DEPARTMENT OF MINES.

South Australia.

-RESEARCH AND DEVELOPMENT BRANCH-

BENEFICIATION OF LAKE FOWLER GYPSUM.

FOR
COLONIAL SUGAR REFINING COMPANY LIMITED.

SECOND REPORT.

Pilot Plant Tests with Estimates of Capital and Operating Costs.

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

Copy No. 3

DATE: September, 1958.

LAKE FOWLER GYPSUM - SECOND REPORT. PILOT PLANT TESTS WITH ESTIMATES OF CAPITAL AND OPERATING COSTS.

-Contents-

LAKE FOWLER GYPSUM - SECOND REPORT.

PILOT PLANT TESTS WITH ESTIMATES OF CAPITAL AND OPERATING COSTS.

1. SUMMARY.

The Colonial Sugar Refining Company Limited submitted samples of Lake Fowler dune gypsum for treatment. The work was performed in the following two stages:

1. Preliminary testing of a half ton sample to determine the best treatment method.
2. Washing of a fifty ton sample using the best conditions determined from (1).

The preliminary testing compared classified washing with classifier washing and attritioning. It was found that, although the product from classification and attritioning was superior to that from classification only, the recovery of seed gypsum was reduced by approximately thirty per cent. Tests by the Company indicated that the product from the classifier washing test was acceptable and consequently this method was adopted for treating the fifty ton sample.

The sample was screened to pass a one-half inch opening and pugged with fresh water in a logwasher at eighty per cent solids. This pulp was treated in two classifiers in series. Fine gypsum in the overflows from both classifiers was discarded. Sand from the second classifier was drained on a concrete floor and then packed in plastic lined 44 gallon drums and despatched to Sydney. Recovery of seed gypsum was approximately eighty per cent.

Plants to treat either 500 or 1000 tons per week have been designed and estimates covering capital and operating costs prepared.

The fresh water supply in the Edithburgh district is poor and it is doubtful if sufficient water would be available there for treatment of the dune gypsum with straight classification. Two alternative plant designs are presented in an attempt to resolve this problem.

2. INTRODUCTION.

The Colonial Sugar Refining Company Limited submitted samples of dune gypsum material from Lake Fowler for treatment. A product free from fine, or flour, gypsum was required.

Air separation methods had been used on dried material from this deposit in previous work but work on gypsum samples from other deposits had shown that wet-attritioning at high pulp density was necessary to effect a good separation of the adherent flour from seed gypsum. However double drying of the raw feed, once for direct dry separation and again after wet attritioning, is costly and it was decided to investigate complete treatment by wet methods.

In this report the terms "seed" and "flour" will be used to describe the granular and powdery types of gypsum respectively.

3. MATERIAL EXAMINED.

Two separate samples, approximately one half ton and fifty tons respectively in weight, were supplied by Colonial Sugar Refining Company Limited from their dune gypsum deposit at Lake Fowler.

The samples were received packed in jute bags and comprised typical dune gypsum material. The presence of hard lumps and entrained organic matter was evident.

4. EQUIPMENT.

The following equipment was used:

Preliminary Test Work:

1. 9" Spiral classifier.
2. Small scale agitators.
3. Two stage attritioner.

Major Test Work:

1. 12 x 20 inch jaw crusher.
2. Half-inch screen.
3. 30 x 15 inch rolls.
4. 30 x 72 inch logwasher.
5. 3 x 14 foot rake classifier.
6. 18 inch diameter spiral classifier.

All sizings were carried out using standard Tyler screens.

5. TREATMENT OF HALF TON SAMPLE.

5.1 Procedure and Results.

Two tests were designed to produce washed gypsum.

The raw gypsum for both tests was broken to pass a 1/4 inch screen. Organic matter remaining on the screen was discarded.

In Test 1, the raw gypsum was agitated in water at a low pulp density and then classified in a spiral classifier. Most of the flour gypsum was rejected in the overflow fraction. The classifier sand was treated in a two stage attritioner as a pulp containing fifty per cent solids. Discharge from the attritioner was treated in a spiral classifier to remove the fines produced during attritioning.

Test 2 was similar to Test 1 except that the attritioning and second classification steps were deleted.

Flowsheets for Tests 1 and 2 are shown in Figures 1 and 2 respectively.

Material balances for these two tests are given in Table 1, and the sizing of the feed and final product from each test are shown in Table 2.

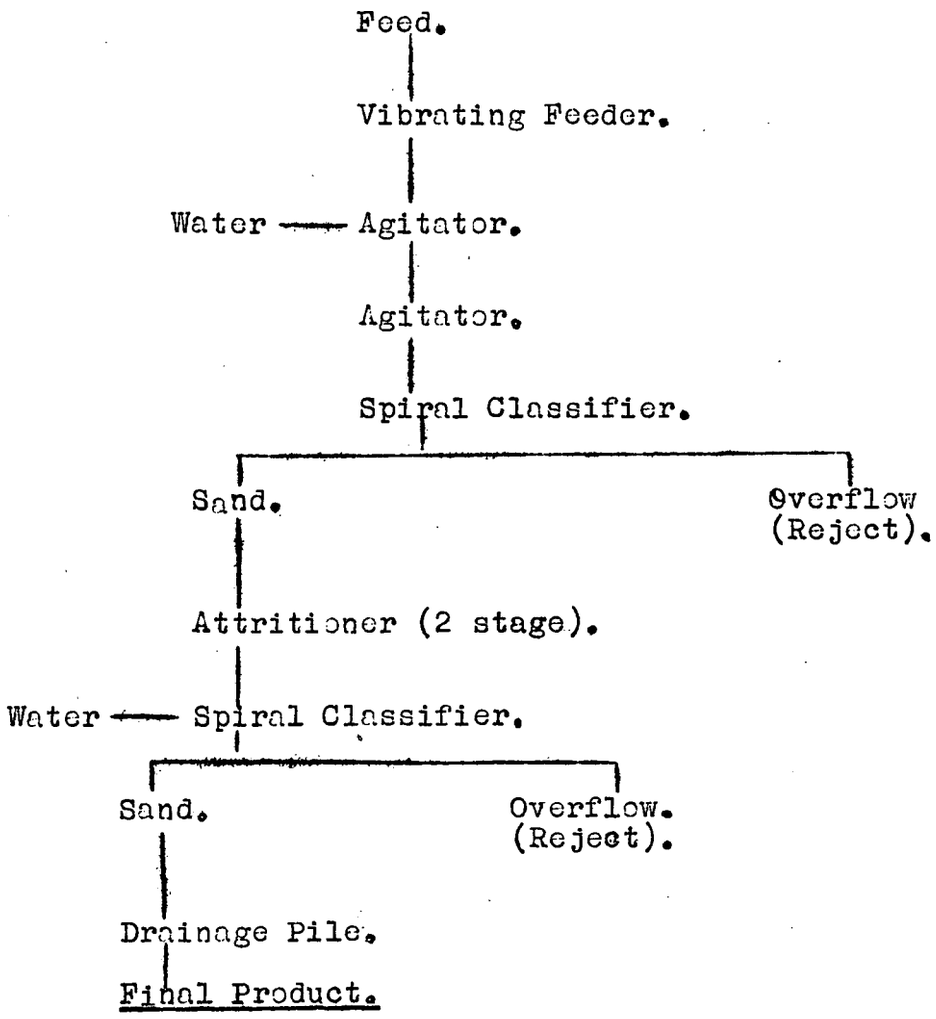
TABLE 1.

