acacia, by downstream processing our gold and copper ore into a gold copper **concentrate** on site in Tanzania and then selling this product for smelting and refining in other countries.

Asante Sana
Mark Morcombe