Metal Mining Industry

Industry Description

The metal mining industry engages in metallic mineral exploration, mine development and ore mining. In the U.S. mining for metals predominantly occurs in the Western states where ore is extracted from the ground to recover metal minerals such as copper, gold, iron, lead, silver and zinc. These raw metals are used for a wide variety of alloys, chemicals, pigments and other products by numerous industries. For instance:

- Copper is used in building construction, machinery, transportation and electronic industries
- Gold is used in the electronic, dental, art and jewelry industries
- Iron ore is used in the steel industry
- Lead is used in the electrical, electronic, communication and transportation industries
- Silver is used in the electrical, electronic, electroplating, photographic, silver ware, jewelry industries and dental industries
- Zinc is used in the brass, bronze, alloy and galvanizing industries

Extraction Methods

Underground Mining Method

Historically, the most common mining method, underground mining is now only used domestically to recover lead, antimony and silver. With this method, miners sink a shaft at various depths in an underground mine to reach deposits and remove the ore.

Surface or Open Pit Mining Method

With the advent in recent decades of large earth moving equipment, less expensive energy sources and improved mining technologies, surface mining has become a preferred method for economy and safety. With surface or open pit mining, the earthen walls are blasted and cut into benches, so that shallow subsurface materials or overburden (e.g. rock, vegetation and soil) can be removed to access the mineral ores. This method is common when mining copper, gold, iron and silver.

Solution or Fluid Mining Method

With solution or fluid mining, miners drill intact rock and use chemical or leaching solutions (usually a dilute acid) to penetrate the ore and dissolve the soluble metals. The pregnant leach solution is then retrieved and transported to a solvent extraction and electrowinning

(SX/EW) plant, where the dissolved metals are extracted. A variety of solutions are used to extract soluble metals such as alkaline sodium cyanide for gold, sulfuric acid for copper, sulfur dioxide for manganese, and sulfuric acid-ferric sulfide for uranium ores.

Types of Deposits

Metals are extracted from two types of deposits. Lode deposits are concentrated deposits and fairly well defined from surrounding rock. Iron, copper, lead, gold, silver and zinc are mined primarily from this type of deposit. Placer deposits, which are usually created by flowing water or ice that contain metals from a lode deposit, occur in sand, gravel and rock. Only a small amount of domestic gold and silver come from placer deposits.

Mucking

Once raw ore is extracted from the mines, it is transported to a beneficiation (concentration operation) facility. Mucking is a common term used to describe the process where mined ore is removed and transported from the mine to the mill using loading and hauling equipment.

Beneficiation

During beneficiation, one or more metals are targeted, separated, and concentrated to reduce particle size, remove unwanted constituents and improve the quality or grade. Typically, beneficiation includes one or more of the following processes: milling (crushing and grinding), washing, filtration, sorting, sizing, magnetic separation (separates iron ores from less magnetic particles), flotation (separates minerals from the rock and produces a metal concentrate slurry), leaching, gravity concentration (separates minerals based on gravity differential), and agglomeration (includes sintering and pelletizing).

After beneficiation, the metals and materials are separated further and purified through operations such as solvent extraction and electrowinning (SX/EW), smelting, mineral or acid (e.g., sulfuric acid) recovery plants, and are ultimately ready for refinement.

Regulatory Issues:

In the metal mining industry, an emphasis is placed on point source discharges to waters, regulated by the Clean Water Act. In addition, this industry faces existing and future regulation under the Comprehensive Environmental Response, Compensation and Liability Act, the Clean Air Act and numerous other regulations.

Defining the Exposure

Potential Environmental Exposures:

- Unlined tailings (chemical residues, metal and other wastes) impoundments or ponds
- Unprotected fuel and chemical storage areas
- Abandoned, improperly closed mines
- Underground storage tanks (USTs) and aboveground storage tanks (ASTs)
- Improper storm water management
- Unchecked acid mine drainage
- History of past on-site spills and releases
- Past operations
- Old equipment storage (bone) yards
- Inadequate preventative environmental management/maintenance
- Insufficient emergency and spill control plans
- Electrical equipment that contains polychlorinated biphenyls (PCB)
- Loading/unloading of materials from trucks, railcars, or barges
- Slurry impoundment from unknown previous mining activities
- Former on-site disposal practices (such as landfills, land farms, wastewater lagoons, or injection walls)
- Poorly maintained or outdated wastewater process equipment
- Poor management of cooling water, or storm water runoff
- Inadequate venting of explosive gases from mine shafts

