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26 April 1985
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India.

Development of Plastics Testing and Training Facility
at the Extension Centre of CIPET in Ahmedabad.

DP/IND/82/044/11.05/32.1.H

INDIA.

Three-week Mission Technical Report:

TESTING OF PLASTICS

Prepared for the Government of India
by the United Nations Industrial Development Organization
acting as the executing agency for the
United Nations Development Programme

Based on the work of Mr. Jan Brzezinski, Asst. Prof., expert in plastics testing

United Nations Industrial Development Organization
Vienna

This report has not been cleared with the United Nations Industrial Development Organization which does not, therefore, necessarily share the views expressed. (1)

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(1) To be omitted after clearance by UNIDO

1. To introduce new testing methods with the available facilities, according to Table 1.
2. To prepare a programme of fabricating new devices at the Extension Centre and of introducing new testing methods, according to Table 2.
3. To procure the most essential apparatus and to introduce the relevant test methods, according to TaBle 3.
4. To arrange a testing expert mission for 2-3 months after having introduced the methods and after procurement of equipment, as under points 1-3 above.
5. To use in the future ISO-Recommendations as the primary source of testing methods and procedures, as far as possible.
6. To organize the training of one chemical engineer in the infrared spectrophotometry of plastics and additives.
7. To prepare "Test Method Cards" and distribute them among all the plastics industrial enterprises interested (see Report, Activities, point 18).
8. To organize the collection of manufacturers' information o. raw materials, processing machines, testing apparatus, etc. (see Report, Activities, point 21).

CONTENTS

S U M M A R Y

This Report is concerned with my 3-week mission as Testing Expert to the Project DP/IND/82/044. In its original version, my mission and job description were planned for 3 months but the mission was curtailed due to work programme modifications of the Extension Centre in Ahmedabad.

My activities followed the Programme of UNIDO Expert elaborated for me by Dr. A. B. Mathur, Assistant Engineer (Testing) of the Extension Centre (cf. Appendix I). Due to personal affairs, Mr. Mathur was absent during my stay. My report keeps to the points of this Programme.

Abnormal conditions during my stay in Ahmedabad (riots, curfew) considerably disturbed the Centre's activities and compelled me to work for four days outside the Centre.

Findings and recommendations are included in the Section "Activities", which follows.

I also delivered lectures to the Training Course actually run by the Centre (2 hrs on Product Design in Plastics, 3 hrs on Thermosetting Materials, 1 hr on Testing of Plastics and 2 hrs on Mechanical Properties of Plastics).

In future, the testing activities of the Extension Centre should use the ISO Recommendations as the primary source of testing procedures and specifications, as far as possible.

A C T I V I T I E S

The sequence of reporting follows the points of the Programme (Appendix 1).

Point 1. To find out possibilities of introducing new test methods as per international standards with available facilities.

Besides the conventional standard test methods connected with each apparatus, there are also sometimes other new test methods possible. These possibilities have been identified. A list of proposed test methods, comprising 6 apparatus and 15 test methods is given in Table 1 of the Report.

Points 2 & 5. Discussion for the design and fabrication of test specimen moulds. Optimization of processing parameters for moulding test specimens out of different materials.

I have reviewed the actual needs and possibilities of fabricating moulds for the preparation of test specimens. A list of test specimens as well as dimensions and details of designing the relevant moulds are given in ASTM D 647. This standard contains sufficient information for mould designer.

The most necessary now is the construction of:

1) 4-cavity injection mould giving in one shot a 3.2 x 12.7 x 12.7 mm bar, a 6.4 x 12.7 x 12.7 mm bar, a tensile-test dumbbell specimen according to ASTM D 638M and a disk.

2) A compression mould for polyethylene (according to ASTM D 1928) and for rigid PVC (according to ASTM D 3010).

3) A mould for transfer moulding of thermosetting moulding materials (bars).

