

BACK FORTY PROJECT

VMS SULFIDE MINERALS AND ACID ROCK DRAINAGE

PREDICTING, PREVENTING AND MANAGING ACID ROCK DRAINAGE

Acid rock drainage (ARD) and metal leaching are environmental concerns to be addressed where metal sulfide minerals are exposed to air and water. A natural process of oxidizing the sulfide can generate acidity. If not managed through engineering controls, this acidity can be potentially harmful to the aquatic environment because of its acidity and dissolved metal content. The Back Forty Project involves a volcanogenic massive sulfide (VMS) deposit and will expose pyrite and other sulfide minerals to air and water.

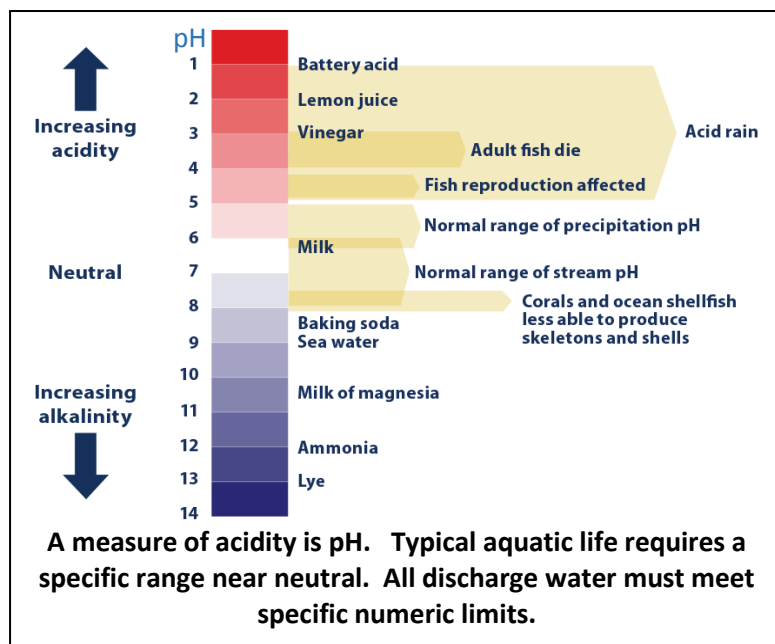
The potential formation of acidic drainage and metal leaching is one of the primary issues that is factored into the design of any modern mining operation. Modern mining operations incorporate engineered controls to prevent impacts to the environment that could arise from ARD. The potential for mined waste material to generate acidity from sulfide minerals is variable. Although ARD is primarily attributed to pyrite, each rock may have a unique potential to generate acidity and neutralize acidity. Michigan requires extensive testing of all rock types encountered in the mine to assess acid generation and demonstrate adequate engineered control measures to mitigate impacts to the surrounding environment.

There are proven and well-established management practices to prevent and neutralize ARD. Prevention is much more cost effective than treatment and is preferred.

At Back Forty prevention will involve removing the oxygen by placing the waste rock under water in the backfilled pit. Prevention with the surface tailings storage facility will involve reducing the water and oxygen available by sealing the wastes in a double lined and capped facility. Neutralization involves blending the wastes with alkaline material, such as limestone. Aquila will blend an excess quantity of high quality limestone into the waste in both situations.

ARD Quick Facts

- Acid production is affected by mineralogy, particle size and the availability of oxygen and water.
- Battery acid is sulfuric acid but ARD is not battery acid.
- Alkaline material such as limestone neutralizes acid.



Waste Characterization

Key to prevention and management are the analyses used to predict the rock's potential to generate acidity, neutralize the acidity and the rate of reaction. The permitting process requires waste analyses that include predicting and measuring acid generation and metal mobility to determine how much limestone is needed. Results of all these tests are available to the public in the permit application.

AQUILA HAS DEMONSTRATED ADEQUATE MEASURES TO CONTROL AND MITIGATE ACID ROCK DRAINAGE AND MDEQ HAS ISSUED A DRAFT MINE PERMIT

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WASTE CHARACTERIZATION

Thousands of analyses comprise the waste characterization used to predict the different rock's ARD and metal leaching potential. Some of the following tests estimate acid potential while others directly measure the acid generated.

- Whole rock analyses quantify sulfur, metal and other element concentrations.
- Acid potential (AP) estimates acid generation of each rock based on the amount of total sulfur in each rock.
- Neutralizing potential (NP) measures the ability of each rock to neutralize acidity.
- Net acid generation (NAG) measures acidity generated from each rock.
- Acid-base accounting (ABA) compares and contrasts NP and AP results.
- Humidity cell testing simulates weathering and measures the pH and metal mobility of the humidity cell leachate over time.



Humidity cells simulate the weathering of rock by alternating wetting and drying periods. Samples of leachate from the rock are collected weekly for analysis that measures acidity and metal concentrations.

Back Forty Acid Management

During mining, waste rock and tailings will be blended with limestone and placed on a double lined facility. As the air, water and sulfide minerals react, the limestone will neutralize the acid as it is generated.

After mining, a portion of the waste rock and limestone will be used to reclaim the pit with additional limestone being added during backfilling. As the backfilled pit fills with groundwater, oxygen is depleted and acid generation is stopped. The waste rock and tailings remaining in the storage facility will be encapsulated with an engineered cover to stop water entry, limit oxygen and slow the acid generation. All leachate from this waste will be treated before discharge.

There will be **NO**
Acidic Drainage
to the environment



To Learn More About Acid Rock Drainage and the Back Forty Project Visit Our Website or Call Us

906-753-9602

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