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UNITED NATIONS INDUSTRIAL DEVELOPMENT ORGANIZATION
Vienna International Centre, P.O. Box 300, 1400 Vienna, Austria
Tel: (+43-1) 26026-0 · www.unido.org · unido@unido.org

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INDUSTRIAL DEVELOPMENT AND CONSULTING BUREAU
- PHASE II*
TF/KUW/76/001,
KUWAIT

(R) Technical report: Feasibility study on synthetic fiber and textile manufacture.

12 JUN 1978

Prepared for the Government of Kuwait by the
United Nations Industrial Development Organisation

Based on the work of Robert D. Evans,
synthetic fiber and textile expert

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Explanatory notes

The monetary unit in Kuwait is the Dinar (KD) divided into 1000 fils. The value of the Dinar used in this report is 1 KD = 3.5 US $

A period (.) is used to indicate decimals and a comma (,) is used to distinguish thousands and millions.

m= meter; m^2 = square meter ; m^3 = cubic meter

References to tons are metric tons;

K g = Kilogram ; g = gram ; d = denier ; cc cotton count

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Introduction

The Industrial Development and Consulting Bureau was established in collaboration with the Ministry of Commerce and Industry in Kuwait and UNIDO/UNDP. One of its main concerns is the promotion of investment opportunities in industry by identifying viable industrial projects through carrying out feasibility studies and evaluating others submitted by local entrepeneuers. In addition, it assists the Industrial Affairs Department in other development objectives.

The main revenue of the country is dervied from oil exports and is one of the major oil exporting countries. Its per capita income is one of the highest in the world, Diversification of its economy is an important objective of the development policy and the substitution of locally manufactured textile products for imported fabrics and clothing through the use of synthetic fibers is recommended. Of particular interest is the use of synthetic fibers based on chemical intermediates which could be produced domestically.

The Industrial Development Committee has granted licenses for the establishment for the production of carpet and rugs.

This report covers a study of synthetic fibers and textiles and the feasibility of their production in Kuwait. The study, executed by UNIDO/UNDP-Project, TF/KUW/76/001/11 - 05/D/32.1.H started on January 8,1978 and ended on March 7 1978. The job description is attached as Annex 1.

Summary

Kuwait has no existing textile industry to consume either natural or man made fibers and must import fabrics and made up textile products to meet its needs. Import statistics in many cases cover broad textile categories and the actual fiber content of both imports and exports is difficult to determine. Information on fiber type within a given imports-export category is either incomplete or non-existent. There is a sizable export market and a large but ill defined indirect export market.

After discussions with government officials, importers and distributors the per caput availability of fiber products of all types has been estimated to be 29.2Kg in 1976. This is approximately equal to the consumption in Western developed countries but includes the large but poorly defined indirect exports. Based on the population projections of the Ministry of Planning and with a modest growth in per caput consumption over the next decade estimates of fiber utilization by product category for 1980, 1985 and 1990 have been made.

Assuming that the eventual consumption pattern for synthetic fibers in Kuwait will approximate that of Western countries the Potential utilization of nylon, polyester, acrylic and polypropylene fibers in these product categories has been made for the period 1980-1990. In a similar manner the demands for continuous filament and staple products have been estimated for polyamides and polyesters. The largest markets for polyamides require continuous filament yarns whereas the largest markets for polyester fibers are in staple applications. The total market for nylon continuous filament will be 9100 tons in 1980 rising to 21,900 tons in 1990. Polyester staple markets will be 15,900 tons in 1980 and 37,100 tons in 1990.

Most of the nylon applications are in markets dominated by style with highly fragmented markets insufficient in size to permit construction of a textile denier nylon plant. Acrylic fiber markets even by 1990 are judged to be insufficient in size to build a plant. The polypropylene markets are largely as replacements for jute and are not expected to grow rapidly. There are no known projects for the production of polypropylene in the Gulf Area. No further considerations were given to the construction of nylon, acrylic or polypropylene fiber plants.

Polyester staple fiber particularly in blends with cotton 65-35 can be used in three areas where style does not play an important role in determining marketability. These are in dishdasha fabrics, bed linens and in woven polyester and spun rayon markets. These latter markets are considered as second generation markets. The entire Kuwait and 25% of the other Gulf Areal Markets for dishdasha fabrics amount to 4100 tons. A textile industry yarn and fabric plant of 2000 tons is proposed. Similarly, the Kuwait and 25% of the Gulf Area market for bed linens is 12,500 tons and a 6,000 ton yarn and fabric plant is proposed. These two textile industrry plants at a 65-35 polyester cotton blend level can support a 5000 to polyester staple plant.

The cost of producing polyester staple fiber at a 15% ROI using domestic raw materials has been shown to be competitive with staple fiber produced in existing plants. The plant will require a fixed investment of about 3.2 million KD and will require 38 operational and supervisory personnel.

The cost of producing dishdasha fabric in a 2000 ton plant have been estimated. These costs include a yarn preparation plant and a fabric weaving and finishing plant.

The total cost ex capital charges for both yarn and fabric would be 3,717,000 KD and with a sales volume of 6,980,000 KD the profit would be 3,263,000 KD. With a total fixed investment of 10,451,000 KD the return would be 31,2%. Operating and maintenance personnel will be about 348.

FINDINGS.

General Comments

The terms MAN-MADE FIBERS, SYNTHETIC FIBERS, TEXTILE INDUSTRY AND NEEDLE INDUSTRY are terms which are often used ambiguously and frequeently connote different meanings to different people. In this report MAN-MADE FIBERS will be used to describe all types of artificial fibers made by man to distinguish these fibers from the natural fibers, cotton, wool. silk and the soft or hard vegetable fibers linen, jute, sisal and the like. Although the vegetable fibers depend upon man for their separation and recovery they exist as such in the plant and hence are classed as natural fibers. Thus, the term, man-made fibers, is a general class of fibers which will include fibers produced by regenerative or derivative means from natural polymers, fibers produced from inorganic materials and synthetic fibers.. Viscose rayon fibers are ex examples of regenerative filers made from celluluse whereas celluluse acetate fibers are produced from the acetate derivative of cellulose. Textile glass fibers are normally regarded as man-made fibers and are destinguished as such from other glass fibers commonly used for insulation.

As used in this report SYNTHETIC FIBERS are fibers made from polymers which do not exist in nature and are, therefore truly synthetic in the sense that both the polymer and the fiber made therefrom are man made. Examples of these include the polyamides, polyacrylonitrile, polyesters and polyolefins fibers. Generally the synthetic polymers from which synthetic fibers are produced are highly crystalline polymers with well defined and definite melting points. Acrylic fibers made from acrylonitrile copolymers are exceptions. Synthetic fibers may fall into several classifications. Generally they are primarily classified according to the chemical composition of the synthetic polymer from which they are produced as indicated above. Another classification can be based on the general method by which they are produced ie melt, wet or dry spun. These processes will be discussed briefly later. The other classification is based on the type of product produced, staple or continuous filament. Staple fibers are fibers of a definite predetermined length and in this respect resemble cotton or wool. Continuous filament fibers are fibers of almost infinite length and therefore resemble silk.

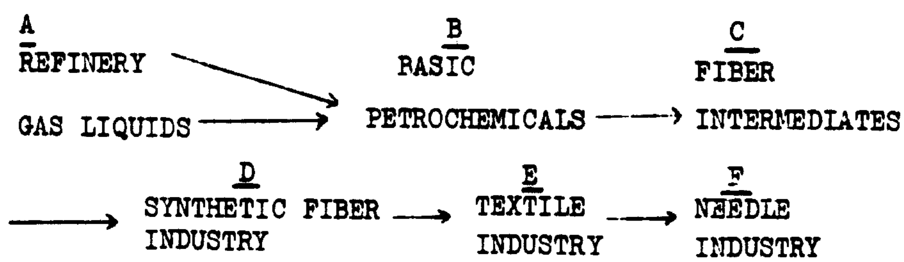
The TEXTILE INDUSTRY is that very broad, complex industry which converts all types of natural and man made fibers into products which either are useful to consumers as such or which can be used by other industries to make consumer products. For simplicity its raw materials are fibers and its finished products are wovens, knitted or non-wovens fabrics. This industry historically was developed to convert cotton, wool and other staple fibers and silk, the continuous filament fiber, into useful yarns for weaving or knitting into fabrics or useful commodity products. In addition, it includes the dyeing and finishing of these fabrics.

Although closely related to the textile industry the NEEDLE INDUSTRY takes the products of the textile industry and converts these products into those articles of clothing or other products which all of us demand. This industry would include the home as a fashion center, the tailoring shops for custom clothing and the large apparel manufacturing centers for ready made clothing.

As would be expected these artificial classifications include many grey areas for example the textile industry includes manufacture of sweaters, hosiery, towels, bed linens and carpets which are really consumer products while the fiber industry with its production of non-woven fabrics by the spun bonded process is producing a product of the textile industry.

From the very broad standpoint of these definitions we have elected to concentrate on the problems connected with the possible production of synthetic fibers in Kuwait and to confine our textile industry studies to those limited areas offering the best chances for commercial success.

The various industries involved in the conversion of crude oil and natural gas into consumer textile products is depicted felow.



Kuwait with its planned olefin and aromatic complex is well established through step.B. The situation for fiber intermediate is not as clear. Projects are under consideration for caprolactam and terephthalic acid and ethylene glycol will be available from Saudi Arabia. There are no projects in Kuwait for polypropylene or acrylonitrile. The synthetic fiber industry and the textile industry, steps D and E, are non existent in Kuwait at the moment. Since the textile industry is non-existent there are no domestic markets for synthetic fibers. The Ministry of Commerce and Industry has licensed two small carpet and rug projects but these will use primarily wool. The needle industry, Step F, is well established for custom made clothing for men and employs approxmately 4600 workers.

With the absence of a well established textile industry there are no present markets for synthetic fibers in Kuwait and any plans for synthetic fiber production must envision the establishment of an accompanying textile industry. The Gulf States and Saudi Arabia are equally devoid of an established textile industry and the neighboring states do not supply therefore any readily avilable export market. Thus, the problem becomes one of establishing the fiber equivalents of the local import markets and selecting only those markets which can serve as a basic for both synthetic fiber plants and the accompanying textile plants. For this reason the import market will be examined in detail.

Imports of Textile Products:

The import statistics for textile products covering approximately 95% of the textile products are detailed when available for the years 1972-76. Data are available for 1976 by month through August and the the imports for the remainder of 1976 are projections of the previous months. In some instances data are available only for the past few years. Data omitted have been examined and not included either because they represent unusual usesnot amenable to penetration by synthetic fibers or because of certain inconsistencies related to procedural problems. The data are presented in Tables 1-28 of annex 2 for fabrics or price goods and non-clothing items and in Table 1-6 of annex 2A for clothing and summarized in Table 1 for the period 1974 -76 in tons. Using 1974 as a base

Table 1
Imports-Exports of Textile Products 1974-76
(Tons)

Product	Imports	Exports	Net
1974			
Fabrics and Nonapparel	26223	4074	22149
Clothing	7872	1200	6672
Total	34095	5274	28821
1975			
Fabrics and Non apparel	30757	4847	25910
Clothing	10055	1662	8393
Totll	40812	6509	34303
1976			
Fabrics & Non Apparel	42510	10896	31614
Clothing	12746	3541	9205
Total	55256	14437	40819

year imports in 1976 the increase in both fabric and non-apparel and clothing averaged 62 % and 1976 imports averaged 35% higher than 1975. Considering only the increases over 1975 the greatest surges in fabric and non apparel uses accurred in the following areas

Product	% Increase
Woven Cotton Fabrics	52
Woven Syn. Fiber Fabrics	47
Woven Rayon	61
Blankets	34
Bed Linen	44
Knotted Carpets	125
Other Carpets	79

There was an actual decrease of 33% in imports of woolen fabrics.

In the clothing field the largest increase in 1976 occurred in the following areas.

Product.	% Increase.
Womens and Childrens Outerwear	31
Men and Boys Shirts.	50
Other Clothing	36

It is of course much too early to determine if these changing patterns will continue and if they are a result of the changing economic conditions related to the total amount of disposable income or to the start of a fundamental change in life style.

Future Demands for Textile Products:

Any attempt to project such a rapidly escalating textile product demand as outlined in the previous section will be unreliable but in order to try to relate potential demands for synthetic fibers to textile products the gradual change in demands for textile products must be estimated.

Based on Table 1 the per caput net availability of textile products in 1976 is 38,4 Kg. Data from Textile Organon[3], a quite reliable publication associated with the U.S. Man Made Fiber Producers Association, the per caput consumption of all textile fibers in the U.S. in 1976 was 25.5 Kg. This drastic difference led us to examine the data of both countries more closely. Adjusting the U.S. data to correspond to the Kuwait data by including both hard and soft vegetable fibers the U.S. per caput consumption becomes 27.8 KG. Examination of Kuwait data indicated that gross import weight rather than net weight had been used. After inspecting imported carpets, fabrics, and clothing through the courtesy and cooperation of the Port Authorities, judgments were made of the net weights imported. These corrections varied with each of the classified products in annex 2 and 2 A. Furthermore it is known that in certain cases notably "Other Carpets" considerable amounts of rubber are included as fibers. Based on the tufted carpet practice in the United States it is assummed that the rubber content was approximately 30% of total carpet. An arbitrary judgment of the factor to convert gross imported coated fabric weight to net fiber imported weight was 52% with a high degree of uncertainity. The corrected data for 1976 are presented in Tables 1.and 2 of Annex 3.

Assuming that those individual correction factors also apply to exports the corrected net availability of fiber in Kuwait on 1976 in tons follows

Product	Imports.	Exports	Net.
Fabric and Non-apparel	36,850	9630	27220
Clothing	11,980	3130	8850
Tatals	48,830	12760	36070

With a 1976 estimated population of 1,064,000 the per caput availability of all fiber is 33,9 Kg.

Dr. Mahmoud Assaf, Dean of the Faculty of Commerce of Mansura University, Cairo and presently on leave with the Ministry of Commerce and Industry has pointed out very convincingly that not all of the imported products during periods of rapid business upturns can be considered consumed because of additional purchases for inventory and that normally inventories under such conditions approach 40% of imports. Application of this suggestion to the past five years has shown that this factor would amount to 14%. On this basis the per caput consumption of all textile fibers in Kuwait could be 29.2Kg. This base figure for 1976 will be used to project future fiber demands.

This estimated consumption is 5% higher than the U.S. consumption which is most surprising since the Kuwait data do not include many industrial items such as tires which in the U.S. amount to about 1.5 Kg per caput.

In addition to the undoubted heavy purchases of textile products associated with the rising living standards of all segments of the population and the creation of new households at a rapid rate it is believed that indirect exports particularly of expatriates either visiting or returning to their homelands where currency restrictions or higher prices exist may account for substantial quantities of textiles. It is also widily believed that many visitors from Saudi Arabia come to Kuwait to take advantage of the lower prices and better selection available.

In 1976 the departures from Kuwait amounted to 1,155,000 slightly more than the total population and of these 20% were Saudi Arabians, 16% Iraqis, 13% Jordanians and

Palistinians and 6% Egyptians. The exact amount of textile products associated with each departure is impossible to estimate accurately but the consensns of knowledgeable people who are familiar with the local scene indicates that a range of 5-10Kg would be reasonable. Over the next years this situation is not expected to change so that the per caput consumption has not been reduced. Although the per caput consumption can not be accurately estimated there can be little doubt that it is much higher than the value of 2.8 Kg for 1974 estimated by Chem. Systems International[4] for IDCAS.

The population increase until 1985 has been estimated by the Ministry of Planning based on an annual increase of Kuwaiti population of 6.4% and a Non-Kuwaiti increase of 5,9% and we have assumed the same rate of increase for the population in the period 1985-90. The estimated population is shown in table 2

Table 2
Estimated Population in Kuwait 1975-1990
(Thousands)

Year	Non-Kuwaiti	Kuwaiti	Total
1975	526	476	1,002
1976	557	507	1,064
1977	590	539	1129
1978	625	574	1,199
1979	662	611	1,273
1980	701	650	1,351
1981	742	692	1,434
1982	786	736	1,522
1983	832	783	1,615
1984	881	833	1,714
1985	933	887	1,820
1986	988	944	1,932
1987	1046	1004	2,050
1988	1108	1068	2,176
1989	1173	1137	2,310
1990	1243	1210	2,453

Although per caput consumption including indirect exports has increased at a very rapid rate in recent years we have assummed a much more modest increase as shown in table 3, Over the past 15 years in the U.S. the annual per caput increase has been 3% with a range of -14% to a high of 10% reflecting the changing business cycles. It is believed that this growth rate is reasonable.

Table 3
Per Caput Consumption of Textile Fibers.
1976-1990

Year	Growth Rate %	Availability Kg.
1976		29.2
1977	4	30,4
1973	4	31,6
1979	4	32,8
1980	4	134,2
1981	3	35,2
1982	3	36,2
1983	3	37,3
1984	3	38,4
1985	3	39,6
1986	2	40,4
1987	2	41,2
1988	2	42,C
1990	2	43,7

In addition we have assumed that exports from Kuwait should be at a 20% level over the period 1976-1990. In 1976 exports were estimated at 26% of total imports whereas in 1975 exports were at a 16% level. With the continued growth of the Gulf Area this rate of exports trade appears reasonable Thae data are summarized in Table 4.

Table 4
Fiber Demand (1) in 1976-1990

Year	Population	PerCaput(2)	Demand Domestic	Export 1000 Tons	Total. 1000 Tons
	1000's	Kg.	1000 Tons.		
1977	1,129	30.4	34.3	6.9	41.2
1978	1,199	32,6	37.9	7.6	45.5
1979	1,273	32,8	41,8	8.4	50.2
1980	1,351	34,2	46,2	9,2	55,4
1981	1,434	35.2	50.5	10.1	60.6
1982	1,522	36,2	55,7	11.1	66.8
1983	1,615	37.3	60.2	12.0	72,2
1984	1,714	38,4	45.8	13.2	79.0
1985	1,820	39.6	72.1	14.4	86.5
1986	1,932	40.4	78,1	15.6	93.7
1987	2,050	41.2	84.5	16.9	101.4
1988	2,176	42,0	91.4	18.3	109.7
1989	2310	42.9	99.1	19.8	118.9
1990	2453	43,7	107.2	21.4	128.6

(1) Demand includes domestic consumption including indirect exports but with no allowance for indirect imports.

(2) Data from Table 3.

In order to indicate the effects of a somewhat higher per caput growth rate we have estimated the fiber demand assuming a per caput increase of 6% through 1980, 4% through 1985 and 3% thereafter.

The data are shown in Table 5. By 1980 this translates in a 17% increase into demand.

Table 5
Effect of Increased Per Caput Growthh
Rate on Fiber Demand

Year	Population	Increase	Rate	Demand. Domestic	Export	Total
	1000's	%	Kg.	1000tons	1000 tons	1000 tons
1977	1,129	6	31,0	35,0	7,0	42,0
1978	1,199	6	32.8	39.3	7.9	47.2
1979	1,273	6	34,8	44.3	8.9	53.2
1980	1,351	6	36,9	49.9	10.0	59.9
1981	1,434	4	38,3	54,9	11.0	65,9
1982	1,522	4	39,9	60.7	12.2	72.8
1983	1,615	4	41.5	67.0	13.4	80.4
1984	1,714	4	43.1	73.9	14,8	88.7
1985	1,820	4	44,9	81.7	16.3	98.0
1986	1,932	3	46.2	89.3	17.9	107.2
1987	2,050	3	47.6	97.6	19.5	117.1
1988	2,176	3	49,0	106.6	21.3	127.9
1989	2,310	3	50,5	116.7	23.3	1400
1990	2,453	3	52,0	127.6	25.5	153.1

Synthetic Fiber Demand:

The previous sections were concerned with the demands for all fibers, natural and man made. We now turn our attention to the demands for synthetic fibers, Since the import statistics have not been refined to the point where fiber con tent is recorded no information on the amount of individual synthetic fiber exists. Since the present classification system, which will be altered to conform with world standards, includes some very broad categories it is impossible without a detailed knowledge of the actual products imported, to estimate the synthetic fiber content of the actual products imported. Such knowledge can only come with long experience in the local scene.

We have approached this problem by assuming that synthetic fiber properties ultimately will determine the fiber selection for a given application in a free and economically competitive market. We assume, further, that Kuwait will approach the same consumption, consumption pattern/as far as fiber selection is concerned as the more fully industrialized countries. Although each should reach eventually the same point the rate of acceptance of synthetic fibers in Kuwait will be determined by many factors including the quality of the textile products produced, the merchandizing efforts of the fiber producers, the textile product producers and the merchants and, of course of the competitive economic factors. The success of the proposed merchandizing efforts is complicated by a rapidly changing life style coupled with an increasing disposable income. At the present consumption level it is of interest to determine what would be the utilization pattern of the several synthetic fibers assuming that Kuwait had more nearly approached the point where fiber properties were the determining factor in determining fiber consumption pattern. Thus, it is proposed to examine the potential use of synthetic fibers in the several categories of Tables 1-A3 and 2-A2 when fiber uses are fully developed as determined by the acceptance in other countries. With this estimation it should be possible to project the future pattern of synthetic fiber demand. Provision will be made for fiber demand arising from the manufacture of tires in the future.