Besides, in many cases specimens can be cut and machined

directly from sheets supplied by the customer. The processing parameters for moulding specimens out of different materials should always follow the specifications for any materials.

Point 3. To find out the possibilities for the development/ fabrication of the new test equipment for CIPET Extension Centre.

CIPET Extension Centre is well equipped with many metal working machines and its design section and workshop have the capacity of designing and fabricating many devices (chambers, clamps, funnels,etc.) described in the standards.

Taking into account these possibilities, as well as the availability of other items on the domestic market, I have prepared a list of such standardized test methods (Table 2). A schedule for the preparation of the necessary devices and implementation of these methods should be elaborated by the Extension Centre so that it may have at its disposal as many as possible of them directly after removal to new premises. The actual congested working conditions probibit their implementation now.

Point 4. Repairs of some test equipment .

My programme of solving some of the problems connected with the defects observed in several test equipment items was invalidated due to my absence at the Centre during several curfew days.

The broken vice and damaged microprocessor control for the Impact Tester, Ceast, necessitate advice and possible replacement by the manufacturer.

Point 5 - see P. 2 above.

Point 6. Standardizing some testing methods.

This point related to some problems in introducing the mentioned testing methods, according to ASTM procedures. Below some remarks are given:

a) Gas permeability.

Oxygen permeability by polyethylene films was measured and a procedure for optimization of the measurement and treatment of results proposed. A.o., a stand for keeping and moving the enlarging glass (readout of the mercury level) should be provided; the NBS-standard Reference Material 1470 of known permeance to O_2 (see ASTM D 1434, point 11.2) should be ordered.

b) Moisture transmission rate.

Oven for this test was ordered, not yet received.

c) Carbon black dispersion.

Procedures are given by ASTM D 3015 (general) and D 1603 (carbon black dispersion in polyethylene).

A roll-mill (already ordered) and a special hot plate are necessary for the preparation of specimens from PE compositions. Other devices (metal shimstock, wooden block) - can be fabricated by CIPET's workshop.

The microscope and camera meet the requirements of the method.

Reference standards of required quality of carbon black dispersion should be prepared to compare them with the specimens under test.

d) Igepol CO-630 (or Antarox CO-630) recommended for the envi-

ronmental stress cracking test by ASTM D 1693 as a reference wetting agent is a nonylphenoxy poly(ethyleneoxy)ethanol surfactant from the group of modified poly(ethylene oxides) and corresponds to the formula:

$$C_9H_{19}C_6H_4O(CH_2CH_2O)_nCH_2CH_2OH.$$

Surfactants of this group (and, maybe the same surfactant) are surely being manufactured in India. Manufacturers of such products should be contacted. In routine tests any other surfactant of this group could be used, and that corresponding to Igepol CO-630 only in cases of dispute.

e) Use of some accessories of Instron Tensile Tester.

This point not carried out due to shortage of time.

f) Use of the vice of the Izod Impact Tester.

See point 4 above.

7. To identify the essential items i.e. accessories and equipments for testing.

After discussion with Mr. Padnis and taking into account the present facilities and the expected demand for tests, a list of the most essential apparatus to be purchased by CIPET, Ahmedabad, has been prepared (Cf. Table 3). The relevant ASTM standards and their brief characteristics, if necessary, are also given in the Table. It contains 16 items of equipment and 23 standards.

A complete list of new standard methods, based on Tables 1, 2 and 3, is given in Table 4 with an additional classification according to group of materials and group of properties tested in each of the methods proposed. Altogether, 51 new standards methods are mentioned.

These lists do not include tests and equipment for measur-

ing electrical properties, because the needs in respect of them are not yet sufficiently known. This field can be reasonably defined after more experience from future contacts with the plastics processing industry will have been accumulated. The present apparatus for measuring the surface and volume resistivity should satisfy the most urgent needs in this field.

Due to shortage of time, testing of tubes was left for future consideration.

8. To find c the possibilities for developing test methods for qualitative and quantitative check of additives in plastics, especially in PVC.

