Abandoned Mine Drainage:

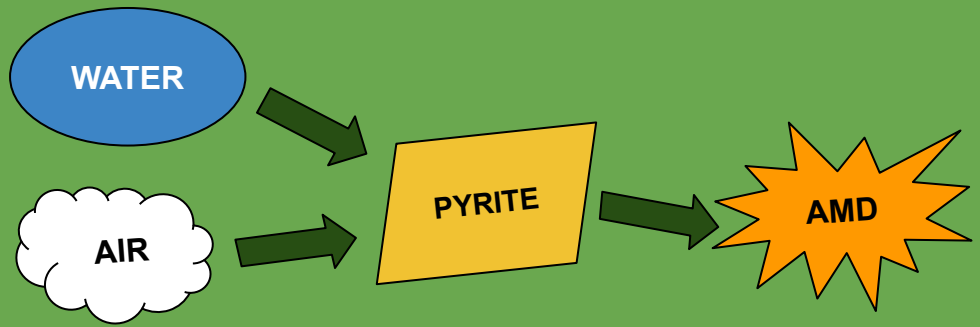
Treatment Systems

EPCAMR

Eastern Pennsylvania Coalition for Abandoned Mine Reclamation

What is Abandoned Mine Drainage (AMD)?

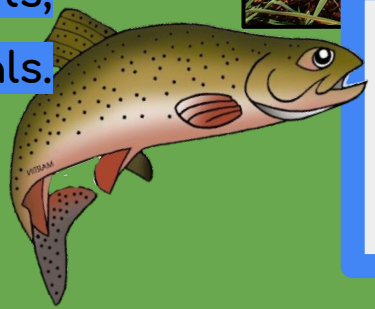
Acid Mine Drainage (AMD) at its most basic level, is water that flows through abandoned mines, interacts with the rock inside of mines, and flows from abandoned features (seeps, boreholes, tunnels, air shafts, slopes, stripping pits).



AMD occurs when water and air are exposed to a mineral called Pyrite (Fool's Gold) and undergo a chemical reaction called oxidation. The end result is heavy iron sedimentation at the bottom of our rivers, streams, and tributaries.

Environmental Risks

Abandoned Mine Drainage (AMD) affects the iron levels and pH in streams. When water reacts with the rocks and minerals inside of mines, they release sulfuric acid and dissolved iron. It harms not only fish, but also plants, aquatic insects and animals.

