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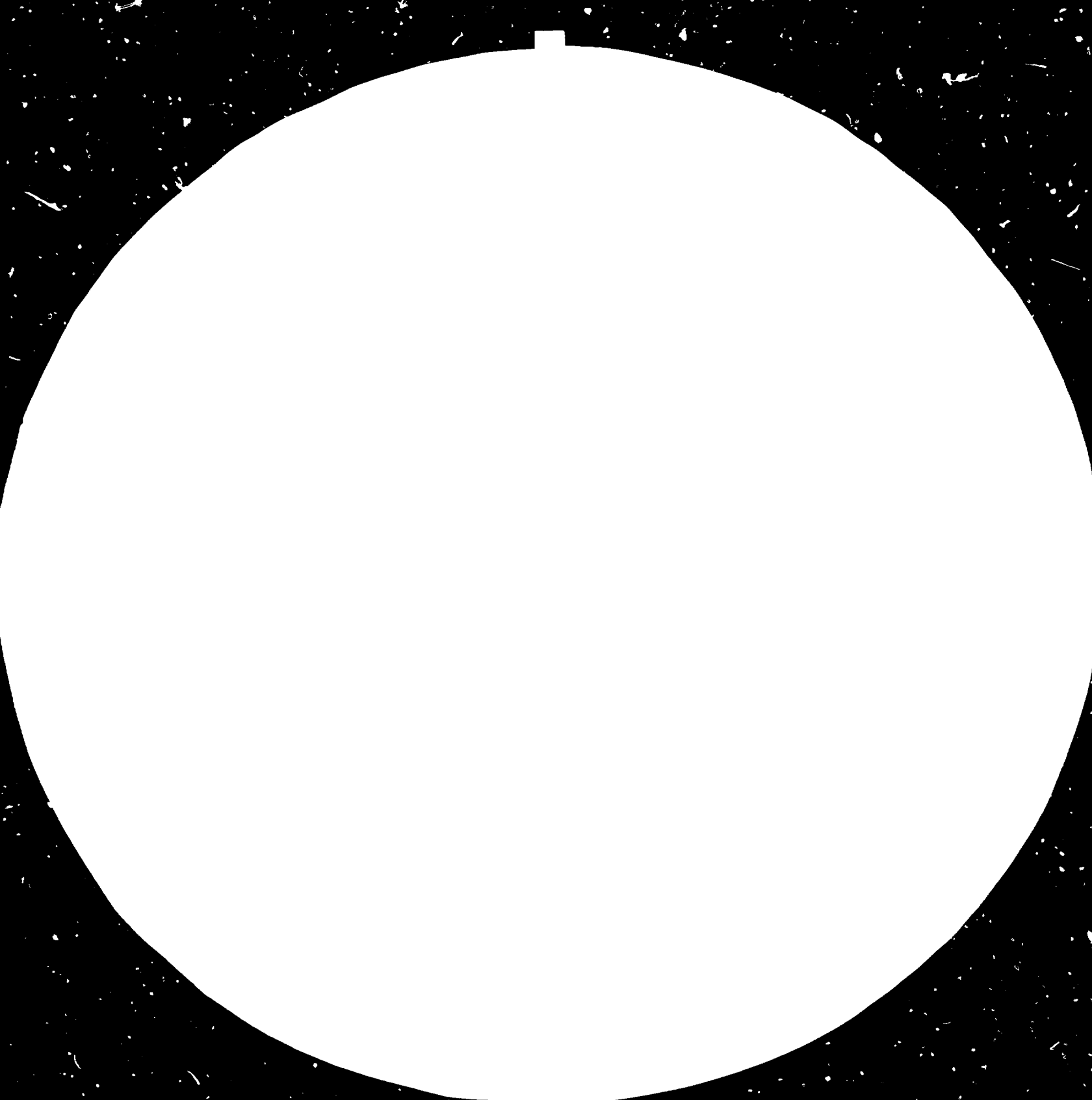


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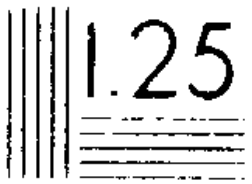
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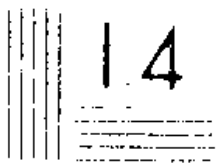
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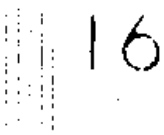
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April 1984
English

PILOT PLASTICS PROCESSING, TESTING, TRAINING AND INFORMATION CENTRE("PLASTICS TECHNOLOGY CENTRE")

PHASE I & PHASE II

DP/BGD/72/025 and DP/BGD/77/025

B A N G L A D E S H

Terminal report

Prepared for the Government of Bangladesh by the United Nations Industrial Development Organization, executing agency for the United Nations Development Programme.

Based on the work of B.W. Misterek
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United Nations Industrial Development Organization
Vienna

I. EXPLANATORY NOTES

(1) Reference to dollars ($) are to United States dollars.

(2) The monetary unit in Bangladesh is the Taka (T). During the period covered by the report mean value of the Taka in relation to the United States dollars was US$ 1.00=T 19.50.

(3) A slash between dates (e.g. 1980/81) indicated a financial (fiscal) year or academic year.

(4) Use of a hyphen between dates (e.g. 1978-1984) indicates the full period involved, including the beginning and end years.

(5) A full stop (.) is used to indicate decimals.

(6) A comma (,) is used to distinguish thousands and millions.

(7) The following abbreviations of organizations are used in this publication:

BITAC - Bangladesh Industrial Technical Assistance Centre
PTC or
Centre - Plastics Technology Centre
BUET - Bangladesh University of Engineering and Technology
BCIC - Bangladesh Chemical Industries Corporation
BTMC - Bangladesh Textile Mills Corporation
BJMC - Bangladesh Jute Mills Corporation

United Nations Bodies:
UNDP - United Nations Development Programme
UNIDO - United Nations Industrial Development Organization

The following abbreviations of plastics names are used in this publication:

Pe - polyethylene
pvc- polyvinyl chloride
hd polyethylene - high density polyethylene
ld polyethylene - low density polyethylene

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uhmw, hd polyethylene - ultra high molecular weight, high density polyethylene

FRP - fibre reinforced plastics

GRP - glass fibre reinforced polyesters

XPS - expanded polystyrene

(8) Symbols of United Nations documents are composed of capital letters combined with figures, e.g. DP/BGD/77/025. Mention of such a symbol indicates a reference to a United Nations document.

(9) Countries are referred to by the names that were in official use at the time the relevant data were collected.

(10) The papers were reproduced in the form in which they were received; only typographical errors and errors of fact or terminology have been corrected.

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(12) The views expressed in this paper are those of the author and do not necessarily reflect the views of the secretariat of UNIDO.

II. A B S T R A C T

Pilot Plastics Processing, Testing, Training and Information Centre ("PLASTICS TECHNOLOGY CENTRE") is a UNDP/UNIDO Project operating under BGD/72/025 during the years 1974-1978 and, as the second phase, under BGD/77/025 during years 1978-1984. The purpose of the project to create the technical assistance unit to the plastics processors and users in Bangladesh. Now the 2nd project phase has been completed successfully in general, only mould making activities of BITAC were too much delayed for becoming developed up to schedule. The third phase of the project (BGD/81/032) will start immediately with the following recommendations: to expand Plastics Technology Centre staffwise including one new economist, to find the way for increasing salary scale for Centre staff, to speed up the mould expert assistance mission to BITAC, to expand training programme for plastics users and processors, to reduce further the custom taxes on plastics raw materials.

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IV. INTRODUCTION

A. Project background

The establishment of "Plastics Technology Centre" or " Demonstration Documentation and Training Centre for Plastics Processing" (Centre) was first proposed in the frame of recommendations of the Special Fund Project PAK-26 "Pre-investment Studies for the Promotion of Fertilizer and Petrochemical Industries". The proposal was contained in paragraph 7.2 of the Final Report (UNIDO/TCD 70, dated October 1971) of the above project. The recommended location for the Centre was the then Pakistan Industrial Technical Assistance Centre (PITAC), the predecessor of present Bangladesh Industrial Technical Assistance Centre (BITAC) in Dhaka.

The proposal was included in the work programme of the above project PAK-26 and accordingly plastics processing equipment costing about US$ 30,000 was arranged for the scheduled Centre. During the events of 1971, the just delivered equipment was heavily damaged.

On the request of the Bangladesh Government of 1972 the next activities started in the frame of Project DP/BGD/72/025 "Pilot Plastics Processing, Demonstration & Training Centre" with the preparatory mission of Mr. M.C. Verghese, Chief, Fertilizers, Pesticides and Petrochemicals Industries Section, UNIDO in August 1973. The mission resulted in recommendations suggesting a 2-phase project, with the UNDP inputs of US$ 630,584 (including 108 m/m expert services) for the 1st phase and US$ 300,000 (including 48 m/m expert services) for the 2nd phase. The eventually signed in July 1974 1st phase Project Document covered UNDP inputs of US$ 160,618 (including 26 m/m expert services) with the later amendments increasing UNDP inputs to US$ 245,424 (30.6 m/m expert services). The government inputs were estimated on the level of Taka 850,000 (actually spent US$93,000 equivalent*). The immediate objective of the 1st phase was to complete the establishment of the Centre with the main functions: assistance to industry in improving processes and utilization of equipment, introduction of standardization, quality control and testing of plastics materials advising on new materials and technology and training of personnel for industry.

* during the years 1974-78 Taka lost about 50% of value to US$.

The project was justified by the wide, but underdeveloped plastics industry in the country (lacking trained staff, poor mould making capacity, out-dated and under utilized equipment, poor product quality and Government intentions of developing local plastics raw material manufacture (Polyvinyl Chloride and Polyacrylnitrite factory). The 1st phase project (originally intended for 2 years and 8 months) was completed in March 1978 and was followed immediately by 2nd phase project starting in April 1978. Since there was no gap between the both phases and the 2nd phase was to some extent just the further development and extension of the 1st phase, it was decided not to arrange any formal termination (with terminal report, handing over the equipment to the Government etc.) of the latter, but to convert it directly into 2nd phase project. The 2nd phase project was introduced in April 1978 with the initial UN inputs scheduled for US$ 398,100 (including 28 m/m expert services), risen gradually up to US$ 1,152,583 (including 54.3 m/m expert services). The government inputs were scheduled Taka 7,262,000 and Taka 7,588,664 (equivalent to US$ 297,478) have been spent actually. The objectives of the 2nd phase project were: expansion of Plastics Technology Centre and its services to the industry, improvement of mould making capacity at BITAC, development of plastics application in selected industries and introduction of specialized teaching on plastics at the Bangladesh University of Engineering and Technology (BUET). The 2nd phase project was originally scheduled for 4 years, but its implementation was delayed; for that reason the project duration was gradually extended up to 5 years and 11 months.

B. Official arrangements

The assistance in the frame of the project was requested by Bangladesh Government in 1972. The 1st phase project document was eventually approved on 19.6.1974 on behalf of the Government and on 2.7.1974 on behalf of UNIDO and UNDP. After a few short missions of experts the project became fully operational only in 1977 when the local counterparts became available (after 1 year training) and the both plastics testing and processing experts joined the project for longer assignment. The 1st phase project continued

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to operate till April 1978 and was converted into 2nd phase at that time. The 2nd phase project document was signed retroactively on behalf of the government on 20.6.1978, on behalf of UNIDO on 12.5.1978 (a cable authorization) and on behalf of UNDP on 27.6.1978. The 2nd phase project became operational from April 1978 and continued for 5 years and 11 months. The 2nd phase project was completed at the end of February 1984 and converted into 3rd phase project at that time, awaiting still for retroactive approval of the Government.