Material Balance - Treatment of Half Ton Sample.

	Test 1.	Test 2.
Feed - lb.	544	416
Washed seed gypsum - lb.	263	327
Rejected flour gypsum - lb.	281	89
Washed seed gypsum - per cent of feed.	48.3	78.6

FIGURE 1.

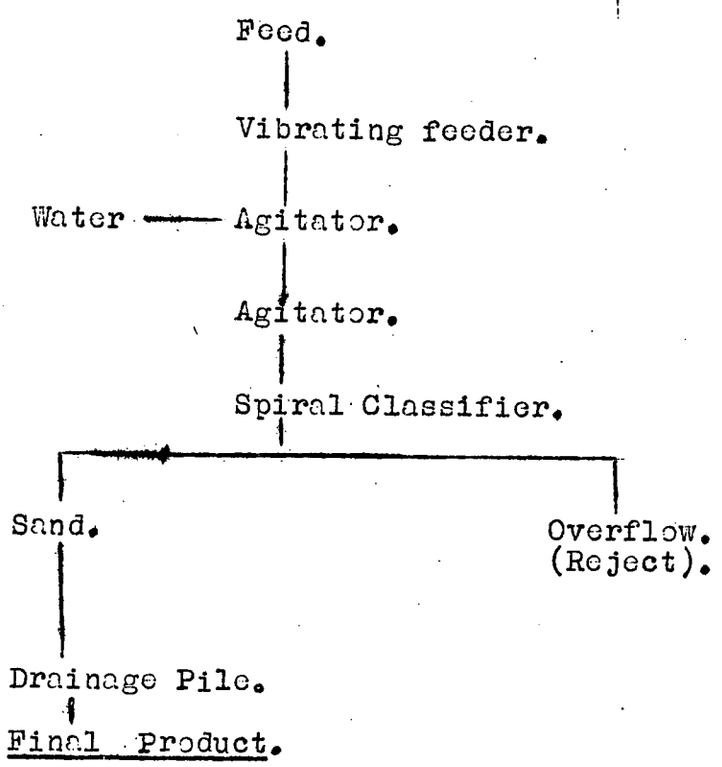
Flowsheet of Test 1.



---oOo---

FIGURE 2.

Flowsheet of Test 2.



---oOo---

TABLE 2.

Sizing of Raw Gypsum and Final Product - Treatment of Half Ton Sample.

FRACTION.	Cumulative % retained. Test 1.		Test 2.	
	Raw Gypsum.	Washed Product.	Raw Gypsum.	Washed Product.
+ 3/16.	1.1		0.4	0.1
+ 6 mesh.	2.4		1.3	0.3
+ 8 "	3.6	0.2	2.1	0.7
+ 10 "	4.3	0.7	3.1	1.4
+ 14 "	5.5	1.6	4.1	2.6
+ 20 "	9.9	5.0	8.5	6.3
+ 28 "	21.3	18.6	19.1	20.4
+ 35 "	40.6	46.3	38.7	48.1
+ 48 "	61.0	80.2	60.2	79.3
+ 65 "	65.4	84.6	64.3	83.6
+100 "	70.4	96.8	69.8	95.7
+150 "	72.1	99.2	71.6	96.2
+200 "	72.9	99.8	74.0	98.9
-200 "	-	-	-	-

5.2 Discussion.

Washed material from Test 1 contained very few agglomerates of flour and seed gypsum. However a large quantity of the seed was reduced in size during attritioning and subsequently lost in the classifier overflow.

The product from Test 2 contained agglomerates of flour and seed representing approximately two per cent by weight of the washed product.

The final washed product from each test was submitted to the Company for examination and assessment.

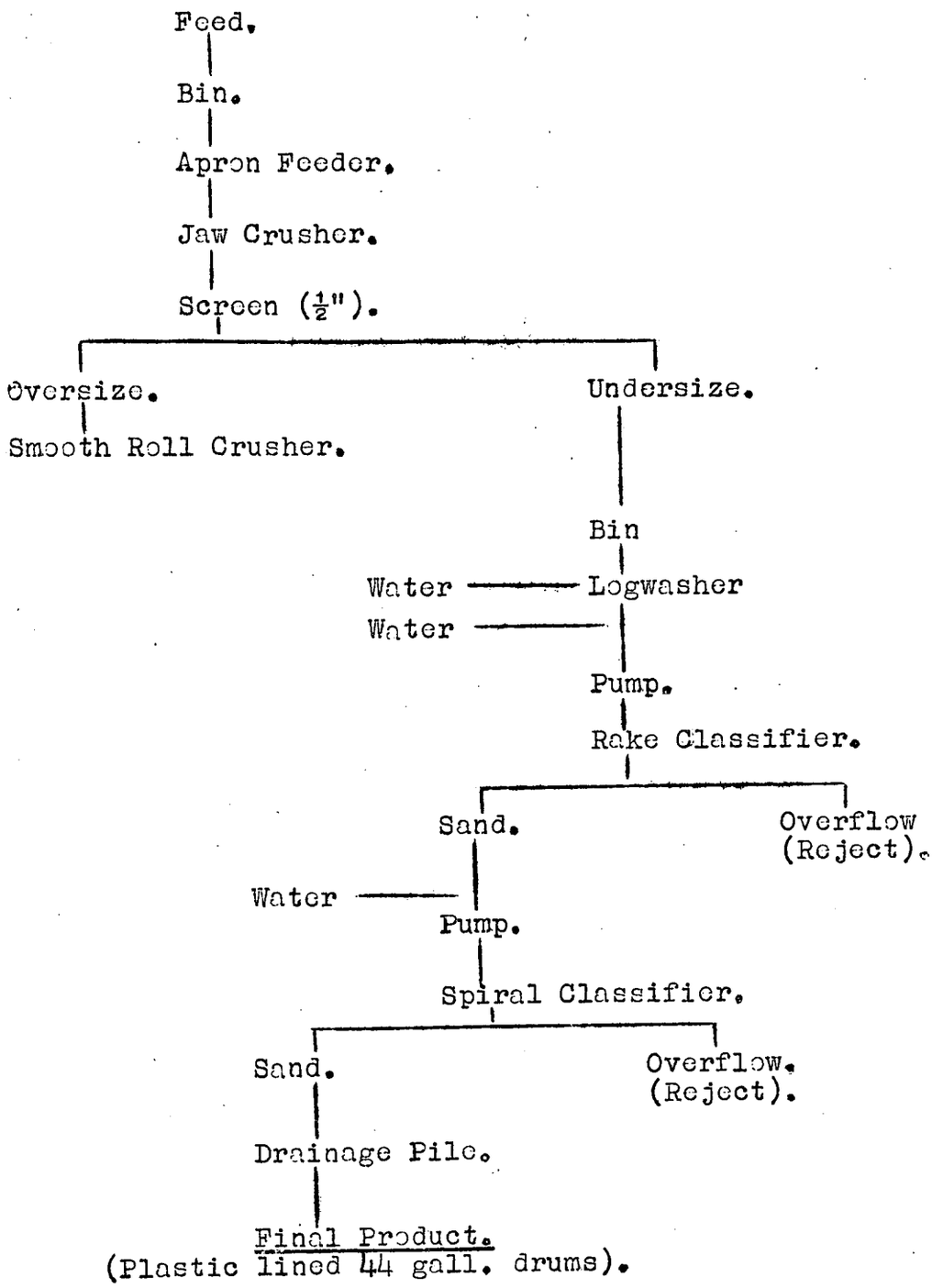
6. TREATMENT OF FIFTY TON SAMPLE.

