



Energy, Mines and
Resources Canada

Énergie, Mines et
Ressources Canada

CANMET

Canada Centre
for Mineral
and Energy
Technology

Centre canadien
de la technologie
des minéraux
et de l'énergie

LABORATORY REQUIREMENTS FOR THE ANALYSIS OF
HYDROCARBONS BY DIRECCION GENERAL DE MINES
E HIDROCARBUROS DE HONDURAS
CONSULTANT'S REPORT FOR CIDA

W. J. MONTGOMERY

DECEMBER 1977

ENERGY RESEARCH PROGRAM
ENERGY RESEARCH LABORATORIES
ERP/ERL 78-05

LABORATORY REQUIREMENTS FOR THE ANALYSIS OF
HYDROCARBONS BY DIRECCION GENERAL DE MINES
E HIDROCARBUROS DE HONDURAS
CONSULTANT'S REPORT FOR CIDA

by

W.J. Montgomery

INTRODUCTION

As a CIDA consultant to the Direccion General de Minas E Hidrocarburos de Honduras during the period of the fifth to sixteenth of December 1977, I carried out a thorough physical inspection of the existing laboratory facilities, and examined the qualifications of the personnel designated to carry-out the various functions in the proposed Hydrocarbons Laboratory.

The existing laboratory space is fully committed to fire assay and geochemical analysis, however plans have been made to provide additional space for each of the two proposed laboratories, i.e. Hydrocarbons and Environmental. The proposed space for each of the above laboratories is small, however it may be adequate under the present circumstances. The only hydrocarbon analyses required at present is the monitoring of products produced by the Texaco refinery at Puerto Cortés and marketed in Honduras. The refinery is relatively small, processing about 10,000 b/d of reconstituted Venezuelan crude. The refinery produces fuel oil, diesel oil, LPG, and motor gasoline, which limits both the volume and the extent of the analyses to be carried out. If petroleum is discovered in Honduras, facilities could then be expanded. There are known sources of coal, and from a study of geological reports I conclude that they are of low rank, i.e. lignite or subbituminous, and not readily accessible. The need to carry-out coal analyses in the near future is also limited.

As mentioned in Dr. Landine's report, the need for environmental analysis is also limited at this time due to the lack of industry which may contribute to water or air pollution.

SINCE THE ORIGINAL TYPED COPY IS TO BE PHOTOGRAPHED, PLEASE WRITE
ANY PROPOSED REVISIONS ON THE CARBON COPY ONLY

This sheet is supplied for preparing master sheets for reproduction of paper or metal offset
plates by "Xerox" or photography. All material to be reproduced (typed, drawn or mounted)
is to be kept within the blue boundary lines.

As it is not feasible to fully equip the aforementioned laboratories and train personnel in the use of equipment immediately, I intend to describe in detail the test procedures and equipment needed to make a modest beginning in the field of hydrocarbon testing.

RECOMMENDATIONS

Laboratory-General

Due to the additional fire hazards associated with the analysis of hydrocarbons, the use of metal furniture is advisable. The bench tops should be resistant to acids, alkalies and organic solvents, tile as in the present geochemical laboratory would be satisfactory. Glass breakage on tile surfaces may be minimized by the use of neoprene matting as required. Two fireproof fume-hoods 4' to 5' wide with exhaust fans as close as possible to the fume-hood to reduce suction loss, is advisable. Benches and fume hoods should be provided with:

1. Water lines and drains.
2. Electrical outlets properly grounded:
 - 220 V 20 amp for muffle furnaces,
 - 110 V 15 amp for heaters, stirrers, etc.

Each muffle furnace should be controlled by a pyrometer controller e.g. Thermolyne as in geochemical laboratory.

A drying oven with control is required.

3. Metal containers for disposal of solvents and hydrocarbons should be available. Solvents should not be disposed of by dumping in drains.

