DRAFT
ARSG Meeting Summary for the Technical Workgroup
10/18/12

Attendees: Steve Fearn, Bill Simon, Peter Butler, Kirstin Brown, Kay Zillich, Ty Churchwell, Darlene Marcus, Dale Rodebaugh. On the phone: Larry Perino, Todd Hennis, Mike Holmes, Camille Price, and Craig Gander.

The group met at the Public Lands Center in Durango, courtesy BLM, to discuss formulating a proposal that might be put on the Innocentive website. The meeting was essentially a brainstorming session. Instead of trying to follow the conversation chronologically, this summary attempts to organize topics discussed in three categories suggested by Bill Simon at the end of the discussion: underground, in-situ treatment; remediation process issues and waste stream issues. There is some overlap between these categories.

Underground, In-situ treatment:

Camille suggested looking at the four main ingredients responsible for acid mine drainage: pyrite, water, oxygen, and bacteria, and how to isolate or remove some of these ingredients from the equation. A number of ideas were offered:

- Is there a substance that can be sprayed on the walls of the mine working to isolate the pyrite.
- Can we chemically tie up the water entering the mine (like water glass) so that it fills the mine or conveyance fractures.
- Can a foam be developed to fill the workings which may inhibit oxygen or water.
- Can one freeze the interior of the mine.
- Is there a bacteriacide that can kill off bacteria which breaks down pyrite.
- Is there a way to reverse the chemical and biological reactions which cause acid drainage.
- How to better utilize bulkheads and minepools.
    - How can one better seal a minepool so there is less flow through (e.g. an additive to solidify the pool)
    - For in situ treatment of abandoned mines, How does one insure that the water is adequately mixed with the additive(s).
    - How can one better monitor what is happening in the minepool.

The group also discussed how many of these potential options could make it more difficult to mine the site in the future. That led to how could one use the interior of the mine to treat water within the workings. In our part of the country two of the biggest constraints on outdoor passive systems are freezing temperatures and lack of reasonably flat land. The suggestion was to make passive systems underground and have the ability to remove the sludge which would be less likely to inhibit future mining.

There was also a suggestion that one might want to concentrate metals somehow within the mine to potentially make treatment and removal more economical if metal concentrates from treatment could be sold.

Remediation Process Issues:

This category includes ways to remove or minimize the effects of high metal concentrations and/or acid. Most of the discussion centered on challenges associated with different treatment technologies. Managing or solving those challenges could become a proposal for the website.

In categorizing different technologies, the point was made that passive and active treatment systems are really part of a continuum – all systems need maintenance and the metals in the water eventually must go somewhere.

Current systems that lie on the more passive side of the continuum tend to be less expensive to build and operate, but also remove less metals, occupy large volumes of space, and are less predictable or reliable. Some of the challenges that were mentioned include:

- Do they really take metals out of the environmental system, and if not, is there the potential for the metals to be re-mobilized in forms detrimental to the environment.
- More passive systems (i.e. wetlands) need space and don't function well with extreme low temperatures.
- If there is a biological upset, it may take a long time to get the system running properly again.
- Some systems may have odor problems (sulfur smell).
- Can systems be made more vertical to reduce the footprint.

Systems that might be considered more on the active side of the continuum have some of these challenges that could be addressed:

- Lime systems
    - How can lime (or other pH modifiers) be used more efficiently to reduce lime input and mass output

    - Can the reaction/retention time be reduced which could reduce the overall footprint of a facility (e.g. faster reaction time using nano technology)
    - Sludge reduction and disposal is discussed below
- Electro-coagulation
    - How can one reduce plating on the cathode and anode (e.g. reversing polarity)
    - Can this method be used without having to raise pH.
    - How to reduce material loss on the anodes.
    - How can energy costs be reduced.
- Other methods
    - Can iron be removed first which inhibits some treatment (although iron may be helpful with others)
    - There was mention of ion exchange, reverse osmosis and electro winning, but little discussion of these technologies.
    - Are there technologies associated with "solution mining" that could be used for metal removal.

Waste Stream Issues

Any system which removes metals from water will have a waste stream which will contain the metals removed and perhaps additives (e.g. pH modifiers, coagulants). Some of the challenges (and opportunities) the group identified with regard to waste streams are:

- Almost any treatment plan will produce sludge; how do we reduce its amount. (As much as 98% of the solids in a lime treatment system may be the added lime. How does one reduce this percentage;
- also 30-70% of the sludge in a lime system may be water. Is there a more thorough and efficient way to dewater sludge than filtration (e.g. mechanical vapor compression)
- Can metals be removed from a waste stream to create a salable product?

OVERALL THEMES

Many people in the group commented that developing a proposal for the website is probably going to be much more complex and challenging than they initially realized. Part of the dilemma is that we want to allow people to think outside the box to come up with solutions, yet there need to be parameters on the proposal. Since most of us have experience in mine remediation, the parameters we come up with will reflect our collective biases and may inhibit innovative approaches.

There was discussion about how the wording we use to frame the proposal may really impact the response we get. For example, do we call metal removal from water “mine water treatment” or “resource recovery from water”.

Here are some tentative themes that seemed to permeate our discussions at the meeting:

- Generally, we want to remove metals from water.
- Preferably, the metals removed should be useable, not just landfilled.
- We want to minimize overall environmental costs such as the energy and spatial footprint. This can also be a surrogate for reducing overall financial costs.
- While we want to address the specific problems we have in Upper Cement Creek, we also want the proposal to have broad applicability to other situations around the country or around the world. We are less interested in solutions, at least in the website proposal, that would only be site specific to our situation.