

Hydrocarbon type:									
Saturates									
Olefins									
Aromatics, total									
Aromatics, polynuclear									
Luminescence number									
Aniline point, °F									
H/C atom ratio									
Elemental analyses, wt%:									
C	85.72							87.14	
H	9.98							7.56	
N	0.23							0.59	
S	0.40							0.32	
O	5.00							4.05	
Trace metal analyses, ppm:									
V	0.0							0	
Ni	1.2							0.3	
Na	1.9							1.6	
K	0.4							0.4	
Mg	0.1							0.2	
Ca	0.5							0.4	
Pb	0.9							0.3	
Cu									
Fe	17.9							4.4	
Si	0							0	
Zn									
Ba									
Mn									
Mo									
W									
Tl	11.0							13.6	
Al	0.6							1.5	

(f) SMC products from Kentucky #9 co-ii data from letter of May 16, 1975, to T. W. Reynolds, NASA Lewis Research Center, from Robert G. Sprague, Pittsburgh & Midway Coal Mining Co.

Property	Test	Solvent-refined coal	Wash solvents	Light oil	Institute categories
Gravity, °API (specific)	D-86		---- (0.964)	---- (0.914)	
Boiling range:					
Initial boiling point, °F					
5 %			383	155	
10 %			402	212	
20 %			408	230	
30 %			413	110	
40 %			417	322	
50 %			421	332	
60 %			425	342	
70 %			430	350	
80 %			436	357	
90 %			444	366	
0.1 %			455	380	
Final boiling point, °F			463	400	
Final boiling point, °F			482	402	
Pour point, °C; fusion point, °F		430			
Flashpoint, °F					
Viscosity at 77°F, cS				1.236	
at 100°F, cS			2.25	0.794	
at °F					
Ash, wt %		0.1			
Ash: melt temperature, °F					
Heat of combustion, Btu/lb					
Carbon residue					
Carbon: ambottom, wt %					
Thermal stability					
Electrical conductivity					
Water					
Sediment					
Neutrality					
Corrosion					

Hydrocarbon type:								
Saturates								
Olefins								
Aromatics, total								
Aromatic, polynuclear								
Lumifrometer number								
Analyne point, °F								
H/C atom ratio								
Elemental analyses, wt%:								
C	87.1	86.2				82.7		
H	5.3	8.6				10.1		
N	2.2	0.6				0.9		
S								
O	0.5	0.2				0.3		
	4.4	4.4				6.4		
Trace metal analyses, ppm:								
V								
Ni								
Na								
K								
Mg								
Ca								
Pb								
Cu								
Fe								
Al								
Zn								
Ba								
Mn								
Mo								
W								
Ti								

66. SAC light organic liquids and recycle solvents; data from ref. 32

Property	Test	Maltinate categories			
		Light organic liquid (760-1291)	Recycle solvent (760-3019)	Recycle solvent (760-1289)	Recycle solvent (760-1290)
Gravity, °API (specific)		---	---	---	---
Boiling range:					
Initial boiling point, °F					
- 2		83	321	306	336
10 %		149	361	373	367
20 %		177	375	393	390
30 %		213	400	409	403
40 %		250	416	414	431
50 %		284	443	453	470
60 %		317	468	483	501
70 %		339	498	510	550
80 %		347	537	551	586
90 %		384	586	594	667
95 %		399	647	669	711
Final boiling point, °F		420	688	724	859
Free point, °F		563	844	902	1007
Flashpoint, °F		18		180	182
Viscosity at 100°F, cs			2.56	3.79	10.44
at 210°F, cs			1.45	1.48	2.23
at 300°F					
Ash, %			10	100	100
Ash: melt temperature, °F					
Heat of combustion, Btu/lb					
Carbon residue (Conradson), wt%		18.148	16.826	16.921	
Carbon remaining, wt%			0.29	0.19	0.27
Thermal stability					
Electrical conductivity					
Water		0		0	0
Sulfur					
Neutrality					
Corrosion					

Hydrocarbon type:													
Saturates													
Olefins													
Aromatics, total													
Aromatics, polynuclear													
Laminometer number													
Analysis point, °F													
H/C atom ratio													
Elemental analyses, wt%:													
C	81.70	88.00	88.50										
H	11.31	7.65	7.43	8.78									
N													
S	0.30	0.39	0.42	0.50									
O	0.60	0.41	0.37	0.35									
	4.00	4.00	3.90	3.30									
Trace metal analyses, ppm:													
V	0.2	0.2	0.9	4.0									
Ni													
Nb	0	0.2	0	0									
K	0.4	0.1	0.4	0.4									
Mg	0.1	0.1	0.2	0.8									
Ca	0	0	0	0									
Pb	3.1	13.0	0.4	0.5									
Cu	7.4	4.0	0	0.9									
Fe													
Si	2.1	32.0	31.0	56.0									
Zn	0	0	1.0	0									
Ba													
Mn													
Mo													
W													
Ti	10.0	9.6	20.0	0									
Al	0	1.0	1.0	0									