SINCE THE ORIGINAL TYPED COPY IS TO BE PHOTOGRAPHED, PLEASE WRITE ANY PROPOSED REVISIONS ON THE CARBON COPY ONLY

This sheet is supplied for preparing master sheets for reproduction of paper or metal offset plates by "Xerox" or photography. All material to be reproduced (typed, drawn or mounted) is to be kept within the blue boundary lines.

NECESSARY REFERENCE LITERATURE

The following ASTM Annual Book of Standards of the latest edition should be made available for use in the laboratory. These may be purchased

at the prices indicated from: American Society for Testing and Materials
1916 Race Street
Philadelphia, PA 19103
USA

For Petroleum Analysis

1. Part 23 Petroleum Products and Lubricants (I); Price \$34.00.
2. Part 24 Petroleum Products and Lubricants (II); Price \$34.00.
3. Part 25 Petroleum Products and Lubricants (III) Aerospace Materials; Price \$33.00.
4. Part 47 Test Methods for Rating Motor, Diesel & Aviation Fuels; Price \$20.00.

For Coal and Coke

1. Part 26 Gaseous Fuels; Coal and Coke; Atmospheric Analysis; Price \$28.00.

SINCE THE ORIGINAL TYPED COPY IS TO BE PHOTOGRAPHED, PLEASE WRITE
ANY PROPOSED REVISIONS ON THE CARBON COPY ONLY

This sheet is supplied for preparing master sheets for reproduction of paper or metal offset
plates by Xerox or photography. All material to be reproduced (typed, drawn or mounted)
is to be kept within the blue boundary lines.

ANTICIPATED TEST PROCEDURES IN ORDER OF PRIORITY

Petroleum Analysis

1. Distillation of Petroleum Products ASTM D 86.
2. a) Test for API Gravity of Crude Petroleum and Petroleum Products (Hydrometer Method) ASTM D 287.
b) Density, Specific Gravity, or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method ASTM 1298.
3. Test for Sulphur in Petroleum Products by the Bomb Method ASTM D 129.
4. Test for Pour Point of Petroleum Oils ASTM D 97.
5. Test for Conradson Carbon Residue of Petroleum Products ASTM D 189.
6. Test for Aniline Point and Mixed Aniline Point ASTM D 611.
7. Test for Ash from Petroleum Products ASTM D 482.
8. Test for Water in Petroleum Products and Bituminous Material by Distillation ASTM D 95.
9. Test for Flash Point by Tag Closed Tester ASTM D 56.
10. Test for Gross Calorific Value of Solid Fuel by the Adiabatic Bomb Calorimeter ASTM D 2015.
11. Cloud Point of Petroleum Oils ASTM D 2500.
12. Test for Vapor Pressure of Petroleum Products (Reid Method) ASTM D 323.
13. Test for Neutralization Number by Color-indicator Titration ASTM D 974.
14. Test for Smoke Point of Aviation Turbine Fuels ASTM D 1322.
15. Test for Lead in Gasoline - Volumetric Chromate Method ASTM D 2547.
16. Test for Mercaptan Sulfur in Aviation Turbine Fuels ASTM D 1323.
17. Test for Kinematic Viscosity of Transparent and Opaque Liquids ASTM D 455.
18. Test for Detection of Copper Corrosion of Petroleum Products by the Copper Strip Tarnish Test ASTM D 130.
19. Test for Existant Gum in Fuels by Jet Evaporation ASTM D 381.

SINCE THE ORIGINAL TYPED COPY IS TO BE PHOTOGRAPHED, PLEASE WRITE ANY PROPOSED REVISIONS ON THE CARBON COPY ONLY

This sheet is supplied for preparing master sheets for reproduction of paper or metal offset plates by "Xerox" or photography. All material to be reproduced (typed, drawn or mounted) is to be kept within the blue boundary lines.

