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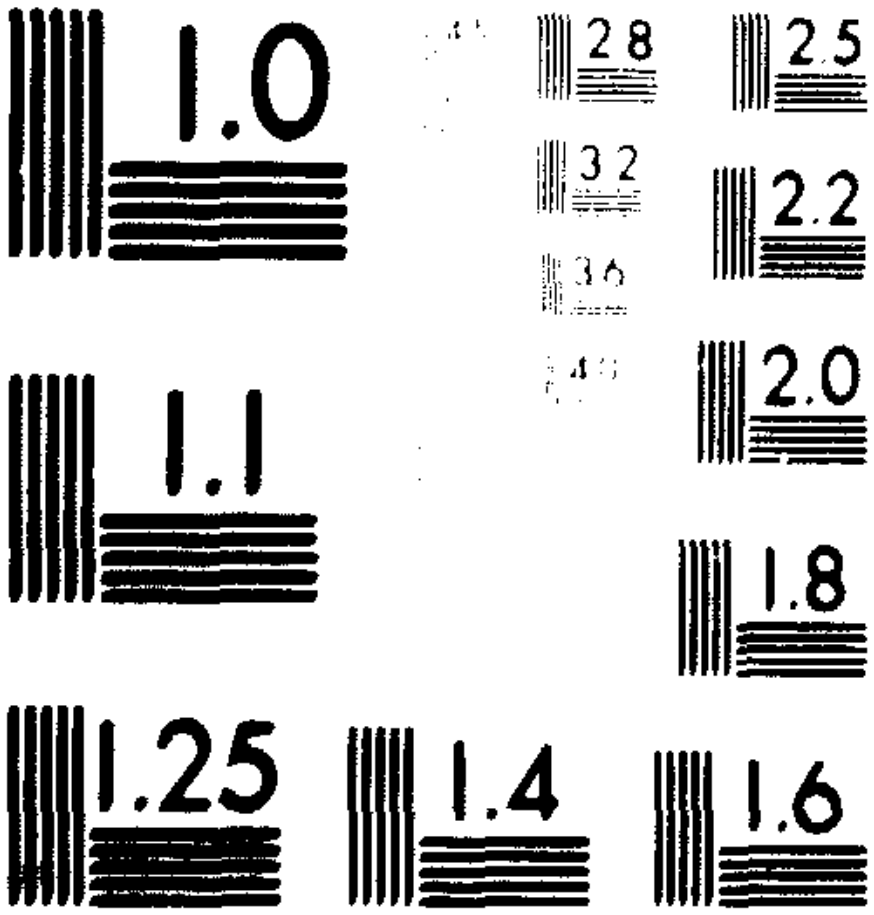

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STUDY ON

# ESTABLISHMENT OF RUBBER & PLASTICS DEVELOPMENT CENTRE IN KUWAIT

Prepared for the Government
of Kuwait

by

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This report has not been cleared with the United Nations Industrial Development Organisation which does not therefore necessary share the views presented.

Part I. RUBBER AND PLASTIC INDUSTRIES IN KUWAIT.

Part II. THE RUBBER AND PLASTICS TECHNOLOGY CENTRE.

Annexes:

## ABBREVIATIONS

| | |
|---|---|
| AIDO | Arab Industrial Development Organisation |
| BTX | Benzene-Toluene-Xylene. |
| GFR | Glass Fiber Reinforced. (or GRP) |
| GOIC | Gulf Organisation for Industrial Consulting |
| GRS | Government Research Station |
| HDPE | High Density Polyethylene. |
| IDC | Industrial Development Committee |
| IDCB | Industrial Development & Consulting Bureau |
| KCC | Kuwait Cement Company |
| KNPC | Kuwait National Petroleum Company |
| KISR | Kuwait Institute for Scientific Research |
| KPC | Kuwait Petroleum Corporation |
| KIT | Kuwait Institute of Technology |
| KU | Kuwait University |
| LDPE | Law density Polyethylene. |
| MCI | Ministry of Commerce & Industry |
| MWE | Ministry of Water & Electricity |
| MO | Ministry of Oil |
| MC | Moulding Compounds. |
| MKD | Million Kuwaiti Dinars. |
| MPH | Ministry of Public Health |
| MTBE | Methterbutyl Ether |
| PE | Polyethylene |
| NIC | National Industries Company. |
| PS | Polystyrene |
| PIC | Petrochemical Industries Company. |
| PP | Polypropylene. |
| PVC | Polyvinylchloride. |
| PU | Polyurethane. |
| SAA | Shuaiba Area Authority |
| VCM | Vinyl Chloride Monomer. |
| Ton | Metric Ton. |

Part I

# RUBBER AND PLASTICS INDUSTRIES IN KUWAIT

Part I

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## 1. INTRODUCTION

Plastics and Rubber industries were introduced in the manufacturing sector of the Kuwaiti economic structure 25 years ago with very few and small in size establishments. The development of these industries did not follow, due to the rapid changes in the economic growth rates during that peridd, the natural gradual growth. Such country is facing the problem of skill shortage and other problems [illegible] will have soon 50 establishment using round KD 60 million as investment and dealing with about KD 32 million raw and semifinished material mainly importdd.

The Government is studying to set up a huge petrochemical complex to produce annually 160000 tons LLDIE and some important intermediate products. The realisation of this project together with other two private projects will raise the investment in this field up to KD 530 million. Such massive increase in supply of polymers requires urgent need to expand present market, to identify and develop new fields of application, to increase the processor's capacity in order to exploit more the added-value gained.

In order to secceed in penetrating into a free market, like Kuwaiti market, with a new product, the [illegible] manufacturing up to the standards accompaind by quality control measures. For the majority of the local processors this will be a new experience and will necessitate international communications and services to enable the industry to adapt itself to the changing circumstances.

In order to support the plastics and Rubber industry [illegible] to successfully meet such challenges in market identification and

and development, transfer and adaptation technology, creating and up grading of skills, creating new investment and employment opportunities through the expanding process capacity, a specialised organisation geared to such services is to be established.

Such organisation was suggested to be established in the report No MT/90/82 dated 24/3/1982 prepared by the same petrochemical Expert during the period of the project No DP/KUW/79/009/11-03

The proposal was accepted by IDC on 22/9/1982 and detailed study was requested by the committee. The project of studying the development of Rubber and plastics industries and the possibility of establishing a specialised centre for its development, was included in the country programme having the number DP/KUW/82/007/01/37. The objectives, the technical and the financing requ requirement of the centre are the subject of the present report. The report also includes a proposed plan of action for setting up the centre.

# I. GENERAL REVIEW OF MANUFACTURING SECTOR SITUATION WITHIN THE KUWAITI ECONOMY

## - Present Economic Structure

It is unquestionable that the Kuwaiti economy depends essentially on oil activities and that its development reflects directly its impacts on the overall economic and financial activities.

The share of the oil sector in GDP increased rapidly during the past twenty years from 54.6% in 1967/68 and reached its peak value (77.2%) in 1974/1975 as a result of combined effect of higher production and prices rates. In 1976 oil production rates started to fall and so was its share in GDP. Due to the higher oil revenues that started in the early seventies, the non-oil sector were accordingly developed by different rates of growth.

The GDP of manufacturing sector, as an exampls, became in 1979 more than eight times its value in 1970, the GDP of construction sector in 1979 was also more than six times its value in 1970. Comparatively lower growth rates during the same period were observed in the transport, communiations and electricity/ water sectors. Agriculture and Fishing had the lowest share in the GDP allover the whole period. The highest rate of growth in the total GDP was in year 1974 (table No 1).

## - The manufacturing Sector

The manufacturing GDP grew from KD 42.8 million in 1970 to more than KD 366 million by 1979. This increase implied an annual rate of growth of 27% which was higher than the annual rate of growth of the total GDP at purchaser's price (of 22%) during the same period.

Table No 1

GDP by Type of Economic Activity at Current Prices (million K.D.)

| Years / Kind of Economic Activity | 1970 | 1972 | 1974 | 1976 | 1978 x | 1979 xx |
|---|---|---|---|---|---|---|
| Agriculture and Fishing | 2.9 | 3.8 | 5.9 | 10.3 | 13.5 | 16.7 |
| Mining and quarrying | 618.8 | 914.5 | 3022.7 | 2524.1 | 2520.1 | 4433.8 |
| Manufacturing | 42.8 | 65.4 | 168.6 | 229.8 | 256.6 | 366.3 |
| Petroleum refineries | - | - | - | 109.8 | 118.3 | 204.5 |
| Chem.fertilizers, Plastic | 23.4 | 35.0 | 128.7 | 22.0 | 28.2 | 31 |
| Electricity,gas,water | 7.2 | 10.7 | 12.6 | 18.8 | 22.9 | 26.2 |
| Construction | 28.1 | 38.4 | 62.8 | 122.6 | 176.1 | 180 |
| Trade and Hotels | 85 | 110.7 | 147 | 303.4 | 339.6 | 373.5 |
| Transport, Communication | 29.3 | 34.5 | 50.4 | 72.4 | 90 | 103.4 |
| Finance and business service | 77.9 | 94.8 | 116.7 | 207.6 | 291.5 | 341.4 |
| Social & personal Services | 126.9 | 182.5 | 212.7 | 317.3 | 441.7 | 552.4 |
| Total | 1018.9 | 1455.3 | 3799.4 | 3806.3 | 4152 | 6394.2 |
| Import duties | 7.4 | 8.7 | 13.6 | 33.4 | 42.5 | 45 |
| GDP at Purchaser's Value | 1026.3 | 1464 | 3813 | 3839.7 | 4194.5 | 6439.2 |
| Annual Rate of Growth (GDP) | - | 21.3 | 80.2 | 0.35 | 4.6 | 26.75 |

Source: MP " Annual Statistical Abstract" 1981

(x) may be revised.
(xx) Provisional.

In fact the share of the manufacturing sector in he total GDP was low representing 4.2% in 1970 in 1970 which has increased slightly up to 5.7% by 1979. Many reasons were behind the deficiency of this sector., Some of them are worth mentioning here. First, the direct export of cruide petroleum and natural gas; second, the openoress of the economy for all imported consumable articles and its heavy dependence on importing the required semifinished material; Third, the very low domestic utilisation of saving i.e. investment allocation, in spite of the highest rate of saving the state of Kuwait had, and still has, within the world community. The major part of this saving belongs to the government.

The number of operating establishments in the manufacturing sector, taken as coparative indicator, were only about 2.6% of the total establishments operating in 1975. The number of establishments operating in whole and ratail trades represented 33.4% of this total by the same year. The annual growth rate in number of establishments d during the period 1973-1975 was only 6.7% compared to that of whole and retail trade which was 14.5% (Tables No 2,3). Again, the labour force in the manufacturing sector was only 8.2% of the total active labour force in 1975 where as those in the trade sector represented 15.4% of that total in the same year. The corresponding percentages in 1965 were 7.6% for manufacturing and 12.9% for whole and retail trade. In 1975 about 89% of the establishmat were of small size in manufacturing trade and services, where as lower parcentage in number of establishment were observed in construction and mining. Only large establishment with over 500 employees each were observed in construction, manufacturing & Mining.

Table No 2

Operating Establishment by Size and Economic Activity (1973)

| ploy-rt. Groups | Agriculture & Fishing. | | Mining Quarring | | Manufacturing | | Construct-ion. | | Whole Sales Retail Trade | | Transport & Communications | | Finance & Insurance | | Servicies | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No Est. | No Empl. | No Est. | Np Empl. | No Est. | No Empl. | No Est. | No Empl. | No Est. | No. Empl. | No Est. | No. Empl. | No. Est. | No Empl | No. Est. | No. Empl. | No Est. | No. Empl. |
| | 1 | | 1 | | 33 | | 24 | | 337 | | 3 | | 3 | | 29 | | 432 | |
| -4 | 381 | 768 | 5 | 15 | 2669 | 5665 | 198 | 423 | 10925 | 19488 | 134 | 325 | 369 | 831 | 3559 | 6806 | 17895 | 34341 |
| -9 | 84 | 517 | 6 | 42 | 431 | 2614 | 77 | 496 | 971 | 5979 | 78 | 487 | 145 | 958 | 322 | 1978 | 2115 | 13078 |
| -14 | 34 | 445 | 3 | 49 | 164 | 2193 | 30 | 429 | 276 | 3540 | 39 | 500 | 46 | 585 | 130 | 1695 | 722 | 9436 |
| -19 | | | | | | | | | | | | | | | | | | |
| -49 | 2 | 75 | 2 | 63 | 95 | 2766 | 30 | 669 | 97 | 2944 | 13 | 380 | 17 | 519 | 65 | 1926 | 321 | 9642 |
| -99 | 2 | 126 | - | - | 26 | 1757 | 14 | 990 | 26 | 1715 | 9 | 534 | 7 | 476 | 17 | 1154 | 102 | 6848 |
| 00-199 | 2 | 321 | 2 | 304 | 16 | 2325 | 16 | 2223 | 3 | 429 | 4 | 585 | 3 | 401 | 15 | 1907 | 62 | 9606 |
| 00-499 | - | - | 3 | 1135 | 8 | 2827 | 10 | 3195 | 3 | 895 | 2 | 708 | 6 | 1521 | 3 | 1015 | 35 | 11296 |
| 00 + | 2 | 1444 | 2 | 2431 | 2 | 1943 | 3 | 2880 | - | - | 2 | 2734 | - | - | - | - | 11 | 11432 |
| tal | 508 | 3696 | 24 | 4039 | 3084 | 22090 | 402 | 11605 | 12638 | 34990 | 284 | 6253 | 590 | 5291 | 4140 | 16486 | 21695 | 104679 |

Table No 3

Operating Establishments by Size and Economic Activity (1975)



| Employment Groups | Agriculture& Fishing | | Mining & Quarring | | Manufacturing | | Construction | | Whole Sale & Retail Trade | | Transport& Communication | | Finance & Insutrance | | Services | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | No Established | No Employees. | No Est. | No Empl. | No Est | No Empl; | No Est | No Empl. | No Est. | No. Empl. | No Est. | No Empl | No Est. | No Empl | No Est | No Empl | No Est. | No Empl. |
| -4 | 200 | 548 | 2 | 6 | 2623 | 6408 | 249 | 553 | 11710 | 23287 | 148 | 385 | 522 | 1191 | 4000 | 7991 | 19463 | 40388 |
| -4 | 103 | 642 | 12 | 82 | 529 | 3213 | 87 | 550 | 1167 | 7213 | 80 | 504 | 154 | 1039 | 406 | 2575 | 2544 | 15823 |
| 0-14 | 22 | 259 | 8 | 98 | 104 | 1208 | 33 | 376 | 217 | 2514 | 24 | 288 | 58 | 668 | 90 | 1040 | 550 | 6451 |
| 5-19 | 10 | 157 | 3 | 49 | 67 | 1106 | 13 | 213 | 94 | 1640 | 9 | 151 | 19 | 323 | 51 | 854 | 272 | 4508 |
| 0-49 | 3 | 82 | 16 | 571 | 130 | 3723 | 51 | 1478 | 141 | 4048 | 16 | 496 | 30 | 886 | 96 | 3051 | 484 | 14375 |
| 0-94 | 1 | 70 | 2 | 147 | 41 | 2787 | 26 | 1731 | 39 | 2567 | 5 | 384 | 10 | 630 | 20 | 1391 | 144 | 9712 |
| 00-199 | 1 | 105 | 1 | 128 | 16 | 16 | 2376 | 12 | 1570 | 14 | | | | | | | | |
| 00-199 | 1 | 105 | 1 | 128 | 16 | 2376 | 12 | 1570 | 14 | 2002 | 3 | 395 | 5 | 660 | 11 | 1320 | 63 | 8556 |
| 00-499 | 2 | 695 | 5 | 1532 | 15 | 4384 | 18 | 6132 | 7 | 2131 | 4 | 1088 | 4 | 1321 | 4 | 1903 | 59 | 18586 |
| 00+ | - | - | 2 | 1988 | 4 | 2898 | 9 | 10011 | - | - | 2 | 2000 | 1 | 628 | - | - | 18 | 17525 |
| Total | 342 | 2558 | 51 | 4601 | 3529 | 28103 | 498 | 22614 | 13394 | 45402 | 291 | 5691 | 808 | 7351 | 4678 | 19525 | 23603 | 135924 |

As can be deduced from the published statistics, the majority of the Kuwaiti nationals in the labour force are not in the manufacturing and petroleum sectors but in the commerce and services sectors. This has its direct impact on the development of the manufacturing, and accordingly in the plastics industry, as will be discussed in detail at a later stage.

## III PRESENT STATUS OF THE RUBBER AND PLASTICS INDUSTRY

### 1. Introduction:

The manufacturing of plastics and Rubber products is for the most part a recent development. Prior to 1960, there was little interest in large-scale manufacturing and the prevailing production pattern was characterised by the trend towards the production of consumable articles.

As late as 1960 Kuwait had only 4 factories working in rubber and plastics sector. In year 1977 the nmuber of licensed establishments reached 14. This represented only 1% of the total number of establishment in manufacturing sector, whereas 50% of that number was in cloth cutting and sewing and 17% in furniture. The majority of these establishment were of small and medium sized with respect to both number of employee per each end investment. The period between 1978 and 1981 has witnessed rapid industrialisation. Not only has the number of establishment increased, but also the capital invested in these establishment has also grown. Several factors have contributed to these developments, most of of which have been themselves activities in construction and packaging where huge quantities of plastics products are consumed.

The most characteristic feature of this period.is the absence of the basic material manufacturing for both plastics and rubber industries, and of the public ownership.

The purpose of this section is to present the present status of the manufacturing facilities and the technologies used in each, categorised according to type of product application.

2. Production Facilities Categorised by:

2.1 Process (Table No:- )

The Processing includes both the main (like extruction) and the auxiliary(like thermofarming) methods. The production often include secondary processing such as cut.../ assembling and printing.

- Extrusion

Extrusion is the most widely used process representing 27% of the total number of processing lines presently exist. It is prefered locally in the continuous manufacturing of film/ sheet, tubes profiles, pipes, conduits and sheathing of wire and cables. Single-screw extruders are the most popular, however, twin screws units are increasing in number with wider use in pipe/sheet production. Extruders of small capacities are used for pelletizing,other of higher capacities ( 300 kg/hr )are used in connection with film blowing. PVC and PE are the predominate polymers processed.

Injection

- Injection-molding machines with 3-heating zone cylinders are used in a wide range capacities (one oz-450 oz) are used. Clamp gorces (for new machines) varies from several tons to over 800 ton. Round 40% of equipment have middium range of clamp force with10+20seconds as injection cycle. Eleven production lines are now in operation using mainly PS and PVC.

Table No 4

Distribution of Industry-Units

By major processing

| Process | No Units exist | No Units 1984 | Principal Polymer | Principal products. |
|---|---|---|---|---|
| 1. Extrusion | 15 | 23 | LDPE,PVC,PS,HDPE | Pipes,bags,sheets profils. |
| 2. Injection molding. | 11 | 16 | PS,PVC | Fitting, Housewares,containers, cover. |
| 3. Forming | 6 | 11 | PU,PS | |
| 4. Blow moulding | 6 | 8 | HDPE,PVC | Jerrycans bottles, drums. |
| 5. Open molding (GRP) | 8 | 9 | Polyester,Unsat. | Tanks,boats,pipes. |
| 6. Thermoforming(from semifinishing. | 5 | 7 | PS | Housewares,cups. |
| 7. Compression molding. | 5 | 6 | rubber, melamine and Urea formaldehyde. | utensils,Sanitary-ware-ing. |
| 8. Spraying | 2 | 3 | PU | roof and industrial applications. |
| 9. Casting | - | 1 | Polyacrylic | Sheets. |

NB. Units may contain more than one machine.