The methods have been considered. They are included in Tables 2 & 3 and correspond to the following ASTM D standards: 2124, 2222 and 2288. I see the necessity and possibility of their implementation at the Extension Centre. They require procuring of an IR-spectrophotometer (Table 3, item 2) and a Soxhlet extraction apparatus (Table 3, item 13), as well as special training in IR-spectral analysis.

9. Requirements and methods of test to find out biological decomposition of plastic materials.

Testing of the biological resistance of plastics materials to the action of bacteria (ASTM G 22) and fungbi (ASTM G 21) can be carried out only in specialized microbiological laboratories under stringent hygienic conditions.

10. Use of polaroscopy in quality control.

This possibility has been considered in Table 1, point E.

Points 11 & 16. Literature to be prepared for testing of plastics. Preparation of literature for plastics testing.

In Table 6, I have given a list of Standards and Books to be purchased by the Extension Centre for its library.

CIPET, Madras has issued a handbook comprising about 20 test methods, majority of them being of interest also to the Extension Centre. In spite of some editorial errors and some shortcomings resulting from recent developments in many standardized methods, this handbook could serve as a primary guide for the future elaboration of a similar handbook at Ahmedabad. I prefer the following sequence: first - each methods should be mastered in details by practical use of it, then - working procedures and a general description of each method should be prepared. I recommend a stepwise gathering of information on each of the methods and keeping it on files.

Point 12. Use of instruments for rubbers, fibres, adhesives and coatings.

These fields of application of the instruments available at the Extension Centre are very broad and they could be discussed in future, as need may be.

Points 13, 14 & 17. Training methods on "Quality Control and Testing of Plastics". Preparation of teaching aids for the

training. Preparation of test procedure sheets for the training.

I consider it advisable to nominate in the future a person at the Extension Centre responsible exclusively for training of students in the range of Testing and Quality Control and for the preparation of the necessary teaching aids in the form of specimens and sheets with abbreviated and simplified testing procedures, aimed at:

1) dissemination of several simple and easy to introduce testing methods (in particular those concerned with the evaluation of processing properties of materials and useful properties and quality of final products) on site in the industrial enterprises,

2) promotion of the knowledge of methods available at the Extension Centre among the industry personnel, to encourage them to utilize these facilities in future.

Point 14 - see p. 13 above.

Point 15. Preparation of reviews on Plastics Testing and Quality Control.

It is now prematurely to develop this activity. Some kind of it is treated below, under point 18 of the Programme.

Point 16 - see p. 11 above.

Point 17 - see p. 13 above.

Point 18. To popularize the activities of CIPET Extension Centre and testing facilities.

One of the best methods, already applied in practice, is

direct contact with industry by consulting visitors and by visiting enterprises to find out and to solve their problems. Also training courses with the participation of engineers from industry are popularizing the Extension Centre's activities.

In the field of testing popularization, I have suggested the preparation of special "Test Method Cards" containing the data about each method available, namely about its fields of application, apparatus used, principle of method, results obtained, materials to be tested as well as practical significance and evaluation of the results of test.

By way of example, I have prepared two such cards on "Gas Permeability" and "Oxygen Index" tests. The Test Method Cards should be printed or photocopied on one-page thick paper sheets and distributed among enterprises from a special list. A file of these Cards should be kept by the customers and should be supplemented and kept up-to-date by the Extension Centre.

Point 19. To discuss on developmental work required to help the industries.

By developmental work is meant the development of new formulations, processing methods and products, both exclusively at the Extension Centre and in a direct cooperation with the intetested industrial enterprises. Such tasks necessitate having at the disposal of some laboratory equipment items for mixing, roll-milling, extruding etc. of the new formulations. This work must be tightly connected with the evaluation and testing of the properties. This field of activities should be prepared now,

but it can be started only after shifting to new premises in next year.