The estimated potential demand for synthetic fibers by fiber type is shown in Tables 6,7 and 8 for 1976. The demand for synthetic fibers exclusive of tires is 63% of total fiber demand whereas in the United States the consumption of man made fibers in the apparel and home furnishing market areas, areas roughly comparable, is 67%. Since melt spinning process for staple fibers will require different equipment than for continuous filament it is of interest to estimate the corresponding demands for these two products for polyamides and polyesters as shown in Tables 9,10 and 11 over the same time period.

It must be realized that these estimates are, at best, rough and are based on U.S. experience and information. The annual November issue of Textile Organcn divides fiber consumption into three broad general categories, apparel, home furnishings and industrial and further subdivides these into 40 subclasses. In former years these three classes were broken down into some 70 odd subclasses. For each subclass they report the consumption of cotton, wool, man made cellulosics and synthetic fibers. In the man-made fiber classes these are further reported as filament or staple but synthetic fibers are not further broken down by fiber type except in a few instances such as carpet. This information has been used, where applicable, but in general heavy reliance has been placed on U.S. experience.

Although estimates have been made for acrylic and polypropylene fibers no attempt has been made to further analyze the consumption by fiber product. Acrylic fiber are produced only as staple and the end uses envisioned for polypropylone in rope, primary carpet backing and in sacks and bags require either heavey denier monofilaments, ribbons or fibrillated yarns. Most of these end uses can utilize fiber produced from slit film. It may be helpful in visualizing end uses for staple and continuous filament yarns to remember that textile products made from staple fibers have the appearance and feel of cotton or wool fabrics wheras continuous filament fabrics more nearly resemble silk.

Projections of demands for 1980 are shown in Tables 12-17, for 1985 in Tables 18-23 and for 1990 in Tables 24-29. With the exception of carpet all of these projections are based on the data of Tables 6,7,9 and 10 by the use of appropriate factors. In the carpet area it was projected that tufted carpet would capture increasing shares of the market and that its mrket share from 50% in 1976 and would reach 62% in 1980, 76% in 1985 and 86% in 1990. Tufted carpet now holds 99.5% of the tufted and woven carpet market in the United States and we believe that there will be a distinct trend toward the much less expensive tufted carpet in Kuwait as indicated in the above growing market share.

From the viewpoint of manufacturing nylon fiber Kuwait will have a demand in 1980 for 11,100 tons split into 2000 tons of staple and 9100 tons of continuous filament, These demands do not include tire card which will be discussed separately. The continuous filament yarns include about 6000 tons of textile denier yarns, 1930 tons high strength industrial type yarns and 890 tons of bulked continuous filament (BCF) yarn for carpet. The bulk of the staple applications will be in carpets (57%) which requires one type of staple and the remainder in a much finer denier for textile fabric applications. It should be recalled that these demands represent the total market and require that corresponding textile industry plants be built to meet the demands of a highly fragmented style conscious market. A single large market can not be readily identifies and even though the total nylon market appears interesting and large enough to support a nylon plant, if the corresponding textile industry existed, it is concluded that it would not be practical at this time to build a nylon plant and the corresponding textile industry to serve such a diverse market.

If the decision of the proposed tire plant is to use nylon tire cord it is suggested that a small rope and cordage plant be constructed to use second quality tire cord arising from the nylon tire cord production. For nylon tire cord plant to be viable it is a requirement that the tire plant produce its own tire fabric. If a nylon tire cord plant is constructed the same plant could make fibers suitable for tarpaulins and tents which would add approximately 850 tons capacity and the corresponding textile industry plants would be rather simple consisting primarily of simple twisting and weaving facilities. We do not recommend the construction of a fish net factory because of its high labor requirements.

By 1990 the total demand for nylon ex tires will be 33,125 tons with 5000 tons of staple and 27,500 tons of continuous filament, Tufted carpets would use some 6600 tons of nylon with about 3700 tons of staple and 2900 tons of BCF nylon. These usages could be minimal requirements since it is believed that nylon will increase its share of the carpet face fiber market at the expense of wool. If small segments of the total nylon markets for textile denier continuous filment yarns are developed by the introduction of textile equipment to capture a portion of the fabric and clothing market, particularly in the knitted area, it should be possible to built a 5000 ton contnuous filament plant.

The total market for polyester fiber in 1980 will be 24,900 tons. It is estimated that 9000 tons will be in continuous filament yarns and 15,900 tons in staple. As is the case of nylon these demands do not include any provision for tire cord. Fortunately, most of the staple deniers can be made on the same equipment and at roughly the same rate. Although some 3100 tons of staple will be used in the clothing area and will be in the highly fragmented market and hence not readily available there are large areas cotton fabrics, dishdasha fabrics, woven rayon fabrics and bed liners, where fabric demand could be as much as 6500 tons or more. These areas will be discussed in the next section. Continuous filament used will be largely 150 denier yarn of either the fully drawn or partially oriented yarn for false twist texturing. Although no category for knitted goods is shown it is felt that single and double knit fabrics represent a real potential for growth.

By 1990 total demand ex tire cord for polyester fiber will be 58,1000 tons with 37,100 tons staple and 21,000 tons continuous filament. This is a very large production and it is reasonable to assume that a staple plant of at least 10,000 tons and a continus filament plant of at least 5000 tons could be used.

The demand for polyester production in chip form will be enhanced by the rapid development of polyester resins for bottling large family size soft drink containers. It was noted that a recent Kuwait Times article on the new R.C. Cola Company bottling plant announeed that their new plant would supply R.C. Cola in large family sized bottles. The process for polyester bottles was apparently developed in the United States by DU PONT who have decided to license rather than manufacture themselves. Currently Amoco, Hoover Ball Berring Co. and others are suppling both Pepsi Cola and Coca Cola with these bottles. The polymer will be manufactured by Goodyear. Polymer will be manufactured at one location and shipped to the bottle manufacturing site located either in some central location or at the bottling plant. The bottles are non-returnable and Goodyear has claimed that these bottles can be reprecessed to produce polymer which can be later converted to certain types of polyester fiber. A project of this type could conceivably result in a world size polymer plant which would ship polymer to bottling plants located in much of the Arabic World. In addition to greatly increasing consumption of terephthalic acid and decrease its cost it could offer polymer at reduced costs not only for staple but also for continuous filament. It is recommedded that a study of this new development be undertaken in the very near future.

In 1980 the potential market for acrylic fibers was estimated at 5900 tons most of it in blankets with the remainder in sweaters and woolen fabrics. By 1990 the demand is expected to reach 13,200 tons. The blanket market is an attractive market in Kuwait and a license, since cancelled, had been granted for the manufacture of blankets. These blankets were to be manufactured primarily from wool. Although sweaters are another product of possible interest to Kuwait the markets would be seasonal and the demand limited. Unfortunately, the production of acrylic staple is either by dry or wet spinning which requires recovery of the solvents from aqueous systems and the recovery systems are volume dependent. For this reason, since our potential volume is below the minimum size for an efficient plant, no further consideration has been given to acrylic fibers. The minimum size which could compete probably is in the 15-20,000 tons per year range. With the necessity for handling and recovering liquids the installation costs more nearly resemble similar costs for chemical plants in contrast to the rather simple installation of melt spinning equipment.

The last fiber to be considered is polypropylene. In all its fiber forms the consumption of polypropylene fiber in the U.S. now exceeds acrylic fibers. Uses are mainly in low pile height tufted carpets, needle punched carpets, upholstery fabrics and the very large volume uses in primary carpet backing and packaging applications in which it competes directly with jute. The latter applications are normally low profit margin products. Since there no plans for building a polyproplylene plant in Kuwait, no additional consideration has been given to polypropylene fibers.

Table 6
Synthetic Fiber Potential demand in Piece
Goods and Non Apparel 1976

Product	All Fibers	Syn. Fiber	Nylon	Polyester	Acrylic	Polypropylene
Textile Yarn	410	210	60	150	-	-
Cotton Fabrics	2440	1190	-	1190	-	-
Silk Fabrics	30	-	-	-	-	-
Woolen Fabrics	690	275	-	190	85	-
Linen Fabrics	-	-	-	-	-	-
Woven Syn.Fabrics	9030	9030	2700	6330	-	-
Woven Rayon	2270	1475	-	1475	-	-
Artificial Fur	20	20	-	-	20	-
Woven Fabrics Nes.	500	250	100	150	-	-
Tulle Net Fabrics	-	-	-	-	-	-
Ribbon Fabrics	110	60	25	35	-	-
Embroedary	10	-	-	-	-	-
Coated Fabrics	270	135	100	35	-	-
Cord of Syn Fibers	580	580	435	145	-	-
Cord of Vegt.Fibers	510	400	80	20	-	300
Nets	180	180	140	20	-	20
Cotton Bags	360	360	-	-	-	360
Non Cotton Bags	3160	1580	-	-	-	1580
Tarpaulins	620	150	75	75	-	-
Tents	1030	620	500	120	-	-
Blankets	4940	3500	300	300	2900	-
Towels	500	50	25	25	-	-
Bed Linens	2730	1420	-	1420	-	-
Curtains	10	-	-	-	-	-
Textile made up	200	100	50	50	-	-
Carpets Knotted	920	-	-	-	-	-
Rugs	660	300	200	100	-	-
Tufted Carpets	1945	1565	1110	190	75	190
Woven Carpets	3025	490	95	-	400	-
Sub Total	37150	23,940	5995	12020	3480	2450

Table 7
Synthetic Fiber Potential Demand in Kuwait in
1976 in Clothing

(Tons)

Product	All Fibers	Syn Fibers	Nylon	Polyester	Acrylic	Polypropylene
Mens Outerwear	4140	2520	300	1770	450	-
Women's Outerwear	2620	1500	225	1135	140	-
Shirts	1760	1030	-	1030	-	-
Socks	220	110	110	-	-	-
Scarfs	300	180	120	60	-	-
Other	2940	1200	500	700	-	-
Sub Total	11980	6540	1255	4695	590	-

Table 8
Total Synthetic Fiber Potential Demands
in 1976

(Tons)

Products	All Fibers	Syn Fibers	Nylon	Polyester	Acrylic	Polypropylene
Non Apparel	37150	23940	5990	12020	3480	2450
Clothing	11980	6540	1255	4695	590	-
Sub Total	49190	30480	7245	16715	4070	2450

Table 9
Polyester and Polyamide Fiber Demand in
Kuwait in 1976 in Piene Goods and Non Apparel

(Tons)

Product	Polyamide Total	Polyamide Cont. Fil	Polyamide Staple	Polyester Total	Polyester Cont Fil.	Polyester Staple
Textile Yarn	60	60	-	150	75	75
Cotton Fabrics	-	-	-	1190	-	1190
Woolen Fabrics	-	-	-	190	-	190
Woven Syn. Fabrics	2700	2500	200	6330	3000	3330
Woven Rayon	-	-	-	1476	-	1476
Woven Fabrics NES.	100	100	-	150	-	150
Ribbon Fabrics	25	25	-	35	-	35
Coated Fabrics	100	100	-	35	35	-
Syn.Fiber Cords.	435	435	-	145	145	-
Vegt.Fiber Cords	80	80	-	20	20	-
Nets	140	140	-	20	20	-
Tarpaulins	75	75	-	75	75	-
Tents	500	500	-	120	-	120
Blankets	300	150	150	300	50	250
Towels	25	-	25	25	25	25
Bed Linens	-	-	-	1420	-	1420
Made up textiles	50	50	-	50	-	50
Rugs	200	50	150	100	-	100
Tufted Carpets	1110	480	630	190	-	190
Woven Carpets	95	-	95	-	-	-
Totals.	5995	4745	1250	12020	3420	8600

Table 10

Polyester and Polyamide Fiber Demand in 1976 in Clothing.

(Tons)

Product	Polyamide Total	Polyamide Cont Fil	Polyamide Staple	Polyester Total	Polyester Cot. Fil	Polyester Staple
Mens Outerwear	300	300	-	1770	1470	300
Women's Outerwear	225	225	-	1135	910	225
Shirts	-	-	-	1030	-	1030
Socks	110	110	-	-	-	-
Scarfs	120	120	-	60	60	-
Other	500	500	-	700	200	500
Total	1255	1255	-	4695	2640	2055

Table 11

Polyester and Polyamide Potential Demand in 1976

Product	Polyamide total	Polyamide Cont fil	Polyamide Staple	Polyester Total	Polyester Contk fil	Polyester Staple
Non Apparel	5995	4745	1250	12020	3420	8600
Clothing	1255	1255	-	4695	2640	2055
Sub Total	7250	6000	1250	16715	6060	10655

Table 12
Projected Synthetic Fiber Demand in Piece
Goods and non Apparel in 1980 (Tons)

Product	All Fibers	Syn Fiber	Nylon	Polyester	Acrylic	Polypropylene
Textile Yarns	610	310	90	220	-	-
Cotton Fabrics	3630	1770	-	1770	-	-
Silk Fabrics	45	-	-	-	-	-
Woolen Fabrics	1030	410	-	280	130	-
Woven Syn. Fabrics	13430	13430	4015	9415	-	-
Woven Rayon	3375	2190	-	2190	-	-
Artificial Fur	30	30	-	-	30	-
Woven Fabrics NES	745	370	150	220	-	-
Ribbon Fabrics	165	90	40	50	-	-
Embrodery	15	-	-	-	-	-
Coated Fabrics	400	200	150	50	-	-
Syn Fiber Cords	860	860	650	210	-	-
Vegt.Fiber Cords.	760	590	120	30	-	440
Nets	270	270	210	30	-	30
Cotton Gags	535	535	-	-	-	535
Non Cotton Bags	4700	2350	-	-	-	2350
Tarapaulins	920	220	110	110	-	-
Tents	1530	920	740	180	-	-
Blankets	7345	5200	450	450	4300	-
Towels	745	70	30	40	-	-
Bed Linens	4060	2110	-	2110	-	-
Curtains	15	-	-	-	-	-
Textiles made up	300	150	70	80	-	-
Carpets Knotted	1370	-	-	-	-	-
Rugs	980	450	300	150	-	-
Tufted Cappets	3570	2880	2050	355	130	345
Woven Carpets	3410	560	110	-	450	-
Sub Total	54845	35965	9285	17940	5040	3700

Table 13
Synthetic Fiber Potential Demand in Clothing in 1980

Product	2All Fibers	Syn Fibers	Nylon	Polyes-ter	Acrylic	Polypropylene
Men's Outerwear	6160	3750	450	2630	670	-
Women's Outerwear	3900	2230	330	1690	210	-
Shirts	2620	1530	-	1530	-	-
Socks	330	160	160	-	-	-
Scarfs	450	270	180	90	-	-
Other	4370	1780	740	1040	-	-
Total	17830	9720	1860	6980	880	-

Table 14
Synthetic Fiber Potential Demands in 1980

Products	All Fibers	Syn Fibers	Nylon	Polyes-ter	Acrylic	Polypropylene
Non Apparel	54845	35965	9285	17940	5040	3700
Clothing	17830	9720	1860	6980	880	-
Sub total	72675	45685	11145	24920	5920	3700

Table 15

Polyester and Polyamide Fiber Demand in Piece Goods and non apparel in 1980

Product	Polyamide			Polyester		
	Total	Cont. fil	Staple	Total	Cont.12 fil	Staple
Textile Yarn	90	90	-	220	110	110
Cotton Fabrics	-	-	-	1770	-	1770
Woolen Fabrics	-	-	-	280	-	280
Woven SyN.Fabrics	4015	3715	300	9415	4460	4955
Woven Rayon	-	-	-	2190	-	2190
Woven Fabrics NES	150	150	-	220	-	220
Ribbon Fabrics	40	40	-	50	-	50
Coated Fabrics	150	150	-	50	50	-
Syn.Fiber Cords	650	650	-	210	210	-
Vegt. Fiber Cords	120	120	-	30	30	-
Nets	210	210	-	30	30	-
Tarpaulins	110	110	-	110	110	-
Tents	740	740	-	180	-	180
Blankets	450	225	225	450	75	375
Towel	30	-	30	40	-	40
Bed Linens	-	-	-	2110	-	2110
Made up Textiles	70	70	-	80	-	80
Rugs	300	75	225	150	-	150
Tufted Carpets	2050	890	1160	355	-	355
Woven Carpets	110	-	110	-	-	-
Sub Total	9285	7235	2050	17940	5075	12865

Table 16

Polyamide and Polyester Fiber Potential Demand

in clothing in 1980 (tons)

Product	Polyamide			Polyester		
	Total	Cont. fil.	Staple	Total	Cont. fil.	Staple
Men's Outerwear	450	450	-	2630	2180	450
Womens Outerwear	330	330	-	1690	1355	335
Shirts	-	-	-	1530	-	1530
Socks	160	160	-	-	-	-
Scarfs	180	180	-	90	90	-
Other	740	740	-	1040	300	740
Total	1860	1860	-	6980	3925	3055

Table 17

Polyester and Polyamide Potential Demand in 1980

(Tons)

Product	Polyamide			Polyester		
	Total	Cont. Fil	Staple	Total	Cont. Fil	Staple
Non-Apparel	9285	7235	2050	17940	5075	12865
Clothing	1860	1860	-	6980	3925	3055
Sub-Total	11145	9095	2050	24920	9000	15920

Table 18

Projected Synthetic Fiber Demand in Piece Goods and non apparel in 1985 (Tons)

Product	All Fibers	Syn Fibers	Nylon	Polyester	Acrylic	Polypropylene
Textile Yarns	950	480	140	340	-	-
Cotton Fabrics	5660	2760	-	2760	-	-
Woolen Fabrics	1610	640	-	440	200	-
Woven Syn.Fabrics	20950	20950	6260	14690	-	-
Woven Rayon	5265	3420	-	3420	-	-
Artificial Fur	50	50	-	-	50	-
Woven Fabrics NES	1160	580	235	345	-	-
Ribbon Fabrics	260	140	60	80	-	-
Embroidery	20	-	-	-	-	-
Coated Fabrics	620	310	230	80	-	-
Syn.Fiber Cords.	1340	1340	1010	330	-	-
Vegt. Fiber Cords.	1185	920	190	55	-	675
Nets	420	420	330	50	-	50
Cotton Bags	830	830	-	-	-	830
Non-Cotton Bags	7330	3670	-	-	-	3670
Tarapaulins	1435	340	170	170	-	-
Tents	2390	1435	1150	285	-	-
Blankets	11460	8110	700	700	6710	-
Towels	1160	110	50	60	-	-
Ben Linens	6330	3290	-	3290	-	-
Curtains	20	-	-	-	-	-
Textiles made up	470	230	110	120	-	-
Carpets Knotted	2140	-	-	-	-	-
Rugs	1530	700	470	230	-	-
Tufted Carpets	6830	5510	3925	680	245	660
Woven Carpets	3370	550	110	-	440	-
Silk Fabrics	70	-	-	-	-	-
Sub Total	84855	56785	15130	28125	7645	5885

Table 19

Synthetic Fiber Potential Demand in Clothing in 1985

(Tons)

Product	All Fibers	Ayn Fibers	Nylon	Polyester	Acrylic	Polypropylene
Men's Outerwear	9610	5850	700	4100	1050	-
Womens Outwrwear	6080	3480	510	2640	330	-
Shirtss	4090	2390	-	2390	-	-
Socks	515	250	250	-	-	-
Scarfs	700	420	280	140	-	-
Other	6820	2780	1160	1620	-	-
Total	27815	15170	2900	10890	1380	-

Table 20

Synthetic Fiber Potential Demands in 1985

Products	All Fibers	Syn Fibers	Nylon	Polyester	Acrylic	Polypropylene
Non-Apparel	84855	56785	15130	28125	7645	5885
Clothing	27815	15170	2900	10890	1380	-
Sub Total	112670	71955	18030	39015	9025	5885

Table 21
Polyester and Polyamide Fiber Potential Demand in
Piece Goods and non Apparel in 1985

Product	Polyamide Total	Polyamide Cont. Fil.	Polyamide Staple	Polyester Total	Polyester Cont. Fil.	Polyester Staple
Textile yarn	140	140	-	340	170	170
Cotton Fabrics	-	-	-	2760	-	2760
Woolen Fabrics	-	-	-	440	-	440
Woven Syn. Fabrics	6260	5790	470	14690	6960	7730
Woven Rayon	-	-	-	3420	-	3420
Woven Fabrics NES	235	235	-	345	-	345
Ribbon Fabrics	60	60	-	80	80	-
Coated Fabrics	230	230	-	80	80	-
Syn. Fiber Cords	1010	1010	-	330	330	-
Vegt Fiber Cords	190	190	-	55	55	-
Nets	330	330	-	50	50	-
Tarpoulins	170	170	-	170	170	-
Tents	1150	1150	-	285	-	285
Blankets	700	350	350	700	120	580
Towel	50	-	50	60	-	60
Bed Linens	-	-	-	3290	-	3290
Made up Textiles	110	110	-	120	-	120
Rugs	470	120	350	230	-	230
Tufted Carpets	3925	1710	2215	680	-	680
Woven Carpets	110	-	110	-	-	-
Sub Total	15130	11585	3545	28125	8015	20110