C. Contributions

Contributions to the 1st phase project:

The originally scheduled UNDP contribution to the 1st phase project was (according to the Project Document) US$ 160,618. This amount was gradually risen up to US$ 245,424 (final budget revision K) for the following reasons:

1. Personnel expenditures were almost doubled because of increased experts man-month cost US$ 4600 at the end of the project, against scheduled US$ 2500 and because of increase in experts participation (actual 30.6 m/m instead of scheduled 26 m/m).

2. Training costs were increased by 150% because of increased training time (actually 33 m/m instead of scheduled 18 m/m) and increased cost of 1 m/m training.

3. Investment (equipment) costs were increased by almost 7% (additional purchase of hydraulic press and spare parts).

4. Miscellaneous costs were, however, reduced by US$ 1?00.

The Government contribution to the 1st phase project was scheduled Taka 850,000. The actual contributions totalled US$ equivalent to 93,000 (ca' Taka 1,488,000 according to the exchange rate at the end of the 1st phase project) and consisted of 30% of contribution in kind (land and building) and of 70% of cash support (salaries, equipment, operational costs).

Contributions to the 2nd phase project:

The originally scheduled UNDP contribution to the 2nd phase project was US$398,100 and consisted of 34.7% of personnel costs, of 25.3% of training costs and of 38.8% of equipment costs. Actual contributions rose up to US$ 1,147,438 (budget revision F) and consisted of 28.3% for personnel, 45.6% for training and 24.3% for equipment.

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The high increase of all project costs was caused by the following factors:

1. in personnel costs (135,4% increase) the experts' participation in the project was extended by 94% (54.3 m/m instead of scheduled 28 m/m). The extended project duration (5 years 11 months instead of intended 4 years) influenced also the cost of 1 m/m experts' assistance due to routine progression (US$ 4400 in 1978, US$ 6,250 in 1984).

2. in training costs (419% increase) the duration of individual fellowship for the Centre staff was extended and the actual study tour programme was much richer, than anticipated (study tours for the Centre staff only were scheduled originally). The main reason however of the high increase in training costs was related to the radical change of fellowship costs at CIPET, Madras - the training institution for mould making personnel of BITAC (411 m/m in total).

3. in equipment costs (81% increase) the actual purchasing programme extended the scheduled one for the both testing and processing equipment, as well as for the books to the library, and for mould making equipment, instrumentation and materials. On the other hand however the equipment prices were much high than anticipated due to the sharp rise of machinery and instrumentation prices during project implementation.

The Government contribution to the 2nd phase project was originally scheduled Taka 7,262,000. The actual expenditures reached the level of US$ equivalent 297,478 (Taka 7,588,664 according to the exchange rate at the end of the project) and consisted of 23.4% in kind (land, building, equipment) and of 76.6% in cash support (salaries, equipment, operational costs).

D. Objectives of the project

The long range (development) objective of the 1st phase project (DP/BGD/72/025) was referring to the Government plan to develop a large petrochemical industry based on natural gas. The success of this plan was linked to the growth of

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the plastics processing industry considered to be the major consumer of petrochemical end-products. The Centre was intended "to strengthen and support the expansion of the Bangladesh plastics processing industry to enable it (a) to continue further import substitution (b) to develop a strong and vigorous export market and (c) to broaden the technological applications still to be developed in Bangladesh e.g. the use of plastics in agriculture and in housing".

The immediate objective of the project was "to complete the establishment of the Centre which main functions will be:

a) Application of research findings in plastics technology to improve processes and the utilization of equipment;

b) Introduction of standardization, quality control and testing of plastics materials such as - phenolics, PVC, polyethylene, polystyrene, polypropylene and amino plastics as well as of semi-finished and finished articles made by injection, compression, blow moulding, extrusion, vacuum forming and glass fibre/resin lamination;

c) Advising on new materials and technology which might be suitable for adaptation to the plastics industry in Bangladesh and on the application of plastics in various industries which are the consumers of plastics materials;

d) Training of personnel for industry.

During implementation of the 1st phase project it became evident that the Government plan of developing large petrochemical industry may be postponed but the market oriented plastics processing industry's development should be assured. It became also evident that the Plastics Technology Centre, if operated at the scale intended at the beginning (three young engineers assisted by 2 technical staff members) and left alone will not be able to survive; not speaking about further development and effective assistance to the industry.

The plastics processing industry on its own was suffering from lacking personnel with basic knowledge on plastics from limited mould availability (only imported or very primitive local moulds were available) and from the unfavourable economic situation (the Government high tax system combined with limited low buying capacity, market created conditions in which the most

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manufacturers could not operate in profitable way).

The above statements led to the decision of extending the project by the second phase which would be utilized for further development of Plastics Technology Centre as well as for developing plastics mould making activities and specialized teaching on plastics (university level). The direct training support to the plastics using industries was intended to be initiated in the frame of the 2nd phase project as well.

The development objective of the 2nd phase project (DP/BGD/77/025) was to "increase import substitution in the plastics industry in Bangladesh and to enable the industry to compete in export markets". This was intended to be achieved "through increasing the efficiency of the industry, improving the quality and quantity of products produced, and increasing the range of products manufactured in accordance with domestic needs and world trends. Increased efficiency will also involve the introduction as appropriate of new materials and processing methods".

The immediate objectives of the 2nd phase project were:

a) To expend the existing capacity of the Plastics Technology Centre at BITAC in the fields of plastics processing, testing and training so that it is able to :

1. meet the plastics industry's requirements for testing of plastics raw materials and products and develop and introduce in industry standardized testing methods;
2. provide consultancy services to the plastics industry in plastics processing, testing and new product development,
3. offer up-todate technical literature to industry,
4. develop selected new products and production processes on a trial production basis,
5. train skilled workers in plastics processing and testing,
6. organize lectures and discussions, films and demonstrations on plastics manufacture.

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b) To improve BITAC's capacity to make metal moulds and dies for plastics processing so that:

1. imports of moulds and dies could be eliminated,
2. the plastics industry can increase the range of products produced,
3. skilled workers in the plastics industry can be trained at BITAC in mould manufacture and maintenance.

c) To enable the Plastics Technology Centre to develop certain new products for the chemical and jute industries so that:

1. a corrosion protection service is set up for the chemical industry,
2. an increased range of locally manufactured plastics spare parts are available for the jute industry.

d) To enable the Bangladesh University of Engineering and Technology to introduce specialized teaching in plastics technology".

When comparing the development objectives and immediate objectives of the both project phases it may be easily concluded that the second phase was the logical continuation of the first phase project.

The intention of replacing plastics product import by local plastics processing industry was fully understandable because in early seventies the most of plastics products (pvc pipe, machine spare parts, household articles etc) were imported. On the other hand the intention of developing "a strong and vigorous export market" for plastics products seemed to be a bit risky from the beginning, if taking into account the limited local availability of natural resources for plastics manufacture and the existence of more plastics developed countries in the region (India, Thailand, Malaysia, Singapore). It became almost impossible when the government postponed the development of local petrochemical based plastics raw material manufacture. Actually only in a few exceptional cases of specialized products (power cables) exporting trade was successful.

Nevertheless the creation of Plastics Technology Centre and development of its assistance to the industry was the only way for technical upgradation of plastics processing industry in Bangladesh.

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V. ACTIVITIES CARRIED OUT AND OUTPUTS PRODUCED

A. Activities and outputs of 1st phase project (DP/BGD/72/025)

Preparatory activities and outputs related

Construction of building.

The building for Plastics Technology Centre has been constructed within BITAC premises in 1974. The space of building is 4080 sq. feet(almost 380 m^2) with double level structure 1/3 of its surface is serving properly its purpose from the beginning, accomodating under one roof all the Centre's property, staff and operations. There is still some free space in the building for accomodating the additional testing and processing equipment and additional staff, if required.

Delivery of machinery elements for replacement of broken/missing ones, putting existing machinery in operating condition.

Some elements to Angel injection moulding machine have been delivered. As the effect of Mr. Gattinger's and Mr. Rossi's short missions in 1975 (Appendix 1) the injection moulding machine has been put into operation provisionally (simplified mode) and Polyspray 11M-A gel-coat spraying unit tested with water.

Selection of additional equipment.

Plastics testing laboratory equipment has been selected (and subsequently ordered and delivered in 1976/77) during Mr. Laaly's short mission in 1975 (Appendix 1).

Project implementation activities and outputs related

Appointment of experts (See appendix 1).

The both plastics processing engineer and plastics testing specialist were appointed simultaneously in May 1976. Unfortunately the former's mission failed due to health reasons and finally death; the follower started his duty only in February 1977. Plastics testing expert's 12 months mission has been split into 7 months in 1976 and 5 months in 1977; thanks to it he worked during his second mission together with plastics processing expert and one project counterpart who returned already from his training at that time. The new plastics processing expert on his own spent the 1 year

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mission (extended later by 1.6 months up to the end of the 1st phase) with the project, working all the time with the project counterpart (after his returning from training in U.K.).

Most of the project activities were perfomed during the both experts' missions to the project.

Appointment of project counterpart staff (see Appendix 2).

Two mechanical engineers were selected for the project in 1975. The third counterpart, a Senior Supervisor was additionally selected in 1976 as the counterpart to plastics testing expert in 1976. The counterpart staff was additionally supported by 2 technicians.

Training of project counterpart staff (see Appendix 3).

Two mechanical engineers have been granted fellowships in plastics testing and plastics processing in U.K. in 1975 before starting their activities in the project. The counterparts were extensively trained in their fields of operation by experts in the frame of Centre's activities (reported later). The Senior Supervisor was sent for training at the end of 1st phase and failed to return after completing it. Later (in September 1978) also the mechanical engineer specialised in plastics processing left the project for better job abroad. As a result only one trained counterpart remained in the project. Final effects of the fellowship programme of the 1st phase have been heavily affected by the separation of 2 counterparts (during absence of experts the project was closed to collapse in 1978).

Delivery and putting into operation the processing and testing equipment at the Centre.

Not only the previously delivered machinery, but also the currently shipped equipment suffered heavy damage during transportation (in some case the full replacement was necessary). All the broken or missing elements were identified and repaired or manufactured locally, if possible. In the cases of failure the cooperation with manufacturers was arranged for the additional delivery. Each unit was thoroughly cleaned, its individual functional and control systems put into operation one by one and finally the whole unit commissioned. In some cases the machines were evidently upgraded during this procedure (better shock absorbing system of vacuum forming machine, more versatile and useful programming

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of inj tion moulding machine). The most essential effect of the described procedure was that the counterparts were made used to it and able to follow it successfully in the case of any future need in the Centre or in the industry. They were also made perfectly familiar with all the machinery components and systems and able to maintain them or repair in the case of need.

As the final effect of discussed procedure all the equipment of the Centre (Appendix 4) was made fully operational and could be used in processing or testing activities of the Centre. Unfortunately not all the processing machines and testing instruments specified and ordered before 1976 met the local demands and for that reason some of them (Polyspray units, accelerated aging oven etc) were not utilized.

On the other hand the local needs identified by experts resulted in additional ordering of processing and testing equipment, delivered later in the frame of 1st and 2nd phase projects.

Standard furniture, some special arrangements in the building (airconditioning in testing laboratory rooms, concrete benches for testing instruments, book shelves for the library etc), laboratory testing equipment (glass ware, water destillation plant etc) and processing equipment (spare or missing machine parts, tools and moulds) were required for the proper functioning of the Centre. They were all provided by the Government budget using local purchase from the market or manufactured by BITAC (Appendix 5 lists the non-expendable technical deliveries in detail).

Delivery of documentation.

The books on plastics were selected and ordered via UNIDO, the local subscription of plastics journals was initiated (but never became fully reliable). In the effect a library at the Centre could be organized with the amount of 53 volumes at the end of the 1st phase. This collection was extended by many catalogues, leaflets, booklets etc., collected from suppliers of raw materials and processing machinery or their local representatives). They lent also to the Centre 11 films on plastics, being utilized in film shows and conferences for the industry. Plastics raw material suppliers and local processors supplied also the Centre with some samples of plastics products; the resulting permanent exhibition is showing the existing and possible applications of plastics in Bangladesh. All the (listed above) means of disseminating knowledge on plastics were offered to the industry and other

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authorities for improving their technical skill and developing their interest in modern technology.