Point 20. Standardization of data sheets, i.e. test reports, maintaining the records and presentation of test results.

When preparing the handbook on testing methods for plastics and products (cf. Points 11 & 16 above) some standardization of data sheets should be introduced. The already used at the Extension Centre forms of reporting the test results could serve as a good first approximation of such test reports. However, each method has its specific characteristics and overdoing in the standardization of the test reports should be avoided. In principle, they could follow the indications given in each ASTM standard under the heading of "Report".

Point 21. To collect the addresses of raw material manufacturers for procuring the literature on raw materials.

The Extension Centre subscribes to several technical periodicals for its library, a.o. the Modern Plastics International. They contain "Reader's Information Cards". These Cards should be utilized as an important source of procurement information from manufacturers about their raw materials, processing machines, testing apparatus, etc.

The other method of collecting information are direct contacts with the manufacturers, both in India and abroad.

An exacting catalogue of manufacturers and their products, as well as an alphabetical register of all entries should be the

responsibility of one person from the technical staff, nominated by the management.

Proposed Programme of U.N.I.D.O. Expert — Appendix 1.

Date : 8-4-85

1. To findout possibilities of introducing new test methods as per international standards with the available facilities.

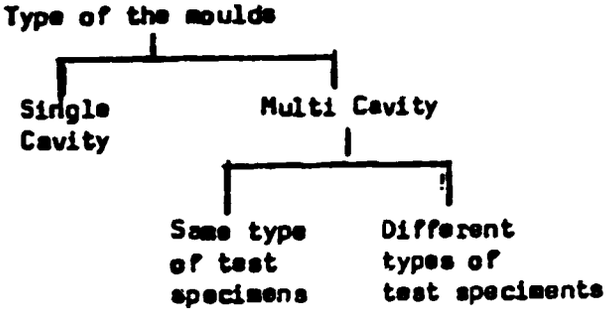
2. Discussion for the design and fabrication of test specimen moulds.

3. To findout the possibilities for the development/fabrication of new test equipments for CIPET Extension Centre.

4. Repairs of some test equipments.

5. Optimization of processing parameters for moulding test specimens out of different materials.

(a) - Type of the moulds



(b) - Sheet moulding and machining the samples fromiit.

(c) - Optimization of cycle for the specimen preparation i.e. for thermosets & thermoplastics.

6. Standardizing some testing methods

(a) Gas Permeability.

(b) Moisture Transmission Rate.

(c) Cabbun Black Disperaion.

(d) Indegenously Available Material.in place of Igepol for Environmental Stress Cracking Test.

(e) Use of some accessories of Instron Tensile Tester.

(f) Use of the vice of Izod Impact Tester.

7. To identify the essential items i.e. accessories and equipments for testing.

8. To find out the possibilities for developing test methods for qualitative and quantitative check of additives in plastics especially in P.V.C.

9. Requirements and methods of test to find out biological decomposion of plastic materials.

10. Use of Polaroscopy in quality control.

11. Literature to be prepared for testing of plastics.

12. Use of instruments for rubbers, fibres, adhesives and coatings.

13. Training methods on "Quality Control and Testing of Plastics".

14. Preparation of teaching aids for the training.

15. Preparation of reviews on Plastics Testing and Quality Control.

16. Preparation of literature on product testing.

17. Preparation of test procedure sheets for the training.

18. To popularize the activities of CIPET Extension Centre and testing facilities.

19. To discuss on developmental work required to help the industries.

20. Standarization of data sheets i.e. test reports, maintaining the records and presentation of test results.

21. To collect the addresses of raw material manufacturers for procuring the literature of raw materials.

Table 1. List of the new standardized test methods possible with the facilities already available at CIPET, Ahmedabad

A. Methods connected with the use of the Instron Tensile Machine :

a) D 732. Shear strength of plastics.
A special shear tool necessary, to be fabricated by the CIPET workshop.

b) D 882. Tensile properties of thin plastic sheeting. Method A : Static weighing.

c) D 1623. Tensile and tensile adhesion properties of rigid cellular plastics.
Necessary: special grips, load and extension indicators and specimen cutter.

d) D 1893. Blocking of plastic film.
Only special rod and frame are necessary.

e) D 1938. Tear propagation resistance of plastic film and thin sheeting by a single tear method.

f) D 2659. Column crash properties of blown thermoplastic containers.
Load indicator and extensometer - necessary.

