LMFS-94-13
ACTIVATED CARBONACEOUS ADSORBENTS -
A PRODUCTION AND TESTING STUDY

CONTRACTOR: Coal Corporation of Victoria
Morwell, Victoria
Australia

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CONTRACT AMOUNT: $32,725

Project Schedule - One Year
Contract Date - 7/11/94
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Completion Date - 12/31/94

Project Deliverables
Status Report - 10/15/94 ✔
Final Report - 12/31/94 ✔

OBJECTIVE / STATEMENT OF WORK

The objectives of the study are:

- to demonstrate the efficacy of North Dakota lignite towards the potassium hydroxide mediated production of an extruded or granular activated carbon using proven technology; and
- to characterize the carbon sample using tests which focus on the ability to compete with established commercial products in the market place.

STATUS

One 200-liter drum of representative run-of-mine lignite from the Beulah Mine of Knife River Coal Mining Company was shipped to HRL Technology Pty Ltd, a Coal Corporation of Victoria affiliate. Analysis of the lignite, crushed to minus 6-mm, revealed the following;

- Proximate Analysis
  37.5% moisture as received basis,
  41.2% volatile matter dry basis (d.b.),
  9.2% ash d.b., and
  49.6% fixed carbon d.b.
- Ultimate Analysis
  64.7% C d.b.,
  4.4% H d.b.,
  0.8% N d.b.,
  19.27 MJ/kg(Gross Dry)(8,063 Btu/lb).

Scouting runs on minus 30-mesh samples, bracketing operating temperature and KOH additions, gave the following results:

Operating Conditions	Microstrength Hardness	Iodine Number mg I_2/g carbon	Ash % d.b.
900° C, 90 min	76	1500	4.5
900° C, 45 min	74	1395	3.7
950° C, 120 min	80	1475	6.2
950° C, 240 min	75	1625	5.4
950° C, 60 min	80	n.d.1	n.d.
950° C, 90 min	86	n.d.	n.d.

The iodine numbers are encouraging and indicate high microporosity. Target microstrength hardness values are 85 - 90. Premium carbons have a hardness value of 90. The ash content is satisfactory. The yield of activated carbon after washing was 32.7%. This is a relatively high yield when compared to classical steam activation.

The table on the following page compares the experimental North Dakota lignite based activated carbon with commercial coconut shell, peat and lignite based activated carbons. The conclusion is that the North Dakota product is a promising high activity carbon. The results are sufficiently promising to warrant further investigation into the development of optimum carbon properties to fit a particular market niche and pilot plant scale operation of the CCV KOH technology using North Dakota lignite.

As part of the program, a limited quantity (10 lbs) of the experimental carbon product was made available for testing. Samples of this product whose analytical data is presented in the following table are available through the ICND.

1 N.d. indicates not determined.

Comparative Data for North Dakota lignite based and Commercial Activated Carbons

		VALUE (Dry Basis)			
Parameter	Units	DARCO 12 X 20	PICA G210 AS	NORIT R03515	North Dakota CCV/94/295
Mean Diameter	mm	Granular	Granular	1.4	1.62+/-0.07
Length of extrudate	mm	Granular	Granular	4	4 +/- 2
Hg (0.003 -414 Mpa) Pore intrusion Volume/surface area	cm^3/g m^2/g	0.6838 162.441	n.a.[2]	n.a.	0.3556 83.3950
Apparent density	kg/m^3	430	n.a.	n.a.	762
Stirring abrasion number	%	89	100	99	99
Takeda Microstrength Hardness	%	55	91	91	86
PH (acidity)		6.0	10.3	10.1	6.8
CO_2 surface area	m^3/g	740	1080	1150	1300
CO_2 micropore volume	cm^3/g	0.20	0.29	0.31	0.35
N_2 surface area	m^2/g	655	1290	1080	1325
Non micropore surface area	m^2/g	220	625	380	500
N_2 pore volume	cm^3/g	0.79	0.63	0.60	0.72
Iodine number	mgI_2/g	620	1180	1050	1400
Benzene index	%	n.a.	40	36	39
Carbon tetrachloride index	%	n.a.	n.a.	70	66
Methylene blue number	mg/g	150	338	275	425
Moisture	% ar[3]	8.2	2.8	2.6	5.8
Ash	%ar	32.5	1.9	4.8	5.9
Fixed Carbon	%ar	63.4	95.6	94.2	90.9
Au adsorption capacity constant (Gold loading capacity)	kg/ton		19	24	22.8
Apparent kinetic activity (Gold uptake rate)	hr^{-1}		n.a.	880	594
Relative kinetic activity	%[4]		125	100	80

[2] n.a. means not available

[3] ar means As Received.

[4] Relative to Norit R03515.