COALTECH

DRY PROCESSING OF COAL – PROGRESS REPORT: TESTS CONDUCTED ON THE IMS / SLATER COAL MARKETING ALLAIR DRY JIG

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Executive overview

Tests were conducted on a 30 tonne per hour pilot Allair dry jig to assess the potential of the jig to upgrade raw coal to a saleable quality. Tests were done on run-of-mine coal and also on duff.

The results obtained show that the Allair jig has potential to beneficiate run-of-mine coal to the required quality for use as thermal coal but the jig was not able to effectively beneficiate the finer duff coal.

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1. Introduction

IMS in cooperation with Slater Coal Marketing installed a 30 tonne per hour Allair dry jig at Slater Coal's site near Balmoral for the purpose of evaluating the technology and to assess the potential of these jigs to upgrade raw coal to thermal coal specification. Slater Coal kindly invited Coaltech to participate in some of the test work conducted on the jig and this provided Coaltech the opportunity to gain valuable information on the performance of the Allair jig.

Four tests were conducted on run-of-mine coal sized between 50 mm and 0 mm and two tests were carried out on duff coal sized between 12 mm and 0 mm. The results obtained from these tests are presented and discussed in the report.

A view of the Allair jig is shown in Figure 1.

Figure 1: Allair jig at Slater Coal Marketing's Balmoral site

2. Allair jig

The Allair jig is a modern version of the Stump jig (1932) and the Roberts & Schaefer Super Air-flow table (1942) which were popular dry processing units in the United States. Dry processing of coal in the United States peaked in 1965 when some 25 million tonnes of clean coal was produced annually by dry processing.

A schematic view of the Allair jig is shown in Figure 2.