- Blow Moulding

It is another moulding process followed in 6 Kuwaiti establishment in connection with either extrusion or injection processes, .

Compression moulding equipment of 20-30min. cycle time, 2000-4000 psi and 100-200 °C temperature are used with thermosets like urea/melamine formaldehyde, unsaterated polyester and valcanised rubbers. The capacities of these equipment are limited and of conventional types with low efficiencies. About 4 valkaniser presses are used for production rings & recladings of tyres.

- Thermoforming.

Five thermoformers ( either vacuum or compression) with wide range of cycles/mins are presently in operation. A modern one is in-line with a sheet extruder of high capacity. Polystyrene is the only polymer presently used.

- Foaming

Foaming is also a common process used to produce blocks of definit volume. The moulding areas from 5-10 $ft^2$ are similar for expanding and fusing pre-expanded IS beads. Similar moulds but with larger areas are used for foaming two-component liquids (polyurethanes).

- Foaming is followed also to produce thin layers through spraying. This process, using polyurethanes, has limited application.

Processes for reinforced Plastics

Open mould is a manual process applied by smaller processors using room temperature curing resins and chopped glass fibres. Centrifugal casting and filament widding are more advanced techniques applied by few relatively larege processors using a rotating cylinrical moulds or mandrels. Heat is used to accelerate curing. About 8 industrial factories & many workshops are working in this field.

2.2 Applications (Table No 5)

2.2.1 Building, Construction and Agriculture

- Insulation Material

These are produced from rigid foamed plastics for example:

- Sheets from formed PS or PU by block moulding.
- Containers and sandwich panels from PS or PU by injection moulding.
- Insulation layers from formed PU by spraying.

The major part of the above insulation material are further processed into walls & partitions for cold stores and similar products. The foamed plastics are the core with double skin made from gypsum plaster, Chipboard, Kraft paper, plywood, glazal, aluminum foil or galvanized steel sheets. Six factories are carrying out such type of production. Annex (2) shows the types of isulating material & products used in Kuwait according to its place in the building & the agency applying it.

- Pipes, Conduits and tubes

Five establishments converts PVC compounds through feeding into extruders, sizing, cooling and cutting into pipes. The production of conduits from PB through extrusion came on stream

Table No 5
Number and Capacity of Establishment
by product-application.

| Product Type | No Est. | Total annual capacity Capacity | Unit | Major final products |
|---|---|---|---|---|
| 1 Building, Construction, Agriculture: | | | | |
| Insulation material | 3-8 | 4460 | tons | Sheets, panels, doors, roofing. |
| Pipes, Conduits. | 8 | 6700 | tons | Pipes and conduits for water, electricity and drainage, irregation. |
| GFR-plastic tanks | 8 | 25600 | tanks | Water and Chemical tanks. |
| Sheets & films. | 4 | 1600 | tons | cups, Agriculture film sheets. |
| Tiles | 2 | 500 000 | m2 | tiles |
| 2. Packaging | | | | |
| Bags | 6 | 7600 | tons | Shoppings & fertilizers bags. |
| Cups | 6 | 5000 | tons | cups, yugort. |
| Bottles and Jerrycans | 2 | 2180 | tons | beverage bottles. |
| 3. Industrial | | | | |
| Wire/Cable | 1 | 6000 (cables) | ton | cable, wire. |
| 4. Furniture & Furnishing | 3 | 3000 | ton | matresses. |

| Product Type | No Est. | Total annual Capacity | Capacity Unit | Major final products |
|---|---|---|---|---|
| 5.Houseware | 5 | 700 | Tons | dinnerwares,mats |
| 6.Recreational | 7 | 1300 | boats | boats, |
| 7 Engineering | 3 | 290 | Ton | Oil seal,Tyre-retreading. |

last year. The majority of pipes are produced through vacuum sizing technique. Fitting are manufactured from PVC or polyacetals by injection. Socket forming machines are also available. continuous filament winding and resin casting are applied for the production of large pipes. Profils are produced from soft PVC through extrusion. Agriculture pipes and films are produced in a single processer from PVC through extruction. Maximum diameter of PVC pipes are 250 mm and of GRP pipes are 2500 mm.

. Tiles and floor covering

Two licenses were given to produce PVC tiles through - extrusion, only one establishment was erected. The production was stoped due to technical and marketing problems.

. GFR- Plastics tanks

They are manufactured from unsaturated polyester and glass fibre mats or rovings. Three large companies produce tanks (2-300 m3/tank) machanically by compressing impregrated chapped strands.

.2.2 Industrial Products

• Furniture and furnishing.

Only one type of flexible Polyurethand foam of Polyether type is manufactured in three establishement through two-component injection.

The foamed blocks are further processed to manufacture matresses and pillows. The waste is ground and used partially in pillows or sold after compression in block forms.

- Cable and Wire sheathing / insulation

This is done in a single big establishment through extrusion of flexible PVC compound of suitable ingridients. The process is done using crosshead die under pressure to give products of specific standards requested by the authorities.

- Taps and Cords

Two factories produce taps and cords by extruding p.p.

2.2.3 Packaging

- Shopping & garbage bags

Shopping bags are made from continuously extruded blown film. Six establishment (out of 14 establishment in Packaging field) have extruders for manufacturing bags from LDPE and HDPE.

- Fertilizers bages

A single big company produces woven bags for fertilizers packagingfrom pp film. A protective PE-bag is inserted into each pp bag.

- Cups with/without covers

Cups 50cc -1000 cc are produced in three companies through thermo forming of polystyrene(GPPS-HIPS) sheets by pneumatic means (Vacuum or Compressed air). The waste trim is ground and fed back into the extruder for making sheets to be thermoformed.

- Bottles, Jerrcans and containers

They are produced in two companies by injection or blow molding

of HDIE, LDIE and PVC. The bottle size varies from few cc up to 5 litre.

2.2.4 Household Articles

Houseware are made from polyethlene by injection and from melamine formaldehyde by compression moulding. Only few articles (like dinnar wares are produced in 5 establishments.

2.2.5 Recreational

Only boats ( [illegible] ) are produced from GFR. Polyester in 7 establishment.

2.3 Location :

Kuwait has established and is in the process of completing several industrial areas. The lrgest of these areas is the Shuaiba, which isdesigned especially for heavy and medium size industries related mainly to petroleum. The plants allocated in this Area have a sort of relation with each other.For instance, one factory is producing woven pp bags for the fertilizer plant, another is producing melamine from urea manufactured in the adjacent plant. Five plaxtic factories are operating in this area covering 234 700 $m^2$ equivalent to 57% of total area covered by the rubber and plastic factories.Eighteen factories covering an area equivalent to 27% of the same total area are allocated in a new industrial area (Sabhan) near the Kuwait International Airport. This indicates that the factories allocated in Sabhan Area are of smaller size than those allocated in Shuaiba area. The industries located in Sabhan area (mainly food industries) consume a greater part of the plastics products processed in these factoreid.

Showeikh Industrial Area was also for heavy and medium industries including metal pipes, flour mills, Fisheries, besides the plastics industries producing insulation materials and packaging

products. According to the Amiris decree the industrial establishment in this area will be gradually demolished.

ALRAI industrial Area includes foamed plastics industries for insulation and furniture besides GFR-plastics, wood, paints, varnish and metal production.

The Other industrial areas have few plastics establishments, they are more specialised in metal pipes prefabricated houses, Asphalt production Storage and maintenance facilities for construction equipment. Table No shows the distribution of R & P industries among the a.m. industrial areas.

Table No ( 6 )

Distribution of Rubber and Plastics Industries according to Industrial Area

| Name of Industrial Area | Area (1000 $m^2$) | Rubber and Plastics Industries distribution | | | Remrks |
|---|---|---|---|---|---|
| | | Number | Total Area occupied 1000 $m^2$ | Percent | |
| 1. SHUWAIKH & MINA ABDALLAH | 23 660 | 5 | 234.7 | 57.4 | Olefin project not included |
| 2. SUBHAN | 674 | 18 | 113.0 | 27.6 | |
| 3. AL-SHOWEIKH | 10 000 | 9 | 18.0 | 4.4 | |
| 4. AL RAI (total) | 1 950 | 6 | 35.0 | 8.6 | |
| 5. AL-AHMADI | 692 | 1 | 3.0 | 0.7 | |
| 6. FAHAHIL | 210 | | | | small scale Industries |
| 7. KIBAR AL MUQUALEEN | 140 | 3 | 5.3 | 1.3 | |
| 8. AL SALIBIAH | 830 | | | | |
| Total (mid 1982) | 38 156 | | 409 | 100. | |

## 2.4 Investment :

The total capital invested in the rubber and Plastics industries has increased by more than folds during the period 1974 to 1982 reaching K.D. 28.7 m. in 1982. This is mainly due to the increase in capacities of pipe manufacturing with investment reaching 28% of total capital and of insulation material manufacturing having 26% of the total capital. Packaging represents the third field of interest having 12.8% of total capital invested.

The majority of the factories have capitals between KD 0.5-1 m few factories have capital below KD 0.5m. few have capitals round KD 2.0m and only 4 factories have capital above KD 4m.

## 3.0 Assisstances and Incentives :

The incentives offered to the plastics and Rubber industries Establishment fall within the boundaries of the general industrialisation policies directed to realise certain objectives. The most important incentives given are the following:

- Provision of industrial sites in the industrial areas at nomial rates, (75-150 fils/$m^2$)
- Provision of loans or participation in equity Capital through the IBK.
- Exemption of imported machinery, equipment and raw material from custom duties during the first year of the plant operation.
- Supply of Utilities at subsidised rates.
- Tax exemptions of corporate profits from 5 to 10 years starting from the date of operation.
- Protective tariffs on competing imported products having adequate characheristics with the local production for maximum of 10 years.

- Preferential treatment of local products in government purchases of similar technical specifications with imported goods.
- Exemption of locally manufactured products from all export fees and duties.

IBK is the main source of industrial loans in Kuwait.

IBK supplied 114 projects with total loans of KD 173.5 million during the years 1974-1981. The chemical projects received 10.16% of the total IBK loans. Although this percentage is considered relatively small, as compared

Table No. 7

Distribution of IBK's Cumulative Loan & Equity Commitment according to industrial Subsector (period 1974 - 1981)

A-Cumulative Loan classified by Industrial Subsector

( K.D 1000)

| Industrial Subsector | No of Projects | | Total Cost of Projects | | IBK finance | | Percent | |
|---|---|---|---|---|---|---|---|---|
| | 78 | 74-81 | 1978 | 74-81 | 1978 | 74-81 | 1978 | 74-81 |
| Construction Material | 6 | 68 | 24312 | 120,853 | 11445 | 55,912 | 43.2 | 32.23 |
| Metal Products & Engineers | 6 | 33 | 5622 | 66,546 | 3165 | 31,164 | 12.0 | 17,96 |
| Food & Beverages | 6 | 26 | 18351 | 53,321 | 8000 | 25,591 | 30.2 | 14,75 |
| Furniture | 1 | 12 | 2880 | 13,903 | 1650 | 6,790 | 6.2 | 3,9 |
| Marine & Oilfield Services | 1 | 8 | 2185 | 31,915 | 1050 | 18,375 | 4.0 | 10,59 |
| Chemical Products | 6 | 41 | 1800 | 47,246 | 815 | 17,620 | 3.1 | 10,16 |
| Paper & Paper products | 2 | 15 | 391 | 9,178 | 185 | 8,360 | 0.7 | 4,82 |
| Textile | - | 5 | - | 8,866 | - | 3,815 | - | 2,2 |
| Miscellanious | 1 | 5 | 381 | 2,696 | 150 | 715 | 0.6 | 0.4 |

B- Bookings/loans according to Size

| Size (KD) | Number of Projects | | | | |
|---|---|---|---|---|---|
| | 1976 | 1977 | 1978 | 1980 | 1981 |
| 1 million & over | 5 | 8 | 8 | 7 | 9 |
| 500,000-Under 1 Million | 3 | 5 | 1 | 3 | 5 |
| 100,000 up to 500,000 | 8 | 29 | 15 | 29 | 24 |
| 50,000 up to 100,000 | 6 | 4 | 5 | - | 3 |
| Total | 22 | 46 | 29 | 39 | 41 |

Source: IBK, Annual Reports 1977-1981.

to other sub sectors like construction materials (32.2%), or food and Beverage subsector (14.7) , it seems that more chemical projectsiincluding plastics have been financed by the Bank (Table No 7 6 ) Large size chemical projects like KNPC, PIC are financed completely by the Government. Melamine and tires projects are two exceptions.

As a new tariff system approved by the Council of Ministers in November 1978 is the restrictions on imports of products that compete the local production when the later reaches 75% of domestic demand. This limit is reached or will be reached soon for products like GRP water tanks, disposable cups, bags, PU-matteresses and others The following table No. shows some locally, manufactured products that have benefitfrom protective tariff for 10 year and those who still get such benefit i.e not yet completed the 10-years period of protective tariffs. In 1972, the council of Ministers, in accordance with the law No 18 of 1970, confereed a 10% premium in prices to domestic goods over imports. This percent premium is, however, increased in some cases. The products that may enter in this incentives system are the insulation products made from PU and EPS, PVC-pipes and conduits.

Table No 8

| Products consumed the Protective tariff period | Percent Protection | Products still covered by Protective tariff | Percent Protection |
|---|---|---|---|
| - Flexible foamed PU | 15 | Light and heavy bags from | 30 |
| - Mattresses from PU | 15 | PE and/or PP | 30 |
| | | Films for Agriculture and | |
| - Table wares from Melamine formaldehyde | 15 | Constructions Applications made from PE. | |
| Plastics Bottles | 15 | | |
| Disposable Cups for milk products. | | | |
| - Boxes for soft drinks | 15 | | |
| - Ash trays | 15 | | |

## IV TRENDS IN DOMESTIC MANUFACTURING

### 1. Production & Equipment

The present establishments manufacture a wide range of products that serve different economic sectors in Kuwait. In addition, the past two years were characterised by an active contribution of the local investors in the plastic industries. Many licences and permissions were given to these investors either to install new factories or to increase and/or to modernize the existing capacities. The following table gives a picture on some of these activities.

| Type | No. of Permission/ Licences |
|---|---|
| - Packaging products (bottles, bags,..) | 5 |
| - Insulation material (sheets) | 4 |
| - Pipes, (conduits), profiles | 4 |
| - Construction material (sheets. sandwitch panel..) | 3 |
| - Housewares | 3 |
| - Furniture and furnishing | 3 |
| - Rubber products (tyres) | 1 |
| - Medical products (disposable serings) | 1 |
| - Compounding, fillers, intermediates | 4 |

Acrylic sheets represent a new products type that will be soon domestically manufactured. These sheets will be either casted or extruded, plain or embosed. Extruded polystyrene will also be soon manufactured and processed insulation products. Plastics mats and disposable serings will be manufactured locally. Table No ( 9 ), shows the total expected capacities after the realisation of the a.m. projects which will exercise a tremendous growth in the demand on raw material as estimated and represented in Table No. ( 10 ).

Table No. 9

The expected total capacities of production
(by application)

| Application/products | Expected total capacities | | Final major products |
|---|---|---|---|
| | Annual Capacity | Unit | |
| Building, Construction | | | |
| Insulation material | 9250 | tons | sheets, panels,..etc |
| pipes | 14000 | tons | pipes, conduits,tubes, |
| GRP-tanks | 26600 | tank | water,chemical tanks |
| Films | 900 | tons | agriculture films,lining |
| Packaging | | | |
| Bags | 13750 | tons | shopping,fertilizer bags |
| Cups | 8300 | tons | cups & cans (yogort) |
| Bottles | 2760 | bott. | food & medical bottles |
| Industrial | | | |
| Wire/cables | 10000 | tons | cables,wire sheeting |
| Tyres | 13000 | tons | tyres |
| Others | 460 | tons | oil seals-retreading |
| Furniture/furnishing | 19000 | tons | mattresses |
| Recreational | 2000 | boats | |
| Medical | 31 million | piece | disposable serings etc. |

Table No. 10

Annual Raw-Material Requirements

for Kuwaiti Processors

| No. | Resin | Major Specification | Annual Requirements | | | | Main products |
|---|---|---|---|---|---|---|---|
| | | | Present | % | Future | % | |
| 1. | Polyethylene | Pellets(LD/HD) granules | 8800 | 22.1 | 14900 | 17.1 | bags, film, bottles, pipes.. etc. |
| 2. | Polyurethanes | Rigid, flexible (liquid) | 6800 | 17.1 | 19500 | 22.3 | insulation products, furniture |
| 3. | Polystyrene | beads, pellets, GP, HI, E | 10100 | 25.3 | 12800 | 14.7 | cups, containers, sheet insulation material |
| 4. | Polyvnylchloride | Pellets (rigid, soft) | 6800 | 17.1 | 15900 | 18.2 | pipes, box, tubes, cables. |
| 5. | Polyesters | (Unsaturated) Liquid(GR) | 4200 | 10.5 | 4700 | 5.3 | tanks, pipes, boats, sheets |
| 6. | Polypropylene | Pellets(flexible) | 2300 | 5.8 | 4850 | 5.5 | bags, toys, taps |
| 7. | Polybutylene | Pellets | 400 | 1.0 | 450 | 0.5 | pipes, conduits |
| 8. | Melamine/ Urea resin | granules | 80 | 0.2 | 120 | 0.2 | dinnerwates, electrical articles |
| 9. | Polyacrylics | Liquid | -- | - | 1900 | 2.2 | decoration, lighting |
| 10. | Other resins | Powder | -- | - | 80 | - | |
| 11. | Rubber Material | (natural + Syn.) | 300 | 0.8 | 12000 | 13.7 | tyre, retreading |
| | Total | | 39780 | 100 | 87200 | 100 | |

(*) Quantities do not reflect the pure resin requirement, they include the additional requirement through the realisation of 80% of newly licenced projects.

1 - Equipment

Many new and modern equipment will be introduced into the domestic plastics industry through the realisation of the licenced projects. Coextruders to produce films and sheets will be errected to diversify the product-mix of one factory. Scrap-free injection blow moulding machine will be used to produce bottles. These is a great tendency to use build-in-line extruders with thermoformers in order to reduce power requirement through the elimination of cooling and reheating steps.

Some new auxiliary equipment will be employed soon by the processors like lamination, embassing machines and automatic winding (Table No. 11 ).

2 - Labour force

The labour force engaged in the rubber and plastics industries are about 1868 workers including those working in production as well as in administration and services. This labour force is expected to reach about 2670 by 1985 when all the licenced and presently under construction projects are on stream. This gives an annual growth rate of 12%. The majority of the labour force are from Arab and Asian countries, very few are of Europian nationalities.

Table No. 12
Distribution of Labour force by occupation and Nationality

| Year / Occupation | 1982 | | 1985 | |
|---|---|---|---|---|
| | Number | % | Number | % |
| Management & Service | 668 | 35.7 | 962 | 36 |
| Production | 1200 | 64.3 | 1708 | 64 |
| Kuwaitis | 58 | 3.1 | | |
| non Kuwaitis | 1810 | 96.9 | | |
| Total | 1868 | 100 | 2670 | 100 |

Table No 11

Auxiliary process Equipment

in domestic Plastic Industry

| Type | No Equipment | Remarks |
|---|---|---|
| Mixers | 28 | for raw material, additives and fillers. |
| Grinders | 33 | for waste material. |
| Printing Machines | 25 | for bags, cups, tins, containers |
| Welding machines | 46 | films, pipes |
| Cutting machines | | pipes, films, sheets. |
| Weaving machines | | threads, ropes. |
| Take-off machines | 6 | pipes, sheets. |

The share of the Kuwaiti labour is very low, about 3.1% and is expected to remain undramatically changed during the coming period. The occupational mix of the labour force indicates that this share of the Kuwaitis is only in management and the majority have enough experience in their field. The availability of skilled labour to fulfil the expected rate of growth is doubtful. Importation of skilled labour should be taken as a temporary solution.