b) SIC (Wilsonville Process Solvent), data from ref. 32

Property	Test	Distillate categories		
		Process solvent (76D-1289)	Hydroprocessed process solvent J-8311	Hydroprocessed process solvent J-8312
Gravity, ° API (specific)		5.3	13.0	19.5
Boiling range:				23.4
Initial boiling point, ° F	D-2887	324	175	180
5 %		375	303	216
10 %		394	362	268
20 %				232
30 %				
40 %			411	402
50 %				
60 %		492	469	463
70 %				
80 %		564	534	525
90 %				
95 %		665	627	602
Final boiling point, ° F		709	681	669
Four point, ° F		872	857	818
Flashpoint, ° F				814
Viscosity at 100 ° F, cS		180	87	48
at 210 ° F, cS		5.79	3.43	2.20
at ° F		1.48	1.10	0.93
Ash, wt%				
Ash: melt temperature, ° F				
Heat of combustion, Btu/lb				
Carbon residue		16.921	17.728	18.572
Carbon ramabottom, wt%				18.903
Thermal stability				
Electrical conductivity				
Water				
Sediment				
Neutrality				
Corrosion				

Hydrocarbon type:									
Saturates									
Olefins									
Aromatics, total		74	66	46	34				
Aromatics, polynuclear									
Lampometer number									
Aniline point, °F									
H/C atom ratio									
Elemental analysis, wt%:									
C									
H		7.43	8.88	10.32	10.99				
N		0.62	0.44	0.11	0.02				
S		0.37	0.06	0.01	0.01				
O		1.90	2.60	0.60	0.20				
Trace metal analyses, ppm:									
V		0.9	<0.1	0.2	<0.1				
Ni									
Na		0.39	1.1	0.08	0.05				
K		0.19	0.22	0.03	0.01				
Mg									
Ca		0.35	0.21	0.12	0.12				
Pb		0.9	0.9	0.6	0.3				
Cu									
Fe		61.0	2.3	1.5	3.4				
Si									
Zn									
Ba									
Mn									
Mo									
W									
Ti		24.0	1.0	1.0	1.0				

TABLE 0. - FUEL DATA FROM COED PROCESS

(a) COED fuel from West Kentucky conds distil from ref. 18<sup>a</sup>

Property	Test	Distillate categories			
		Whole crude	Naphthas (22.4 percent)	Middle distillate (46.2 percent)	Gas oil (27.8 percent)
Gravity, °API (specific)		23.1	44.5	20.7	12.0
Boiling range:					
Initial boiling point, °F	Simulated distillation	97	97	366	217
5 %					
10 %			144	434	663
20 %			219	468	693
30 %			230	499	712
40 %			257	525	731
50 %			260	555	750
60 %			298	581	769
70 %			323	611	790
80 %			345	637	811
90 %		835	367	671	835
95 %					
Final boiling point, °F					
Four point, °F					
Flashpoint, °F					
Viscosity at °F					
at °F					
at °F					
Ash, wt %					
Ash: melt temperature, °F					
Heat of combustion, Btu/lb					
Carbon residue					
Carbon ramabottom, wt %					
Thermal stability					
Electrical conductivity					
Water					
Sediment					
Neutrality					
Corrosion					



Hydrocarbon type:													
Saturates													
Olefins													
Aromatics, total													
Aromatics, polynuclear													
Luminescence number													
Analytical point, °F													
H/C atom ratio													
Elemental analysis, wt %:													
C	88.1	86.6	88.3	89.0									
H	11.5	13.0	11.2	10.7									
N	0.125	0.056	0.16	0.09									
S	0.013	0.0089	0.0035	0.0090									
O	0.344	0.342	0.362	0.246									
Trace metal: analyses, ppm:													
V													
Ni													
Na	<0.5												
K													
Mg													
Ca	<0.5												
Pb													
Cu	<0.5												
Fe	0.1												
Si	0.6												
Zn													
Ba	<1.0												
Mn													
Mo	<0.2												
W	<0.1												
Ti													
Cr	<0.1												
Co	<0.2												
Sr	<0.1												
Mg	<0.5												
	<0.01												

\*Report contains detailed hydroprocessing data on COPD fractions.