Table 22

Polyamide and Polyester Fiber Potential Demand in Clothing in 1985 (Tons)

Product	Polyamide			Polyester		
	Total	Cont. fil	Staple	Total	Cont. fil	Staple.
Mens Outerwear	700	700	-	4100	3400	700
Womens Outerwear	510	510	-	2640	2110	530
Shirts	-	-	-	2390	-	2390
Socks	250	250	-	-	-	-
Scarfs	280	280	-	140	140	-
Other	1160	1760	-	1620	470	1150
Total	2900	2900	-	10890	6120	4770

Table 23

Polyamide and Polyester Potential Demand in 1985 (Tons)

Product	Polyamide			Polyester		
	Total	Cont. Fil	Staple	Total	Cont. Fil	Staple
Non Apparel	15130	11585	3545	28125	8015	20110
Clothing	2900	2900	-	10890	6120	4770
Sub Total	18030	14485	3545	39015	14135	24880

Table 24

Synthetic Fiber Demand in Piece Goods and Non Paaprel in 1990 (Tons)

Product	All Fibers	Syn Fibers	Nylon	Polyest-er	Acrylic	Polypropylene
Textile	1410	710	210	500	-	-
Cotton Fabrics	8420	4105	-	4105	-	-
Woolen Fabrics	2395	950	-	650	300	-
Woven Syn. Fabrics	31150	31150	9310	21840	-	-
Woven Rayon	7830	5085	-	5085	-	-
Artificial Fur	75	75	-	-	75	-
Woven Fabrics NES.	1725	860	350	510	-	-
Ribbon Fabrics	390	210	90	120	-	-
Embroidery	30	-	-	-	-	-
Coated Fabrics	920	460	340	120	-	-
Syn Fiber Cord	1990	1990	1500	490	-	-
Vegt Fiber Cord.	1760	1370	280	80	-	1010
Nets.	625	625	475	75	-	75
Cotton Bags	1235	1235	-	-	-	1235
Non Cotton Bags	10900	5460	-	-	-	5460
Tarpouling	2130	505	250	255	-	-
Tents	3550	2130	1710	420	-	-
Blankets	17040	12060	1040	1040	9980	-
Towels	1725	160	75	90	-	-
Bed Linen	9410	4890	-	4890	-	-
Curtains	30	-	-	-	-	-
Textiles made up	700	340	160	180	-	-
Carpets Knotted	3180	-	-	-	-	-
Rugs	2275	1040	700	340	-	-
Tufted Carpets	11480	9260	6600	1140	410	1110
Woven Carpets	2930	480	100	-	380	-
Silk Fabrics	105	-	-	-	-	-
Sub Total	125410	85150	23185	41930	11145	8890

Table 25

Synthetic Fiber Potential Demand in Clothing in 1990 (Tons)

Product	All Fibers	Syn Fibers	Dylon	Polyester	Acrylic	Polypropylene
Mens Outerwear	14290	8700	1040	6100	1560	-
Womens Outerwear	9040	5170	760	3920	490	-
Shirts	6080	3550	-	3550	-	-
Socks	765	370	370	-	-	-
Scarfs	1040	620	420	200	-	-
Other	10140	4130	1720	2410	-	-
Total	41355	22540	4310	16180	2050	-

Table 26

Synthetic Fiber Potential Demand in 1990

Products	All3 Fibers	Syn Fibers	Nylon	Polyester	Acrylic	Polypropylene
Non-Apparel	125410	85150	23185	41925	11145	8880
Clothing	41355	22540	4310	16180	2050	-
Sub Total	166765	107690	27495	58105	13195	8880

Table 27

Polyamide and Polyester Fiber Potential Demand in

Piece Goods and Non Apparel in 1990

Product	Polyamide			Polyester		
	Total	Cont. fil	Staple	Total	Cont. fil	Staple.
Textile Yarn	210	210	-	500	250	250
Cotton Fabrics	-	-	-	4105	-	4105
Woolen Fabrics	-	-	-	650	-	650
Woven Syn Fabrics	9310	8610	700	21840	10350	11490
Woven Rayon	-	-	-	5080	-	5080
Woven F brics NES	350	350	-	510	-	510
Ribbon Fabrics	90	90	-	120	120	-
Coated Fabricsd	340	340	-	120	120	-
Syn Fiber Cord	1500	1500	-	490	490	-
Vegt. Fiber Cord	280	280	-	80	80	-
Nets	475	475	-	75	75	-
Tarpoulines	250	250	-	255	255	-
Tents	1710	1710	-	420	-	420
Blankets	1040	520	520	1040	180	860
Towel	70	-	70	90	-	90
Bed Linen	-	-	-	4890	-	4890
Made up Textiles	160	160	-	180	-	180
Rugs	700	180	520	340	-	340
Tufted Carpets	6600	2880	3720	1140	-	1140
Woven Carpets	100	-	100	-	-	-
Sub Total	23185	17555	5630	41925	11920	30005

Table 28

Polyester and Polyamide Fiber Potential Demand in Clothing in 1990 (Tons)

Product	Polyamide Total	Polyamide Cont. Fil	Polyamide Staple	Polyester Sotal	Polyester Cont. Fil	Polyester Staple
Mens Outerwear	1040	1040	-k	6100	5055	1045
Womens Outerwear	760	760	-	3920	3135	785
Shirted	-	-	-	3550	-	3550
Socks	370	370	-	-	-	-
Scarfs	420	420	-	200	200	-
Other	1720	1720	-	2410	700	1710
Total	4310	4310	-	16180	9090	7090

Table 29

Polyamide and Polyester Fiber Potential Demand in 1990

Product	Polyamide Total	Polyamide Cont. fil	Polyamide Staples	1Polyester Total	1Polyester Cont. fil	1Polyester Staple
Non - Apparel	23185	17556	5630	41925	11920	30005
Clothing	4310	4310	-	16180	9090	7090
Sub Total	27495	27495	5630	58105	21010	37095

Tire Cord Markets

The Kuwait Tire company with Saudi Arabian interests will build a tire factory with a reported capacity of 1,000,000 tires per year to supply the replacement tire market. The actual size of the replacement tire market can only be estimated since it is difficult to determine the exact number of tires imported since the imports include both tires and tubes. It is very difficult to estimate average car life since the number of passenger cars reported operating in 1975 exceeded total passenger car imports during the period 1971 through 1975 by about 57,000. This would indicate a car of life of approximately 9 years. In order to supply the total replacement market in Kuwait the new plant would have to produce a vast array of sizes and types. The older cars are undoubtedly equipped with bias and bias belted tires and the newer cars with radials. In all probability the plant will concentrate on bias or bias belted passenger tires. Truck tires are most important in the replacement market and 70% of the tire market (K.D. value) is said to be in truck tires.

With an undefined technology source and with an uncertain product mix the utilization of fabric in this plant is difficult to predict. It is not even certain that the plant will purchase fiber and make its own fabric. For some time it may elect to purchase fabric from one of the plants owned by its supplier of technology.

In the U.S. nylon 6 can only be used in truck tires because the curing temperatures for passenger tires is too high for the lower melting nylon 6 fiber. It should be noted that the consumption of polyester in tires is larger than the combined usage of nylon 6 and 66. Normally the larger tire companies purchase nylon tire cord from fiber producers and treat the fibers with their own proprietary processes for example the Goodyear 3 T process (time, temperature and tension) and add their own adhesive system to the fabric to promote adhesion. The adhesive system is partimlarly important in the case of polyester cords.

The amount of fiber in a tire is dependent upon its size and use. Passenger tires vary from 2 to 4 plies whereas truck tires may have many more plies. In the absence of any firm product mix we have assumed that the fabric content may average 22%. Over the past five years the average weight of the tire imported into Kuwait was 20,2 Kg and thus the amount of fiber which would be consumed by the plant would be 4,400 tons of either nylon or polyester.

Since the Company plans on selling 500,000 tires to Kuwait and 750,000 tires to Saudi Arabia within three years of start up, obviously expansion is planned. The entire Gulf Area is reported to have a total replacement demand of 1.5-2,000,000 Tires which would indicate that Kuwait tire can produce a major portion of the replacement market. Additional capacity could only be obtained by capturing a portion of the original equipment market.

With all of the uncertainity surrounding this market it is recommended that the progress of this project be followed very closely but that no facilities for tire cord production be planned until the markets are clearly defined.

Attractive Markets for Polyester Staple Fiber:

Although the previous section outlined the possible demands for synthetic fibers the realities of constructing at the same time a textile industry to produce the products of interest in a sufficient volume to make the entire project viable imposes strict limitations on the possible candidates. The ideal candidates would consume polyester staplein sufficient quantities to permit the construction of an efficient small polyester staple plant and the textile prodcts would in themselves be relatively simple products which are relatively independent of style changes. The three markets to be examined are markets for dishdasha fabrics, bed linens and woven cotton and rayon fabrics.

The most popular fabric for summer dishdashes in Kuwait is a polyester cotton 65-35% blend fabric which contains about 35 threads per cm. in each direction and weighs about 97g per running meter. The width of the fabric is about 91 centimeters. The fabric is mercerized, pre-shrunk and resin treated. It sells at retail for about 740 fils per running meter. The fabric examined was made by NISSHIN SPINNING CO. of Japan using TEIJIN polyester staple. Facilities available did not permit analysis of the turns per inch in the yarn nor the staple length. It is assumed that the later is 3,8 cm long.

There are no statistics on the imports of dishdasha fabric into Kuwait. Dishdashes made from this type fabric are worn by all Kuwaiti male age groups but not by most expatriates. The total amount of fabric consumed will be determined by the male Kuwaiti population within an age group.the amount of fabric required to make a dishdasha for each age group and the average number purchased per year for each age group.

Tale 30

Fabric Consumption in the Dishdash Market

Age Group Yrs.	Popul. 1975	Meters Per unit	No. unit	Per pop. Total Meters 1000's	Total Weight Tons
1-4	36,956	1.1	6	243.9	23.7
5-9	35,715	2.2	8	628.6	61.0
10-14	35,715	2.6	10	928.6	90.1
15-19	23,513	3.1	9	656.0	63.6
20	95,016	3.6	9	3078.5	298.6
Totals	226,915			5,536	537

Consumption in Kuwait 1980-1990 is given in Table 31. The total population is firm the Ministry of Planning using 995,000 for 1975 as the base Table 31

	1980	1985	1990
Population Millions	1.35	1.82	2.45
1000 Meters	7.510	10.120	13,620
Weight tons	729	982	1322
Polyester Content	474	619	859

In order to estimate the consumption of fabric in dishdashs in Saudi Arabia and the %"Other" Gulf States we are simplifying the problem by assuming that the life syle is similar and and that the population spread and consumption pattern will be the same as in Kuwait. By the "Other" Gulf States we are including Bahrain, Qatar, the United Arab Emirates, Oman and the two Yemens.

The population forecast for the "Other" Gulf States and Saudi Arabia is taken from an IDCAS study on synthetic fibers prpared by Chem. Systems.

Table 32

Total Population in the Gulf Area

(Millions)

	1980	1985	1990
Saudi Arabia	10.7	12,5	14,0
"Others"	9,85	11.2	13,1
Sub Total	20,55	23,7	27,1
Kuwait	1,35	1,82	2,45
Total	21,9	25,52	29,55

The total market for dishdash fabrics in shown in Table

Table 33

Fabric consumed in dishdash markets

(Tons)

	1980	1985	1990
Kuwait	729	982	1,322
Saudi Arabia	5,778	6,745	7,554
Others	5,319	6,043	7,069
Total	11,826	13,770	15,945

Although the above data gives the total consumption of fabrics in the several dishdasha markets not all of the markets would necessarly be available to a Kuwait based company. We are assuming that a textile fabric plant in Kuwait could obtain all of the Kuwait market and 25% of the Saudi Arabia and "Other" Gulf States markets, the so called Gulf Area mrket. These fabric markets together with the polyester fiber contents are shown in Table 34.

Table 34

Fabric Markets Available in Gulf Area

To fabric Plant in Kuwait (Tons)

	1980	1985	1990
Kuwait	729	982	1,322
Gulf Area	2,774	3,197	3,655
Total	3,503	4,179	4,977
Polyester Content	2,276	2,716	3,235

The above totals do not include the considerable amount of a similar fabric dyed black which is used by the female Kuwait population. The initial fabric plant for this plant is projected as 2000 tons.

In other tables it has been shown that the bed linen market in Kuwait is quite large. In the market place both muslin and percale sheets are available. Many of the muslin sheets are white while others are printed or solid colors. Percale sheets which sell for a higher price are frequently printed or carry some minimal decoration on the top side such as an embroidery. As the market becomes more sophisticated printed designs in varions patterns will be more widely used. In the U.S. cotton and cotton blend sheets are widely used with synthetic fibers representing 45% of the market and cotton 53%. One of the preferred blends is 50-50 polyester blends but 65-35 blends also available and in Kuwait this blend should be acceptable.

A 50-50 blend of polyester sheet was purchased at retail for 2.475 K.D. It was a white percale sheet decorated at only the top with small simple design and was made by the U.S. Cannon Co. Analysis of the fabric design showed that it contained 31 threads per cm. in the pick direction and 40 threads per cm in the warp direction. The sheet was designed for a twin bed, 168 cm. wide and 264 cm long and weighed 600g. It had a 20 cm hem at the top and 2.5 cm hem on the bottom. Although itwas not possible to determine actual yarn constructions it was estimated that the warp was possibly a 40 CC yarn and the fill a 24 CC yarn. Muslin sheets were not as c refully analyzed and the estimates were 30 threads per cm in both warp and fill direction. The equipment for yarn preparation and weaving of dishdasha fabrics could be redily adjusted to produce bed sheets.

The markets for bed sheets in Kuwait, Saudi Arabia and the other Gulf States are shown in Table 35 over the period 1980-1990 using the same technique as in Table 33.

Table 35
Fabric Consumed in Bed Linen Markets.
(Tons)

	1980	1985	1990
Kuwaiti	2,600	4,050	6,020
Saudi Arabia	20,600	27,800	34,400
Others	19,000	24,900	32,200
Total	42,200	36,800	72,600

As before assuming that a Kuwait plant could capture all of the Kuwait market and 25% of the Gulf Area market the market potential is shown in Table 36

Table 36
Potential Market for Kuwait Bed Linen
(Tons)

	1980	1985	1990
Kuwait	2,600	4,050	6,020
Gulf Area	9,900	13,200	16,700
Total	12,500	17,300	22,700
Polyester Content	8,100	11,200	14,800

Other large fabric markets for woven polyester cotton fabrics are those classified under cotton fabrics and rayon fabrics. Much less is known about these fabrics and time did not permit an accurate analysis of the fabrics in these categories. Nevertheless, most of the spun yarn fabrics could be produced using the yarn preparation and weaving equipment used for dishdash and the bed linen markets. Undoubtedly the fabrics used in these markets may require more style. For this reason these fabrics are regarded as the second generation type products but more thorough investigation of these broad markets may indicate that specific market areas may be no more complicated than the deshdasha or bed linen markets and may be produced on the same finishing equipment.

Using the same techniques as described earlierthe total market is shown in table 37 and the potential market available for a Kuwait plant is given in Table 3.

Table 37

Woven Cotton and Rayon Fabric Markets

(tons)

	1980	1985	1990
Kuwait	4,900	7,600	11,300
Asudi Arabia	38,800	52,200	64,600
Others	35,800	46,800	60,400
Total	79,500	106,600	136,300

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Potential Woven Cotton and Rayon Markets for

A Kuwait Fabric Plant (Tons)

	1980	1985	1990
Kuwait	4,900	7,600	11,300
Gulf Area	18,700	24,800	31,300
Total	23,600	32,400	42,600
Polyester Content	15,300	21,100	27,700m

Summarizing, the data for woven polyester cotton blend fabrics which could be produced using the same type of yarn preparation and weaving equipment are shown in Table 39. Much of this tonnage is in white or solid colors but as the mrkets develop more printing and dyeing equipment will be required. In this table it should be emphasized that the market potential represents only the Kuwait market plus 25% of the Gulf Area markets. They do not include men and boys white shirts, men and boys underwear, womem and children underclothes, blouses, dresses and shirts for women and girls, summer weight skirts and the like. The yarn preparation and weaving equipment for all of these products would be similar but substantially more dyeing, printing and finishing equipment would be required. Since present markets exist for fabrics summarized in Table 39 the creation of a new segment of the needle industry would not be required, The existance of yarn preparation equipment could in addition, provide the inpetus for the creation of a knitting industry.

Obviously, one of the weaknesses in this approach is the basic assnmption that market potential in all the Gulf Areas is equal to the Kuwait market consumption pattern. This obviously is not true and should be thoroughly explored. Market analysis of existing markets is limited and would require more investigation. This is particularly true of the cotton and rayon markets.

Table 39
Fabric Markets for a Kuwait Located
Polyester-Cotton Blend Fabric Plant.
(Tons)

	1980	1985	1990
DISHDASH			
Kuwait	729	982	1,322
Gulf Area	3,385	3,900	4,470
Total	4,114	4,882	5,792
Bed Linens			
Kuwait	2,600	4,050	6,000
Gulf Area	9,900	13,200	16,700
Total	12,500	17,300	22,700
Cotton Fabric			
Kuwait	4,900	7,600	11,300
Gulf Area	18,700	24,800	31,300
Total	23,600	32,400	42,600
Total Market			
Kuwait	8229	12632	18620
Gulf Area	32,000	41,900	52,500
Total	40,230	54,530	71,120
Polyester Content of Total Market			
Kuwait	5,350	8,210	12,100
Gulf Area	20,800	27,200	34,100
Total	26,150	35,410	46,200

Polyester Staple Manufacturing Costs

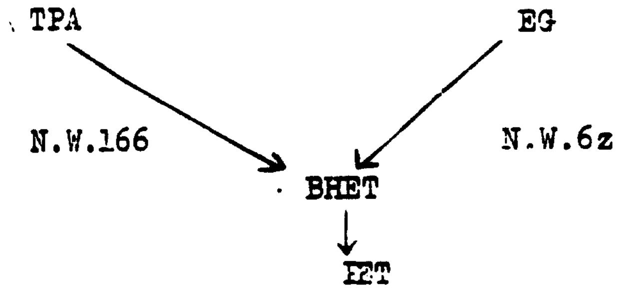
As indicated in the previous section the manufacture of staple fiber in Kuwait requires the installation of a textile industry to consume the staple product produced in the fiber plant. Examining only the dishdasha and bed linen markets it is apparent that the markets should be able to support a 2000 ton dishdasha fabric plant and a 4000 ton bed linen plant. As originally sized these plants should consume roughly 4000 tons of polyester staple based on a normal textile plant utilization of a 15 shifts week. Sudden surges in demand can thus be accommodated. By placing the plant on a 24 hour seven day a week basis the plants would require at 65% blend level about 5500 tons of polyester staple and the fiber plant was sized for 5000 tons.

In establishing the design concept for the plant it was decided that the plant should be designed in such a manner that the building should be designed to accommodate a larger plant (spinning area primarly) but that the plant should contain only the indicated equipment for a 5000 ton plant and that costs for the plant would be allocated to that area which would be utilized. In addition, the plant should be designed so that even greater capacity could be added in the future. This planning is similar to the block plan used for designing a large chmical complex. The plant will receive raw materials from either domestic or nearby sources to minimize storage costs. The plant will produce both polymer and staple and the staple plant will be sized to consume the entire output of the polymer plant. In turn the staple plant will be sized to meet the requirements of the textile industry plants. It is assumed that the polymer and staple plants will be under one management and that the corresponding textile industry plants even, if not under the same management, will be closely coordinated with the fiber plant. Since the textile products are so closely related it is assumed that the fiber plant will produce only one product and that this proudct will be semi-dull 1.5 denier staple for use in cotton blending. By concentrating production on only one product the costly production of many products for the normal merchant market will be eliminated.

Polymer for the plant will be produced from ethylene glycol and terephthalic acid, TPA, but will not use direct spinning. These possible surprising choices are based on the fact that experience should be gained on continuous polymerization for the production of staple by continuous polymerization direct spinning at some point in the near term future. At that point the chip produced in the polymer plant can be utilized to produce continuous filament yarns, either high strength yarns for the tire factory or textile denier continuous filament yarns for weaving, knitting or texturing. Terephthalic acid was chosen rather than dimethyl terephthalic,DMT, because private studies not here reported have shown that TPA has a lower production cost than DMT on an equivalent basis and because there are some inherent cost advantages to polymer production from TPA.

The production scheme contimplates using basic raw materials produced domestically or from nearby sources. It is realized that sources will not be operatioaal in 1980. We have elected to use 1980 as the first operational year in consideration of plant construction times. For estimation purposes the polymer plant will produce 98% first quality polymer chip and the fiber plant will convert polymer chip tofirst grade staple in 96% yields. This requires that the polymer plant produce 5200 tons of first grade polymer and the polymer plant will require reactants to produce 5310 tons of polymer. The molar ration of ethylene glycol to TPA was 1.5 to 1.