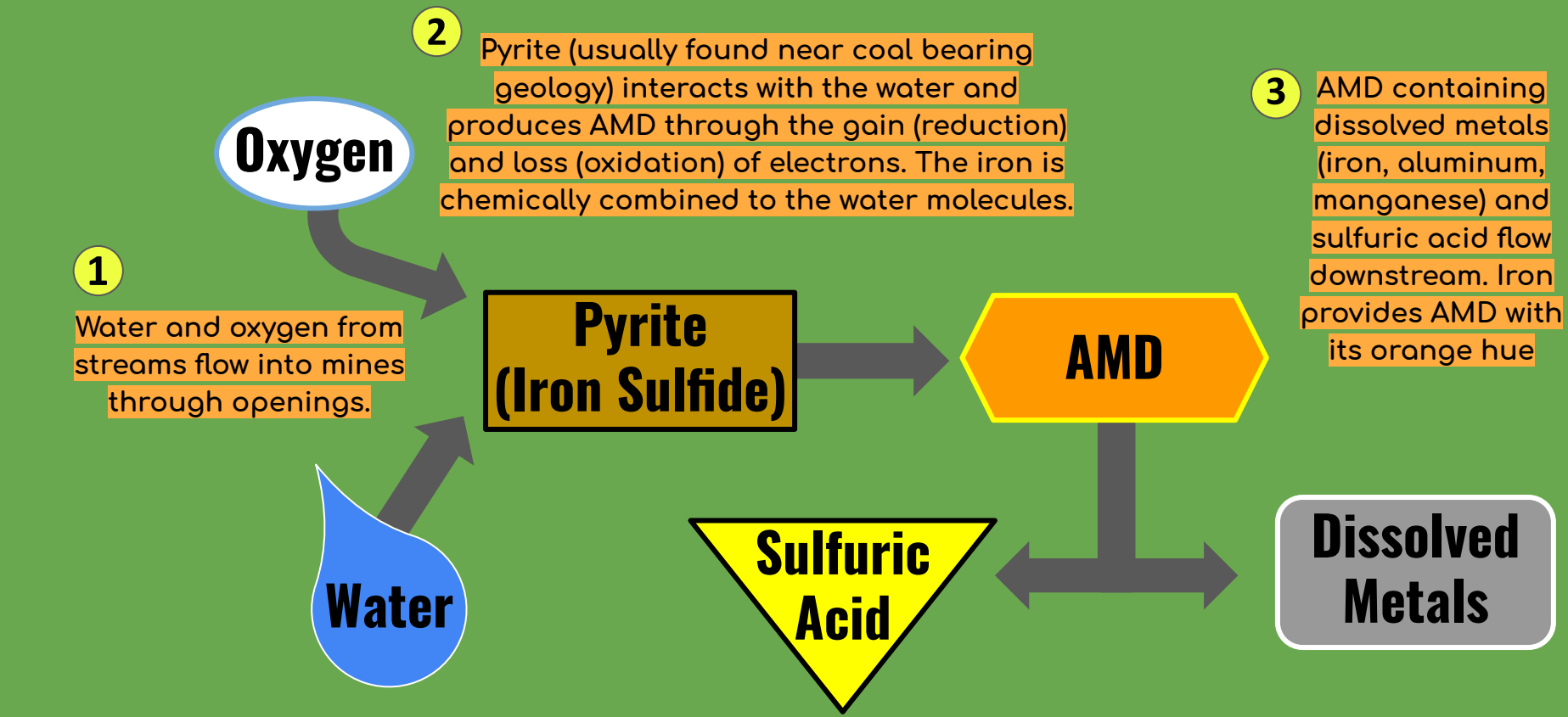


Sulfuric acid is an extremely strong acid; it can dissolve most metals. Now, imagine being a fish that swims in it!

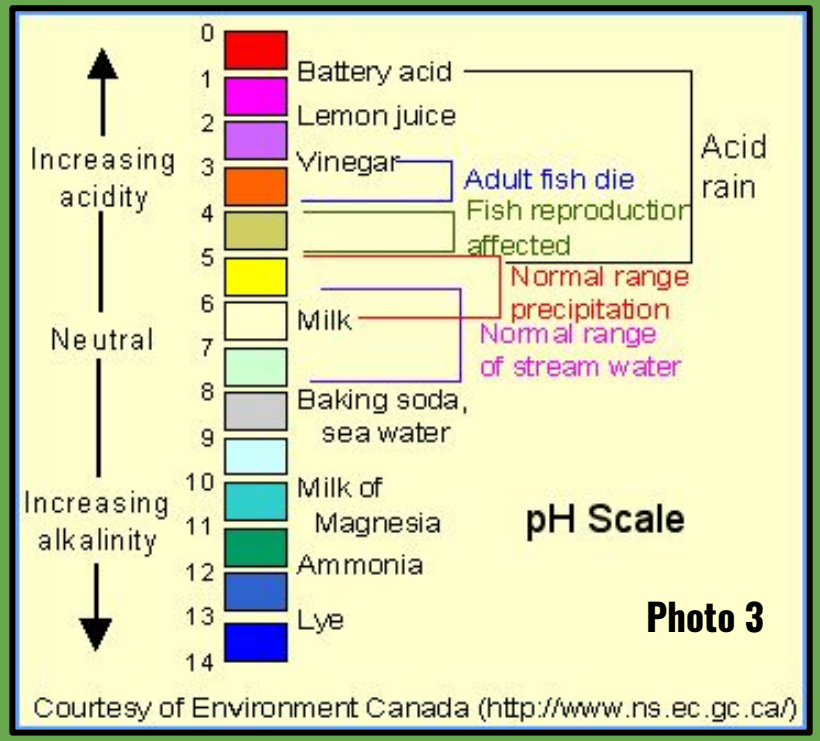
Health Risks

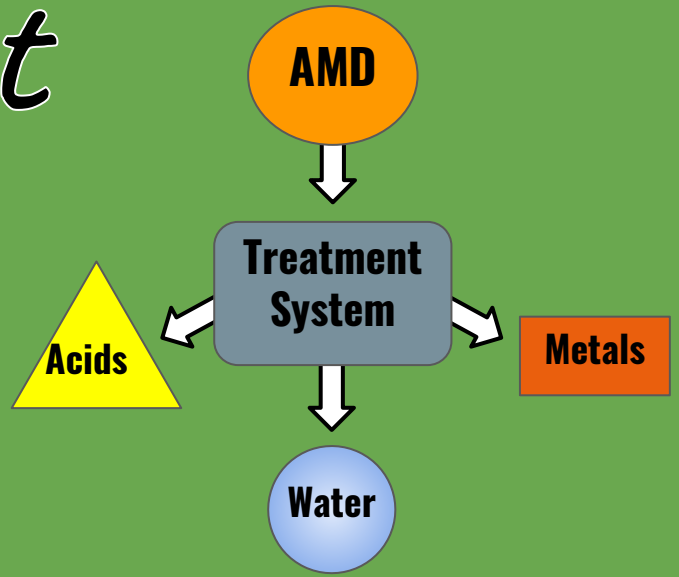
Abandoned Mine Drainage can contain heavy metals which can cause health concerns if congested. If these metals make their way to groundwater or soil, they are unusable. Sulfuric acid is also harmful as it can irritate the skin, eyes, and lungs when it releases gases.

