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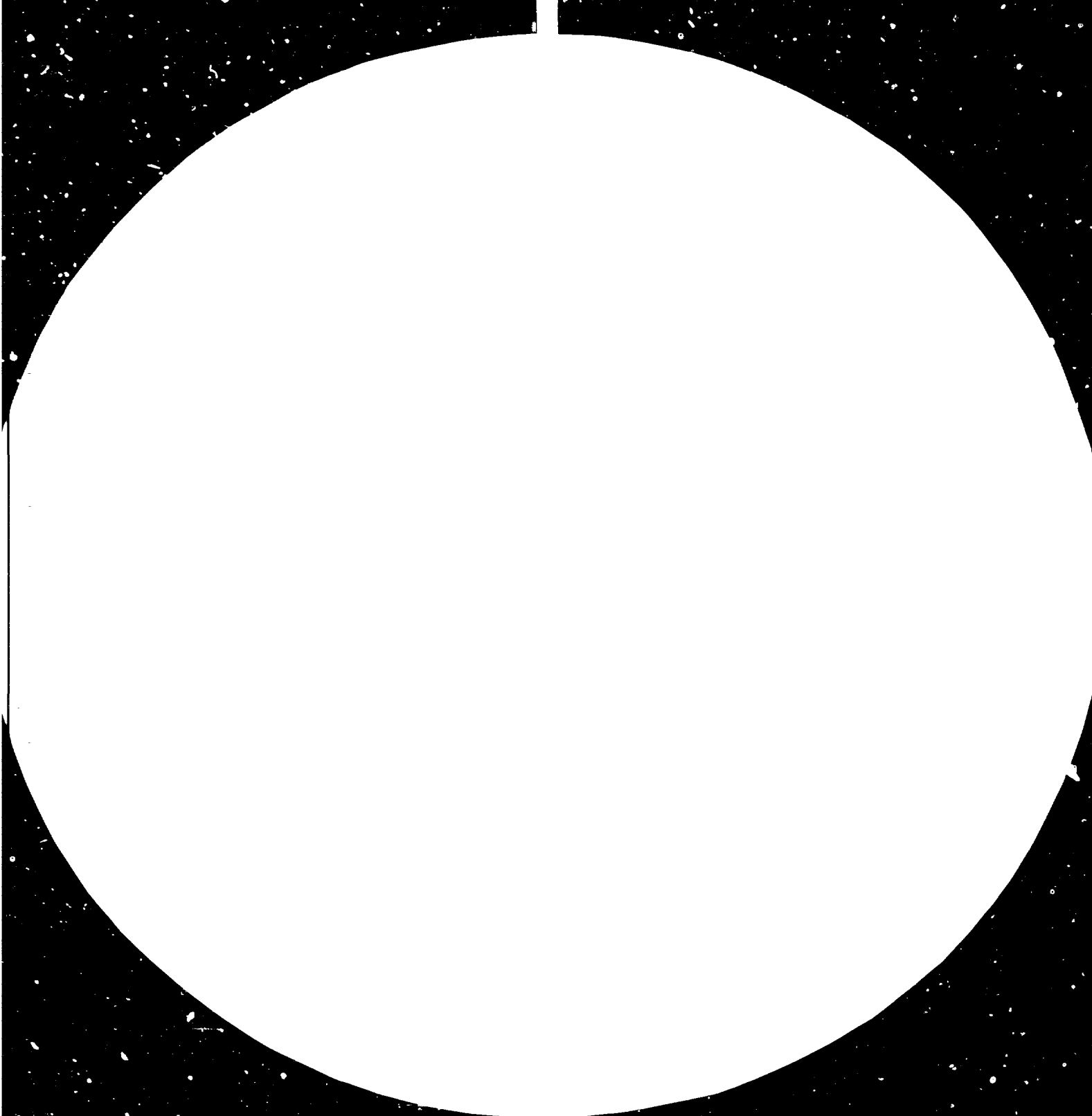