3- Investment

More capital is allocated for rubber and plastics industry. The total investment is expected to reach K.D 61M. through the realisation of all projects and extensions permitted (Table No. 13 )

Table (13)
Investment allocated for Rubber & Plastics Industries

| Investment / Product | Exist | | Expected | |
|---|---|---|---|---|
| | Investment 1000K.D | % | Investment 1000 K.D | % |
| Pipes, conduits.. | 10934 | 38 | 14000 | 22.7 |
| Insulation material | 7560 | 26.3 | 18260 | 29.7 |
| Tanks, boats | 3930 | 13.6 | 4400 | 7.1 |
| Furniture | 1300 | 4.5 | 1710 | 2.8 |
| Housewares | 1100 | 3.8 | 1700 | 2.7 |
| Packaging | 3700 | 12.8 | 4520 | 7.3 |
| Acrylic sheets | -- | - | 2400 | 3.9 |
| Medical products | -- | - | 256 | 0.4 |
| *Intermediates & others Intermediates | 200 | 1.0 | 14200 | 23.2 |
| Total | 28724 | 100 | 61446 | 100 |

(*) excluding the Aromatic/Olefins complex.

More projects have now above K.D 1 M/ each as Capital investment. More investment is allocated for a new establishment to produce insulation material. The interest in producing tanks, boats and similar products seems to become low. On the contrary this interest moves more toward the manufacturing of intermediates and support products.

4. The local Petro-chemical development Program

As stated before Kuwait has not yet entered into the field of basic petrochemical manufacturing. Based on the abundancy of feedstock for such material, active steps have been started to materialise a huge complex to produce ethylene (partially captive), ethylene glycol (export), and styrene (partially captive). The complete realisation of such complex is still questionable. Two other projects for manufacturing formaldehyde/its resins and PVA/alkyd resins/unsaturated polyesters are under construction. The tyre-project is in its final stage of preparation. Private initiates started also to install units for fillers and PVC-Compounding. A summary of these projects are illustrated in Table No. 14

## V. FUTURE MARKET TRENDS

### 1. Import and Export trends

Kuwait had imported about 11630 tons of plastics material of value K.D. 5.3 M. by 1975. These quantities had increased about four fold thus reaching 41000 tons of value K.D. 21 M. by 1980. Plastics raw material represent one of the major item (about 31%) imported. It is clear from Table No. 15 that there were increased demand on plastics products like: bags, sacks, mats sponage and household articles during the period 1975-1980.

In the contrary, the import of tiles and ropes were characterised by unsteady state. Almost complete saturation of the local market was observed by national production of GRP-tanks. Evenmore, exportation of such items represented about 50% of the total quantities of plastic products of Kuwaiti origin.

Table No. 14

Pehochemical Projects under production,

| Project | Construction & planned Capacity | Unit | Start-up | Final products |
|---|---|---|---|---|
| 1. Basic, inter. Petrochem. | | | | |
| Ethylene | 325000 | Ton | 1986 | mainly for LE production |
| xStyrene | 340000 | Ton | 1987 | mainly for LS production |
| xEthylene Glycol | 135000 | Ton | 1987 | |
| xXylenes | 150000 | Ton | 1987 | |
| Formaldehyde | 20000 | Ton | 1985 | production of formaldehyde resins. |
| Melamine | 15000 | Ton | 1979 | melamine resins. |
| 2. Final Petrochemical | | | | |
| xLLDPE | 160000 | Ton | 1987 | |
| Unsat. Polyester | 6000 | Ton | 1983 | GFR plastic products |
| xPolystyrene | | Ton | 1986 | GPPS,EPS,HIPS. |
| Polyvinyl acetate | 5500 | Ton | 1983 | |
| Alkyd resins | 5500 | Ton | 1983 | |
| 3. resins and fillers | | | | |
| Products: | | | | |
| Urea formaldehyde<br>Melmaine formaldehd | 10000 | Ton | 1985 | dinnar electrical articles |
| PVC Compounds | 10000 | Ton | 1984 | pipes, cable,sheets, profiles. |
| Adhesives | 900 | Ton | 1984 | |
| Fillers | 10000 | Tons | 1984 | for PVC compounding. |

x planned projects.

Table No. 15
PLASTICS IMPORTS AND EXPORTS
(Metric Tons)

| Product | 1977 | | | 1978 | | | 1979 | | | 1980 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Import | Net Import | Re Export | Import | Net Import | Re Export | Import | Net Import | Re Export | Import | Net Import | Re Export |
| Raw Material Resins(Liquid, Powder etc) | 11479 | 11376 | 103 | 8100 | 7991 | 109 | 11184 | 11122 | 62 | 13137 | 11214 | 1923 |
| Intermediates | | | | | | | | | | | | |
| Tubes & Rods | 1313 | 1181 | 132 | 2267 | 2191 | 76 | 1159 | 981 | 178 | 951 | 829 | 122 |
| Plates & Sheets | 2621 | 2529 | 92 | 1528 | 1474 | 54 | 2138 | 1832 | 306 | 2884 | 2206 | 678 |
| Sponge | 146 | 136 | 10 | 295 | 285 | 10 | 864 | 842 | 22 | 1785 | 1728 | 57 |
| Wastes | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- | -- |
| | 4080 | 3846 | 324 | 4090 | 3950 | 140 | 4161 | 3655 | 506 | 5620 | 4763 | 857 |
| GRP Boats | | | | | | | | | | | | |
| Cords & Rope | 615 | 440 | 175 | 595 | 514 | 81 | 403 | 314 | 89 | 1178 | 969 | 209 |
| Linoleum | 170 | 169 | 1 | 369 | 368 | 1 | 209 | 190 | 19 | 141 | 134 | 7 |
| G F R Tanks | 15 | 15 | -- | 13 | 13 | -- | 15 | 15 | -- | 89 | 89 | -- |
| | 800 | 614 | 176 | 977 | 895 | 82 | 627 | 519 | 108 | 1408 | 1192 | 216 |
| House hold Articl | 1543 | 1340 | 203 | 1505 | 1418 | 87 | 1269 | 1219 | 50 | 1197 | 1125 | 72 |
| Tiles | 1610 | 1542 | 68 | 1297 | 1240 | 57 | 1486 | 1417 | 69 | 1106 | 1047 | 59 |
| Tablecloths Curtains | 312 | 277 | 35 | 391 | 328 | 63 | 359 | 326 | 33 | 686 | 490 | 196 |
| Bags & Sacks | 1497 | 1431 | 66 | 3378 | 3314 | 64 | 1910 | 1842 | 68 | 3984 | 3934 | 50 |
| Mats | 4764 | 3430 | 1334 | 3808 | 2801 | 1007 | 3912 | 3037 | 875 | 4834 | 3837 | 997 |
| Other Articles | 2843 | 2490 | 353 | 3088 | 2805 | 283 | 5086 | 4704 | 382 | 8872 | 8284 | 588 |
| | 12569 | 10510 | 2059 | 13467 | 11906 | 1561 | 14022 | 12543 | 1479 | 20679 | 18717 | 1962 |
| Total | 28928 | 26346 | 2662 | 26634 | 24742 | 1892 | 29994 | 29839 | 2155 | 40844 | 35886 | 4958 |

Table No. 16

Rubber Goods Imports and Exports

(Metric Tons)



| Product | 1976 | | | 1977 | | | 1978 | | | 1979 | | | 1980 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Import | Export | Net Import | Import | Export | Net Import | Import | Export | Net Import | Import | Exp. | Net Import | Import | Exp. | Net Import |
| Raw Material | | | | | | | | | | | | | | | |
| Waste & Scrape | 24 | 433 | (409) | - | 290 | (290) | - | 361 | (361) | 5 | 544 | 539 | 114 | 455 | 341 |
| Crude rubbers | 90 | 7 | 83 | 65 | 4 | 61 | 21 | - | 21 | 17 | 1 | 16 | 0.5 | - | 0.5 |
| Intermediates | 114 | 440 | 326 | 65 | 286 | (229) | 21 | 361 | (340) | 22 | 545 | 555 | 114.5 | 455 | 341.5 |
| Tubes & pipes | 1390 | 471 | 919 | 2051 | 772 | 1279 | 1117 | 421 | 696 | 1527 | 338 | 1189 | 1358 | 871 | 587 |
| Sheets, threads, rods | 135 | 2 | 133 | 81 | - | 81 | 327 | 17 | 310 | 264 | 23 | 241 | 464 | 31 | 433 |
| Final Products | 1525 | 473 | 1052 | 2132 | 772 | 1350 | 1444 | 438 | 1006 | 1791 | 361 | 1420 | 1822 | 902 | 1020 |
| Tyres&TubesforCycl. | 56 | 6 | 50 | 32 | 10 | 22 | 34 | 0.2 | 33.8 | 34 | 0.4 | 33.6 | 64 | 7 | 57 |
| Tyres&Tubes for Aircraft | 88 | 2 | 86 | 68 | 5 | 63 | 118 | 30 | 88 | 118 | 52 | 66 | 182 | 30 | 152 |
| Other Tyres & Tubes | 16178 | 3928 | 12250 | 24696 | 5096 | 19600 | 17860 | 6443 | 11417 | 28176 | 14834 | 13342 | 46481 | 20072 | 26409 |
| Apparel/Clothing accessories of rubber | 424 | 92 | 332 | 889 | 97 | 792 | 1055 | 51 | 1004 | 1548 | 88 | 1460 | 1300 | 104 | 1196 |
| | 16746 | 4028 | 12718 | 25685 | 5208 | 20477 | 19067 | 6524 | 12543 | 29876 | 14974 | 14902 | 48027 | 20213 | 27814 |
| Total | 18395 | 4941 | 13454 | 27882 | 6266 | 21596 | 20532 | 7593 | 13209 | 31689 | 15880 | 16077 | 49963 | 21570 | 29175 |

The import of the rubber products of about 13400 tons grew by the same rates, as those of the plastic products, during the same period to reach 49[illegible] tons by 1980. The quantities of raw material and the intermediate products imported represent a minor percentage, where as those of the tyres represent about 9?% of the total net import (Table No. 16 ).

2. Present main consumers

- Public consumers

  These are the Ministries of Public Works, Public health, Housing, Electricity & Water, Kuwait Municipality, N.H.A. .... etc.

- Private consumers

  They consume, in general terms, individual items used in house ware, furniture, toys, boats, tanks, etc..

- Industrial consumers

  They use the rubber and plastics products as intermediates in their manufacturing processes to produce, tyres, cold stores, refrigerators, insulated walls and tunnel, food and beverage packaging, product-transport (trays, containers, pipes, .. etc).

- Private Constructors

  They use the concerned products in installing electricity and water networks in buildings, green-house-covering, irregation, drainage, soil mulching, water storage ...etc.

The main bulk of the plastics products (insulation, piping) are consumed in buildings and construction. Therefore, the present and future activities of this sector have direct impacts on the market volume of the a.m. products.

The statistics of the built-up areas licenced by the Kuwait Municipality showed that:

- The residential buildings represent 75% of the total built-up area and reaches its peak in 1977.
- The commercial buildings represent about 20% of that area and reaches its peak on 1979
- The industrial area represent about 5% and reaches its peak on 1978.

Therefore the residential building is the directive type of building from the market point of view.
Refering to the announced future plan of NHA and to the growth trends in relation to the expected population growth, possible forecasting could be made to estimate the projected built-up areas. Using the accepted conversion factors, it is possible to calculate the corresponding walls and roof area and to convert these into expected insulation material requirements. Taking into account, the preferance of the different insulation material according to its place of applications (PLs compare Annex No. 2) and the competition of other insulation material produced (or will be produced), table No. 17, it is easy to conclude the following:

Table No. 17

Production Capacities of Insulation Material in Kuwait

| Product | Type | Year 1982 Capacity $m^2$ | Year 1986 Capacity $m^2$ | Remarks |
|---|---|---|---|---|
| Polyurethane | Sheets | 500 000 | 2 000 000 | 5 cm sheet thickness |
| | injection | 150 000 | 758 000 | 80% of newly-licenced capacities. |
| | | 650 000 | 2 758 000 | |
| Polystyrene | black expansion | 1100 000 | 1 430 000 | 5 cm sheet thickness |
| | extruded | -- | 1 120 000 | 80% newly licenced capacities |
| | | 1100 000 | 2 550 000 | |
| Vermiculite | | 75 000 | 975 000 | 8 cm sheet thickness |
| Glass fibre | rigid | 200 000 | 800 000 | 5 cm sheet thickness |
| | flexible | 6000 000 | 6 200 000 | density: 16 kg/$m^3$ flexible glass |
| | | 6200 000 | 7 000 000 | 60 Kg/$m^3$ rigid glassfibre |
| Perlite | expanded | -- | 5 360 000 | 8 cm sheet thickness 80% of newly licenced |
| Total | | 8625 000 | 18 643 000 | |

- The quantities of insulation material will increase by more than twofolds and will cause an oversaturation in the market.
- More insulation material from origins other than plastics will represent competitor products in the local market.

Through the enforcement of the code for the application of insulation material for the conservation of energy in conventional buildings like the residential building, more demand might occur in the near future. This demand might also increase through the application of insulation materials in the existing dwellings.

The official agencies do not specify the insulation material, but the degree of insulation, however these agencies prefer polysterene, polyurethane and fiberglass.
With respect to the PVC-pipes-consumers who belong to the construction sector, they are mainly public agencies. They increased their request on these pipes for executing electrical and water supply networks, drainage and irrigation. The bulk of their consumption are for pipes of diameter 100-150 mm according to BS. The Kuwaiti standard will come into force in the near future and will facilitate the use of this type of pipes. The Kuwaiti specifications are taken into consideration forehand by the newly licensed factory of 7500 t/y capacity. There are only restrictions of using such pipes for potable water. The competitors PB-pipes and GRP-pipes of moderate diameters find their way to replace PVC-pipes in some fields of application.

The factory that produce woven sacs for fertilizers, flour and chemicals faces certain degree of competition from foreign products. They have the following specifications:

Length : 45-140 cm
Wideth : 30-68 cm
Thickness: 100-300 micron
Material : inner: PE, outer: PP
Colour : Two

The major part of the agriculture film market is covered by import. Both the private and public agencies will increase their demand very shortly due to the implementation of the large program of protected cropping and drip irrigation. The national production should be adapted to suit the different applications under the local invironment.
The main consumers of cups and bottles are of private food sector who increased their request on the national products with parallel increase in production capacities. This product-type is no more protected after it reached complete penetration in the domestic market.

## 3. Future trends and possibilities in applications

The distribution percentages of plastics products-consumption among different applications for a number of countries are shown in annex (3). It is clear that the major fields of applications are in building and construction, packaging, electrical and electronics. Building and construction will remain the major field of application growing in areas like reinforced plastic houses, insulation, windows, door-frames and shutters, translucent walls (FVC), swimming pools, pipe networks (ABS, PVC, PE) and GRP-tanks. Plastic applications will grow with high rates in agriculture (film/mulch covers) irrigation (PE, PVC, PMMA, GRPE). One of the main expanding areas is in the automatic and hydraulic transportation of liquids and solids, (PP, PU, PVC, ABS, PE).

Plastics products are mostly used in Kuwait in building and construction as insulation (PU,PS) and piping products (PVC). The second main field of applications is the packaging (PE, PP). There are plenty of possibilities for applying plastics products even in the three major applications mentioned above. To illustrate this statement PVC products, e.g., are used only in piping,cable sheathing and packaging. The full pattern of PVC-applications in USA for year 1981 is given Annex No. 4. To penetrate in all these fields, time equipment, and experience are needed.

Again, rigid polyurethane is used only for thermal insulation, although it has wide applications as structure foams and for packaging. This limited domestic application is essentially due to the type of product manufactured. Rigid integral skin foams can easily be produced and used for decorative applications and structural purposes. These products have tight skin and cellular core. The overall density is 200-600 $kg/m^3$ compared to the type now produced having density 35-50 $kg/m^3$. The suggested type is suitable for the usage of bolts, screws, and nails.

Another example, is the flexible polyurethane which is used locally for mattresses and to a limited scale for upholstered furniture. The local consumer expects that

these products retain their elasticity, firmness and dimension-tolerances, as the conventional products, for a long period which is not the case. New composite PU-foams are now used with great success in countries with similar climatic conditions as Kuwait. The suitability of such products have to be checked for replacing the traditional production of simple PU mattresses. Some socially related aspects like product flammability and high income per capita will continue to play a hindering effect against the penetration of such products. Therefore, well-planned advertisements are required.

The Ministry of Public Health, which is the single c consumer for medical packaging, tends to follow restricted specifications. The domestic processors should adapt their product specifications accordingly.

There is a great trend in using GRP in recreation, decoration and construction activities. Follow up for the application of the Kuwaiti standards is required in this enstance to bring the domestic products up to the standards. Vaccum processing and up-grading training could be helpful arms in this respect.

The a.m. trends categorised according to material type are as follows:

- Polyvinyl chloride; increased demand will be on pipes, fitting, tiles, profils for constructions and agriculture. Bottles for beverage, sheathing of cables and artificial leathers are also fields of interest having well established markets. Artificial leather issused in manufacturing travel sacs.
- Polyurethane: the major demand will be on rigid PU for insulation. The market for flexible PU needs activation.
- LD-polyethylene: big market volume will be available for bags of all types in addition to the new application of shrink film. Reduction in price could be acheived through the introduction of LLDPE which lead to reduction in product thickness while

maintaining basically the same mechanical properties.

- HD-polyethylene: main demand will be on bottles, containers, boxes for industrial and agriculture applications. Bags will remain the major products requested. Toys-manufacturing is a field of interest but it needs technology assistance to satisfy the market trends.
- Polystyrene: The increase in market volume will be to the introduction of extruded foamed PS for insulation. Disposable cups and sheets for industrial applications are the main consumption fields for HIPS and GPPS.
- Polypropylene: besides its use in woven sacs other demand will be on medical products, toys and some injection moulded articles.
- Polyacrylics: Its products are already domestically used in construction, lighting decoration and advertisement. Its growth rate will be not as high as that of the other main polymers; namely PVC & PE.

## VI. PROBLEMS FACING THE DEVELOPMENT OF THE INDUSTRY

In this chapter, a detailed account of the obstacles that hinder the development of the domestic rubber and plastics industries, is represented.

1. Technology, Raw material and related aspects:

Simple and obsolete technologies are followed in some factories producing insulation material. The batch-wise process with its related low productivity, high waste percentage and high cost, limit the fields of applications of its products. Some flexible PU-products suffer from non-uniformity of physical properties and dimension tolerances. Safety regulations concerning the handling of hazardous isocyanates have to be well known to the workers.

More frequent is the unsuitability of the compound formulations for the specific applications. Uptill now neither raw material nor intermediates have been manufactured in commercial quantities in Kuwait. There are projects to produce some intermediates and fillers in the near future. The local processors therefore, have to import their requirement mainly from the Far East, Europe and USA. The value of this material has increased more than three-fold during the period 1975-1980 reaching K.D. 9.5 Millions (excluding semifinished products like sheets).

The prices of these products vary as widely as does the spectrum of properties, the final price being dependant on a number of factors. Among the most important factors that affect the final price of this material in Kuwait are the following:

- Original cost of raw polymer
- Cost of additives, fillers ...etc.
- Density of final products
- Required specification of product
- Part of processing executed (raw, mixed, extruded, compound ..)
- Volume of purchase.

