Doctoral Thesis

Flotation of low-grade gold ores

Author(s):
Ahmad, Hussein Safwat

Publication Date:
1951

Permanent Link:
https://doi.org/10.3929/ethz-a-000098926

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Flotation of Low-Grade Gold Ores

THESIS

PRESENTED TO

THE SWISS FEDERAL INSTITUTE OF TECHNOLOGY
ZURICH

FOR THE DEGREE OF

DOCTOR OF TECHNICAL SCIENCE

BY

Hussein Safwat Ahmad B. Sc.

of Cairo (Egypt)

Accepted on the recommendation of

Prof. Dr. A. Guyer and Prof. Dr. G. Trümpler

Zürich 1951
Dissertationsdruckerei Leemann AG.
D. Summary

1. A historical survey of gold metallurgy is given, with a brief review of the development of gold recovery since the Ancient Egyptians started the earliest mining and metallurgical operations (4000 B.C.) and including the most modern combinations of processes used at the present time.

2. No two ores in nature are exactly alike. Consequently, each ore must be regarded as a problem to be solved. The gold ore dealt with in this work is from the Barramia district, in the Egyptian Eastern Desert, half way between Edfu (Nile Valley) and the Red Sea. The ore represents a certain type of gold ores, namely the low-grade pyritic gold ores. It contains a certain amount of graphite. It is refractory to straight cyanidation, and it was thought that this was due to the presence of graphite. The object of this work was to conduct laboratory investigations on this ore in the light of modern scientific and metallurgical principles.

3. A mineralogical examination of the ore showed the major constituents of the same to be quartz, dolomite and feldspar. In addition, the ore contains a small amount of sulphide minerals, mostly pyrite, arsenopyrite and pyrrhotite, and a little iron oxide and graphite. No free gold was seen in the ore and the sulphide minerals were found to contain gold, therefore it is considered that most, if not all, of the gold is in association with these sulphide minerals. This mode of occurrence of gold suggested the general line of treatment which was pursued in our investigations.

4. A part of the ore was sorted by hand-picking into the whitish and greyish quartz; a series of flotation tests were conducted
on each, in addition to tests conducted on the original ore. In each case, satisfactory recovery by flotation proved to be attainable.

5. With regard to the theoretical aspects of flotation, nothing really new was found. Placing such investigations on a very scientific basis is not an easy undertaking when one appreciates how such ore deposits were formed in nature. Facts about the different factors to be considered in flotation operations were confirmed, such as the different types of reagents used, the size of particle amenable to flotation, the pulp density, the amount of aeration and agitation, and the $p_H$ of the pulp.

6. Some studies on the depression of graphite were made with reference to the action of depressing agents, by measuring the contact angle.

7. It was proved that the ore is refractory to straight cyanidation owing to the presence of some other cyanicides, and not to the presence of graphite.

8. Cyanidation of flotation concentrates yielded a good recovery without the application of any special treatment. Investigations were conducted into the influence of regrinding and roasting on the time of agitation and on the cyanide consumption.

9. Finally, it can be said that it was possible to combine the basic features of flotation and cyanidation and thereby to achieve results unattainable by either process alone. Maximum recovery attained by flotation was 98.5 per cent, and by cyanidation of the flotation concentrate 95.6 per cent.