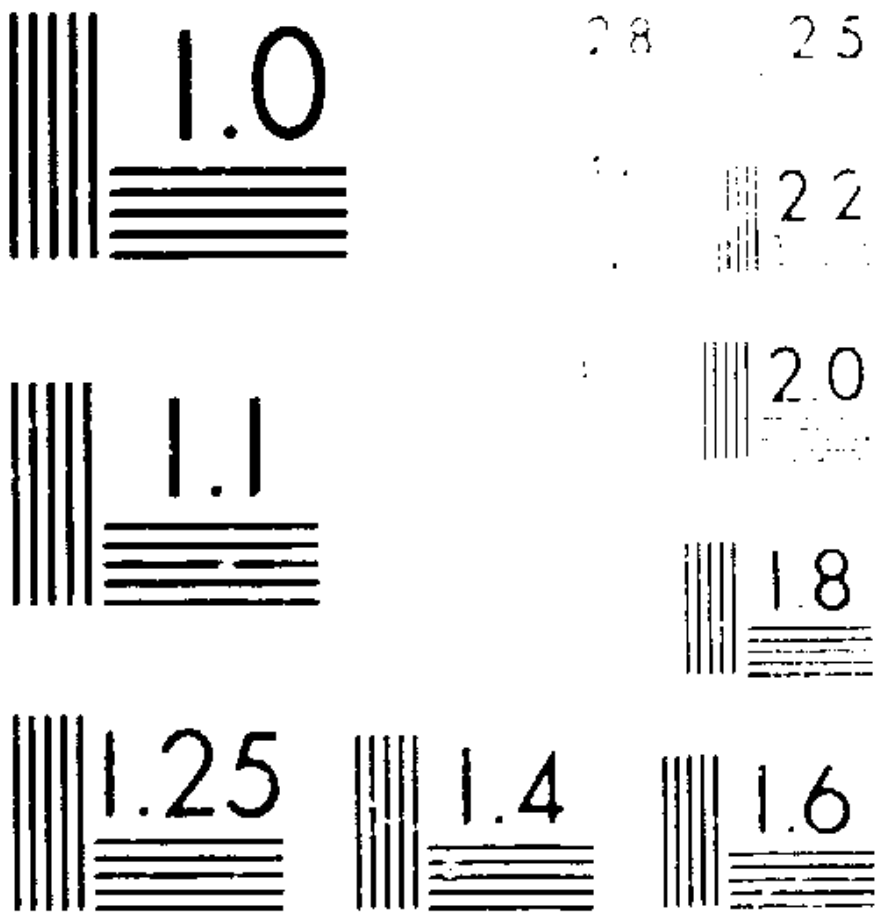
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WAYS AND MEANS IN WHICH TO DEVELOP THE INTERNAL MARKET FOR PLASTICS IN DEVELOPING COUNTRIES AND THE FORM WHICH INTERNATIONAL CO-OPERATION COULD TAKE.

by

C.A. Brighton**

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** UNIDO Consultant.

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SUMMARY

The growth rate of plastics is expected to continue at about 9% p.a. during the next decade as compared with about 15% p.a. before the oil crisis. There are enormous opportunities for much higher growth rates in Latin America, Africa, Middle East and other Asian countries.

The plastics industry comprises many different elements which range from the manufacture of monomers and polymers to the supply of equipment and a wide range of other chemicals which are essential for the processing of polymers to finished products.

The plastics industry in developed countries has expanded dramatically over the last three decades as a result of substantial investments by the major chemical and plastics companies on increasing output and helping, by co-operation with fabricators, the equipment suppliers and users, to extend the range of applications for plastics materials.

While such experiences and technical resources can help to establish a plastics industry in a developing country, the pattern of development will be different and must be aimed maintainly at helping to improve the basic needs of the people by the use of plastics in agriculture and housing where these materials have so much to offer. Where oil and gas resources are not available it should be the long term aim to produce synthetic polymers from indigenous raw materials.

There are several factors which must play a vital role in the direction and pace of establishment of a plastics industry. The type of plastics products required are not necessarily those which are produced in an industrialised country, but will be those which can be used for a wide range of applications, these include pipe, film, sheet and containers.

It is suggested that a preliminary survey should concentrate on establishing those areas where plastics can overcome problems concerned with agriculture and housing and the definition of projects which require the design and production of products by appropriate techniques, specially suited to the country. Industrial research and development organisations in developed countries are well suited to carry out such work, they have vast technical experience and laboratory facilities where prototypes can be made and tested.

The provision of training facilities in plastics, and all the associated disciplines, is considered to be of vital importance, and these are required for technicians and engineers as well as for shop floor supervision. Experience in marketing and product development is needed also. It would be a considerable advantage if trained personnel from the country itself could participate as fully as possible in the projects under development.