- Source of supply (direct, wholsaler, ..etc.)
- Distance of delivery (frequent long term delivery)

Therefore, the local processor finds himself facing a very dramatic problem when he wants to select a raw material fulfilling his requirements but with minimum cost. The majority of the local processor claimed for this particular point and the related reliability of the vender deliveries.

This applies also for the spare parts, high rates of depreciation were noticed from the frequent request for equipment replacement. In addition, there is no regular supply of spare parts to cover the requirements. The foreign suppliers overrate the prices of spare parts. Sometimes, the factory owner, or his representative travel abroad to purchase the spareparts so as to shorten the delivery time.

There are other factors, besides the scarcity of spare-parts, like the production planning according to market variations, that cause low productivity and under utilization of capacities.

Particular problems face the finishing processes of the products. Some of these obstacles are related to the mould itself. Others are due to the lack of auxielary equipment that are used for repolishing, lettering, printing or plating.

## 2. Quality Control & Standard Specifications

Big companies have their own facilities for material testing and control of product-quality. Small establishments approach government and private laboratories to carry out on their behalf, the analysis of raw material and products. The local processors rely mainly on foreign standards as ISO, ASTU, DIN which to a great extent do not apply to Kuwaiti conditions. However, there are few national standdards for testing plastics material and their applications in specific fields. (annex No 6 ). It is expected that there will be an increasing number of standards promulgated in the coming years in particular with regard to the insulation material &

products used in construction and beverage and food conservation. It should be noted that many of the local processors are concerned with having their own sets of material specifications that have to meet the local users thus leading to a variety of problems. Since there is no legislation yet in force in Kuwait that specifically restricts or controls the use of plastics products in any application (except medical bottles), it is the users decision to select the product that comply his needs.

The properties that seem to restrict the wider use of certain rigid foamed plastics, as insulation material in buildings and constructions, are: water absorption, thermal conductivity and compressive strength.

There is a great tendency to obtain codes of practice that provides clear statements as to performance & functions of such material , rather than a general catalogue of material properties determined under ideal test conditions. Such performance specifications will be of great benefit to both processors and end user industries. An example was already prepared by the Ministry of Electricity and water (Code of Practice No. MEW/R/7C, April 1982) specifying the properties and applications of Insulating Materials for Kuwaiti Buildings. Comprehensive studies in view to establish national standards for rubber and plastics products, their ingredients and applications are still required.

3. Skilled labour & training

There is a serous gab between the supply and demand of labour for the rubber and plastics industries. The gab is not only in quantity, but also and more critically, in quality. This causes unstability of skilled labour due to attraction by higher wages offered by the competing companies.

The deficiency in local supplies are mainly due to

- Lower desire of Kuwaitis to join the industry
- Irregular supply of expatriates of reasonable level of skillness.
- Absence of creation or up-grading of skills through training courses.

Rubber & Plastics education and training are minimum in both the University and the Technical Institute. Furthermore, no specialised courses in plastics technology, processing, installation maintenance, and applications are available. The preparation and implementation of such courses require co-operative efforts of resin suppliers, machinery manufacturers and processors to ensure the adequacy of the courses to the real requirement.

4. Market and Marketing

Poor market studies led to serious problems in some factories. In an open market, like Kuwait market, the severe competition of the foreign products should be covered from all aspects by comprehensive studies. Examples of domestic products that suffer from such competition are housewares, agriculture films, pipes and some types of insulation material. Marketing of new products specially those supposed to replace traditional products like windows, pipe net works, decorature sheets ..etc need special skills in advertisement, handling and installation

## VII. RUBBER AND PLASTICS INDUSTRIES IN GULF AREA

### 1. General Considerations

The Gulf Countries imported round 450,000 tons of plastics raw material and finished product by 1980. About 40% of this quantity was raw material. Saudi Arabia processed about 129000 tons and Iraq about 106000 tons of plastic materials by 1980 (Table No. 18 ). PolyvinylChloride was the main raw material, its quantity was equivalent to 39% of the total quantities processed in the Gulf Area. The major P.V.C products were pipes for irrigation, sewerage, water electrical network, fittings, shoes, cables and bottles. Polyethylene (LD & HD) was the second polymer (=31%) that was used widely. Its products were essentially shopping and trash bags films for agriculture and construction uses and household articles.

Other polymers like PP & PS were also used in different quantities as represented in Table No
The main processes employed were extrusion, injection moulding, blow moulding and casting. Calendering, compounding and compression moulding exist to a lesser extend.

The percent share of local processors in covering the domestic demand differs from country to country. The highest percent share, tonnagewise, was found in Iraq and Saudi Arabia (for specific products in Eastern region). Very low share exists in U.A.E.
All factories belong to the private sectors, except in Iraq where the establishments were either Governmental or joint venture.

Table No( 18 )
Plastics Materials Processed in
Arab Gulf Countries

| Country / Material | Bahrain an: prod- ion. | Products | Qatar an. Prod.(t) | Products | Saudi Arabia an. Prod.(t) | Products | Iraq an. Prod(t | Products | Total Gulf Area 1980 Quantity. | % | 1985 Tons | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| LDPE | 1500 | Shopping bags | 800 | Shopping bags | 19700 | bags,bottles | 26000 | Pipes,bages, | 53000 | 19 | 77800 | 18.7 |
| HDPE | 750 | Crates, Jerry cans. | 300 | Crates,bags. | 15000 | bags,crates | 15000 | bags,crates | 33550 | 12 | 47100 | 11.3 |
| PVC (flexible, (rigid) | 550 | Pipes,conduits. | 1200 | pipes,conduits. | 62000 | pipes,profiles fittings, tiles crates | 38000 | tiles pipes, cables, bottlesshoes crates. | 107550 | 39 | 165600 | 39.9 |
| PS (Exp.,Impact) | 100 | Cups | 100 | insulation, | 6500 | insulation, | 8000 | cups,insulation. | 23500 | 8.5 | 30200 | 7.3 |
| PP | 50 | mates | 50 | mats | 2000 | woven bags | 10000 | battery cases woven sacs, mats. | 14030 | 5 | 20500 | 4.9 |
| PU(rigid,soft) | 100 | mattresses | 100 | mattresses | 12000 | insulation, mattresses | 8000 | insulation, mattresses. | 26000 | 94 | 40100 | 9.6 |
| Polyester | 350 | tanks,boats. | 400 | tanks,boats | 12000 | Sanitary, tanks. | 1000 | Sanitary, tanks. | 16950 | 6 | 25600 | 6.2 |
| Formaldehyde resin. | - | - | - | - | - | - | 300 | table wares and electrical | 380 | - | 900 | - |
| Others | - | - | - | - | - | - | - | - | 400 | - | 16500 | 1.6 |
| Total (1980) an Prod. Nr.Establish | 3400 7 | 1.2 | 2950 5 | 1 | 129200 75 | 46.9 | 106300 400 | 38.6 | 275360 520 | 100 | | |
| Capacity (ton) Forecast | 5000 | 1.2 | 4400 | 1 | 180000 | 43.4 | 149000 | 35.9 | | | 414300 | 100 |

Source :- UNIDO Survey 1981
- Official publications of the Gulf States.
- Consultant's visit to Saudi Arabia in Dec. 1982.

The quantities of the rubber raw material represented a small percent in the total quantities of rubber products imported. This reflected the very low share of the local manufacturers in this respect. In fact there are few small scale manufacturers in Iraq and Saudi Arabia only. These are producing non tyre products like footwear, hoses, tubes, belts and oil seals. They depend on ready blended rubbers to meet specific conditions that would not allow for any modifications. There is one tyre establishment belonging to public sector in Iraq and one private project in Suadi Arabia.

All the rubber and plastic industries import their raw material from countries outside the region except PE (Qatar) and PVC (Iraq).

Few highly efficient industrial units exist in the region, the majority of small size-units appear to suffer from low productivity, frequent shut-down and marketing problems. The application of these rubber and plastic products are limited to the conventional fields of construction, packaging & agriculture. Few examples of applications in furniture transport and household articles were noticed. Plastics pipe have a well established market. There are only two institutes in the region that include among its activities R & D in the plastics field.

## 22 Products Penetration forecasts

The following aspects were considered in the methodology of forecasting the quantities to be processed by 1985:-

- the realisation of the announced projects
- the average annual rates of Growth in GNP and Per Capita income (in one reference country).

The total quantities expected to be processed by 1985 are round 414000 tons. Table No. 18 summarise the figures forecasted according to type of resin:

- Polyvinylchloride is expected to remain the main resin processed into pipes, tiles, cables, containers and ... utilities networks. Artificial leather will be the new application introduced in the region.
- LDPE will remain also the second main resin processed into its traditional products. Increased capacities are expected in agriculture films and medical bottles besides the new application as shrink films for packaging. Saudi Arabia already introduced LLDPE to replace and widen the market-penetration.
- HDPE is expected to have relatively lower rate of growth without significant modification in the field of application.
- PS is characterised by a steady rate of penetration due to its stability in the Gulf market. The increase in capacities will be mainly in packaging.
- PU will have reasonable rate of penetration attributed to the appreciation of its products in furniture and insulation. This penetration is hindered partially by the product flammability characteristics.
- GRP tanks, pipes and sheets will replace gradually the conventional products because of their favourable properties. This will call for increase in polyester production capacities.
- Increased demand is expected for PP-mats and PP-battery boxes. New products made from polyacrylic and polycarbonates will be soon marketed in the Gulf area which will be used in building and constructions.
- Limited growth in application of non-tyre rubber products specially pipe fittings, tubes and hoses. This is partially due to the competition of similar plastic products.

The annual growth rate predicted from the previous table is about 8.4% which is in harmony with growth rate in GNP and per capita income. The apparent consumption per capita on the contrary is relatively low compared to that of many developed countries (Table No 19 ).

According to a UNIDO-survey (1980) and to the present survey the apparent consumption per capita is expected to reach 13.9 Kg by 1985 (Table No. 20 ). This is expected

Table No ( 19 )

Per Capita Consumption of Plastics Products in Gulf States Compared to that of some developed countries

| Year | 1978 | | Year | 1978 | | 1990 / | | Annual rate of Growth % |
|---|---|---|---|---|---|---|---|---|
| State | Annual Consumption (1000t) | Annual Per Capita Consumption Kg/Person | Gulf Country | Annual Consumption (1000t) | Annaul Per Capita Consumption. | Annual Consumption | Annual Per Capita Consumption Kg/person | |
| U.S.A. | 14900 | 68 | Iraq | 70 | 5.5 | 400 | 22 | 16.6 |
| W. Germany | 5600 | 91 | Saudi Arabia | 85 | 11 | 450 | 40 | 14.9 |
| England | 2500 | 44 | Kuwait | 22 | 18 | 280 | 50 | 13.7 |
| France | 2800 | 52,5 | Other Gulf Countries. | 40 | 18 | | | |
| Japan | 5500 | 48 | | | | | | |
| Mean | | 45 | | | 9 | | 32 | 14.8 |

Source GCIC Petrochemical Study 1980

to be 32 k.g by 1990 according to a GOIC-study.

Table No.
Apparant Consumption per Capita of Plastics Products in Gulf Area

| Year / State | 1980 | | | 1985 | | |
|---|---|---|---|---|---|---|
| | Total & Consumption (1000 t.) | Popul-ation (million) | Per capita Consumption kg/person | Total & Consumption (1000 t) | Popul-ation (million) | Per capita Consumption Kg/person |
| Bahrain | 3.4 | 0.39 | 8.7 | 5.0 | 0.49 | 10.2 |
| Qatar | 2.95 | 0.22 | 13.4 | 4.4 | 0.3 | 14.6 |
| Saudi-Arabia | 129.2 | 9.71 | 13.3 | 180.0 | 11.69 | 15.4 |
| Kuwait | 17.0 | 1.32 | 12.9 | 75.2 | 1.69 | 38.3 |
| Iraq | 106.3 | 13.18 | 8.1 | 149.0 | 15.58 | 9.6 |
| Total | 258.85 | 24.82 | 10.4 | 413.6 | 29.75 | 13.9 |

This low apparant consumption per capita is attributed to many factors among which are the following:

- The limited penetration of major plastic products in some traditional fields. No serious efforts to promote the introduction into new fields of application.
- The high standards of living in some Gulf countries do not accept easily the usage of plastic products.
- --Lack of advertisement and demonstration for new products and applications.
- Variation in specifications due to irregular and poor quality control.
- Under utilisation of capacities attributed to different technical and economic problems.

3. The Gulf Development Programmes for Petrochemicals

The Gulf State Governments have realised the importance of diversification to more economically and technologically feasible production of intermediates and to release the dependance of national processors on import through the conversion of these intermediates to plastics resins. Many projects are either planned or under construction to manufacture these valuable products (Table No. 21 ). Some other projects are now under consideration by the Governments to determine its feasibilities. These projects are for the production of Butadiene, phthalic anhydride, terphthalic acid, polypropylene and polyisoprene. One project for SBR, on Arab Countries level, is also under consideration. These petrochemicals are the key ingredients for the resins required by the national processors. Still the sector needs other support industries to produce plasticizers, fillers, stabilizers and colorants.

4. Impacts of the regional development

There will be suplus of resins supply, specially that of PE, if all projects announced in the Gulf area are realised. The bulk of this surplus will be temporarly directed to export. Naturally, the Gulf Countries will then try to avoid the strong competition in the international market through expanding the production and utilisation of downstream products within the area. The potential markets for Kuwaiti products that will be affected by such expansion are the Saudi Arabian (Eastern area) and Iraq. The markets of other Gulf countries are expected to remain unsignificantly changed. A considerable degree of saturation is observed in Riyadh and neighbouring area for products made from flexible and rigid PU and EPS and PVC pipes. No more licence are given to manufacture such products. Other products that will have reasonable market volumes are the acrylic and polycarbonate sheets, household articles, dinnerwares and electrical articles made from urea/melamine resins, PP-mats, sanitary wares, high pressure pipes and lining and some other products.

Table (No ( 21 )

Petrochemical Projects Under Construction or planned in Gulf Area

(capacity 1000 tons)

| Country / Product | Bahrain annual capacity | Bahrain remarks | Qatar Annual capacity | Qatar Remarks | Saudi Arabia Annual capacity | Saudi Arabia Remarks | Iraq annual capacity | Iraq remarks | Total Gulf. A. | Total Arab. Countries |
|---|---|---|---|---|---|---|---|---|---|---|
| Basic Petrochemi | | | | | | | | | | |
| Benzene | - | - | - | - | - | - | 25 | under construction. | 25 | 400 |
| Xylenes | - | - | - | - | - | - | - | - | 150 | 186 |
| Ethylene | - | - | 280 | production start. | 1606 | Start prod 1985. | 135 | exist | 2021 | 3700 |
| Methanol | 330 | Und Const- | - | - | 1250 | " " " | - | - | 1510 | 2340 |
| Ethanol | - | - | - | - | 281 | Start prod. 1985. | - | - | 281 | 281 |
| Propylene | - | - | 5 | - | - | - | - | - | 5 | 170 |
| Intermediates: | | | | | | | | | | |
| Ethylene glycol | - | - | - | - | 520 | Start prod 1985. | - | - | 655 | 9055 |
| Ethylene Dichlor- | - | - | - | - | 454 | Start prod. 1985. | - | - | 454 | 454 |
| Vinyl Chloride | - | - | - | - | 102 | planned " | 66 | Start up | 168 | 273 |
| Styrene | - | - | - | - | 295 | Start prod. 1985. | - | - | 635 | 810 |
| Final Petro Chem: | | | | | | | | | | |
| LDPE | - | - | 140 | exist | 590 | Under Construction. | 60 | exist | 955 | 1183 |
| HDPE | - | - | 70 | planned | 90 | " " | 30 | exist | 190 | 310 |
| PP | - | - | - | - | - | - | - | - | - | 50 |
| PS | - | - | - | - | 95 | Planned | - | - | 95 | 95 |
| PVC | - | - | - | - | 102 | Planned | 60 | exist | 160 | 317 |
| Polyester | - | - | - | - | - | - | 20 | Planned | 26 | 66 |
| Polyacrylic | - | - | - | - | - | - | 15 | Planned | 15 | 35 |
| Formaldehyde Resin | - | - | - | - | 20 | Planned | - | - | 30 | 51 |

The development of agriculture and construction sectors in Gulf countries, other than Saudi Arabia, will stimulate the application of plastic products in these fields. This will create opportunities for local investors to manufacture and market such products like PE films for mulches, lining and green houses, plastics pots and bins, pipes for water distribution and drip irrigation.

It is worth mentioning that some Gulf Countries have started to establish their own standards for particular plastic products. This has to be taken into consideration before producing or marketing such products.

The availability of polymer resins in the Gulf area will, on the other hand, solve various problems presently facing the local processors. It is also worth while to consider the announced Gulf-projects (summarised in Table No. 21 ) during the planning of the Kuwaiti petrochemical industries.

5. Possible regional cooperations

The Kuwaiti rubber and plastics establishments and agencies having activities in this field could cooperate with the Gulf partners in the following fields of activities to develop and eliminate the obstacles facing the industry in the whole region:

- Creation of Plastic technology education at all levels of employees.
- Market promotion through application-demonstration.
- Regional marketing facilities and incentives policies.
- Joint R & D programs.
- Development and promotion of regional standards, codes and specifications in cooperation with ASMO.
- Rubber and Plastics waste recycling and marketing on regional level.
- Reliable regional testing and analysis facilities.
- System for technical and market informations exchange.

## VIII. SUMMARY AND CONCLUSIONS

- The rubber & Plastics Industries subsector is one of the important branches that serve many essential econmic sectors in Kuwait. sincere efforts for its development are required.

- About 48 factories and 12 under construction are dealing all together with K.D. 61 M. investment. A great number of these factories are of sole proprietorship or of limited liability and they get industrial loans from IBK. The overall picture indicates that the investment / individuals are from relying on loans for financing their projects.

- These investorsrecieve different types of incentives and protections which fall within the national scheme. Other types of incentives may be necessary to promote the industry and its export capabilities specially for rubber industry which is represented in two establishment only.

- The local processors will deal with 87000 tons/year of raw materials, using common processes like extrusion, injection and blow moulding. Some establishments have more than one process and are equiped with automatic machines of low or moderate capacities, but they have not enough auxillary equipment. They are mainly located in Sabhan and Shuwaikh industrial areas.

- The industry faces some obstacles that worth to be considered. The origin of these obstacles are the responsibilities of the resin manufacturers, the local processors and the consumers. Besides, the shortage of the skilled labour and the absence of R.& D. activities are additional important factors in this respect.

- The recent development in resins and plastics industries in Saudi Arabia will effect the Kuwait export capabilities. The Kuwaiti rubber and plastics industries should proceed to produce new products that have reasonable Gulf market volume, but with low or no domestic supply. The problems of having products specifications that might not be accepted by the Gulf countries, should be taken forehand into consideration.

