INSTITUTION OF PETROLEUM TECHNOLOGISTS

STANDARD METHODS of Testing Petroleum and Its Products

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PREFACE

THE importance of standardization has in recent years become increasingly apparent in scientific and technical progress. In the United States its development and application have already reached a high level, while in this country the British Engineering Standards Association has achieved satisfactory results in more than one direction with the co-operation of the industries concerned.

The suggestion that the Institution of Petroleum Technologists, as the premier society in this country dealing with petroleum technology, should concern itself with the standardization of methods of tests, was first mooted in a letter to the late Sir Boverton Redwood in 1917. At that time, although the Council was in favour of taking action, it was felt that war conditions precluded the securing of the attention necessary to the work. It was not until May, 1921, that the Standardization Committee was appointed.

The appropriate Government departments, the leading petroleum companies, and certain individual gentlemen of recognised authority were approached with the object of securing the co-operation of every branch of the industry, whether producing, merchanting, using, consulting or purely academic.

The complete Committee comprises the gentlemen whose names are given on p. vii., viii., and their occupation is stated in order that the diversity of interests and the degree of technological ability may be appreciated.

In order to expedite the work of the Committee, it was decided to divide its work into six classes and to appoint a Sub-Committee to deal with each class. The classes are as follows :—

(1) Naturally Occurring Bituminous Substances.
(2) Distillates up to Kerosenes.
(3) Kerosenes and Intermediates.
(4) Lubricants.
(5) Liquid Fuels.
(6) Asphaltum and Artificial Residues.

The names of the members of the Sub-Committees will be found on p. ix.

As it was felt that the main Committee would be too unwieldy to deal with the detail work of the Sub-Committees, an Executive Committee was appointed, consisting of the Chairman of each Sub-Committee and the Chairman of the main Committee. One of the functions of this Executive Committee is to secure definite decisions in cases where the recommendations of the Sub-Committees may not be unanimous. In the event of any test concerning more than one Sub-Committee, the respective Chairmen of the Sub-Committees meet, and if then there are any differences of opinion which they cannot reconcile, the matter is referred to the Executive Committee for decision. It is a remarkable fact that the Executive Committee has never had to exercise this function as regards any material difference of opinion.

The chief aim of the Committee has been to produce authoritative decisions as soon as possible in order to remove the difficulties under which petroleum technologists labour owing to divergences in methods and results. The spirit of the Committee throughout has been the reverse of parochial, and it has always given, and will continue to give, considerable weight to the valuable work achieved by the American Society for Testing Material and the American Bureau of Standards, and has, with the consent of these bodies, made use of their work and adopted many of their methods of test, and grateful acknowledgment is made to them for their willing assistance.

In the case of certain tests the Committee has not felt it possible to recommend departure from generally accepted methods, desirable as it is to secure uniformity with other countries—where such methods offer no grounds for technological objection—*e.g.*, the Abel closed flash-point apparatus is the one legally recognised throughout the British Empire ; then, again, the Redwood viscometers are so firmly established that any recommendation to adopt a different standard could only be justified by some serious shortcoming in the method.

The Committee decided to issue the approved methods as " Standard " and not as " Tentative " (the description used by our American confrères) because it was felt that the use of the word

" Tentative " would weaken the confidence of technologists, by giving an impression of indecision and indefiniteness. The use of the word " Standard," on the other hand, may possibly cause uneasiness to technologists as giving the impression of irrevocable permanency, but this is not the intention of the Committee, for it is intended that they shall continue their work and, from time to time, revise the tests as experience may demand and progress is made in methods and apparatus.

This first edition does not pretend to cover every test—in fact, is the first instalment ; some of minor importance are still under consideration, but it was thought inadvisable to delay the publication of the work—which it is hoped will be of immediate and considerable use to petroleum technologists—in order to incorporate less important matter.

Not only have methods of testing been considered, but also the standardization of apparatus. The Committee's researches have revealed an unexpectedly grave variation in what have been generally regarded as standard instruments and, in order to secure certification of instruments, the Committee has arranged with the National Physical Laboratory that they will calibrate, test and mark hydrometers, thermometers, and, in specified cases, instruments as complying with the adopted standards. (Also p. iv.)

The British Engineering Standards Association was, in due course, approached with a view to avoiding duplication of work, and the Association decided that they would no longer concern themselves with methods of test of petroleum products, but would adopt, for the purposes of their specifications, whatever methods were standardized by the Institution.

The standardization of nomenclature has not yet been considered by the Committee, although it is their intention to review this matter at an early date. It is felt that nomenclature is not of prime importance to British Petroleum Technologists, and that when the time comes for considering it, it should be dealt with on very broad and international lines in the hope of bringing our nomenclature as far as possible into line with that used by the principal petroleum-producing countries.