Developed countries can help in establishing plastics manufacture and processing at both government and industrial level. Financing

will be of crucial importance not only for supporting development projects but also for setting up joint manufacturing ventures. Academic personnel will be needed for planning courses in plastics and polymer chemistry at both university and high school level. University research must be developed so that properly trained personnel will be available for ultimately setting up a research and development organisation for plastics. Industry in developed countries should provide training for graduate personnel within their organisation in all the aspects needed for establishing a progressive plastics industry.

It should be possible to co-ordinate the supply of surplus processing equipment through the agency of plastics trade associations operating in the various industrial countries.

The emphasis should be guidance of capable trained personnel in the developing countries so that they can help in the planning and take over the organisation of a plastics industry at the earliest opportunity.

It could be helpful to arrange a conference between a number of developing countries and certain industrial research and development organisations together with plastics trade associations to create a better understanding of the possibilities of collaboration.

1. INTRODUCTION

Synthetic polymers which mainly comprise plastics, synthetic rubbers and synthetic fibres are now well established as raw materials in their own right. The overall world production in 1976 was about 65 million tons, of which 48 million tons was plastics while the remainder was almost equally divided between synthetic rubbers and fibres. Over the last decade up until the time of the oil crisis, the growth in the use of plastics averaged about 15% p.a., thermoplastics materials making much stronger headway than the thermosetting resins, and after a period of stagnation during the last three years, overall growth is expected to average about 9% p.a. in the next decade. This growth will be accompanied by at least corresponding growth in the petrochemical industry since this is now the main supplier of the monomers and chemicals for the manufacture of synthetic polymers, thus plastics and other synthetic polymers account for about 35% of the overall usage of petrochemicals.

Up until the present, the production of plastics has been largely concentrated in W. Europe, U.S.A. and Japan, these countries account for 80% of world production but this is expected to decline to 72% by 1990. Eastern Europe's share accounts for almost 10% of production and this will increase to over 14% by 1990. The greatest growth will undoubtedly take place in Latin America, Africa, Middle East and other Asian countries, largely by technological co-operation with

large multinational companies, and it can be anticipated that the petroleum rich countries of the Africa - Mideast region will become exporters during the 1980's.

This is the general pattern of events as predicted by many forecasters, but in those areas where the chemical and plastics industries are not yet established to any great extent, there is a necessity for plastics because the technology developed in the industrial world has created ways and means of greatly improving living standards and for this reason alone, there will be considerable expansion in the plastics industry, and the use of plastics products. It is therefore the aim that the extent to which this takes place, will be in accordance with the declaration of the Second General Conference of UNIDO, held at Lima, Peru, in March 1975 that the share of total world industrial production of developing countries should be increased to at least 25% by the year 2000 (Lima Declaration and Plan of Action on Industrial Development and Co-operation, ID/Conf. 3/31 Chap iv, para 28).

2. DEFINITION OF THE PLASTICS INDUSTRY

Before giving detailed consideration to the ways and means by which the use of plastics can be developed in those areas where the present usage is very low, it is as well to ensure that the various elements which go to make up the plastics industry in developed countries are understood, these are:

a) Manufacture of Polymers - this involves the conversion of monomers such as ethylene, propylene, styrene and vinyl chloride into plastics raw materials.

b) The Manufacture of Additives and Plasticisers.
These are essential for the processing and ultimate performance of the plastics articles produced.

c) Conversion of polymers to semi-finished and finished products.
By semi-finished products, it is intended to mean those which may need subsequent fabrication to make a useful product (e.g. flat sheet).

d) Fabrication of consumable items from semi-finished products.

e) Production of Engineering items (e.g. moulds) for conversion processes.

In a developed country, all of these particular elements work very closely together so that the plastics industry becomes a network of different skills and technologies which are dependent on each other for the ultimate efficiency of operation and quality of product as presented to the consumer. It will not be practicable, where no plastics processing exists, to introduce all the above facets of the industry at the outset and indeed, it would be unwise to attempt to do so. However it will be as well to realise that a plastics industry can only become firmly established if there is a proper plan for the future with the aim of developing ultimately all the above elements. The manner in which this is done will not necessarily follow the evolution of the industry in developed countries but it is helpful to set out the various factors which have been involved.