6.1 Procedure and Results.

After testing the preliminary samples the Company advised that treatment along the lines of Test 2 would be acceptable. Equipment as shown in Figure 3 was therefore set up to carry out this form of treatment.

FIGURE 3.

Flowsheet for Treatment of 50 Ton Sample.



—-oOo—-

6.1.1 Sample.

The fifty tons of gypsum were received in jute bags in a very damp condition. Jute fibre from broken rotted bags caused trouble throughout the crushing and washing sections.

An accurate moisture determination could not be made on the material as received owing to the difficulty of obtaining a reliable sample from a large number of bags varying widely in moisture content. The approximate moisture content was ten per cent.

6.1.2 Crushing.

Frequent stoppages were necessary to remove damp material which built up on the crushing surfaces of the jaw crusher and the rolls.

Belt conveyors and belt type bucket elevators were similarly affected, and very stiff scrapers were required to keep them operating efficiently. Build-up of gypsum on head and tail pulleys of conveyors and elevators caused incorrect tracking in these units and loss of buckets in one elevator. These disadvantages have been avoided as far as possible in the design of the plant.

6.1.3 Washing.

The damp nature of the feed also made it difficult to maintain a steady feed rate to the washing plant. However, once the material had been pulped in the logwasher, very few handling troubles, other than pump blockings due to wood fibre, were experienced.

A close watch was required to maintain the logwasher discharge at eighty per cent solids, although with a constant feed rate this machine would require little attention. The rake and spiral classifiers required routine inspection only and caused no trouble during the treatment run.

Sands from the spiral classifier were piled on a concrete drainage floor before being packed into plastic lined 44 gallon drums. Floor drainage was fast and effective.

Table 3 shows the pulp density at various locations throughout the washing plant.

TABLE 3.

Pulp Density of Various Locations in the Washing Plant. Treatment of 50 Ton Sample.

Location.	% Solids.
Feed.	90
Logwasher discharge.	80
Rake classifier feed.	19
Rake classifier sands.	70
Rake classifier overflow.	8
Spiral classifier feed.	12
Spiral classifier sands.	70
Spiral classifier overflow.	1
Final product packed for despatch.	89

Provision could not be made in the crushing system for the removal of wood fibres and these caused trouble in pump inlets and impellers.

The worst trouble arose from pieces of wood under two inches long which, if water-logged, reported immediately with the classifier sands. The remainder floated on the surface of the classifier pool until it was either removed in the overflow or became water-logged. The rake classifier feed-well was altered several times to facilitate the removal of the floating wood in the overflow, but with only partial success. The suggested screening of the dried product will overcome this problem.

6.1.4 Product Distribution.

Because of the large variations in moisture content of the raw gypsum and the consequent difficulty in maintaining a steady feed rate, normal recovery calculations using the dry weights of total feed to the plant and of finished product were not possible.

As an alternative, internal balances were made in the plant and used to determine the recovery. Weights of the second classifier sands and the volumes and per cent solids of the overflows from both classifiers were measured and the product distribution calculated from these figures. Results are shown in Table 4.

TABLE 4.

Product Distribution.
Treatment of 50 Ton Sample.

Test No.	Weight %. 1st Classifier Overflow.	2nd Classifier Overflow.	Washed Product.	Feed
1.	16.2	2.6	81.2	100
2.	14.3	2.4	83.3	100
3.	14.2	2.8	83.0	100
4.	15.1	2.5	82.4	100
5.	15.3	2.1	82.6	100
6.	16.0	2.4	81.6	100
7.	12.7	3.6	83.7	100
8.	18.4	2.6	79.0	100
9.	15.6	4.0	80.4	100
Average.	15.3	2.8	81.9	100.

By using the actual weight of raw gypsum a check on the order of this recovery figure can be obtained.

Weight of wet feed.	52.9 tons.
Approximate moisture (10 per cent).	5.3
Approximate net dry weight of feed.	47.6
Weight of product shipped.	39.7
Moisture (11 per cent).	4.3
Net dry weight of product.	35.4
Indicated recovery (per cent).	74.

This recovery does not make allowance for spillage or a considerable amount of material left in classifiers and other equipment. The classifier beds were not retreated as they contained excessive amounts of organic matter and pebbles.

6.1.5 Product Sizings.

Control samples for moisture determinations were taken throughout the run. The results of screening two sets of these samples are shown in Table 5.

TABLE 5.

Sizing of Typical Feed and Washed Product Samples.
Treatment of 50 Ton Sample.

Fraction. Mesh Tyler.	Cumulative Weight % Retained. No.1		No.2.	
	Feed.	Washed Product.	Feed.	Washed Product.
+ 8	1.6	0.6	1.2	0.3
+ 10	2.3	1.1	1.7	0.6
+ 14	3.0	1.9	2.5	1.3
+ 20	5.7	4.9	5.4	4.6
+ 28	15.0	16.3	15.3	16.5
+ 35	35.6	44.5	36.5	45.1
+ 48	60.2	79.6	61.5	80.6
+ 65	66.5	89.4	68.0	86.0
+ 100	72.1	95.8	72.8	96.3
+ 150	74.0	98.7	75.2	98.4
+ 200	74.9	99.3	75.9	99.0
- 200	-	-	-	-

6.1.6 Chemical Analysis of Final Product.

Chemical analysis of the final product is given in Table 6.

TABLE 6.

Chemical Analysis of Final Product.
Treatment of 50 Ton Sample.

Calcium Oxide.	CaO	31.40 per cent.
Sulphur Trioxide.	SO_3	43.95 " "
Water.	H_2O	20.02 " "
Chlorine.	Cl	0.01 " "
Magnesium Oxide.	MgO.	nil
Ferric Oxide.	Fe_2O_3	0.10 " "
Aluminium Oxide.	Al_2O_3	0.50 " "
Silicon Dioxide.	SiO_2	3.70 " "
Carbon Dioxide.	CO_2	0.23 " "
		99.91

6.1.7 Further Beneficiation of Washed Product by Dry Screening.

A representative sample of the final washed product was dry screened at ten mesh. The material flowed freely through the screen leaving the major portion of the wood fibre, pebbles, and larger agglomerates of flour gypsum as oversize. This material mounted to approximately 1.2 per cent of the washed product.

6.1.8 Water Consumption.

Water was used at the approximate rate of 2000 gallons per ton of feed, this amount, because of the type of pumps used, being much higher than that required for an operating plant.

6.2 Discussion.

Lake Fowler dune material can be treated by simple classifier washing. Care would be required in the initial wetting of the feed to ensure that the pulp entering the classifier is dispersed sufficiently for good classification.