Coal Analysis

1. Test for Moisture in the Analysis Sample of Coal and Coke ASTM D 3173.
2. Test for Ash in the Analysis Sample of Coal and Coke ASTM D 3174.
3. Test for Volatile Matter in Analysis Sample of Coal and Coke ASTM D 3175.
4. Test for Total Sulphur in the Analysis Sample of Coal and Coke ASTM D 3177.
5. Test for Carbon and Hydrogen in the Analysis Sample of Coal and Coke ASTM D 3178.
6. Test for Nitrogen in the Analysis Sample of Coal and Coke ASTM D 3179.
7. Test for Equilibrium Moisture of Coal at 96 to 97 per cent Relative Humidity and 30°C ASTM D 1412.
8. Test for Gross Calorific Value of Solid Fuel by Adiabatic Bomb Calorimeter ASTM D 2015.

EQUIPMENT LIST IN ORDER OF PRIORITY

Note: Each item indicates source of supply and current price in Canadian dollars, duty free.

General Equipment

1. Analytical balance, Fisher Scientific; Mettler, Cat No 1-909-30, 160 g capacity. Price \$955.00.
2. Furnace, Fisher Scientific; Thermolyne, F 6020, Cat. No. 10-588; Price \$851.00.
3. Controller for above, Fisher Scientific, Thermolyne, Cat. No. 10-558-21; Price \$809.00.

Specific Equipment for Petroleum Analysis

(for ASTM D 86)

1. Petroleum distillation apparatus, Fisher Scientific, Cat. No. 13-456; Price \$1083.00.
2. Engler flasks, Fisher Scientific, 100 ml pyrex, case of 24, Cat. No. 10-145; Price \$96.68.
3. Graduated cylinders, Fisher Scientific, 100 ml, 12 only, Cat. No. 8-558; Price (each \$3.59 - \$89.90.).
4. Bath jars, Fisher Scientific, pyrex, Cat. No. 13-476; case of 6; Price \$68.23.

SINCE THE ORIGINAL TYPED COPY IS TO BE PHOTOGRAPHED, PLEASE WRITE ANY PROPOSED REVISIONS ON THE CARBON COPY ONLY

This sheet is supplied for preparing master sheets for reproduction of report or data off-set plates by "Xerox" or photography. All material to be reproduced (typed, drawn, illustrated) is to be kept within the blue boundary lines.

5. Low distillation thermometer ASTM 7C, Fisher Scientific, Cat. No. 1-603; Price \$13.49.
6. High distillation thermometer ASTM 8C, Fisher Scientific, Cat. No. 1-733; Price \$15.23.

(for ASTM D 1298)

1. Hydrometers, one of each required.

S.G. Range	Length	Fisher Scientific No.	Price
0.640 - 0.710	325 mm	11-555 A	\$ 8.93
0.700 - 0.770	"	" B	"
0.760 - 0.830	"	" C	"
0.820 - 0.890	"	" D	"
0.880 - 0.950	"	" E	"
0.940 - 1.010	"	" F	"
1.000 - 1.070	"	" G	"
1.060 - 1.130	"	" H	"

2. Cylinders, Fisher Scientific, Cat. No. 8-530J; case of 18; Price \$120.70.
3. Thermometer, API gravity thermometer 12C, Fisher Scientific, Cat. No. 11-604-5; Price \$16.28.
4. Thermometer, API Gravity Thermometer 12F, Fisher Scientific; Cat. No. 11-604; Price \$16.28.

(for ASTM D 129 and D 2015)

1. No. 1241 adiabatic calorimeter with No. 1108 bomb, automatic controls, 115V 60 Hz; Price \$3300.00.
2. No. 1541 water heater, 2.75 litre, 950 W, 115V 60 Hz; Price \$250.00.
3. No. 1654 programmer to operate No. 1241 adiabatic calorimeter and digital thermometer printer 115V 60 Hz; Price \$480.00.
4. No. 1655 digital thermometer with 230E thermister probe 115V 60 Hz.

The above items 1 - 4 obtainable from: Parr Instrument Co
211 Fifty-third Street
Moline, Illinois 61265
USA

THE ORIGINAL TYPED COPY IS TO BE PHOTOGRAPHED, PLEASE WRITE ANY PROPOSED REVISIONS ON THE CARBON COPY ONLY

This sheet is supplied for preparing master sheets for reproduction of paper or metal offset plates by "Xerox" or photography. All material to be reproduced (typed, drawn or mounted) is to be kept within the blue boundary lines.