Activities in plastics testing.

Plastics testing services were offered by the Centre free of charge to the local industry. Standard testing methods based on already delivered equipment were introduced (Appendix 6), some additional testing methods (determination of PVC heat stability, natural aging) were selected for introduction on the basis of equipment locally purchased or manufactured at BITAC. The most of the available testing methods have been standardized by the Centre and approved by Bangladesh Standard Institution (Appendix 6). In spite of existing possibilities the actual utilisation by the industry of offered testing services was well below the Centre's capacity. This was the effect of stagnant situation in plastics industry, lacking technical knowledge and interest in product quality improvement, very poor quality of market products and limited competition on the market. In addition to occasional testing services the Centre initiated and conducted some more complex testing programmes: assessment of applicability of local urea formaldehyde moulding powder for electrical component manufacture (negative result), quality testing and improvement of locally manufactured PVC pipe, quality assessment of locally manufactured jute/glass fibre/polyester laminates.

The existing demand for some additional testing methods (and equipment) was identified for being met during 2nd phase project implementation (mechanical properties, plasticiser content in plasticised PVC compounds, hardness etc.).

Activities in plastics processing.

The equipment available for plastics processing was very limited (only vacuum forming machine and injection moulding machines were applicable); its applicability was further limited by the poor mould availability. The both machines were used for practical demonstrations mostly; in the case of injection moulding however the existing mould has been modified for demonstrating modern modifications of injection moulding (flow moulding, structural foam injection). Vacuum forming machine, on the other hand was used for experimental development of the most useful shape of the field latrine pan (cooperation with UNICEF); several moulds have been made and the prototype pans moulded on them for practical evaluation. The finally selected pan shapes was later used by UNICEF on the mass

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scale manufacture of latrines (not using plastics in this country, however); the same shape has been followed by some plastics latrine plan manufacturer in Malaysia (actually this development work on latrine pans was completed in the frame of 2nd phase project). The other plastics processing activities were performed in the processing industries. They consisted usually of assistance in solving current problems identified during visiting the factories by the staff of the Centre, or risen by the industrial staff. The most frequent problem solutions assisted by the Centre were concerning:

a) improving the operation of plastics processing machinery and putting into operation abandoned units,

b) rationalization and improvement of technological processes in existing manufacture for higher output,

c) proper selection of raw material for the specified product manufacture,

d) identification of market demand for new plastics products,

e) selection of proper machinery for new investments in plastics processing industry.

The assisted factories totalled 30 (Appendix 7), assistance to 15 of them were rather occasional, but the rest continued the cooperation links with the Centre.

In some cases the assistance in plastics processing to the local manufacturers helped to channelize the Centre's assistance in other activities (testing, technical information), involving them into more complex assistance programme.

The range of the most important processing assistance covered pvc processing (pipe, cables, footware, leather cloth etc.), polyester/fibre laminates, processing of local urea-formaldehyde and melamine-formaldehyde moulding powders, etc.

The effects of plastics processing activities were not always satisfactory. Sometimes the existing equipment was so much outdated, that no technical development was possible. Sometimes the market limitations or poor availability of moulds hampered the possible manufacturing development. But in most cases the effects of technical assistance to the plastics processing industry were limited by lacking technical and industrial tradition of the industrial staff,

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limited interest in technical development and lacking understanding for product quality problems.

Other activities in plastics field.

The Centre started the assistance to plastics users (developed later during the 2nd phase project). They were supported by advice on proper raw material selection, local manufacturing possibility, suggested adjustment of product shape to requirements of moulding process. These contacts helped to identify the most essential fields of plastics application in the country; on the other hand the Centre started to play a role of contacting point to local plastics processors and users.

The contacts with the Government institutions (Industrial Corporations, Bangladesh Standard Institution, Central Testing Laboratory) helped the Centre to develop testing activities, to get the approvement of prepared standards and to identify the fields of future operations.

B. Activities and outputs of 2nd phase project (DP/BGD/77/025)

Activities and outputs related to increase in the capacity of Plastics Technology Centre.

Establishment of technical documentation unit at the Centre. Gradually 252 new books have been selected, ordered and delivered to the Centre's library (totalling 305 *). The same applies to 15 journals, and many conference papers althougn their delivery never became very regular. The Centre imported also 5 sets of slides on plastics processing technology as well as on processing equipment and procured many catalogues, brochures, leaflets etc., from manufacturers of plastics raw materials and processing machinery. These sources of information were supported with new audio-visual equipment (slide projector, 2 film projectors) and plain paper photostat copying machine, as well as the expanded collection of plastics raw materials, domestic and foreign plastics products, etc. The resulting documentation unit's services are available to all the visitors free of cost (including the free copies of any fragments of books or journals according to request); they are also utilized for organizing seminars, lectures, teaching at BUET and individual discussions. They are intended to be utilized for supporting group training activities of the Centre (in preparation) as well.

* including 53 books procured during the 1st phase

Additional plastics processing facilities available in the Centre (Appendixes 4&5). New Plastics processing equipment has been selected, ordered, delivered, commissioned and put into operation at the Centre. Not only all the machines listed in the Project Document have been procured (fluidized bed coating unit has been made locally at BITAC instead of being imported), but the scrap granulator was additionally imported. The capacity of existing processing machines (old and new) was increased and diversified by the locally manufactured (at BITAC) injection moulds, compression moulds and entrusion die (Appendix 5). All the new equipment (as well as the equipment procured during 1st phase) has been used for practical demonstrations, for development of new products, for experimental production and even for commercial manufacture.The accidental failures in machinery operation were currently identified and their causes eliminated. In the case of need the construction of processing machines and their control systems were improved (timers in vacuum forming machine, pipe extrusion equipment).

Additional testing facilities available at the Centre (Appendixes 4 & 5).
New testing instruments have been selected, ordered by UNIDO, delivered and put into operation. Not only all the instruments listed in the Project Document, but also some additional ones (photoelectric reflectometer, hardness meter and tester, high capacity airconditioner) were procured in that way. The testing equipment was further extended by locally made units at BITAC: two moulds for preparation of test specimen, natural aging stand and many spares to the imported equipment.

All the testing equipment was offered for free plastics testing services to the local industry. It is however necessary to mention about difficulties with maintaining the equipment in operational status (this applies to the processing equipment to some extent as well). Unfortunately in some cases (laboratory oven of Gallenkamp, universal mechanical tester of Instron) the delivered equipment was not of the proper quality - the instruments had faults in their construction and/or control systems causing failures during operation. In some cases (Instron) the manufacturer did not even respond to the requests for assistance in putting the instrument into operational status.

Staff Development.

Due to limited resources and limited absorbing capacity of the Centre the new counterparts could be employed only gradually. It required 5 years for completing the staff of 6 graduates (Appendix 2), and 3 technical assistants (the increase by 5 graduates and 1 technical assistant). They were all young absolvents of technical university (or secondary school) without any experience or theoretical knowledge on plastics. They started immediately to participate in Centre's activities, collecting the practical experience in their field of operation. After being nominated for fellowships (unfortunately the Government nomination procedure required sometimes more than 1 year), they have been sent for

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training to UK (with the exception of recently employed physicist for machinery control systems). Three of them already completed their fellowships and after returning joined the Centre's activities. The counterpart staff was further trained during participation in the operations of the Centre as well as in the frame of study tours organized jointly for the Centre's and industry's personnel (Appendix 8). Unfortunately only 2 engineers for plastics processing have been employed by the counterpart instead of scheduled 3; 1 physicist specialized in applied electronics has been, however employed instead for caring about complicated control systems of processing and testing equipment of the Centre and in the industry.

Development of new testing methods and introducing them in selected industries.

Nineteen new testing methods were introduced to the plastics testing activities of the Centre (Appendix 6). They were related to the imported or locally procured testing equipment. The introduced methods were based on foreign standards; at the beginning local standards have been prepared on the base of foreign standards and officially approved, but later this procedure was not used because of very limited utilization of introduced methods.

Unfortunately the possibilities of introduction of testing methods to the industry were very limited because of lacking industrial interest in product quality testing. Only in very few individual cases the manufacturers followed the suggestion of introducing some routine testing of their products("Lira" of pvc pipe, "Plasticam" of containers). The most manufacturers didn't even make use of testing services of the Centre offered to them free of cost. For that reason the plastics testing capacity of the Centre remained underutilized during the 2nd phase (some testing methods offered to industry were not utilized at all (Appendix 6).

Trial productions at the Centre of selected new products and new processes. The following new processes were introduced to the operations of the Centre :

a) compression moulding of thermoplastics.
b) compression moulding of u.h.m.w.h.d. polyethylene
c) extrusion of polyethylene pipe.

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d) injection moulding of structural foam
e) ultrasonic welding of plastics elements
f) fluidized bed powder coating of metal elements.
g) dehumidification of plastics prior to processing

Compression moulding of thermoplastics is applicable only to the manufacture of small plates being utilized for preparation of testing specimens For that reason it found only internal application in the Centre as the initial step of raw material testing procedure. Compression moulding of uhmw, hd polyethylene was first experienced in the Centre for experimental manufacture of pickers for jute looms, intended to replace imported ones. The know-how of this product manufacture (after proper product testing) was made available to plastics processors (Bengal Plastics Industries, Continental Progressive Industries, Texpick Industries) who are preparing their facilities for commercial scale manufacture. The same technology was utilized by Habib Plastics Ind. for manufacture of sheet used for fabrication of other pickers by machining. Compression moulding of the same material is also used (according to the Centre's suggestion) by Texpick Industries for making discs; when turned later in a special way on the lathe, the resulting "scrap" has the shape of continuous belt. This belt is replacing another imported spare part to jute looms. Extrusion of hd polyethylene pipe is utilized at the moment as the experimental process in the Centre only. This process is used for demonstration to the may-be manufacturers and users of polyethylene pipe and for the manufacture of experimental quantities of pipe (4 different pipe grades are made available) for practical experiments on application for gas and water distribution lines. These experiments may be followed by the considerable demand for polyethylene pipe, but the extensive experimental application programme should be conducted first.

Injection moulding of structural foam has been introduced at the moment in the Centre only and used there for demonstrations. There is no evident demand for this technology at the moment because of limited market capacity.

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Injection moulding of structural foam has been introduced at the moment in the Centre only and used there for demonstrations. There is no evident demand for this technology at the moment because of limited market capacity.

Ultrasonic welding of thermoplastics was introduced to the Centre processing activities only and used for demonstration of this new technology. Unfortunately the industry is not developed enough yet to absorb this advanced technology and to purchase costly equipment required.

Fluidized bed powder coating was introduced in the Centre for experimental and demonstration purpose. For that reason special equipment has been manufactured locally. Unfortunately the proper application for commercial utilization of this method couldn't be found yet.

Dehumidification of plastics prior to processing has been introduced to the Centre's operations and frequently used (injection moulding of polyamide, extrusion of black polyethylene pipe). It is also used for demonstrations to the customers interested in processing of moisure absorbing plastics.

As far as new products is concerned, the Centre depends on the mould availability, very limited until the last year (when BITAC's mould making started).

Besides the already mentioned manufacture of pickers of uhmw, hd polyethylene (the experimental manufacture was followed by extensive practical application evaluation; now the know-how transfer to the industry is in process), the Centre started the commercial manufacture of replaceable polyamide bushes for the pickers (already almost 60,000 pieces sold). The other polyamide product - a special roller for jute loom was already manufactured in experimental quantity and after practical evaluation the small scale commercial manufacture will follow. The other commercial manufacture - hd polyethylene sancers (more than 7000 already) is run just for utilization of improted mould.