Polyesters can be produced from TPA and excess ethylene glycol ,EG, by the indicated following reaction



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In this reaction BHET (bis- hydroxyethyl tereph thalate) can be prepared by reacting two or more moles of EG with a mole of TPA. Since TPA is highly intractable the reaction between TPA and EG is usually carried out inthe presence of BHET as a solvent so that the intermediate formed is in reality a mixture of products. After removal of any free EG and the water formed in the reaction the polymer is formed by the elimination of EG between two BHET molecules and oligomers usually under increasingly high vacuum and in the presence of certain catalysts to give the final polymer, polyethylene terephthalate or PET. Polyethylene terephthalate is a very hard , white crystaline polymer which when relatively pure have a melting range of 260-265C. The literature on polyester formation is very extensive and there aree many review (5) articles.

Rather than attempt to size and estimate the construction and erection cost of each piece of equipment in the process we have elected to use a known construction cost in the textile area of the United States in cents per annual pound in 1975 of 22 including a 25% uncertainity allowance for a similar sized plant and escalate these costs to 1979, the anticipated year of major expenditure for a plant operational in 1980. It is believed that this is a reasonably safe projection. As a further hedge the cost of providing raw material and final product storage has been reduced by using local suppliers of raw materials and by control of both polymer and staple manufacturing centers. In order to translate U.S. textile area costs to Kuwait costs a factor of 130% was used. This may be lower than many current estimates for chemical intermediate plants but our estimate was based on the fact that equipment suppliers in these areas are faced with a depressed market and that much of the equipment will be shop rather than field erected. The plant does not anticipate purification of byproduct ethylene glycol and therefore no equipment is provided.

Raw material prices for the Gulf area are difficult to estimate but we have assumed that these costs should be world prices minus some average transportation charge. The contract price for TPA in 1977 to fiber customers was about 139KD per ton . With the general slump in polyester business and only modest recovery for continuous filament yarn there is little increase in demand to force up prices. Supply is more than adequate and prices are not expected to increase much beyond 145KD per ton by 1980. IF demand arising from the development of polyester bottles should increase as anticipated prices in 1980 could possibly be somewhat higher. It has been estimated that a new plant for TPA built in 1976 and operational in 1977 would have a cost plus a 15% DCF return of 152.4KD per ton. As an average transportation charge we have used 12.8KD per ton. and have assumed that the price of tereplithalic acid would be 132KD per ton.

In the United States the price of high purity ethylene glycol to fiber producers has been lower than for an inferior product for industrial uses. Contract prices for 1977 as estimated by a glycol producer was 129KD per ton. As is the case for TPA the price for ethylene glycol in 1980 should be approximately 135.4KD per ton and with a transportation charge of 12,8KD per ton the estimated price used in the report is 123KD per ton. For comparison the estimated price for ethylene glycol for 1977 was 120.3 KD with a 15% DCF return.

Labor costs are estimated for 1980 based on information supplied by the Industrial Development and Consulting Bureau, and escalated 8% per year until 1980. No provision has been made for direct supervision since the polymer plant is to be operated in conjunction with the staple fiber plant and supervision can come from that plant.

Working capital represents four weeks production by utilizing local sources of raw materials and maintaining only two weeks supply of polymer. These are minimum quantities but should be sufficient for a plant producing only one product.

Since the recovered glycol only amounts to about 800 tons the product will be returned to the glycol supplier for purification in his plant. This practice is common in the United States where the freight distances are substantially higher.

The costs of producing polymer are shown in Table 40 These costs do not include any capital charges and in that sense are not true costs. Since all of the polymer produced will be consumed by the fiber plant these polymer costs will be combined with similar fiber costs and capital charges will be applied to both processes.

In a similar manner the costs of converting polymer into staple are shown in Table 41. Since information on melt spinning is not readily available a very brief review of this subject may be found in Annex 4.

Data are combined in Table 43 for the combined processes and capital charges at several levels are included with conversion costs in Table 42 for the 1980 production of 5000 tons of staple fiber.

currently polyester staple sellsin the United States for about 371 fils per Kg and assuming a 4% import duty and transportation and insurance charges of 20 fils per Kg the competitive price for U.S. staple in Kuwait would be 406 fils. Although the manufacture of polyester staple is attractive at these costs detailed engeneering studies would be required to verify these costs.

Table 40
Polyester Polymer Manufacturing Costs

Plant		**Capital Costs**	
Construction	1979	Battery Limits	1,570,000 KD
Operational	1980	Off Sites	510,000 KD
Capactiy	5000 Tons	Total Fixed	2,080,000 KD
Production	5200 Tons	Working Capital	80,000 KD

Raw material	Quant	Unit	Unit Price	Annual Cost	Unit Cost Fils/Kg
Terephthalic Acid	4580	ton	132 KD	605,000 KD	
Ethylene Glycol	2570	ton	123	316,000	
Titanium Dioxide	26.5	tons	279	7,000	
Catalysts				9,000	
			Sub Total	937,000	187
Utilities					
Power	3,135,000	Kwhr	0,002	6000	
Cooling Water	2,750,000	m^3	0,009	25,000	
Process Water	41,000	m^3	0,083	3,000	
Steam	21,000	ton	0.43	9,000	
			Sub Total	43,000	19
Operating Cost					
Labor 11	Year	2770		30,000	
Supervision Included in Fiber Area				-	
Maintenance (3% BL)				47,000	
			Sub Total	77,000	15
Overhead Expenses					
Direct Overhead (30% Labor)				9,000	
General Plant Overhead (60% Operat Cost)				46,000	
Insurance (0,75% Fixed)				16,000	
Depreciation					
Battery Limits 10%				157,000	
Offsites 5%				26,000	
Interest 8% Working Capital				6,000	
			Sub Total	260,000	52

By product Credit					
Ethylene Glycol	790	ton	91	(72,000)	(14)
		Total Costs Ex Capital		1,245,000	249

Table 41

Polyester Staple Manufacturing Costs 1980

Plant		Capital Cost	
Construction	1979	Battery Limits	830,000 KD
Operational	1980	Offsites	270,000KD
Capacity	5000 tons	Total Fixed	1,100,000 KD
Production	5000 tons	Working Capital	110,000 KD

Raw Materials	Quant	Unit	Unit Cost KD	Annual Cost KD	Unit Cost Fils /Kg
Polymer Chip	5200	tons	-	-	
Finish	26	tons	375	10,000	
Bale Wrap	20000	-	0.5	10,000	
			Sub Total	20,000	4
Utilities					
Power	5,100,000	Kwh	0.002	10,000	
Cooling Water	1,370,000	M^3	0,009	12,000	
Steam	11,000	ton	0.43	5,000	
Process Water	31,000	m^3	0.083	3,000	
	Sub Total			30,000	6
Operating Cost					
Labor	22	Year.	2770	61,000	
Supervision	4	Year	3860	15,000	
	1	Year	7000	7,000	
Maintenance 3% Bl				25,000	
	Sub Total			108,000	22
Overhead					
Direct Overhead (30% Labor & Super V.)				25, 000	
General Plant Overhead (60% Operating Cost)				65,000	
Insurance (0,75% Fixed)				8,000	
Depreciation					
Battery Limits 10%				83,000	
Offsites				14,000	
Interests 8% Working Capital				9,000	
	Sub Total			204,000	41
	Total Cost Ex Capital Charges.			362,000	72

Table 42

Polyester Staple Fiber Manufacturing Costs
Monomer to Fiber 1980

Plant		Capital Charges	
Construction	1979	Battery Limits	2,400,000 KD
Operational	1980	Offsites	780,000 KD
Capacity	5000 tons	Total Fixed	3,180,000 KD
Production	5000 tons	Working Capital	190,000 KD

Raw Materials	Quant	Unit	Unit Price KD	Annual Cost KD	Unit Cost Fils/Kg
Terephthalicacid	4580	tons	132	605,000	
Ethylene Glycol	2570	ton	123	316,000	
Titanium Dioxide	26.5	ton	279	7,000	
Finish	26	ton	375	10,000	
Bale Wrap	20000	-	0,5	10,000	
Catalysts	-	-	-	9,000	
	Sub Total			957,0000	191
Utilities					
Power	8,235,000	Kwh	0,002	16,000	
Cooling Water	4,120,000	M3	0,009	37,000	
Process Water	72,000	M3	0,083	6,000	
Steam	32,000	ton	0,43	14,000	
		Sub Total		73,000	15
Operating Cost					
Labor	33	Year	2770	91,000	
Supervision					
	4	Year	3860	15,000	
	1	Year	7000	7,000	
Maintenance 3% BL				72,000	
	Sub - Total			185,000	37
Overhead Expenses					
Direct Overhead (30% labor & Supervision)				34,000	
General Plant Overhead (30% Operating Cost)				111,000	
Insurance)(0.75 Fixed Costs)				24,000	
Depreciation					
Battery Limits 10%				240,000	
Offsites 5%				39,000	
Interest 8% Working Capital				15,000	
Sub-Total				463,000	93
By product Credit					
Ethylene Glycol	790	Ton	91	(72,000)	(14)
Total Costs Ex Capital Charges				1.606,000	321

Table 43

Polyester Staple Fiber Costs Including Capital Charges

Monomer to Polymer

Fixed Capital 1000 KD	ROI %	Capital Charges 1000 KD	Conversion Costs 1000KD	Annual Cost 1000KD	Unit Costs Fils/Kg
3180	5	159	1606	1,765	353
3180	10	318	1606	1,924	385
3180	15	477	1606	2083	417
3180	20	636	1606	2242	448
3180	25	795	1606	2401	470

Spun Yarn Costs For Dishdasha Fabric

In this section we are examininig spun yarn costs. All of the data are based on the work of Rieter A.G. of Winterthur, Switzerland, who have a computer program for this analysis. It should be emphasized that there are many good ring spinning systems which can be purchased either in the form of turn key plants or designed around standard pieces of equipment. Current prices of all Swiss made equipment are extremely high because of the very high value of the Swiss Franc in terms of other currencies. Ring systems for spinning yarn rather than the less labor intensive open end spinning systems have been selected because of the high quality of the yarn which will be required. Although the plant was designed specifically for 40CC yarns the same plant with adjustments can be used to prepare blended yarns for bed linens. Althoughthe principles of converting staple into spun yarn are the same it is not possible ecomonically to prepare heavy spun yarns, which would be used for heavy fabrics such as tarpaulins or carpets on the same equipment as is used for shirts, bed linens, blouses, dresses and dishdashas. The existence of a plant which can produce these fine yarns would give the basic background and capability of producing other textile products at some point in the future.

The process of converting all staple fibers, natural and man-made, into yarns regardless of staple length or fiber type have been developed using the same principles. The essential features include some method of taking a completely random arrangement of short fibers and combing groups of these fibers until a fairly heavy uniform array of parallel fibers is produced. These arrays are combined and drawn down into smaller units several times to form a smaller more uniform parallel arrangement of fibers. These fiber arragnements have very little sttength and the final yarn step, the so called spinning step (hence the name spun yarn) draws the arrangement of fibers into the desired weight and twists it into a high strength yarn using a ring and spindle system. It should be emphasized that the strength of a spun yarn arises solely from the greatly increase fiber frictional forces imparted by the twist. Details of the process will be found in Annex 5.

The cost for producing spun yarns of the size demanded by the dishdasha fabrics is given in Table 44 . The entire yarn produced in this plant will be used in the corresponding fabric plant.

Table 44

Cost of Producing 65-35 Polyester Cotton Yarn (40 cc)

Plant		Capital Costs in KD	
Construction	1979	Equipment	2,554,000
Operational	1980	Building	463,000
Capacity	2000 tons	Total Fixed	3,017,000
		Working Capital	157,000

Raw Materials					
Product	Quant	Unit	Unit Price KD	Total Cost KD	Unit Cost Fils/Kg
Cotton	1010	ton	428	432,200	216
Polyester	1389	ton	417	579,000	290
Utilities					
Power	10,710,000	kwh	0.002	21,000	10
Supplies				42,000	21
Labor					
Operating	87	year	1380	120,000	
Maintenance	9	year	2520	23,000	
Supervision					
Foremen	6	year	3600	29,000	
Supervisor	2	year	7020	14,000	
General Mgr.	1	year	12000	12,000	
			Sub Total	198,000	99

Overhead					
Direct Overhead (30% Labor)				59,000	
General Plant Overhead (60% Operating)				144,000	
Insurance (0.75% Fixed)				23,000	
Depreciation					
Equipment 10%				255,000	
Building				23,000	
Interest 8% Working Capital				13,000	
			Sub Total	517,000	259
By product Credits					
Cotton Wastes	310	ton	179	(55,000)	(27)
			Total Costs	1,734,000	867
Capital Charges (15% ROI)				453,000	226
			Total Costs	2.187,000	1094

Dishdasha Fabric Costs

Before the yarn produced in the dishdasha yarn plant can be used for producing fabric it must be rewound from the spin bobbins onto either tubes for weaving or cones for warping and beaming. Since both yarn and fabric plants with be under the same management this separation is purely artificial and for convenience these have been combined with the fabric plant. To give some concept of the problems involved in handling yarns in this volume the plant will use 126 million kilometers of yarn and this handling must be repeated several times without developing snarls in the yarn.

Briefly the steps involved in preparing dishdasha fabrics are

1. Winding onto tubes or cones.
2. Prepartion of warps .
3. Sizing of warps.
4. Wearing of fabric and inspection.
5. Desizing and washing.
6. Resin treating and Dring.
7. Final inspection and packaging.
8. Warehousing.

These steps are described in more detail in Annex 6.

The costs of producing fabric are shown in Table 45 In arriving at these costs we have used a plant operating seven days a week but with the workers working a 6 day 48 hour week with two weeks annual leave. The equipment costs are high primarily because of the decreasing value of the dollar and its infuence on the Kuwait Dinar in relation to the Swiss franc. In this report this has been established at 1 US = 1.85 Swiss francs.

In estimating working capital we have assumed 4 months inventory because of the seasonal nature of the business. This is a requirement for about 4 months of the year but ovbiously inventories will be drawn down during the busy late spring and summer seasons.

Labor costs have been adjusted to 1980 using an 8% annual increase. Basic data are from the Industrial Development and Consulting Bureau. Loom load per weaver has been established at 10 and as experienced is gained a gradual decrease in loom labor can be anticipated.

Plant sizing has been based on the actual number of pieces of equipment required and its allocated working space requirement. An additional allowance of 50% has been provided for in process lag space and for traffic patterns.

Table 45

Possible Dishdash Fabric Production Costs

Plant		Capital Costs in KD	
Construction	1979	Equipment	6,266,000
Operational	1980	Building	1,168,000
Capacity	2000 tons	Total Fixed	7,434,000
		Working Capital	1,121,000 for 4 mos. 700,000 for 8 mos.

First Quality	18.4×10^6	linear meters
Second Quality	0.5×10^6	linear meters
Scrap	0.5×10^6	linear meters

Product	Quant	Unit	Unit Price KD	Total Cost KD	Unit Cost Fils/Kg
Raw Material					
40 cc Yarn	2000	ton	1094	2,188,000	1094
Utilities					
Power	22.2×10^6	kwh	0.002	44,000	
Process Water	30,000	m^3	0.0083	3,000	
Steam	27,000	ton	0.43	12,000	
			Sub Total	59,000	30
Supplies					
Ind. Packages	1.84×10^6	unit	0.03	55,000	
Cartons	9.2×10^5	unit	0.15	14,000	
Chemicals	100,000	kg	0.40	40,000	
Resin	100,000	kg	0.6	60,000	
Maintenance				50,000	
			Sub Total	219,000	110
Operating Cost					
Operating Labor	164	year	1380	226,000	
Maintenance	30	year	2520	76,000	
Skilled Labor	30	year	2100	63,000	
Unskilled Labor	28	year	1020	29,000	
Supervision					
Foreman	8	year	3600	29,000	
Supervisor	3	year	7000	21,000	
General Manager	1	year	12000	12,000	
			Sub Total	456,000	228

Overhead

Direct Overhead 30% Labor and Supervision	137,000	
General Plant Overhead 60% Operating	304,000	
Insurance 0.75% Fixed Capital	56,000	
Depreciation		
Equipment 10%	627,000	
Building 5%	58,000	
Interest on Working Capital 8%	67,000	
Sub Total	1,249,000	625
Total Cost Ex Capital	4,171,000	2086
Capital Charges 15% ROI	1,115,000	558
Total Costs	5,286,000	2643

The retail sales price for one grade of dishdasha fabric is 0.743 KD per meter. If we assume that mill price is 50% of retail price for first quality and that second quality sells for 0.186 KD/lin.meter and scrap at 0.093 KD per lin.meter the total sales volume will be 6,980,000 KD. Under these circumstances the project appears to be quite attractive with a return on investment of about 30%. It must be pointed out that these returns are based on the case of a fabric construction which is based on a 40 cc yarn in both warp and pick direction and that the construction and finishing conditions are those described. At this point we do not know the acceptability of this fabric in the intended end use. As discussed in Annex 9 it is known that the highest quality of dishdasha fabrics uses a 120 cc yarn two plied in both warp and fill. There appear to be no difficulties in wearing such fabrics, but the actual spinning of such fine yarns may be difficult and certainly will be costly. For that reason the technique of spinning such yarns and the finishing of the fabrics will be important. It is apparent that much more work remains to be done before the actual costs of producing these fabrics can be accurately pinpointed. However, the assumptions on which these estimates are made have been clearly defined.

Conclusions and Recommendations.

Conclusions

There is no existing market for synthetic fibers in Kuwait nor is there an established textile industry. Markets for s synthetic fibers must await the establishmnt of a textile industry.

Textile products imported into Kuwait consume large quantities of natural and synthetic fibers with consumption approximately equal to well developed Western countries. Indirect exports play an important role in this large consumption of textile products. The potential demand for synthetic fibers in Kuwait is high and by 1980 the demand for synthetic fibers of all types will be 46,000 tons rising to 108,000 tons in 1990. In 1980 the synthetic fiber potential demand will be nylon 11,000 tons, polyester 25,000 tons, acrylic 6,000 tons and polypropylene 4,000 tons. The potential demand for acrylic fibers is too small for an acrylic fiber plant and polypropylene fiber demands are in low end textile products as replacements for jute. Nylon fiber demands 1980 will be continuous filament 9,000 tons and staple 2000 while polyester demands in 1980 will be continuous filament 9,000 tons and staple 16,000 tons. These demands meet the minimum size for construction of fiber plants.

The applications for nylon continuous filament fibers are in style dominated highly fragmented markets not suitable for the establishment of a textile industry in sufficient voulme to justify building a nylon plant. Staple demands are too low to contribute significantly to the establishment of a nylon plant.

Polyester continuous filament demands are also in style dominated fragmeted markets and are not suitable for the establishment of a textile industry. Polyester staple demands include style dominated markets as well as several large volume markets in which style is of lesser importance. These markets include dishdasha fabrics, bed linens and woven cotton and rayon fabrics with the last two areas judged second generation fabrics.

The Kuwait and 25% of the Gulf Area markets for dishdasha fabrics will be 41,000 tons in 1980 which is sufficient to build a 2,000 ton yarn and fabric plant. Similarly the Kuwait and 25% of the Gulf Area markets for bed linens will be 12,500 tons whichis sufficient to build a 6,000 ton yarn and fabric plant. The combined polyester staple fiber demand for these two plants is 5200 tons permitting construction of a 5,000 ton per year polyester staple plant.

The production of polyester staple in a 5,000 ton per year plant using <u>locally produced</u> terephthalic acid and ethylene glycol at transfer prices equal to world prices minus average transportation charges is commercially viable. The plant is capital intensive rather than labor intensive and will employ 40 people, labor and supervision, in the operational area. Continuous polymer production is well suited for future expansion either in volume or in other end uses. For future staple demand continuous polymerization combined with the selected staple process to form direct spinning units will be equivalent to world standard plants.