(for ASTM D97 and D 2500)

1. Cloud and pour point apparatus, Fisher Scientific, Cat. No. 13-405; Price \$270.00.
2. Thermometer, ASTM 5C, Fisher Scientific, Cat. No. 13-411; Price \$9.43.
3. Thermometer, ASTM 6C, Fisher Scientific, Cat. No. 13-413; Price \$12.59.
4. Graduated cold test jars, Fisher Scientific, package of 12, Cat. No. 13-415; Price \$31.07.

Note: As the climate of Honduras is mild to tropical this test may be unnecessary.

(for ASTM D 189)

1. Conradson carbon residue apparatus, Humbolt Manuf. Cat. No. H-2495; Price \$75.00. Available from; Humbolt Manufacturing Co.
7300 W. Agatite Avenue
Northridge (Chicago), Illinois 60656
USA

(for ASTM D 611)

1. Aniline point thermometers, Fisher Scientific:

ASTM 33C	Cat. No.	13-394-30A	Price \$18.09
34C	"	13-394-30B	"
35C	"	13-394-30C	"

(for ASTM D 482)

1. Evaporating dishes 120 ml capacity, Fisher Scientific, Cat. No. 8-690E, case of 24; Price \$47.17.

(for ASTM D 95)

1. Standard taper distillation traps, 24/40, Fisher Scientific, Cat. No. 9-14605, case of 8; Price \$81.48.
2. Round bottom flasks 500 ml 24/40, Fisher Scientific, Cat. No. 10-067G, case of 2; Price \$13.32.
3. Round bottom flasks 1000 ml 24/40, Fisher Scientific, Cat. No. 10-067H, case of 12; Price \$75.82.
4. Condensers, 300 mm, 24/40, Fisher Scientific, Cat. No. 7-734A, 2 required \$26.07 each; Price \$52.14.

SINCE THE ORIGINAL TYPED COPY IS TO BE PHOTOGRAPHED, PLEASE WRITE ANY PROPOSED REVISIONS ON THE CARBON COPY ONLY

This sheet is supplied in preprinted master sheets for reproduction of paper or metal offset plates by Xerox or photography. All material to be reproduced (typed, drawn or mounted) is to be kept within the blue boundary lines.

5. Hemispherical mantle for 500 ml flask, Fisher Scientific, Cat. No. 11-472-10F; Price \$34.50.
6. Hemispherical mantle for 1000 ml flask, Fisher Scientific, Cat. No. 11-374-10G; Price \$36.90.
7. Variable transformer 0/120V, 10 amp, Fisher Scientific, Cat. No. 9-521-100 2 required, Price each \$56.43.

(for ASTM D-56)

1. Fisher/tag closed tester, Fisher Scientific, Cat. No. 13-509-1; Price \$517.00.
2. Flask point cup, Fisher Scientific, Cat. No. 13-510-10; Price \$17.22.
3. Cover assembly, Fisher Scientific, Cat. No. 13-510-25; Price \$155.62.
4. ASTM flash point thermometer, 57G, Fisher Scientific, Cat. No. 13-510-100 Price \$12.30.

(for ASTM D-323)

1. Constant temperature bath, Fisher Scientific, Cat. No. 13-419-50; Price \$1434.00.
2. Thermometer, fahrenheit, Fisher Scientific, Cat. No. 13-575-H; Price \$12.30.
3. Vapor pressure bomb, Fisher Scientific, Cat. No. 13-419-25; Price \$136.02.
4. Vapor pressure bomb guages, 0-15 lb, Fisher Scientific, Cat. No. 13-419-30B; Price \$95.00.