3. PATTERN OF DEVELOPMENT OF THE PLASTICS INDUSTRY IN INDUSTRIALLY DEVELOPED COUNTRIES

The development of the plastics industry has resulted from the co-ordinated efforts of the different sectors which are responsible for the various elements of the industry together with the ultimate users of the products. Plastics materials are generally more costly than naturally occurring raw materials so that in order to become established in many fields of application, they have to show not only superior performance characteristics but also economic advantages by use of highly efficient processing techniques. This has resulted from substantial financial and technological investment by the major chemical companies, (the producers of the main polymers), in order to obtain a rate of growth which for a long period prior to the oil crisis, led to a continuing reduction in price structure. In addition, the designers of processing equipment have realised that with the prices of polymers becoming more competitive with established raw materials, the increasing consumption required more efficient and sophisticated conversion techniques so that full advantage could be taken of the basic potential of plastics particularly in the packaging industry which has now overtaken the building industry in being the largest user. The manufacturers of the several additives which play such an important part in the conversion to the finished product and also in its ultimate performance have contributed an important role in helping to maintain the growth rate at about 15 per cent per annum.

All of these various sectors have worked closely together, new grades of plastics have been developed with special processes and even specific machines in mind - the consumer has demanded improved products and, as polymer prices have fallen, at lower and lower prices. This was the situation in 1973, when in spite of large investment programmes, the major polymer producers were forced by the general market conditions to sell at uneconomic prices and the converters to do likewise. It is unlikely that such a situation could develop in a country which is not yet firmly established in the plastics industry but it can be envisaged in certain sectors on a limited scale. However, opportunities will continue to increase for plastics as it is anticipated that in spite of higher oil prices, they will become more competitive with established raw materials. The reason is that plastics products require in general less energy to make than from traditional raw materials, even allowing for the oil used as feedstock.

The outcome of this situation is that in developed countries, the plastics sector, in all its elements has become one of high technology, requiring high investment both financial and in human endeavour and the minimum of operational labour; this implies a high rate of obsolescence so that continuing high investment is needed to maintain its competitive position.

4. MARKET REQUIREMENTS IN DEVELOPING COUNTRIES

In general, the evolution of the internal market for plastics is likely to follow entirely different patterns to those outlined above. Plastics have a lot to contribute to the basic essentials of life and in those countries where these aspects are being given priority, the applications for plastics need to be given special attention. They will be mainly concerned with

Food Production and Storage

Water Distribution

Housing Improvement

The requirements will differ according to a number of existing factors such as

a) the extent of industrialisation

b) the availability of skilled labour

c, raw materials available

d) general living standards

e) finance available

Conversion processes for the manufacture of plastics products have become, over recent years, very sophisticated requiring high capital investment with the minimum labour for operation and also having high production rates of uniform standard articles. In general, these are not what are required in developing countries where there is a limited demand for basic products and a chronic shortage of skilled personnel who are needed not only to control the manufacture but also to guide

the consumer to ensure that products are used effectively. The type of plastics products are not necessarily those which are produced in abundance in an industrial society but rather basics such as pipe, film sheet and containers which can be used for a whole range of applications.

The main areas of application will be in agriculture and house construction. Agriculture will include not only crop production, with the various techniques for handling, storing and conserving water but also in the storage and shipment of agricultural products, particularly where export markets are involved.

Where plastics are being considered for housing construction and improvement then it will be essential not only to make use of local raw materials but also to take account of any socio-logical aspects.

The aim of the market development must be the most effective use of plastics to improve the standard of living and the GNP, with due regard being taken of the long term aim to make the fullest use of the local resources and establish the market on the widest possible geographical base. It has already been pointed out that ultimately the plastics industry must include all the various elements set out in para. 2 but it is likely that only sectors c and d could be introduced in the early years and the whole spectrum would require at least 5 to 10 years in most countries and even longer in the least developed areas.