(b) COED fuel from West Kentucky coal; data from ref. 10<sup>b</sup>

Property	Total	Distillate categories			
		Crude	Distillate (<205 °C; 21 percent)	Distillate (205°-300°C; 54.2 percent)	Residuals (>300°C; 24.2 percent)
Gravity, °API (specific)		24.8 (.013)	40.4 (.823)	18.9 (.541)	10.1 (.999)
Dolling range:					
Initial boiling point, °F			123	236	
5 %	Percent	212	198	367	
10 %		302	216	415	
20 %		392	234	455	
30 %		437	250	492	
40 %		527	270	512	
50 %		437 at 40 mm	288	532	
60 %		482 at 90 mm	313	554	
70 %		517 at 40 mm	336	582	
80 %		572 at 40 mm	362	611	
90 %			400	646	
95 %			435	682	
Final boiling point, °F			495	706	
Pour point, °F		<5	<5	<5	80
Flashpoint, °F					
Viscosity at 77 °F, SUS		48			
at 100 °F, SUS		43(-5.1 cS)			
at 100 °F, cS			0.89	4.51	
Ash, wt%	445		0	0.002	0
ash: melt temperature, °F					
Heat of combustion, Btu/lb					
Carbon residue (Conradson)					
Carbon tarbottom, wt%	D-189			0.0	0.36
Thermal stability		n			
Electrical conductivity					
Water					
Sulfur					
Neutrality, acid number	D-974		0.03	0.08	0.37
Corrosion					

Hydrocarbon type:									
Saturates			23.6					23.4	
Olefine									
Aromatics, total			74.4					76.6	
Aromatics, polynuclear			32.0					31.6	
Luminescence number									
Aniline point, °F									
H/C atom ratio									
Elemental analyses, wt%:									
C									
H									
N									
S			0.225	0.190			0.248	0.294	
O			0.08	0.05			0.04	0.01	
Trace metal analyses, ppm:									
V									
Ni									
Na									
K									
Mg									
Ca									
Pb									
Cu									
P									
Si									
Zn									
Ba									
Mn									
Mo									
W									
Ti									

More detailed hydrocarbon analysis contained in report.

(c) COED fuel from Utah A-seam and Illinois #6 coal, data from ref. 6

Property	Total	Distillate categories			
		Utah A-seam	Illinois #6 seam		
Gravity, °API (specific)		20	22		
Boiling range:					
Initial boiling point, °F					
5 %		280	190		
10 %		430	273		
20 %					
30 %		530	390		
40 %					
50 %		660	518		
60 %					
70 %		780	600		
80 %					
90 %		920	684		
93 %					
Final boiling point, °F		950	746		
Pour point, °F		60	0		
Flashpoint, °F		25	60		
Viscosity at 100 °F, cs		8	5		
at °F					
at °F					
Ash, wt %		<0.01	<0.01		
Ash: melt temperature, °F					
Ash: heat of combustion, Btu/lb					
Carbon residue (10% bottom)					
Carbon residue bottom, wt %			4.6		
Thermal stability					
Electrical conductivity					
Water, wt %		0.1	0.1		
Sediment					
Neutrality					
Corrosion					

Hydrocarbon type, 11q, vol %:					
Saturated		31.9	31.4		
Olefins		0	0		
Aromatics, total		34.1	48.2		
Aromatics, polynuclear					
Laminometer number					
Aniline point, °F					
H/C atom ratio					
Elemental analyses, wt%:					
C		87.2	87.1		
H		11.0	10.9		
N		0.2	0.3		
S		0.1	0.1		
O		1.4	1.6		
Total		<10 ppm	<10 ppm		
Trace metal analyses, ppm:					
V					
Ni					
Na					
K					
Mg					
Ca					
Pb					
Cu					
Fe					
Si					
Zn					
Ba					
Mn					
Mo					
W					
Tl					
Paraffins		23.7	10.4		
Naphthenes		52.2	43.4		

TABLE 9. - Continued.  
 e) COED fuel from Illinois #6 coal (distillate cuts) data from ref. 6

Property	Test	Distillate categories				
Gravity, °API (specific)		18.4	22.5	11.2		
Boiling range:						
Initial boiling point, °F		354	436	557		
5 %						
10 %						
20 %						
30 %		409	459	705		
40 %						
50 %						
60 %						
70 %						
80 %						
80 %		780	886	870		
95 %						
Final boiling point, °F			613			
Pour point, °F		25	-70	20		
Flashpoint, °F		180	215	400		
Viscosity at 100 °F, SUS		52.5 (6.1 cS)	39.3 (3.9 cS)			
a:						
a:						
Ash, wt %		0.007	0.0			
Ash: melt temperature, °F						
Heat of combustion, Btu/lb						
Carbon residue	0-189	0.4		1.13		
Carbon ramabottom, wt %						
Thermal stability						
Electrical conductivity						
Water						
Sediment		0.10				
Combined						
Neutrality						
Corrosion						

