INDUSTRIAL CONFIDENTIAL.



DEPARTMENT OF MINES.

South Australia.

-RESEARCH AND DEVELOPMENT BRANCH-

# FLOTATION TESTS FOR NAIRNE PYRITES LTD.

by

P.B. Moffitt.

ISSUED BY:
T.W. Dalwood.
Chief Superintendent.

Copy No. 3

DATE: August, 1957.

This document consists of 10 pages.

# FLOTATION TESTS FOR NAIRNE PYRITES LTD.

## -Contents-



---

# FLOTATION TESTS FOR NAIRNE PYRITES LTD.

REPORT No.2

-Abstract-

Tests carried out on ore supplied by Nairne Pyrites Ltd showed that the Fortisol series reagents can be used to replace secondary butyl xanthate and/or Flotation Oil 66.

***

## 1. SUMMARY.

The examination of the effect of the Fortisol series of reagents on Nairne pyrite flotation showed:-

1. The replacement of Secondary Butyl Xanthate and Flotation Oil 66 by the Fortisol reagents. produced no changes in metallurgical efficiency.

2. Fortisol 15 used in place of Flotation Oil 66 produced a noticeable increase in sulphur recovery. It is considered that plant scale testing of this reagent should be carried out.

## 2. INTRODUCTION.

Secondary butyl xanthate used for the flotation of pyrite, by Nairne Pyrites Limited, produces poor recoveries when treating oxidised ore. A request to examine the effect of the Fortisol Series of reagents on this particular feed was submitted by the Company.

It was suggested that the Fortisol reagents should be used to replace either the Flotation Oil 66 or both the Flotation Oil 66 and the secondary butyl xanthate.

## 3. MATERIAL EXAMINED.

Approximately 5 cwt of rod mill feed was received from Nairne Pyrites Limited. The sample had been taken from the mill feed when oxidised ore was causing low recoveries. This material contained 10.8 percent total sulphur with 0.17 percent oxidised sulphur.

A drum of mill circuit water was also received. pH measurements of this water varied from 6.4 when dispatched from Nairne to 5.3 when tested during experimental work.

## 4. EQUIPMENT.

1. Rolls crusher.
2. 500 gram Laboratory ball mill.
3. 500 gram Laboratory Fagergren flotation cell.

## 5. EXPERIMENTAL PROCEDURE and RESULTS.

### 5.1 Crushing of Sample.

The sample received from Nairne was reduced to minus half inch. The sample was then split by riffling, and one half further reduced to minus 10 mesh.

The minus 10 mesh material was mixed and samples for flotation test work were produced by riffling.

### 5.2 Grinding Data.

Several grinding tests were made to determine the time required to produce a product containing approximately 55 percent minus 200 mesh. A six and one half minute grind was used and the size range produced is given in Table 1, together with that of the minus 10 mesh material.

All grinding and flotation tests were carried out in Nairne Mill circuit water.

TABLE 1.

Screen Analyses of Ball Mill Feed and Discharge.

| Fraction. | Ball Mill Feed. | Ball Mill Discharge. |
|---|---|---|
| + 20 mesh Tyler. | 24.0 percent. | - percent. |
| - 20 + 48 " | 33.5 " | 9.0 " |
| - 48 + 65 " | 4.8 " | 7.5 " |
| - 65 +100 " | 5.2 " | 12.5 " |
| -100 +150 " | 4.2 " | 10.5 " |
| -150 +200 " | 1.8 " | 5.8 " |
| -200 | 26.5 " | 55.5 " |
| | 100.0 | 100.0 |

5.3 Standard Tests.

Two standard tests were completed using the flotation and conditioning times used at Nairne.

5.3.1 Conditions for Standard tests.

The ground sample was transferred from the laboratory ball mill to the glass bowl of the flotation machine and the following procedure carried out:-

(a) 0.15 lb of copper sulphate per ton was added and the pulp conditioned for two minutes.

(b) 0.21 lb of secondary butyl xanthate per ton added and conditioned for two minutes.

(c) 0.22 lb Flotation Oil 66 per ton added and conditioned for seven minutes.

(d) The pulp was floated for 6 minutes and then 0.07 lb of secondary butyl xanthate per ton was added. Flotation was continued for one minute. An amount of 0.08 lb of Flotation Oil 66 per ton was then added and flotation continued for two minutes.

Results of the standard tests appear in Table 2.

TABLE 2.

