Total Ore Processing Integration and Management

4th Quarterly Technical Progress Report
01 April - 30 June 2004

written by

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Abstract

This report outlines the technical progress achieved for project DE-FC26-03NT41785 (Total Ore Processing Integration and Management) during the period 01 April through 30 June of 2004.

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Executive Summary

Work in Progress: Data Mining and Analysis, Minntac Mine

The results of research conducted and notes compiled by Wayne Plummer, former chief geologist at Minntac Mine, are being studied and compared with the notes from discussions with Pete Niles, formerly of the Coleraine Research Laboratory.

Several approaches were applied to describe the grindability behavior of the iron ore at Minntac Mine. Due to the very large amount of this type of data that Minntac has collected over the decades, this task is still underway. The curve-fit constants and points of interest are being summarized for comparison and analysis between different areas of the mine, between the different ore layers, and between the splits of the ore segregation tests.

Work in Progress: Data Collection, Hibtac Mine

This is underway. Work stations have been set up in the core analysis area to measure the point-load strength and the density of the five ore layers being mined at Hibtac. Seven representative exploration coreholes were selected for these measurements.

The WipFrag image analysis system installation continues.

Work in Progress: Ore Segregation Tests

This quarter was spent in preparation for the third, and most comprehensive, ore segregation test at Minntac Mine. It is scheduled to begin in July and continue into August. A large number of mine and mill personnel have been involved in planning it.

Basic hypothesis testing has been completed for both previous ore segregation tests at Minntac Mine.

Work in Progress: Orebody Models

Two series of maps have been produced from the assay, grindability, and liberation data from the exploration cores that were incorporated into the Minntac Mine orebody model during the preceeding quarter.

Future Work: Ore Segregation Tests

A third ore segregation test is being planned for Minntac Mine.

Future Work: Statistical Analysis

Two statistics professors with industrial experience will determine the relationships among data mined from the databases and the ore segregation tests of both mines.

Research Partners

Queens University has joined the project as a Research Partner. They are conducting an independent suite of laboratory tests to characterize the breakability of ore samples.

Dissemination and Outreach

Three technical papers are being prepared, two for the SME Annual Meeting to be held in Salt Lake City, UT in 2005, and one for the APCOM to be held in Tucson, AZ, also in 2005.

Introduction

This fourth quarterly report discusses the activities of the project team during the period 1 April through 30 June 2004.

Work in Progress

Data Mining and Analysis, Minntac Mine

The results of research conducted and notes compiled by Wayne Plummer, former chief geologist at Minntac Mine, are being studied and compared with the notes from discussions with Pete Niles, formerly of the Coleraine Research Laboratory.

Several approaches were applied to describe the grindability behavior of the iron ore at Minntac Mine. Both linear and exponential curves were fitted to the measured grindability and liberation data for both silica and magnetic iron, and various points of interest on the curves were calculated (Figures 1 through 6). Due to the very large amount of this type of data that Minntac has collected over the decades, this task is still underway. The curve-fit constants and points of interest are being summarized for comparison and analysis between different areas of the mine, between the different ore layers, and between the splits of the ore segregation tests.
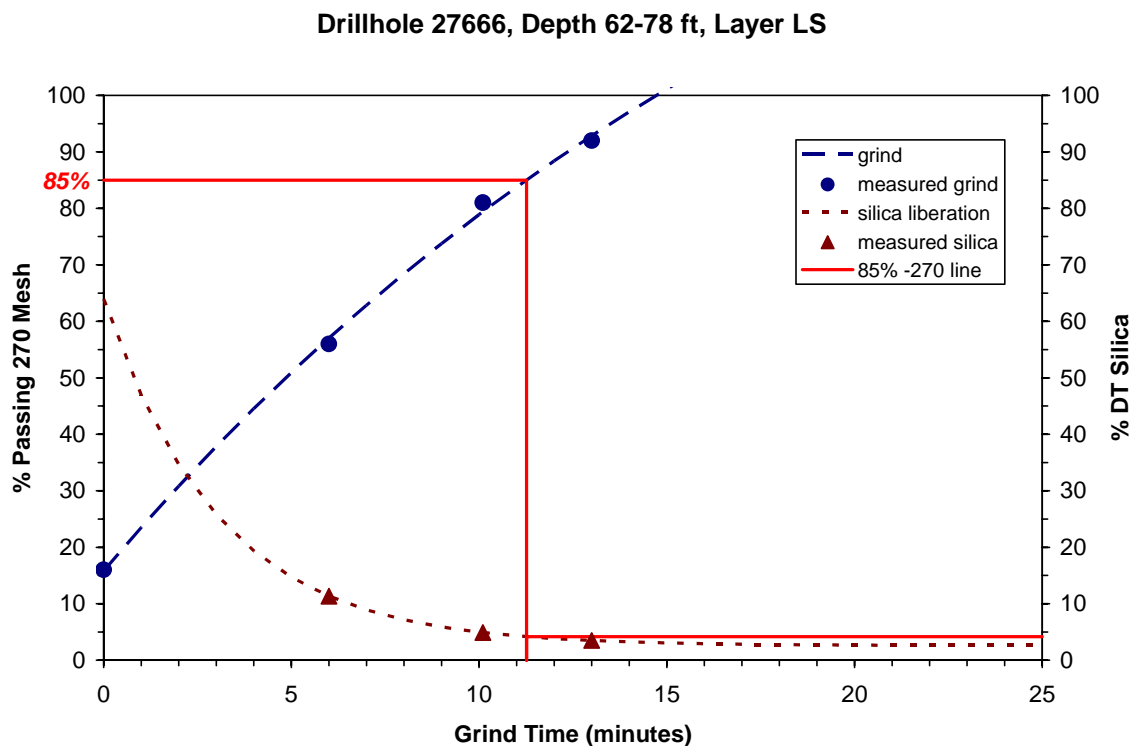
Drillhole 27666, Depth 62-78 ft, Layer LS