Hydrocarbon type:										
Saturates										
Olefins										
Aromatics, total										
Aromatics, polynuclear										
Lumino:eter number										
Analino point, °F										
H/C atom ratio										
Elemental analysis, wt%:										
C										
H										
N										
S						0.16				
O								0.004		0.07
Trace metal analysis, ppm:										
V										
Ni										
Na										
K										
Mg										
Ca										
Pb										
Cu										
Fe										
Si										
Zn										
Bn										
Mn										
Mo										
W										
Ti										

(c) COED fuel from Utah light and heavy coals data from ref. 13

Property	Test	Distillate categories		
		Utah light	Utah heavy	
Gravity, °API (specific)		41.9	22.5	
Boiling range:				
Initial boiling point, °F		176	<300	
5 %				
10 %		215	314	
20 %		220	416	
30 %				
40 %				
50 %		287	552	
60 %				
70 %		352	680	
80 %				
90 %		439	736	
95 %				
Final boiling point, °F		545	849	
Pour point, °F		-65	60	
Flashpoint, °F		80	120	
Viscosity at 100°F, cs		0.94	6.82	
at °F				
at °F				
Ash, wt %		<0.01	<0.01	
Ash: melt temperature, °F				
Heat of combustion, Btu/lb	Lower	18,356	18,040	
Carbon residue		0.05	1.46	
Carbon remanent, wt %				
Thermal stability				
Electrical conductivity				
Water				
Sediment				
Neutrality				
Corrosion				



Hydrocarbon type:									
Saturates									
Olefins									
Aromatics, total	32.	45.							
Aromatics, polynuclear	J.	14.							
Luminescence number									
Aniline point, °F	84.2	Too dark							
H/C atom ratio	1.86	1.81							
Elemental analysis, wt%:									
C									
H									
N	0.193	0.143							
S	<0.01	0.05							
O									
Trace metal analysis, ppm:									
V	<6.1	<5.6							
Ni									
Na	0.92	6.13							
K	1.81	0.38							
Mg	3.68	3.21							
Ca	<0.51	20.3							
Pb	0.74	<0.54							
Cu									
Fe									
Si									
Zn									
Bn									
Mn									
Mo									
W									
Ti									

TABLE 9. - Continued.

(f) COED fuel from Utah and West Kentucky coals, data from ref. 20

Property	Fuel		Nastillite categories			
	Utah T-460A	W. Kentucky T-460C				
Gravity, °API (specific)	19.0	22.3				
Boiling range:						
Initial boiling point, °F	198	148				
5 %	340	246				
10 %	412	387				
20 %	485	366				
30 %	510	420				
40 %	520	492				
50 %	675	537				
60 %	697	603				
70 %	755	657				
80 %	803	715				
90 %	860	782				
95 %	910	824				
Final boiling point, °F	950	844				
Pour point, °F	30	-15				
Flashpoint, °F	120	<70				
Viscosity at						
at						
at						
Ash, wt %						
Ash: melt temperature, °F						
Heat of combustion, Btu/lb						
Carbon residue						
Carbon remainder, wt %	0.83	0.37				
Thermal stability						
Electrical conductivity						
Water						
Sediment						
Neutrality						
Corrosion						

Hydrocarbon type:														
Saturates														
Olefins												7.7		
Aromatics, total												27.4		
Aromatics, polynuclear												54.9		
Laminometer number														
Aniline point, °F														
H/C atom ratio														
Elemental analysis, wt%														
C							85.91					86.98		
H							11.97					12.12		
N							0.25					0.18		
S							0.0288					0.0271		
O							1.62					0.60		
Trace metal analysis, ppm:														
V														
Ni														
Na														
K														
Mg														
Ca														
Pb														
Cu														
Fe														
Si														
Zn														
Ba														
Mn														
Mo														
W														
Ti														

TABLE 10. - FUEL DATA FROM GULF CATALYTIC LIQUEFACTION PROCESS

[Data from ref. 31.]

Property	Test	Distillate categories			
		Full-range #1 (Western subbituminous)	Full-range #2 (Bituminous, Pittsburgh spec)	Distillate D from #1	
Gravity, °API (specific)		7.0	10.4	14.0	
Boiling range:					
Initial boiling point, °F				266	
5 %					
10 %					
20 %					
30 %					
40 %					
50 %					
60 %					
70 %					
80 %					
90 %					
93 %					
Final boiling point, °F				688	
Pour point, °F					
Flashpoint, °F					
Viscosity at					
at °F		In range of #4 or #5 fuel oil		In range of #2 fuel oil	
at °F					
at °F					
Ash, wt %				0.0030	
Ash: melt temperature, °F					
Heat of combustion, Btu/lb					
Carbon residue					
Carbon remainder, wt %					
Thermal stability					
Electrical conductivity					
Water					
Sediment					
Neutrality					
Corrosion					