Results of Standard Tests.

| Test No. | Fraction. | Weight Percent. | Sulphur Percent. | Sulphur Distrib. Percent. |
|---|---|---|---|---|
| 1. | Concentrate. | 24.2 | 37.6 | 84.4 |
| | Tailing. | 75.8 | 2.06 | 15.6 |
| | FEED. | 100.0 | 10.66 | 100.0 |
| 2. | Concentrate. | 24.8 | 36.4 | 88.6 |
| | Tailing. | 75.2 | 1.52 | 11.4 |
| | FEED. | 100.0 | 10.19 | 100.0 |

5.4 Testing of Fortisol 30.

Four tests were carried out in this series, Fortisol 30 replacing both the secondary butyl xanthate and Flotation Oil 66.

5.4.1 Conditions and Results.

The conditions for the test work were:

(a) 0.15 lb of copper sulphate per ton added and conditioned for two minutes.

(b) 0.2 lb of Fortisol per ton added and the pulp conditioned in the flotation cell for nine minutes.

(c) Flotation carried out for six minutes 0.07 lb of Fortisol 30 per ton added and flotation continued for a further three minutes.

Similar tests were carried out using additions of 0.24 0.27 and 0.30 lb of Fortisol per ton as the main addition and 0.08, 0.09 and 0.10 lbs/ton respectively as the secondary additions. Results of these tests are set out in Table 3.

TABLE 3.

Results of Testing Fortisol 30.

| Test No. | Fortisol 30 Addition. First Addition lb/ton. | Second Addition lb/ton. | Fraction. | Weight Percent. | Sulphur Percent. | Percent Sulphur Distrib. |
|---|---|---|---|---|---|---|
| 3. | 0.20 | 0.07 | *Conc. | 27.0 | 34.4 | 86.8 |
| | | | *Tail. | 73.0 | 1.94 | 13.2 |
| | | | FEED | 100.0 | 10.70 | 100.0 |
| 4. | 0.24 | 0.08 | Conc. | 26.4 | 34.7 | 88.5 |
| | | | Tail. | 73.6 | 1.62 | 11.5 |
| | | | FEED | 100.0 | 10.35 | 100.0 |
| 5. | 0.27 | 0.09 | Conc. | 26.6 | 33.5 | 90.6 |
| | | | Tail. | 73.4 | 1.26 | 9.4 |
| | | | FEED | 100.0 | 9.84 | 100.0 |
| 6. | 0.30 | 0.10 | Conc. | 31.0 | 30.5 | 89.2 |
| | | | Tail. | 69.0 | 1.66 | 10.8 |
| | | | FEED | 100.0 | 10.60 | 100.0 |

* Concentrate * Tailing.

5.5 Testing of Fortisol 25.

This series was carried out in the same manner as section 5.4, except for the substitution of Fortisol 25 for Fortisol 30. Results appear in Table 4.

TABLE 4.

Results of Testing Fortisol 25.

| Test No. | Fortisol 25 Addition | | Fraction. | Weight Percent. | Sulphur Percent. | Percent Sulphur Distrib. |
|---|---|---|---|---|---|---|
| | First Addition lb/ton. | Second Addition lb/ton. | | | | |
| 7. | 0.20 | 0.07 | Conc. | 27.0 | 32.4 | 88.2 |
| | | | Tail. | 73.0 | 1.60 | 11.8 |
| | | | FEED | 100.0 | 9.92 | 100.0 |
| 8. | 0.29 | 0.08 | Conc. | 29.8 | 32.4 | 88.9 |
| | | | Tail. | 70.2 | 1.71 | 11.1 |
| | | | FEED | 100.0 | 10.86 | 100.0 |
| 9. | 0.27 | 0.09 | Conc. | 30.8 | 30.6 | 88.6 |
| | | | Tail. | 69.2 | 1.75 | 11.4 |
| | | | FEED | 100.0 | 10.64 | 100.0 |
| 10. | 0.30 | 0.10 | Conc. | 33.2 | 28.4 | 90.5 |
| | | | Tail. | 66.8 | 1.48 | 9.5 |
| | | | FEED | 100.0 | 10.42 | 100.0 |

5.6 Testing of Fortisol 15.

A further series was carried out in similar manner to the series outlined in Section 5.4 except that Fortisol 15 was substituted for Fortisol 30.

The results appear in Table 5.

TABLE 5.

Results of Testing Fortisol 15.

| Test No. | Fortisol 15 Addition | | Fraction. | Weight Percent. | Sulphur Percent. | Percent Sulphur Distrib. |
|---|---|---|---|---|---|---|
| | First Addition lb/ton. | Second Addition lb/ton. | | | | |
| 11. | 0.20 | 0.07 | Conc. | 29.2 | 31.0 | 86.7 |
| | | | Tail. | 70.8 | 1.96 | 13.3 |
| | | | FEED | 100.0 | 10.44 | 100.0 |
| 12. | 0.24 | 0.08 | Conc. | 29.8 | 28.3 | 88.5 |
| | | | Tail. | 70.2 | 1.56 | 11.5 |
| | | | FEED | 100.0 | 9.53 | 100.0 |
| 13. | 0.27 | 0.09 | Conc. | 30.4 | 28.7 | 88.1 |
| | | | Tail. | 69.6 | 1.70 | 11.9 |
| | | | FEED | 100.0 | 9.91 | 100.0 |
| 14. | 0.30 | 0.10 | Conc. | 26.4 | 30.9 | 86.8 |
| | | | Tail. | 71.6 | 1.89 | 13.2 |
| | | | FEED | 100.0 | 10.11 | 100.0 |

