



Mining is one of the principal resource-extractive industries in Canada that has a presence in every province and territory and plays an important role in developing rural economies. Metals such as iron, nickel and copper are extracted from metal ores and processed in refineries and sold to domestic and international markets. However, the extraction process in sub-surface mining operations has significant impacts on water quality and the environment.

Acid Mine Drainage (AMD) or Acid Rock Drainage (ARD) is a phenomenon whereby surface and ground water in abandoned mines react with metal ores and create acidic waters that contain dissolved minerals and even poisonous heavy metals. AMD-contaminated water can also be generated from coal extraction facilities as well. Acidic water leaches out of the earth and drains to the environment. The acidity of contaminated water can reach exceptionally low levels that effectively kill plants and animals that consume it. It can also potentially pose a significant contamination risk to drinking water resources.

The main constituent of AMD is iron sulfide compounds. The chemistry of oxidation reaction is quite complex and results in a mixture of sulfates, dissolved iron (II) and iron (III) ions. When acidity levels are low, a yellow-orange iron (III) hydroxide precipitate forms. This compound is commonly known as “Yellow boy” and severely impacts plant and animal life.

It is estimated that AMD occurs in thousands of locations around the world where abandoned (or active) mines are present. Some of the notable locations include Berkley pit site in Montana, Pronto mine site in Ontario, Cheat River watershed in West Virginia as well as a few sites in Wales, England, and Australia.

There are several remediation technologies developed for AMD and they include lime neutralization and constructed wetland systems. Conventional treatment with quicklime (calcium oxide) neutralizes the acidity of AMD water since quicklime is an alkaline (basic) solution. This method restores balance to the neutral water pH level, but it does not remove heavy metals from solution.

Constructed wetland systems are innovative solutions that rely on natural biochemical pathways and the natural ecosystem to treat contaminated AMD water. Wetland plants, in combination with certain microorganisms, are consorted in a natural system to neutralize acidity and

precipitate heavy metals out of the system. Although promising, this remediation technology is relatively slow and cannot handle heavily polluted streams. Typically, additional treatment is required after constructed wetlands to completely neutralize water and remove trace heavy metals.



**Acid Mine Drainage in the Rio Tinto River, Spain. The orange colour is due to sulfide minerals. CREDIT: Carol Stoker – NASA Ames Research Center**