Figure 1. Example of grindability data, fitted curves, and the T_{85} point of interest. To reach 85% passing 270 mesh requires slightly more than 11 minutes of grinding, and liberates about 4% silica, for the ore in this particular corehole interval.
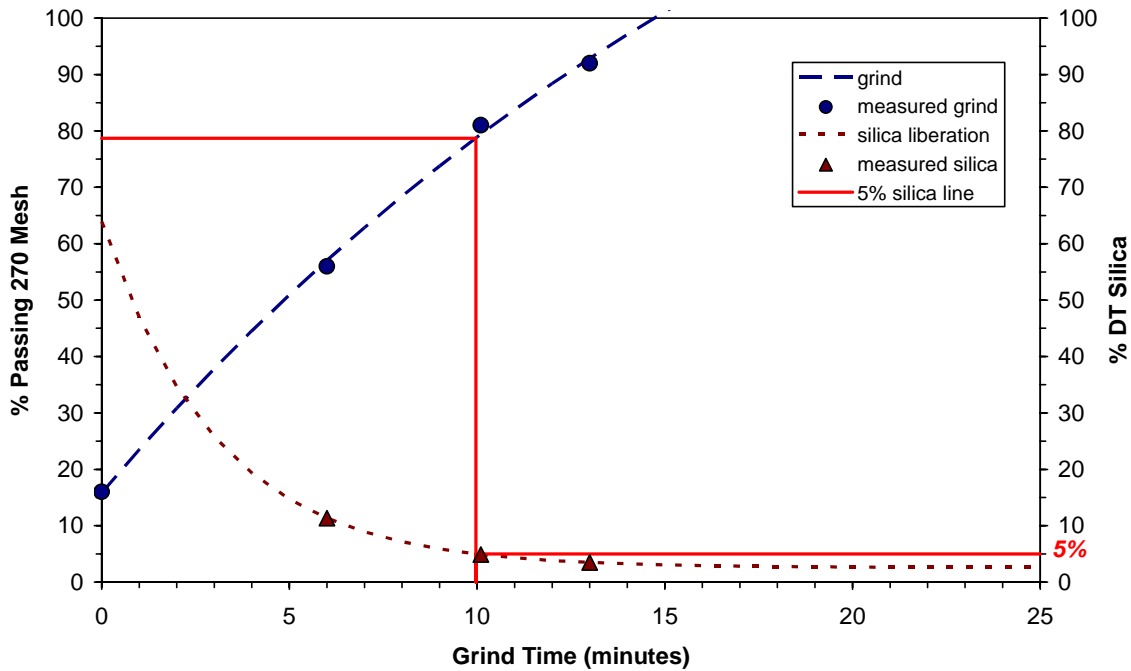
Drillhole 27666, Depth 62-78 ft, Layer LS