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HD Polyethylene pipes are being extruded in 2 sizes using both imported and local die (in fact the local one, designed at the Centre is better). It proves, that the Centre is able to manufacture any size pipe (within extruder limit) according to order.

Proposal for limited number of new applications of plastics.
New applications of plastics were introduced in colaboration with plastics users and sometimes with plastics processors as well (when manufacture of the product was intended by them). In colaboration with the World Bank and Lira the manufacture of ribbed pvc pipe (for the production of water filters) was introduced in Lira.

Power Development Board was suggested to replace imported polycarbonate power distribution boxes by locally manufactured GRP boxes. Local manufacture started in Jute Plastic Plant Commercial with the assistance of the Centre (already 4,000 pieces were produced).

The application of blown hd polyethylene containers as replacement of vulcanised fibre/steel sliver cans in jute and cotton mills was suggested and specially imported containers were submitted extensive practical evaluation. The results of experimental testing (more, than 1 year) are satisfying and the commercial manufacture may be introduced later (new equipment will be required).

HD Polyethylene pipes were suggested to the local gas authorities for natural gas distribution lines. The suggestion is under consideration, but the decision (if positive) will require previous extensive applicability testing - in this field the assistance of the Centre will be required.

The other possibility of hd polyethylene pipe application - for transportation of water in irrigation systems is not yet meeting interest of agriculture authorities.

Co-operation with plastics processors, users and other institutions.

This is the most developed field of Centre's activities involving most of its capacity. During the 2nd phase the Centre had more than 560 visitors; at least the same number of visits was paid by Centre's staff

to the customers. Not taking into account the accidental or single contacts with the customers (sometimes sufficient for solving their problems) the Centre colaborated with (Appendix 7) : 68 product manufacturers, 16 plastics users, 14 raw material suppliers, 25 Government authorities and other instututions, 2 foreign training/ educational institutions. The assistance (colaboration) covered the following fields:

a. assistance to the new investors in plastics processing. The Cnetre assisted them in selection and rationalization of intended manufacturing programme, in selection of proper machinery, in selection of proper raw materials and technology, in mould design, in building design and machinery layout, in solving the problems of power supply, water cooling etc. The Cnetre assisted also the industry in comissioning, installation and putting into operation the new machinery, in staff training in proper machine operation and utilization. The Centre tried also to assist them in introduction of raw material and final product quality testing, but (with the exception of a few cases) without much success.

b. assistance to established plastics processors. In addition to many of the above functions (manufacturing programme rationalization, selection of raw materials trouble shooting, staff training, quality testing) the Centre was often requested to assist in putting into operation the abandoned machinery (not being utilized during the last decade).

There should be listed here : 350 t clamping force injection moulding machine (the biggest in the country at that time) and a big vacuum forming machine at Mehar Industries and slit die pvc film extrusion equipment at Bella Artifitex - they have been all put into operation thanks to the assistance of the Centre : unfortunately the long period of " desinvestment " (reprivatization) procedure stopped the practical utilization of already operable machinery.

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c. assistance to plastics product users. The Centre assisted them in identification of raw materials and manufacturing methods used for production of imported plastics products in assessing of local manufacturing possibilities, in finding local manufacturers, in specifying the requirements to the plastics products intended to be ordered locally, in testing of locally manufactured products. In some cases the Centre started experimental manufacture of products required by the users (pickers, bushes, rollers, hd pc pipe); in the others the Centre contacted the users with the potential manufacturers, helped to specify the requirements for the products, assisted the manufacturers in introduction of new materials and manufacturing technologies (if applicable) and tested the products. As the most important products in this field, the following may be listed just as examples:

water gates for irrigation systems, special pvc pipes including ribbed pipe for water filter manufacture, power distribution boxes, textile bobbing.

d. Colaboration with raw material suppliers: This field of operation was used mainly as communication channel for collecting the information on the raw materials and their properties; on the other hand however, the Centre assisted the suppliers in selecting the proper plastics grade for specified manufacture and in trouble shooting in the operation of their customers.

e. Colaboration with the government's and other authorities.

This colaboration had many aspects, sometimes reflecting on the activities of the Centre described in other parts of this report. For mentioning just a few:

- the colaboration with BUET resulted in introduction of specialized teaching on plastics technology,
- the colaboration with BITAC resulted in introduction of mould making as the new field of BITAC's operation,
- the colaboration with the National Board of Revenue and with the Tariff Commission resulted in substantial

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reduction of taxes on plastics in 1982,

- the colaboration with Central Testing Laboratory helped the Centre to conduct source testing of plastics not possible at the Centre at that time because of lacking equipment,

- The colaboration with the Bangladesh Standards Institution helped the Centre to prove standard for plastics testing,

- the colaboration with Agrani Bank and Bangladesh Shilpa Bank helped the banks to nationalize their assistance to investors in the plastics industry,

- the colaboration with the Institute of Polymer Technology in Loughborough resulted in proper training of BUET teachers and helped to train properly the technical staff of Plastics Technology Centre,

- the colaboration with CIPET, Madras was intended for supporting the development of mould making activities at BITAC, Dhaka. unfortunately in the both functions: training of BITAC staff at CIPET and CIPET experts' assistance to BITAC the results and effects were below expectations.

For practical reasons the assistance to the industry was not fully documented and the economic effects of the assistance were usually not directly calculable. In some cases however, the customers exactly calculated financial effects of the assistance (Appendices 9 & 10). The calculations show that even short consultations resulted sometimes in savings of several thousands US Dollars.

Training of industrial staff.

Due to the diversified industrial equipment and very diversified level of industrial staff (mostly without any educational back-ground and without knowledge of English), there was no possibility of arranging group training courses for industrial staff.

The people were instructed and trained practically in the operation of their machinery in the frame of technical assistance to the individual plants. During the implementation of the 2nd phase project, however,

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the industry expanded evidently; the same time expanded also the trained technical staff of the Centre and BUET got 3 professors with the good knowledge of plastics. In the new situation the introduction of group training courses was possible. BUET organized the 1-week (full time) course on plastics technology for technical management staff in 1982 with the participation of lecturers from the Centre. In 1984 the Centre started preparations for introduction of broad range of training courses (in Bengali) at various levels (from machine operator to factory manager). The first 1-week (full time) training course for operators of injection moulding machines (the most popular technology) was already conducted in April 1984 and may be repeated soon. The other courses will be introduced gradually, depending on the industrial interest.

Activities and outputs related to the mould manufacture at BITAC.

The project imported 3 machines for the use for mould manufacture at BITAC and put them into operation. 27 people from BITAC (including engineers) have been selected and gradually trained at CIPET, Madras. Unfortunately all these actions were delayed from the beginning due to delayed and limited availability of experts from CIPET (the last trainee will return from Madras only in July 1984). What more, the results of mould making staff training at CIPET did not correspond to expectations. According to trainees' reports their training time was misused to the large extent because of CIPET lacking enough instructors and mould making machinery as well as good training organisation. The same applies to the results of activities of 2 consecutive mould making experts from CIPET during their short missions to Bangladesh. Although being quite effective in workshop floor level operations (selection commissioning and installation of machines, training the staff in operating them), they failed to assist BITAC in the introduction of industrial methods of mould manufacture (on the both workshop and management levels) and in the smooth integration of the new mould manufacture with the traditional BITAC's metal working activities. As the result, the mould manufacture at BITAC is developing very slowly (only a few moulds have been sold till now) and the quality of manufactured moulds is still far from being perfect. The limited mould making activities are not giving the full employment to all the persons trained by the project in mould making; for that reason some of them have been transferred (hopefully temporarily only) to the other operation sectors of BITAC. It is quite

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evident that without urgent assistance of a good expert in mould making, BITAC will not be able to develop properly in this particular field. Unfortunately in the existing situation BITAC is also not able to support technically the traditional mould manufacture in street-side workshops and to train the industrial staff in proper mould manufacture, as intended originally. It is necessary to mention that the Government fulfilled properly its obligation of constructing the separate building for mould manufacture and all the imported machines were accommodated in it from the beginning. Also the material inputs from the UNDP side not only fulfilled the obligations listed in project document but even exceeded them (some additional accessories to imported machines, some special tools and measuring instruments as well as some special steels for mould manufacture have been imported additionally).

Activities and outputs related to increasing the interest of industry in developing new plastics application.

The intended outputs in this field were based on the activities connected with the fellowships on plastics application offered to BCIC and BJMC. The fellowships were organised but the both fellows left their original organizations shortly after returning from training. Unfortunately no further provisons for replacing training were available and in fact the corporations (especially BCIC) did not show very much interest in continuation of this field of operation. The initiated links with BJMC helped however the plastics technology centre to develop some activities in the field of application of plastics in jute industry (as machinery spare parts, sliver cans and other products) already described previously.

Activities and outputs related to introduction of teaching on plastics at BUET.

Three BUET professors have been trained in U.K., for 1 year each in plastics technology at the cost of the project. After returning, they started to teach students of the both chemical engineering department and mechanical engineering faculty.

At the Mechanical Engineering Department, under-graduate level, teaching on plastics was added to the manufacturing process courses, being studied by about 150 students yearly. About 10 of them are supervised for carrying out project works related to plastics.

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At the postgraduate level a new course "Plastics Process Technology" has been introduced. Already about 20 students used that optional opportunity. At the Chemical Engineering Department a new course "Polymer Processing Principles" is offered to the students as the optional subject and usually about 10 students yearly take the advantage of it. Unfortunately the only professor of Chemical Engineering Department trained in plastics left BUET for better job and his contribution to the teaching programme is very limited now.

The number of 2 professors educated for teaching on plastics is not sufficient for continuation and developing specialized teaching on plastics at BUET. For that reason the project intended to offer further assistance to BUET for training more professors and for BUET to maintain links with the Institute of Polymer Technology in Longhborough, U.K. - the place of the original training of the professors. Unfortunately the Ministry of Industries objected to any financial U.N.assistance to BUET in the frame of the project despite former promises and obligations of Mr. Zagoria (the former UNDP Resident Representative in Dhaka) in this respect. At the moment the assistance of the project to BUET teaching on plastics is limited to the free access to Centre's processing machinery and testing equipment.

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VI. ACHIEVEMENT OF IMMEDIATE OBJECTIVES

A. Achievement of the 1st phase project objectives

The immediate objective.

The immediate objective of the 1st phase " to complete the establishment of the Centre" was achieved only partly. The Centre was established in the sense of creating some unit consisting of a small group of people (engineers and support staff) with some basic professional knowledge and practical experience, backed by proper administrative services, equipped with fundamental plastics processing and testing equipment as well as technical documentation. located in a separate building and supportad by a government budget. The Centre elaborated an operational programme based on informal links with the plastics industry and other organizations/ institutions involved in processing, testing and using plastics.

Such a Centre was however too small and too new for being able to establish for itself an evident position in the government system, to fulfil its role in the national economy, and even to survive if left alone (in fact the Centre was close to collapsing later, when 2 trained counterparts separate in 1978). During 6 years between submitting the project document and completion of the 1st phase of the project, the situation in the country and in the national economy changed considerably. Thus also the assessment of the situation in the plastics industry and the views on the position and functions of the Centre in the National development changed. From these points of view the establishment of the Centre could not be considered as the process fully completed; the need for further support and development was very evident.

The immediate objective specified also the main functions of established Centre. The possibility of fulfilling them should be discussed one by one.

The function of "application of research findings in plastics technology to improved process and the utilization of equipment".

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The expected technology transferring function of the Centre would require industrial demand for technical development support. Such demand did not exist in 1978 because of the stagnant situation in the plastics industry resulting from economic conditions. Most factories could operate their equipment only occassionally and for that reason did not look for intersification or modernization of their equipment or processes. On the other hand the limited counterpart staff would require much more theoretical knowledge and practical experience for being able to assist the industry to upgrade noticeably. This would apply rather to some research findings of developed countries followed locally, as with the existing capacity the Centre was not able to carry out any local complex research programme.