5. RELATIVE IMPORTANCE OF VARIOUS FACTORS TO BE CONSIDERED

The successful establishment and operation of a plastics industry in developing countries requires:

a) The availabliity of raw materials

There are many countries with substantial natural gas and oil resources so that there exists the possibility of the establishing of a petrochemical industry with the manufacture of monomers and polymers. Such a production would require adequate market outlets and it is likely that this could be achieved only by exporting. Countries without these hydrocarbon resources will have to accept that plastics raw materials will have to be bought on the world market unless other manufacturing routes can be adopted. An interesting technique is that used in India where polyethylene is made from ethylene which is produced by dehydration of alcohol, this latter is produced by fermentation of molasses. Nylon 66 was originally made on the commercial scale by Du Pont from corn husks (via furfural) and even at the present time, various types of nylon are made from soya oil, sperm oil and castor oil. Alternatively naturally occurring carbon in the form of wood can be converted by long term energy sources to acetylene which can be converted into any of the synthetic polymers required. At the present time only six per cent of the oil used goes into organic chemicals, and in the long term when oil reserves are dwindling it should be reserved preferentially for this use. In the meantime the time so gained should be used to advantage by developing new routes for organic chemicals - this could be used to great advantage by developing countries.

b) Finance for Investment

This will depend on the extent of the involvement but unless a petrochemical operation is set up, the evolution of the plastics industry is likely to proceed relatively slowly. If this is linked with the supply of equipment and know-how, then joint financing by industry from developed countries operating with local industry could be envisaged.

If well conceived feasibility studies are carried out then the necessary capital may be forthcoming from the international money market for viable projects.

c) Technology, initial and subsequent

In the first instance the technology will have to evolve by collaboration and co-operation with all the facilities at the disposal of UNIDO, and also by working with technological organisations and plastics companies from developed areas.

Unless the manufacture of monomers and polymers are undertaken, the technological requirements are likely to be less sophisticated, at least in the early stages, and the rate at which obsolescence occurs will be slower than in developed countries. If however the export market in polymers and plastics is developed, it will need continuing technological development of both materials and processes to maintain its competitiveness.

There needs to be an understanding of the product requirement and product development, and this will entail continuing collaboration with all the possible sources of technological

input. Organisations will have to be set up to ensure that manufacturing standards and product specifications are maintained particularly where export potential exists.

d) Technical Training

The technical and administrative personnel will require extensive training and background knowledge not only in the manufacturing processes for plastics but also in the use and performance requirements of the finished products. The skills in equipment maintenance, marketing and market development are just as important as the efficient operation of the manufacturing process. There is a wealth of this technology in developed countries and it will be essential to draw upon this in the widest manner possible.

A sound academic background is a prerequisite to a good technical performance and this can be obtained only at an establishment of higher education followed by intensive training in the field. It is preferable that these facilities are available in the developing countries. In the early stages, technical expertise can be provided by consultants, and personnel from industrialised countries but the attitude that 'training on the job' is sufficient has been proved to be inadequate for full and continued exploitation of a process. Motivation can only be developed if local personnel are given every opportunity to become effective and contribute meaningfully at every possible stage.

e) Operational Training

In many areas where opportunities for plastics exist, there is only very limited industrial experience and operational labour has to be drawn from people who are quite unfamiliar with such work. The real key lies with the supervisors who are the link between the people working on the machines and the controlling personnel. Proper training of these supervisors is essential and in fact is probably the most difficult to carry out properly. It entails not only the basic knowledge of plastics processing but also development of normal supervisory functions. There are many examples where equipment has been installed and yet after a relatively short time is not operating efficiently because of lack of shop floor control. Proper operational training for mechanics who will be doing the maintenance work is just as important. For these reasons, emphasis will need to be placed on installation of the more basic types of processing equipment, which requires less control and maintenance.

f) Physical Infra-structure

In many areas there are problems with an inadequate system of public services, such as electricity and water for efficient operation. Product storage and distribution may limit the market drastically so that the full sales potential cannot be realised. With certain types of product such as pipe, effective control can only be achieved if continuous running of the extruder, at least for several days, is maintained and this requires a discipline which is very often not realisable. The supply of

raw materials could be critical and it should be appreciated that the various additives used in plastics compositions play an important role in the actual performance of the product in the field so that minor changes or ommissions of a particular ingredient could have dramatic effects.

g) Pollution and Disposability

Plastics have the advantage that they are very durable and this can lead to problems with accumulations of waste and rubbish. The lessons which have been learnt in developed countries over the last decade should be taken into account right at the outset so that pollution can be avoided and material is not wasted. Recycling must play a much more important role than in wealthier countries particularly when the polymers have to be imported. There must be a sociological appreciation of the need for the conservation and most effective use of the country's resources.