Figure 2. Example of grindability data, fitted curves, and the T_5 point of interest. To reach 5% silica liberation requires about 10 minutes of grinding, and produces a grind of which about 79% is finer than 270 mesh.
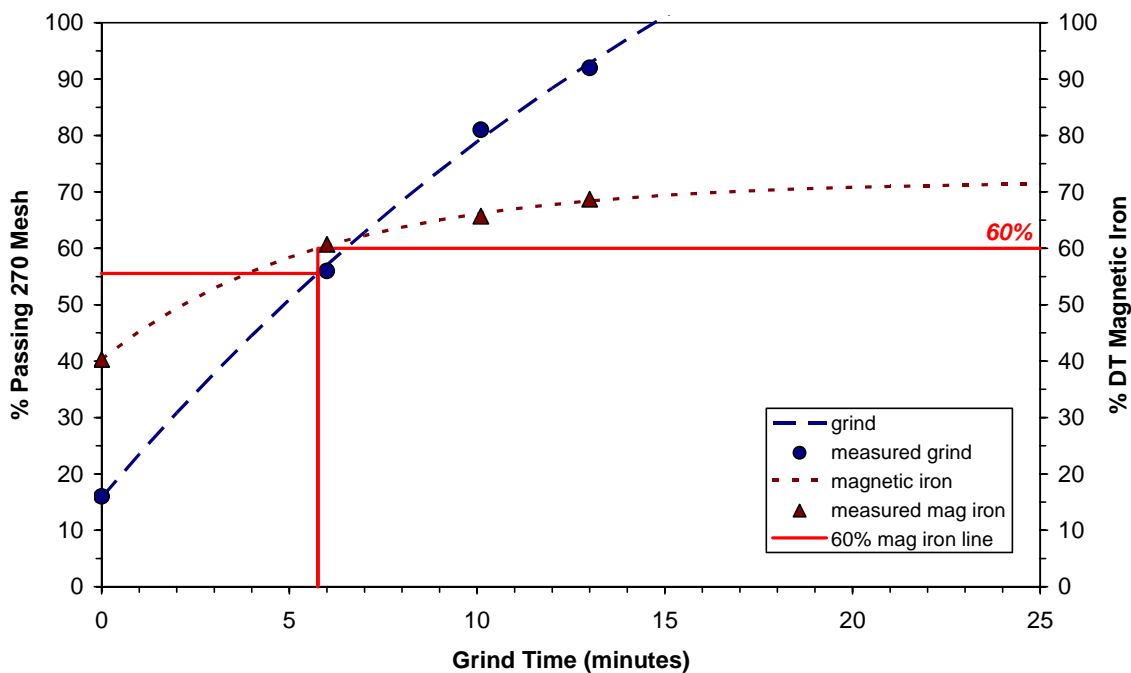
Drillhole 27666, Depth 62-78 ft, Layer LS

Figure 3. Example of iron liberation chart #1, showing 60% iron liberation requirements.
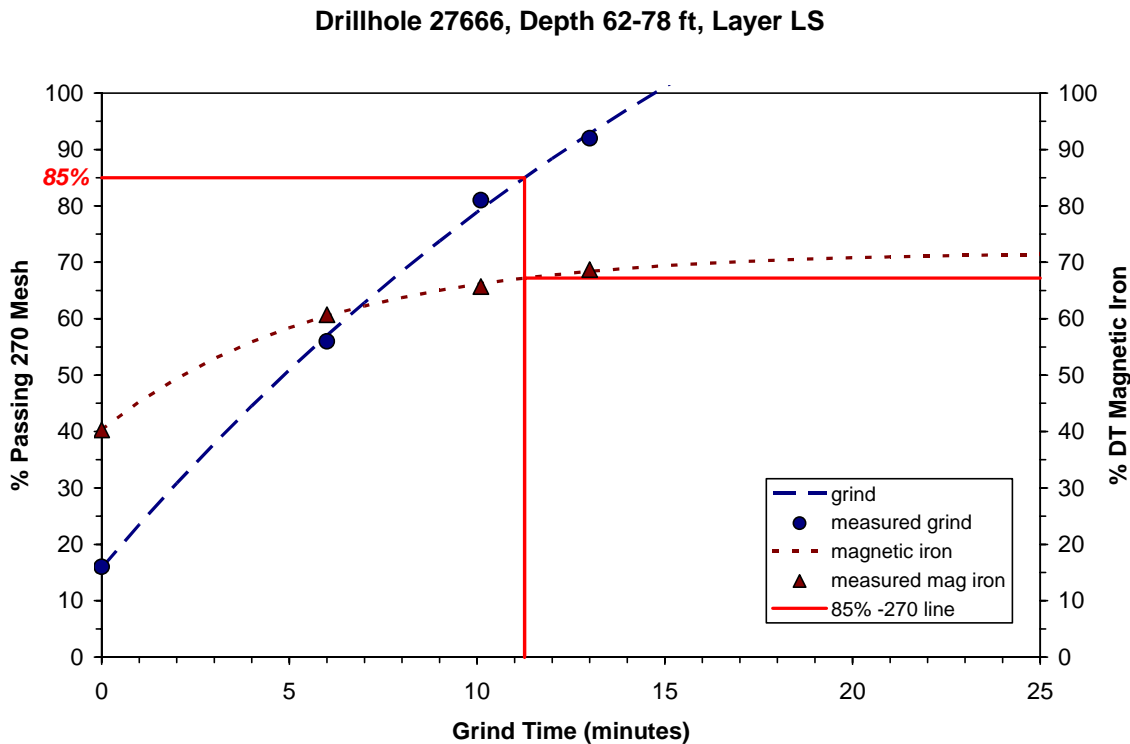
Drillhole 27666, Depth 62-78 ft, Layer LS