Basic Chemistry



Goal of Treatment





The goal of treating abandoned mine drainage is to raise the pH of streams to conditions that support aquatic life as well as remove metals (mainly iron, aluminum, and manganese).

AMD Avengers

Scan or click

for the story!

Pollution Posse

Treatment Systems

A treatment system works to take abandoned mine drainage (AMD) and change it into water that is safe and able to be used by plants, animals, and people! There are two types of treatment systems:

- Active Treatment Systems
- Passive Treatment Systems

Active treatment systems require electricity, chemical additives, and routine maintenance to treat the water. They look similar to a water treatment plant and often require less space.

Passive Treatment Systems utilize constructed wetlands from limestone, mushroom compost, forebays, polishing and flush ponds to treat the water that don't require electricity or constant maintenance, but use a lot of land.


Passive
Treatment Systems

Treatment Steps

1. Impacted Waters Flow into the Treatment System
2. Waters often first enter a settling pond(s), allowing sediment deposition and some oxidation to occur. This also slows water velocity, allowing for better treatment.
3. Water then enters wetlands where organic matter (mushroom compost), plants, and sometimes limestone more aggressively treat it. Mushroom compost is often used because it strips out sulfur reducing bacteria.
4. Plants release oxygen, aerating the water, causing metals to separate from the water molecules and drop out. The organic matter (often compost), and limestone raise the pH, making it less acidic.
5. Cleaner Water Exits the Treatment System

Step 1

Impacted Waters Flow into the Treatment System

Inflow from Gutten Drift (Bernice) PTS in the Loyalsock Creek Watershed, Sullivan County, PA

Step 2

Waters often first enter a settling pond(s), allowing sediment deposition and some oxidation to occur. This also slows water velocity, allowing for better treatment.

This former passive treatment system once treated the Askam AMD Borehole along Dundee Road in Hanover Township, Luzerne County (Nanticoke Creek Watershed)

Step 3

Water then enters wetlands where organic matter, plants, and sometimes limestone more aggressively treat it.

A vertical flow pond utilizing limestone treats the Connell C AMD Tunnel near Lopez, PA (Loyalsock Creek Watershed)

Step 4

Plants release oxygen, aerating the water, causing metals to separate from the water molecules and drop out. The organic matter (often compost), and limestone raise the pH, making it less acidic.