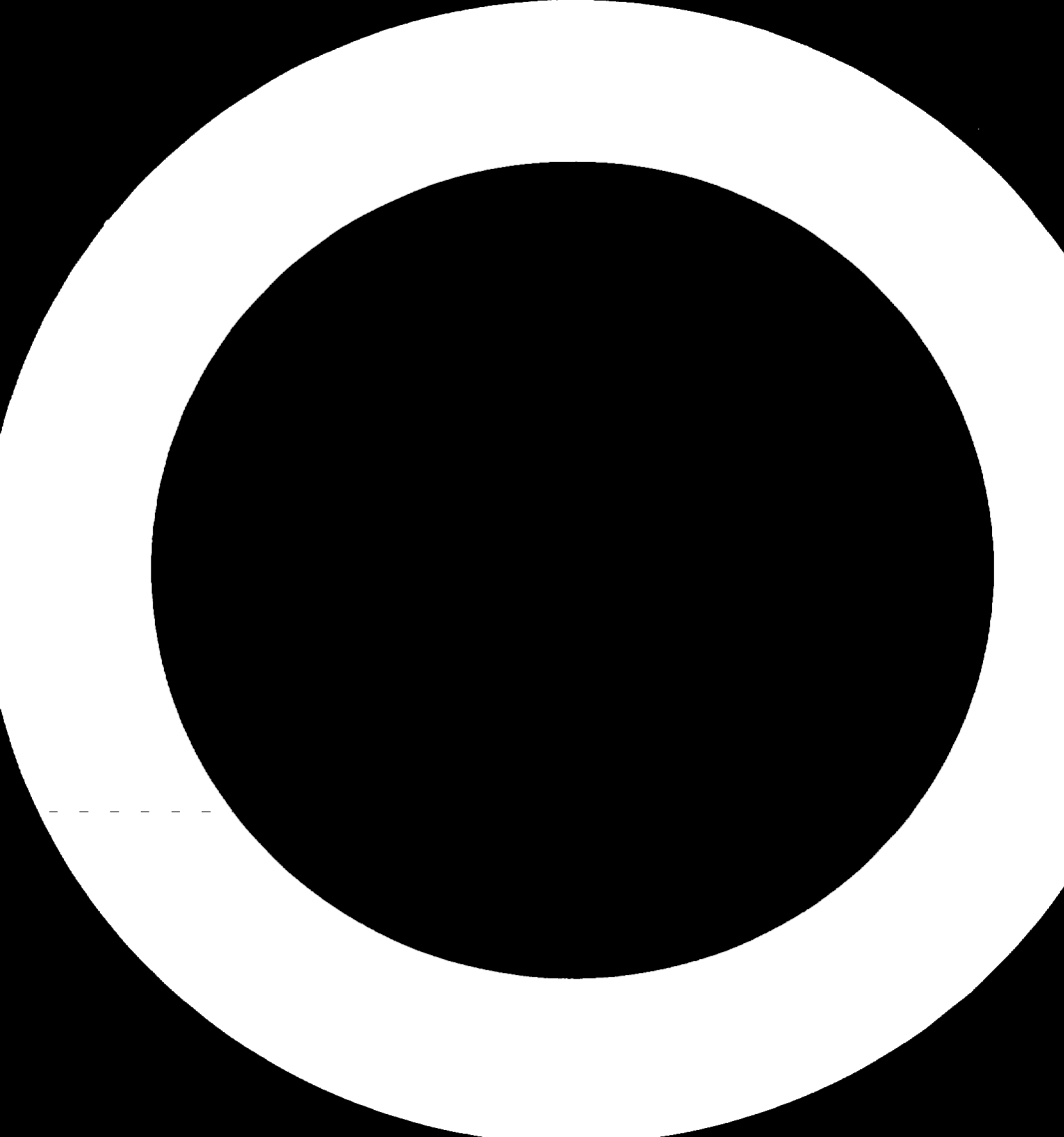
- The major intermediate and final petrochemicals will be produced by 1986 in Saudi Arabia. This will create new material balance in the region.

- There are common problems that hinder the development of the rubber and plastics industries in the Gulf countries. Eight fields for joint efforts to promote the industry are identified in the report.

- Urgent needs for the Kuwaiti melamine/urea formaldehyde resins production accompanied by moulding capacity for promotion to cover the Gulf demands for dinner wares, electrical parts, decorative sheets and other products.

- Since almost the activities in the field of rubber and plastics industries will, to a great extent, continue by relatively commercially minded enterpreneurs, a centralised, non profitable agency should be formulated to carry over the responsibility of technological advancement, application promotion, process trouble shooting, engineering design and repair, maintenance, skill-creation for this industry.

- The creation of a specialised centre to be located in Kuwait was discussed with the higher authorities in the Ministry of Industry and SABIC during the author's visit to Saudi Arabia in Dec. 1982. The same idea was exposed by the author during the symposium on "Plastic Technologies and Applications" held in Amman, Jordan (11-15 Dec. 1982).Joint ECWA/UNIDO). The project is completely appreciated and a recommendation was taken in this respect.



Part II

# THE KUWAIT
# RUBBER AND PLASTICS TECHNOLOGY CENTRE

Part II

Contents

5. Equipment Locally Available.

6. Work Plan Bar Chart.

7. The Centre Budget and Financing.

VII REGIONAL CONTRIBUTION OF THE CENTRE.

VIII SUMMARY AND CONCLUSTIONS.

# I N T R O D U C T I O N

This part deals, in detail, with different aspects of creating a rubber and plastics development centre in Kuwait. The structure of the centre, its technical and financing requirements are investigated. A programme of Action for the implementation of the centre is also prepared.

The possible contribution and/or utilisation of the existing institutes, and the regional contribution capabilities are exposed as the result of achievements reached through field surveys and visits to two neighbouring countries.

## II OUTLINE OF THE OBJECTIVES

The Plastics and Rubber industries development Centre will have the main target to narrow the gab between the raw material producers, the plastics processors and the end product users . The field survey has revealed the suffering of local processors from the problems created between them and the polymer producers, compounders or the machinemanufacurers. These problem will be handled by the centre. It will guide the applied research towards the direct assistance to the industry. Thus it will eliminate the obstacles and bottle neck problems facting the industry development and thus reducing the idle capacities to minimum.

The centre will have a key objective of assisting the industry to produce according to the national or the international standards suitable to the domestic climate. It should participate in preparing such national standards specifications . The plastics & Rubber industries development Centre (PRDC) will be equiped with sufficient machine and expertise so that it can undertake the responsibility of implementing the programmes for the development of new fields of applications. The areas of immediate priority were identified as to be the insulation, construction, packaging.

The use of foamed plastics as insulations material has gained a great interest for the sake of conservation of energy. These material are used in the insulation of roofs, internal and external walls and floors. There is strong competition between the processors of the foamed plastics and whose who produce other insulation materials. This competition will be much severe when the production of foamed perlites, vermucilitie start . This field of application requires very urgent and intensive programmes of investigations.

In the building and construction areas, plastics are used as pipes/fittings for water supply and storage and as pipe covering, . . Still there are a ide range of applications, speically in GFR- plastics, that are not tried and the centre will be the tool to identify its feasibility.

The types and specifications of plastics products used for packaging need to be rectified. The competition of the imported foreign products must be minimised through sincere amelioration of the present technology and procedure of applications.

The application in Agriculture and water conservation is limited due to the nature of the land and the climatic conditions. Other Gulf Countreis consume more plasties products in this field. As examples grain storage and packaging, pond lining in semi-arid zones, trickle irregation, canal and channel lining, tunnel covering for green houses..etc There are a large number of potential applications that can be developed and used to whole gulf agricultural add fisheries outputs. Cooperation with other instiutional bodies which are ctively operating in his field e.g. Agriculture department, MPW, WRDC, KUF, KISR, is recessory. The Centre should also have close ties with Gulf ministries of Agnicultures, Committees and other institutes for the benefits of the whole area.

Another key role that the centre will play is the creation and the up-grading of skills. This can be executed through the local and international expertise by providing on-the-job training for the different levels of labour on periodic terms. The creation of skill cannot be executed in Universities of scientific research institition but only in such type of specialised centres. This will save unpredictable money, material and equipment that the private industry presently loose.

Another major objective of the centre is to introduce, to adapt and to develop new process and product that support the identified fields of application. This support should be associated assistance in the form of technical and training services. The processes will in main topics like formulations, compounding, injection, blow moulding, extrusion and compression.

The recovery of Plastic scrap is of great importance from both the economic and environmental protection points of view. The traditional method of waste recovery is not always successful for all types of products. When dealing with thin-walled films, other processes like zerglomat can be used. The introduction of such new technologies is the responsibility of the centre.

It is deduced from the survey that the domestic processors are in need of mould-maintenance and repair service. As a further step in this field that can be achieved through the centre will be the design and manufacturing of the moulds. This field of activity can be executed at the present time in an engineering institute or company like Kuwait Foundry Co, Arabian Transportation Vehicles Industrial Co. and Shorline Maintenance Works and contracting Co. Some of these establishment appreciated the idea and expressed their willingness to do the job as well as the necessary training whenever requested. There are many specialized centres in this field in Europe, one in Cairo and one in Madrid . These have been established with UNDP/UNIDO assistance and they have short- and long-term courses in mould design and mould making on an international basis.

## III STRUCTURE OF THE CENTRE

The structure of the centre should be different from any research institute or scientific college and must fulfil the real needs of the local Rubber and Plastics Industries. This is expressed in form of services and activities that can be better offered by such specialised mono-purpose, than from multi purpose institute.

The field survey has cleared out the fields of activities that the centre should have in order to support, in a continuous manner these industries during their development. These activities are

1. Testing and investigation services on raw materials and finished products.
2. Market and technical Information servides .
3. Processing and Application development.
4. Training.
5. International Cooperation.
6. Techno-economic studies.
7. Engineering Services.

The facilities to execute such activities may be called "sections" linked togetherthrough common departments and headed by the director. organisation chart should be simple and flexible.

1. Management Board

The Centre has to operate as an autonomous body administrated by a board having full authority to establish policy guidelines, to approve the annual programmes, budget and salary scales.

The board must represent the different governmental and private agencies concerned. The suggested composition of the board is represented in the following.

Suggested Board of Management

| Agency | Number of Representatives |
|---|---|
| - Ministry of Commerce and Industry (Industrial Affairs,) | 2 |
| - Kuwait Industrial Bank | 1 |
| - Kuwait Chamber of Commerce and Industry | 1 |
| - Ministry of Petroleum, Kuwait Petroleum Organization. | 1 |
| - Ministry of Public works. | 1 |
| - Private Industry | 3 |
| - Kuwait Institute for Scientific Research | 1 |
| - Kuwait Foundation for the Advancement of Science | 1 |
| Total members | 11 |

2. The Director of the Centre

The quality and characteristics of the director have the direct impact on the success and continuity of the centre. He should be a highty qualified technologist with broad experience in Rubber and Plastics industries. An advanced background on Polymer science and engineering is essential. The director must have managerial and planning experience and be a skilled administrator. He should have experience in modern management techniques in relation to control of finance, human and physical resources.

Above all he must be self motivated with a pleasant personality and capable of exerting the driving force necessary for the successful establishment and operation of the centre.

3. Organisational Structure

The centre is to be divided functionally into two main departments and seven principlal sections as shown in the proposed organisation chart attached (annex 5) This simple organisation structure should fulfil the required functions of the centre and lead to its smooth operation as long as the responsiblities of these sections and individuals are clearly defined. The following are the outlines of the proposed structure:

Technology Department

This deprtment includes essentially two sections namely: pilot processing and Applications. Previous experience has shown the advantages of not including testing & investigations section in the same department. This facilitates the formulation of multi-disciplinary teams sometimes required to solve industrial problems. However, due to the nature and the volume of work expected during the first phase of the centre, it is recommeded to attach the testing and investigation section to this departments. The section should be concerned with the following:

- Cooperation with the governmental Agency in the technical aspects during the setting up of national standards.
- Testing and checking the performance under standard conditions (multi disciplinary team) (client request).
- Assisting the establishment to set up its own quality control system (client request).
- Assisting the production up to the standards (multidisciplinary team) (client request)

- Carring out sophisticated instrumental analysis (e.g. UV-infrared- spectrography, X-ray diffraction. etc) (Government or client request).

The pilot and industrial processing section deals with

- Upscaling ofmanufacturing processes (multi disciplinary team)
- Manufacturing of special and costly products.
- producing proto-types for market evaluation.
- developing new processes and products (multi disciplinaryteam)
- Training and demonstrating various proceses. (government and private cliants).
- Solving industrial problem (private client requests).

The applicatbns-section has a wide area of activities covering the following fields:

- Building and constretion.
- Packaging.
- Housewares.
- Electrical & Electronic.
- Furniture.
- Agriculture.
- Appliances.
- Medical.

The responsiblities can be summarised in

- field performance-testing of newly introduced and/or manufactured articles.
- Solving of field application problems (client request).
- Setting up proper application procedures (client request)

Technical Services Department

This department includes the engineering and the tehno-commerical sections. It provide direct services to both the industry and other sections of the centre.
The engineering section should be responsible for:

- Maintenance, repair and engineering modifications work.
- Running andmaintaning of utilities.
- Engineering design, drawing and fabricating small items.
- Running workshops (machines and instruments)

At a later stage, this section should be capable of designing and manufacturing moulds,repairing sophisticated equipment and in collaboration with the appropriate technologists, of selecting the suitable equipment. This represents a vital seryice to all companies working in plastics and rubber industries sector.
The techno-commerical services include, among others, industrial information and documentation activities which covers technological, economic, as well as, commerical aspects of the sector. This implies the existanceof a well-advanced library, which is by no mean essentail at thefirst stage of implementation, within the boundary of the centre. It is only essentail tohave a rapid source of up-to-date information onspecific topics. Specialists should be available for accurate translation and (summarisation)of information and publications for each specific process or product. Computerisation could be done with the cooperation of any existing facility. International linkage with sister institutions,and industries is a vital responsibility of this section beside the provision of industrial inquiry services to private and governmental clients.

Commercial Services will be separated at a later stage forming a department of itsown. It deals with market and economic assessment, contracting and even feasibility studiesin cooperation with other departments. It provides the clients with full pictures on market prices of raw & intermediates material, finished products and licences. Selected personnel ( may be one) working in this section can act as industrial liaisonofficer betwwen the centre and the clients. All the previously indicated work to be carried out by the centre upon clients request will be executed under the umbrella of contracts prepared by this section.

The Administration Section

The responsibilities of the administration section, (department later) are similar to those of other institutesalthough they may differ in procedure.

The Training Section

Full attention should be given to the training task of the centre, therefore, a separate section is suggested in the organisation chart to take over this reponsibility .

Local as well as abroad training programmes covering a range of skills and techniques have to be prepared and emplemented by the section. These programmes are very useful for creating and/or upgrading of skill required for running the plastic and rubber process equipment. It is possible to train locally on techniques like: impact/hardness test, weathering, chromatography, thermal conductivity, flammability...etc,while training on sophisticated processes and machinery like blowmoulding,calendering lamination, rotational moulding are preferabley be carried out abroad.at earlier stage of the centre-realisation.

These training programmes will include

- Fellowship training overseas.
- Studytours.
- On-job training.
- Technologists team training.

Institutional linkages help much during the preparation and execution of training programmes. Also twinning agreements with foreign competent institutes are of great benefit to the national Centre.

## IV TECHNICAL REQUIREMENTS

### 1. Equipment

The equipment suggested for the proper running of the centre are listed in accordance with the various sections, in annex No 8

Some equipment are of top priority (marked items), others are ofsecondary order of manitude. These equipment should be purchased from the specialishd manufacturers and its ordering should be done after very careful evaluations. The manufactures are best located in England, Germany, US.. Very few specialised items canbe obtained frm Japan, France and Sweden. The major equipment must be adapted for training purposes. The total cost of equipment is stated below including and additional cost of 5% for spare parts

Equipment Cost

| Section | K.D. |
|---|---|
| A. Product testing equipment | 130710 |
| B. Pilot Units equipment | 218700 |
| C. Administration and technical Service equipment | 28480 |
| D. Demonstration equipment | 6260 |
| Total | 384150 |

2. Buildings and Civil Work

The Centre buildings comprise of the following

- Offices and Social Services:round 40 rooms including a conference in Two-storey block, air conditioned.
- Testing and Investigations Three, air-conditioned
- Pilot-units- Hall air - conditbned (4 x 10).
- Stores for raw materials and spare parts: two air conditioned,
- one kept at 5 °C ± 1°C.
- General purpose warehouse and welfare services.
- Workshop.

As the work of the centre varies in nature from time to time, it is important that building and allied facilities be set up with the highest degree of flexibility so as they can easily be adapted to meet changes required. The building design and the construction materials should conform to the international and local standards that are peculiar to laboratory work, such as the need to temperature-,humidity-,vibration-and noise-control, to provide suitable lighting and to prevent fire, fumes, hazards and corrosion.

- Particular attention should be paid to the arrangement. and location of water-,gas,- electricity, drain, and ventilation new-work, They should be readily accessible for repair,, modification, or extension. After having carried out comparative study to the various methods of constructions at KISR, University, and GRS (Government Research Station), it is recommended to use lightweight brickwork, thermaly insulated external walls for the two story block. Sandwich

panels (galvanizid steal sheets with insulating Core) can be used as external walls for the pilot plant Hall. light weight roofing covered with insulating material and pitches can be also used. The buildings have to be kept internally under pressure to prevent the infiltration of sand and dust. The layout as per the drawing attached has been prepared to fullfil the main objectives of the centre. The total area is estimated to be 4200 m2 distributed as follows. (annex No 9)

| | | | |
|---|---|---|---|
| 1. | Administration building | 192 | m2 |
| 2. | Testing /Investigation Lab (12mx25m) | 108 | m2 |
| 3. | Pilot units Hall (39mx25m) | 975 | m2 |
| 4. | Offices | 144 | m2 |
| 5. | Stores (including one cold store) | 50 | m2 |
| 6. | Labour Welfare services | 50 | m2 |
| 7. | Workshop | 25 | m2 |
| 8. | Utilities building (6m x 6m) | 36 | m2 |
| 9. | Open Area for application investigation | 672 | m2 |
| 10. | Parking Area (8m x16m) | 128 | m2 |
| 11 | Internal roads | 1821 | m2 |
| | Total | 4200 | m2 |

The total cost of the building including that of the site preparation, the civil engineering and the external fences is KD 306,900

## 3. Manpower Requirement and Recruitment

As can be identified from the proposed organisational chart of the Centre, there will be a need for management, technical and administrative personnel. The total labour required for the first phase of implimentation is estimated to be 49. During the first year

of the project there will be intensive preparation work including the finalisation of equipment specifications and ordering,, Therefore the first step will be the identification of the director who should be of high education level with both industrial research and development experiences. The recruitment of the deputy-director and the section leaders should follow. The deputy-director is expected to be a post-graduate with practical, financial and administrative experiences. The other technical and service personnel required are listed in table No ( 22 )

It is preferable to state, in this occasion, that the Key national personnel are difficult to find and to keep.. Therefore there should be some types of incentives for such personnel that encourage them to stay in the centre as its competitive team of experts. Some proposed incentives are:

- 20% higher in salary than these in industry.
- Periodic overseas up grading trips.
- Achievement-publications after a certain period of protection.

The local research instutites and industry can participate in this respect by releasing some of its personnel with research experiences to the centre. These personnel can be sent for overseas training courses.