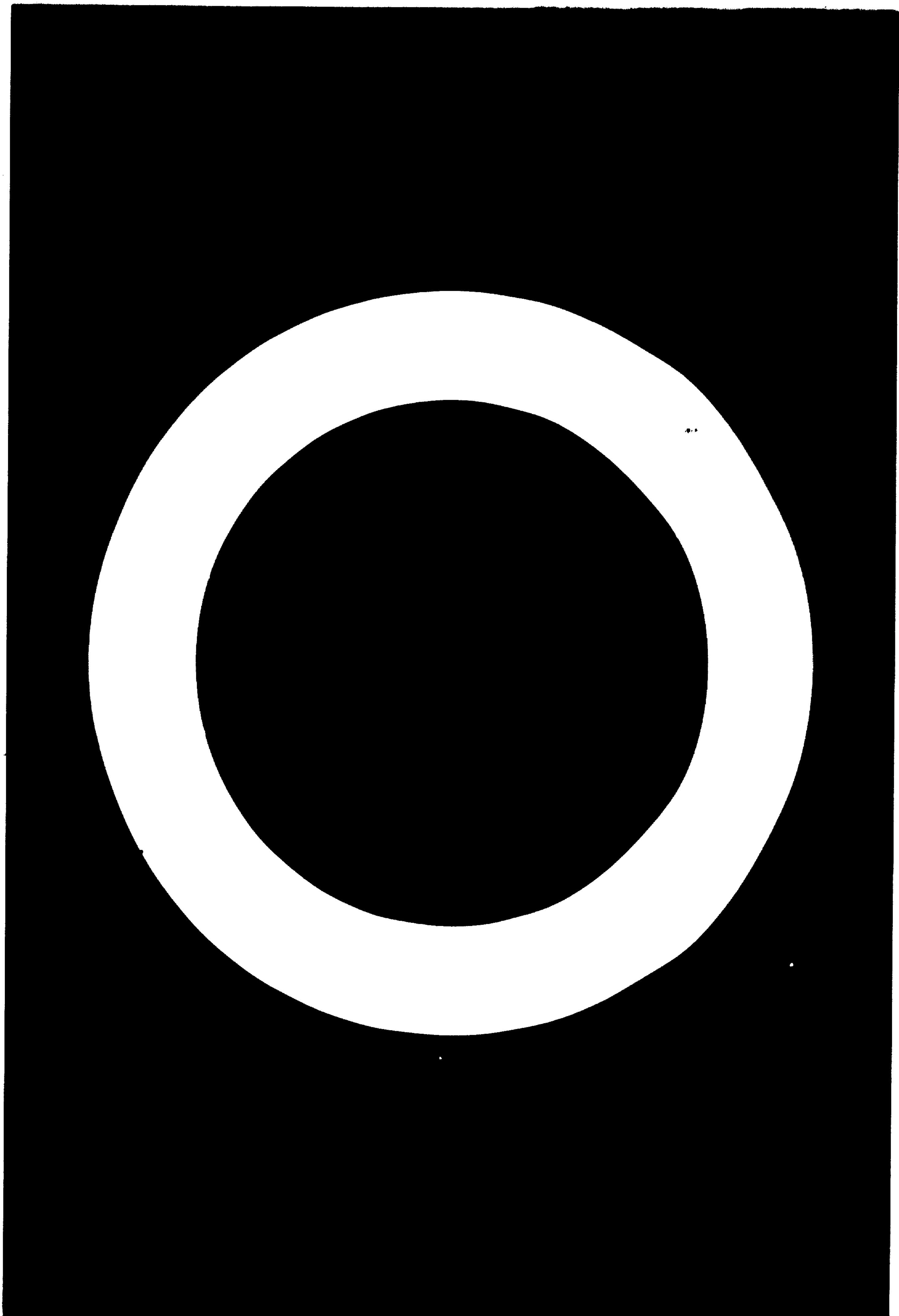
The production of dishdasha fabrics using the domestic polyester staple and imported cotton fiber is a viable commercial operation. The plant will produce both yarn and weave and finish the fabric. The plants are labor intensive but will uitilize largely semi-skilled labor including a large number of expatriate females. Yarn production for bed linen fabrics is commercially viable. The yarn and fabric plants for both fabrics will use similar equipment and the yarn plants can be used to make similar weight yarns for a wide variety of textile products. The yarn plants are well suited to be the spring board into other textile products and processes.

Recommendatinns

It is recommended that the polymer and staple plant be based on domestic or nearby locally produced chemical intermediates. To make domestic production of terephthalic acid and ethylene glycol more attractive it is recommended that two broad studies be initiated for the feasibility of producing (1) world size polyester staple plants for the export market and (2) world size plants for the production of polyester polymer for (A) conversion into continuous filament and (B) conversion into soft drink bottles for the explosive growth of the family size container packaging field. The basic thoughts underlying these recommendations can be developed.

It is recommended that studies be initiated to determine the methods and the costs of distribution of fabrics. originating at the Asian dishdasha fabric finishing plant to the ultimate consumer. These studies would give some indication of the ultimate competitive prices for dishdasha fabrics which the creation of a Kuwait fabric plant might encounter both in Kuwait and in the Gulf Area. The studies should include the advantages of creating a limited number of factory outlet stores rather than conventional distribution channels as well as the possible advantages from a marketing as well as a fabric manufacturing viewpoint of creating a quality factory to supply ready to wear dishdashas.

Finally it is recommended that studies be undertaken of the cost of producing bed linens in the sizes and types (muslin and for percale) to meet the Kuwait and Gulf Area markets. These studies should include the cost of dyeing, printing and sewing the bed linens.



Annex 1.

JOB DESCRIPTION
TF/KUW/76/001/11 - 05/D/32.1.H

Post Title: Consultant in Synthetic Fibers and Textiles.

Duration: Two months

Date Reauired: January 1978

Dury Station: Kuwait

Purpose of Project: To provide sufficient information and guidelines to enable local investars to take a decision with regard to establishing a synthetic fibers and textile idustry.

Duties: The consultant will be attached to the Industrial Development and Consulting Bureau, and as a member of a team of international experts under the leadership of the Project Manager, will specifically be expected to:

1. Visist local importers and examine imports.
2. Assess present requirements for domestic and export markets as well as future potentials.
3. Prepare a feasibility study for setting up a factory for the production of synthetic fibers and textiles. The feasibility study should include:

   a) marketing of the products for local and export markets;
   b) advice on techno-commercial problems of establishing the plant, including location, appropriate capacity, engineering, raw materials, packing, energy, etc., and manpower requirements and organization;
   c) description of manufacturing process;
   d) description of machinery and equipment;
   e) tabulation of estimated project costs, estimation of working capital and suggested capital structure;
   f) estimation of unit costs of production and profitability statements for local and export markets and calculation of break-even analysis;
   g) recommendations for know-how and if necessary for future assistance.

The expert will also be expected to prepare a final report, setting out the findings of his mission and his recommendations to the Government on further action which might be taken.

QUALIFICATION

University degree in chemical engineering or chemistry with extensive experience in synthetic fibers and textile industries, and with experience in the preparation of feasibility studies.

LANGUAGE

English

BACKGROUND INFORMATION

The country is one of the major oil producing countries, revenues from oil constituting the majortity of the total revenues of the country. Diversification of its economy is an important objective of the country development policies. The substitution of nationally manufactured goods for imported products and the establishment of viable industries in this connexion are recommended.

A project for an aromatic-petrochemical complex in the country has been agreed upon. which should be able to supply a substantial part of the raw materials.

The Industrial Development and Consulting Bureau, which was established in 1973 in collaboration with the Ministry of Commerce and Indusgry and UNIDO/UNDP, is primarily concernéd with promoting investment opportunities in industry by identifying viable projects through carrying out feasibility studies and evaluating those submitted by local investors, as well as assisting the Ministry in other development objectives. Synthetic fibers and textile manufacture is a project among those identified by the Bureau for investigation.

Annex II

IMPORTS OF FABRICS AND NON APPAREL TEXTILE PRODUCTS

Table 1 - A 2
Textile Yarns and Thread of All Materials
classification 651.000

Years	Imports Tons	Imports 1000 KD	Exports Tons	Exports 1000KD	Net Tons	Net 1000KD
1972	182	131	86	31	96	100
1973	246	187	84	28	162	159
1974	216	253	71	23	145	230
1975	229	308	51	37	178	271
1976est	470	411	247	108	223	303

Table 2 - A 2
Woven Cotton Fabrics
Classification 652,000

Year	Imports Tons	Imports 1000KD	Exports Tons	Exports 1000KD	Net Tons	Net 1000KD
1972	1922	1624	1003	786	919	838
1973	2002	1887	705	682	1297	1205
1974	1580	2005	198	239	1382	1766
1975	1849	2386	130	161	1719	2225
1976est	2810	3433	633	777	2177	2656

Table 3 - A 2
Woven Silk Fabrics
Classification 653.100

Year	Imports Tons	Imports 1000KD	Exports Tons	Exports 1000KD	Net Tons	Net 1000KD
1972	25	236	-	-	25	236
1973	29	258	2	13	27	245
1974	10	185	-	-	10	185
1975	25	266	0.9	7	24	259
1976est	35	426	1	8	34	418

Table 4 - A2
Woven Woolen Fabrics
Classification 653.200

Year	Imports. Tons	Imports. 1000.KD.	Exports. Tons	Exports. 1000 .KD.	Net. Tons	Net. 1000.KD
1972	955	2442	83	94	872	2348
1973	975	3181	253	140	722	3041
1974	825	2825	41	96	784	2729
1975	1183	4012	29	236	1104	3775
1976est	791	2500	91	316	700	2184

Table 5 - A2

Linen Fabrics

Classification 653.300

Years	Imports. Tons	1000.KD.	Exports. Tons	1000.KD.	Nets. Tons	1000.KD.
1972	68	53	1	0.5	67	52
1973	15	15	-	-	15	15
1974	5	6	-	-	5	6
1975	2	8	0.7	0.8	1	7
1976	-	-	-	-	-	-

Table 6-A2

Woven Synthetic Fiber Fabrics

Classification 653.500

Years	Imports. Tons	1000KD	Exports. Tons	1000KD	Net. Tons	1000KD.
1972	673	1342	22	36	650	1306
1973	3311	6588	595	857	2716	5731
1974	3988	9417	214	471	3774	8946
1975	7037	14319	789	1701	6248	12618
1976est	10376	24,880	2369	4345	8007	20,535

Table 7 -A2

Woven Rayon Fabrics

Classification 653.600

Year	Imports Tons	1000KL	Exports Tons	1000KD	Net. Tons	1000KD
1972	4763	6768	767	690	3996	6078
1973	2674	3761	745	911	1929	2850
1974	1652	2757	195	351	1457	2406
1975	1615	2602	190	370	1425	2232
1976est	2606	3864	527	767	2079	3097

Table 8-A2

Artificial Fur. Fabrics

Classification 653.901

Year	Imports. Tons	1000KD	Exports. Tons	1000KD	Net. Tons	1000KD
1972	8	14	-	-	8	14
1973	17	26	1	1	16	25
1974	18	30	2	3	16	27
1975	26	37	4	9	22	28
1976est	21	36	3	4	18	32

Table 9-A2
Woven Fabrics N.E.S.
Classification 653.900

Year	Imports. Tons	Imports. 1000KD	Exports. Tons	Exports. 1000KD	Net. Tons	Net. 1000KD
1972	991	296	83	19	908	277
1973	125	38	63	11	62	27
1974	116	172	6	2	110	170
1975	282	102	52	16	230	86
1976est.	570	162	228	61	342	101

Table 10 - A2
Tulle and Other Net Fabrics
Classification 654.001

Year	Imports. Tons	Imports. 1000KD	Exports. tons.	Exports. 1000KD	Net. tons.	Net. 1000KD
1972	26	82	-	-	26	82
1973	13	35	-	-	13	35
1974	13	35	-	-	13	35
1975	6.	25	1.6	5.8	4	19
1976	-	-	-	-	-	-

Table 11-A2
Ribbon and Other Narrow Fabrics
Classification 654.002

Year	Imports. tons.	Imports. 1000KD	IExports. tons.	IExports. 1000KD.	Net. tons.	Net. 1000KD
1972	179	296	26	20	153	276
1973	69	141	1	2	68	139
1974	206	84	7	9	199	75
1975	103	269	5	8	98	261
1976est	127	318	19	25	108	293

Table 12-A2
Embroidery
Classification 654.005

Year	Imports. Tons	Imports. 1000KD	Exports. tons.	Exports. 1000KD	Net. tons	Net. 1000KD
1973	15	36	-	-	15	36
1974	8	44	-	-	8	44
1975	11	70	-	-	11	70
1976	-	-	-	-	-	-

Table 13-A2
Coated Textiles
Classification 655.400

	Imports.		Exports.		Net.	
Year	Tons	1000KDa	Tons.	1000KD	Tons.	1000KD
1972	625	199	85	14	540	180
1973	241	102	41	13	200	89
1974	201	416	15	7	186	409
1975	618	288	23	12	595	276
1976est	520	283	95	67	425	216

Table 14 - A2
Synthetic Fiber Rope
Classification 655.601

	Imports.		Exports.		Net.	
Year	Tons	1000KD	Tons	1000KD.	tons.	1000KD
1972	817	152	-	-	817	152
1973	437	128	144	40	293	88
1974	263	165	111	46	152	119
1975	523	237	109	44	414	193
1976est	615	184	260	95	355	89

Table 15 -A2
Vegetable Fiber Cordage.
Classification 655.615

	Imports		Exports		Net.	
Year.	Tons.	1000KD	Tons	1000KD	Tons	1000KD
1973	473	77	90	12	383	65
1974	479	119	79	18	400	101
1975	925	204	109	26	816	178
1976est	542	125	183	31	359	94

Table 16-A2
Nets of Cordage.
Classification 655.620

	Imports.		Exports.		Net.	
Year.	Tons.	1000KD	Tons.	1000KD	Tons	1000KD
1972	224	159	12	11	212	148
1973	151	114	3	3	148	111
1974	164	242	-	-	164	242
1975	238	282	9	10	229	272
1976est	193	222	185	140	8	82

Table 17-A2
Cotton Bags and Sacks
Classification 656.101

Year	Imports. Tons	Imports. 1000KD	Exports Tons	Exports 1000KD	Net. tons	Net. 1000KD
1973	273	561	47	2	226	559
1974	503	248	-	-	503	248
1975	278	132	37	2	241	130
1976	-	-	-	-	-	-

Table 18 - A2
Non Cotton Sacks and Bags
Classification 656.109

Year	Imports.m Tons.	Imports.m 1000KD	Exports.m Tons	Exports.m 1000KD	Net Tons	Net 1000KD
1973	4500	1269	934	91	3566	1178
1974	4711	1719	571	33	4140	1686
1975	3350	947	446	63	2904	884
1976est	3302	699	367	70	2935	629

Table 19-A2
Tarpaulins
Classification 656.201

Year	Imports. Tons	Imports. 1000KD	Exports. tons.	Exports. 1000KD	Net. Tons	Net. 1000KD
1977	289	75	1	0.3	288	75
1973	206	80	10	4	196	76
1974	361	131	19	11	342	120
1975	321	155	55	28	266	127
1976est	650	347	225	97	425	250

Table 20-A2
Tents
Classification 656.202

Year	Imports. Tons	Imports. 1000KD	Exports. Tons	Exports. 1000KD	Net. Tons	Net. 1000KD
1972	255	89	45	18	210	71
1973	270	119	32	11	238	108
1974	524	381	59	34	465	347
1975	947	674	60	50	887	624
1976est	1087	761	559	434	528	327

Table 21-A2
Blankets and Coverlets
Classification 656.800

Year	Imports. Tons	1000KD	Exports. tons.	1000KD	Net. Tons.	1000KD
1972	2553	1391	1407	517	1146	874
1973	2489	1571	1014	571	1476	1000
1974	2778	2317	959	673	1819	1644
1975	3964	3693	1315	1183	2649	2510
1976est	5307	5333	1992	1783	3315	3550

Table 22-A2
Towels
Classification 656.911

Year	Imports. Tons.	1000KD	Exports. Tons.	1000KD	Net. tons.	1000KD
1972	323	264	29	13	294	251
1973	376	334	84	64	292	270
1974	391	314	35	39	356	275
1975	575	671	64	81	511	590
1976est	536	663	90	90	446	573

Table 23-A2
Bed Linens and Table Cloths
Classification 656.912

Year	Imports. Tons.	1000KD	Exports. Tons.	1000KD	Net. Tons.	1000KD
1972	1446	1271	228	112	1218	1159
1973	1269	1364	534	446	735	918
1974	1134	1622	284	368	850	1254
1975	2036	2811	587	776	1449	2035
1976est	2938	3641	896	1016	2042	2625

Table 24 -A2
Curtains
Classification 656.919

Year	Imports. Tons.	1000KD	Exports. Tons.	1000KD	Net. tons.	1000KD
1972	422	518	4	5	415	513
1973	1	4	-	-	1	4
1974	5	17	2	3	3	14
1975	8	12	0.5	1	7	11
1976	-	-	-	-	-	-

Table 25 - A2

Other Made - up Textile Articles N.E.S.

Classification 656.929

	Imports.		Exports.		Net.	
Year	Tons	1000KD	Tons	1000KD	Tons	1000KD
1972	168	80	24	10	142	70
1973	515	197	84	29	431	168
1974	225	144	17	8	208	136
1975	233	183	17	12	216	171
1976est	215	213	22	12	193	201

Table 26-A2

Knotted Capets

Classification 657.500

	Imports.		Exports.		Net.	
Year	Tons.	1000KD	Tons.	1000KD	Tons.	1000KD
1972	419	656	64	83	355	573
1973	354	546	112	149	242	397
1974	331	566	73	123	258	443
1975	434	980	115	184	324	796
1976est.	988	1436	141	297	847	1139

Table 27 -A2

Rugs

Classification 657.601

	EImports.		Exports.		Net.	
Year	Tons	1000KD	Tons	1000KD	Tons.	1000KD
1973	189	88	66	27	123	61
1974	282	103	85	35	197	68
1975	188	92	22	18	166	74
1976est.	70 5	361	366	186	339	175

Table 28-A2

Other Carpets And Carpeting

Classification 657.609

	Imports.		Exports.		Net.	
Year	Tons.	1000KD	Tons.	1000KD	Tons.	1000KD
1972	3001	2352	374	220	2627	2132
1973	2467	2076	547	414	1920	1662
1974	3550	3092	665	562	2885	2430
1975	3746	3808	574	715	3172	3093
1976	6700	6303	1345	1815	5355	4488

Annex II A

IMPORTS OF CLOTHING

Table 1. A2A

Mens and Boys Outergarments

Classification 841.001

Years	Imports Tons	Imports 1000KD	Exports Tons	Exports 1000KD	Net Tons	Net 1000 KD.
1974	2809	7830	578	1110	2231	6720
1975	3841	10680	786	1478	3055	9002
1976est	4401	13000	1212	2486	3189	10514

Table 2 - A2A

Women, Girls and Infants Outergarments

Classification 841.002

Year	Imports. Tons	Imports. 1000K.D	Exports. Tons	Exports. 1000KD	Net Tons	Net 1000KD
1974	1558	6746	124	316	1434	6430
1975	2122	9496	259	6541	1863	8842
1976est	2786	11726	693	1439	2088	10287

Table 3 - A2A

Men and Boys Shirts

classification 841.003

Year	Imports Tons	Imports 1000KD	Exports. Tons	Exports. 1000KD	Net Tons	Net 1000KD
1973	782	1641	43	68	739	1573
1974	956	2622	98	194	858	2428
1975	1250	3220	75	155	1175	3065
1976est	1869	5648	258	571	1611	5077

Table 4 - A2A

Socks and Stockings

Classification 841.004

Years	Imports Tons	Imports 100KD	Exports Tons	Exports 1000KD	Net. Tons	Net. 1000KD
1973	226	506	27	37	199	469
1974	167	461	15	21	152	440
1975	257	644	12	20	245	624
1976est	237	539	14	27	223	512

Table 5 - A2A

Scarfs and Yashmags

Classification 841.007

Year	Imports Tons	Imports 1000KD	Exports Tons	Exports 1000KD	Net Tons	Net 1000KD
1973	290	739	108	177	182	562
1974	213	555	21	48	192	507
1975	277	617	54	148	223	469
1976	323	815	78	219	245	596

Table 6. - A2A

Other Clothing

Classification 841.009

Year	Imports. Tons	Imports. 1000KD	Exports. Tons.	Exports. 1000K.D.	Net. tons	Net. 1000KD.
1974	1721	4471	357	614	1364	3857
1975	2308	5700	476	758	1832	4942
1976	3130	7638	1281	2144	1849	5494

Annex III

ADJUSTED IMPORTS OF FABRICS AND NON APPAREL TEXTILE PRODUCTS AND CLOTHING
Table 1-A3

Imports of Fabrics and Non-Apparel Textiles in 1976.

Classification	Product	Imports tons	Factor %	Corrected Imports Weight Tons
651.000	Textile Yarn	470	87	410
652,000	Cotton Fabrics	2810	87	2440
653.100	Silk Fabrics	35	87	30
653.200	Woolen Fabrics	791	87	690
653.300	Linen Fabrics	3	87	-
653,500	Woven Nylon	10376	87	9030
653.600	Woven Rayon	2606	87	2270
653.901	Artificial Fur Fabrics	21	87	20
653,900	Woven Fabrics NES	570	87	500
654.001	Tulle and Net Fabrics	2	87	-
654,002	Ribbons & Narrow Fabrics	127	87	110
654.002	Embroidery	15	87	10
655,400	Coated Textiles & Products	520	52%	270
655,611	Cordage of Syn Fibers	615	95	580
655,615	Cordage of Veget Fibers	542	95	510
655,620	Nets of Cordage	193	95	180
656.101	Cotton Bags	375	95	360
656.109	Non Cotton Bags	3302	95	3160
656.201	Tarpoulins	650	95	620
656.202	Tents	1087	95	1030
656.600	Blankets Coverlets	5307	93	4940
656.911	Towels	536	93	500
656.912	Bed Linens	2938	93	2730
656.919	Curtains	11	87	10
656.929	Textile Made up textiles	215	94	200
657.500	Carpets Knotted	988	93	920
657.601	Rugs	705	93	660
657.609	Other Carpets			
	Tufted			1780
	Woven			2890
	Totals			36850

Table 2.A3

Imports of Clothing in 1976

Classification	Product	Imports tons	Corrected Imports. Factor %	Corrected Imports. Weight Tons
841.001	Men & Boys Outerwear	4401	94	4140
841.002	Women & Children Outerwear	2786	94	2620
841.003	Men & Boys Shirts	1869	94	1760
841.004	Socks & Stockinap	237	94	220
841.007	Mens Scarfs	323	94	300
841,009	Other Clothing	3130	94	2940
			Total	11.980

ANNEX 4

MELT SPINNING PROCESSES

Melt spinning, the process of converting molten polymers into synthetic fibers, was developed by the team working under the brilliant chemist, Wallace H. Carothers, at the duPont Company in Wilmington, Delaware, in the mid to late 1930's. In the short time since the first introduction to the trade in the post war period melt spun fibers have dominated the fiber world and in the United States, for example, the production of melt spun fibers in 1977 was 2,470,000 tons or slightly more than twice the consumption of cotton. There are two types of melt spun synthetic fibers, staple and continuous filament, and each type requires its own special type of equipment. However, staple equipment within certain limitations can produce either polyester, polyamide or polypropylene staple and similarly continuous filament equipment can produce either nylon, polyester or polyproplyene fibers. Although the principles and the general type of equipment are the same these changes can not quickly be made so that in the true sense of the interchangeability of fiber type the plants are relatively fixed. This is particularly true where special plants have been built for a given specific fiber to meet the competitive prices now existing in many parts of the world.

