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EVALUATION OF JET FUELS

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TABLE 1

Hydrocarbon Type Determination

Hydrocarbon Groups	Diesel	JP-4 B1	JP-4 B2	Jet A-1 Shale	Jet A-1	Jet A-1 B2	Herbs	JP-4	Jet A-1 B1
<u>Saturates</u>									
monocyclicnaphthenes	22.6	25.9	25.8	27.0	28.4	21.5	19.9	32.0	24.3
dicyclicnaphthenes	9.1	6.2	6.4	7.6	10.4	7.9	10.5	7.9	9.0
acyclic parafines	31.8	33.6	33.6	40.6	38.3	31.0	32.1	38.8	32.9
TOTAL	63.5	65.7	65.9	75.1	77.1	60.4	62.5	78.7	66.3
<u>Olefins, TOTAL</u>	nil	nil	nil	nil	nil	nil	nil	nil	nil
<u>Aromatics</u>									
monoaromatics	9.1	14.8	15.1	10.1	13.0	13.8	9.1	15.4	12.9
diaromatics	7.8	2.0	1.9	2.5	2.6	3.3	8.7	1.7	3.4
polyaromatics	2.4	0.3	0.3	0.7	0.8	0.5	2.3	0.5	0.7
naphthalines	6.0	12.0	12.0	1.5	1.5	15.2	9.3	1.4	10.8
indans and tetralines	11.0	5.1	4.9	10.1	4.9	6.8	8.1	2.4	5.9
TOTAL	36.5	34.3	34.2	24.9	22.9	39.6	37.5	21.3	33.7

NOTE: The diaromatics reported are those of biphenyl type while the polyaromatics include anthracenes and phenanthrenes.

INTRODUCTION

The jet fuel samples were submitted by Dr. Coleman of the Defence Research Establishment in Ottawa. The analytical work is the part of the Energy Research Laboratories' commitment to assist in the chemical characterization of liquids.

Combustion properties of the fuels are being evaluated by Pratt and Whitney of Canada. The project is funded jointly by the Department of National Defence, Department of Industry, Trade and Commerce in Ottawa and the U.S. Air Force. The study is being conducted under the auspices of the NASA with the aim to assess jet fuels produced from oil shale, coal and bitumen.

ANALYTICAL PART

The CHN 240 Perkin Elmer analyser was used for the determination of carbon and hydrogen, while the Dohrman analyser for the determination of nitrogen.

The Varian CFT-20 Carbon 13 NMR instrument was used for the hydrogen distribution analyses. Hydrocarbon type analysis was performed on the Finigan GC/MS instrument.

Simulated distillation results were obtained on the Hewlett-Packard 5710A gas chromatograph.

ADDITIONAL COMMENT

The sample identified as JP-10 appears to be a single compound dissolved in very small quantities of a kerosene fraction. The molecular weight of the component was estimated to be 136. No aromatic hydrogen and carbon were found in the sample. The GC/MS analysis confirmed the presence of $-CH_2-$ bridging typical for adamantane and terpene structures.

TABLE 2

Elemental Analysis and Calorific Values

	Diesel	JP-10	JP-4 B1	JP-4 B2	Jet A-1 Shale	Jet A-1	Jet A-1 B2	Herbs	Jet A-1 B1	JP-4
Carbon, wt %	86.4	87.8	87.0	86.8	85.9	86.0	87.6	86.8	87.0	85.5
Hydrogen, wt %	12.9	12.0	12.9	13.0	14.0	13.9	12.4	13.2	13.0	14.2
Nitrogen, ppm	73	5	trace	trace	12	1	1	45	1	trace
Hydrogen Distribution by NMR										
Saturate	94.7	100	90.4	90.6	96.0	96.2	87.4	93.5	91.8	96.4
Olefinic	0	0	0	0	0	0	0	0	0	0
Aromatic	5.3	0	9.6	9.4	4.0	3.8	12.6	6.5	8.2	3.6
Calorific Values, cal/g	10980	10830	10960	10940	11040	10980	11010	10950	10920	11190
Btu/lb	19770	19490	19730	19690	19880	19760	19810	19700	19660	20140

NOTE: Determined nitrogen in concentrations below 1 ppm is reported as trace. The amounts of saturate and aromatic hydrogens are in % of the total hydrogen.

TABLE 3

Results of Chromatographic Distillations

% Off	Temperature °C											
	Diesel	JP-10	JP-4-B1	JP-4-B2	Jet A-1 Shale	Jet A-1	Jet A-1	B-2	Herbs	Jet A-1	B-1	JP-4
IBP	148	169	44	34	146	131	135		145	133		30
5	201	170	85	73	162	157	161		170	159		64
10	218	172	111	93	169	165	170		182	167		82
15	230	174	127	107	173	171	177		192	173		93
20	239	176	143	126	177	175	183		197	178		105
25	248	177	158	139	181	180	188		202	183		117
30	255	179	169	151	186	184	193		208	188		127
35	264	180	180	161	192	188	196		211	193		137
40	270	181	191	169	194	193	200		216	195		145
45	275	182	198	177	197	195	203		221	198		152
50	281	182	204	184	200	197	206		226	201		159
55	287	183	208	192	204	200	207		231	204		164
60	293	184	217	198	208	203	212		237	207		169
65	301	185	224	204	210	205	217		243	208		175
70	308	186	231	207	213	206	220		248	213		180
75	314	186	238	215	217	210	223		259	217		187
80	322	187	249	225	223	214	227		270	221		194
85	330	188	256	231	229	218	234		282	225		198
90	339	189	267	237	235	225	243		300	234		205
95	353	190	280	255	246	235	256		326	246		213
FBP	401	323	326	290	284	280	299		428	292		235

NOTE: One single peak was observed in the chromatogram of the JP-10 liquid in addition to very small quantities of a heavier material. The position of the peak changed with the size of the injected sample as the result of the column overloading. Reported results for the JP-10 fuel represent the run with 0.02 μ l compared to 0.6 μ l used for the analysis of the other liquids.