Nevertheless the presence of experts has been utilized for suggesting technical improvements to the industry in individual cases, paving the way for the Centre to Develop these activities in the future.

The function of "introduction of standardization, quality control and testing of plastics raw materials (listed individually), semifinished and finished articles made by (individually listed) processing methods".

The above product quality oriented functions could be executed by the Centre to some extent, but the effects depended on the industry's response. The Centre got some testing equipment and used to applicable testing procedures (most of them officially standardized). Available testing methods did not cover the whole spectrum of possibilities; some properties (including mechanical properties) could not be tested due to lacking equipment; on the other hand however some of available testing equipment was outdated and not every much applicable for that reason. Still the existing possibilities of testing at the Centre were only marginally utilized by the industry.

As far as raw material testing is concerned, the bigger processors relied on the imported plastics offered by reputable suppliers, who cared about product quality and supplied the properly selected product grades. In such cases the raw materials were usually not tested at all and only a few factories had some testing facilities or used the Centre's testing services occasionally for that purpose.

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The small processors purchased their raw materials from the market, not caring about raw material or product quality at all so long the raw material was processable. Any local standardization of plastics raw materials would not be practically applicable to the industry that consumes them in small quantities and in may diversified grades. As far as testing of semifinished and finished products is concerned, the market for them was very limited, usually not very much technically developed and lacking sufficient competition; the latter, if any, usually being rather price them quality-oriented. Only in a few cases of technically applicable products (machine spare parts, cables, pressure pipes) some consumers' interest in quality existed and some demand for standardization might be expected. In specialized field of application (lime textile machinery spare parts or electrical components the Centre could however only assist the specialized authorities in introducing product standardization and quality testing.

It is necessary to mention that the government policy of nationwide introduction of standardization and quality control was declared only recently (in 1984) and much time will be needed for making the country used to it.

The function of "advising on new materials and technology which may be suitable for adaptation to the plastics industry in Bangladesh, and on the application of plastics in various industries which are consumers of plastics materials".

Advisory services to the industry belonged to the most developed activities of the project and could be continued further. This kind of service requires, however extensive technical knowledge and practical experience. In fact most of the advisory services during the lst phase were possible mainly due to experts' participation in these activities. The counterparts, if left alone, would not be able to continue these services at the same capacity.

The effects of the advisory services were usually out of control of the Centre. They were limited by the stagnant situation in the industry, low technical level of industrial staff, poor investment

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possibilities (in the case of new technologies) and a small and conservative market.

The function of training personnel for industry.

The counterpart staff of the Centre being very young, limited in technical knowledge, in practical experience and in number was not able to arrange and execute any training programme for industrial staff. Only individuals could be trained in some functions, if matching the counterpart field of knowledge (operation of some processing machinery, using some plastics texting methods).

B. Achievement of the 2nd phase project objectives

The immediate objectives.

The immediate objectives of the second phase project (a) to expand the existing capacity of the Plastics Technology Centre at BITAC in the fields of plastics processing, testing and training (b) to improve BITAC capacity to make metal moulds and dies for plastics processing (c) to enable the Plastics Centre to develop certain new products for the chemical and jute industries (d) to enable the Bangladesh University of Engineering and Technology to introduce specialized teaching in plastics technology" were generally achieved although not always to the level initially intended. The individual objectives and their achievement should be discussed in detail. The objective of expanding the capacity of the Plastics Technology Centre at BITAC in the field of plastics processing, testing and training. The capacity of Plastics Technology Centre was expanded in every respect. After loosing 2 trained counterparts in 1978 the staff of the Centre rose gradually until reaching 1983 the number of 6 graduated counterparts and 3 technical support staff members. Out of the 5 new graduated counterparts 4 have been granted fellowships (3 already completed). All the staff members of the Centre improved their professional knowledge and working capacity thanks to fellowships, study tours, individual on-the-job training and practical experience collected during participation in activities of the Centre. The equipment of the Centre was expanded by

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more than 100% and better adjusted to the locally demanded services of the Centre. The library grew from 53 volume to 305 volume, 15 journals, slides, as well as audio-visual and reproduction equipment.

The immediate objective specifies the level of ability of the Centre to the achieved during the 2nd phase of the project: "Meet the plastics industry's requirements for testing of plastics raw materials and products; develop and introduce in industry standardized testing methods". This ability was achieved in the sense that the Centre was able to meet the requirements of the industry and also arranged for official approval of introduced standards. The industry, however, is still not developed enough to absorb fully the testing services offered and to accept (with a few exceptions) the introduction of quality control and testing methods suggested. "Provide consultancy services to the plastics industry in plastics processing, testing and new product development". This ability fully met the demand of the industry. It is however necessary to mention that without the assistance of experts the counterparts wouldn't be able to offer the full consulting capacityjust because of not having yet collected enough practical experience.

"Offer up-to-date technical literature to industry". In this respect the capacity of the documentation unit is for excessing the existing industrial interests and requirements (not very much developed yet, however).

"Develop selected new products and production processes on a trial production basis". -This ability was developed and utilized especially for the manufacture of spare parts to jute machinery.

"Train skilled workers in plastics processing and testing". - This ability was achieved only recently because of limited availability of qualified counterparts. The extensive group training programme for industrial staff will be gradually introduced during 1984-86 (until now only individual training has been arranged).

"Organize lectures and discussions, films and demonstrations on plastics manufacture". - This ability was fully achieved.

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The achievement of abilities listed above was accomplished by other fields of operation, not specified in the project objective. At least one should be mentioned here: the assistance and recommendations to Customs authorities resulted in evident tax reductions from 1.7. 1982 since that day the combined tax level for plastics dropped from 173% to 68% of C&F value of imported raw materials, changing considerably the plastics market situation and market supply - demand balance. This change contributed to a large extent to the recent development of the plastics industry and its more efficient operations. Although achieving the immediate objective of expension, the Centre is still considered to be too small for operating and developing on its own, without any further support.

The objective of improving BITAC capacity to make metal moulds and dies for plastics processing.

Due to existing delays in experts' services and specialized training, the objective has not been achieved yet, although the material imputs from both the government (building, staff, some machinery) and U.N. side (training provisions, some specialized machinery, expert provisions) were made available.

Unfortunately the assisting capacities of CIPET in both expert services and staff training were over estimated at the time of introducing the 2nd phase of the project, or perhaps detoriorated gradually later. In any case training effects of fellowships already completed were below expectations and the mould making staff of BITAC has not been made fully qualified for its job. Also both consecutive experts from CIPET failed to assist BITAC in rational introduction of mould manufacture at both management and workshop level, and in integrating it smoothly with the traditional BITAC's metal working activities.

As a result of all the above impediments, BITAC started the manufacture of moulds only recently (in 1983) at the capacity much below the estimated 50-75 moulds/year, as was originally intended. The achievement of this objective will require at least 2-3 years of manufacture development assisted by expert's participation.

Some additional specialized mould making equipment will be required as well. The delay in achievement of the project objective is affecting also the intended effects specified in it:

- "Imports of moulds and dies can be eliminated,
- The plastics industry can increase the range of products produced,
- Skilled workers in the plastics industry can be trained at BITAC in mould manufacture and maintenance".

In fact none of them has materialized yet.

The objective of enabling the Plastics Technology Centre to develop certain new products for the chemical and jute industries.

This objective was linked to the fellowship support offered to both chemical and jute industries in the field of plastics application. Unfortunately only one engineer of each of the corporations (BCIC and BJMC) was trained and they both left their posts for better jobs soon after training. In this way the possibilities of identification of industrial requirements for plastics application become limited. Not finding enough cooperation in the chemical industry, the Centre had to postpone the activity leading to the first goal specified by the objective that

-" a-corrosion protection service is set up for the chemical industry." Also the Centre concentrated on reaching the other goal, that - "an increased range of locally manufactured plastics spare parts is available for the jute industry". Five products were identified for local manufacture; two of them are being already commercially manufactured at the Centre, one is manufactured one an experimental scale at the Centre with the intended technology transfer to industry for commercial manufacture (in preparation). In one case the extensive practical application testing of prototypes is running, with the intention of introducing commercial manufacture to the industry.

The Centre developed some new products (or assisted the industry to develop them), such as ribbed PVC pipe for water filter in tube wells, HD polyethylene pipe for gas distribution, for sectors originally not mentioned in the project objective.

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In conclusion it may be stated that as for the existing capacity of the Centre, the discussed objective was achieved. For wider assistance programme, however, not only the Centre itself should be developed further, but also some more fellowship assistance in plastics application should be offered to the industries involved.

The objective of enabling BUET to introduce specialized teaching in plastics technology.

As the effect of 3 fellowships offered to BUET professors, they introduced teaching on plastics at both the Mechanical Faculty and Chemical Engineering Department. Unfortunately the only professor specialized in plastics technology at the Chemical Engineering Department left his post recently for better salary and activities of teaching on plastics at the Chemical Engineering Department have been almost discontinued. They could be revised only if other professors were trained in specialized teaching. Taking the above into account, the objective may be considered as partly achieved.

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VII. UTILIZATION OF PROJECT RESULTS

A. Improvement of product quality

The activities of the project influenced the quality of locally manufactured products in many ways:

a) assistance in the selection of proper raw material for the given product: thanks to collaboration with new material suppliers and to wide range of raw material catalogues in the library of the Centre the customers are advised on the best applicable raw material for given purpose, considered from the point of view of material properties, processing properties, application conditions, requirements to the product and the raw material cost. In such system of selection the potentially existing effects of plastics applicability are utilized in the best way,

b) assistance in the proper operation of the processing equipment: the properties of final plastics products depend to some extent on the proper processing parameters, design of the mould etc. The advice regarding proper processing parameters and operating programme for the machinery was the routine assistance to the processors of plastics,

c) experimental manufacture of plastics products: the products manufactured by the Centre are usually quality-oriented and much better than the other locally manufactured products of the same kind. When Centre's products appear on the market, the other manufacturers may only follow them with improving the quality of their products (the Centre offers know-how in this field free of cost) or to resign. Such situation applies to the limited range of technical products (pickers, picker bushes) but reflects on the general market situation,

d) assistance in quality testing: although not being very much utilized yet, in some cases of technical products the testing

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of product properties is unavoidable for meeting the market demand. This applies to such products, like pvc pipe for water supply, textile bobbins, water dam sealing strip. The Centre offers free testing services for every customer (processors and users), issues accordingly testing reports and certificates,

e) increasing competition on the market: growing competition on the market (discussed later) is also influencing the quality of market product. Although the manufacturers in Bangladesh still prefer to compete on price basis, in some cases (technical products) the quality has already the preference.

B. Increasing product quantity and range

The project activities influenced the increasing quantity and range of products in many ways:

a) reduction of taxes on plastics: the evident reduction of taxes on plastics (from 193% to 80%) ordered by the government on the recommendation of the Centre in July 1982 changed evidently the situation on the plastics goods market. The prices dropped and the demand on plastics products rose immediately. The established manufacturers increased their turnover, new enterpreneurs also started to invest in plastics processing industry, creating tougher competition on the market (leading to further price reduction),

b) assistance to investors in plastics industry: the Centre assisted investors directly and through the financing banks, trying to nationalize the intended manufacturing programmes, improve machinery utilization, introduce marketing research and proper product selection,

c) assistance to plastics processors and plastics products users helped to identify new possibilities of application (hd, pc pipe for gas distribution, power distribution boxes, water gates for irrigation projects) and to assist their development.

As the result not only the traditional application of plastics were widened evidently but the new fields of application started to grow as well.

