The Safe and Effective Use of Cyanide

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Issue

The family of chemicals containing "cyanide", a combination of carbon and nitrogen, has been used safely and effectively for over 130 years for the efficient extraction and recovery of gold and silver from ore. Cyanide is also used for a variety of other applications both within and outside the mining industry. While cyanide is an acutely toxic chemical under certain conditions and when in sufficiently high concentrations, with proper management and control of its use, cyanide has been and continues to be used safely and without harm to humans or the environment.

Background

Cyanide is used to make a number of things we use every day. Over 1.1 million tons of it is used annually in the production of plastics, adhesives, fire retardants, cosmetics, pharmaceuticals, food processing, metal processing, the production of organic chemicals, photography, insecticides and in anti-caking additives for both table (food) and road salts. The mining industry uses about 6% of the total cyanide produced.[1,2]

Low concentrations of cyanide are also present in the everyday environment including over 110 different plant families, such as cassava, lima beans and almonds. Pits and seeds of common fruits such as apricots, apples and peaches, may naturally contain up to 700 parts per million (ppm) of cyanide.[3]

Role of Cyanide in Ore Processing

A process called "Cyanidation", or cyanide leaching, has been the dominant gold extraction technology since the 1970s. In this process sodium cyanide, in a dilute solution of ranging from 100 ppm to 500 ppm or 0.01% to 0.05% cyanide, is used to selectively dissolve gold from ore. The two most common processes that use cyanide for gold recovery are heap leaching and milling, also known as carbon-in-leach (CIL).

Although considerable scientific research has been conducted over many years, no other chemical reagent has been found to come close to exhibiting the superior economic and environmental qualities of cyanide in the recovery of precious metals.

As part of their best practices, mines use as little cyanide as possible for environmental, safety and economic reasons. The cyanide leach process is often carried out following other physical processes like crushing and grinding. Once the gold is dissolved, the solutions are further processed to recover the gold, which is then smelted into gold bullion.

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[1]International Cyanide Management Code, https://www.cyanidecode.org/cyanide-facts/use-mining

[2] Centers for Disease and Control and Prevention (CDC), Facts About Cyanide, CDC | Facts About Cyanide, 2019

[3] Cyanide in environment analysis – problems and challenges, Jasczak, Polkowska, Narkowicz, Namiesnik, May 2107, Page 4, Table 1

Tailings slurries and solutions containing leached material, water and residual cyanide are treated with different chemical and physical methods to reduce or remove cyanide left over from the gold dissolution process prior to discharge into a tailings facility. Additionally, different technologies are used to recover and reuse residual cyanide in the aforementioned processing circuits.

The solutions that collect in a tailings facility generally have cyanide concentrations that are not harmful to people, birds or animals. While a cyanide concentration of less than 50 ppm is required for compliance with the International Cyanide Management Code to protect wildlife, many mining operations achieve cyanide concentrations of less than 10 ppm in their tailings facilities.

Following discharge, the residual cyanide is rapidly diluted and destroyed through natural processes, such as oxidation and ultra-violet-catalysis (by sunlight). Local, state and national regulations limit the amount and concentration of cyanide that may be discharged into a tailings facility. These regulations vary by jurisdiction.

Cyanide Toxicity and Management

Cyanide is an acute toxin that may be fatal. It does not cause cancer, however, and does not accumulate or "biomagnify" in the food chain.[4] It does not persist in the environment and is quickly broken down into ammonia and carbon dioxide by sunlight and air.[5]

A significant health concern is that mine personnel might be exposed to toxic cyanide levels. A number of precautionary steps are taken to protect workers such as limiting worker exposure through automation, protective clothing and respirators.

The greatest environmental threat from cyanide in mining is to aquatic life from unintentional discharges into surface waters. Secondary retention ponds and other measures are designed as part of the mining facility to guard against accidental spillage.

Discharge into the environment is usually minimized when cyanide is used. Tailings facilities are often sealed with an impermeable liner, however, discharge from tailings facilities may occur and are often planned and permitted. Solutions containing cyanide are often treated to reduce the level of cyanide present. Again, local, state and national regulations limit the amount and concentration of cyanide that may be present in these solutions. These regulations vary by jurisdiction but generally the solutions that are discharged contain cyanide in concentrations of 0.2 to 0.5 parts per million or 0.00002% to 0.00005% cyanide.

Gold Mining Industry Cyanide Management

The industry has promoted adherence to a voluntary "*International Cyanide Management Code for the Manufacture, Transport and Use of Cyanide in the Production of Gold*" (Cyanide Code) that aims to assist in the protection of human health and reduce environmental impacts through the implementation of best practices for cyanide management and verification through third party audits. The Cyanide Code was developed by a multi-stakeholder Steering Committee under the auspices of the United Nations Environmental Program and the International Council on Metals and Environment (now known as the International Council on Metals & Mining or ICMM). The Cyanide Code focuses exclusively on the safe

[4] International Cyanide Management Code, https://www.cyanidecode.org/cyanide-facts/environmental-health-effects

[5] International Cyanide Management Code, https://www.cyanidecode.org/cyanide-facts/cyanide-chemistry

management of the reagent sodium cyanide during all steps including the manufacture, transport, storage, mixing, gold leaching, cyanide destruction and trace cyanide tailings, solution management, emergency response, training and the decommissioning of cyanide facilities.

Companies that adopt the Cyanide Code are subject to an audit of their mining operations every three years by independent third party health, safety and environmental professionals with the technical expertise to determine compliance with the program's requirements. Those operations that meet the Cyanide Code requirements are certified and authorized to display a unique trademarked symbol representative of this achievement. Audit results are made public to inform stakeholders of the status of the cyanide management practices at the certified operation.

Federal and State Regulatory Framework

Mining operations are also subject to comprehensive state and federal regulations governing the use of chemical reagents, including cyanide. In response to a Congressional request, the National Academy of Sciences, Engineering and Medicine (NAS) conducted an extensive study examining the framework for mining of hardrock minerals – such as gold, silver, copper, and uranium – on over 350 million acres of lands managed by the U.S. Bureau of Land Management within the Department of the Interior and the Forest Service in the Department of Agriculture. Virtually all of these lands are also subject to regulation by the individual states. The committee concluded that the "complex network of state and federal laws that regulate hardrock mining on federal lands is generally effective in providing environmental protection." (NAS Study at 3, 6).[6]

Even more recently, the Environmental Protection Agency cited a study of the environmental laws of mining states, concluding that they work in tandem with federal environmental laws and regulations to ensure the proper design, operation, management and closure of mining sites.[7]

SME Statement of Technical Position

- Cyanide has been used effectively and safely for over 130 years for gold and silver recovery in the mining industry;
- Mining consumes only 6% of the total amount of cyanide manufactured worldwide;
- Cyanide is typically not persistent in the environment, and degrades to products existing in nature, including carbon dioxide, ammonia and nitrates;
- Mining facilities that use cyanide are designed to contain and treat solutions so that minimal impact on the environment occurs;
- The discharge of cyanide into the environment is subject to local, state and national regulation; and
- Mining companies using cyanide are subject to comprehensive regulations and are encouraged to undergo certification through the "International Cyanide Management Code for the Manufacture, Transport and Use of Cyanide in the Production of Gold" to ensure safe operational practices and transparent community relations.

[6] https://www.nap.edu/catalog/9682/hardrock-mining-on-federal-lands

[7] *See,* EPA–HQ–SFUND–2015–0781–2794 at Appendix A; 83 FR 7556, 7567, fn. 96 (February 21, 2018).