6. HOW CAN THE PLASTICS PROCESSING INDUSTRY BE DEVELOPED?

Although processing techniques and market outlets are well established, the requirements in developing countries are such that a new approach will be called for both as regards the product design and the methods of fabrication. The first stage will be an exploratory mission to establish the potential uses to meet the basic needs of the economy.

a) Aims and Function of Exploratory Mission

In order to carry out an effective operation on establishing the potential applications for plastics over as wide a field as

possible, a well balanced team of UNIDO experts would be needed in the first instance. Probably three would be sufficient to cover all the likely areas such as agriculture, housing and packaging and this could take anything up to six weeks. It would be essential to include a corresponding number of the country's personnel who, if it is possible, have been trained in basic plastics technology, so that a better understanding of the local conditions and habits can be obtained. The main questions would be:

- what products are needed and what are the potential markets?
- are there special problems which might be overcome by designing products in plastics?
- are special fabrication techniques needed?
- can improvements be made to existing exported materials i.e. to reduce losses, improve production and upgrade the quality?
- can plastics products be used on a barter basis with nearby countries?
- is there a possibility of export of plastics products on a world-wide basis?
- what utilisation of local raw materials can be made, particularly in composites?
- is there a possibility of manufacture of basic organic starting materials other than via the use of oil and natural gas?

It would not be possible with such a wide ranging survey to do more than indicate the specific areas for closer study. It is considered that such an approach is essential to ensure that a proper development plan is drawn up and that the right priorities adopted in organising the follow up and in setting up a plastics industry.

b) Project Identification and Follow up

After having identified the possible areas for development, the nature of the follow up must depend on the type of project which is formulated.

i Possible operation of an established process

If it is clear from the outset that there is sufficient demand for the product manufactured, then it remains to work out the details for the manufacture, technical control and marketing to make for a viable operation. If it is possible, the team of experts should co-operate with local technical personnel who would be ultimately responsible for that section of the industry. The importance of having well qualified and experienced personnel has already been stressed, and the project will be more sure of success if these people can be involved at the planning and design stages. Their knowledge of their compatriots and possible reactions to an industrial process may minimise further problems. The project team will have to make detailed proposals on the following aspects -

financing - possible joint operation with established company from developed world

equipment - perhaps surplus items may be available from the joint operator

technical know-how and back-up - appreciation of the need for continuing process and product development

infra-structure - an important aspect

marketing and product application - a proper proportion of the technical effort must be devoted to this sector

raw material supply - essential to make full use of imported materials with recycling where possible

In addition, the team of experts should do a follow up within a reasonable period - two to three years - to ensure that the proposals have been effectively implemented and also to learn from possible mistakes.

ii Applications involving the design of new products

This is where plastics can probably contribute most to an undeveloped economy - it needs imagination from the investigating team to establish fundamental problems and visualise where the properties of plastics can be used to design products to overcome them. This will best be achieved not by trying to collaborate with an industrial manufacturing company which already has a range of plastics products but by making an industrial research and development association responsible for the work. Such associations have no commercial bias so that the problem is studied completely objectively and they have the practical resources in order to make up and test any prototypes.

Naturally, with the design of the product, the manufacturing technique must also be developed and this would be done taking into account local facilities and making the fullest use of the raw materials.

There are a number of universities and colleges of higher education which specialise in research work on plastics and it could be advantageous to study product design in a developing country as a post-graduate research project.

The technical resources in developed countries, as outlined above, are well suited to provide active members of teams of experts in all possible projects where wide experience and extensive laboratory facilities are needed.

iii Development of Polymers from Locally Available Raw Materials

The setting up of a petrochemical industry utilising local oil and gas supplies would involve the same problems as in (i). The expertise and know-how is available from a number of contractors who are skilled in the erection of such plants, and the only problems which remain are the availability of properly trained technical personnel from the developing country, an adequate infra-structure and a good marketing facility.

If polymers are to be produced, then it can be assumed that in the first instance, existing know-how would be used by collaboration with a major manufacturer. Since

polymers requirements are constantly changing, there is need for continuing development of improved grades, and provision must be made for further development either through the partner or by setting up research facilities within the country itself.

Where no hydrocarbon resources are available, it would be necessary to import polymers from other countries so as to allow the plastics fabrication industry to become firmly established. In the long term, it would seem to be logical to consider the manufacture of polymers by other routes, such as polyethylene from alcohol produced by fermentation of molasses. This technique can be extended since ethylene is the starting material for other monomers such as vinyl chloride and styrene.

