

From: Rajive Ganguli
Sent: Friday, February 28, 2014 5:42 PM
To: Bruce Campbell
Subject: Re: Chemistry of Alaska Coal specifically Mercury

From what I have found in the past, UCM coal has a lower level of contaminants than coals from WV etc.

1) As to mercury, see Table 3.6 in my 2008 report to DOE (attached). The Hg level in the stack emission (i.e. in the smoke that leaves the power plant) was very low - being close to detection limits.

3.1.5 Emissions Data

Table 3.6 lists the total Hg (mercury) data (particle bound, oxidized, and elemental) on the stack gas samples taken for Tests 23 and 24. Note that Hg testing was added to the project at the very end. A contractor (Alaska Source Testing, Anchorage, AK) was hired to sample the stack gases and measure Hg emissions using the Ontario-Hydro method.

Table 3.6. Hg emissions through the stack

	Hg, kg/hr (lb/hr)	Hg type (percent of total)		
		Particle bound	Oxidized	Elemental
Test 23 (finer)	0.000408 (0.000760)	0.19	34.03	65.78
Test 24 (coarser)	0.000300 (0.000663)	0.66	14.02	85.31

2) As to feed coal, see my 2012 report to US Air Force (this was a chapter in a bigger UAF-wide report). In Tables 2 and 3, see the values for sample C074 (raw coal). Thus, the UCM coal showed up as having 0.067 mg of mercury (Hg) per kg.

Table 2: Coal and ash characterization

Sample*		C070	C071	C072	C073	C074
Test	Unit					
AS RECEIVED BASIS						
Total Moisture	% wt	8.84	8.97	10.06	9.42	27.98
Ash	% wt	1.76	0.93	0.71	0.44	8.50
Volatile Matter	% wt	48.63	48.89	48.47	49.02	35.34
Fixed Carbon	% wt	40.77	41.21	40.76	41.12	28.18
Sulphur	% wt	0.26	0.26	0.26	0.26	0.09
DRY BASIS						
Ash	% wt	1.93	1.02	0.79	0.49	11.80
Volatile Matter	% wt	53.34	53.71	53.89	54.12	49.07
Fixed Carbon	% wt	44.73	45.27	45.32	45.39	39.13
Sulphur	% wt	0.29	0.28	0.29	0.29	0.13
Calorific Value - Gross (as received)	BTU/lb	10378	10444	10350	10461	7489
Calorific Value - Gross (dry basis)	BTU/lb	11384	11474	11508	11549	10399
Calorific Value - Net (as received)	BTU/lb	9852	9923	9818	9936	6887
Calorific Value - Net (dry basis)	BTU/lb	10908	11003	11032	11077	9966
ULTIMATE ANALYSIS (dry basis)						
Carbon	% wt	66.44	67.36	67.19	67.46	59.15
Hydrogen	% wt	5.14	5.08	5.13	5.09	4.67
Nitrogen	% wt	0.77	0.78	0.78	0.78	0.65
Sulphur	% wt	0.29	0.28	0.29	0.29	0.13
Ash	% wt	1.93	1.02	0.79	0.49	11.80
Oxygen (diff)	% wt	25.43	25.48	25.82	25.89	23.60

* C070 – Nitric Acid Leach (5 mins), followed by 2 hour HF leach (2Molar);

C071 – Nitric Acid Leach (5 mins), followed by 4 hour HF leach (2Molar);

C072 – Nitric Acid Leach (5 mins), followed by 8 hour HF leach (2Molar);

C073 – Nitric Acid Leach (5 mins), followed by 16 hour HF leach (2Molar);

C074 – Raw Coal

Table 2: Coal and ash characterization (continued)

Sample*		C070	C071	C072	C073	C074
MINERALS OF ASH						
Alumina, Al ₂ O ₃	%	10.55	12.36	10.09		16.96
Barium Oxide, BaO	%	0.26	0.39	1.01		0.46
Lime, CaO	%	7.89	2.83	3.74		20.52
Ferric Oxide, Fe ₂ O ₃	%	5.88	9.08	11.13		7.10
Potassium Oxide, K ₂ O	%	2.24	2.35	1.94		1.05
Magnesia, MgO	%	2.60	0.93	0.92		3.26
Manganese Oxide, MnO	%	0.04	0.06	0.08		0.14
Sodium Oxide, Na ₂ O	%	0.80	0.29	0.30		0.17
Phos. Pentoxide, P ₂ O ₅	%	0.14	0.25	0.30		0.09
Silica, SiO ₂	%	50.88	58.41	52.43		39.21
Strontium Oxide, SrO	%	0.05	0.05	0.07		0.17
Titania, TiO ₂	%	3.05	5.47	6.67		0.71

* C070 – Nitric Acid Leach (5 mins), followed by 2 hour HF leach (2Molar);

C071 – Nitric Acid Leach (5 mins), followed by 4 hour HF leach (2Molar);

C072 – Nitric Acid Leach (5 mins), followed by 8 hour HF leach (2Molar);

C073 – Nitric Acid Leach (5 mins), followed by 16 hour HF leach (2Molar);

C074 – Raw Coal

Table 3: Trace Element Analysis

Sample ID:*		C070	C071	C072	C073	C074
TRACE ANALYSIS * (air dry basis)						
Vanadium	mg/kg	2.88	2.08	2.07	1.99	10.5
Chromium	mg/kg	13.4	12.6	12.3	11.8	8.36
Nickel	mg/kg	6.6	6.06	5.8	5.7	5.88
Zinc	mg/kg	9.2	4.86	4.02	3.29	3.10
Arsenic	mg/kg	2.31	1.32	2.57	2.46	1.15
Selenium	mg/kg	2.02	0.759	1.06	1.01	0.637
Cadmium	mg/kg	0.173	0.099	0.074	0.053	0.109
Mercury	mg/kg	0.051	0.102	0.115	0.099	0.067
Lead	mg/kg	1.89	1.92	1.83	1.70	2.02

* C070 – Nitric Acid Leach (5 mins), followed by 2 hour HF leach (2Molar);

C071 – Nitric Acid Leach (5 mins), followed by 4 hour HF leach (2Molar);

C072 – Nitric Acid Leach (5 mins), followed by 8 hour HF leach (2Molar);

C073 – Nitric Acid Leach (5 mins), followed by 16 hour HF leach (2Molar);

C074 – Raw Coal