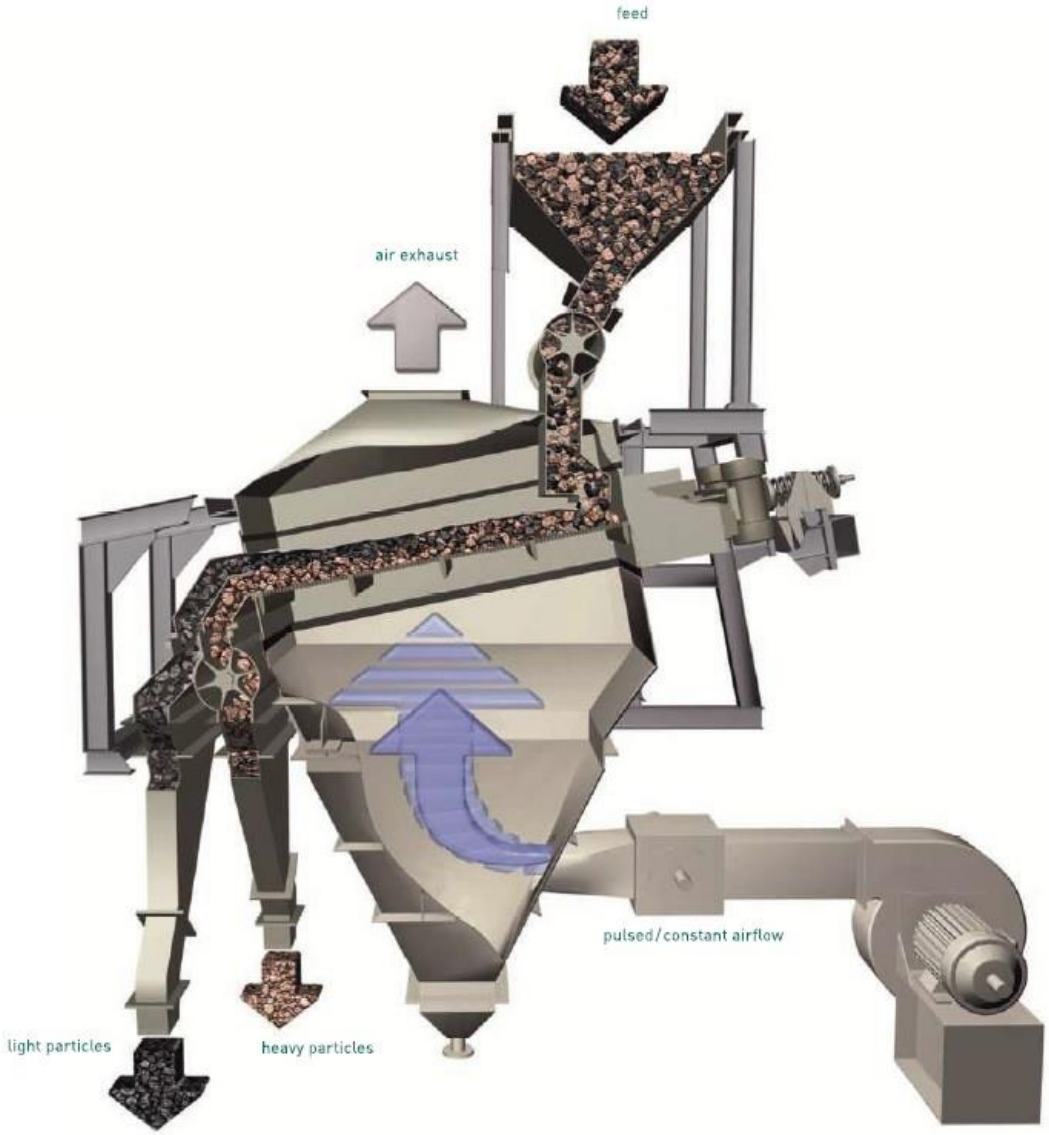

Figure 2: Schematic view of Allair jig

The Allair jig consists of an inclined, perforated vibrating table. A controlled flow of raw coal is fed onto the bed via a star gate and the coal on the table is fluidized by a constant flow of air supplied by a fan. Pulsating air is also supplied via a flutter valve and this provides a jigging action to the bed which allows the coal to stratify according to the density of the particles. Lighter particles migrate to the top of the bed and are discharged onto the product conveyor. The heavier discard particles move to the bottom of the bed. A nuclear density gauge and a second star gate are used to control the thickness of the layer of discard coal in the bed. A close-up view of the controller and star gate is shown in Figure 3.

Fine coal and dust is carried out of the bed by the air flow and is captured in a bag filter. The fine coal can be added back to the product if the quality of the coal is acceptable.

Figure 3: Density gauge and star gate for controlled removal of discard

3. Tests carried out

Four tests were conducted on 50 x 0 mm run-of-mine coal and two tests on 12 x 0 mm duff coal. The run-of-mine tests were carried out on 11 May, 6 July, 12 July and 23 August while the tests on the duff coal were conducted on 21 September and 5 October 2016.

During all the tests, the following procedure was employed:

- The raw coal was sampled from the feed conveyor whilst the feed bin located above the jig was being filled.
- Once the correct settings on the jig were established, the jig was run at these settings until the bin reached a low level.
- The product and discard from the jig were collected on separate ‘stockpiles’ which were cleared before the test started.
- Samples of the product and the discard were taken from these small stockpiles upon completion of the test run.

This method of sampling was adopted due to the fact that the discard was emitted from the jig intermittently and it was not possible to obtain representative samples from the discard conveyor. Sampling of the coal in progress is shown in Figure 4.

Figure 4: Sampling of the jig discard

The samples taken during the tests in which Coaltech participated were sent to Noko Analytical Services in Emalahleni for analysis.

4. Results obtained

The results obtained from the four tests conducted on the run-of-mine coal are summarised in Table 1. The partition curves of the four tests are shown in figures 5, 6, 7 and 8 respectively.