Study projects on the looking for new routes from plant life should be undertaken if possible within a research organisation in the country itself but in the first instance, this could best be undertaken by universities and research organisations in developed countries.

iv Added Value to Export Products

Many developing countries earn the greater part of their foreign currency by export of natural products, which are subject to continuing price variation in world markets. It is essential therefore to ensure that the overall productivity and quality is as high as possible. There are always possibilities that this can be achieved by use of plastics and any study projects would involve teams which

include experts in plastics and also in the products under consideration. It would be absolutely essential to include local people so as to have the benefit of full understanding of the problems and conditions. It is likely that after the problems have been identified, the resources of the research organisations would be needed to provide the practical answers.

In pursuing the development of the plastics industry, full use will have to be made of all the technical resources in developed countries, but in order to achieve effective results, it will be necessary to develop the technical expertise within the country itself so that projects can be studied on a collaborative basis.

7. Essential Resources

Progress in the establishment of a plastics industry will proceed more rapidly in developing countries if the local resources, men and materials, can play a major role

a) Human Skills

The need for properly trained technical personnel seems to be common in all developing countries and this can only be overcome by:

- Introduction of plastics and polymer chemistry in both university and technical school courses
- Exchange of science and engineering graduates to industrial companies in developed countries. (It is essential that this should be restricted in the first instance to graduates who will be working in the industry when they return.)

- Provision for training engineering maintenance personnel.
- Development of technological skills in relation to market development and product use.
- Training in management skills.
- Setting up research and development facilities either as an independent organisation or as post-graduate training within a university.

b) Equipment

There will be a need for:

- Equipment suitable for the production requirements and for the technological experience available.
- Engineering facilities for making items such as dies and moulds
- Equipment for the utilisation of the plastics products e.g. pipe-welding tools.
- Items of equipment to sustain an adequate infra-structure.

8. HOW CAN DEVELOPED COUNTRIES HELP?

a) Provision of Finance by Industrialised Country Governments

i. of joint manufacturing operations with established companies which would provide the know-how. This could overcome the reluctance by companies to invest directly in the countries because of the difficulty of ensuring a viable operation and other financial problems.

ii. of projects for study of potential applications for plastics and implementation by government and industry controlled scientific organisations.

iii. of university research projects for graduates from developed countries to study plastics manufacture and use.

iv. of technological training of graduates from the countries concerned at universities and within industrial organisations in developed areas.

v. by secondment of teachers from higher education establishments in industrialised countries for setting up plastics courses at all levels.

vi. of research and development facilities.

vii. by subsidies on supply of plastics raw materials for an extended period.

b) Industry Co-operation

i. by setting up jointly owned companies directly with the developing government or with local industry. This could ensure continuing in-flow of technological know-how - this assumes however that the commercial product range of the company concerned can be readily assimilated into the economy.

ii. by carrying out in their own laboratories development studies of special products requirements, this could include monomers, polymers and finished products.

iii. provision of personnel for training establishments to be set up in developing countries.

iv. provision of training facilities for graduates, from the developing country, within the company organisation on:

manufacturing techniques

technical and quality control

product development

market outlets

v provision of training facilities for engineering personnel on equipment design, manufacture and maintenance.

vi supply of raw materials and acceptance of finished products on a barter basis.

vii liaison with Plastics Trade Organisations on co-ordination of projects, particularly with regard to organising redeployment of surplus equipment and tools from the industrial country.

CONCLUSIONS

There is a wealth of plastics technology associated with industrial undertakings in the industrial world, but some thought is needed in drawing on these resources for the establishment of plastics manufacturing facilities in developing countries. Individual companies in the industrial world are now under considerable financial pressure, and their technical resources have been reduced to a minimum in an attempt to maintain their profitability. They are, in the main, very reluctant to consider participating in joint operations in developing countries because of uncertainty of the financial outcome.

The research and development organisations however present a very different prospect; although they are supported and controlled by the plastics and chemical industries with some government aid, they are usually enthusiastic in putting their

technical experience at the call of developing countries. Industry is only too anxious to be seen to be contributing as a group when individual companies would hesitate to become involved. However there is unlikely to be any difficulty in finding companies to provide practical training of technologists and engineers from developing countries, particularly if the arrangements are made through the plastics trade associations.

