PREPARING FOR TIGHTER MINE regulations

What miners need to know about the amended MDMER

By Marc Laliberté

On May 13, 2017, the federal government published new regulations amending the *Metal Mining Effluent Regulations* (MMER) in the Canada Gazette. These amendments, the product of long consultations, will come into force between June 1, 2018, and June 1, 2021. This article will review what impact the amended regulation will have on water treatment.

MBBR (moving bed biofilm reactor) tanks and the water treatment plant at a gold mine in Canada.
CREDIT: VEOLIA

Diamond mines

The most obvious change is that the regulation now applies to diamond mines: the regulation is now the *Metal and Diamond Mining Effluent Regulation* (MDMER). Previously, diamond

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mine effluents had not been regulated countrywide. While the diamond mining industry was small when the original regulations were published in 2002, there are now six or seven diamond mines in Canada in various stages of operation. Diamond mine effluents are usually fairly easy to make compliant with the MDMER, as the main contaminant is usually total suspended solids (TSS) with minor releases of dissolved salts and nutrients. The impact of the new regulations for that part of the mining industry is thus expected to be minimal.

New limits

One of the changes in the new version of the MDMER is that the allowed limits of many contaminants (called "deleterious substances" in the regulation) have been made more stringent. One important change is for arsenic, where the maximum monthly mean went down from 0.5 to 0.1 mg/L. Arsenic is not especially difficult to remove in the presence of a ferric or aluminum coagulant, but at 0.1 mg/L a good control of pH, coagulant dosage and efficient TSS removal is required if the water contains a lot of arsenic. For mines where a fraction of the arsenic in the influent is present as an organic species, an unusual but not unheard-of occurrence, then it is possible that coagulation will not be sufficient to meet the new criteria. A second treatment stage might then become required, using advanced oxidation, adsorption on activated carbon, reverse osmosis or some other mean.

The maximum monthly mean concentration for copper is reduced from 0.3 to 0.1 mg/L. Copper is fairly easy to remove at high pH with a coagulant provided it is not complexed with ammonia or some other substance, and with the new ammonia requirements it is unlikely that enough ammonia will be present to cause issues. The old limit was high enough that barely meeting it would have caused issues with trout lethality. Even at 0.1 mg/L trout lethality might be an issue, and it is safer for toxicity conformity to target 0.02 mg/L. It is thus likely that mines where there is no issue with trout lethality will easily meet the new limit.

Top: MBBR (moving bed biofilm reactor) tanks and the water treatment plant at a gold mine in Canada. CREDIT: VEOLIA

Above: Biological treatment, such as Veolia's AnoxKaldnes MBBR technology, can be very effective in dealing with cyanates and ammonia. CREDIT: VEOLIA

Cyanide, lead, nickel and zinc all see their maximum allowed concentration reduced. In all cases the reduction should not be an issue with a modern water treatment plant with good pH control and removal of TSS. It should be noted that with the tighter nickel and zinc limits, it might become difficult to meet the new arsenic requirement if these contaminants are present at the same time in the water to treat. Arsenic will usually be better removed at a lower pH than nickel or zinc, and with the new requirements it might not be possible to remove them all in one go. A two-stage treatment might be required.

Unionized ammonia

The addition of a criteria of 0.5 mg N/L for unionized ammonia is to be considered with the requirement that the effluent be non acutely lethal for the rainbow trout. Trouts, and salmonids in general, are exquisitely sensitive to ammonia. The Canadian Council of Ministers of the Environment has established that the low toxicity threshold for unionized ammonia for the rainbow trout is 0.4 mg N/L, and it has been our experience that acute toxicity may occur in water containing 0.1 to 1.0 mg N/L of unionized ammonia, depending on the water composition. The fraction of ammonia being unionized diminishing rapidly with pH, the main impact this requirement will have, in my opinion, is to force mines that are borderline with respect to ammonia to operate at the lower end of the allowed pH range: instead of being able to operate between 6.0 and 9.5 they may find themselves forced to operate at 6.0 to 7.5. Old water treatment plants may require updates to operate in such a narrow range, or might have to add some treatment capability to reduce ammonia.

On a side note related to ammonia, environmental managers should be aware of the fact that if their effluent contains cyanate (it will if the mill use a cyanide process followed by detoxification), and if they analyze ammonia using bottles stabilized with sulfuric acid (most ammonia analysis kits do), cyanates will hydrolyze to ammonia in the presence of the acid. The ammonia results reported by the lab will then actually be the sum of the true ammonia plus any cyanates present in water. If the manager finds the treated effluent close to the unionized ammonia criteria this might be worth investigating, as cyanates do not actually count in the calculation of unionized ammonia.

D. magna toxicity

We finally come to the last change, and perhaps the one which is going to affect miners the most: the obligation to be non toxic for *Daphnia magna*. Toxicity is a tricky issue. It varies between species. A substance might be toxic in a given water, not so in a different water. Some substances increase the toxicity of other substances, some substances decrease it. All of this to say that even if the mine effluent was not toxic for the trout; it might very well be for *D. magna*. By now all mines should have been testing for *D. magna* toxicity (even if they did not have to make the water non toxic), so it should be known which water treatment plants will require improvement. The tricky question will be, what kind of improvement? There is no easy answer to that, and toxicity identification evaluations (known as TIE studies) might be required in many instances.

As an example, consider the above mentioned cyanates. Cyanates are the end product of the detoxification of cyanides. The detoxification process was named as such as it produces water much less toxic to fishes, birds and mammals. Unfortunately, *D. magna* is very sensitive to cyanates. So, ironically, the water produced by the detoxification process might need further treatment to reduce its toxicity.

Treatment to reduce toxicity to *D. magna* will depend on what the actual cause of the toxicity is (hence the necessity of TIE studies). Biological treatment in an aerobic environment, as an example, is very effective in dealing with cyanates and ammonia (Veolia has installed biological systems at gold mines throughout Canada), but it is useless if the toxicity is caused by beryllium.

The future

The new MDMER regulations will take into effect gradually. For most mine sites the impact on the water treatment should be minimal. Older sites may require some upgrade to lower TSS or control pH to a narrower range. Sites where D. magna toxicity is an issue will have to identify the source of the toxicity. Depending on the investigation results, more significant results might be required.

Water treatment plants at new mines will have to be designed according to the new regulation and this design will have to take into account the new criteria for ammonia and the toxicity requirements. It has been my personal experience that geochemical models used for water quality prediction do a poor job of predicting nitrogen species concentration, including ammonia, cyanate, thiocyanate and cyanide. New mine owners should make sure that these parameters are included in their water quality models. This, in turn, will ensure that the water treatment plant will be properly designed to meet the new regulations. **CMJ**

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