

R.667 Field tests on centrifuging washery effluents, Cornwall Coal Company N.L.

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Encouraging results were obtained in Investigation R.665 in the clarification of washery effluent using a laboratory batch centrifuge. That report recommended that a suitable test centrifuge be placed on stream at the washery to examine the laboratory findings under the approximate operating conditions.

The Company was able to obtain a suitable unit and this report deals with the results and analyses of a number of tests conducted on various effluent products during a visit to the works on 9 August 1973.

THE TEST CENTRIFUGE

Type	Bird solid bowl continuous centrifuge
Size	18-inch (457 mm) x 28-inch (711 mm) bowl
Drive	Vee-belt (4) 11 kW motor
Operating Speed	1600 rpm ($\approx 6400 \text{ m/s}^2$)
Rated Speed	2000 rpm ($\approx 10\,000 \text{ m/s}^2$)
Capacity (at rated speed)	1 m ³ /h of solids discharged
Scroll Drive	80:1 reduction.

The centrifuge was operating at well below its apparent capacity.

PRODUCTS TESTED

- (1) Main sump overflow.
- (2) Settling cone underflow.
- (3) Composite: all effluents.

Main sump O/F	} 70% by volume
Basket centrifuge O/F	
Settling cone U/F	30%

The 70/30 proportion used in product 3 was estimated to represent the total composite plant effluent if the cone was to continuously discharge an underflow product.

Each effluent was tested in both the 'as discharged' condition and when flocculated by sulphuric addition to the indicated pH values.

The basket centrifuge liquid could not be tested separately.

TEST RESULTS

1. Main Sump Overflow

Test	% Solids			pH	F/D Rate	% Solids Recovered
	F/D	S/D	L			
A. 'As discharged'	6	73	2.8	8.2	45.5 l/min 5.0 kg/min	78

Test	% Solids			pH	F/D Rate	% Solid Recovered
	F/D	S/D	L			
B. Flocculated	6	70	2.8	6.2	68.2 l/min 8.6 kg/min	79
2. Settling Cone Underflow						
Test	% Solids			pH	F/D Rate	% Solid Recovered
	F/D	S/D	L			
A. 'As discharged'	16	70	1.5	8.2	22.7 l/min 1.8 kg/min	91
B. Flocculated	18	76	2.5	6.5	27.2 l/min 5.4 kg/min	90
3. Composite Effluent						
Test	% Solids			pH	F/D Rate	% Solid Recovered
	F/D	S/D	L			
A. 'As discharged'	22	71	4	8.2	54.5 l/min 13.6 kg/min	87
B. Flocculated	16	72	4	5.8	63.6 l/min 12.2 kg/min	81

LABORATORY TESTING OF FIELD TEST PRODUCTS

Samples of the solid and liquid products from the field tests were examined in the laboratory as follows.

A. *Cakes (S/D)* Determination of per cent solids as shown above, as well as a flotation test on the cake from 3B to determine the amount of recoverable coal in this product.

B. *Liquid (L)* Laboratory batch centrifuging tests were done on these products to determine whether further clarification could be obtained under the conditions described in Investigation R.665.

RESULTS OF LABORATORY TESTS

Solids. The result of the per cent solids determinations are shown in the table indicating the quantitative performance of the solid bowl centrifuge.

Flotation S/D 3B

Product	% Mass	% Ash
F2C	66.0	21.5
FT	34.0	68.4
H/D	100.0	37.5

Liquid. Numerous tests were done in the batch centrifuge at various speeds and times. The results of these are as follows.

Test No.	Floc.	Speed (rpm)	C.A.* (m/s ²)	Time (min.)	% Solids		% Solid Recovered
					S/D	L	
L1A	No	3000	15 000	4	34	0.6	76
	No	2500	10 000	4	29	0.7	71
L1B	Yes	3000	15 000	4	35	Trace	100
	Yes	2500	10 000	4	24	Trace	100
	Yes	2500	10 000	1	20	Trace	100
	Yes	2500	10 000	0.25	15	Trace	100
	Yes	2000	7 000	4	23	Trace	100
L3B	Yes	3000	15 000	4	20	Trace	100
	Yes	2000	7 000	4	16	Trace	100
L4A	No	3000	15 000	4	40	1.1	78
	No	2500	10 000	4	39	1.3	75
L4B	Yes	3000	15 000	4	37	Nil	100
	Yes	3000	15 000	0.5	23	Trace	100
	Yes	2000	7 000	0.5	18	Trace	100

SUMMARY

The solid bowl centrifuge at the washery was operating at about 64% of its apparent capability. Even so, a significant reduction of the solid content of all washery effluents was achieved, only the ultra-fine material remaining in the centrifuge liquid.

The tests represent a quantitative assessment of its performance under the conditions of operation.

The application of higher centrifugal forces in the laboratory batch centrifuge to samples of solid bowl liquids resulted in further significant decreases in solid contents, particularly in the flocculated material.

Two-thirds of the solid bowl centrifuge cake from the composite slurry feed consisted of good quality fine coal recoverable by froth flotation.

CONCLUSION

The necessary electrical and engineering modifications to allow the solid bowl experimental centrifuge to perform up to its rated capability should be made before further tests are undertaken.

The amount of solids in the centrifuge feed is a significant factor in determining its capacity. The point has already been made that about two-thirds of the slurry solids content can be removed as good quality.

Future field experiments in clarification of washery effluents should incorporate a froth flotation stage for fine coal recovery followed by centrifuging of flotation tailings.

The handling characteristics of the separated solids components of the slurry can then be more accurately assessed, as well as the extra degree of clarification obtainable.

[29 August 1973]

*C.A. = centrifugal acceleration.