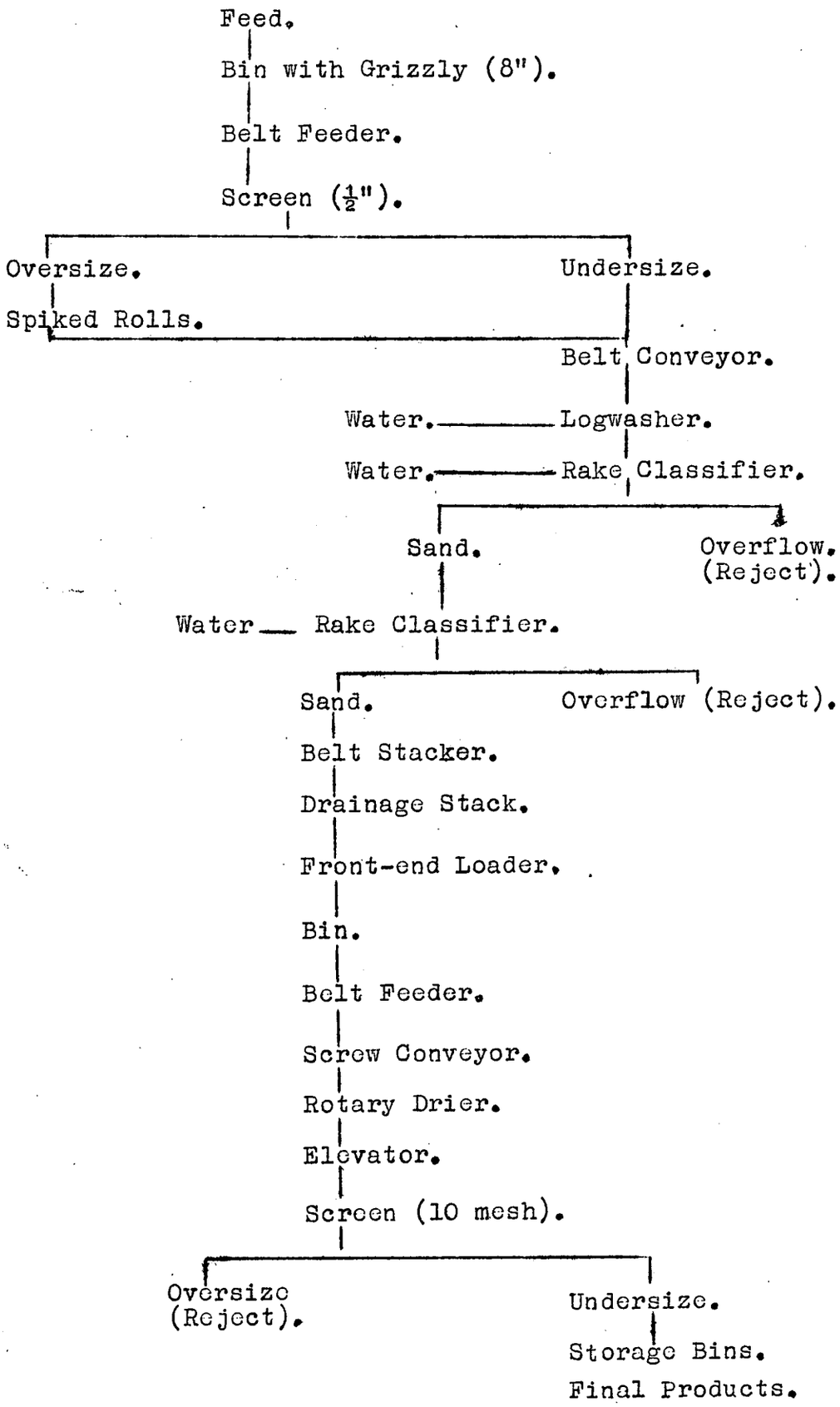
Major treatment difficulties and factors to be considered in design are listed below:

1. Nature of the feed would range from dry and dusty to damp and sticky.
2. Fine gypsum is difficult to handle by conveyors and elevators.
3. Water-logged wood fibre present in the feed reports with the washed product in straight classifier washing.
4. Washed material drains quickly.
5. Washed and dried seed is easily screened at 10 mesh.

The flowsheet shown in Figure 4 outlines a treatment plant which has been designed with attention to the above mentioned details. Variations of this flowsheet have been considered in the estimates of plant costs.

FIGURE 4.

Flowsheet for Treatment of Lake Fowler Dune Gypsum.



---oOo---

Treatment in the manner proposed in Figure 4 is dependent on the supply of a large amount of fresh water. Information available indicates that the water supply will be inadequate for straight classifier treatment without water reclamation.

Final washed product drains well on storage and should remain in the drainage stacks some days to allow the maximum benefit to be derived from this property.

7. DESIGN OF TREATMENT PLANT.

Because of the high water consumption the following three treatment methods have been considered:

1. Classifier washing with fresh water without reclamation of water.
2. Classifier washing with fresh water with thickener reclamation of wash water.
3. Sea-water washing followed by fresh water washing in Sydney.

In cases 1 and 2 drying of the washed product would be carried out at the washing plant site. In case 3 the cost of transporting the entrained moisture in wet material must be balanced against the cost of drying before shipping.

Because of the acute water position in the Lake Fowler district the washing plant has been placed at Edithburgh to take advantage of the town's water supply. In case 3 close proximity to the sea is required for a cheap supply of sea-water.

7.1 Classifier Washing with Fresh Water without Reclamation of Water.

In determining the capital and operating costs the following assumptions have been made:

1. Raw feed is delivered to the plant so mining and delivery charges are therefore not included.
2. Plant situated at Edithburgh, unless otherwise stated.
3. Fresh water is available at 2/6 per 1000 gallons.
4. The fresh water will dissolve all the salt present.
5. Power is available at the plant site.
6. The salt content of the final washed product must not exceed 0.1 per cent.
7. The washed product will drain to 15 per cent moisture.
8. Cost of spares and standby pumping equipment has not been included.

(Note: Fresh water includes water up to 250 grams per gallon salt content).

7.1.1 Cost of Equipment and Buildings.

The capital costs of buildings and necessary equipment are set out in Table 7 (attached).

The active life of the washing plant has not been stated and therefore no attempt has been made to include depreciation, interest, and working capital in the estimates.

7.1.2 Summary of Operating Cost.

Table 8 sets out the operating cost of this plant. Explanation and calculations of these figures are shown in the subsections following.

TABLE 8.

Summary of Operating Costs.
Fresh water washing with no reclamation of water.

	Shillings/ton. 500 ton/week Plant.	1000 ton/week. Plant.
Water (1540 gallons/ton.).	3.9	3.9
Power-washing.	0.9	0.6
" -drying.	0.7	0.5
Labour.	7.3	3.7
Drying.	8.1	8.1
Maintenance.	2.0	2.0
Cost per ton of raw feed.	22.9	18.8

7.1.3 Calculations of Operating Costs.

7.1.3.1 Water.

To prepare the raw feed for classification 4 tons of water must be added to each ton of feed. Classifier sand leaves the classifier containing 30 per cent moisture or 0.34 tons of water per ton of sands. This sand is then diluted to 20 per cent solids again by the addition of 2.86 tons of water per ton of seed. Therefore a total of 6.86 tons of water per ton of raw feed is required to wash the gypsum free of fines.

This amount is equivalent to 1540 gallons per ton of raw feed. The cost of this water at 2/6 per 1000 gallons is 3.9 shillings per ton of raw feed.

7.1.3.2 Power.

Power has been charged at the following rates.

Washing plant.

1st 1000 units.	@	4.35 pence/unit.
Next 1500 "	@	2.9 " "
Remainder "	@	2.5 " "

Drying plant.

Between 9 p.m. and 7 a.m.

1st 2500 units.	@	2.05 pence/unit.
Remainder.	@	1.75 " "
Between 7 a.m. and 9 p.m.	@	2.45 " "

Table 9 contains installed horsepower and cost of power in the washing and drying plant.