Table 1: Summary of test results on run-of-mine coal

Parameter	Test 1	Test 2	Test 3	Test 4
Feed % Ash	15.9	27.2	36.5	30.9
Product % Ash	12.8	23.4	32.7	28.7
Discard % Ash	25.1	38.7	50.6	41.4
Product Yield %	74.23	75.56	78.78	82.48
D50 cut-point density	1.722	2.083	2.139	>2.20
EPM	0.1357	0.2783	0.1742	-
Organic Efficiency %	79.1	82.0	85.9	86.5
Sink in float %	4.94	4.07	5.03	-
Float in sink %	19.91	17.95	14.10	-
Total misplaced %	24.85	22.02	19.13	-
% Near-dense material	-	8.3	-	-

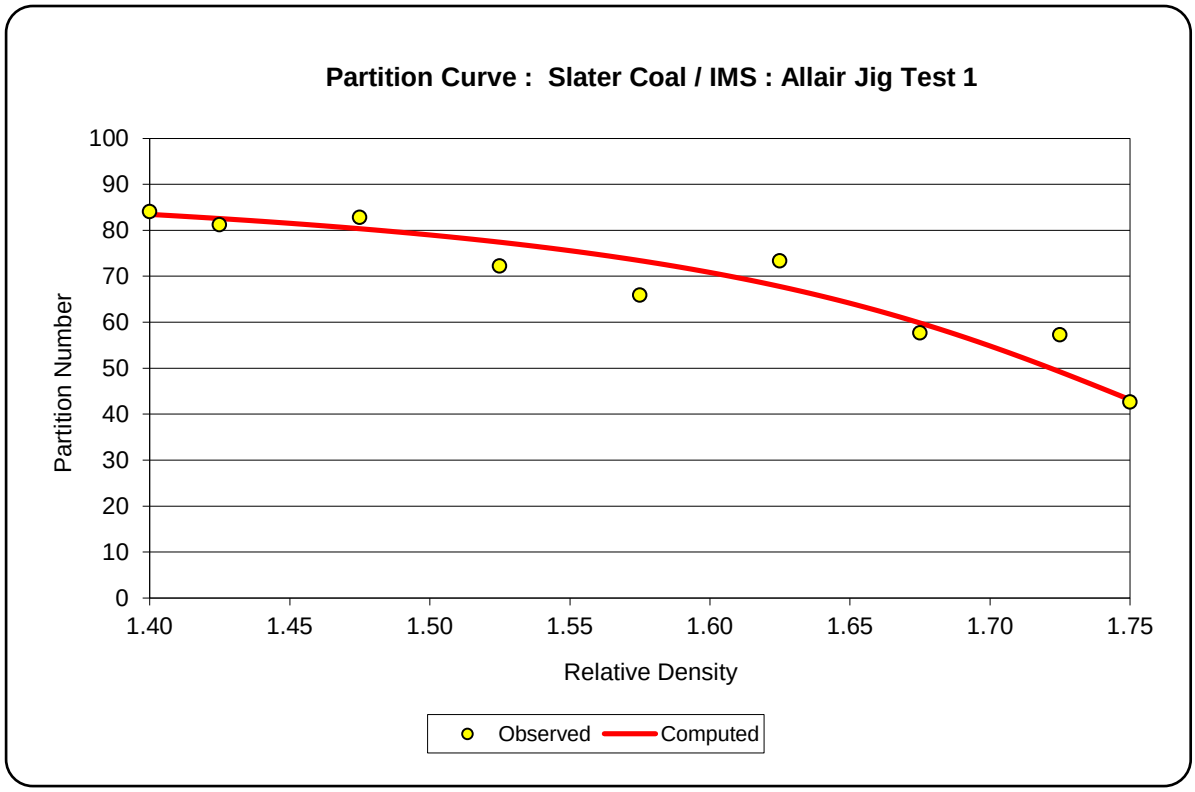

Figure 5: Partition curve for Test 1

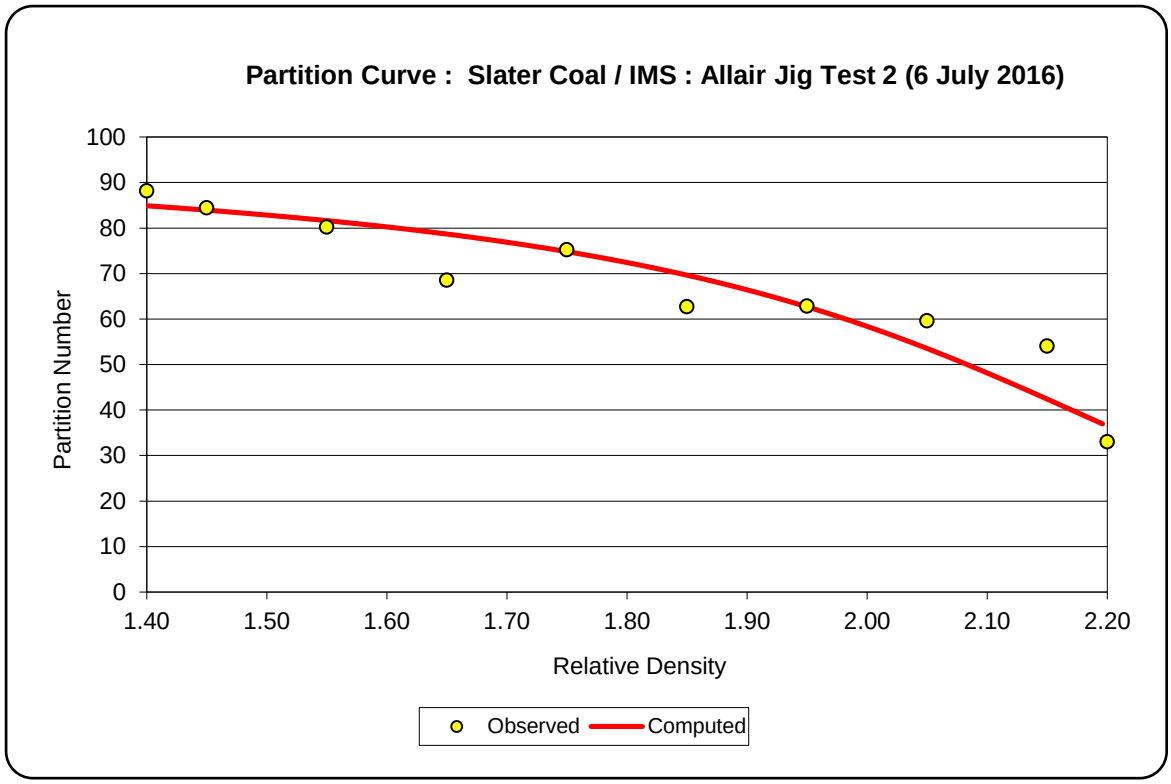

Figure 6: Partition curve for Test 2

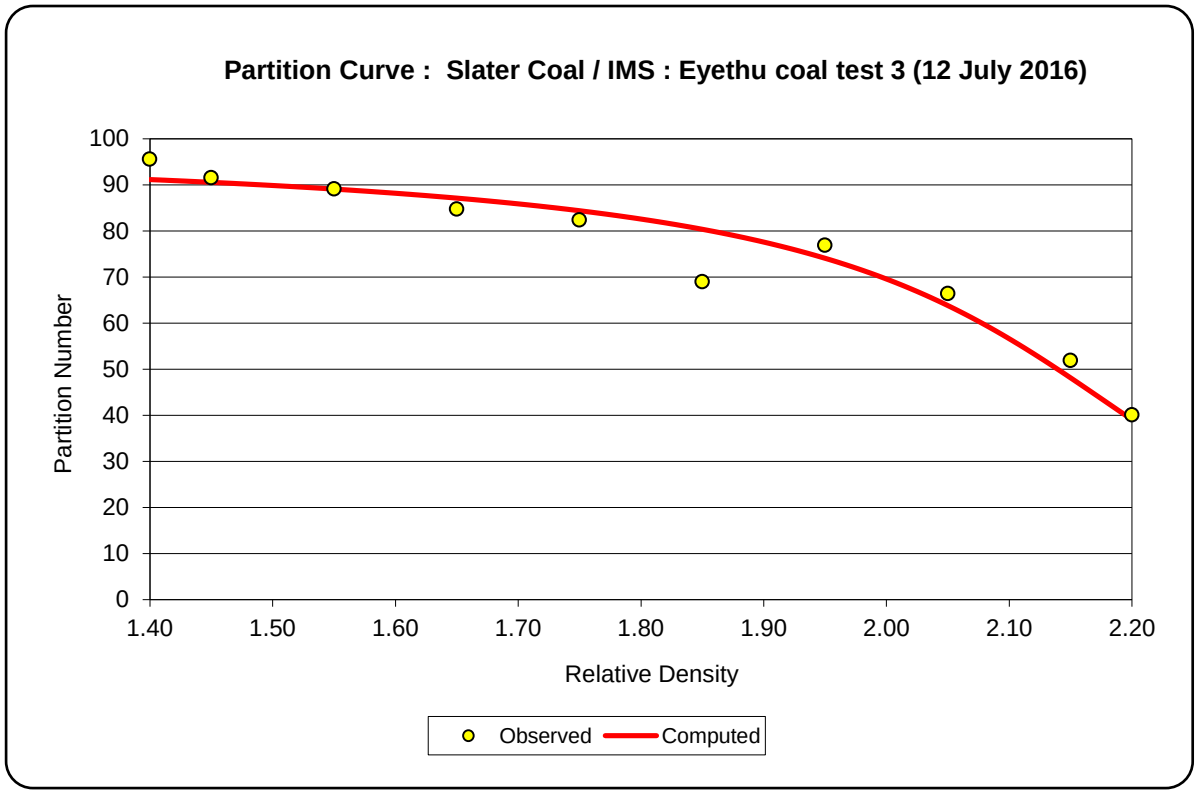

Figure 7: Partition curve for Test 3

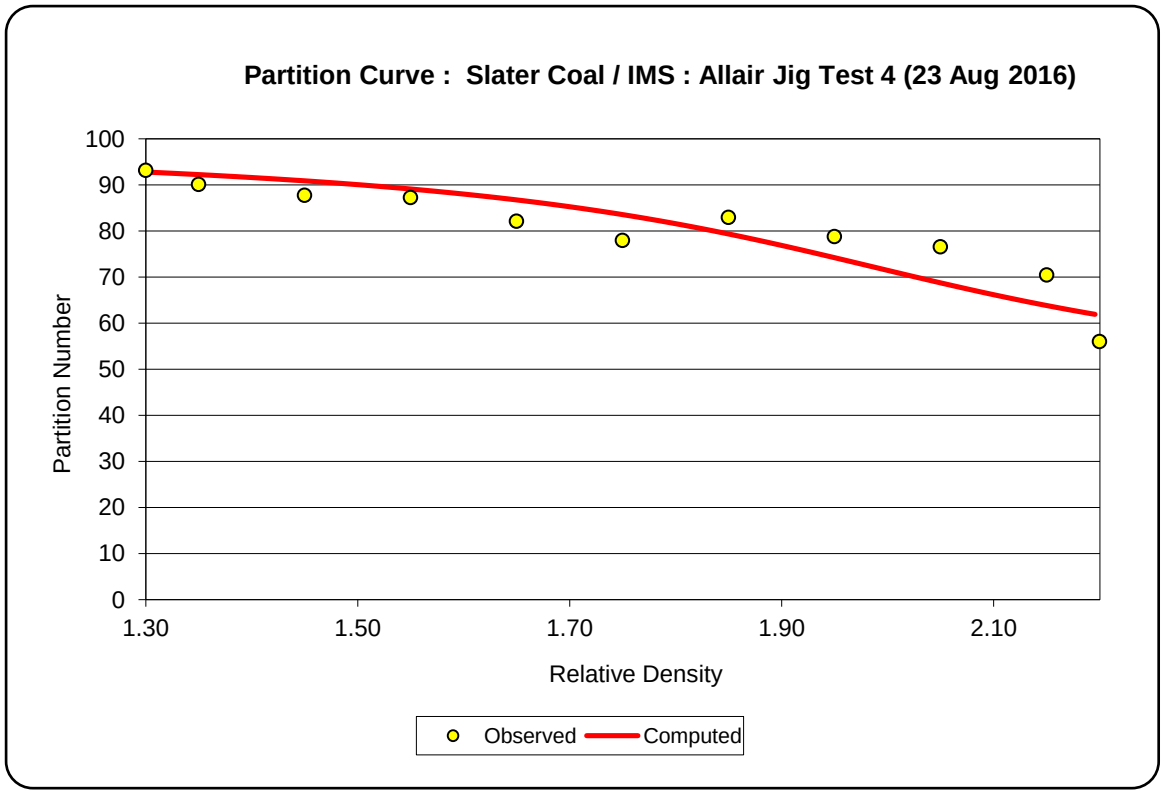

Figure 8: Partition curve for Test 4

The results of the two tests conducted on duff coal are summarised in Table 2 and the partition curves are shown in Figures 9 and 10.

Table 2: Summary of tests on duff coal

Parameter	Test 1	Test 2
Feed % Ash	40.6	31.0
Product % Ash	38.4	29.3
Discard % Ash	47.5	34.6
Product Yield %	75.7	68.1
D50 cut-point density	>2.20	>2.20
EPM	-	-
Organic Efficiency %	79.3	70.4
Sink in float %	-	-
Float in sink %	-	-
Total misplaced %	-	-
% Near-dense material	-	-