(for ASTM D 445)

1. Kinematic viscosity bath, Fisher Scientific, Cat. No. 13-619-100; Price \$1422.00.
2. Cannon-Fenske viscometers, calibrated, Fisher Scientific, for transparent liquids:

ASTM Size	Cat. No.	Price each
* 25	13-617A	\$ 53.65
* 50	B	"
* 100	C	"
* 150	D	"
* 200	E	"
* 300	F	"
* 350	G	"
* 400	H	"
500	J	"
600	L	"

* It is suggested that 2 of each be purchased.

SINCE THE ORIGINAL TYPED COPY IS TO BE PHOTOGRAPHED, PLEASE WRITE ANY PROPOSED REVISIONS ON THE CARBON COPY ONLY

This sheet is supplied for preparing master sheets for reproduction of paper or metal offset plates by "Xerox" or photography. All material to be reproduced (typed, drawn or mounted) is to be kept within the blue boundary lines.

3. Kinematic viscosity thermometers, Fisher Scientific:

ASTM No. 45F	Cat. No. 13-618C	Price \$45.24
ASTM No. 28F	Cat. No. 13-618D	\$45.24

Specific Equipment for Coal Analysis

(for ASTM D 3173)

1. Coal moisture oven, Preiser/Mineco, Cat. No. 91-1630; Price \$161.70.
2. Crucibles, capsule form 22.4 ml, Fisher Scientific, Cat. No. 8-103C; Price \$1.50 each, 2 doz required \$36.00.
3. Crucible covers, aluminum, Fisher Scientific, Cat. No. 8-106; pkg. of 12; Price \$5.50.
4. Ethylene glycol, antifreeze, 1 gallon; Price \$5.00.

(for ASTM D 3174)

1. Muffle furnace - as described for petroleum analyses.

(for ASTM D 3175)

1. Crucibles, platinum capacity 10 ml, 25 x 30 mm complete with capsule cover, Fisher Scientific, Cat. No. 8-036A; 2 required, price approx. \$145.00 each.
2. Furnaces, Fieldner 110-115V, Preiser/Mineco; Cat. No. 90-8480; Price each \$70.40; 2 required, \$140.80.
3. Variable transformers 0 - 120-140V, 10 amp, Fisher Scientific, Cat. No. 9-521-100; Price each \$56.43; 2 required, \$112.86.
4. Crucible holders, Preiser/Mineco, Cat. No. 90-8510 ; Price each \$7.40 2 required, \$14.80.

Items indicated as Preiser/Mineco may be purchased from:

Preiser/Mineco
Jones and Oliver Streets
St. Albans, WV 25177
USA

(for ASTM D 3177 and D 2015)

1. Adiabatic bomb calorimeter as described for petroleum analyses.

(for ASTM D 3178 and Organic Analyses)

1. Furnace - three zone for ultimate analysis, Preiser/Mineco, Cat. No. 90-8710; Price \$945.00.

(for ASTM D 3179 and Environmental Testing)

1. Kjeldahl, portable distillation unit, Fisher Scientific, Cat. No. 13-157; Price \$815.00.
2. Kjeldahl, fumeless portable digestion unit, Fisher Scientific, Cat. No. 13-158; Price \$785.00.
3. Bulbs, 48 mm, Fisher Scientific, Cat. No. 13-177 A, case of 12; Price \$120.01.

Specific Equipment for Environmental Analysis

(for pH and Specific ion determinations)

1. Orion Portable, Model 407AL specific ion meter, Fisher Scientific, Cat. No. 13-641-737; Price \$683.00.
2. Box, inner chamber filling solution, Fisher Scientific, Cat. No. 13-641-899; Price \$15.16.
3. Double-junction reference electrode, Fisher Scientific, Cat. No. 13-641-900; Price \$99.14.
4. Specific ion electrodes for the above may be purchased as the need arises; these electrodes covering a wide range of anions and cations of importance in environmental testing are available at prices ranging from \$175.00 to \$325.00 each.

(for Dissolved Oxygen DO)

1. Portable dissolved oxygen meter, Model 51B, Fisher Scientific, Cat. No. 13-298-76; Price \$355.00.
2. Oxygen/temperature probe, Fisher Scientific, Cat. No. 13-299-43, Price \$110.00.
3. Set detachable cables, 3m, Fisher Scientific, Cat. No. 13-299-40; Price \$29.00.
4. Standard membrane K Cl Kit, Fisher Scientific, Cat. No. 13-299-16; Price \$6.00.

