CBM 93 – 004 Float and Sink Results with Analyses 31st July 2010

Dr. Mike Clarke, Consultant to Central Petroleum
(07) 5502 8093, metts@metts.com.au

Detailed analyses of the float and sink testing were finally received on Friday 30th July, from the Brisbane laboratories of Bureau Veritas. Some significant results are tabulated in Table 1.

Table 1. Selected Analyses of CBM-004

Sample/Factor	Raw Coal	Floats SG 1·6
Sample 1. 543 – 560m		
Sulphur, Dry Basis	1·68	0·34
Ash – Fe_2O_3	13·9	1·7
Na_2O	3·08	3·7
K_2O	2·47	2·7
Ash Fusion Temp - deformation	1200ºC	1220ºC
Ash Fusion Temp - hemisphere	1260ºC	1250ºC
Slagging Index	1212ºC	1226ºC
Slagging Factor	0·829	0·096
Fouling Factor	1·59	1·049
Sample 2. 610 – 620m		
Sulphur, Dry Basis	0·89	0·33
Ash – Fe_2O_3	12·6	4·4
Na_2O	4·46	4·1
K_2O	6·1	4·5
Ash Fusion Temp - deformation	1160ºC	1190ºC
Ash Fusion Temp - hemisphere	1190ºC	1210ºC
Slagging Index	1170ºC	1194ºC
Slagging Factor	0·501	0·104
Fouling Factor	2·164	1·286
Sample 3. 640 – 650m		
Sulphur, Dry Basis	2·25	0·55
Ash – Fe_2O_3	26·9	5.7
Na_2O	4·64	4·8
K_2O	5·7	5·1
Ash Fusion Temp - deformation	1230ºC	1190ºC
Ash Fusion Temp - hemisphere	1290ºC	1210ºC
Slagging Index	1242ºC	1194ºC
Slagging Factor	2·26	0·20
Fouling Factor	4·66	1·75

Slagging Propensity Estimations

Empirical Indices for quantifying the slagging propensity of coal ash are,

Slagging Index (SI), Slagging Factor (R_s) and Fouling Factor (R_f) with

SI = 0·8 DT + 0·2HT $\quad R_s = \frac{B}{A} S_{dry} \quad R_f = \frac{B}{A} Na_2O$

where DT is the ash Deformation Temperature (ºC) and HT is the Hemisphere Temperature (ºC) as measured in the ash fusibility test in a reducing atmosphere, and where

B (Base) = Fe_2O_3 + CaO + MgO + Na_2O + K_2O (as a percentage of the ash)
A (Acid) = SiO_2 + Al_2O_3 + TiO_2 (as a percentage of the ash)
Sdry = total sulphur in the coal in percent, dry basis, and Na_2O the sodium percentage.

Table 2. Slagging propensity of bituminous coal ashes (Spero, 1997)

Slagging Index SI (℃)	Slagging Factor Rs	Slagging Propensity
> 1340	< 0·06	Low
1230 - 1340	0·06 - 0·08	Medium
1050 - 1230	0·08 - 0·2	High
< 1050	> 0·2	Severe

Table 3. Fouling propensity of bituminous coal ashes (Spero, 1997)

Na_2O % in ash	Fouling Factor Rf	Fouling Propensity
<0·5	< 0·2	Low
0·5 – 1·0	0·2 - 0·5	Medium
1·0 – 2·5	0·5 - 1·0	High
> 2·5	> 1·0	Severe

Table 4. Slagging Propensity due to Iron (Spero, 1997)

Slagging Propensity	Low	Medium	High	Severe
Total Iron in Ash (as % Fe_2O_3)	3 - 8	8 - 15	15 - 23	> 23

Table 5. Summary Table, Raw Coal and Floats SG 1·6

Factor	Sample 1. 543 – 560m		Sample 2. 610 – 620m		Sample 3. 640 – 650m	
	Raw Coal	F SG 1·6	Raw Coal	F SG 1·6	Raw Coal	F SG1·6
Slagging Propensity	Severe	High	Severe	High	Severe	High-Severe
Slagging Propensity Fe	High	Low	Medium	Low	Severe	Low
Fouling Propensity	Severe	Severe	Severe	Severe	Severe	Severe

From the above it can be ascertained that:

1. Float and sink testing has seriously reduced the iron and sulphur (pyrites) content of the coal, and in doing so has improved the quality of the coal*,
2. The removal of the pyrites has improved the slagging and fouling propensities of the coal to some extent,
3. F&S being a gravity (density) based separation system would indicate that industrial washing systems based on heavy media would be effective in improving the coal,
4. Since the Indigo Technologies milling separation system also works on density, that system would likely produce useful results if applied to Pedirka coals, and
5. When samples of suitable become available, it would be useful to take up the offer of Indigo Technologies for free bench testing.

* If the coal was to be offered to a gasification project (or possibly a fluidised bed combustion system), then the removal of the pyrites and altering of the slagging potential would not be wanted. Whole coal would be offered to those customers.

The Indigo Technology's process is intended to be placed adjacent to a pulverised fuel combustor, where 'sand' is removed in the pulverising process immediately prior to firing. With the Pedirka coals it could be placed near the mine, and would in effect act as a washing procedure prior to briquetting or pelletisation. Note: The 'sand' would be in part pyrites.

Email: 26/07/2010

To: John and Greg.

Finally some results from BV.

Re Joanne comments on the sulphur contents of the floats versus the feed, there are significant changes - see below.

	Feed S db	Floats S db
Sample 1	1.68	0.34
Sample 2	0.89	0.33
Sample 3	2.25	0.55

This means that a significant portion of the sulphur can be washed out.

It should also mean that the Ash Fusion Temperatures go up for the washed coal, and the fouling and slagging indices change, making the coal more friendly for pulverised fuel combustion.

For gasification and fluidised bed use you would probably leave the sulphur in, ie use a whole, unwashed coal feed.

I will contact Weatherford to see where the other samples are.

I am looking forward to more drips of info!