In any survey intended to make proposals for the establishment of a plastics industry, it will be necessary, at any early stage, to assess the potential pattern by which development is likely to take place with special attention to the full utilisation of local raw materials and the effect on the economy of the country. The main requirements will be for products with a range of uses, and manufactured by techniques which are relatively easy to control and maintain. It is likely that suitable equipment could be obtained through plastics trade organisations; equipment which is surplus to requirements of their member companies.

It is not essential that the developing countries should have oil and gas resources to establish the manufacture of synthetic polymers, although it would be quicker to get a plastics industry into being if they were available. The investment required for a viable petrochemical operation could create difficulties and the full utilisation of the plant might cause some marketing problems. Petrochemical operations are only viable if they are running at high capacity. It would be logical therefore

to concentrate efforts on routes for making polymers which do not rely on hydrocarbons.

The industry research and development organisations and the trade associations have all the technical resources and abilities which could make far reaching contributions to the development of plastics manufacturing operations. Universities also could play an important role.

In order to stimulate interest and establish a rapport between these industrial organisations and the developing countries who are facing problems in getting a plastics industry founded, it would be helpful to have an opportunity for discussions between all the interested parties. These could be held in Vienna in the near future when further ideas would be likely to emerge. An understanding of the needs of developing countries and an appreciation of the available resources to help in establishing plastic industries would be a useful starting point.

Developing countries must be encouraged to regard the possible establishment of a plastics industry within their countries as a project which can draw on extensive resources from industry and organisations concerned with plastics but in which they should make every effort to participate by realising that they must have a better understanding of their needs and problems than anyone else.

APPENDIX A

PLASTICS RESEARCH ORGANISATIONS IN EUROPE

(Members of ADICEP)

These organisations are financed partly by the industry and partly by government funds, although their constitution varies considerably one with another. They have one thing in common, a high degree of academic ability coupled with extensive experience and knowledge of plastics technology. All have laboratory and development facilities at their disposal.

Name	Director
Laboratorium fur Kunststofftechnik LKT-TGM der Gesellschaft zur Forderung der Kunststofftechnik, Wien Severingasse 9 A-1090 WIEN	Ernst Schmitz, FV Reg. Rat. Dipl-Chem.
Oesterreichisches Kunststoffinstitut im Chemischen Forschungsinstitut der Wirtschaft Oesterreichs 1030 WIEN, ARSENAL OBJEKT 213.	Baurat h.c. Dr H. Tschamler
Centre Belge d'Etudes des Matières Plastiques et des Caoutchoucs Belgisch Studiecentrum voor Kunststoffen en Rubber Quai Banning, 6 B - 4000 LIEGE.	Dr. Ir. R. Degeimbre

Name	Director
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Deutsches Kunststoff-Institut Darmstadt D-6100 DARMSTADT Schlossgartenstrasse 6 R	Dietrich Braun, Prof. Dr. rer.nat
Institut fur Kunststoffverarbeitung an der RWTH Aachen D-5100 AACHEN Pontstrasse 49	Prof.Dr.-Ing. G. Menges
Suddeutches Kunststoff-Zentrum (SKZ) Institut fur Kunststoffverarbeitung, - Anwendung und -Prufung D-5700 WURZBURG Frankfurterstrasse 15	Wilbrand Woebcken Prof.Dr.-Ing.
Rubber & Plastics Association RAPRA SHAWBURY, Shrewsbury, Shropshire SY4 4NR.	Dr J. P. Berry
Kunststoffen en Rubber Instituut TNO Plastics and Rubber Research Institute TNO Schoemakerstraat 97 Postbus 71, DELFT	Dr. Ir. P. J. Bakker
Instituto de Plasticos y Caucho IPC Juan de la Cierva, 3 MADRID-6.	Prof. Dr. J. Fontan

APPENDIX B

ASSOCIATIONS OF PLASTICS MANUFACTURERS

These organisations are supported directly by the plastics industry and are concerned primarily with the commercial development of its member companies. Their work includes many of the technical aspects which affect the use of plastics. The following are the associations in industrialised countries which are likely to be willing to participate in arranging placement of trainees and co-ordinating the supply of surplus equipment.

Name	Director
AUSTRALIA	
The Plastics Institute of Australia Inc. (P.I.A.), 157 Fitzroy Street, PO Box 131, St. Kilda West 3182. Australia	Robert A. Leschen
AUSTRIA	
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