SINCE THE ORIGINAL TYPED COPY IS TO BE PHOTOGRAPHED, PLEASE WRITE ANY PROPOSED REVISIONS ON THE CARBON COPY ONLY

This sheet is supplied for preparing master sheets for reproduction of paper or metal offset plates by "Xerox" or photography. All material to be reproduced (typed, drawn or mounted) is to be kept within the blue boundary lines.

In discussions with Sr. David Funés, he indicated the immediate need for equipment to carry out knock ratings, and a gas chromatograph. A knock rating engine costs in the order of \$30,000 and requires an experienced operator to run it. At least 6 months of training would be required before one could expect satisfactory results. This type of testing could be carried out quite reasonably by many commercial laboratories in the U.S. This item should be given a low priority for the present. A gas chromatograph is at this point unnecessary and will only be of value if petroleum is discovered in Honduras in commercial quantities. This equipment should be given a low priority.

TRAINING REQUIREMENTS FOR THE HYDROCARBONS LABORATORY

As the present need for a hydrocarbons laboratory is based on quality control of products from the Texaco Refinery at Puerto Cortés and imported petroleum products it would seem logical to use the same staff and laboratory space to carry out the required environmental analyses. As only limited technical training in these fields is available in Honduras it would be advisable to send one or two of the most highly trained technical staff to Canada or the U.S. for extensive training in these fields. Candidates for such training should have the following qualifications:

1. A university degree in chemistry having specialized in inorganic and organic chemistry, quantitative analysis, physical chemistry and biochemistry.
2. Bilingual in Spanish-English.
3. Several years laboratory experience. As bilingual candidates with the above qualifications may not be available, language training could be undertaken in Honduras prior to technical training abroad. Training in the analysis of both solid and liquid fuels has in the past been provided to CIDA trainees at CANMET, in Ottawa, and we have noted that those with a good grasp of English reap the greatest benefits from their training.

A nine-month, hands-on training period would be required to thoroughly cover the following disciplines:

1. Four months training in all phases of liquid fuels analysis and testing. The training would include apparatus and instrument set-up, standardization, fault-finding, and practice in ASTM, API, and non standard methods.
2. Four months training in all phases of solid fuels analysis and test methods. This too would include apparatus set-up, standardization, routine fault-finding, and practice. The analysis of coal ash, residues from combustion, particulates, and petroleum products for major and trace elements by various analytical procedures is carried out as part of the solid fuels analysis program, much of the work would also apply to environmental testing.
3. Training in the operation of knock testing engines could probably be arranged with the National Research Council who now operate this facility in Ottawa.
4. Opportunities would also be available to visit other laboratories of the department where geochemical and assay work is carried out, as a means of broadening the scope of the trainee(s).
5. If however training in petroleum analysis could be arranged with the Texaco Refinery at Puerto Cortés, the training of a non-bilingual trainee should be considered. Training at a refinery would however be limited to the tests carried out, and may not cover all phases of petroleum analyses.
6. As no equipment to carry-out petroleum analysis is presently available it is suggested that some of the more important equipment and supplies be ordered. The prices quoted for equipment are in Canadian dollars, and could be considerably less if quotations from several suppliers were obtained prior to placing orders.
7. When the laboratory facilities are ready for use and at least some of the equipment delivered I could return to Tegucigalpa for about two weeks to instruct personnel in the proper use of the equipment using locally obtained samples of the products to be tested.

This sheet is supplied for preparing master sheets for reproduction of paper or metal offset plates by "Xerox" or photography. All material to be reproduced (typed, drawn or mounted) is to be kept within the blue boundary lines.

SINCE THE ORIGINAL TYPED COPY IS TO BE PHOTOGRAPHED, PLEASE WRITE ANY PROPOSED REVISIONS ON THE CARBON COPY ONLY