Table No 22

Labour Requirement for the Centre

(First phase and Total)

| | Salary KD/month | Total Requiremtn Number | Total Wages + salaries | First Phase Nubber | Total Wages + salaries | Start date |
|---|---|---|---|---|---|---|
| A. Management/Administration | | | | | | |
| Director | 1100 | 1 | 13200 | 1 | 13200 | mid 1983 |
| Deputy director | 1000 | 1 | 12000 | 1 | 12000 | end 1983 |
| Technologists (Chief) | 850 | 2 | 20400 | 1 | 10200 | mid 1983 |
| Engineers | 600 | 1 | 7200 | 1 | 7200 | mid 1983 |
| Training Officer | 400 | 1 | 4800 | 1 | 4800 | mid 1984 |
| Administration Officer | 400 | 1 | 4800 | 1 | 4800 | begin 1984 |
| Librarian | 400 | 1 | 4800 | 1 | 4800 | mid 1983 |
| Librarian assistant | 300 | 2 | 7200 | 1 | 3600 | as required |
| Administration Officers | | | | | | |
| Economists | 300 | 5 | 18000 | 4 | 16400= | end 1983 |
| Data Research Offier | 300 | 2 | 77200 | 1 | 3600 | mid 1984 |
| | | 17 | 99600 | 13 | 78600 | |
| Technology Service staff | | | | | | |
| Technologists | 400 | 5 | 24000 | 4 | 19200 | 1983, as rqquired. |
| Assistant technologist | 300 | 6 | 21400 | 4 | 14400 | 1982-1984 |
| Process workers | 250 | 9 | 27000 | 7 | 21000 | 1984 as required. |
| Unskilled Labour | 150 | 6 | 10800 | 4 | 7200 | 1984, as required. |
| Application workers | 200 | 8 | 19200 | 4 | 9600 | 1984- as required |
| | | 34 | 102600 | 23 | 71400 | |

| | Salary KD/month | Total Requirement Number | Total Wages | First Phase Number | Total Wages+ Salary | Start Date |
|---|---|---|---|---|---|---|
| C. Servicing Personnel | | | | | | |
| Secretaries, Typist | 150 | 5 | 9000 | 4 | 7200 | mid 1983, as required. |
| Store keepers | 150 | 3 | 5400 | 2 | 3600 | end 1984 |
| Technicians | 250 | 5 | 15000 | 3 | 9000 | end 1984 |
| Guards | 100 | 3 | 3600 | 2 | 2400 | end 1984 |
| Drivers | 100 | 3 | 3600 | 2 | 2400 | 1984, as required |
| Total C | | 19 | 36600 | 13 | 24600 | |
| Total (A+B+C) | | 70 | 238000 | 49 | 174600 | |
| 10% termination benefits | | | 238000 | | 17460 | |
| Total wages and Salaries | | 70 | 262600 | 49 | 192060 | |

4. Sister..... Sister-institutional Linkage

It is of great benefit for a newly established centre to create a continuous linkage with a more advanced one in countries like England, Germany, USA or France. Such a linkage with a sister institutes may be materialised through diredt contact, or a part of a bilateral assistance programme between the two countries or through the assistance of UNIDO. The sister institute will participate in staff training, exchange of technical experience process development and evaluation.

## V. INVESTMENT REQUIREMENT

### 1. Basis For Cost Estimates

The following are the major basis considered during the procedure for cost estimation for the centre-

- The estimates are based on the prices prevailing at the beginning of 1982.

-= Land is considered of no booking value for the present estimation. After the final sittlement of form of the Centre there will be certain value allocated for the land in the final budget.

- Building cost-estimate is based on the measure followed in MCI and the prices of the newly established building

- Equipment cost-estimates are based on the information supplied by UNIDO, KISR and some recent offers.

  The estimates include the transportation, insurance and erection-costs. No custom duties are included.

- Consultation, trainingand start-up cost contains the cost of travelling, consultantation and training during installation period. It contains also 25% of manpower cost andthe cost of expandable equipment and supplies required for the start up as listed in the following table No-23,and 15% of miscellaneous expenses.

Table No 23

Expendable Equipment and Supplier
for Start running the Centre

| Item | Description | Estimated cost KD |
|---|---|---|
| . Chemicals | for testing and envestigation | 4000 |
| . Raw material and semi finished prod. | valcanished rubber powder/sheets resins, fillers, additives ..etc | 4600 |
| . Finished products | films, pipes,condiats, sheets GRP products, foamed products. | 6700 |
| . Articles for applicatbns. | Sandwish panel,pipes, mats, fittings.... etc. | 3000 |
| . Office supplies | Paper, pencils, small articles, photo copy paper ..etc. | 1000 |
| . External Services | KISR-and University supply for technical and scientific information. and statistics. | 9000 |
| Total | | 28300 |

2.Total Cost of Installation and Investment Estimate.

This is represented in the following table ( 24 ) not taking into consideration the degree of cooperation withthe existing institutes but the conditions prevailing during the implmentation. The total investment reaches KD 1.03 million, The cost of the installed equipment represents 42% and the building 29.7% of the investment required.

Table No

Investment requirement

(1982)

| Item | | Cost Estimate KD 1000 |
|---|---|---|
| 1. | Building and Civil work | 306900 |
| 2. | Equipment and machinery | 384150 |
| 3. | Errection of Equipment and machinery | 49940 |
| 4. | Air conditionming (included) | - |
| 5. | Furniture, fire fighting, stores requirement, library. | 38400 |
| 6. | Start up, consultancy and training | 191300 |
| 7. | Spare parts and material | 17600 |
| 8. | Transportation means. | 24000 |
| | Total | 1029890 |

VI PROGRAMME OF ACTION

The critical examination of the informations and data obtained throught the field survey carried out as a part of the activities of the present UNIDO-project, has helped to identify the real bottle necks, priority areas and mode of cooperation with the existing e institutions and finally to reach the programme of implementation as discussed below.

1. Fields of Priorit ies

The following fields of applications for the rubber and plastics products are specified as fields of priorities on the national Level, the list is arranged in a descending order of importance and the main activities required in each field are stated in font of each field.

| Field | Activities required |
|---|---|
| - Building and construction (including insulation piping) | specifications, processing new products techno economic studies, skill. |
| - Packaging (including bottling) | processing, new products, techno economic studies. |
| - Furniture and furnishing | quality, processing, marketting processing, quality control. |
| - Housewares | processing, quality control. |
| - Electircl and electr. onics. | specificatbns, market research. |
| - Engineering (including rubber products) | market studies. |
| - Textiles (Lamination) | new applications and process |
| - Recreational | quality control, new products. new process, skill. |

2. Degree of cooperation with the existing Institutbns

By reviewing the functions that can be performed or the services that can be provided by the present institutions for the rubber and plasties industries, it was found that these are unsufficient. Examples of functbns and services required and degree of coverage by the present institution are given below:

Table No 25

| Functional Activities | Existing Institutions capable of under-taking the activity | Degree of covering |
|---|---|---|
| **Support Services** | | |
| Standared Specification Preparation | MCI | Low |
| Analysis, testing | GRS,KISR, MPW | Covered |
| Quality control, certification | GRS,MCI | moderate |
| Technical Information | KISR,K.U, | moderate |
| Market research | MCI, | Low |
| Techno economic studies | MCI, KISR, consulting offices | moderate |
| **Technological services** | | |
| Technical Investigations | KISR, Consulting officer | L w |
| Industrial trouble shooting | - | absent |
| Process Problems | - , KISR | V. Low |
| Engineering Problems | KIT, GRS | V.Low |
| Processing promotion/development | - | absent |
| Application promotion/development | - | absent |
| Engineering repair and design | | absent |
| **Scientific Research** | | |
| Products applications & Propertics | KU,KIT,KISR | moderate |
| process develpment | KU,KISR | moderate |
| **Training** | | |
| Graduate level | KISR, Factores | v. Low |
| Vocational level | Factories, KIT,KISR | Low |

| Functional Activities | Existing Institutions Capable of under-taking the activity | Degree of covering |
|---|---|---|
| Policy and Planning | | |
| Investment oppurtunity identification | MCI, MO, | Low |
| Project preparation & implementation | MCI, Public/Private | Moderate |
| Negotication and contracting | Public/Private factories | Low |
| Contribution to policy | MCI, National Council | Low |
| Development Planning | MCI, MP, Planning commission. | Moderate |

KISR has two advanced laboratories for products and material applications included in the petroleum division. Two governmental agencies have equipment and instruments for material analysis and quality control, only one gives certificates. By reconstructing any of the existing facitlities, providing firm linkage with other agencies and by allocating necessary tasks and responsibilities together with supplemental imputsto make it industrially oriented, this will shorten the realisation period and reduce the expenses. This may be an interim procedure that might not meet fully the Kuwait long-term industrial development targets, but it safeguards against idle capacities that might exist during the first phase of the centre. The installation of a completely new centre will be a better way if the centre will operate on the regional level this will be discussed in another part of the report.

Reference is made again to the results of the field surveys executed during the course of the present project. In order to utilise any of the existing facitilities, some modifciations are to introduced

in the requirements stated before, these modification are indicated in the following pages.

3. Procedure for Realisation

Since it is realised that the local Rubber and Plastics industries are in urgent need for sincere market forecasting and technical support that can be achieved through the establishment of a specialised centre. It is proposed to start the realisation of this centre by formulating an active ad-hoc committee from.

- Ministry of Commerce and Industry.
- Kuwait Institute for Scientific Research.
- KUwait Chamber of Commerce and Industry.
- Industrial Bank of Kuwait.

to take the following initiative steps:

a- Detailed requirement of the industry according to priority.
b- Degree of coopration with KISR.
c- Preparation of the organisation.
d- Selection of location and building.
e- Identification ofthe director.

Once the director is recruited, he should start immediately with the ad-hoc committee to prepare the four-year programme(proposed) to develop the centre. At this stage more representatives of the interested agencies could join the ad-hoc committeee, more authorities should also be given thus converting it to the suggested governing board of the centre. (annex N. 10)

Recruitment of national personnel should also start gradually. The readiness of the national institutions and establishments that was proved during the field survey, to release few skilldd personnel, on part-or full time basis, during the first phase of development is highly appreciated. Proper scheduling of personnel recruitment in harmony with the sequence of other development tasks is essential.

Training of Key personnel e.g. Section leaders will follows after their recuirtment. Since experienced Kuwaiti personnel are difficult to obtain, freshly graduated can be sent on longer overseas followship training Programmes e.g. 12 months divided into 3 sessions over3 successive years. There are about 5 specialised centres and more than 10 big companies in Europe that carry out such training programmes. More are available in USA. The followships can be made available through UNIDO, which will arrange for the successive execution of the training progamme.

On-job training has to be also executed within the centre for both its staff and client staff. The presence of local facilities can accelerate the start date of this type of training. International consultants can be scheduled to assist the centre during its development including the training programmes. Annex No summarizes the suggested requirement of international consultants who can be recruited through UNIDO . The respective roles of the international consultants shall be in accordances with the established concept and specific purpose of technical cooperation The recruitment of these consultantsshall be scheduled in a way that suit the work plan established.

4. Site Selection and Building

Although Shuaiba area has high concentration in terms of capitals invested in plastics industry, very few establishment were erected in this area. On the contrary, Sabhan & Al Ray and Shewaikh

industrial Areas have got the majority of establishment active in this sector( table No 6 ) Since the needs of the rubber and plastics industries would be best fulfilled by placing the centre near the largest concentration of processors, it is advisable to allocate the centre near in one of these areas to obtain the best accessability . The Government is also alttempting to develop new industrial areas and to demolish gradually the establishments existing in Shewaich area .

A. review of three existing institutions and departments was carried out trying to ascertain whether any of these is operating in related fields and to consider whether the centre may be more effectively located within such an existing institution. Investigationswere also made during the field survey to find out if there is an existing building with adequate facilities to accommodate the centre. It is generally more feasible and quicker to make conversion than to start from vacant land. It was found as a result of these investigations that KISR is relatively the best of these locations It has highly advanced documentation centre as well as department which includes testing apparatus and pilot equipment for polymers. About 40% of the contacted processor prefer the Sabahan allocation of the centre ,30% of these prefer the Shewaich allocation The precise site selection will depend, however, on the national policybesides the results of the techno-economic investigations to be carried in a later stage.

. Equipment Locally available

Some of the equipment, previously proposed for the proper running of the centre, were found available in the existing institutes (Annex No 12) The total cost of the major equipment of these reach KD 154000 . Some of the available equipment can be used by the centre through bilateral agreement, some other are essential for the centre and have to be purchased sooner or later.

The purchase of equipment should be processed in harmony with the execution-schedule of the centre, taking into consideration the time necessary for the preparation of equipment specification, quotation request, ordering and delivery. The general practice in Kuwait indicate that one should calculate from 6 up to 15 months from the time when the equipment- specifications are ready till the arrival of the equipment to the site.

6. The Work Plan

A detailed work plan (annex No 10 ) for setting up the centre was prepared according to the achievements reached through direct communications & field surveys. This work fplan has to be revised after the final settlement to the type and form of the centre. has been concluded and the director of the centre has been recruited. Another work plan can be prepared by a UNIDO - Consultant in cooperation with the director after all fields of activities have been clearly defined.

7. The Centre Budget and Financing

The time span of phase I of the centre is suggested to be 4 years. The total financial requirements are estimated and distributed over the whole period according to the work plan stated before taking into consideration the complete recruitment of manpower by the end of phase I. (annex No 13)

The estimated budget of KD 1.54 million does not include the cost of normal running of the centre and the cost of the programmes to be executed by the centre. A separate annual budget should be prepared for these programmes including salaries, wages utilities, services, consumable materials and the amortization of

equipment.

Many institutes and industrial establishment expressed their willingness to participate in covering the cost of implementation. The following is a summary of the survey-results:

- Cash money.
- Civil expenditure.
- Iroduction & application equipment.
- Testing and investigation equipment.
- Others.

The openion of these agencies and establishment with respect to the method of covering the running cost of the centre, varied considerably. The following scheme could be stated representing the major part of the survey-results.

| | % total |
|---|---|
| - Government participation. | 40-50 |
| - IndustrialBank of Kuwait. | 20 |
| - Tercentof industry net profit. | 0.5-1 |
| - Income from services offered to industry. | the rest |

## VII REGIONAL CONTRIBUTION OF THE CENTRE

About 80% of the answer received, to the questionnare distributed for this purpose, suggested the establishmnt of the centre to serve the countries of the Gulf Area. This of Curse needs more consideration add studies covering technical and financing aspects of the matter. The followings fields of activities on regional level were suggested by regional agencies like

- Joint studies for: technology assessment, acquisition of technology, development alternatives, patent information, adaptation and creation of technologies .

- Setting regional /domestic standards.

- Joint programme for training.

- Inflow and joint utilization of techniques. and processes between enterprises in the Gul Area.

- Centralization of engineering services like mould design and mould making in the centre for the whole region.

Such regional activities can be governed by the rules applied by other regional institutions. With the experience now available, such regional institution requires more time and efforts for creation, such time can be considerably shortened if similar facilities exist in any country of the region.

## VIII SUMMARY AND CONCLUSIONS

The results of the field surveys have revealed the urgent needs for a specialised instrument that can acquire and apply modern technological knowledge directly to rubber and plastics industries. The requirements of these industries are summarised in the following.

- Process amelioration and/or modernization.
- Solving trouble shooting problems.
- Application development.
- Market studies, analysis and assistance in marketing.
- Techno- economic, cost accounting, efficiency and productivity studies.
- Testing and quality control (certifications)
- Instrumentation and maintenance.
- Training, up grading and creation of skills.

A specialised industrial centre is the only instrument that can fulfill these requirement. Accordingly the suggested centre should have the following departments and sections:

- Technical services department including: technocommercial services and engineering sections.
- Technology department including: testing, pilot & processing and application sections.
- Training section.
- Administration section.

The organisation structure of the centre should be simple and flexible and headed by a highly qualified director, its policy has to be established and varified by a governing board.

The proposed centre requires duringrts first phase of implementation to the following:

| | | | |
|---|---|---|---|
| Equipment installed | KD | 434 090 | |
| Buildigg and construction | KD | 306 900 | |
| Total investment | KD | 1.03 | million |
| Manpower | | 49 | |
| Area | m2 | 4200 | m2 |

Some agencies expressed their readiness to participate in the centre-realisation in cash, equipment or manpower .

The following are some of the final features reached after taking into consideration the various opinion of the agencies and institutions contacted:

- The application fields of high priorities are: Building/ construction, and packaging.
- The Site should be either in Showeich-(near or inside KISR) or in Subhan area.
- The equipment in the existing Institutions can be utilized by the Centre through bilateral agreement.
- The estimated international consultations are 33 m/m.
- The phase I duration is4 years, and thetotal budget of K.D. 1.5 million is distributed according to the work plan over this period.
- The financing procedure recommended includes:
  - Government and IBK contribution: 30-40% of budget.
  - Industrial Establishment: 0.5% of Net Profit.
  - Direct earning from services provided through contracting
  - Donations from organisations and agencies.

It is recommended to start the implementation by carrying out a seminare(workshop) to be organised jointly by MCI and UNIDO on "the Development of Rubber and Plastics industries in Kuwait". This will be followed creating the centre on a modest scale through detaching an existing department and develop it to meet the specific targets of the centre. The centre in this form will start its activities by providing urgent services to clients who will be entirely industrial entreprises and agencies, consumers and their associations and the international organisations.

The centre, after compl ting its final form, should be an autonomous body with independant financial and administrative systems that enable it to operate with high flexibility.

It is expected to have idle capacities in the pilot Units section. However, with continuous contact with the potential clients, the centre can develop its own earning from the services provided to them. These earnings will cover a greater part of the centre budget.

The cnntre can preed as a proceeding step, depending on its success on the nationa level, its services to the Gulf countreies and may be converted completly on a later stage to a regional centre.

The project of creating a rubber and plastics development centre to serve the industry is greatly appreciated by the high authorities in the saudi Ministry of Industry, SIDF and SABIC during the consultant's visit to Saudi Arabia in Dec. 1982. It was suggested that the healthy growing cooperation between the industries and agencies in Kuwait and Saudi Arabia could be channeled through the proposed Centre.

The project was briefly presented by the consultant during the seminar on "The Plastics Technologies and Applications" held in Amman, 10-15 Dec. 1982(Joint UNIDO/ECWA). The idea was accepted and a conclusion was reached that such a centre charged with a regional mandate, might be well-suited for coping with regional issues and a coordinated approach to a variety of technological and market problems.