To give some concept of the problems involved the relative sizes of the products should be outlined. The older but still widely used term to describe the size of a fiber is denier. This is the weight in grams of a single fiber or filament 9000 meters long. Normally staple blended with cotton will be 1.5 denier with wool 6 denier and for most carpet staple about 15-20 denier. For cotton blends the yarn strength for yarns produced on equipment capable of converting cotton into yarns is dependent upon the length of the cotton type used and could be 38 mm long. Thus, one Kg of a single fiber suitable for blending with cotton prior to cutting would be 6,000 kilometers long and one Kg of staple fiber after cutting would contain 1.58 X 10^8 fibers and each fiber would be 38 mm long. In contrast, continuous filament fibers or yarns are, in reality, bundles of single filaments and the denier of the yarn is the total weight in grams of 9000 meters of all of the single filaments in a bundle. A common nylon yarn used for many apparel fabrics is designated 70/34. This means that 9000 meters of the yarn would weigh 70 grams and that there are 34 filaments in each bundle of yarn and each single filament would have a denier of 70/34 or about 2.

It should be recalled that each single filament either in staple or in continuous filament yarns must be produced from an individual hole in a metal plate called the spinnerette. The method of final packaging of staple and continuous filament yarns differ because of the textile industry equipment developed to handle the two products. The final package for staple is a bale which may contain 225 Kg or more of these fine, short fibers with a random arrangement of the fiber. The final package for a continuous filament yarn is a bobbin, tube or pirn of yarn in which one continuous filament yarn is wound in a controlled precise manner on the yarn holder. The method of placing the yarn on the package is analogous to that used in a casting reel for fishing except that the packaging speeds can be as high as 4000 meters per minute.

In the STAPLE process molten polymer either directly from a continuous polymerization unit or an extruder is fed through a pipe distribution system, known as a spin block, in which the polymer temperature is precisely controlled by a Dowtherm heating system, to a number of high temperature gear pumps. Each pump is driven by a synchronous motor so that each pump is driven at exactly the same controlled speed and each pump delivers exactly the same volume of polymer. Inserted into the spin block are the so-called spin packs which contain some method of filtering the polymer, usually some arrangement of various sized sands or wire screens or various sintered metal disks, a breaker plate to distribute the polymer at a constant pressure to the spinnerette and a spinnerette. The latter is a thick metal plate containing thousands of counter bored holes arranged in a precise pattern. The size of the holes is fortunately much larger than the final cross section dimensions of the fibers. In most cases the fiber cross section is round but in some cases delta or multilobal cross sections are required and the manufacture of these spinnerettes has required very high skills. Similar precision techniques are required to manufacture the interchangeable parts for the precise gear pumps. Since the viscosity of these molten polymers is quite high and since viscosity usually doubles with each 10°C drop in temperature the precise control of temperature is important to insure fiber uniformity. Furthermore, the spinning temperatures of most polymers is within a few degrees of the polymer decomposition point so that the design of the spin block has been developed to minimize polymer residence time in the molten condition.

On emerging from the spinnerette hole into atmospheric pressure the polymer will relax and form a melt pool on the spinnerette surface similar in shape to a carrot. The polymer is drawn off from the pool by two precisely driven metal rolls known as godets located at least one and frequently two stories below the spinnerette surface. The fiber passes around the lower roll and up to the second roll located about a half meter above the bottom roll. Both rolls are driven at the same speed by synchronous motors but the upper godet usually has a circumference approximately 3% greater than the lower to insure adequate contact between the roll and the yarn. Since the gear pump is metering a constant volume of polymer to the spinnerette and since the godets are withdrawing the fiber at a constant speed from the spinnerette face, the volume of polymer extruded and the speed with which it is withdrawn will determine its denier. Since fiber spinning requires multiple units fiber uniformity demands that the speeds of the pumps and the godets remain the same. In order to ensure this sophisticated and costly drive systems are required.

As indicated the fibers are molten as extruded and to preserve their identity they must be cooled below their sticking point before they are allowed to touch. Since spinning speeds are high, in order to reduce costs and range from 600 to 1000 meters per minute, the fibers are normally cooled by a carefully controlled and uniform stream of air blowing normal to the fiber stream in a chamber known as the quench chamber. Usually these chambers are about 150 to 180 cm high and are located immediately below the spinnerette. After leaving the quench chamber the fibers enter a large pipe or "stack" leading to the godet rolls previously described. On leaving the "stack" the fibers are sufficiently cool so that they can be allowed to touch without sticking. Before reaching the godets the fibers are collected by a guide into a flat band or ribbon and pass over a ceramic kiss roll which applies the fiber "finish". The "finish" for most melt spun fibers consists of an emulsion of a high grade mineral oil containing a quaternary ammonium compound as an antistatic agent. The temperature and humidity of the quench air is usually controlled. Generally for nylon steam is introduced in the "stack".

On leaving the upper godet the fibers normally pass under an idler roll located about 75 centimeters below the upper roll and on to the next spinning position where it joins a similar group of fibers coming from that spinning position. The distance between the spinning positions is, of course, governed by the design of the spin block. In many cases in staple spinning this distance will be 60 to 75 cm. The number of spinning units will in turn be governed again by the design of the spin block but usually these will be limited to no more than sixteen and frequently as low as eight in one spinning unit.

The "as spun" yarn from the several spinning positions is pulled under the idler rollers by a set of pinch rolls as part of the can plaiter. The can plaiter is automatic and lays the fiber bundle in a large metal can at spinning speeds of up to 1000 meters/min in a manner so that the bundle can later be removed from the can without entangling. When the can is full the plaiter automatically transfers the fiber bundle to an empty can. The cans are quite large and may hold as much as 250 Kg or more.

The polymer is fed to the spin block either by large extruders supplied with polymer chip or by forwarding augers receiving molten polymer from the continuous polymerizers. From that point until the plaiter cans must be removed the process is continuous. When the spinnerettes or spin packs become partially blocked by dirt or polymer gel particles they must be changed. For polyester pack life without changing can be as long as two weeks.

As mentioned earlier the as spun fiber has inferior properties and must be stretched in order to obtain the desired physical properties. Stretching large bands of fibers can be accomplished by means of two sets of seven roll godet stands operating at different speeds. The individual rolls in the seven roll stands are placed in two horizontal rows of four and three and the band of fibers laced over the surface of these rolls. The rolls are staggered in such a manner that the band is in contact with as much of the surface of the roll as possible. Experience has shown that the friction developed between the yarn bundle and the surface of these large rolls is sufficient to prevent fiber slippage. The fiber passes through a slot oven to another seven roll stand operating at a speed fixed between 3 and 5 times as fast as the first set. Under these conditions the fiber is stretched or drawn and the so-called draw ratio is determined by the ratio of these two speeds. Usually this ratio is around 4 but may vary somewhat depending upon the actual spinning conditions used in preparing the as-spun fiber.

In practice, the cans from the fiber spinning machine are placed in a prearranged pattern in front of the first seven roll stand and the fiber from each can placed in its individual opening in an eye board to form a fiber ribbon. The fiber is pulled from the cans by a set of pinch rolls to a three roll stand which is a pretensioning device to ensure that the fiber band is in good contact with the rolls on the first seven roll stand. Frequently, the drawing may be done in two stages and a third set of draw rolls and a second oven used. Finally, in some cases a three or five roll stand with another oven and operating at a somewhat lower speed than the previous set is used. This permits the fiber band to shrink or anneal. In the drawing operation the fiber should be at a temperature above its second order transition point and is usually about 90-120°C. Annealing temperatures are substantially higher.

After leaving the annealing section the fiber, although it has most of its desired physical properties, is straight and would not process on either cotton or wool processing equipment and must be crimped. The zig-zag shape is imparted by a stuffing box crimper in which fiber is forced by rollers into a confined space at a rate greater than it is released and is forced to assume the desired zig-zag shape. Depending upon the amount of finish imparted during spinning additional finish may be added at this point. After crimping the crimped fiber is plaited onto the moving belt of a drier where the crimp is heat set and the fiber dried. After air cooling the fiber is cut into the desired staple length and blown to an automatic baler for baling. The bales are wrapped in polypropylene woven fabric and weigh usually about 225 Kg.

The process can be continuous from the plaiter cans through to the baler. In the larger installations TPA and EG are fed into a continuous polymerizer which in turn feeds molten polymer into the spin blocks and no labor is required until the as-spun fiber reaches the plaiter cans. Thus, the process is interrupted only once. Under these conditions labor demand is very low and this process is particularly suitable for high labor cost countries and for large high volume markets.

The textile industry processes for using <u>CONTINUOUS FILAMENT</u> yarns depend upon the ability to unwind a continuous filament yarn from a yarn package with minimum change in unwinding tension. This means that one yarn must be carefully and precisely wound on one package. Although the same general principles of melt spinning apply the equipment differs substantially from staple equipment. These differences are largely differences in size and in packaging.

As in staple each filament must be extruded from an individual hole in such a manner that it will not touch another fiber before it is cool and, in addition, the holes must be grouped in such a manner that the exact number of filaments required for the yarn can be readily separated from another group. This means that there is a physical limit to the number of individual fiber bundles which can be separated from any given spinnerette. Furthermore, each end must be wound separately which further complicates the picture. Gear pumps have been built which can meter 4 streams simultaneously which would mean that each metered gear pump stream could theoretically supply a spinnerette with two different yarn bundles and theoretically each spinning position could produce 8 continuous filament yarns. For finer denier yarns this has been accomplished but the associated problems are substantial and a maximum of 4 ends per spinning position for textile denier yarns is more practical. Thus, in our example of 70 denier yarns each spinning position would produce a maximum of 560 denier and more probably 280 denier yarns whereas a staple spinning position could produce 3000 to 6000 denier or even more depending upon staple denier. It is true that continuous filament spinning speeds could be higher than staple but they would have to reach 10 to 12 times as fast to give the same production rate.

In the normal processes for producing continuous filament textile denier yarns the as-spun yarn is wound on an individual package. When the package is full each individual yarn must be transferred to an empty package. Package weight depends upon the number of ends per position but could be from 4 to 10 or 12 pounds.

The individual package of as-spun yarns must then be drawn on a draw twister or drawinder and each individual end again packaged. Draw twisters or draw winders are devices carefully designed to minimize space requirements in which one or two stage drawing followed by an annealing section can be used. Each yarn would thus require two or three godets with an idler roll for at least two of the godets.

The difference between draw twisters and draw winders reside in the fact that draw twisters impart a slight twist to the yarn using a ring-traveler-spindle arrangement for packaging whereas draw winders package an untwisted or flat yarn. Draw winders typically use some type of an entangling device to prevent the individual filament from spreading or becoming "wild".

Just as in the staple process the yarn spinning process for continuous filament yarn is interrupted at the as-spun fiber stage. Since the draw ratio is usually around four the winding speed would have to be four times as fast as the spinning speeds which would mean a winding speed of up to 4000 meters. For a draw twisting or draw winding process the number of draw twisting or winding positions must be at least four times the number of spinning positions at equal spinning and drawing speeds. Since drawing speeds are usually somewhat slower the number of drawing positions may more likely approach 5 or more times the number of spinning positions. This imposes a very high capital and labor cost on interrupted continous filament processes.

The most recent process for producing continuous filament yarns involves the so-called spin draw process. For many years the upper speed limit to package continuous filament yarns was about 1000 meters/minute. For these reasons the interrupted process was used. In the newer spin draw process the yarns are extruded as before and are stretched and/or annealed using a series of high speed godets and finally packaged at up to 4000 meters/minute without interruption. As might be expected equipment capable of winding at such high speeds, 240 kilometers per hour, is expensive. However, in high labor cost areas this capital intensive equipment must be considered. For Kuwait such equipment is essential for textile denier yarns.

As discussed in the TEXT polyester yarns are used in the single and double knit industry using so-called texturized yarns.

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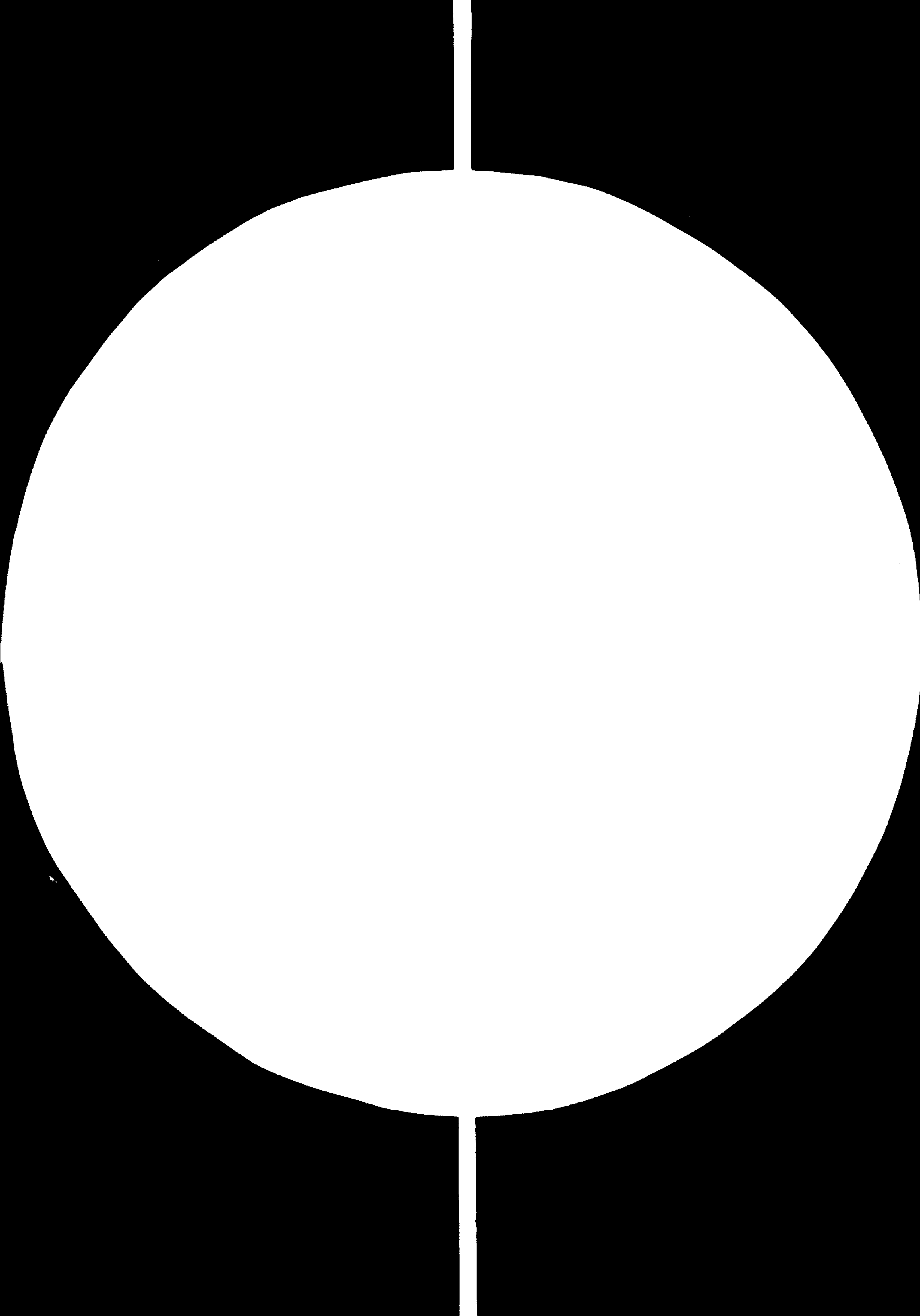

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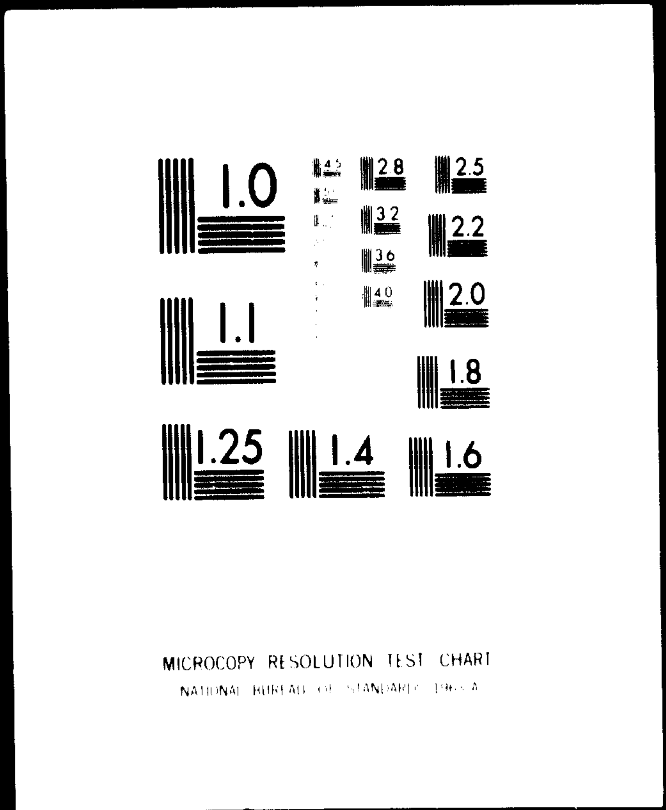

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These are yarns which have been given a high degree of twist and then heat set in this highly twisted or coiled form. On twist release the yarns will remember their heat set shape and will tend to return to that shape. The texturizing process on fully drawn yarn is very sensitive to yarn properties and the industry now favors the use of partially drawn yarns which are drawn in the texturizing process. These so-called POY, partially oriented yarns, can be readily produced in spin draw processes.

Industrial yarns, particularly tire cord yarn, require high strength. This demands higher molecular weight polymers as well as a high degree of orientation in the yarn. Such high strengths require maximum orientation under controlled conditions. Fortunately, however, the yarns are usually 840 denier or higher which leads to more efficient and productive use of equipment than textile denier yarns.

In a similar manner BCF yarns (Bulked Continuous Filament) for carpets and upholstery demand a carefully controlled texturizing process. Again yarn deniers are high so that yarn costs can be reasonable. Yarn deniers for carpets are normally in the range of 1200 to 3600 denier with individual filaments usually around 15. For polyesters continuous filament yarns, with the exception of tire cord, most continuous filament yarns are about 150 denier and are used in false twist texturing.

ANNEX 5

SPUN YARN PROCESSES

The estimation of spun yarn costs has been made by Rieter, AG of Winterthur, Switzerland. Unfortunately, for reasons beyond either their or our control, the computer analysis has been delayed by the late arrival of the necessary information and this section has been written prior to the receipt of their detailed estimation. For that reason this section will describe general methods of preparing cotton polyester blend yarns. Cotton fibers have many desirable features and with the development of the cotton gin have been the fibers of choice for most textile applications. However, they do have several serious weaknesses including low wet abrasion strength and poor wrinkling characteristics. It is not generally recognized but most cotton shirts fail because of abrasion during laundering and nearly any housewife will attest to the problem associated with ironing all cotton fabrics. Polyester staple has excellent wet abrasion properties and the use of polyester cotton blend fabrics, coupled with resin treatment, has minimized the wrinkling problem. The "wash and wear" concept is almost a reality but for many applications it may be more accurately described as "Machine wash, tumble dry, touch up and wear".

For most applications the preferred blend levels are 65-50% polyester and 35-50% cotton. Higher polyester blends of 80% have been used and with the aid of some promotional advertising funds from the National Cotton Council in the U.S., one large U.S. shirt firm has been promoting a 35-65% polyester cotton shirt but without marked success. Cotton has a real function in the blend since the resin used to minimize the "messy" appearance of the fabric is ineffective on polyester. Hence this section will be devoted to the more commonly used blends ranging from 50-65% polyester.