B. Methods connected with the use of the Impact Tester:

a) D 1822 M. Tensile energy to break plastics.

C. Methods connected with the use of the Haze Meter:

a) D 1746. Transparency of plastic sheeting.

b) D 4093. Reflectance - reflectivity photoelastic measurements of birefringence and residual strains in transparent and translucent plastics (cf. also p. E, below).

D. Methods connected with the use of the Melt Flow Indexer :

a) D 2839. Using melt index strand for determining density of polyethylene.
Includes additional use of the density column.

Table 1 - continued

b) D 3835. Rheological properties of thermoplastics with a capillary rheometer.
To measure the melt viscosity, critical shear stress and critical shear rate, melt compressibility, intrinsic melt viscosity and die swell ratio - by the determinations at different temperatures and under different loads.

E. Methods connected with the use of Polariscope.

a) D 4093. Photoelastic measurements of birefringence and residual strains in transparent or translucent plastic materials.

F. Methods connected with the use of Density Gradient Column.

a) D 2839. Cf. p. D a) above.

b) D 4321. Package yield of plastic film.
Determination of area per unit mass of film. Comprises: column density determination, thickness measurement and weighing with analytical balance.

c) E 252. Thickness of thin foil and film.
Comprises the use of density column, analytical balance and thickness measurement.

Table 2. List of the standardized test methods to be introduced at CIPET, Ahmedabad, after fabrication of some simple devices by the CIPET workshop or purchasing some easily available items (in the sequence of increasing numbers of the relevant ASTM standards)

1. D 543. Resistance of plastics to chemical reagents.
   A set of chemical reagents to be provided. In Procedure I - weight and dimensions changes of specimens are determined. In Procedure II - changes in mechanical properties (mainly - tensile properties) are determined.

2. D 568. Rate of burning of flexible plasticles in a vertical position.
   Sample shield and clamps to be constructed.

3. D 57α. Water absorption of plastics.
   Tests in water at room temperature, at 50° C and in boiling water.

4. D 635. Rate of burning of self-supporting plastics in a horizontal position.
   As test chamber, a laboratory hood is used. A ring stand and burner are sufficient.

5. D 955. Measuring shrinkage from mould dimensions of moulded plastics for compression- and injection-moulding materials.

6. D 1042. Linear dimensional changes of plastics under accelerated service conditions.
   A simple scriber and a measuring microscope of micrometer microscope are used.

7. D 1204. Linear dimensions changes of nonrigid thermoplastic sheeting or film at elevated temperatures.
   Specimens are placed between sheets of heavy paper and exposed to elevated temperature in an oven.

8. D 1239. Resistance of plastics films to extraction by chemicals.
   Six typical chemicals of various classes are used, after immersion for 24 h at 23° C weight loss is determined.

Table 2 - continued

9. D 1435. Outdoor weathering of plastics.
Special racks are to be constructed and situated outdoors. Specimens placed on them are to be systematically observed and tested.

10. D 1622. Apparent density of rigid cellular plastics.
Necessary - analytical balance and micrometer.

11. D 1895. Apparent density, bulk factor and pourability of plastic materials.
Only some special simple funnels and glass cylinders are necessary.

12. D 2842. Water absorption of rigid cellular plastics.
Necessary equipment: analytical balance, immersion tank, underwater weighing jig and micrometer.

13. D 3713. Response of solid plastics to ignition by a small flame.
Necessary: test chamber, burner, timer and flowmeter for air.

