

Interesting Zinc Plant facts

Notes taken from a talk given by Emily Boyd about 1992-3 and updated in April of 1999 and April of 2009. Ron Robertson, Chemistry Dept., APSU

The plant started in 1978 and produces 125,000 metric tons of Zn per year. It is the only remaining zinc smelter in the U.S.

Over 1,200,000 gal of water per day is taken from the Cumberland River and used in the process. Much of this is returned with equal or better quality than it came from the river.

Zn ore concentrate comes from East TN and from Peru. About a million pounds of ore (ZnS based) is used per day. The ore is about 57% Zn and 32 % Sulfur. The ore contains some impurities which can be separated and sold. Essentially 100% of all the ore's components are made into saleable products.

The process involves roasting (heating) the ore at 950°C to drive off the SO₂. The SO₂ is then used to produce sulfuric acid. Most of this sulfuric acid is sold.

The remaining 74% Zn residue (a ZnO product called calcine) is then reacted with the sulfuric acid. The resulting solution is an ZnSO₄ solution which is purified with zinc dust. The impurities of cadmium and copper from this purification are sold. Gypsum (CaSO₄) is another byproduct from the wastewater and is sold (very cheaply) to a cement manufacturer in southwestern TN.

Electrolysis is used with Pb anodes and Al cathodes to produce Zn. In electrolysis electricity is used to make a non-spontaneous reaction react. At the aluminum cathode zinc ions become zinc metal. At the lead anode water molecules are oxidized to hydrogen ions and oxygen gas. The overall reaction is:



Over 1 million kWh is used per day for the electrolysis, and the electric bill is about \$2,000,000 a month. This is enough to power each and every household in Clarksville. The Zn produced in the electrolysis is stripped off and then melted (at 787 °F) and finally cooled into bars. The bars are shipped to steel mills and other custom applications, including Greenville, TN where it is used to make pennies.

The overall process is called the "RLE" process. "R" represents the roasting which converts an insoluble sulfide to a soluble oxide. "L" stands for leaching in which zinc oxide is dissolved with dilute sulfuric acid to form a zinc sulfate solution. "E" is the process of electrolysis which is used to convert zinc ions to zinc metal.

The lab is well equipped for quality control work and includes x-ray emission, ICP (Inductively Coupled Plasma), and atomic fluorescence instruments.

Many thanks to Ron Butler, John Ledbetter, and the rest of the staff that made the 2009 tour a great success.