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Natural Acidity and Copper Precipitation

Frank Cloke

A record
of practical
experiences of
copper leaching
operations.

The author considers it may be of interest to place on record two instances, within his own knowledge and experience, in which insufficient knowledge of the effect of natural acidity on copper precipitation gave rise to very considerable losses in cash and metallic copper values.

In 1913, when engaged in the leaching and precipitation of the copper in about 135,000 tons of burnt arsenical-copper ore on an abandoned mine, he had his first experience of the kind.

In digging trenches to intercept the pregnant water passed through the dump a drain was met carrying about 400 g.p.m. of water. This was assayed and proved to contain several ounces of Cu per ton of water. A plant was promptly constructed large enough to treat it, but without success. There was a notable suspension of hydrated oxides of iron and alumina, which quickly coated the iron and steel lathe turnings used and precipitation, if at all, was very sluggish indeed.

The late Dr. Alfred C. Fryer, in the usual course of his duties, went over the plant. His attention was called to the stream and its failure to respond to the usual treatment. He suggested acidifying it and recommended "nitre-cake"—a waste-product in the manufacture of sulphuric acid—for the purpose. This was tried at once, with complete success. Very considerable losses had, of course, taken place already.

The second instance of this phenomenon took place during the author's last stay in the United States, from 1924 to 1933. He was surveying for eight years of that period, but was the assistant to the chief chemist for one year. While engaged on a 7-mile surface triangulation survey which passed through a very large adjoining mine the writer noticed many thousands of tons of over-

burden dumps, on both properties, which showed small pieces of copper carbonate throughout. At the base of a dump of about 500,000 tons there was a small derelict precipitation plant. On the top of the same dump a number of bays had been thrown up, showing that an attempt had previously been made to leach out and precipitate the copper.

The author was then transferred, on loan, from the surveying to the assaying laboratory. Upon proper acquaintance he expressed his surprise to the chief chemist that no attempt was being made to leach that 500,000-ton dump, but was then told that a well-known expert had carried out experiments for about a year with a view to leaching and recovering the great amount of copper values in it. In his report the expert had stated that the copper was amenable to sulphuric acid leaching, but upon passing the leach liquor through the test plant no precipitation took place at all. In an endeavour to ascertain the cause of the failure a number of experiments were carried out in the laboratory. The results of these led to the belief that the abundance of aluminous clay in the material was almost entirely responsible for the failure of precipitation.

This was naturally a reminder of the experience in 1913. While readily accepting the verdict of the expert he felt that it was, in all probability, a matter of acid condition. He decided to pursue the matter to its logical conclusion, if able, and being employed in the laboratory had all that he required for the purpose. - Knowing the importance of working with pure solutions a few crystals of copper sulphate were taken and dissolved in distilled water. It was expected, the salt being a chemical union between an acid much more powerful than the base, that the solution would perhaps

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give an acid reaction. A leaf of blue litmus paper shaken in the solution turned red quickly. The next step was to clean the blade of the pocket-knife and dip it into the liquid; at once the usual deposition of copper was obtained.

He next wondered what would happen if the acid reaction were neutralized. Accordingly a suitably-diluted solution of pure ammonia was made up and cautiously added drop by drop with thorough mixing between each drop until the solution gave no visible colour change with either blue litmus or red. Again the knife blade was cleaned and shaken vigorously in the solution for at least a minute; not the least sign of copper appeared on the blade.

The next question was: Would re-acidification of the solution again restore the precipitation reaction? Suitably diluted pure

sulphuric acid solution was added a drop at a time, with mixing, until, approximately, the original acidity was reached. Upon dipping the cleaned knife blade in the solution the precipitation took place at once, as at first.

This clearly proves, of course, that acidity is essential to the precipitating reaction. The acidity may be greater than the natural acidity of a solution of pure sulphate of copper in distilled water, but in view of the fact that precipitation is completely arrested upon neutralization, it necessarily follows that immediately the acidity falls below the natural level the speed of the precipitation falls very rapidly and soon comes to rest.

It is clear, at any rate, that the phenomenon may yet prove of use to anyone contemplating leaching operations on dumps of low-grade cupriferous material.

Aluminium Industry for Australia

Kura East

Introduction

War-time experience showed Australians that a self-contained aluminium industry was essential to defence. In 1939 imports of aluminium were only 1,320 tons; with the war they skyrocketed to a maximum of 10,440 tons in 1944. The annual consumption during 1943 and 1944 was about 5,000 tons. In December, 1944, the Federal Parliament passed the Australian Aluminium Industry Act and so gave parliamentary sanction to plans developed in the early stages of the war for the manufacture of aluminium ingot in Australia. In 1945 the Australian Aluminium Production Commission was set up.

The aluminium ingot industry can be divided into three major operations—mining of the ore, chemical treatment to obtain alumina, and electrolytic reduction of alumina to metal. The three processes may be separated if an integrated plant to carry out

A brief
outline of plans
to create an
aluminium industry
in Tasmania.

all three functions in the same area is not practicable. Before sites for each section can be fixed, however, an examination must be made of the quantity and quality of available bauxite; of water, coal, or limestone supplies; of the use of direct or alternating current for power, and of transport costs of raw, semi-finished, or finished material. A supply of cheap power from hydro-electric resources led Tasmania to be chosen as the most suitable place for the Australian industry. In 1944 an agreement was made between the Commonwealth and the Tasmanian State Government for the joint establishment of the industry.

Its careful investigations completed, the Commission informed the Premier of Tasmania in February, 1946, that a convenient site in the Launceston area in the north of the State had been fixed for the site of the aluminium industry, subject to a final

verification of certain means that aluminium entirely will be carried that plant for the from raw bauxite for the reduction will be established new site. The only units will be in Tasmania and elsewhere. The State Hydro now completing Aluminium Commission power. The Tasmanian asked to vote in Launceston near the Tasmanian River, at Launceston provide the 35,000 need.

American

The Commission processes for the preliminary selecting the for Australian Commission also sent a metal a year to study and return he became ident.

In 1945 the Commonwealth Tasmanian and United States conditions; this by the Dorr Commission the samples had treatment at an information supplied decided that the Australian industry able measure at capital and operational technical data to Dorr Company and initiate in necessary for the has been accepted.

Bauxite deposits in Australia—Queensland, Victoria, Tasmania. The total recorded the end of 1944 amount 18,527 tons South Wales and recent years the averaged about