The Committee have to acknowledge the valuable assistance

afforded by the principal firms of instrument manufacturers and by the British Lampblown Scientific Glassware Manufacturers' Association.

It might appear invidious to select any one member of the Committee for recognition of his work when all have worked so willingly and ably, but I am sure that every member would like me to record in this preface the debt which we all owe to Professor Brame, not only for his work as Chairman of a Sub-Committee, but for the remarkable amount of special work which he has carried out, including the editing of the whole of the Sub-Committees' work for publication.

In conclusion, it is hoped that the results so far obtained will be found of practical use to all those interested, and that, with a continuance of the spirit of co-operation, without which work on a subject such as Standardization cannot be effective, a comprehensive system may be attained and generally adopted, and which, while dealing satisfactorily with developments up to date, will, nevertheless, be of an elastic nature and will keep pace with the petroleum industry's progress.

ALEXANDER DUCKHAM.

VOLUMETRIC GLASSWARE.

When tests require the use of ordinary volumetric glassware, such as pipettes, burettes, etc., apparatus which has been tested at the National Physical Laboratory and passed Class A, or passed Class B, shall be used. In general the tests do not necessitate apparatus of a higher degree of accuracy than Class B.

CLASSES AND SERIAL DESIGNATION OF TESTS.

Petroleum products (including Crude Oils) have been divided in this Report into ten classes, to each of which reference letters have been given. The classes are as follows :—

The Serial Designation has been arranged so that the same number is given to the same test throughout all classes, irrespective of the method of estimation employed. The serial number is preceded by the reference letter indicating the Class. Thus the estimation of sulphur always carries the number 4, so that G.4, K.4, GO.4 refer to this test for Gasoline, Kerosene and Gas Oil respectively.

Where a test is specifically applicable to a particular product a high number has been allotted, thus the well-known "Doctor Test" for Gasoline has the I.P.T. Serial Designation G.33.

DIMENSIONS OF APPARATUS.

The Committee fully recognise the desirability of adopting a consistent method of expressing units of measurement, preferably in the metric system, but this was found impossible, owing to the use of inch and fractions of an inch measurements in certain forms of apparatus which had to be adopted, and the customary use of

such fractions of an inch as thirty-seconds, sixty-fourths, etc. in workshops. Many of these work out to absurd decimals, or when converted into centimetres or millimetres, again give decimals of no practical utility.

A compromise had to be adopted, namely to accept the inch and decimals or fractions for metal parts, and centimetres or millimetres for glass and similar parts, and capacities for such vessels in cubic centimetres.

Again, both degrees Fahrenheit and Centigrade were forced on the Committee by existing conditions. Thus legal enactment for the Abel Flash Point apparatus prescribes the Fahrenheit scale, and the same scale is commonly employed in viscometry. For most methods such as distillations, the Centigrade system has been adopted.

List of Figures.

At a Council Meeting, held on May 30th, 1921, the following members, with power to co-opt additional members, were appointed as a "Standardization Committee": Dr. A. E. Dunstan, D.Sc., F.I.C., F.C.S. (Chief Research Chemist, Anglo-Persian Oil Co.), Dr. W. R. Ormandy, D.Sc., F.I.C., F.C.S., M.I.A.E. (Consulting and Analytical Chemist), Professor J. S. S. Brame, F.I.C., F.C.S. (Professor of Chemistry, R.N. College, Greenwich), Mr. James Kewley, M.A., F.I.C., F.C.S. (Chief Chemist, Shell Group), and Mr. Robert Redwood, F.C.S. (Consulting and Analytical Chemist). From these, Mr. Kewley was elected Chairman, but had to retire through pressure of other engagements. Mr. Alexander Duckham was co-opted and appointed Chairman, in which capacity he rendered valuable service.

The Government Departments were then approached and the following were appointed by their respective Departments:—

Admiralty.—Engineer Rear Admiral (then Eng. Captain) W. M. Whayman, C.B.E., R.N. (Deputy Engineer-in-Chief of the Navy).

War Office.—Mr. W. L. Baillie, F.I.C. (Chemical Inspection Department, Woolwich).

Air Ministry.—Dr. G. Rudorf, Ph.D. (Chemical Research Dept.).

Government Laboratory.—Dr. J. J. Fox, O.B.E., D.Sc., F.I.C., F.C.S. (Superintending Chemist).

National Physical Laboratory.—Mr. W. F. Higgins, M.Sc., A.R.C.Sc. (Principal Assistant, Physics Department).

Petroleum Department, Board of Trade.—Mr. J. L. Jeffery, A.R.S.M., M.Inst.M.M. (Inspector of Drilling).

The leading oil companies were also approached and promised their support.

The following were from time to time co-opted as Members :—

Mr. Arthur A. Ashworth, M.A., A.M.Inst.C.E. (Messrs. Beeby, Thompson and Partners).