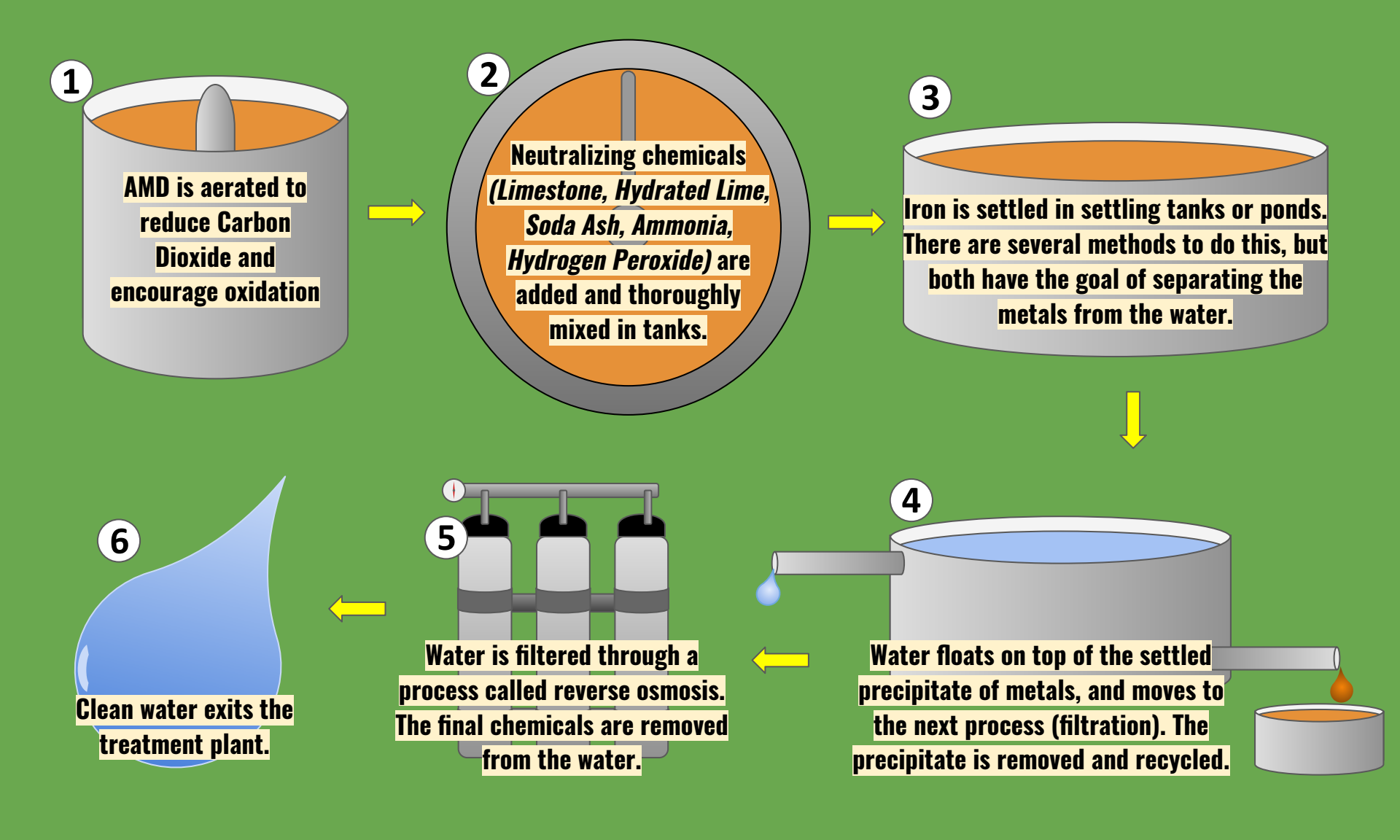
Constructed wetlands treating an AMD Discharge near Lopez, PA (Loyalsock Creek Watershed)

Step 5

Cleaner Water Exits the Treatment System

System outflow of the Askam Borehole Treatment system near Askam, PA. This is not a true passive treatment system. Upstream, it utilizes a Maelstrom oxidizer and is considered semi-active.


Active
Treatment Systems


1
AMD is aerated to reduce Carbon Dioxide and encourage oxidation
2
Neutralizing chemicals (Limestone, Hydrated Lime, Soda Ash, Ammonia, Hydrogen Peroxide) are added and thoroughly mixed in tanks.
3
Iron is settled in settling tanks or ponds. There are several methods to do this, but both have the goal of separating the metals from the water.
4
Water floats on top of the settled precipitate of metals, and moves to the next process (filtration). The precipitate is removed and recycled.
5
Water is filtered through a process called reverse osmosis. The final chemicals are removed from the water.
6
Clean water exits the treatment plant.

We will not cover active treatment systems too deeply as there are many types, and the process can become very complicated. The basic processes it carries out however, are very similar to passive treatment systems!

So, why are there two different types of treatment systems?

Lancashire 15 Treatment System:
Indiana County, PA

Passive

- Best for low acidity and low flow waters
- Do not require routine maintenance
- More costly to initially install
- Designed to treat for 10 - 15 years
- Require much more land
- Used for abandoned mines and minelands
- Uses natural materials and processes
- More economically productive

Active

- Can be built to suit any acidity level and flow rate
- Require routine maintenance and staff
- Require less land than passive systems
- Are resource intensive
- Generally ar more effective
- Often used for active mines
- Can treat for ongoing time period
- Uses chemical processes


Photo 10


Photo 11

Here are some aerial shots of active treatment systems. They might look similar to a drinking water treatment plant!


Photo 12

Two tanks where abandoned mine drainage and chemical additives are thoroughly mixed together.

Sources:

Photo 1: stateimpact.npr.org
Photo 2: alleghenyfront.org
Photo 3: chemistry.elmhurst.edu
Photo 4: epcamr.org
Photo 5: earthconservancy.org
Photo 8: earthconservancy.org
Active Treatment Systems Cover Photo
Photo 9: PA Department of Environmental Protection
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Virginia Tech AMD Treatment: vtechworks.lib.vt.edu
WesTech Incorporated: Acid Mine Drainage Treatment
Lehigh University: Enviro Sci Inquiry (Active Treatment Systems)
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