TABLE 9.

Power Requirements.

	500 ton/week Plant.	1000 ton/week Plant.
Total installed horsepower.	107	154
Washing Plant.		
Installed horsepower.	83	117
Working horsepower.	64	94
Units consumed/20 day month.	7,800	11,200
Cost/month.	£90.7.0	£125.1.0
Cost per ton of raw feed.	0.9/-	0.6/-
Drying Plant.		
Installed horsepower.	24	37
Working horsepower.	20	30
Units consumed/20 day month.	7,160	10,800
Cost/month.	£67.1.0.	£99.17.0
Cost per ton of raw feed.	0.7/-	0.5/-

7.1.3.3 Drying Costs.

The cost per ton of furnace oil and its heating value per pound are taken as 373 shillings and 19700 B.T.U. respectively. Each pound of fuel is assumed to evaporate 6.6 lb of water i.e. 3000 B.T.U. per pound of water. The weight of water contained in the washed product after draining to 15 per cent solids would be 400 pounds per ton of drier feed.

Drying cost per ton of washed seed.

$$= \frac{400 \times 373}{6.6 \times 2240.} = 10.1 \text{ shillings.}$$

Cost per ton of raw feed = 8.1 shillings.

7.1.3.4 Labour.

Each plant would require the labour force set out below:

1 Foreman.	Day shift.
1 Washer operator.	" "
1 Maintenance operator.	" "
6 Drier operators.	2 per shift.

Operators charged at £4 per day.		i.e. £32 per day.
Foreman " "	£4.10.0 "	4.10.0 "
Total charge per day.		£36.10.0

∴ The cost per ton of raw feed for each plant would be:

500 ton/week plant.	7.3 shillings.
1000 ton/week plant.	3.7 "

7.1.3.5 Maintenance.

Maintenance costs are taken as 2/- per ton of raw feed treated.

7.2 Classifier Washing with Fresh Water with Thickener. Reclamation of Wash Water.

Flowsheet of this plant is set out in Figure 5 and is designed in accordance with the assumptions contained in Section 7.1

7.2.1 Cost of Equipment and Buildings.

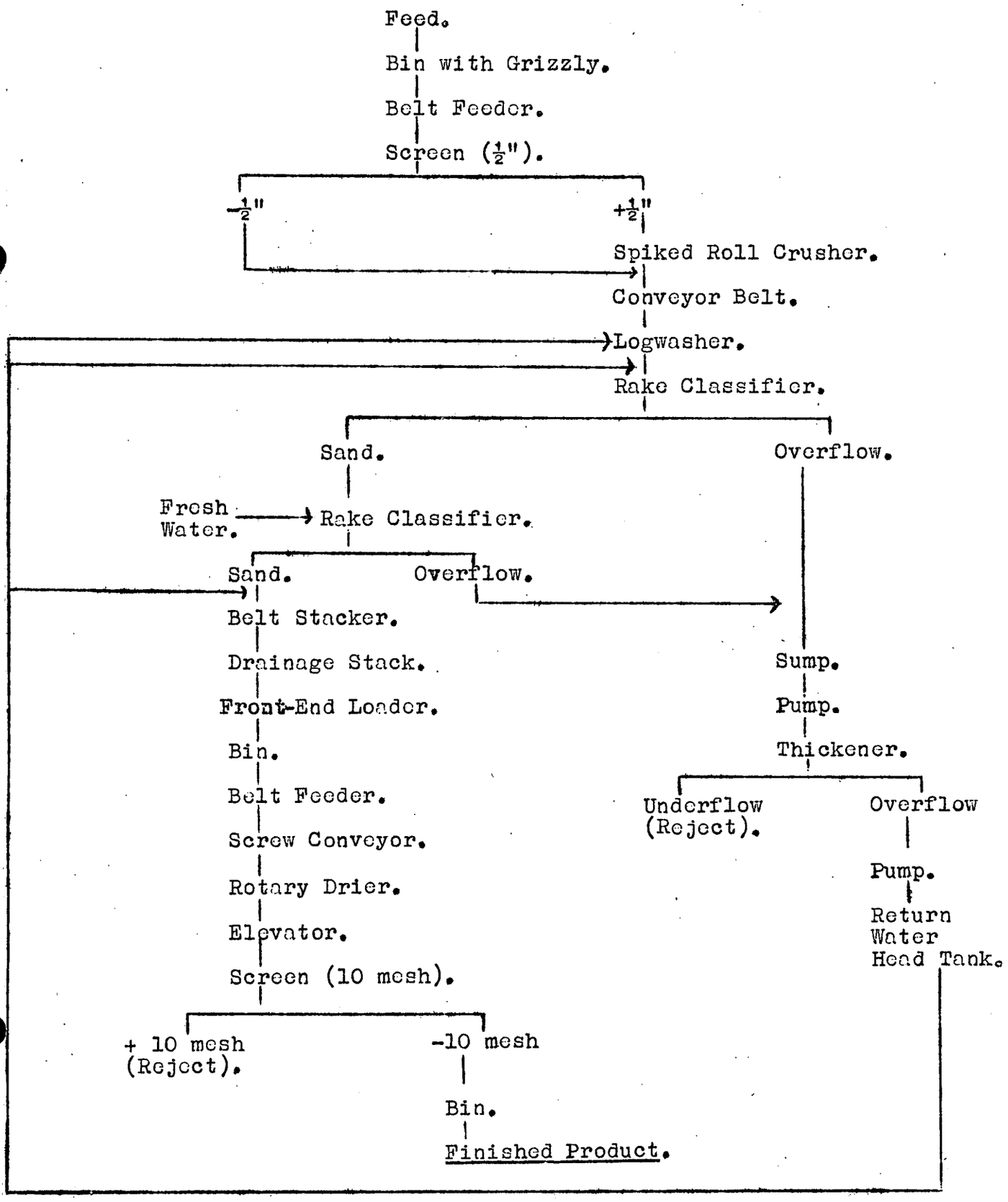
Capital cost of buildings and necessary equipment are set out in Table 10 (attached).

7.2.2 Summary of Operating Costs.

Table 11 sets out the operating costs of this plant. Explanations and calculations of these figures are shown in the subsections following.

FIGURE 5.

Classifier Washing with Thickener Reclamation of Water. Fresh Water Only.



---oOo---

TABLE 11.

Summary of Operating Costs.
Fresh Water Washing with Reclamation.

	Shillings/ton. 500 ton/week. Plant.	1000 ton/week. Plant.
Water (100 gallons/ton of raw feed).	0.3	0.3
Power-washing.	1.2	0.8
" -drying.	0.7	0.5
Labour.	7.3	3.7
Drying.	8.1	8.1
Maintenance.	2.5	2.5
Cost per ton of raw feed.	20.1	15.9

7.2.3 Calculations of Operating Costs.

7.2.3.1 Water.

The amount of water required to wash one ton of raw feed free of salt and the amount of fresh water which must be added to maintain the correct salt content of the wash water has been calculated and shows that the fresh water necessary to replace water removed from the circuit as the diluent in the thickener underflow will be more than sufficient to maintain the liquid balance in the plant.

Salt assays of the seed and flour fractions taken from an earlier report on Lake Folwer gypsum(1). are set out below:

Seed gypsum: per cent NaCl. 0.12

Flour gypsum: per cent NaCl. 0.29

Assuming a ratio of 80:20 seed to flour the amount of salt present in each ton is:

Amount of salt in seed: $0.12 \times 2240 \times \frac{80}{100}$ = 2.2 lb.