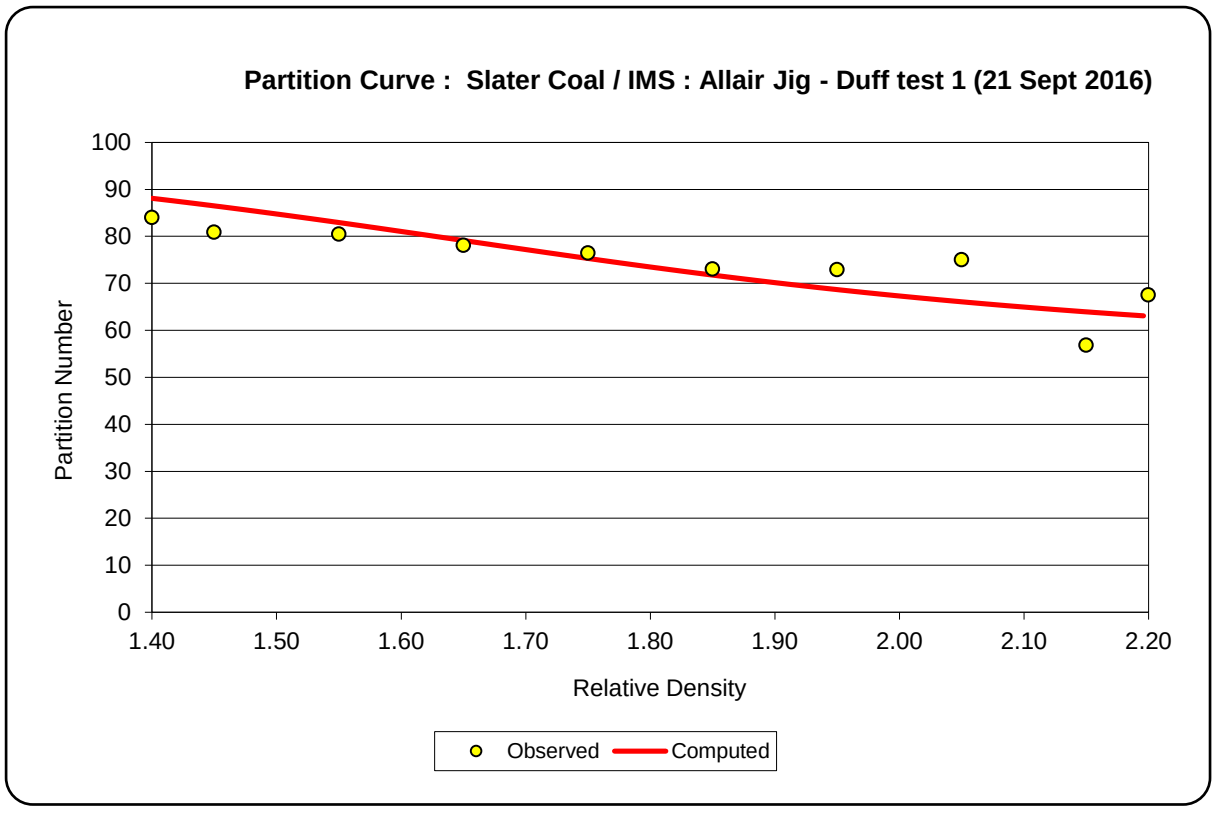

Figure 9: Partition curve for duff test 1

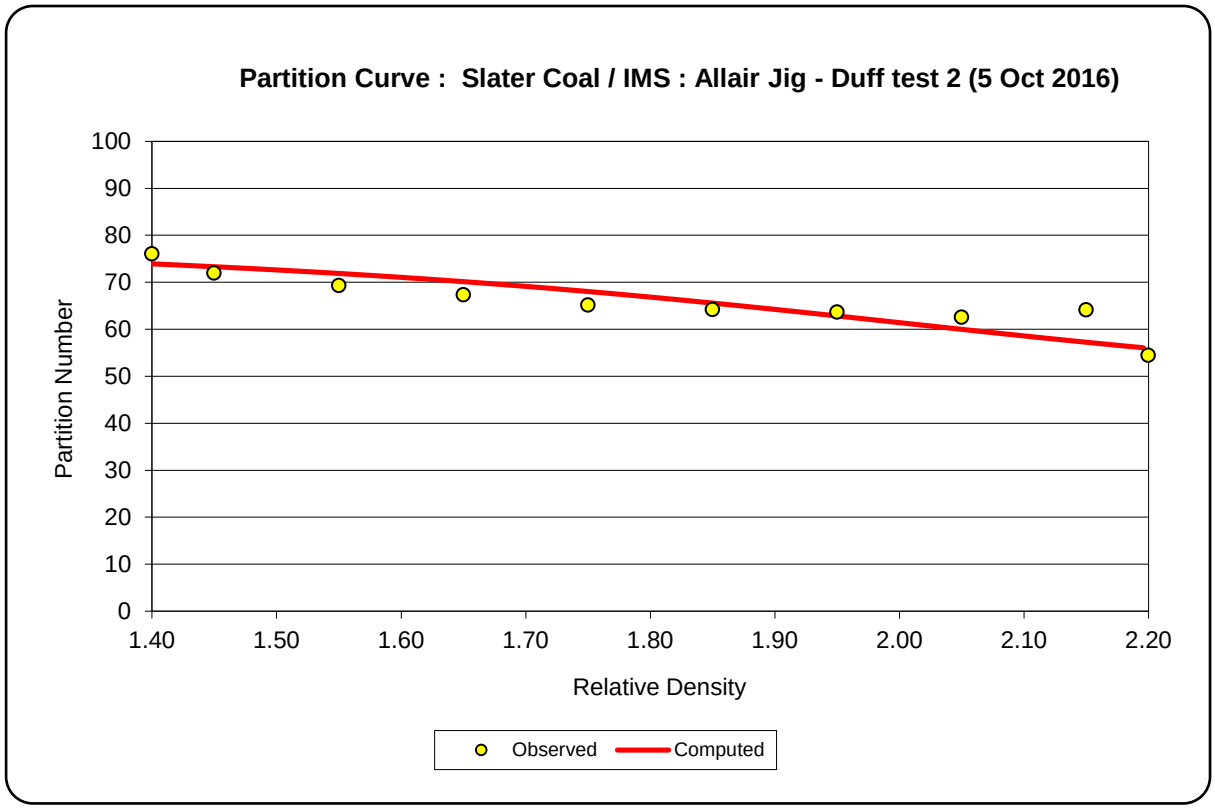

Figure 10: Partition curve for duff test 2

5. Discussion of results

The normalised partition data obtained on the four run-of-mine samples tested are shown in Figure 11. As can be seen from the graph, the results show good agreement between the tests. The average imperfection obtained is 0.095. For a cut-point density of 2.0, this would result in an EPM value of 0.190.