# Annexes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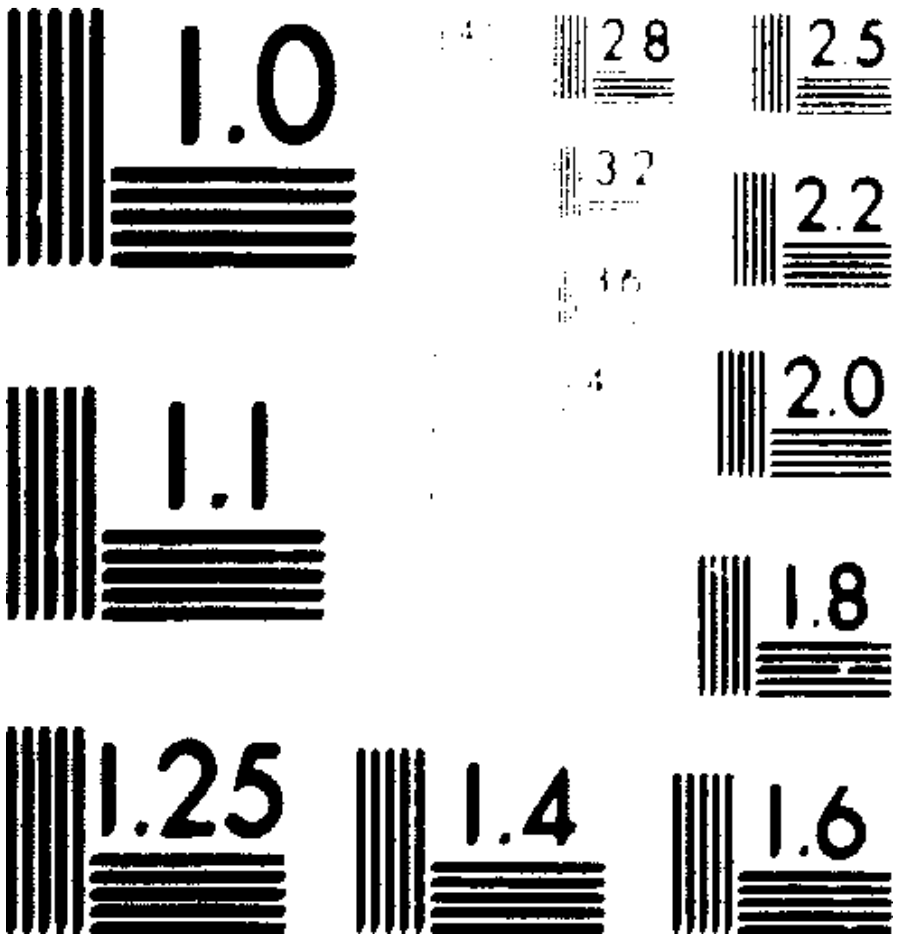


Annex No 1

Labour force by Sex and Group of Economic Activity

| Group of Economic Activity & Sex. | | 1965 | | | 1970 | | | 1975 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Kuwaiti | non Kuwaiti | Total | Kuwaiti | non-Kuwaiti | Total | Kuwaiti | non Kuwaiti | Total |
| Agriculture, Hunting | M | 566 | 1408 | 1974 | 798 | 3253 | 4051 | 3970 | 3522 | 7492 |
| Hunting & Fishing | F | 7 | 2 | 9 | 4 | 5 | 9 | 13 | 9 | 22 |
| | T | 573 | 1410 | 1983 | 802 | 5258 | 6060 | 3983 | 3531 | 7514 |
| - Mining & | M | 1337 | 5241 | 6578 | 1627 | 4828 | 6455 | 1767 | 2953 | 4720 |
| & Quarrying | F | 12 | 402 | 414 | 48 | 668 | 716 | 12 | 127 | 139 |
| | T | 1344 | 5643 | 6992 | 1675 | 5496 | 7171 | 1779 | 3080 | 4859 |
| - Chemical | M | 9 | 74 | 82 | 208 | 795 | 1003 | 884 | 3556 | 4440 |
| manufacturing | F | - | - | - | - | 25 | 25 | 6 | 87 | 93 |
| Total Manufactur- | M | 1823 | 16103 | 17926 | 6100 | 25876 | 31976 | 2237 | 21889 | 24126 |
| | F | 2 | 14 | 16 | 9 | 106 | 115 | 21 | 320 | 341 |
| | T | 1825 | 16117 | 17942 | 6109 | 25982 | 32091 | 2258 | 22209 | 24467 |
| - Construction | M | 1262 | 27566 | 28828 | 2186 | 31418 | 33604 | 1755 | 30357 | 32112 |
| | F | 2 | 18 | 20 | 2 | 66 | 68 | 1 | 143 | 144 |
| | T | 1264 | 27584 | 28848 | 2188 | 31484 | 33672 | 1756 | 30500 | 32256 |
| - Trade | M | 5115 | 17769 | 22884 | 7261 | 25181 | 32442 | 7592 | 36912 | 44504 |
| | F | 14 | 1 7 | 161 | 37 | 534 | 534 | 571 | 112 | 1578 |
| | T | 5129 | 17916 | 23045 | 7298 | 2576 | 33013 | 7704 | 38378 | 46082 |
| - Transport | M | 2612 | 7336 | 9948 | 2357 | 9640 | 11997 | 4305 | 10853 | 15158 |
| Communications | F | 1 | 76 | 77 | 5 | 136 | 141 | 262 | 265 | 527 |
| | T | 2613 | 7412 | 10025 | 2362 | 9776 | 12138 | 4567 | 11118 | 15685 |
| - Service | M | 24571 | 50123 | 74694 | 34919 | 5449 | 89320 | 56011 | 72203 | 128214 |
| | F | 948 | 6892 | 7840 | 1907 | 12909 | 14816 | 6877 | 25188 | 32065 |
| | T | 25519 | 57015 | 82534 | 36826 | 67310 | 104136 | 62888 | 97391 | 160279 |
| Total Active | M | 39163 | 131498 | 170661 | 57614 | 160262 | 217876 | 79666 | 183919 | 263585 |
| Population | F | 1003 | 7620 | 8623 | 2020 | 14458 | 16478 | 7509 | 27525 | 34830 |
| | T | 40166 | 139118 | 179284 | 59634 | 174720 | 23354 | 86971 | 211444 | 298415 |
| Total Inactive | M | 25583 | 10240 | 35823 | 43123 | 17341 | 60464 | 38863 | 17206 | 56069 |
| | F | 60772 | 35580 | 96352 | 96894 | 68938 | 165832 | 112812 | 86634 | 199446 |
| Grand Total | M | 64746 | 141738 | 206484 | 100737 | 177603 | 278340 | 118529 | 201125 | 319654 |
| | F | 61775 | 43200 | 104975 | 93914 | 83395 | 182310 | 120117 | 114159 | 234276 |
| | T | 126521 | 184938 | 311459 | 199651 | 260999 | 460650 | 238646 | 315284 | 553930 |

Source: Ministry of Planning Annual Statistical Abstract 1981.

Annex 2

| | Material/Product Component | | | Residential | | | | | | | | | | | | Commercial | | | Industrial. | | | Public Bldg. | | | Cold Stores | | Prefab Houses. | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | NHA | | | Private | | | Investment | | | Public | | | | | | | | | | | | | | | | | |
| | Outer skin | Insulating M. | Inner skin. | EW | IW | R | EW | IW | R | EW | IW | R | EW | IW | R | EW | IW | R | EW | IW | R | EW | RW | R | W | F | EW | IW | R |
| 1 | ES FE | PS FE | * | x | | x | x | | x | x | | x | x | x | | x | | x | x | | x | x | | xz | x | | | | |
| 2 | - | PS FM | - | x | | x | x | | x | x | | x | x | | x | x | | x | x | | | x | | | x | x | x | | x |
| 3 | - | PU SP | - | x | | * | | | x | | | x | | | x | | | x | | | x | | | x | | | | | x |
| 4 | G. Steel | PU In | G. Steel | | | | x | | | x | | | x | | | x | x | | x | | | | | | | | x | | |
| 5 | Plywood | PU In | Al sheet | | | | x | | | x | | | x | | | x | | | x | | | | | | | | x | | |
| 7 | Al foil | PU Sheet | Al foil | | | | | | | | | | x | | | x | | | x | x | | | | | | | x | | |
| 8 | Kraft paper. | PU Sheet | Al/Kraft | | | x | | | x | | | x | | | x | x | | | x | | x | x | | x | | | | | | |
| 9 | Al Kraft | PS FM | Al/Kraft | | | x | | | x | x | | x | x | | x | x | | x | | | | x | | x | | | | | | |
| 10 | Al Kraft lap.lap. | PS FE | - | | | | * | | | x | | | x | | | x | | | x | | | x | | | x | | | | | |
| 11 | Marble | PS FE | | | | | x | | | x | | | x | | | | | | | | | | | | | | | | | |
| 12 | Chipboard | PS FE | Chipboard | | | | x | | | x | | | x | | | | | | | | | | | | | x | x | | | |
| 13 | GRP | PS FE | | | | | | x | | | x | | | x | | | x | | x | | | | | | | x | | | | |

EW External Wall
IW internal wall
R roof

ANNEX NO 3

## PATTERNS OF PLASTICS CONSUMPTION BY MARKET IN DIFFERENT COUNTRIES FOR 1980

| COUNTRY | % of plastics consumption by marekt | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
| Argentina | 17 | 43 | 3 | 3 | 1 | 2 | 2 | - | 4 | 1 | 3 | 21 |
| Australia | 23 | 25 | 7 | 7 | 8 | 3 | 1 | 9 | 1 | * | * | 16 |
| Austria | 21 | 31 | 10 | 4 | 11 | 4 | 1 | 3 | 2 | 7 | 4 | 2 |
| Belgium | 18 | 30 | 25 | 5 | - | 7 | - | 15 | - | - | - | - |
| Canada | 22 | 34 | 6 | 10 | 5 | 4 | 5 | 4 | 1 | 5 | - | 5 |
| Chile | 18 | 30 | 5 | 4 | 6 | 4 | 4 | 8 | 2 | - | - | 16 |
| Denmark | 20 | 25 | - | - | - | - | - | - | - | - | - | - |
| West Germany | 25 | 21 | 15 | 7 | 5 | 4 | 0.5 | 2.5 | - | - | 10 | 12 |
| France | 20 | 30 | 5 | 6 | 5 | 4 | - | 5 | - | - | 10 | 15 |
| Italy | 11 | 31 | 10 | 6 | 5 | 4 | 7.5 | 5.5 | 0.7 | 1 | 15 | 5 |
| Japan | 13 | 25 | 13 | 8 | 1 | 3 | 1 | 7.5 | 0.3 | 2 | 14 | 14 |
| South Africa | 10 | 35 | 11 | 8 | 4 | 3 | 3 | 2 | 7 | 4 | 5 | 8 |
| Spain | 12 | 30 | 10 | 5 | 6 | 5 | 2 | 5 | 1 | 6 | 6 | 12 |
| Sweden | 18 | 26 | 13 | 5 | 4 | - | - | 4 | - | 16 | - | 14 |
| Switzerland | 27 | 21 | 12 | 4 | 4 | 5 | * | 5 | * | 8 | - | 14 |
| United Kingdom | 20 | 34 | 10 | 5 | 7 | 2 | 4 | 2.5 | 1 | 2 | * | 12.5 |
| United States | 18 | 28 | 7 | 5 | 5 | - | - | 10 | - | 1 | 7 | 19 |

* included in other markets

Key to headings:
1. Building & Construction
2. Packaging
3. Electrical/Electronic
4. Transportation
5. Furniture
6. Agriculture
7. Toys & leisure items
8. Housewares
9. Clothing & footwear
10. Mechanical Engineering
11. Glues, adhesives, paints, lacquers, inks
12. Other markets.

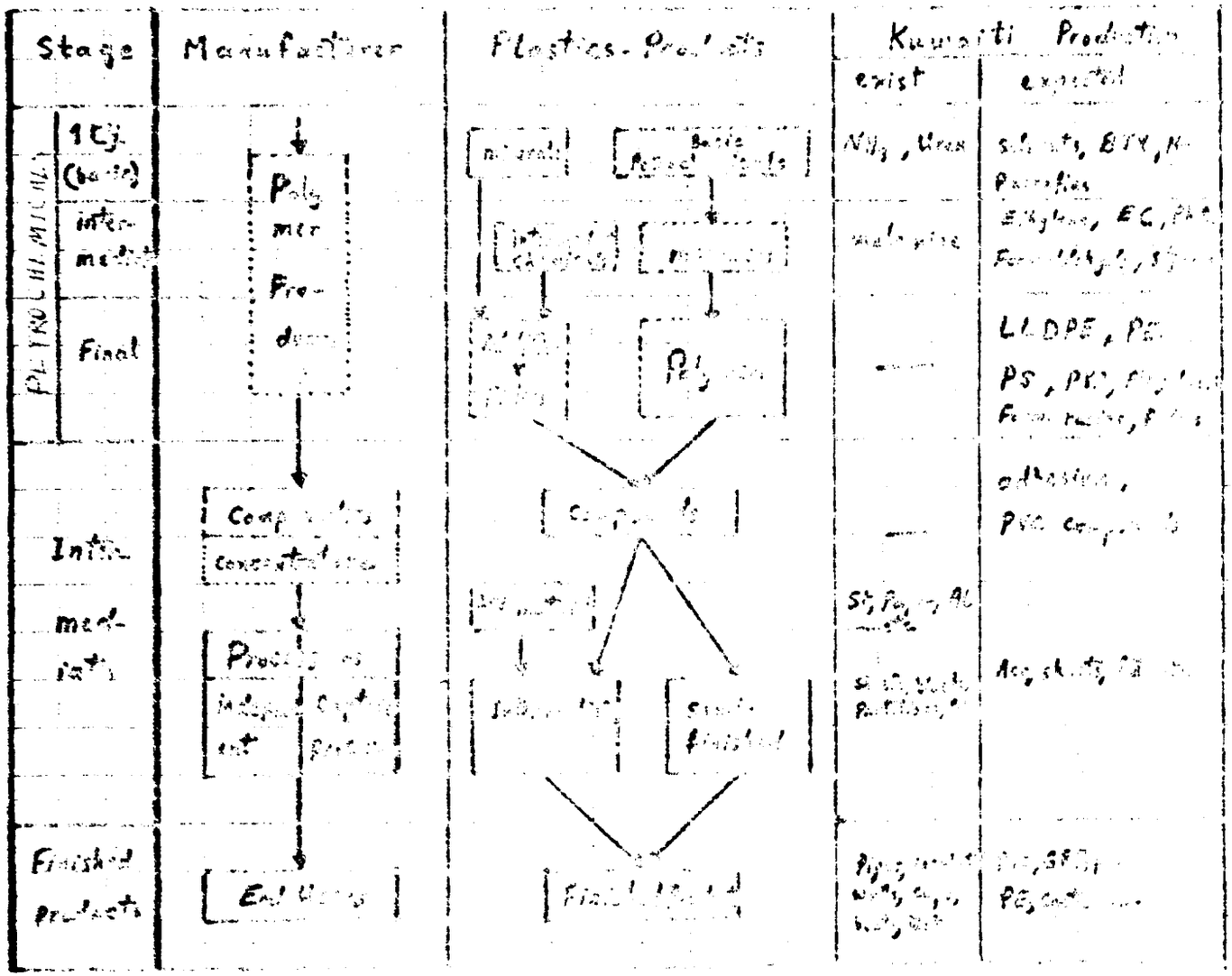
Annex (4)

PVC Consumption Pattern in USA
1981(M. Lbs.)

| Process | Product | Weight | Total weight |
|---|---|---|---|
| Extrusion | Pipes | 2032 | |
| | Wire & Cable | 374 | |
| | Packaging | 308 | |
| | Siding | 180 | |
| | Total | | 3240 |
| Calendering | Flooring | 150 | |
| | Packaging | 79 | |
| | Upholstery | 75 | |
| | Automotive | 70 | |
| | Total | | 812 |
| Injection Moulding | Fitting | 110 | |
| | Others | 213 | |
| | Total | | 323 |
| Compression | Phono records | 108 | 108 |
| Blow moulding | | 99 | 99 |
| Dispersion coating | | 306 | 306 |
| Solution coating | | 55 | 55 |
| Dispersion moulding | | 185 | 185 |
| Latex | | 55 | 55 |
| | | | 5612 |

Figure No 5

The Present Structure of the Kuwaiti Plastics Industry



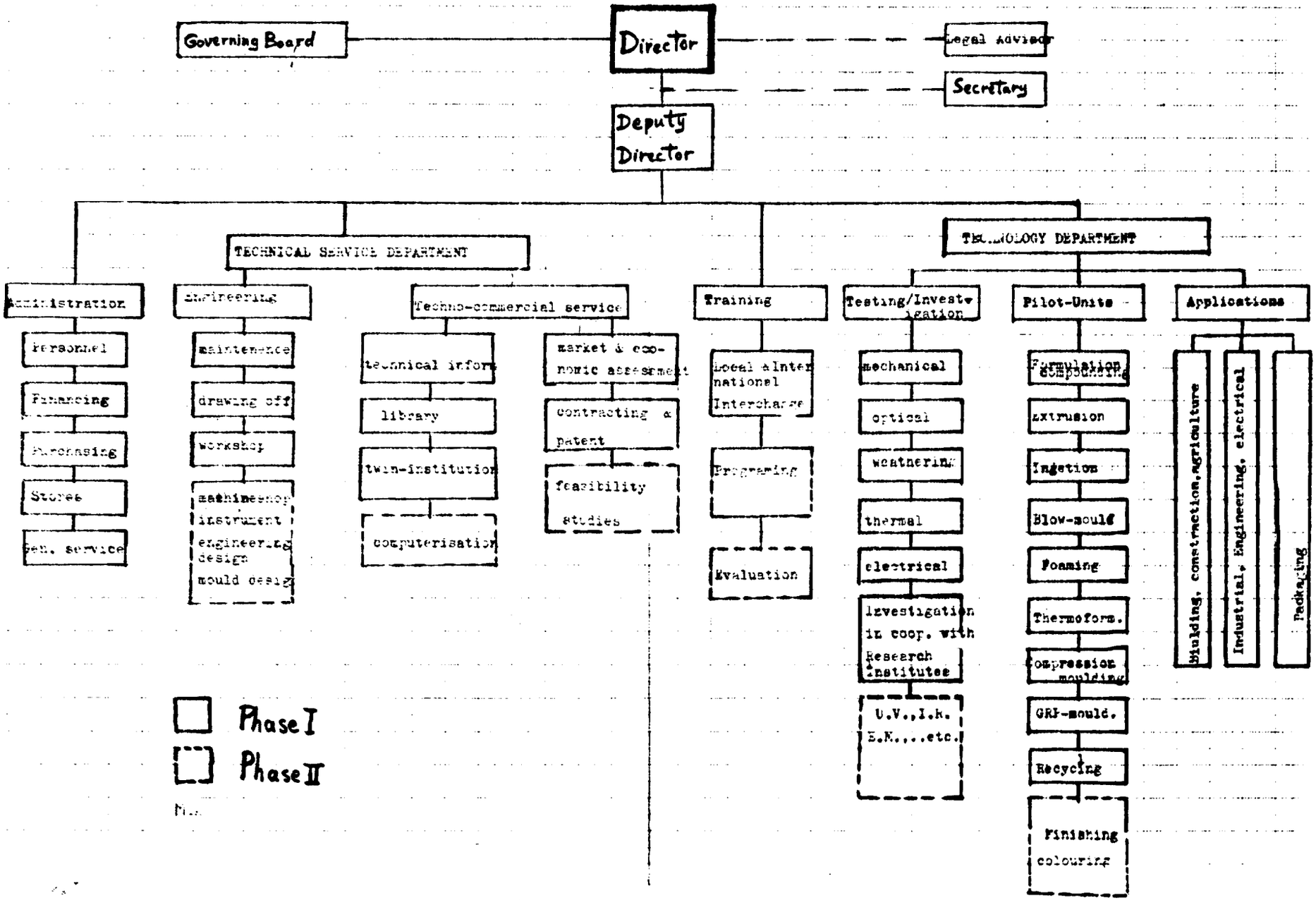
Annex No.6

## Some Kuwaiti Standards

1- Soft Polyurethane foams, and mattresses made from them.
2- Horizontal water tanks made from GRPolyester resins.
3- Dinnerwares made from melamine resins.
4- Cups and containers made from rigid and semi-rigid plastics (single use) for diary products and similar products.
5- Ash trays made from mixed plastics.
6- Plastic bottles for chemicals, detergents and similar products.

