Chief, Ex. Met. Div.
(Dr. K. W. Downes)

CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 60-23

TRACER MEASUREMENT OF CONTACT TIME AT THE ALGOM-QUIRKE MILL

by

G. G. EICHHOLZ

MINERAL SCIENCES DIVISION

COPY NO. 4

FEBRUARY 20, 1960

Mines Branch
Investigation Report IR 60-23

TRACER MEASUREMENT OF CONTACT TIME AT THE ALGOM-QUIRKE MILL

by

G.G. Eichholz*

SUMMARY OF RESULTS

Attempts have been made to measure the residence time of slurry particles in the pachucas of the leach plant of the Quirke mine of Algom Uranium Mines Ltd., by means of a radioactive tracer. The tracer material used consisted of about 30 grams of uranium ore-pyrite concentrate irradiated to a total activity of about two millicuries. With a tonnage of about one ton per minute passing through the pachucas, this amount of tracer material could not be detected. Hence, this contact time determination was not successful. A considerably larger and more active sample would be required in any future test of this kind.

---

*Head, Physics and Radiotracer Section, Mineral Sciences Division, Department of Mines and Technical Surveys, Ottawa, Canada.

INTRODUCTION

In the mill of the Quirke mine of Algom Uranium Mines Ltd. the uranium ore is leached in a series of pachucas arranged in two parallel banks of six. As a check on leaching conditions it was considered important to determine the retention times of the pachucas, particularly to prevent any short-circuiting. In July 1959 tests were done with 300 lb of copper sulphate as an inactive tracer to measure the contact times along the lines developed at Milliken Lake. (See Internal Report Ra-329/59). These tests produced a series of exponential curves of the classical pattern and indicated a mean overall retention time of about 32 hours, rather shorter than expected. The copper sulphate, being very soluble, served essentially as a tracer for the solution in the tanks and some question arose as to whether the solids did, in fact, follow the same path and have the same retention time. For this reason it was decided to go ahead with a tracer test using activated ore, which would give irrefutable evidence of the movement of the solids. Two small samples of tailings material were shipped to Ottawa, and were ultimately sent to Chalk River for irradiation in the NRX pile. After calculating the attainable level of activity for these samples, due mainly to their iron content, it was found necessary to concentrate the pyrite to increase the content of iron in a given sample. This was done at the Mines Branch by super-panning.

TEST PROCEDURE

The crucial point in this test turned out to be the quantity and activity of the radioactive sample employed. The pachuca tailings samples sent to Ottawa contained 2.28% Fe, 2.51% S and 0.003% U_3O_8, with traces of sodium, calcium, phosphorus and silver, in a silica matrix. The irradiation of this sample was discussed with Atomic Energy of Canada Ltd., and it was found necessary to increase the pyrite content to get some reasonable activity within a practical irradiation time. By super-panning, the pyrite content was increased to give assay values of 19.63% Fe, 23.5% S and 0.022% U_3O_8 in the final sample. To irradiate a larger sample of this material would have been extremely expensive and, for reasons of economy, it was decided to limit the irradiation to two self-service capsules, containing about 15 grams of pulp material each, for a four-week irradiation time. This was calculated to give only about 2 millicuries of Fe - 55+59 activity, rather marginal under the circumstances.

On receipt of the active material at the beginning of February, 1960, arrangements were made for conducting the tracer tests at Quirke on February 16th and the following days. A scintillation counter was set up in the pachuca test laboratory using a portable detector head and a Berkeley scaler. A lead castle was set up around the detector to reduce the background from cosmic rays and

from the uranium in the leach tanks. Samples were poured into one-pint milk bottles which could be placed in a reproducible position over the detector head inside the castle.

The first active sample (about 1 mc) was dropped into No. 2 pachuca at 9.50 a.m. on February 16; the second active sample was put into No. 3 pachuca at 3.40 p.m. of the same day. Samples were taken as follows:

No. 2 pachuca: every 10 minutes, 9.45 a.m. to 5 p.m.
and at 6 p.m.

No. 3 pachuca: every 30 minutes, 11 a.m. to 4 p.m.
every 15 minutes, 4.15 p.m. to 7 p.m.

No. 4 pachuca: every 30 minutes, 11 a.m. to 7 p.m.

No. 5 pachuca: every 30 minutes, 3 p.m. to 7 p.m.

No. 6 and 7 pachucas: at 7 p.m.

The sample counts obtained all remained steady, with some slight fluctuations due mainly to minor variations in sampling. Average net count rates were approximately:

Background	117±8	counts/minute
No. 2 pachuca	480	
No. 3 "	350	before 4 p.m.
	420	after 4 p.m. (new sampler)
No. 4 "	340	
No. 5, 6, 7	330	

These count rates were due only to the uranium content of the ore and plainly showed no relation to the added activity. In view of this fact it was decided to terminate the test work at 7 p. m. on February 16.

The differences in count rates for samples from different pachucas were ascribed to variations in solubility of the uranium as the leaching processes proceed. Comparison of filtered samples from No. 2 and 4 pachucas gave the following net count rates for comparable quantities:

	Liquid	Solid
No. 2 sample	60	216
No. 4 sample	31	220

Film badges were worn by Mines Branch staff and the pachuca samplers throughout the duration of the test.

DISCUSSION

Apart from a few minor points of information that arose from the test, the main purpose of the test was not achieved as the added activity could not be detected. With a throughput of one ton of solids passing through each pachuca per minute, a six-hour contact time implies dilution of the active sample in 360 tons of pulp. If half-pound samples are drawn at intervals these represent one part

in 1.4×10^6. Assuming a minimum detectable level of 0.2 microcurie per sample, a total activity of about 300 millicuries would be required, not an impossible amount to handle. However, this must also be distributed in enough particles of slurry to be evenly distributed throughout the pachuca to ensure the appearance of more than one active grain in the counting sample. This means irradiation of at least 10 pounds of pyrite concentrate. To obtain irradiation of such an amount to give 300 millicuries would almost certainly require the use of a control rod position in the NRX reactor. This can be arranged if necessary, but would probably cost in the neighbourhood of $800-$1000 for the time of activation required. Resumption of these tests, therefore, would depend on the value placed on the retention time measurement for the future operation of the mill.

o o o

GGE:eja