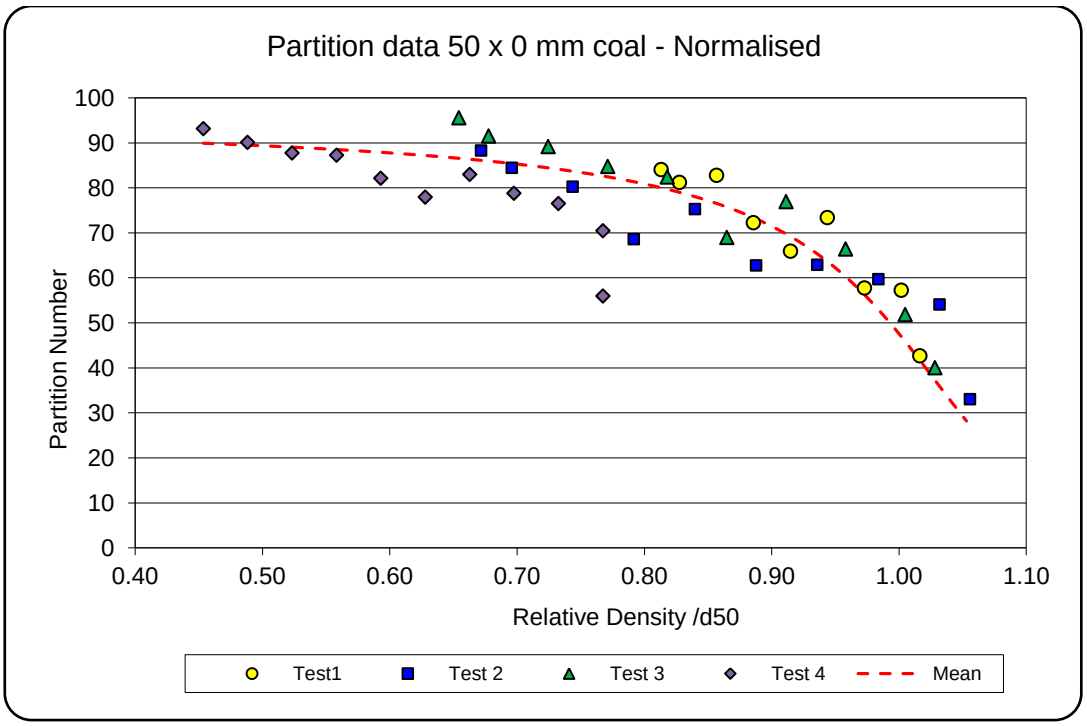

Figure 11: Partition data – 50 x 0 mm coal

The results obtained indicate that the Allair jig tends to cut at a high relative density - approximately 2.0. The amount of misplaced material is quite high at around 20% with more coal lost in the discard than discard misplaced to the product. It is not unlikely that these results can be modified to some degree by changing settings on the jig.

The jig was not able to upgrade the duff coal effectively and only affected a slight improvement in the ash content of the coal although the ash content of the discard was markedly higher than that of the feed. It may be advantageous to remove the duff from the feed to the jig which will result in an effective increase in the capacity of the jig.

The results obtained seem to align well with Allair jig results obtained in the United States (Reference 1).

Table 3: US Allair jig results

	Test 1	Test 2
Coal type	Bituminous	Bituminous
Feed size	50 x 12 mm	40 x 0 mm
Feed ash %	14.8	21.3
Product ash %	6.7	13.1
Discard ash %	51.0	60.4
Cut-point density	2.0	2.2
EPM	0.16	0.21
Imperfection	0.08	0.10

6. Conclusions

The results of the tests completed on the Allair jig to date indicate that the jig is able to upgrade raw coal to thermal coal specifications. The cut-point densities and EPM values obtained are similar to that of other dry processing equipment available but the Allair jig probably offers better control of the parameters affecting the separation. The jig did not prove able to effectively beneficiate fine coal.

Test work is still ongoing and further results are awaited.

7. Reference

1) Snoby, B. Journal of the Coal preparation Society of America. Fall 2009 Page 18