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C. Import substitution

The growing quantity and range of plastics products on the market resulted in evident import substitution. Since the local manufacturer improved the quality of pvc pipe up to the requirements of international standards (with the assistance of the Centre) the factory is running with full capacity, partly replacing import. The same applies to textile machinery spare parts, power distribution boxes (previously imported from UK), household articles etc. There were surely some factors out of control of the Centre, contributing to the rapid change of situation on plastics market as well but the Centre was involved in the majority of them.

D. Competition in export market

As previously stated, there are little chances for the local plastics processors of competing successfully in export markets. The only exception is the well established manufacture of power and telephone cables (actually run successfully without evident assistance of the Centre) being based on european technology. In these unfavourable situation Lira, the only manufacturer of approved pvc pipe for petable water in Bangladesh, got the first order to export pipes to Burma in 1983. It is necessary to mention that Lira was assisted by the Centre from the beginning in improving quality of their pipes, reaching the international standard quality level only years back.

VIII. F I N D I N G S

1. The Centre, although much bigger and more effective in operation than 6 years back, should be still expanded for better covering the demand for assistance already existing in the industry. The new activities demanded by the 3rd phase Project Document (industrial survey) also requires further expansion of the Centre.

2. The system of salaries in the Centre is not attractive for new engineers; even the industry is offering better financial employment conditions; in such situation the existing staff may be affected by more attractive salary offers from outside; in the case of fresh employees the effects of negative selection may become evident.

3. The mould making activities at BITAC are not exhausting the existing human and material resources created in the frame of 2nd phase project operations.

4. The specialized teaching on plastics at BUET started quite efficiently, but was recently slowed down by the separation of one of 3 trained teachers and may deteriorate if not getting further support.

5. The individual branches of industry and of other sectors of national economy are still lacking some basic knowledge about plastics, their possibilities and advantages of their application.

6. The plastics processing industry in general is still neither understanding nor appreciating the essential function of technical knowledge in the prosperous operation in this industrial sector, trying to run this modern branch of industry with the traditional methods, common to hand work operations. This situation should be changed in the interest of both manufacturers and consumers.

7. The plastics processing industry is benefiting very much of the reduction of taxes on plastics introduced in 1982 and the resulting progress in its development is very evident. The taxation rates are however still too high for making plastics products available for the average citizen of Bangladesh.

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IX. RECOMMENDATIONS

1. The Plastics Technology Centre should be developed further. Besides getting additional experts' assistance and supply of additional machinery the Centre should employ more engineers and assisting technical staff, the economist should be also employed for running the activities demanded by the 3rd phase Project Document (industrial survey) and in advising the industry on techno-economical problems advance manufacturing cost calculation etc).

2. The government should try to find the possibility of increasing salaries for the staff of the Centre for making the employment at the Centre more attractive and desireable.

3. The expert's assistance for BITAC's mould making activities should be arranged by UNIDO as soon as possible, considering this action as the one of first priority.

4. The financial support of the 3rd phase project to BUET should be continued and should cover at least training of additional BUET teachers and operational costs of mutual cooperation between BUET and Institute of Polymer Technology, Longhborough.

5. Training activities of the 3rd phase project should be oriented on dissiminating the practical knowledge on plastics application to the main potential users (agriculture, sanitation, water and gas distribution, irrigation etc).

6. Plastics processing industry should be supported by wide training programme arranged by the Centre; it should be consisted of both locally organised training courses as well as fellowships and study tours arranged by UNIDO.

7. The government should consider the possibility of ordering further reduction of taxes (customs duties) on plastics raw materials; they should possibly not be taxed higher then popular commodity non-ferrous metals (copper, brass, aluminium).

X, APPENDICES

Appendix 1

List of international project staff

Name	Function	Starting date of assignment	Concluding date assignment
1st phase (BGD/72/025)			
1. LAALY, H.	Laboratory Advisor	February 1975	February 1975
2. GATTINGER, G.	mechanical engineer	April 1975	April 1975
3. ROSSI	mechanical engineer	April 1975	April 1975
4. BRZEZINSKI, J.	Plastics testing expert	a) February 1976 b) April 1977	September 1976 September 1977
5. FINDLAY, D.	Plastics engineer	April 1976	June 1976
6. MISTEREK, B. W.	Plastics processing expert project co-ordinator	February 1977	March 1978
2nd phase (BGD/77/025)			
1. MISTEREK, B. W.	Plastics processing expert project co-ordinator	a) April 1978 b) January 1979 c) June 1979 d) January 1980 e) June 1980 f) April 1981	September 1978 February 1979 August 1979 February 1980 July 1980 February 1984
2. FRANCIS, M.S.	Mould making expert	a) June 1979 b) October 1979	August 1979 November 1979
3. BRZEZINSKI, J.	Plastics testing expert	April 1981	June 1981
4. RAZACK, M.A.	Mould making/workshop advisor	a) July 1981 b) April 1982 c) August 1982	July 1981 May 1982 October 1982

List of counterpart project staff

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Name	Function	starting date of assignment	concluding date of assignment
1st phase (BGD/72/025)			
1. SIKDER, S.	Junior engineer (plastics testing)	August 1976	-
2. KHAN, S-u-D.	Junior engineer(Plastics processing)	August 1976	-
3. ISLAM, S.	Senior supervisor (plastics testing)	March 1976	-
2nd phase (BGD/77/025)			
1. SIKDER, S.	Senior Engineer (Plastics testing)	As above	-
2. KHAN, S-u-D	Senior Engineer (Plastics processing)	As above	September 1978
3. ISLAM, S.	Senior supervisor (Plastics testing)	As above	July 1978
4. RABBANI, G.	Junior engineer (Plastics processing)	June 1978	-
5. HAIDER, M.S.U.	Junior engineer (Plastics processing)	September 1979	-
6. KASHEM, M. A. U.	Apprentice engineer (Plastics testing)	June 1980	August 1980
7. QUAMRUZZAMAN, M.	Apprentice engineer (Processing machinery)	June 1980	August 1980
8. HOSSAIN, M.D.	Apprentice engineer (Plastics processing)	June 1980	August 1980
9. CHOUDHURY, S.H.	Junior engineer (Plastics testing)	October 1980	-
10. AHMED, S.	Junior engineer (Processing machinery)	October 1980	-
11. SHAHIDULLAH, M.	Physicist, Appl.Electronics(Control Systems)	June 1983	-

Appendix 3.

List of fellowships

NAME	LOCATION	TRAINING PERIOD	TRAINING STARTED	REMARKS
1st phase (BGD/72/025)				
PLASTICS TECHNOLOGY CENTRE STAFF:				
1. SIKDER, S.	U.K.	11M.	August 1975	Plastics testing
2. KHAN, S.-u-D.	U.K.	10M.	September 1975	resigned in 1978
3. ISLAM, S.	U.K.	9M.	October 1977	didn't return
2nd phase (BGD/77/025)				
PLASTICS TECHNOLOGY CENTRE STAFF:				
1. RABBANI, G.	U.K.	7M.	January 1980	Plastics processin
2. HAIDER, M.S.U.	U.K.	7M.	November 1980	Plastics processing
3. AHMED, S.	U.K.	15M.	September 1982	Processing machinery
4. CHOWDHURY, Z.H.	U.K.	14M.	September 1983	Plastics testing (not yet completed)
BITAC MOULD MAKING STAFF:				
5. KABIR, G.	India	16M.	August 1980	engineer mould making
6. CHAKARAVARTY, S.	-" -	- " -	January 1983	engineer mould making (not yet completed)
7. SHAHIDULLAH, M.	- " -	15M.	August 1981	mould design
8. HANNAN, M.A.	- " -	- " -	- " -	- " -
9. JOARDER, L.R.	- " -	- " -	January 1983	engineer mould design (not yet completed)
10. HARUN-UR-RASHID	- " -	- " -	- " -	- " -
11. ISLAM, H.S.	- " -	- " -	- " -	mould design (not yet completed)
12. BARKATULLAH, M.	- " -	24M.	August 1980	mould maker

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	NAME	LOCATION	TRAINING		REMARKS
			PERIOD	STARIED	
13.	WAHEED, A.	India	24M.	August 1980	mould maker
14.	HASAN, K.	- " -	- " -	- " -	- " -
15.	GREGORY, A.	- " -	- " -	- " -	- " -
16.	BAREK, A.	- " -	- " -	- " -	- " -
17.	SARKER, M.A.H.	- " -	- " -	- " -	- " -
18.	KHAN, A.M.	- " -	- " -	August 1981	- " -
19.	RAZZAQUE, H.M.A.	- " -	- " -	- " -	- " -
20.	ISLAM, M.N.	- " -	- " -	- " -	- " -
21.	BAIRAGI, A.	- " -	- " -	- " -	- " -
22.	AKAUDDIN, M.	- " -	6M.	- " -	Machinist
23.	KHAN, A.H.	- " -	- " -	- " -	- " -
24.	BHUIYA, M.F.A.	- " -	- " -	January 1982	- " -
25.	DIN MOHAMMAD	- " -	- " -	- " -	- " -
26.	RAHMAN, M.H.	- " -	- " -	January 1983	- " -
27.	RAHMAN, M.M.	- " -	- " -	- " -	- " -
28.	ROSARIO, J.M.D.	- " -	- " -	- " -	- " -
29.	SOLAIMAN, M.	- " -	- " -	- " -	- " -
30.	CHOUDHURY, S.	- " -	- " -	- " -	- " -
31.	AHMED, H.	- " -	- " -	- " -	- " -

Contd....2/3

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	NAME	LOCATION	TRAINING		REMARKS
			PERIOD	STARIED	
	BUNT PROFESSORS:				
32.	QUADER, A.K.M.L.	U.K.	12 M.	October 1979	Plastics Technology
33.	ILAHI, M.F.	- " -	-" -	-" -	Plastics processing
34.	HUQ, A.	- " -	13 M.	September 1980	Plastics testing and Application
	INDUSTRIAL STAFF:				
35.	ALAM, R. (Bangladesh Chemical Industries Corporation)	- " -	6 M.	February 1979	Left his post in 1981
36.	HUSSEIN, M.J. (Bangladesh Jute Mills Corporation)	U.S.A.	5 M.	August 1981	Left his post in 1983

Appendix 4

List of non-expendable equipment delivered by UNIDO

1	Description 2	Initial value US$ 3	Delivery (year) 4	Present condition 5	Remarks 6
	a) Before Project started (in the frame of PAK-26), processing equipment only:				
1	Injection Moulding Machine, ENGEL ES90/150 with 2 moulds. accessories and spare parts	19373	1972	good	
2	Glass Fibre/Polyester Spraying Unit "Polyspray M30C", with spare parts and accessories	10430	1973	good	not utilized
3	Gel-Coat spraying Unit "Polyspray M11A" with spare parts	no details (before available 1975?)		good	not utilized
4	Vacuum Forming Machine "Bescovac Mark-III" with spare parts	4326	1972*	good	
	b) during 1st Phase Project (DP/BGD/72/025): 1. Processing equipment:				
5 6	2 Cutting Units for GRP Laminate "Polycutter Super" with spare parts	858	1975	good	
7	Compressor	2530	1975	good	
8	Laboratory Mixer with spare parts	2232	1976	good	
9	Hydraulic laboratory Press, 20t	1709	1978	good	
	2. Testing and measuring equipment:				
10	Analytical Balance	1045	1976	good	
11	Student Balance	159	1976	good	
12	Triple Beam Balance	126	1976	good	
13	Vacuum Oven with pump**	2943	1976	good	