Amount of salt in flour: $0.29 \times 2240 \times \frac{20}{100}$ = 1.3 lb.

∴ Amount of salt to be removed from each ton of raw feed would be 3.5 pounds.

In order to keep the total salt content of the dried product below 0.1 per cent the salt content of the water retained in the classifier sand must be kept below 0.56 per cent. This is equivalent to 12.5 lb. of salts per ton of water. Therefore if 0.28 tons $\left(=\frac{3.5}{12.5}\right)$ of fresh water are added for each ton of raw feed this condition will be satisfied. This figure, equivalent to 63 gallons, would need to be increased to 67 gallons if water containing approximately 250 grains per gallon is used for washing.

Thickening tests indicate that thickener underflow can be maintained at 33 per cent solids. To remove the underflow at this liquid/solids ratio would require 90 gallons of water per ton of raw feed, or 100 gallons per ton to cover evaporation, leakages etc.

The 100 gallons of make up water which would be required per ton of feed would be more than sufficient to dissolve all the salt present in the feed and maintain the salt content of the wash water below 0.56 per cent total salt.

7.2.32 Power.

Table 12 contains the figures on installed horsepower and power costs.

TABLE 12.

	500 ton/week Plant.	1000 ton/week Plant.
Total installed horsepower.	131	189
Washing Plant.		
Installed horsepower.	107	152
Working horsepower.	86	122
Units consumed/20 day month.	10,600	14,600
Cost per month.	£118.5.0	£160.5.0
Cost per ton of feed.	1.2/-	0.8/-
Drying Plant.		
Installed horsepower.	24	37
Working horsepower.	20	30
Units consumed/20 day month.	7160	10,800
Cost per 20 day month.	£67.1.0	£99.17.0
Cost per ton of raw feed.	0.7/-	0.5/-

7.2.3.3 Labour.

Labour requirements would be similar to those set out in Section 7.1

7.2.3.4 Drying Costs.

Cost of fuel per ton of feed would be the same as previously calculated in Section 7.1

7.2.3.5 Maintenance.

Maintenance costs are taken as 2/6 per ton of raw feed treated.

7.2.4. Thickener Area Calculations.

Thickeners recommended in the flowsheets have been designed on data obtained from preliminary cylinder tests. Therefore these designs are of approximate nature only.

7.3 Sea-Water Classifier Washing followed by Fresh-water Washing in Sydney.

Flowsheet of this plant is set out in Figure 6 and is designed in accordance with the assumptions contained in section 7.1

7.3.1 Cost of Equipment.

Capital cost of the necessary equipment is set out in Table 13 (attached).

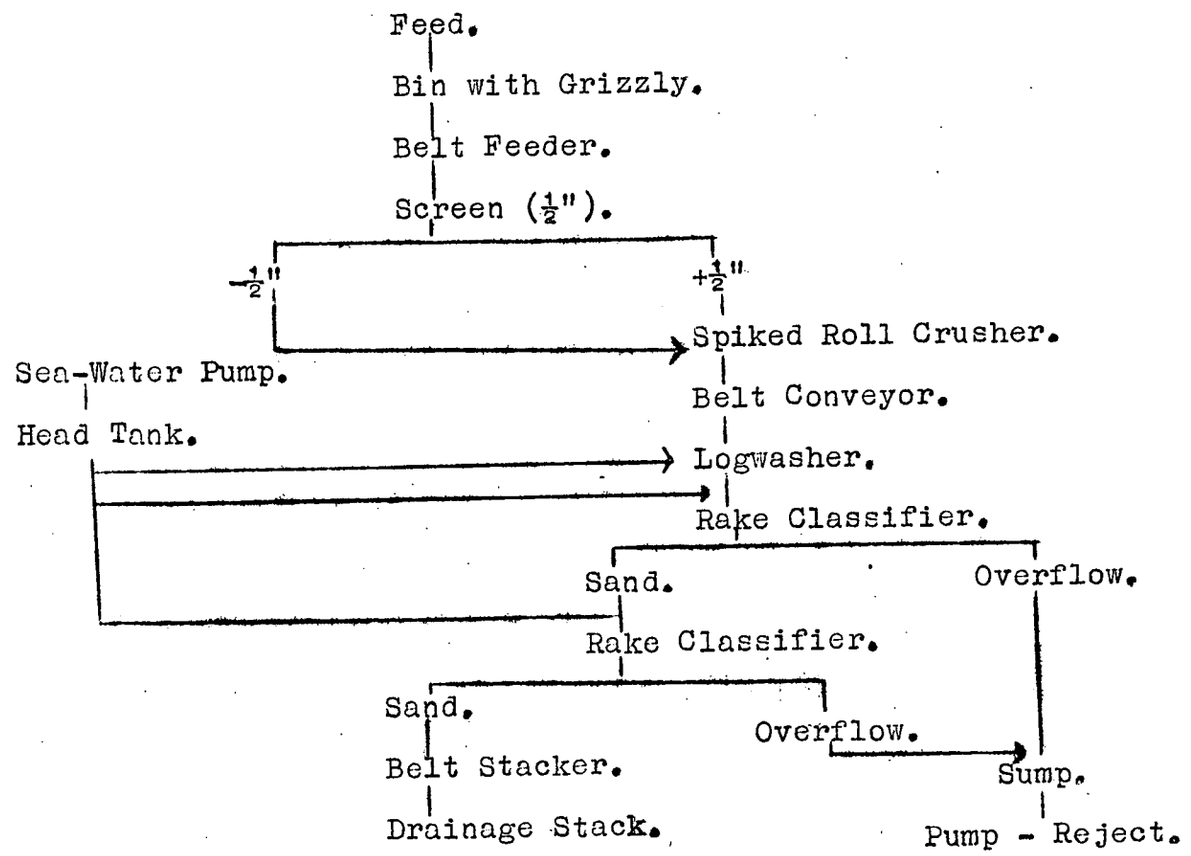
7.3.2 Summary of Operating Costs.

Table 14 contains the different operating costs of this plant. Explanation and calculations of these figures are shown in the subsections following.

FIGURE 6.

Classifier Washing with Sea-Water at Edithburgh.
Fresh-Water Washing at Sydney.

Plant at Edithburgh.



Plant at Sydney.