Figure 4. Example of iron liberation chart #2, showing result of 85% -270 mesh grind.

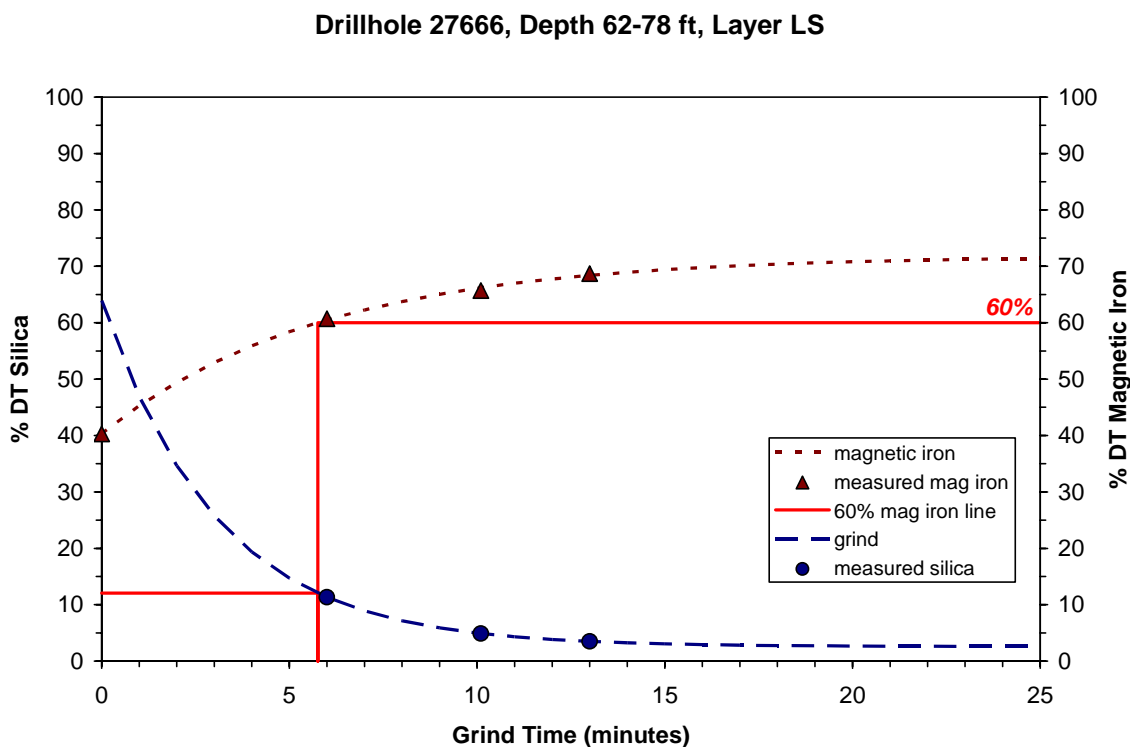**Drillhole 27666, Depth 62-78 ft, Layer LS**