14. D 3894. Fire response of rigid cellular plastics using a small corner configuration.
Necessary: a special simple corner construction, burner, gas and air supply and two gas flow meters.

15. D 4202. Thermal stability of PVC resin.
Congo-red methods, very simple devices and chemicals are necessary.

16. E 96. Water vapour transmission of materials.
Six procedures are proposed, differing in conditions of test. Necessary are: test dishes and a test chamber at 32° C.

Table 3. List of the most essential apparatus to be purchased by CIPET, Ahmedabad, with the relevant ASTM standards - to be served ~~xxxxx~~ by these apparatus.

1. Hot air ignition furnace, Model CS 88, Custom Scient. Instr., USA.
   ASTM D 1929 - Ignition properties of plastics

2. IR spectrophotometer with recorder
   ASTM D 2124 - Analysis of components in PVC compounds using IR spectrophotometer
   (This method comprises extraction of compounds, dissolution of resin, centrifugation of inorganic fillers and stabilizers. Each group of components is analysed separately by IR).

3. Drop impact resistance apparatus, Custom Scient. Instr., USA.
   ASTM D 2463. Drop impact resistance of blow moulded thermoplastic containers. Procedures A, B and C. Fixed height or changing height, and % of failures reported.

4. Atlas Xenon Weatherometer, with light and water cycles and xenon-arc type lamps, Atlas Co., Chicago, USA.
   ASTM D 2565 - Operating xenon-arc type light- and water--exposure apparatus for exposure of plastics.

5. Abbe refractometer, with a set of contacting liquids.
   ASTM D 542 - Index of refraction of transparent organic plastics.

6. Brookfield Viscometer Model LVF, with a set of spindles.
   A.o.:
   ASTM 1824 - Apparent viscosity of plastisols and organosols.
   ASTM D 2393 - Viscosity of epoxy resins and related components
   ASTM D 789 - Nylon injection moulding and extrusion materials

7. Equipment for solution viscosity tests, comprising: constant temperature bath, 25-135°C, ±0.02 °C, with at least two transparent walls, two sets of Ubbelohde viscometers with holders, porous glass filter of G2 porosity.
   ASTM D 2857 - Dilute solution viscosity of polymers (a.o.).

Table 3 - continued

8. Taber abraser
ASTM D 1044 - Resistance of transparent plastic materials to abrasion.

9. Rockwell Hardness Tester, with scales R, L, M, E and K.
ASTM D 785 - Rockwell hardness of plastics and electrical insulating materials

10. Temperature recorder, with thermocouples and digital readout.
Many uses, a.o.:
ASTM D 2471 - Gel time and peak exothermic temperature of reacting thermosetting resins.

11. Air-circulating constant temperature oven, Ballenkamp, U.K.
Many uses, a.o.:
D 756 - Weight and shape changes of plastics under accelerated service conditions.
Eight different ageing procedures can be used, differing in time, relative humidity and temperature. Analytical balance and micrometer serve for measurements before and after ageing.
D 2115 - Oven heat stability of PVC compositions.
D 2288 - Weight loss of plasticisers on heating.
D 3801 - Extinguishing characteristics of solid plastics in a vertical position.
Test chamber in the form of an enclosure, air-circulating oven, burner, and stand - are used.

12. Laboratory two-roll mill, for preparing samples of various materials and compositions (e.g. for D 2115) as well as in the development work on new formulations and procedures.

13. Set of Soxhlet extraction apparatus, two sets, Corning Glass Co. No. 3840 or Fisher Scientific Co. No. 9-556, Size B.
D 2222 - Methanol extract of vinyl chloride resins.
D 2765 - Degree of crosslinking of ethylene plastics by solvent extraction
D 3421 - Extraction and analysis of plasticiser mixtures from vinyl chloride plastics.