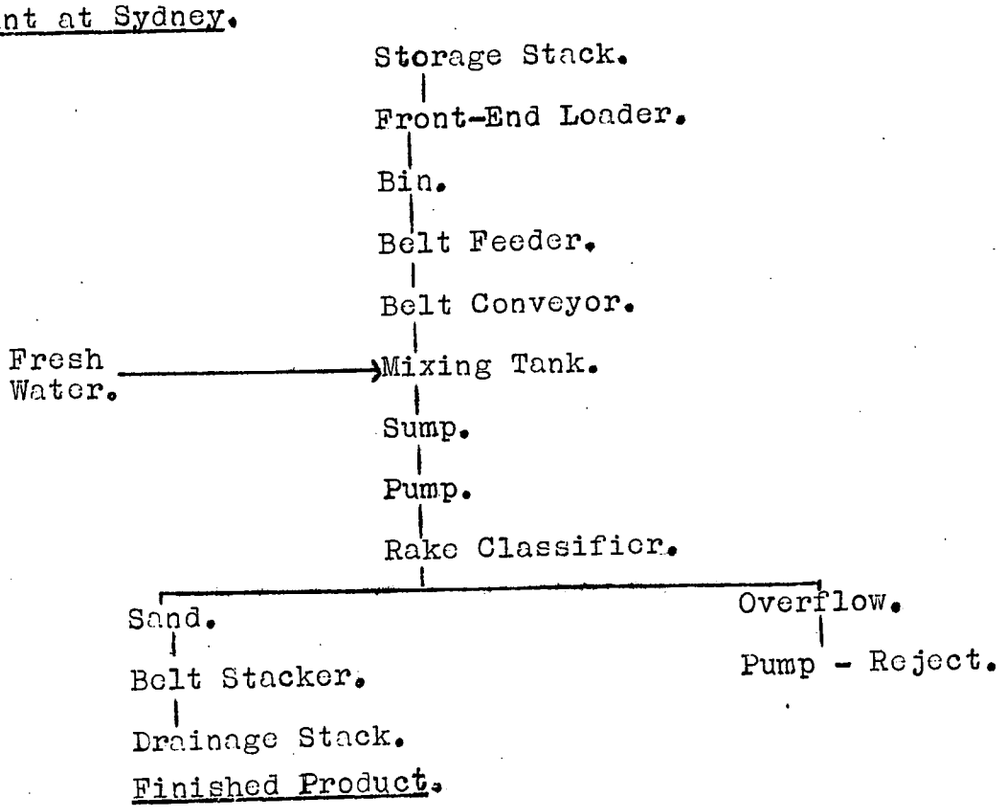


TABLE 14.

Summary of Operating Costs.
Sea-Water Washing.

	Shillings/ton of feed. 500 ton/week Plant.	1000 ton/week Plant.
Water:		
Edithburgh.	-	-
Sydney.	1.2	1.2
Power:		
Edithburgh.	1.1	0.8
Sydney.	0.3	0.2
Labour:		
Edithburgh.	2.5	1.3
Sydney.	1.6	0.8
Maintenance:		
Edithburgh.	2.0	2.0
Sydney.	1.0	1.0
Cost per ton of raw feed.	9.7	7.3

Drying costs in Sydney have not been included in the above summary.

7.3.3 Calculations of Operating Costs.

7.3.3.1 Water.

It is assumed that the sea-water required at Edithburgh would only need pumping to prepare it for plant use. Therefore water charges are included in the power costs.

Fresh-water required in Sydney would be the amount necessary for form a slurry of 30 per cent solids.

i.e. 2.3 tons of water per ton of seed.

or 1.8 tons of water per ton of raw feed.

∴ The cost of water per ton of raw feed would be 1.2 shillings.

7.3.3.2 Power Costs.

Edithburgh power costs are as previously stated and Sydney power costs have been taken as 2 pence/unit. Table 15 lists installed horsepower for each plant and the costs of power to treat each ton of raw feed.

TABLE 15.

	500 ton/week Plant.	1000 ton/week Plant.
Total installed horsepower.	139	194
Edithburgh Plant.		
Installed horsepower.	99	142
Working horsepower.	90	115
Units consumed/20 day month.	9550	13,800
Cost per month.	£107.19.0	£151.12.0
Cost per ton of raw feed.	1.1/-	0.8/-
Sydney Plant.		
Installed horsepower.	40	52
Working horsepower.	32	42
Units consumed/20 day month.	3820	5030
Cost per month.	£32.0.0	£43.0.0
Cost per ton of raw feed.	0.3/-	0.2/-
Total cost per ton of raw feed.	1.4/-	1.0/-

7.3.3.3 Labour.

The washing plant at Edithburgh would require 2 operators, and one foreman. The Sydney section would require 2 operators.

Cost per day:

Edithburgh	£12.10.0
Sydney.	8.0. 0.

Cost per ton of raw feed:

	500 ton/week Plant.	1000 ton/week Plant.
Edithburgh.	2.5 shillings.	1.3 shillings.
Sydney.	1.6 "	0.8 "

7.3.3.4 Maintenance.

The following maintenance charges have been assumed for each plant.

Edithburgh. 2.0/- per ton of raw feed.

Sydney. 1.0/- per ton of raw feed.

7.4 Sea-Water - Fresh water washing at Edithburgh.

As approximately 500 gallons of fresh water per ton would be needed to make a fresh water wash at Edithburgh following treatment in salt water, compared with 100 gallons per ton for a complete fresh water wash, estimates for this plant were not made.

8. DISCUSSION ON WATER SUPPLY.

It was not possible to obtain definite details of water supply in the Lake Fowler district. The Hydrological Section of the Department of Mines report that one bore capable of delivering 2000 gallons per hour intermittantly exists near Lake Fowler. However no details of storage in the water table are available and a field examination of the area to determine the amount of water available for a washing plant would have to be made. Because of the structure of the underlying strata the prospects of a good supply are not high. More favourable conditions do however exist at Edithburgh. Fresh water from the Morgan-Whyalla pipeline is available at Yorketown but the possibility of obtaining water from this source has not been investigated.

It is for these reasons that several different schemes of washing were investigated. A final decision would be dependant on the availability of a suitable water supply.

9. REFERENCES:

(1) Beneficiation of Lake Fowler Gypsum for Colonial Sugar Refining Co. Ltd. First Report.

Department of Mines, South Australia.

---ooOoo---

TABLE 7.

COST OF EQUIPMENT and BUILDINGS.

Plant Designed for use with Fresh Water - No Reclamation of Water.

Item.	Description.	500 ton per week Plant.			1,000 ton per week Plant.		
		Size.	H.P.	Cost. £	Size.	H.P.	Cost. £
1.	Bin with 8 in. steel rail grizzly.	15 ton capacity.	-	1,000	Same as 500 ton.	-	1,000
2.	Belt feeder with variable speed drive.	24 in. belt.	2	1,000	Same as 500 ton.	2	1,000
3.	Screen with 1/2 in. mesh.	8 x 3 ft,	2	1,100	8 x 4 ft.	5	1,600
4.	Spiked rolls 24 in. dia. 2 in. spikes.	Rolls 12 in. wide.	15	1,500	Rolls 18 in. wide.	20	2,000
5.	Conveyor belt 60 ft. centres.	24 in. belt.	5	1,400	Same as 500 ton.	5	1,400
6.	Logwasher, twin logs.	4 x 16 ft.	25	4,000	5 x 20 ft.	30	5,500
7.	Rake classifier duplex type 20 ft. long.	4 ft. rake width.	7.5	3,300	6 ft. rake width.	12.5	4,700
8.	Rake classifier duplex type 20 ft. long.	4 ft. rake width.	7.5	3,300	6 ft. rake width.	12.5	4,700
9.	Belt stacker with concrete slab for stack.	24 in. belt.	5	2,300	30 in. belt.	5	2,500
10.	Front-end loader.		-	1,600		-	1,600
11.	Bins as item 1, but without grizzly.	15 ton capacity.	-	800	Same as 500 ton.	-	800
12.	Belt feeder with variable speed drive.	24 in. belt.	2	1,000	Same as 500 ton.	2	1,000
13.	Screw conveyor 12 in. diam.	15 ft. long.	2	400	Same as 500 ton.	2	400
14.	Rotary drier, complete.	4 x 30 ft.	15	6,000	5 x 40 ft.	25	8,000
15.	Elevator, bucket and chain type.	35 ft. centres.	3	1,100	35 ft. centres.	5	1,500
16.	Screen, ten mesh.	3 x 2 ft.	2	500	5 x 3 ft.	3	600
17.	Bins 80 ton capacity seed. 4 ton capacity discard.		-	2,000	Same as 500 ton.	-	2,000
18.	Sump and concrete slab for classifier support		-	300		-	300
19.	Tailing pump.		15	700		25	800
20.	Building 90 x 30 ft. with concrete floor to house drier.		-	1,600	Same as 500 ton.	-	1,600
	Total equipment costs and installed horsepower		108	£34,900		154	£43,000
	Cost plus erection at 30% of equipment cost.			£45,400			£55,900
	Technical services at 7½% of capital cost.			3,400			4,200
	Electrical wiring at 5% of capital cost.			2,300			2,800
	TOTAL CAPITAL EXPENDITURE.			£51,100			£62,900

TABLE 10.