# ORGANISATION CHART





Annex No 8

## EQUIPMENT LIST

### A. Product Testing Equipment

| name | General Description |
|---|---|
| . Rubber Micro Hardness Tester | T.M. ISO,ASTM |
| . Universal Tester | Tensile, compression, flexural, Properties, (ISO,ASTM) |
| . Universal Impact Tester | Charpy, Izod, Tensile impact properties, (ISO). |
| . Vicat Softening Tester | Dimention stability, (ISO). |
| . Drop Testing machine | Deop impact resistance (for blow molding )ASTM) |
| . Acclerated weathering appearates | heat, moisture, UV, $O_3$, $CO_2$ and other gases supply, (ISO) |
| . $H_2O$-vapour permealbility equppment | for electrical insulation |
| . Dust and Fog Tracking tester | for electrical insulation material, TM ASTM |
| . Dart Drop tester | film and thin sheets |
| . DTA and GTA analyser | for organic material |
| . Gel permeation chomatography | molecular weight distribution |
| . International Hardness tester | vulconized rubber. |
| . Accelerated ageing (or heat resistance) | " " (ISO,ASTM) |
| . Abrasion tester | (BS) |
| . Densimeter | specific grairty (rubber) |
| . Shearing disc viscometer | Mooney visconsity |

| | |
|---|---|
| - Oscillisting disc curemeter | Vuleanization propertics |
| - Tear tester | Elmendorf, for film |
| - Haze/Optical meter | |
| - Flex Cracking tester | Vulcanized rubber. |
| - Dial guages | thickness measuring, for flexable, rigid plastics pipes TM ISO, ASTM. |
| - Compression molding press | Specimens preparation |
| - Injection molding equipment | " " |
| - Punch press | Specimen preparation. (rubber, flexible plastics) |
| - Hydraulic test press | max. load 30 tones, temp. up to 200. |
| - Plasticorder | (Brabender), with mixing and recording units. |
| - Electronic tensile tester | for compression set. |
| - Oven | Temperature up to 200°C with shelves, St. St. inside. |
| - Flammability tester Instion tester. | |

## B. Pilot Units Equipment

### Formulation Compounding

| | |
|---|---|
| - High speed mixer with cooling mantle | 6-10 litre size. |
| - Powder blender | |
| - 2-roll mixer with speed differential. | Rolls ( 15x30 cm) |
| - Multi purpose hydroulic press with automatic programming | 100 ton, heating & cooling patterns. |
| - Top-pan elextronic balance | up to 1 Kg. |

### Extrusion Unit

| | |
|---|---|
| - Multipurpose extruder, screw with controlled variable speed. | different product types (modular unit) |
| - Adjustable cooling rings | onefor the extruder die one in bubble length. |
| - Film assembly unit with adjustable height up-rolls, take-off unit, surface wind-up and air blower. | for film. |
| - Rotating die co-extrusion die and assembly trolley. | for blown film extrusion. |
| - Screw torque, feed centre mandrel die add otheraaccessories. | " |
| - Vacuum sizing and cooling bath. | for pipe and section. |
| - Caterpiller take-off, with speed control and saw-cutter. | for pipe and section extrusion. |
| - Pipes dies for the extruder | for pipe and section extrusion. |

| | |
|---|---|
| - Additional screws. | Two for the extruder. |
| - Antistatic bars. | for very thin film extrusion. |
| - Multipurpose extruder. with variable speed cntrol. | Co-extruded films (packaging, Agriculture applications) |
| - Co-extrusion die | " |
| - Heat sealer for film. | |

. Injection Moulding Unit

| | |
|---|---|
| - Injetion moulding machine moulds, cooling unit, Tumbler unit and accessories. | automatic (or semi-) 60 tons clamping force, 3-6 oz shot capacity. |
| - Control cabinet and instruments | modular unit. |
| - Test moulds. | |

. Blow moulding unit

| | |
|---|---|
| Blow moulding equipment with moulds sets mould cooling unit. | one table action (modular type) |

. Foaming unit

| | |
|---|---|
| - Multi components mixing and molding machine | rigid and flexible foams. |
| - Freexpander | rigid foams. |
| - Comperession moulding | " " |
| - Vacuum oven. | |

. GRI Unit — for pipes, plan & sheets, boats, tanks..etc. Open and closed moulding.

7. Thermo forming Unit — Vacuum and compression units.

8. Additional equipment of second order

| | |
|---|---|
| . Ultrasonic sealer | with accessories. |
| . Hot air welding set. | for rigid plastics. |
| . Tyre mold. | Tyre reclamation. |
| . Granulator | Scrap recycling |
| . Magnetic separator | removal of metalic. cintamination. |
| . Film waste re-pelletiser | |
| . Fluidised bath, ven ventillator. | Cleaning dies & screws. |
| . Flat form scoles | up to 50 Kg. |
| . Platform scales | Up to 200 Kg. |
| . Balances | 0-1 Ky single pan. |
| . Balances | 0-5 by direct reading. |
| . Agricultural hand tools. | different. |
| . Forced convection oven. | |

C. Equipment for Administration and Technical Service

| | |
|---|---|
| . Maintenance workshop | Suitable lathe, power drill, horizontol/vertieal mechanical saws, electrical and mechincal tools and and instraments. |
| . Electronic Calculators. | Different. |
| . Equipment for drawing Office. | Different. |

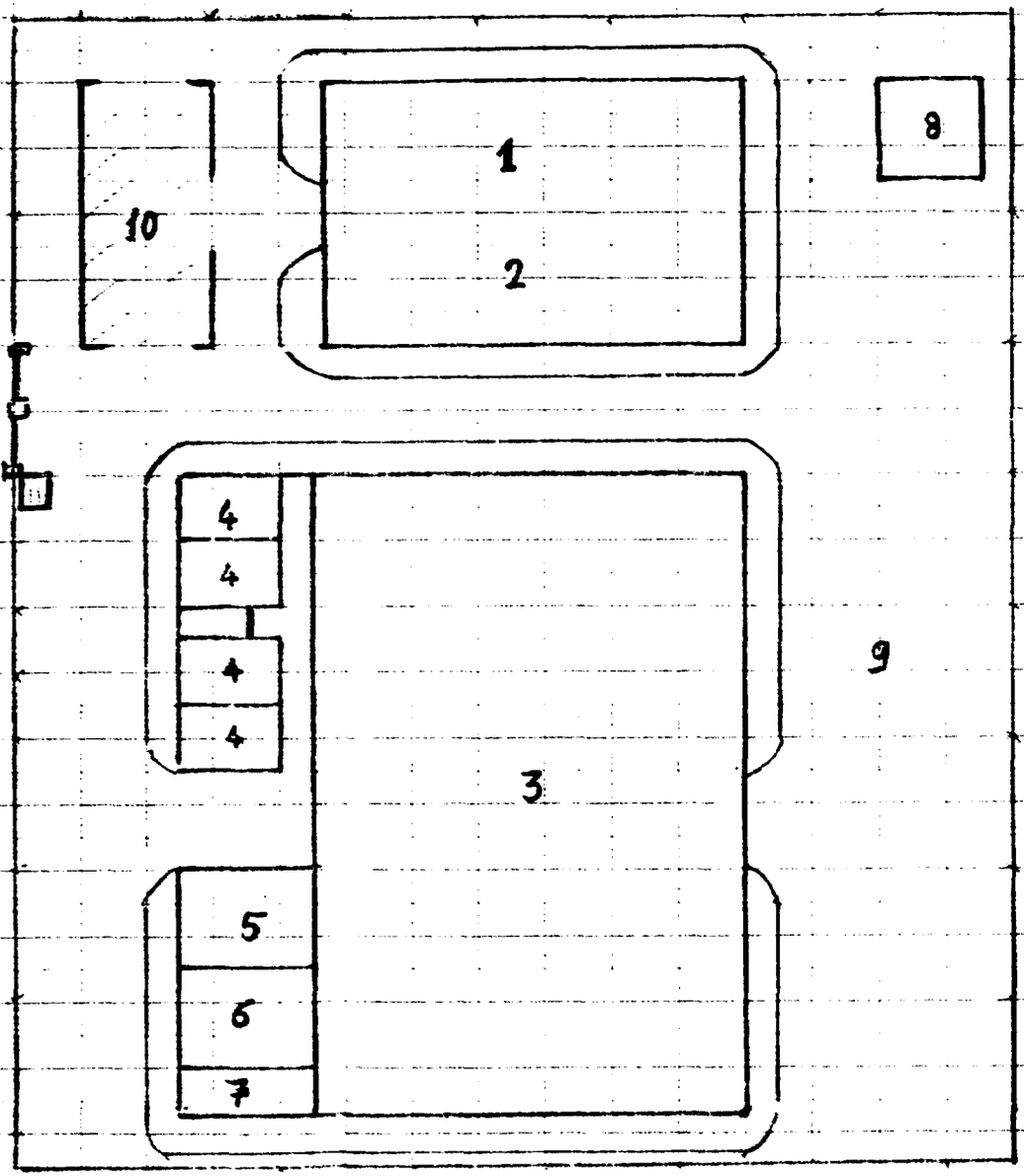
D. Equipment for Demonstration.

| Item | Discription |
|---|---|
| . Tap recordes. | With electronic Cueing equipment. |
| . Slide projector | With Zoom linse, automatic |
| . Portable Screen | |
| . Epidis cope | Projection hand drown transper-encies. |
| . Video Tape Recorder | With editigg facility and 1 colour Camera. |
| . Ihoto copier. | |
| . Visual aids, boards | Different. |
| . Microphones, amplifier and spea ers. | Differnnt. |
| . Ihotographicfacilities. | dark room equipment. |

Annex N° 9

# KUWAIT RUBBER AND PLASTICS INDUSTRIES DEVELOPMENT CENTRE

## LAYOUT




### LEGEND

1 ADMINISTRATION BLDG
2 TESTING LAB
3 PILOT UNITS HALL
4 OFFICES
5 STORES
6 LABOUR WELFARE SERVICE
7 WORKSHOP
8 UTILITIES BLDG
9 OPEN AREA FOR TESTING
10 PARKING AREA
11 GUARD ROOM

# WORK PLAN BAR CHART

| No. | Activity \ Year | 1983 | | | | 1984 | | | | 1985 | | | | 1986 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| 1 | Preparatory Assistance | | | | | | | | | | | | | | | | |
| 2 | Establishment Governing Board | | | | | | | | | | | | | | | | |
| 3 | Appointment of Director | | | | | | | | | | | | | | | | |
| 4 | Appointment Deputy D. and 1 Professional | | | | | | | | | | | | | | | | |
| 5 | Develop policy and organizational structure | | | | | | | | | | | | | | | | |
| 6 | Prepare Staff Profiles. | | | | | | | | | | | | | | | | |
| 7 | Appointment of national staff. | | | | | | | | | | | | | | | | |
| 8 | Develop Contact with R & D Institutes | | | | | | | | | | | | | | | | |
| 9 | Prepare technical programmes | | | | | | | | | | | | | | | | |
| 10 | Prepare Annual budget. | | | | | | | | | | | | | | | | |
| 11 | Site Selection. | | | | | | | | | | | | | | | | |
| 12 | Civil and allocation activities. | | | | | | | | | | | | | | | | |
| 13 | Equipment selection and ordering. | | | | | | | | | | | | | | | | |
| 14 | Overseas training. | | | | | | | | | | | | | | | | |
| 15 | Install sorting equipment | | | | | | | | | | | | | | | | |
| 16 | Study local plastic/rubber institutions | | | | | | | | | | | | | | | | |
| 17 | Develop Contact with local processors | | | | | | | | | | | | | | | | |
| 18 | Develop contacts with International Processors. | | | | | | | | | | | | | | | | |
| 19 | Prepare internal service programmes | | | | | | | | | | | | | | | | |
| 20 | Install pilot plants equipment. | | | | | | | | | | | | | | | | |
| 21 | Provision of short-term consultants | | | | | | | | | | | | | | | | |
| 22 | Implement staff development programme | | | | | | | | | | | | | | | | |
| 23 | Develop current services to industry | | | | | | | | | | | | | | | | |
| 24 | Documentation Activities | | | | | | | | | | | | | | | | |
| 25 | Identify areas for industrial and applications development. | | | | | | | | | | | | | | | | |
| 26 | Prepare detailed plans for the development of the Centre. | | | | | | | | | | | | | | | | |
| 27 | Develop programmes for industrial and applications development | | | | | | | | | | | | | | | | |
| 28 | Arrangement for sister institution | | | | | | | | | | | | | | | | |
| 29 | Develop technical service to industry | | | | | | | | | | | | | | | | |
| 30 | Periodic Publication of Techn. Information. | | | | | | | | | | | | | | | | |
| 31 | Prepare and execute Training Programmes | | | | | | | | | | | | | | | | |
| | Annual reporting and evaluation. | | | | | | | | | | | | | | | | |

Annex NO

List of Equipment available in

thelocal Institutes

- . Micrometers, Calipers, magnatic stands and cans. sets,
- . Impact and handness testers.
- . Plasti-Corder, two-roll-mill and torsion antsmate.
- . Aerosol cans, strain indicator, .... (1-9 items).
- . Porosity and closid cell content tester.
- . Compression moulding machine.
- . Vacuum Oven.
- . Ballance (3Kg).
- . Smoke density Chamber & humidity measuring system.
- . Amplifiers, stain gamges and transducers.
- . Forced convection Ovens (UL50 and UL60 member.)
- . Surface polishing units.
- . Sample cutter with dies.
- . Sample conditioning units.
- . Extruder.
- . Linear & Circular Polarized sheets.
- . Water & vapour permeability tester.
- . Temperature intrumantations.
- . Moisture Anatyzer.
- . Laser & Accessories.
- . Linear & Circular polurized sheets.
- . Water & Vapour permeability tester.
- . Temperature intrumentaortions.
- . Moisture Analyzer.
- . Laser & accessories.

- Flammability testing apparatius.
- Weatherometer (Xeustest 150)
- Alfa Specimen Cutter & Dies.
- Cutting press & dies.
- Aquatest tester.
- Twin screw extruder.
- Water perbeability tester.
- Haake Rotational Viscometer.
- Hardness tester.
- Twin Shell Blender.
- Falling dart tester.
- Testometric Film tester.
- Single column density apparatus.
- Compression Creep tester.
- Notching machine for Izod and Charpy tests.
- Injection Molding Machine.
- Inston Tester Model 1195.
- Torsion A tomat.

Annex No 11

## International Consultants required for RPTC

### 1. Market Research

The consultant should investigate the potential markets for plastics products in the eletrical, furniture, engineering and agricultural fields. The impacts of the neighbouring markets on the expected market volumes.

### 2. Plastics formulation and Compounding

The consultant should be a plastic technologist with a wide experience specially in master batches preparation. He should be able to interprete and advise on the formulation construction and modifications specially for PVC.

### 3. Extrusion technique

The consultant is required to study and solve trouble shooting problems during the extrusion of PVC and PE specially in pipe and blown film production.

### 4. Injection moulding

The consultant is needed to advice on mould problems related to the domestic injection technique. He should be able to introduce modern technique and products in the fields. The field of interest is the neck-injection for tubes.

5. Blow moulding

The creation and up-grading in Blow-moulding technique are urgently needed. An expert in this field is required. He should also be able to introduce new products with minimum modification in investment.

6. Foam processing

This field requires more than one consultant in structural foams and reaction injection moulding as new fields of interest. The technique followed in foam moulding requires deep consdderation and international expertise to amel orate the present production towards better efficiency with competetive specifications.

7. Reinforced Plastics

The consultant shouldbe capable to solve the problems facing both the open moulding and continuous lamination procedure clomestically exist.

8. Applications of Plastics in Water Conservation

The development of this field required an international assistance. The consultant should have wide experience in the installation and maintenance of plastics reservoirs, lining of canals and channels, and applications in green house and the related proper specifications.

9. Short-term Consultantion in training

Assistance is required from international organisation and institutes for preparing and executing or participating in training programmes The programmes cover:

- Technology: process, formulation/compounding, recycling.
- Products: development, evaluation.
- Engineering: maintenance, reparing, design,
- Testing and quality control.

THE CENTRE BUDGET

Annex No 13

| Item | 1983 | | 1984 | | 1985 | | 1986 | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|
| | m/m | | m/m | | m/m | | m/m | | m/m | |
| Building and Civil Works | - | 80,000 | | 226900 | - | - | - | - | - | 306900 |
| Equipment: Equipment | - | 100,000 | | 192000 | - | 92150 | - | - | - | 384150 |
| Erection | - | - | | 29000 | | 20940 | | | | 49940 |
| Furniture-Library | | | | | | 28000 | | 10400 | | 38400 |
| Training: Fellowships | - | - | 12 | 5628 | 8 | 3752 | 9 | 4220 | 25 | 13600 |
| Study Tours(groups) | 2 | 1570 | 2 | 1570 | - | - | - | - | 4 | 3140 |
| Sister Institution | | | | Specified at a later Stage. | | | | | | |
| Start up | | - | | - | | 28300 | | | | 28300 |
| Consultancy | 5 | 8000 | 14 | 22400 | 12 | 19200 | 9 | 14400 | 40 | 64000 |
| Transportation Means | - | - | - | 14000 | - | - | - | 10000 | - | 24000 |
| Spare parts and materials | - | - | - | - | - | 8800 | - | 9400 | - | 17600 |
| Component Total | | 189570 | | 491498 | | 200542 | | 48426 | | 930030 |
| Personnel Director | 10 | 11000 | 12 | 13200 | 12 | 13200 | 12 | 13200 | 46 | 50600 |
| Deputy Director | 3 | 3000 | 12 | 12000 | 12 | 12000 | 12 | 12000 | 39 | 39000 |
| Technologists | 3 | 2550 | 24 | 15000 | 36 | 26700 | 60 | 23400 | 123 | 67650 |
| Engineers | 3 | 1800 | 12 | 7200 | 12 | 7200 | 12 | 7200 | 39 | 23400 |
| Technicians | - | - | 12 | 3000 | 36 | 9000 | 36 | 9000 | 84 | 21000 |
| Assistant Techn | 3 | 900 | 12 | 3600 | 24 | 7200 | 48 | 14400 | 87 | 26100 |
| Skilled Labour | 12 | 2700 | 72 | 16800 | 132 | 30600 | 132 | 30600 | 348 | 80700 |
| unskilled Labour | 6 | 900 | 24 | 3600 | 36 | 5400 | 48 | 7200 | 44 | 17100 |
| Officer | 12 | 4800 | 24 | 9600 | 36 | 14400 | 36 | 14400 | 108 | 43200 |
| Assistant Officer | 12 | 3600 | 36 | 10800 | 72 | 21600 | 72 | 21600 | 192 | 57600 |
| Secretaries | 2 | 1800 | 24 | 3600 | 36 | 5400 | 48 | 7200 | 120 | 18000 |
| Store Keepers | 6 | 900 | 12 | 1800 | 24 | 3600 | 24 | 3600 | 66 | 9900 |
| Drivers | 6 | 900 | 24 | 2400 | 24 | 2400 | 28 | 2400 | 88 | 8100 |
| Guards - | - | - | 19 | 1900 | 24 | 2400 | 24 | 2400 | 67 | 6700 |
| Component total | 88 | 33950 | 319 | 184500 | 516 | 155100 | 588 | 174600 | 1444 | 468150 |
| 10% termination benefit | - | 3395 | - | 18450 | - - | 15510 | - | 17460 | | 46815 |
| Miscellaneous | - | 21600 | - | 37900 | - | 12680 | - | 26065 | | 98245 |
| Grand total | | 248515 | | 644348 | | 383832 | | 266545 | | 1543240 |

Annex No.14

## Visits and Meetings

Kuwait

- Ministries of: Planning
  Commerce & Industry
  Public works
  Public Health
  Oil
- Kuwait Institute for Scientific Research
- Kuwait Institute of Technology
- OAPEC
- Kuwait Chamber of Commerce & Industry
- KNPC - PIC
- Production establishments
- IBK
- Kuwait Organisation for Advancement of Science.
- UNDP-Kuwait.

Saudi Arabia

- Ministries of: Industry & Electricity
  Finance & National Economy
- Saudi Industrial Development Fund
- The Saudi Consulting House
- Riyadh Chamber of Commerce & Industry
- Saudi Basic Industries Corporation
- Two Plastics factories
- UNDP-Riyadh-S.A.

Jordan :

- The Royal Scientific Society
- The Center at the Society

Egypt :

- The Industrial Design Centre
- Plastic Development Centre.
- UNDP- Cairo-Egypt.