The spun yarn system has long been developed for the long staple fibers such as flax or linen and wool and the familiar picture of the woman busily engaged in spinning yarns with a spinning wheel is well known. The process for handling short staple length fibers such as cotton is fairly new and dates from the early 1800's. In some manner the random arrangement of staple fibers found in the bale must be converted into a controlled weight, more or less parallel array of fibers and finally twisted under controlled conditions (spun) to give the desired yarns.

As received in the bale the cotton fibers mixed with more or less vegetable trash, immature fibers and short fibers are randomly arranged. Many of the fibers have not been completely separated and may exist as clumps or tangles. As expected from a natural fiber produced under many conditions and with many varieties of cotton fiber, uniformity is relatively poor. An elaborate cotton grading system has been developed and the price of cotton will vary with the grade and type. After opening the bales of cotton the Rieter Company and others have developed an elaborate system of removing a controlled portion of cotton from each bale to give a more uniform cotton supply. Brochures to be received from Rieter will show pictures of this equipment. Staple length of cotton is frequently about 4.75 cm. If the cotton is of particularly lower quality it is "opened", a process of taking clumps of compressed fiber from the bale and essentially pulling at these clumps with metal fingers and air conveying it to the next step, the "picker". In this step the fiber, which has been partially separated and from which some trash has been removed, is fed to the picker. This device, which fluffs the fiber and air conveys the fiber to the next position within the picker, permits the heavier trash to fall out and thus be separated from the desired cotton fibers. The end product from the picker is the so-called picker lap. This is a fluffly mat or batt of cotton fibers from which the trash has been removed. The fibers in this fluffy batt are randomly arranged.

The next step in the process is to convert the randomly arranged fibers in the batt into parallel array of fibers. The equipment which does this is called a card and the process is called carding. Essentially it is a combing operation. The card consists of a large metal cylinder about 120 cm or more in diameter which has been covered with a fine metal cloth containing thousands of wires. At the top of the card is a series of movable boards or flats which are covered again with wire cloth. These flats move slowly in a direction counter to the direction of the high speed rotating cylinders. A controlled weight of fibers is fed continuously to the card and removed continuously. The net result of this operation is that the average fiber in moving through the card is subject to thousands of combing actions so that it eventually is parallelized. Tangled masses of fibers which can not be parallelized cling to the slowly moving flats and are eventually removed and the staple fiber coming from the card are relatively clean.

The fibers are removed from the card by a doffing comb or stripper roll and are in the form of a very fine uniform web whose width is the same as the width of the card clothing. The web is gathered together by the "trumpet" located about a meter in front of the card and perhaps 30 to 40 cm below the middle of the doffing comb. The wide end or bell of the trumpet faces the card. During its unsupported passage from the doffer to the trumpet the fibers are held together by frictional force derived from the crimp in the fiber and the amount and type of finish. Synthetic fibers are processed in a similar manner and it is for this reason that control of these factors, crimp and finish levels, in the fiber making step is so important. Since the fibers are subjected to so many combing actions in the card static charges would be developed and the highly charged unsupported web would be attracted to other metal parts of the card. Polyester finishes, therefore, contain an anti static agent and the card room is normally controlled at high humidity levels to dissipate any charges which are developed in the carding operation. The condensed fiber web is drawn away from the trumpet by a pair of rollers and is led to a large rotating fiberboard can into which the fibers are coiled by the coiler. At this point it is known as card sliver and is a rather thick rather fluffy cylindrical bundle of fibers in which the fibers are parallel to the long axis of the cylinder.

For the finer yarns the card sliver may be combed to further remove any tangled masses of fibers which may have passed through the card as well as any short immature fibers which are present.

If the web coming from the card was perfectly uniform the sliver would be of uniform weight. Any differences in sliver weight would immediately show up as non uniform final yarn. From long experience it is known that it is impossible to absolutely make certain that the web is perfectly uniform. For this reason four or more card slivers are fed to equipment in which the weight per unit length is drawn down. By combining four or more slivers with a distribution of weights and drawing down to some smaller weight, on a statistical basis the thick and thin spots should eventually even out. If this doubling or quadrupling is carried out several times the uniformity of the final product should be greatly increased. The number of such doubling actions is, of course, dependent upon the uniformity of the card web produced and the yarn count. The products at various stages of this averaging process may be given several names but the products at the final step prior to spinning and which have a low twist are called rovings.

The product is now ready for the final conversion into spun yarn. Depending upon the size of the yarn desired two ends of uniform parallel arrays of fibers from the previous section may be drawn down by removing the product at a faster rate than fed and the drawn down parallel array of fibers with essentially no strength is converted into a twisted spun yarn by means of a ring-spindle system. This system uses a supported ring in which the ring can slowly move up or down in a controlled manner. The ring is fitted with a metal "traveler" which is free to move around the circumference of the ring. The ring is moved in a controlled manner up and down around a spindle rotating at a high speed and located at the center of the ring. The parallel array of fibers coming from the drawing system is fed to the spindle but under the traveler. Under these conditions the twist in the yarn is controlled by the speed with which the fiber array is fed and the rotational speed of the spindle. The spindle is fitted with a yarn holder or bobbin and the traverse movement of the ring up or down determines the lay of the twisted yarn on the spin bobbin.

Production of the ring system of spinning is low. Rotational speeds are now approaching the ultimate. Newer systems of spinning speeds have been developed using rotors and known as open end spinning. However, these open end yarns have certain quality deficiencies which make them less desirable for the finer yarns. In general open end yarns are more "hairy" than similar ring spun yarns.

The writer made a special trip to visit the Rieter Company in Winterthur, Switzerland after completing his stay in Kuwait and prior to his debriefing in Vienna. Their analysis as well as certain descriptive matter is found in Annex 9 and will detail the exact process used in preparing the spun yarn.

ANNEX 6

FABRIC FORMING AND FINISHING PROCESSES

One of the more popular dishdasha fabrics sold in Kuwait is a fabric labeled T-120 made by Nisshin Spinning Company of Japan using a 65-35 blended polyester-cotton yarn. The yarn uses Teijin polyester staple. The fabric is sold in individual packaged 10-yard (9.15 m) bolts. The fabric is sold as a 36 inch (91.4 cm) wide fabric. The actual finished width of the fabric purchased was 36.25 inches. The fabric has a 0.5 cm selvage on each side and the fabric had been pin tentered. The printed package stated that the fabric had been pre-shrunk and resin cured. The fabric was purchased at retail in the souks and sold for 6.75 KD or 738 fils per meter.

Since no textile laboratory equipment was available the assumption was made that the polyester staple was 1.5 denier X 1.5 inch (3.8 cm) long. Twist count was unknown. The weight of the fabric per running or linear meter was 103 g. It was assumed that resin add on was 5%. Under these conditions 2000 tons of fabric would theoretically require 1210 tons of polyester and 650 tons of cotton.

The actual number of yarns in a cross section of the fabric was counted using very crude equipment and the construction roughly estimated at 35. X 35. end per centimeter in each direction. From visual observation the warp and fill yarns appeared to be equal in size and the assumption was made that the same yarn was used in both directions. From these conditions the yarn size was calculated as a 40 cc yarn and the Rieter Company was asked to estimate yarn costs based on this yarn count. It must be emphasized that the cost data for both yarn preparation and fabric preparation and finishing are for a hypothetical dishdasha fabric prepared under the conditions specified. Before placing great reliance on these figures a detailed analysis of the various dishdasha fabrics sold in Kuwait and the Gulf area should be made. These fabrics should be carefully analyzed and the actual cost of preparation of the various fabrics estimated. The conclusions of this report are based on the yarn size and the methods of fabric preparation outlined and probably do not represent all of the qualities available in the Kuwait market. The estimates can be used qualitatively as indicative of potential costs.

The problems of estimating plant costs become quite complicated since it means essentially designing the entire plant and its operation. For the plant to produce dishdasha fabrics the very minimum processes involved include the following steps in sequence winding, creeling and section beaming, sizing and loom beaming, weaving, fabric inspection, desizing and washing, resin padding and tentering, final inspection and packaging and warehousing. For each of these steps it requires an estimation of the practical speed with which these processes can be run, the total number of production units required, the working space required for each unit and process, the number of workers required to operate each process, the cost of each major piece of equipment and the supplies and spare parts required for each process. These calculations and estimations are far too complex and detailed to be reported here. It is planned, however, in this section to describe in some detail the general types of equipment involved in the various processes. For rather obvious reasons time did not permit similar analysis of fabrics other than dishdasha fabrics but this is part of the recommendations for future studies which will be required at a later date.

The yarn as produced as described in the previous yarn preparation section is on bobbins, the yarn packaging unit in ring spinning. In this packaging form, which is the preferred efficient packaging form for the high cost ring spinning system, the yarn is not suitable for use in other subsequent textile processing steps and must be rewound into suitable packages. For the next processing step for warp yarns this requires the use of yarn on a cone while pick or weft yarn can use a tube package. For efficient creeling and beaming each package should contain some multiple length of the loom beam. For example, if the loom beam contains 5000 meters of yarn (ie each beam could produce 5000 linear meters of fabric) and if we establish this preferred multiple as 20 each warp yarn package should contain 100,000 meters of yarn. For the dishdasha yarn each warp yarn package should contain about 1.5 kg of yarn. For pick yarns a metered yarn package is not required. In addition to changing package form each rewound package will contain yarn from several spin bobbins so that the operators must tie ends together.

The rewinding machines are efficiently designed machines with 60 or more multiple units. Each unit is designed to produce a package which is identical to that produced by another unit. In order to conserve required floor space the units are arranged very compactly. These are precise but yet surprisingly rugged machines when it is considered that rewinding speeds of 400 meters per minute with an upper limit of about 1200 meters per minute are possible.

In weaving the yarns running the length of the fabric or the machine direction are known as warp yarns while the yarns running across the fabric are the pick, fill or weft yarns. These yarns complete the full fabric when interlaced. The supply package of warp yarns for the loom is a large metal spool on which the many ends are precisely wound. This metal spool is called a beam and the process of preparing these beams of warp yarns is known as warping or beaming.

In the loom beam for weaving as envisions each loom beam will contain sufficient warp yarns for three fabrics and each fabric will be about 91.5 cm wide and contain 3240 ends. This is the hypothetical dishdasha fabric. In order to prepare this loom it is envisioned that a smaller beam known as a section beam will be first produced. This section beam may contain up to 3240 ends but will probably be much smaller. The machine which prepares the sectional beams is known as a beamer and is analogous to a large fishing reel. However, instead of winding one fishing line the beamer will be winding many yarns simultaneously. The traverse motion of the beamer only spreads each individual yarn over a small section of the beam. The entire beam is full, however, because of the high number of ends which are being wound.

The device holding all of the yarn cones is known as a creel and the process of putting the packages on the package holders is known as creeling. For the proposed dishdasha fabric 3240 warp yarns per fabric will be required and the creel must contain the same number of holders as the number of ends on the section beam. Usually the creel design is such that each post in the creel has as many holders per post as can be conveniently loaded. Since operators must be able to place a yarn package on each holder the arrangement of the creel must be carefully planned to minimize floor space.

In addition each end must be carefully wound on the beam with controlled tension. If the tension is lower on some ends than on others the woven fabric will have a puckered appearance. For these reasons each package has a yarn tensioning control device and the beamer is located some distance from the creel front to minimize the angle the yarn must travel from the outermost posts of creel to the beamer. In addition, each yarn passes through a drop wire arrangement which, if one end breaks or runs out, will automatically stop the high speed beamer before the broken end is wound on the beam and lost. Such a broken end would cause a serious weaving defect in the resulting fabric and would cause serious tangling problems as well.

In weaving the fly shuttle holding the pick yarn or the grippers holding the yarn in shuttless weaving pass over alternate warp ends of yarn in simple fabric patterns such as the dishdasha fabrics. This movement, as well as that of the reed tends to scuff spun yarns and forms small clumps or balls of fibers. In severe cases of scuffing these clumps can be woven into the fabrics causing fabric defects. The technique which has been developed for spun yarns is to coat each warp yarn with a starch or other temporary adhesive solution which on drying stiffens the yarn and ties down the loose fiber ends in the warp yarns. The process of adding some protective agent to the warp yarns is known as sizing and the process of drying the sized yarns prior to weaving is known as slashing. Normally slashing is accomplished by passing the warp yarns over rotating steam heated large rolls or "slasher" cans. Sectional beams can be combined at this point to form a loom beam.

As envisioned weaving for dishdasha fabrics will use 130 inch (330 cm) Sulzer shuttless looms. Three fabrics will be woven at the same time. Normally pick insertions in these looms are at rate of 240 picks per minute. At these rates each loom can produce about 4.1 linear meters of fabric per hour. Weaving is essentially a slow process from the standpoint of linear meters of fabric produced per hour and for this reason weaving of multiple fabrics is important. From the rate at which yarn is being introduced into the fabric the speeds are relatively high. Calculations show that this is at the rate of about 40 kilometers per hour for dishdasha fabrics.

In the weaving process yarns coming from the loom beam are continuously unwound under controlled tension. Each end passes through the eye of a heddle controlled by a so-called harness. At each pick alternate heddles move upward and the pick inserting device inserts the pick between the two layers of warp yarns. At the next pick insertion the relative positions of the alternate heddles are reversed and consequently the alternate up and down pattern of simple woven fabrics is produced. In addition, each pick is pushed tightly against the preceeding pick between pick insertions. In these fine fabric constructions the high number of pick insertions increases weaving costs.

The cost of looms is the largest single capital item in the weaving plant. The number of looms required on an 80% operating efficiency level is 237 and at an estimated price of 18000 KD ex works this is a major expense item. The cost of Swiss looms has risen dramatically. As recently as late 1976 the cost for a 388 cm loom was as low as 12,300 KD and it has been estimated that a 330 cm looms chould have cost no more than about 10,500 KD. It is impossible to predict plant costs using Swiss made equipment until the dollar has stabilized. The dramatic change in exchange rates has caused an increase in equipment costs of 20% in four months.

After weaving the sizing material must be removed and this is normally done by enzymatic action and is followed by washing.

The presence of sizing materials in textile plant effluent adds considerably to the BOD load. Fortunately new high efficiency washing machines have been developed in recent years in which only about 0.6 Kg of wash water are required per Kg of fabric washed. These types of machines are particularly recommended for Kuwait.

Normally "as woven" fabrics are inspected. If defects which can be readily repaired are noted these repairs are made at this point and the damaged fabric upgraded to some secondary use.

After bleaching and washing specially designed textle resins are padded onto the fabric and the resin treated fabric cured in a pin tenter. In this device the fabric selvages are pinned to a moving chain. The width between the chains can be adjusted so that the fabric is dried and the resin cured under tension. Ovens through which the tenter chains pass are either steam heated or direct gas fired.

After inspection and calendering the fabrics will be individually wrapped in bolts of predetermined length and then sold directly to customers or warehoused.

The bed linen market is somewhat more complex. Two general types of products are used in Kuwait. The more expensive product is a percale sheet which contains about 180 threads per square inch while the muslin product contains about 130 threads per square inch. In addition, the products are available for twin, double, queen and king sized beds. Many of the percale sheets are solid colored, printed or have embroidery on the hem of the top sheet. In addition, fitted bottom sheets are available. It was estimated that the percale sheets were made from 40 cc yarn in the warp direction and 24 cc yarn in the fill direction.

Time did not permit an estimation of the cost of producing these several products and it is one of the recommendations of this report that such a study be undertaken. It should be noted that bed linens will require a sewing operation in order to hem the sheets or to make the bottom fitted sheet. This is a very large market and the fabrics can be woven on Sulzer looms. Since sheets are so wide it is only possible to weave multiple selected fabrics on extra wide looms and generally the narrower looms are preferred.

Annex 7.

Partial List of plants and Equipments for Synthetic Fibers and Textiles.

The list of suppliers to the synthetic fiber and textile industries is enormous and can not be even partially covered in this report. The submmitted list by no means indicates that all of the required equipment can be supplied by these vendors. However, these companies are representative of some major suppliers. The writer does not have a complete list of addresses with him and for that reason the reader is referred to other sources for correct addresses.

Synthetic Fiber Plants.

1. LURGI APPARATE - TECHNIK GMBH
FRANKFURT - AM -MAIN
FEDERAL REPUBLIC OF GERMANY

2. ZIMMER AG.
BORSIG ALLEE
FRANKFURT-AM-MAIN
FEDERAL REPUBLIC OF GERMANY

3. KARL FISCHER AG.
WEST BERLIN

4. CHEM TEX
NEW YORK. NY.
U.S.A.

EQUIPMENT SUPPLIERS FOR SYNTHETIC FIBERS

1. BARMER MASCHIENEN FABRIK
   REMSCHEID. (NEAR COLOEGE)
   FEDERAL REPUBLIC OF GERMANY

2. NEUMAG
   (NEAR HAMBURG)
   FEDERAL REPUBLIC OF GERMANY

3. RIETER AG
   WINTERTHUR
   SWITZERLAND.

4. LEESONA MANUFACTURING CO
   WARWICK R.I.
   U.S.A.

EQUIPMENT SUPPLIERS YARNS PREPARATION

1. RIETER AG.
   WINTERTHUR.
   SWITZERLAND.

2. PLATT. GROUP
   MANCHESTER.
   UNITED KINGDOM

3. SACO-PLATT GROUP
   GREENE VILLE S.C.
   U.S.A.

4. WHITIN MANUFACTURING CO.
   CHARLOTTE N.C. AND
   WHITINSVILLE MASS.
   U.S.A.

EQUIPMENT SUPPLIERS WEAVING AND FINISHING

1. SULZER. BROS
WINTERTHUR.
SWITZERLAND.

2. DRAPER. MFG. DIV.
N.AMERICAN ROCKWELL CORP.
HOPEDALE MASS
U.S.A.

3. CROMPTON -KNOWTES CORD
CHARLOTTE N.C.
U.S.A.

4. WEST POINT FOUNDRY MACHINE CORP.
WEST POINT GA
U.S.A.

5. PROCTOR. AND SCHWARTZ CO
PHILADELPHIA,PA
U.S.A.

TEXTILE PLANT ENGINEERS AND BUILDERS

1. LOCK WOOD GREEN CO.
SPARTANBURG S.C.
U.S.A.

2. SIRRINE CO.
GREENEVILLE S.C.
U.S.A.

3. DANIELS DONSTRUCTION CO.
SPARTANBURG S.C.
U.S.A.

Annex 8.

References.

1. Statistical Abstracts, 1977 Edition, Prepared by Central Statistical Office, Ministry of Planning Kuwait P.93.
2. Yearly Bulletins of Foreign Trade Statistics prepared by Central Statistical Office Ministry of Planning Kuwait.
3. Textile Organon March1977.P.36.
4. A Study for the Development of the Synthetic Fiber Industry in the Arab States prepared for IDCAS by Chem Systems International 1975.
5. Chapter on Polyesters in the Encyclopedia of Polymers.
6. Petrodynamics An Economic Analyais of Fiber Raw Mateials by Robert D. Evans.

ANNEX 9

RIETER PROPOSED YARN SPINNING PLANT

The proposed yarn plant for dishdasha fabrics will produce 40 cc blended 65-35 polyester cotton yarn. This means that one pound of yarn will contain 840 X 40 yards of yarn or 67,700 meters per Kg. It was impossible to send Rieter a sample of the fabric in time for them to analyze the fabric and complete their cost analysis in time for completion of this mission. On our visit to Winterthur a sample was submitted and using their laboratory the T-120 fabric woven by Nisshin Spinning Company of Japan, found that the fabric was quite unusual. The yarn, both warp and fill, was a two ply yarn made from 120 cc yarn so that the plied yarn is a nominal 60 cc yarn. We had roughly calculated the yarn as a 40 cc yarn and the methods of producing a 60 cc single yarn would be substantially the same as used for a 40 cc yarn. However, producing a 120 cc yarn may require a finer denier polyester staple, possibly in the range of 1-1.25 denier and certainly this change may alter textile processing. A very good grade of cotton is also indicated. This fabric analysis emphasizes the point made in Annex 6 that complete analysis of the various dishdasha fabrics will be required before yarn and fabric costs can be determined.

The Rieter proposal for a plant to produce 2000 tons of 40 cc yarn for weaving dishdasha fabrics is attached. From time to time reference will be made to certain pieces of Rieter equipment which are described in Rieter bulletins now in the Industrial Development and Consulting Bureau or are presently in the mail to the Bureau. Their designation of a Ne 40 yarn is equivalent to a 40 cc yarn and refers to Number English. Our instructions to Rieter were to size the plant for a 6000 hour year so that operations on a 8400 hour year could increase capacity to 2800 tons. The plant is designed to produce 337 Kg/h. In this Annex reference to Page A-1 will be to page 1 of Plant A proposal and to B-1 to the Page 1 of the Plant B proposal.

On page A-1 note that the requirements for cotton are

44% higher than the theoretical whereas polyester staple requirements only represent about 7% more than theory. The difference represents the cotton losses resulting from trash, immature fibers and the like.