5.7 Testing of Fortisol 15 with Secondary Butyl Xanthate.

This series was carried out to examine the effect of Fortisol 15 as a replacement of Flotation Oil 66 in the standard test. The amount of butyl xanthate was varied while the amount of Fortisol 15 remained constant.

Conditions are set out below:

(a) 0.15 lb Copper Sulphate per ton was added and the pulp conditioned for two minutes as in the standard test.

(b) The remaining steps of the standard conditions were carried out using butyl xanthate with Fortisol 15 as the frother in place of Flotation Oil 66.

(c) The conditions above were repeated using a total of 0.30 lb Fortisol 15 per ton, while reducing the total additions of secondary butyl xanthate to 0.24, 0.20 0.16 lb/ton respectively.

Results of these tests are reported in Table 6.

TABLE 6.

Results of Testing Fortisol 15 in Place of Flotation Oil 66.

| Test No. | Fraction. | Weight Percent. | Sulphur Percent. | Percent Sulphur Distrib |
|---|---|---|---|---|
| 15. | Concentrate. | 32.0 | 31.1 | 93.1 |
| | Tailing. | 68.0 | 1.08 | 6.9 |
| | FEED. | 100.0 | 10.69 | 100.0 |
| 16. | Concentrate. | 34.2 | 30.7 | 92.6 |
| | Tailing. | 65.8 | 1.28 | 7.4 |
| | FEED. | 100.0 | 11.34 | 100.0 |
| 17. | Concentrate. | 30.6 | 27.7 | 88.8 |
| | Tailing. | 69.4 | 1.54 | 11.2 |
| | FEED. | 100.0 | 9.55 | 100.0 |
| 18. | Concentrate. | 29.0 | 32.8 | 91.3 |
| | Tailing. | 71.0 | 1.27 | 8.7 |
| | FEED. | 100.0 | 10.41 | 100.0 |

5.8 Determination of the Effect of the Pulp Density on Flotation.

Laboratory flotation tests were carried out at a much lower pulp density than that used in plant practice. To determine to what extent pulp density effected the results, Test 8 (Table 8) was repeated at twice the normal pulp density. Results of this test are shown in Table 7 together with the results of Test 8 as a comparison.

INDUSTRIAL CONFIDENTIAL.

TABLE 7.

Effect of Flotation at High Pulp Density.

| Test No. | Pulp Density. | Fortisol 25 Addition | | Fraction. | Weight Percent. | Sulphur Percent. | Sulphur Distrib. Percent. |
|---|---|---|---|---|---|---|---|
| | | First Addition lb/ton. | Second Addition lb/ton. | | | | |
| 19. | 36 Percent solids. | 0.24 | .08 | Concentrate. | 35.1 | 26.3 | 91.4 |
| | | | | Tailing. | 64.9 | 1.34 | 8.6 |
| | | | | FEED | 100.0 | 10.10 | 100.0 |
| 8. | 18 Percent solids. | 0.24 | .08 | Concentrate. | 29.8 | 32.4 | 88.9 |
| | | | | Tailing. | 70.2 | 1.71 | 11.1 |
| | | | | FEED | 100.0 | 10.86 | 100.0 |

## 6. DISCUSSION.

### 6.1 Standard Test.

The present flotation tailing at Nairne contains 2.0 to 2.3 percent sulphur. A tailing of this order was obtained in only one of the two standard tests carried out in the laboratory.

### 6.2 Substitution of Xanthate and Oil 66 by Fortisol Reagents.

The replacement of secondary butyl xanthate and Flotation Oil 66 by the various Fortisol reagents showed no improvement in metallurgical efficiency. Comparing the effect of the various Fortisols it is found that concentrate grade improves with the Fortisol number while the recovery remains approximately the same.

### 6.3 Substitution of Flotation Oil 66.

The use of Fortisol 15 as a replacement for Flotation Oil 66 produced a noticeable improvement in the recovery of sulphur. This combination of reagents presents the most promising line for future plant experimental work. The Fortisol 15 produces sufficient froth for flotation and also has sulphidising properties which increase the recovery of the oxidised ore particles.

### 6.4 Pulp Density Effect.

The higher pulp density used in the final test resulted in a higher recovery but a lower grade of concentrate compared with the results of similar test at lower pulp density.