Environmental Contaminants:

- Cyanide, acetylene, calcium oxide, chlorine and sulfuric acid
- Petroleum fuels, mine water, overburden, tailings and spent ore
- Argon, nitrogen and slag
- Pyrites, sulfuric acid and limestone
- Copper ore concentrate and copper slag
- Sulfur dioxide

Defining the Need for Environmental Insurance

Mining operations produce and accumulate large quantities of wastes that are ultimately disposed on site. Total wastes can range from 10 percent to 99.99 percent of the total mined material. For instance, approximately one ounce of gold is generated from twelve

tons of ore. One ton of copper is generated from 30 tons of ore. As such, hundreds of acres of waste rock may be piled adjacent to mines or back-filled into inactive mines.

Abandoned mines and refuse piles can produce acid damage for over 50 years. Considered a major mining environmental concern, acid drainage is a potentially severe pollution hazard that can be difficult to predict. It occurs when pyrite and other sulfide minerals, upon exposure to oxygen and water, oxidize to create ferrous ions and sulfuric acid. Catalyzed (to bring about a change in the chemical reaction) by bacteria, the ferrous ions react further with oxygen, producing hydrated iron oxide, known as “yellowboy.” This combination of yellowboy and sulfuric acid may contaminate surrounding soil, groundwater and surface water producing water with a low pH. In extreme cases, acid drainage can kill all living organisms in nearby streams. Humans may increase disease risk by consuming drinking water and fish tissue with a heavy metal content.

Primary wastes from the beneficiation processing include mine water, overburden, spent process solutions, tailings, spent ore, slag, waste rock and spent leach solutions. Spent ore may contain wastewater, residual cyanide, metal-cyanide complexes and heavy metals. Tailings may contain chemical residue from arsenic, barium, chloride, nitrate, sodium and sulfate along with trace metals and a mixture of impurities. Cyanide residuals may require destruction by adding alkaline chlorination, ozone or hydrogen peroxide.

Here’s how –

- If acid drainage is unchecked, water may become corrosive and unable to support many forms of aquatic life. Also, it can become harmful to vegetation growing along streams.
- Unprocessed mine water can carry toxic, metal-bearing sediment into streams and kill waterborne plant and animal species. Sources include seepage from underground mine workings, runoff from abandoned/inactive mines, and runoff from waste rock and overburden.
- Acid leaching operations produce large volumes of metal-bearing acid solutions that can and do pollute water.
- Unlined solution ponds at older copper sites may leak acids and metal release into the soil and surface water.
- Covering thousands of acres, slurry in unlined tailings impoundments can contaminate the soil and surface water with heavy metals and chemical residue.
- Fugitive dust from road traffic in the mine pit, rock crushers in pits, and mills and tailings ponds may contain toxins such as arsenic and lead that substantially pollute the air.
- By producing carbon monoxide and nitrogen oxide gas that collects in underground areas, exhaust fumes from diesel engines and blasting agents may be a serious hazard at underground mines.

- Earth moving vehicles, drill rigs and trucks can leak fuel, lubricants and oil that pollute the soil and groundwater.
- Other equipment such as conveyers and elevators may leak hydraulic fluid (contains glycol ethers) and battery chemicals (contain sulfuric acid, lead, antimony, and arsenic) that can and do contaminate the soil and groundwater.

What does Environmental Insurance Offer?

The right environmental insurance program, one tailored to met the needs of the metal mining industry, can offer coverage features that offer tremendous benefits, including:

- Protection from third-party claims for bodily injury (includes mental anguish), property damage and off-site clean-up.
- Coverage for on-site cleanup of pre-existing and new conditions.
- Coverage for punitive damages, fines and penalties where allowable by law; legal defense coverage is provided within limit of liability.

Additionally, environmental insurance programs that have value-added services in place, such as AIG Environmental®'s PIER 24-hour emergency response program, a dedicated loss control program with risk-improvement services, add additional value to an industry with inherent environmental liability risks.