COST OF EQUIPMENT and BUILDINGS.

Plant Designed for use with Fresh Water - With Reclamation of Water.

Item.	Description.	500 ton per week Plant.			1,000 ton per week Plant.		
		Size.	H.P.	Cost. £	Size.	H.P.	Cost. £
1.	Bin with 8 in. steel rail grizzly.	15 ton capacity.	-	1,000	Same as 500 ton.		1,000
2.	Belt feeder with variable speed drive.	24 in. belt.	2	1,000	Same as 500 ton.	2	1,000
3.	Screen with 1/2 in. mesh.	8 x 3 ft.	2	1,100	8 x 4 ft.	5	1,600
4.	Spiked rolls 24 in. dia. 2 in. spikes.	Rolls 12 in. wide.	15	1,500	Rolls 18 in. wide.	20	2,000
5.	Belt conveyor 60 ft. centres.	24 in. belt.	5	1,400	Same as 500 ton.	5	1,400
6.	Logwasher, twin logs.	4 x 16 ft.	25	4,000	5 x 20 ft.	30	5,500
7.	Rake classifier duplex type 20 ft. long.	4 ft. rake width.	7.5	3,300	6 ft. rake width.	12.5	4,700
8.	Rake classifier duplex type 20 ft. long.	4 ft. rake width.	7.5	3,300	6 ft. rake width.	12.5	4,700
9.	Belt stacker with concrete slab for stack.	24 in. belt.	5	2,300	30 in. belt.	5	2,500
10.	Front-end loader.			1,600			1,600
11.	Bin as item 1, but without grizzly.	15 ton capacity.	-	800	Same as 500 ton.	-	800
12.	Belt feeder with variable speed drive.	24 in. belt.	2	1,000	Same as 500 ton.	2	1,000
13.	Screw conveyor 12 in. dia.	15 ft. long.	2	400	Same as 500 ton.	2	400
14.	Rotary drier, complete.	4 x 30 ft.	15	6,000	5 x 40 ft.	25	8,000
15.	Elevator, bucket and chain type.	35 ft. centres.	3	1,100	35 ft. centres.	5	1,500
16.	Screen, ten mesh.	3 x 2 ft.	2	500	5 x 3 ft.	3	600
17.	Bin 80 ton capacity seed. 4 ton capacity discard.		-	2,000		-	2,000
18.	Sump and concrete slab for classifier support.		-	300		-	300
19.	Pump to thickener.		15	700		25	800
20.	Thickener complete.	30 ft. dia.	5	5,000	40 ft. dia.	5	7,000
21.	Overflow pump.		15	700		25	800
22.	Underflow pump.		3	300		5	300
23.	Return water head tank.	5,000 gallons.	-	400	Same as 500 ton.	-	400
24.	Fresh water head tank.	5,000 gallons.	-	400	Same as 500 ton.	-	400
25.	Building: 90 x 30 ft. with concrete floor to house drier.		-	1,600	Same as 500 ton.	-	1,600
	Total equipment costs and installed horsepower		131	£41,700		189	£51,900
	Cost plus erection at 30% of equipment cost.			£54,200			£67,500
	Technical services at 7½% of capital cost.			4,100			5,100
	Electrical wiring at 5% of capital cost.			2,700			3,400
	TOTAL CAPITAL EXPENDITURE.			£61,000			£76,000

TABLE 13.

COST OF EQUIPMENT and BUILDINGS.

Plant Designed for use with Salt Water.

Item.	Description.	500 ton per week Plant. Size.	H.P.	Cost. £	1,000 ton per week Plant. Size	H.P.	Cost. £
		PLANT at EDITHBURGH.					
1.	Bin with 8 in steel rail grizzly.	15 ton capacity.	-	1,000	Same as 500 ton.	-	1,000
2.	Belt feeder with variable speed drive.	24 in. belt.	2	1,000	Same as 500 ton.	2	1,000
3.	Screen with 1/2 in. mesh.	8 x 3 ft.	2	1,100	8 x 4 ft.	5	1,600
4.	Spiked rolls 24 in. dia. 2 in. spikes.	Rolls 12 in. wide.	15	1,500	Rolls 18 in. wide.	20	2,000
5.	Conveyor belt 60 ft. centres.	24 in. belt.	5	1,400	Same as 500 ton.	5	1,400
6.	Logwasher, twin logs.	4 x 16 ft.	25	4,000	5 x 20 ft.	30	5,500
7.	Rake classifier duplex type 20 ft. long.	4 ft. rake width.	7.5	3,300	6 ft. rake width.	12.5	4,700
8.	Rake classifier duplex type 20 ft. long.	4 ft. rake width.	7.5	3,300	6 ft. rake width.	12.5	4,700
9.	Belt stacker with concrete slab for stack.	24 in. belt.	5	2,300	30 in. belt.	5	2,500
10.	Sump and concrete slab for classifier support.			300	Same as 500 ton.		300
11.	Pump, tailings disposal.		15	700		25	800
12.	Pump. Sea-water.		15	700		25	800
13.	Head tank, for sea-water.	5,000 gallons.		400	Same as 500 ton.		400
	Total cost of Plant at Edithburgh.		99	£21,000		142	£26,700
		PLANT at SYDNEY.					
14.	Storage stack (no cost)	-	-	-		-	-
15.	Front-end loader.	-	-	1,600		-	1,600
16.	Bin as in item 1, but without grizzly.	15 ton capacity.		800	Same as 500 ton.		800
17.	Belt feeder with variable speed drive.	24 in. belt.	2	1,000	Same as 500 ton.	2	1,000
18.	Conveyor belt 60 ft. centres.	24 in. belt.	5	1,400	Same as 500 ton.	5	1,400
19.	Mixing tank complete with motor and stirrer.		5	1,000		7.5	1,200
20.	Sump including concrete slab around mixer and classifier.			500			500
21.	Pump.		7.5	400		10	500
22.	Rake classifier duplex type 20 ft. long.	4 ft. rake width.	7.5	3,300	6 ft. rake width.	12.5	4,700
23.	Belt stacker with concrete slab for stack.	24 in. belt.	5	2,300	30 in. belt.	5	2,500
24.	Pump, tailings disposal.		7.5	400		10	500
	Total cost of Plant at Sydney.		40	£12,700		52	£14,700
	Total equipment costs and installed horsepower		139	£33,700		194	£41,400
	Cost plus erection at 30% of equipment cost.			£43,800			£53,800
	Technical services at 7½% of capital cost.			3,300			4,000
	Electrical wiring at 5% of capital cost.			2,300			2,700
	TOTAL CAPITAL EXPENDITURE.			£49,300			£60,500