* some components delivered during 1st phase
** delivered during 2nd phase

Contd...P/2

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1	2	3	4	5	6
14	Stereoscopic Microscope	2048	1976	good	
15	Wallace Softness Tester	390	1976	good	
16	Wallace Specimen Cutting Press with cutters	681	1976	good	
17	Deformation Test Apparatus	635	1976	good	
18	Wallace Specific Gravity Balance	335	1976	good	
19	Bench Thickness Gauge	195	1976	good	
20	Wallace Specimen Buffing Machine	1071	1976	good	
21	Aging Oven	1875	1976	good	not utilized
22	Thermostat Water Bath (3 Pcs.)	748	1976	good	
23	"Unicam" PH Meter	303	1976	good	
24	Abbe Refractometer	769	1976	good	not utilized
25	Humidity Oven	[illegible]	1976	good	
26	Laboratory Oven	644	1976	good	
27	Zwick Pendulum Impact Tester	1508	1976	good	
28	Heat Distortion/Vicat Softening Point Apparatus	1908	1976	good	
29	Melt Flow Indexer	1506	1977	good	
30	Density Gradient Apparatus	1012	1977	good	
31	Elmendorf Tear Tester	1148	1977	good	
32	Burst Strengh Tester	760	1977	good	
33	Flexural Modulus Apparatus	1382	1977	good	
34	Extrusion Rheometer with recorder	11006	1977	good	not uitilized

Contd...P/3

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1	2	3	4	5	6
35	Pocket Calculator	100	1977	good	
36	Vacuum Cleaner	102	1978	good	
37	Universal Electric Meter	70	1977	good	
	c) during 2nd Phase Project (DP/BGD/77/025):				
	1. Processing equipment:				
38/39	2Hot Air Plastics Welding Tor Ches with accessories	2368	1980	good	
40	Ultrasonic Welder with accessories	4429	1980	good	
41	Transfer Moulding Press (37t)	16977	1980	good	
42	Single Screw Extruder (32mm) with Pipe Manufacturing Unit	33930	1980	good	
43	Hopper-Dryer with accessories	3313	1980	good	
44	Impulse Sealer	350	1980	good	
45	Scrap Granulator with accessories	3895	1982	good	
	2. testing & measuring equipment:				
46/47	2 Hydro-Termographs	827	1979	good	
48	Universal Mechanical Tester "Instron 1121" with accessories (including High Temperature Cabinet and optical Extensometer)	47041	1980 -1982	good	
49	Shore A & D Hardness Tester	365	1981	good	
50	Hardnoss Meter	496	1982	good	
51	Photoelectric Reflectometer	5336	1982	good	
52	Air Conditioner Model GS632D	1300	1981	good	

Cont1....P/4

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1	2	3	4	5	6
	3. Documentation equipment:				
53.	Chinon S-8 Sound Movie Projector	259	1979	good	
54.	Bell & Howell 16 Projector with optical sound	1049	1979	good	
55.	Rollei 50x50 Slide Projector	125	1979	good	
56.	Canon NP-50 Plain paper copier	2084	1979	good	
57.	Collection of books (305 vols)		1977-1984	good	
	4. Mould making equipment in BITAC				
58.	Single-lip cutter grinder with accessories	5273	1981	good	
59.	GK 21 Universal Engraving and Profilling Miller with accessories	17294	1981	good	
60.	KF2 Universal copy Milling machine with accessories	64600	1982	good	

Appendix 5

List of technical equipment supplied by the Government

(1st & 2nd phase project)

Sl. No.	equipment
1.	Oxygen Regulator
2.	Table Vice
3.	Avometer
4.	Water Destillation Plant
5.	Power Hack Saw Machine
6.	Plate Mould (Compression)
7.	Picker Mould (Compression)
8.	Picker Bush Mould (injection)
9.	Roller Mould (injection)
10.	Testing Specimen Mould (injection)
11.	Teacup Mould (compression)
12.	Impact Testing Machine (in assembly)
13.	Fluidised bed coating unit
14.	Pipe extrusion die
15.	Spare parts, adaptors and components to processing and testing equipment
16.	Technical balance (2 tons)
17.	Natural aging stand

Appendix 6

Testing methods available at the Centre

Remarks:

V - standard for testing method approved
*** - methods utilized frequently
** - methods utilized less frequently
* - methods utilized sometimes
- other methods didn't meet any demand

A. Testing methods introduced during 1st phase (DP/BGD/72/025)

V*** 1. Method for measuring the softness number of thermoplastic materials
V*** 2. Method for measuring the hardness of rubber & rubber-like materials
V*** 3. Method for measuring the specific gravity of plastics
V * 4. Method for measuring the apparent density of moulding materials that can be poured from a funnel.
V*** 5. Method for measuring the water absorption at room temperature and boiling water absorption of plastics.
V 6. Method for measuring deformation under heat of flexible and rigid polyvinyl chloride compounds.
V * 7. Method for measuring temperature of deflection under load (TDL).
V*** 8. Method for measuring vicat softening temperature (VST) of thermoplastic
V * 9. Method for measuring the flexural modulus of plastics
V * 10. Method for measuring resistance to tear propagation of flexible plastics film or sheeting.
V*** 11. Method for measuring the viscosity number and K-value of PVC resin.
V 12. Method for measuring bursting strength of plastic films.
V*** 13. Method for measuring the Melt Flow Rate (MFR) of thermoplastics.
V*** 14. Method for measuring density of plastics by the density gradient column.

B. Testing methods introduced during 2nd phase (DP/BGD/77/025)

V*** 15. Method for measuring thermal stability of polyvinyl chloride and related copolymers and their compounds by the Congo Red test.
V * 16. Method for determination of the Charpy impact resistance of rigid plastics

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Appendix 7

List of customers and partners.

(1st & 2nd phase projects)

Name location	field	remarks
A. PLASTICS PROCESSORS		
1. Lira Industries Enterprize Tongi.	pvc pipe & fittings	continuous
2. Eastern Cables Ltd. Potenga, Chittagong.	power cable(PVC sheeting)	continuous
3. Pylon Industries - Chittagong	Polyamide fibre	continous
4. CARE Jute Plastic Project Aliganj	Jute/glass fibre/polyester products	converted into pos. 5.
5. INTERPARES Jute Plastic Pilot Plant - Aliganj	- " -	closed down in 1982
6. Jute Plastics Plant Commercial Tarabo, Demra	- " -	continuous
7. Regin Complex - Rangunia	manufacture & processing of urea-formaldehyde & melamine-formaldehyde moulding powders.	continuous until desinvestment in 1979
8. Bangladesh Bakelite Industries - Nasirabad, Chittagong.	thermoset electric components	continuous until closing down in 1981
9. Bengal Belting - Nasirabad, Chittagong.	pvc compounds, leather-cloth, pe film	continuous until desinvestment in 1983
10. Rayon Complex - Chondragona	rayon, celophone, corrosion protection	continuous
11. Tritorit Industries - Chittagong	thermoset electric components	continuous
12. Sikander Industries - Tejgaon,Dhaka	blown containers,injection moulded products,rubber latex products.	occasional
13. Telephone Cable Shilpa Khulna	telephone cables (pvc & pe sheeting)	occasional
14. Telephone Shilpa Shangsta - Tongi	telephone component injection moulding	continuous

Contd...P/2

	Name, location	field	remarks
15.	Karim Rubber - Fotullah	pvc compounding shoe injection, polyurethane foam	continuous
16.	Bangladesh Industries - Tejgaon, Dhaka	Injection moulding of consumer goods	continuous
17.	Bengolite	Injection moulding (hand operated)	occasional
18.	Mr. Miar Karim	Intended investor	occasional
19.	Bata Shoe Factory - Tongi	pvc compounding and injection moulding	continuous
20.	Sunshine Cables - Abdullahpur, Dhaka.	pvc cable sheeting	occasional
21.	Sagar Plastics Industry -Dhaka	pvc shoe injection	occsional
22.	Weatherproff Packing Material Industries - Tejgaon,Dhaka	PVC compounding & hose extrusion, pe film extrusion	continuous
23.	Bengal Cables Industries Tejgaon, Dhaka	pvc cable sheeting	occasional (closed down)
24.	Bengal Plastic Industries-Dhaka	textile machinery spare parts	continuous
25.	Star Plastics Industries-Chittagong.	Injection moulding (hand operated)	occasional
26.	Fecto Industries -Tejgaon,Dhaka	Injection moulding extrusion	occasional
27.	Mehar Industries - Dhaka	putting into operation 1 injection moulding machine & vacuum forming machine	continuous
28.	Dawood Sultan - Tejgaon, Dhaka	Injection moulding of textile spare parts	continuous

Contd...P/3

	Name, location	field	remarks
29.	Chemical Industries of Bangladesh - Barabkund, Chittagong.	Corrosion protection with plastics (mainly pvc)	occasional
30.	Eblic Ltd. - Nasirabad, Chittagong	XPS foaming	occasional
31.	Trade & Crafts Ltd - Dhaka	consultation on machinery selection	occasional
32.	Rahim Industries - Chittagong	electrical accessories	occasional
33.	Modern Industrial Gorp. Tejgaon, Dhaka	injection moulding of utensiles	occasional
34.	M. H. Khan & Associates - Dhaka	consultation on textile spare manufacture	occasional
35.	Unitas International - Dhaka	consultation on machinery selection	occasional
36.	Mirdey Industries - Dhaka	spares for machinery	occasional
37.	Addis Bangladesh Ltd. Dhaka	tooth brush (injection moulding)	occasional
38.	Tampaco Coating Ltd. - Tongi	vacuum metalization, pvc coating	occasional
39.	North Bengal Plastics Industries Ltd. - Kushtia	Bottle blowing	continuous
40	Petro Synthetic Products - Tongi	PVC compounding	continuous
41.	East Asia Enterprise - Dhaka	Expansion joint pvc profile extrusion	occasional
42.	Gorashal Containers Ltd. Gorashal, Dhaka	blow moulding	continuous
43.	Mak's Industries - Tongi	injection moulding & blow moulding	continuous

cont./ 4

	Name, location	field	remarks
44.	Dhaka PVC Industry Postagona, Dhaka	PVC pipe extrusion	continuous
45.	Ciba-Geigy - Nasirabad, Chittagong	Pe bottle blowing & cap injection	occasional
46.	Bella Artifitex Industries, Demra	pvc leather-cloth & pe film manufacture, pvc extrusion	continuous
47.	Anwar Group of Industries Tejgaon, Dhaka.	compression moulding of pickers	occasional
48.	Plastican Ltd - Gorashal	blow moulding	continuous
49.	Bangladesh Rubber Industries Tejgaon, Dhaka.	Rubber, EVA & PVC processing	occasional
50	Associated Engineers & Drillers - Dhaka.	intended PVC pipe manufacture	continuous
51.	Jalalabad Plastics Industry, Sylhet	Blow moulding & injection moulding	continuous
52.	Paper Converting & Packaging Industry - Demra	pe film manufacture & printing	occasional
53.	Shah Alam Sons Nephews & Co., Dhaka	comb manufacture (injection moulding)	continuous
54.	Universal Plastics Industry - Mirpur, Dhaka	injection moulding	occasional
55.	Employment Rehabilitation Centre for Physically Handicapped - Tongi	Injection moulding, training	continuous
56.	Fibre Glass Factory Nabiganj, Narayanganj	glass fibre/polyester laminates	occasional
57.	Janata Products - Dhaka	compression moulding	occasional
58.	Mirren Bangladesh Ltd, Borishal	tooth brushes	occasional
59.	Continental Progressive Industries - Dhaka.	textile spare parts	occasional
60.	BRB Cable Industries Ltd, Kushtia	pvc cable sheeting	occasional

Contd. 5/

	Name, location	field	remarks
61.	Ipsha Record Ltd. - Kakrail, Dhaka	phonograph records	occasional
62.	Texpick Industries Ltd - Khulna	textile machinery spares	continuous
63.	Padma Printers & Colour Ltd,Dhaka	extrusion Coating	occasional
64.	Habib Plastics Ind. Ltd. Narsingdi	textile machinery spares	occasional
65.	Raj Trading Co. - Dhaka	textile machinery spares	occasional
66.	Quality Pickers Ltd. - Dhaka	textile machinery spares	continuous
67.	Make More Industry - Dhaka	pvc seal in crown bottle closures	occasional
68.	G. Q. Ball Pen Industries,Jessore	extruded & injection moulded ball pens	starting
	B. PLASTICS USERS		
1.	Bangladesh Tobacco Co. Ltd. Chittagong	plastics containers (internal transport) and spares	occasional
2.	Adamjee Jute Mills - Narayanganj	spares to textile machinery	continuous
3.	Engineering Industries Ltd. Tongi	machining of textile spare parts	occasional
4.	Galfra - Habib Ltd. Chittagong	spares to textile machinery	occasional
5.	Bangladesh Machine Tool Factory Ghazipur	PVC vessels for metal plating	occasional
6.	Oriental Bakery - Chittagong	film for bisquit packing	continuous
7.	ICI Bangladesh Manufacturers - Narayanganj	repair of polyethylene tanks	occasional
8.	Karim Jute Mills Ltd. Demra	practical testing of pickers & sliver cans	continuous

contd. 6 ....