Table 3 - continued

14. Gas flow meters - 2 pieces
Their use is mentioned in many standards, a.o.: ASTM D 3713, D 3894.

15. Extensometer with a digital readout and recorder - for the Instron tensile machine.
It is necessary for many tensile, compression, shear strength tests (e.g. D 1623, D 2659).

16. Heating chamber for the Instron Tensile Machine.

Table 4. A complete list of new testing methods according to ASTM standards, to be implemented in the CIPET Extension Centre, Ahmedabad, comprising standards mentioned in the Tables 1, 2 and 3

No.	No. of ASTM standard	Group of methods	Group of materials tested	Group of properties tested
1	542	III	A	O
2	543	II	A (–C)	C, M
3	568	II	F	F
4	570	II	A (–C, –F)	C
5	635	II	F	F
6	732	I	M	M
7	756	III	M	C
8	785	III	M	M
9	789	III	PA	M
10	882	I	F	M
11	955	II	M	P
12	1042	II	M	C
13	1204	II	F	C
14	1239	II	F;	C
15	1435	II	A	C, M
16	1504	I	F	P
17	1622	II	CR	D
18	1623	I	CR;	M
19	1746	I	F	O
20	1822	I	M	M
21	1824	III	L	M
22	1870	III	A	C, M
23	1893	I	F	M
24	1895	II	MP	D
25	1929	III	M	F
26	1938	I	F	M
27	2115	III	PVC	C
28	2124	III	PVC	C
29	2222	II	PVC	C
30	2228	III	PVC	C
31	2288	III	PVC	C

Table 4 - continued

32	2393	III	L	M
33	2463	III	TP	M
34	2471	III	TS	P
35	2565	III	A	C
36	2659	I	TP	M
37	2765	III	PE	P
38	2839	I	PE	D
39	2842	II	CR	C
40	2857	III	A	M
41	3351	I	F	O
42	3421	II	PVC	C
43	3713	II	M	F
44	3801	III	M	F
45	3835	I	TP	P
46	3894	II	CR	F
47	4093	I	F, M	O
48	4202	II	PVC	C
49	4321	I	F	D
50	E 96	II	F	C
51	E 252	I	F	D

Explanations of symbols used in the Table:

A. Group of methods:

I - new methods with available facilities (cf. Table 1)

II - new methods requiring construction of additional devices at CIPET, Ahmedabad (cf. Table 2)

III - new methods available after procurement of equipment items listed in Table 3.

B. Group of materials tested:

A - all types
CR - cellular, rigid
F - film, foil and sheeting
L - liquid resins and formulations
M - moulded plastic, not cellular
MP - moulding powders and compounds, before processing

PA - polyamides
PE - polyethylenes
PVC - polyvinyl chloride
TP - thermoplastics
TS - thermosets

C. Group of properties tested:

C - chemical, water, weathering and ageing resistance
D - density
F - flammability
M - mechanical and rheological properties, viscosity
O - optical properties of transparent materials
P - processing properties

Table 5. Summary of the numbers of new methods proposed (cf. to Table 4 for data and explanations of symbols)

A. According to the group of test methods:

I	-	15
II	-	18
III	-	18 .

B. According to group of materials tested:

A	-	7
CR	-	4
F	-	14
L	-	2
M	-	10
MP	-	1
PA	-	1
PE	-	2
PVC	-	7
TP	-	3
TS	-	1

C. According to group of properties tested:

C	-	18
D	-	5
F	-	6
M	-	16
O	-	4
P	-	5

Table 6. Standards and Books recommended for the Library of the CIPET Extension Centre Ahmedabad

1. Annual Books of ASTM Standards, Parts 09.01 and 09.02 - Rubber.
2. All the ISO Standards issued by the TC/61 - Plastics and TC/ - Pipes.
3. Presentation and use of data on the mechanical properties of thermoplastics. Technical Service Note G 123, ICI Plastics Div., Herts 1979.
4. Standard Test Procedure for determining plasticizing (plasticating) performance of screw injection machines. Soc. Plast. Ind., New York, 1967.
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