Figure 5. Example of combined silica and iron liberation chart #1, showing silica liberation associated with 60% iron liberation.
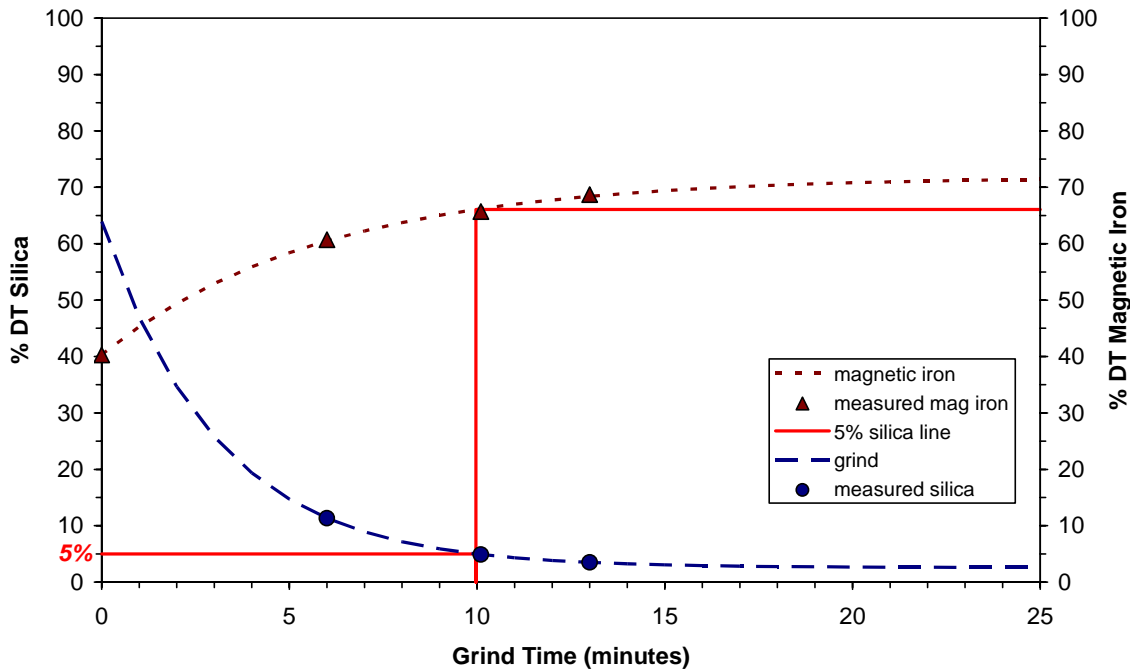
Drillhole 27666, Depth 62-78 ft, Layer LS

Figure 6. Example of combined silica and iron liberation chart #2, showing iron liberation associated with 5% silica liberation.

Data Collection, Hibtac Mine

This is still underway, with the assistance of a summer student intern and in close cooperation with the chief geologist. Work stations have been set up in the core analysis area to measure the point-load strength and the density of the five ore layers being mined at Hibtac. Seven representative exploration coreholes were selected for these measurements.

The WipFrag image analysis system installation continues over the conveyor belts leading from the primary crusher. One frame has been erected and some of the data and power cabling is in place. The work has slowed while the mine and the union re-negotiate their contract. A strike is possible if agreement is not reached before 1 August, which would halt our work at the minesite for its duration.

Ore Segregation Tests

This quarter was spent in preparation for the third, and most comprehensive, ore segregation test at Minntac Mine. It is scheduled to begin in July and continue into August. A large number of mine and mill personnel have been involved in planning it.

Basic hypothesis testing has been completed for both previous ore segregation tests at Minntac Mine. The data will be turned over to two professional statisticians for more in-depth analysis after they have completed their current work preparing for the third ore segregation test and analyzing data mined from Hibtac Mine databases.

Orebody Models

Two series of maps have been produced from the assay, grindability, and liberation data from the exploration cores that were incorporated into the Minntac Mine orebody model during the preceeding quarter. One series consists of plan views of the orebody at constant elevations separated by 20-ft intervals. The other series shows the geologic formation surfaces as indicated by borehole intercepts. The formations dip approximately 5° to the east. The two sets of maps are similar, but the second set shows more clearly the shapes of possible original geologic features that are indicated by changes in silica and iron concentration, ore grindability, and silica and iron liberation behavior.

Future Work

Ore Segregation Tests

A third ore segregation test is being planned for Minntac Mine later this summer, during which lessons learned during the first two tests will be applied. A wider selection of data will be monitored during this test, and the results of preliminary statistical analysis of data from preceding weeks will be applied. The pre-test data collection, test duration, and post-test data collection phases will all be longer than used previously.

Once the muck imaging system comes online at Hibtac Mine, another ore segregation test based on powder factor will be conducted.

Statistical Analysis

Two statistics professors with industrial experience will determine the relationships among data mined from the databases and the ore segregation tests of both mines.

Research Partners

Queens University has joined the project as a Research Partner. They are conducting an independent suite of laboratory tests to characterize the breakability of ore samples from Hibtac Mine.

Dissemination and Outreach

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