Mr. R. G. Batson, A.K.C., M.Inst.C.E., M.I.Mech.E. (National Physical Laboratory).

Mr. S. E. Bowrey, B.Sc. (Chemist, Alexander Duckham and Co.).

Mr. E. A. Evans, F.C.S. (Chemist, C. C. Wakefield and Co.).

Dr. F. H. Garner, Ph.D. (Chemist, Agwi Petroleum Corporation, Ltd.).

Mr. J. E. Hackford, B.Sc., F.I.C., F.C.S. (Consulting and Analytical Chemist).

Mr. Peter Kerr, M.A., B.Sc., A.I.C. (Chemist, Shell Group).

Mr. E. Lawson Lomax, M.Sc., F.C.S. (at that time with the Anglo-Persian Oil Co., Ltd.).

Mr. William Lee (Chemist, Silvertown Lubricants, Ltd.).

Mr. A. G. Marshall, M.A. (Research Chemist, Shell Group).

Mr. T. M. McKenzie, A.I.C., F.C.S. (Chemist, Anglo-Mexican Petroleum Co., Ltd.).

Mr. Arnold Philip, B.Sc., A.R.S.M., F.I.C., F.C.S. (Admiralty Chemist, Portsmouth).

Dr. P. E. Spielmann, Ph.D., B.Sc., F.I.C., A.R.C.Sc. (Highways Construction Co., Ltd.).

Dr. F. B. Thole, D.Sc., F.I.C., F.C.S. (Research Chemist, Anglo-Persian Oil Co., Ltd.).

Mr. H. T. Tizard, M.A. (Department of Industrial and Scientific Research).

Mr. W. J. Wilson, A.I.C. (Chemist, Burmah Oil Co., Ltd.).

Mr. W. A. Woodrow (Chemist, Anglo-American Oil Co., Ltd.).

The main committee has appointed the following six Sub-Committees :—

SUB-COMMITTEE 1.—*Naturally Occurring Bituminous Substances.*—James Kewley, M.A., F.I.C., F.C.S., A. E. Dunstan, D.Sc., F.I.C., F.C.S. (Chairmen); J. L. Jeffery, A.R.S.M., M.Inst.M.M., J.E. Hackford, B.Sc., F.I.C., F.C.S., W. J. Wilson, A.I.C., Robert Redwood, F.C.S., A. A. Ashworth, M.A., A.M.Inst.C.E., Peter Kerr, M.A., B.Sc., A.I.C., and F. B. Thole, D.Sc., F.I.C., F.C.S.

SUB-COMMITTEE 2.—*Distillates up to Kerosene.*—A. E. Dunstan, D.Sc., F.I.C., F.C.S. (Chairman), W. R. Ormandy, D.Sc., F.I.C., F.C.S., G. Rudorf, Ph.D., J. J. Fox, O.B.E., D.Sc., F.I.C., W. L. Baillie, F.I.C., S. E. Bowrey, B.Sc., W. J. Wilson, A.I.C., Peter Kerr, E. Lawson Lomax, M.Sc., F.C.S., H. T. Tizard, M.A., and A. G. Marshall, M.A.

SUB-COMMITTEE 3.—*Kerosene and Intermediates.*—Robert Redwood, F.C.S. (Chairman), Peter Kerr, M.A., B.Sc., A.I.C., W. J. Wilson, A.I.C., W. A. Woodrow, W. F. Higgins, M.Sc., A.R.C.Sc., and J. J. Fox, O.B.E., D.Sc., F.I.C.

SUB-COMMITTEE 4.—*Lubricants.*—F. B. Thole, D.Sc., F.I.C., F.C.S. (Chairman), S. E. Bowrey, B.Sc., W. F. Higgins, M.Sc., A.R.C.Sc., T. M. McKenzie, A.I.C., F.C.S., G. Rudorf, Ph.D., F. H. Garner, Ph.D., Eng. Captain W. M. Whayman, C.B.E., R.N., W. L. Baillie, F.I.C., Wm. Lee, and E. A. Evans, F.C.S.

SUB-COMMITTEE 5.—*Liquid Fuels.*—Professor J. S. S. Brame, F.I.C., F.C.S. (Chairman), Eng. Captain W. M. Whayman, C.B.E., R.N., F. H. Garner, Ph.D., W. J. Wilson, A.I.C., Arnold Philip, B.Sc., A.R.S.M., F.I.C., F.C.S., and W. A. Woodrow.

SUB-COMMITTEE 6.—*Asphaltum and Artificial Residues.*—J. E. Hackford, B.Sc., F.I.C., F.C.S. (Chairman), R. G. Batson, A.K.C., M.Inst.C.E., M.I.Mech.E., T. M. McKenzie, A.I.C., F.C.S., F. H. Garner, Ph.D., P. E. Spielmann, Ph.D., F.I.C., B.Sc., A.R.C.Sc.