

## Passive Solar Distillation of ARD Waters

### Background

Across the west, many legacy mines-sites generate small amounts of acid rock drainage (ARD) from spoils piles or from underground mine drainage. The source of the drainage is from oxidation of pyrite and other sulfide containing minerals within the rock. While some of these drainages can be quite large and have significant impacts on local streams, a much greater number generate small isolated flows that can still impact receiving waters with metals and acidity. In addition, many of these sites are remote and have little access to infrastructure. This has led to the development of passive systems to treat these small flows, that require little infrastructure and infrequent maintenance. The most common of these systems is passive sulfate bioreactors which use biological process to precipitate metals and reduce the acidity of these waters. The technology for small scale solar distillation for drinking water supply has improved dramatically within the last decade as well. This project looks at combining these two concepts to treat these ARD streams.

### Problem Statement

Your team will design a passive solar distillation system that can treat up to 5 gallons per minute of ARD. The solar system will be specifically for a remote site with limited access and no utilities available at the site. The system must make clean water for discharge and dried salts as a final output of the dissolved solids in the water.

### Design Considerations

Your proposed design should provide specific details and outcomes as follows:

- Estimate the total surface area of solar capture that will be required to treat the flow.
- The design should require no outside power source. All equipment should operate using gravity or solar power.
- Address materials of construction for this acidic water.
- Address design considerations for variable solar availability (i.e. nights, cloudy days and winter)
- Address how the solids generated from salts in the water will be stored and managed.
- Address expected water quality of the clean water at discharge.

### Bench-Scale Demonstration

Your team will demonstrate your design at bench scale level with synthetic ARD. Your bench-scale working prototype should be able to treat at least 10 ml/min in mid-day sun. There is no typical ARD but for this test use a synthetic ARD created using the following formulation.

Aluminum sulfate	0.25 g/L
Magnesium sulfate	0.5 g/L
Calcium sulfate	1.0 g/L
Ferrous sulfate	0.5 g/l
Zinc sulfate	0.25 g/L

There should be some measure of the final water quality either by conductivity probe or sulfate analysis.

### **Written Report Requirements**

The written report should demonstrate your team's insight into the full scope of the issue and include all aspects of the problem and your proposed solution. The report will be evaluated for quality of writing, organization, clarity, reason, and coherence. Standards for publications in technical journals apply. In addition to the listed requirements, your report must address in detail the items highlighted in the Problem Statement, Design Considerations, and Evaluation Criteria.

### **Evaluation Criteria**

Each team is advised to read the Participation Guide for a comprehensive understanding of the contest evaluation criteria. Upon registration, WERC will provide you with a copy of the Public Involvement Plan and Participation Guide.

Additionally, your proposed solution will be evaluated on the following:

- Technical fundamentals, performance, safety and other issues stated in the problem statement
- Potential for real-life implementation
- Thoroughness and quality of the economic analysis
- Originality, innovativeness, functionality, ease of use, maintainability, reliability, and affordability of the proposed technology
- How well the bench-scale represents your full scale design concept
- The quality of your treated water – the bench-scale processed water will be evaluated for treated water volume, separation efficiency, and time to process

Other specific evaluation criteria may be provided at a later date.