Name , location	field	remarks
9. Mirpur Agricultural Workshop & Training School - Mirpur, Dhaka.	plastics components for irrigation pumps	continuous
10. TSP Fertilizer Complex - Chittagong	Spare part testing and application consultation.	occasional
11. Monno Textile Mills - Tongi	testing of spares	occasional
12. Bangladesh Tobacco Co. Tejgaon,Dhaka	consultation on plastics application	occasional
13. Jamuna Oil Co. Ltd. Dhaka	quality testing of oil containers	occasional
14. Famous Trading Co. - Chittagong	safety helmet manufacture	occasional
15. Titas Gas Trans. & Dist. Co. Ltd., Dhaka	pe pipe for gas distribution lines	continuous
16. Meghna Textile Mills - Tongi	spare manufacture	occasional
C. RAW-MATERIAL SUPPLIERS		
1. Hoechst Pharmaceuticals , Dhaka	Thermoplastics, Pigments	continuous
2. BAST Bangladesh - Dhaka	Thermoplastics, additives	continuous
3. Eagles Company - Dhaka	Thermoplastics of Bayer	discontinued (converted into PH)
4. Bayer Bangladesh	Thermoplastics, additives	continuous
5. Mistsubishi - Dhaka	Thermoplastics	occasional
6. Nichimen - Dhaka	Thermoplastics	occasional
7. Standmax - Dhaka	Polyesters for FRP (Japan)	occasional
8. Sumitomo Shoi Kaisha - Dhaka	Thermoplastics	occasional

contd. 7

Name, location	field	remarks
9. Kobeda Overseas - Dhaka	PVC pipe compound	occasional
10. I.C.I. Bangladesh - Dhaka	Thermoplastics, additives	continuous
11. Burmah Eastern Ltd. - Dhaka	plastics of Shell	occasional
12. Aico International - Dhaka	additives of Mearl, USA	continuous
13. Broadways Chapmen Ltd. Dhaka	plastics & additives of Degussa A.G.	occasional
14. B. K. Traders Ltd. - Dhaka	pigments of E. Merck	occasional
D. GOVERNMENT AUTHORITIES & OTHERS		
1. Central Testing Laboratory - Dhaka	testing of plastics	continuous
2. Bangladesh Standard Institution Dhaka.	standards for plastics testing	continuous
3. Ministry of Jute - Dhaka (not existing more)	application of jute in plastics products	discontinued
4. UNICEF -, Dhaka	water supply, sanitation	continuous
5. Bangladesh University of Engineering & Technology - Dhaka (Chemical Eng. Dept. & Mechanical Faculty)	seminars, teaching on plastics	continuous
6. Bangladesh Jute Research Institute Dhaka.	application of jute in plastics products	occasional
7. Atomic Energy Centre - Dhaka	modification of jute for polyester reinforcement	occasional

contd.. 8

	Name, location	field	remarks
8.	Bangladesh Chemical Industries Corporation - Dhaka	plastics processing in gov. ■ industry, application of plastics in chemical industry.	continuous
9.	Bangladesh Jute Mills Corporation, Dhaka	application of jute in polyester laminate, application of plastics in jute mills	continuous
10.	Bangladesh Textile Mills Corporation Dhaka.	application of plastics in cotton mills	continuous
11.	Bangladesh Council for Scienfific Industrial Research - Dhaka.	testing of rubber properties,	continuous
12.	Bangladesh Power Development Board Dhaka.	application of plastics in power distribution installations.	continuous
13.	World Bank - Dhaka.	application of plastics in irrigation systems	continuous
14.	Rubber Planting Project, Chittagong.	problems of rubber and plastics competitive applications.	occasional
15.	Directorate of Public Health Engineering - Dhaka.	quality control of PVC pipe	occasional
16.	Bangladesh Water Development Board Dhaka.	quality control of pvc components.	occasional
17.	Bangladesh Small & Cottage Industries Corporation -Dhaka.	quality control of containers	occasional

contd... 9

	Name, location	field	remarks
18.	Water & Sawage Authority - Dhaka	quality control of PVC pipe	occasional
19.	Bangladesh Shilpa Bank - Dhaka	consultations on new plastics projects	occasional
20	Agrani Bank - Dhaka	-do-	occasional
21,	Tarrif Comission - Dhaka	taxation of plastics	continuous
22.	National Board of Revenue - Dhaka	taxation of plastics	continuous
23.	Planning Commision - Dhaka	prospects of PVC application in Bangladesh, consultations	occasional
24.	Dhaka Polytechnic Institure Tejgaon, Dhaka.	consultations and demonstrations of plastics processing	continuous
25.	Director General of Industries Dhaka	Government policy to plastics industry	occasional
	E. FOREIGN INSTITUTIONS		
1.	Central Institute of Plastics Engineering & Tools - Madras, India	experts' assistance & staff training in mould making	continuous
2.	Institute of Polymer Technology, University of Technology - Loughborough (U.K.)	Training staff for the centre and BUET, colaboration with BUET	continuous

Appendix 8

List of Study tours, 2nd phase (BGD/77/025) only

NAME (Institution)	Subject	duration	starting date
1. BHUIYAN, M.U. (BITAC)	Visit to International Plastics Exhibition "Japanplas 78" in Tokyo.	2 weeks	November 1978
2. SIKDER, S. (Plastice Technology Centre)			
3. FAROOK, Y. (Bangladesh Chemical Industries Corporation)			
4. SIKDER, S. (Plastics Technology Centre)	Training in operation and maintenance of INSTRON mechanical properties tester	5 weeks	October 1980
5. SIKDER, S. (Plastics Technology Centre)	"Development in Plastics Processing and Application-81" (Visit to International Plastics Exhibition "Interplas 81" in Birmingham & to plastics industries in europe	5 weeks	October 1981
6. RABBANI, G. (Plastics Technology Centre)			
7. MATIN, G.A. (Bangladesh Chemical Industries Corporation)			
8. RAHMAN, M.H. (Karim Rubber Industries Fotullah)	In-Plant Group Training Programme in the field of Plastics Technology, UNIDO, Vienna.	7 weeks	October 1982
9. CHOUDHURY, A.M.S. (Bengal Belting Corporation, Chittagong.			
10. ISLAM, M.A. (Karnaphuli Rayon & Chemicals, Chandragona)	Group Training Programme "Production & Application of Synthetic Fibres", UNIDO, Vienna.	4 weeks	October. 1982
11. AHMED, K. (Pylon Industries, Chittagong,			
12. KHAN, A.K. (Kerolin Silk Mills, Chittagong.			

contd. 2.

NAME (institution)	Subject	duration	starting date
13. SIKDER, S. (Plastics Technology Centre)	"Development in Plastics Processing and Application-82" (Visit to International Plastics Exhibition "Japan-plas-82" and to plastics industires in Japan).	3 weeks	November 1982
14. RABBANI, G (Plastics Technology Centre)			
15. ILAHI, M. F. (Bangladesh University of Engineering and Technology)			
16. AHMED, K. (Lira Industries Enterprice, Tongi.)			

Appendix 9

GHORASHAL CONTAINERS LTD.

Manufacturers of Pharmaceutical Cosmetic and other Plastic Bottles & Containers

Head Office Plot No 34 Road No 46 Gulshan Model Town Dacca Bangladesh G P O Box 265 Cable DIPSUPLY Tel 300210 300219

5th February, 1982

BITAC
Plastics Centre
Tejgaon Industrial Area
Dacca.

Attn: DR. MISTEREK

Dear Sir,

We take this opportunity to thank you for the excellent co-operation extended to us for setting up our Plastics Blow Moulding Plant.

We sincerely believe that without your technical a stance it would be extremely difficult for us to overcome certain problems specially in selecting the right kind of machineries for our project.

Your co-operation and assistance has not only helped us in solving the technical aspects of our project but it has contributed to saving a considerable sum of money in foreign exchange for us. You will recall that we were going to import alongwith other machineries, an air-cooled chiller from Japan which would cost us US$.16,000.--. But as suggested by you we finally decided to import the chiller from Messrs. Coolmation Limited, U.K. at STG.£.4185.-- which resulted in a saving of US$.8500.-- for us.

As you know we don't have plastics' experts in our company we only hope that your centre will continue to render its invaluable assistance to us in the future as it has always done in the past.

Thanking you once again, we remain,

Yours faithfully,

A. Hossain

NAZMUL HOSSAIN
DIRECTOR.

Appendix 10

Cable :
AL MAHMUD
P.O. Box : 752 Dacca

PHONE : Factory : 38[illegible]
Office : 25[illegible]
Telex : 732 DAC CHAMBER
(ATTENTION-AL MAHMUD

UNIVERSAL PLASTIC INDUSTRIES LTD

Factory :- 102, 103, 104, Mirpur Housing Estate
Industrial Area, Section-3
Block--A, Dacca.

Office : 65/66, Motijheel C. A.
Dacca Chamber Building
(3rd Floor) Dacca.

Ref _____

Date 25-11-1981

Plastics Technology Centre
(Project Egd/77/025)
BITAC, Tejgaon I/A,
Dacca - 8.

Attention : Mr. Boruslaw W. Misterek

Dear Sir

We are extremely grateful to your Centre and yours goodself in particular, for your kind assistance in selecting the grade of Plastic and the processing for the same to produce 1,50,000 pieces of Fan Regulator Cover for "MILLAT" Fan. We were producing the cover with Polysterine (high impact). But your advice to produce it by Polypropyline has not only increased the quality of the product but also saved at least Tk.2,00,000/- towards our cost of Raw Materials in Foreign Exchange in this particular order.

This is a wonderful financial and technological gain for us.

We firmly believe that your Plastics Technology Centre shall continue to render enormous service towards the industrialisation of the country.

We once again express our gratitude for your kind assistance.

In the meanwhile we assure you of our best co-operation at all times.

Thanking you,

Yours faithfully
for Universal Plastic Ind. Ltd.

(A. Satter Mahmud)
Managing Director.

Appendix 11

Availability of the essential documents of the Project

The following document, not included in the report, are available on request from the project Plastics Technology Centre, BITAC premises, Tejgaon 1/A, Dhaka-8, Bangladesh (they should be also available at: External Resources Division, Ministry of Finance of Bangladesh, Ministry of Industries of Bengladesh; UNIDO Headquarters in Vienna):

1. Project Document BGD/72/025
2. Project Document BGD/77/025
3. Project Document BGD/81/032 (3rd phase project)
4. Project BGD/72/025 budget revision "K" (final)
5. Project BGD/77/025 budget revision upto "P".
6. Report of Tripartite Review meeting in 1977
7. Report of Tripartite Review meeting in 1979
8. Report of Tripartite Review meeting in 1982
9. Report of Tripartite Review meeting in 1983.

4.10.02

AD.86.07

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