Page A-2 describes the general type of equipment required to take polyester or cotton from the bale and to prepare it for the cards. Blending of fibers will occur after carding. In other words, there will be essentially two processing areas through carding, one for polyester and another for cotton. Since polyester is a synthetic material of uniform and controlled staple length, the processing is fairly simple. Bales of polyester will be received from the nearby synthetic fiber plant. The fiber is fed to a Rotopic opener which serves to open the fiber tufts before feeding to the Aeromix blending system. It will be recalled from the melt spinning system discussion that many different as-spun cans of polyester yarn are combined prior to drawing and, thereafter, are processed into a single bale. In the Aeromix unit additional blending occurs so that the feed to the cards is very uniform. The cards are fed with an Aerofeed automatic card feeder. All of the required polyester cards can be automatically fed from these units. Thus, once the polyester is fed to the opener the other processes are automatically controlled and the amount of labor is greatly reduced.

In the case of cotton the process required to remove trash and other contaminants is more complicated. In the first place, for the type of yarn needed for the dishdasha fabrics, high quality cotton will be required. Even though the production weight required for the 35% cotton in the blend is much lower than for polyester, much greater effort will be required to clean the cotton and to open the fiber. Therefore, two Rotopic blending openers will be required. The output of these openers is fed to a monocylinder cleaner and then to an Aeromix unit for additional blending. From the blenders the cotton is fed to two ERM cleaners. The feed to these units is controlled automatically and these units working in sequence provide an excellent means of removing foreign material from the cotton. The cleaned cotton next goes to the flock feeders for the cards.

The cards for both cotton and polyester are identical. Carding serves two very useful purposes. The primary function of a card is to parallelize the fibers and to remove fibers which are clumped together. The Rieter cards are fed automatically by the flock shute feeders. In addition waste fibers can be automatically removed and recovered. For polyester staple the number of cards required is 8 while for cotton the number of cards required is 6. For cotton carding using American type cotton production will be about 28 Kg per hour per card while the production rate for polyester will be 30 Kg per hour. Efficiency of carding both fibers is high, averaging about 97%. This means that on a 8400 hour year the cards will actually be producing sliver 8150 hours. This assumes good management but these are the rates which can be achieved and are practiced in Western European plants.

For the fine yarns required the cotton must be combed. The function of the combing process is (1) to remove all of the fine impurities and tangles of fibers called neps which passed through the carding process and were not removed at that point. (2) to remove short fibers which can not provide the strength required in the finer yarns, (3) to improve the parallelism of the fibers and (4) to improve the uniformity of the combed sliver. The card sliver as produced is not suitable for combing with modern machines. In order to form the laps which feed the comber the Rieter processes uses a card sliver lap machine feeding a ribbon lap machine. In the sliver lap machine depending upon the yarn to be produced some 20 to 36 card slivers are combined. The ribbon lap machine takes six of the combined sliver laps, draws these laps six times to give the product suitable for combing. Output from the ribbon lap machine can be automatically controlled and doffed. As a result little labor is required.

In the actual production schedule proposed 20 sliver laps would be combined in the sliver lap machine with a theoretical output of 230 Kg per hour and six of these laps would be used in the ribbon lap machine with a theoretical output of 230 Kg per hour. Efficiencies of these two units are respectively 80 and 75% so that the actual production is substantially below these rates.

The Rieter combers have 8 productive heads and use a nipping device which holds the fibers while they are being combed and which can operate up to 240 cycles per minute. The production per machine per hour is 26 Kg at an average efficiency of 92%. To give some idea of the waste fibers which are produced in the combing operation it was estimated, based on the grade of cotton normally used (American), that the waste fibers from the combing operation would amount to about 19%.

It is possible to recover waste from the blowroom where the cotton is opened, from the card room and finally from the combing area. All of these wastes can be recovered separately and handled automatically and if both textile plants for dishdasha fabrics and bed linens are located at the same site such equipment is recommended.

The synthetic system is much simpler. Six of the card slivers are combined and drawn on the predraw machine. Each of these machines can produce 61 Kg per hour at 85% efficiency and a total of 4 machines will be required.

The blending of the fibers occurs at drawing frames. In this process the combed cotton is combined with the synthetic fiber in the high speed drawing frames. The proper amounts of the two fibers are combined by three passages through these units. In each passage the number of doublings is about 6-8 so that by the time the fibers leave the draw frames they have been doubled 22 times. These units will produce around 60 Kg per hour at an efficiency averaging 87%. The number of machines required will be 18.

The blended fiber coming from the high speed drawing units are not suitable for spinning into yarn using a ring spinning system and must be reduced in size by a drawing system. In order to hold the much lighter assembly of fibers together a slight twist, about

40 turns per meter, is imparted. The machine which takes fiber from two cans and draws it approximately 9 times and imparts the twist, is called a roving frame. Each unit can produce about 650 g/hr at 82% efficiency so that the number of units required will be about 526. The standard roving frame produced by Rieter contains 108 units so that 5 machines will be required.

The last process in converting staple fibers into spun yarns is the ring spinning system. In this process the lightly twisted roving is drawn down and twisted by the ring-traveler-spindle system to give the spun yarn. Although the production rate in actual grams of yarn produced by each spindle per hour is only 11.7 g., at a twist level of 922 turns per meter, the traveler will be going at 13,000 revolutions per minute. To produce the 2000 tons of yarn needed per year will require 28,800 spindles at a high operating efficiency of 98%. The Rieter spinning frames contain 612 spindles per machine so that 48 machines will be required.

In order to use the attached Rieter data found on page 3 and 4, note that in order to work the problem the final product to be produced is at the top of page 3 and is a blend yarn. The equipment for producing synthetic sliver is listed next. On page 4 the equipment for producing combed cotton sliver is listed. Note the equipment for blow room cotton is greatly under utilized and could be available for other products at no increase in equipment costs.

Pages 5 and 6 list the equipment costs for that equipment produced by Rieter. These costs are subject to negotiation and are the so-called list prices and possibly could be as much as 20% above actual selling prices. However, since the currency exchange markets are chaotic at best, these equipment prices can be considered as possibly indicative of prices for 1980. Most of the major pieces of equipment are included and that equipment which is not included is detailed in the attached letter from Rieter. The complete Rieter catalog has been sent to the Industrial Development and Consulting Bureau and limited brochures were received February 28. By referring to pages 5 and 6 the exact Rieter equipment model number is shown and details of the equipment can be determined by reference to the appropriate brochure in the catalog.

Pages 7, 8 and 9 and 10 give the computer costs of producing 40 cc yarn ex raw materials. The details of costs which are included are given in the attachment entitled Explanations of the Investment Study. Rieter was given labor costs in terms of U.S. dollars of current Kuwait costs including 10% social charges with a projection to 1980 of 8% annual increases. In this estimate the standard rate of exchange was 1 KD̂ = 3.5 U.S. dollars. For conversion into Swiss francs Rieter used an exchange rate of 1 U.S. $ = 1.97 Swiss franc. Since their computer standards are based on European achievable labor standards they used a factor of 75% for the efficiency of mid Eastern personnel.

In the details of costs the first column pages 7 and 8 represents the total operating and maintenance people required <u>per shift</u>. Thus, for plant operating 8400 hours per year this total should be 3.65 X 32 or 117 people. This is surprisingly low in view of the many processing steps which are required and is a reflection of the developments in labor saving equipment which Rieter has made.

Building space does not include the space which will be required to store the three months supply of imported cotton. The area included is that area shown in the layout attachment which is enclosed within the heavy lines. Since the yarn plant will be an integrated plant with the fabric plant the work shops, laboratories, etc. can be combined and space has been provided for these functions in the fabric plant.

The equipment costs, pages 5 and 6, include erection or installation charges but do not include freight and insurance charges. However, capital charges, column 13 or pages 7 and 8, do include these charges. The installation of textile equipment is much lower than installation of chemical equipment and generally is about 1 - 2% of equipment costs and is included in the equipment price.

Column 9, pages 7 and 8, gives the net cost of the waste which is incurred after all average credits for waste generated have been taken. Thus, to produce 1 Kg of blended yarn the actual costs of the fibers in the blended yarn would have to be added to this figure. Since net costs implies some knowledge of the original costs of the raw materials and the net worth of the waste, they have used European prices for these products.

Column 11 gives the electric power for manufacturing yarn using current Kuwait costs.

Column 12 gives the auxiliary costs per Kg of yarn which includes essentially the required maintenance supplies.

Column 13 needs some detailed explanations. Included in these charges are interest on all installed equipment but not working capital charges. Depreciation on equipment is included on an 8 year straight line basis with a 20 year depreciation schedule. Accessory materials are depreciated on a 5 year basis.

On the above basis the manufacturing costs for 40 cc blended yarn ex materials is 0.353 KD per Kg (1 KD = 6.9 SF)

From Table 43 at 15% ROI the cost of staple fiber is 0.417 KD per Kg. Assuming cotton can be delivered in Kuwait at 0.43 KD per Kg, the raw material costs would be 0.422 KD per Kg. Thus, the Rieter cost estimate with the exceptions noted would be 0.775 KD per Kg. In November 1977 the sales yarn price for 38 cc 50-50 polyester blend yarn in the United States was 1.03 KD per Kg.

In exactly a similar manner the costs of producing a 65-35 polyester cotton blend yarn (30 cc) for use in bed linens was estimated and is attached. Since we have not analyzed the costs of bed linen fabrics these yarn costs are for future use.

Ministry of Commerce and Industry
Kuwait
STATE OF KUWAIT

Krg/met/500000 24th February, 1978.

Re: Investment Studies for a spinning plant
Our Computer Estimates Nos. 2709 and 2708
both dated 15th February 1978

Dear Sirs,

We refer to the recent telex exhange and have pleasure in submitting to you enclosed our Investment Studies (Computer Estimates) for the plants A and B as requested by you.

Computer Estimate No. 2709

This Investment Study covers plant A, i.e. a complete spinning plant to produce 337 kg/h blended yarns of 65% Polyester and 35% combed cotton, average count Ne 40.

Computer Estimate No. 2708

This Investment Study covers plant B, i.e. a complete spinning plant to produce 672 kg/h blended yarns of 65% Polyester and 35% combed cotton, average count Ne 30.

The explanations on which basis this Investment Study has been carried out are indicated in detail in the Estimates. The expenditure and cost figures are calculated on the marginal conditions as indicated by you. The offered machines cover all necessary production machinery for a spinning plant with the exception of the following items which we are not manufacturing:

- air conditioning plant
- rotary filters for cleaning of blowroom exhaust air
- compressor unit
- round piping for material conveyance and exhaust air conveyance

Ministry of Commerce and Industry
Kuwait 24th February, 1978.

- source of electrical supply
- overhead travelling cleaners, and
- material carriers such as tubes, bobbins and cans.

Spare parts are also not included; you should reckon with building up an initial stock of spare parts amounting to approx. 2 - 2.5% of the machine value to ensure a trouble-free running for 2 years on a 3-shift basis.

The space requirements for the plant are also indicated in the Estimate. As soon as the project enters a more definite stage, we would be pleased to submit a suitable layout proposal.

We informed you in our telexes of 22nd and 23rd February that a possibility would exist that Mr. Krug, our delegate for the Middle East, visits you between 12th and 14th March 1978 at Kuwait. He would be in a position to discuss this project further with you and give adequate advice on the enclosed Investment Studies.

By separate mail we have also sent to your address a collection of pamphlets describing the offered machinery in detail.

We hope to have been of service to you.

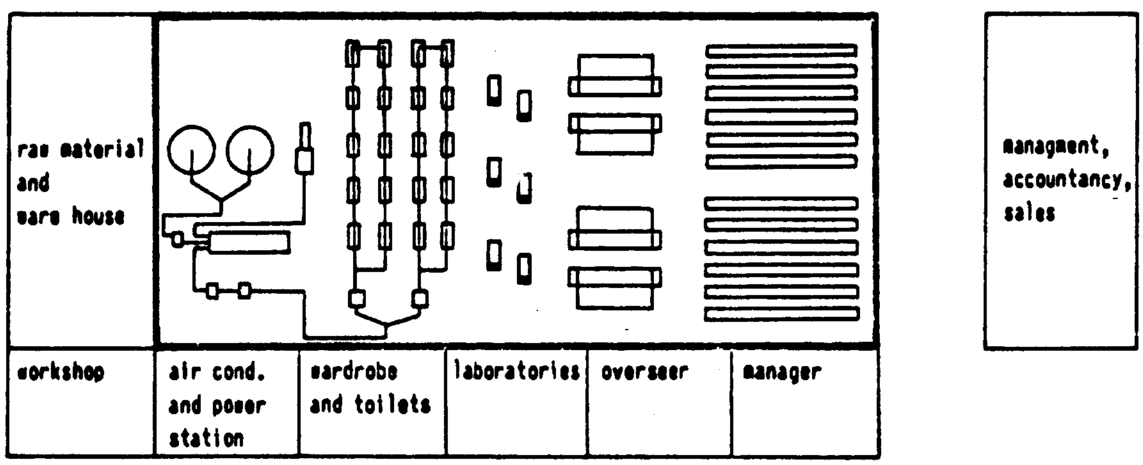
Yours faithfully,
RIETER MACHINE WORKS LIMITED

Enclosures:
Computer Estimates
Nos 2709 and 2708

By separate mail:
1 collection of
pamphlets

Explanations to the investment study of computer projects

The investment study yields information concerning expenditure and manufacturing costs within the production area (framed with thick line in sketch below). The machinery offered and the particular cost conditions for the individual countries serve as a basis.



E x p e n d i t u r e s

Operating personnel

The number of operatives required are determined by work study methods. The individual times are according to our standards, which are based on an average of time studies made in various West European mills. For countries in which a deviation from these standards has been experienced, a correction factor is applied.

Overlookers and supervisors, as well as staff for laboratories, workshops, despatch etc. are not considered.

Overhauling and maintenance personnel

The requirements of skilled and unskilled workers for machine maintenance are determined according to our instructions for overhauling and maintenance of our machines.

The values indicated give the requirements per shift, similar to our indications for operatives.

Installed power for machines

The indicated figures comprise the installed electric power of all motors built into the machines.

Installed power for illumination

The installed power for illumination is based on today's standard values for illumination intensity in spinning mills.

Installed power for air conditioning

The installed power for air conditioning is in direct relation to the heat, generated by the machines (motors) and the illumination, as well as space requirements, the relative humidity etc. Basically a central air conditioning plant with return air system is considered.

Necessary floor space including gangways and reserve

The necessary average floor space for machines, gangways and reserve (can space etc.) has been evaluated from a great number of spinning mill layouts. Certain alterations may arise, all according to machinery layout.

Costs for auxiliary material

These costs refer to the average yearly expenditure for spare parts (parts subject to normal wear), lubricants and cleaning materials.

Costs for accessories

The costs for accessories comprise the purchase costs of spinning tubes, OE and roving spools, spinning cans, transport containers, auxilliary appliances of all kind such as roller pickers, cleaning aids etc.

Costs

Waste costs

The total waste per machine group is mentioned in the spinning schedule. The monetary regain on waste (waste from slivers, filters, flats and grid droppings etc.) are considered when calculating the waste costs.

Wage costs

The wage costs are calculated from the wages paid for operatives and skilled and unskilled labour for maintenance work. All social charges are included. For reserve personnel a percentage figure is added.

Electric power costs

The electric power costs include the costs based on the actual power consumption of the machines, the illumination and the air conditioning plant. Concerning illumination, it is assumed that the mill is lit the entire time of production.

Costs for auxiliary material

The costs for spare parts, lubricants, cleaning materials and maintenance work of the building represent the costs for auxiliary material.

Capital costs

The capital costs include capital interest and depreciation of machines, accessories and building. For the determination of the machinery costs for delivery free spinning mill, erection included, a surplus charge for customs duty, taxes, transport and erection is added to the sales prices indicated. The building costs only refer to the production area and include the costs for the air conditioning ducts for supply and return air, the lighting system, the installations for high and low voltage current, the fire protection etc.

Manufacturing costs

The sum of the five cost groups give the total manufacturing costs. The self incurred costs are obtained by adding the price of raw material, the costs for auxiliary plants, such as laboratory, packing, storage, workshop etc. as well as overheads.

21.1.1976

TW yarn pricing service

Watch the acrylics go—that's the movement that has spinners who produce polyester-acrylic blends and 100% acrylics smiling. Activity is strong and prices excellent as retailers gear up for the cold winter months and a booming sweater and cold-weather-wear market.

Meantime, other markets are doing well, even in the face of cotton prices which appear temporarily stabilized. There's some erosion in coarse-count cotton and blend yarns, but nothing serious. In fact, polyester-cotton blend yarns in finer counts are moving extremely well, especially to singleknitters.

Blend switching from 50-50 polyester-cotton to 65-35, initiated by Springs in its sheeting division, has not grown tremendously. But the polyester-cotton pricing situation is presently confused and may result in further reduction in polyester staple prices if cotton hangs in the mid 50s.

There's another interesting note. At least two medium-sized texturing plants that closed during the doubleknit fallout a couple of years ago have reopened. This could signal improved doubleknit operations. Prices here are holding well.

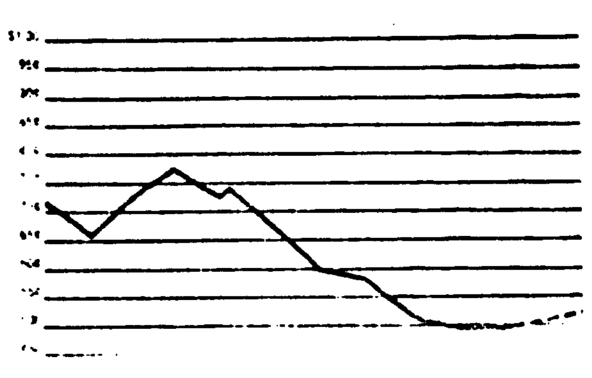
Textured set yarn
(False twist: all putup on cones)

Fiber	Denier	As of Oct 20	Month ago
Polyester	70	$1.88 92	$1.88-92
Polyester	150	88-90	.85-92

Filament yarn

Fiber	Denier	As of Oct 20	Month ago
Nylon	15	$2.28-32	$2.28-32
Nylon	20	2.20-34	2.20-34
Nylon	40	1.60-58	1.60-68
Nylon	840	1 12-18	1.12-18
Polyester	40	1.78-86	1.78-86
Polyester	70	1 15-20	1.15-24
Polyester	150	.65-72	.68-76

Raw cotton, strict low middling, 1-1/16 in., USDA
(Price per pound)



Spun yarns (all putup on cones)

100% carded cotton

Count	Singles price as of Oct 20	Month ago	Plied price as of Oct 20	Month ago
8s	$1.14-16	$1.14-16	$1.23-28	$1 23-26
10s	1.17-20	1.17-20	1.28-32	1.28-32
20s	1.24-28	1.24-28	1.36-42	1.36-42
26s	1 38-42	1.38-42	1 46-52	1 46-52
30s	1.46-50	1.46-50	1.54-58	1.54-58

100% combed cotton

Count	Singles price as of Oct 20	Month ago
10s	$1.30-36	$1.36-40
20s	1.45-50	1.48-50
30s	1.55-60	1.55-62
36s	1.78-82	1.80-85
40s	1.90-92	1.90-95

Manmade fiber-manmade fiber blends

Fiber	Count	Singles price as of Oct 20	Month ago
50-50 polyester-acrylic	18s	$1.30-38	$1.24-25
50-50 polyester-acrlyic	24s	1.42-49	1.30-34

Manmade fiber-combed cotton blends

50-50 polyester-cotton	10s	$1 29-32	$1.29-35
	20s	1.37-38	1.37-40
	30s	1.44-52	1 44-52
	38s	1.58-64	1.59-64

100% manmade

Rayon	6s	$ 94-1.00	$ 94-1.00
	12s	1.04-10	1.04-10
	20s	1 12-16	1.12-16
	24s	1.16-22	1 18-22
	30s	1 26-32	1.26-32
Polyester	10s	1 09-14	1 08-14
	18s	1 15-20	1 15-20
	22s	1.22-26	1 22-26
	30s	1 30-34	1 30-34
Acrylic	8s	1 26-30	1 24-28
	18s	1 37-42	1 35-38
	22s	1 44-49	1 41-45

RIETER MACHINE WORKS LTD. WINTERTHUR SWITZERLAND

YOUR REFERENCE

OUR REFERENCE
Hin/fl-500000-1

CH-8406 WINTERTHUR
15th February 1978

Computer-ESTIMATE

No. 2709

(Investment study, Plant A)

Ministry of Commerce and Industry

Kuwait

State of Kuwait

Complete spinning plant to produce 337 kg/h blended yarns of average count Ne 40

TELEPHONE: 052 - 86 21 21 TELEGRAMS: RIETERCO WINTERTHUR TELEPRINTER: 7 62 41

The technical basis of this estimate

1. **Raw material to be processed:**

Various cotton:	Staple length	24 - 30 mm
	Micronaire	3.5 - 4.5 ug/" (range)
		4.2 ug/" (average)
Polyester fibres:		1.5 den., 40 mm

2. **Range of counts:**

   To be clarified

3. **Planned yarn production:**

   Blends of 65% Polyester/35% combed cotton, average count Ne 40 with an hourly production of 337 kg.

4. **Raw material requirements:**

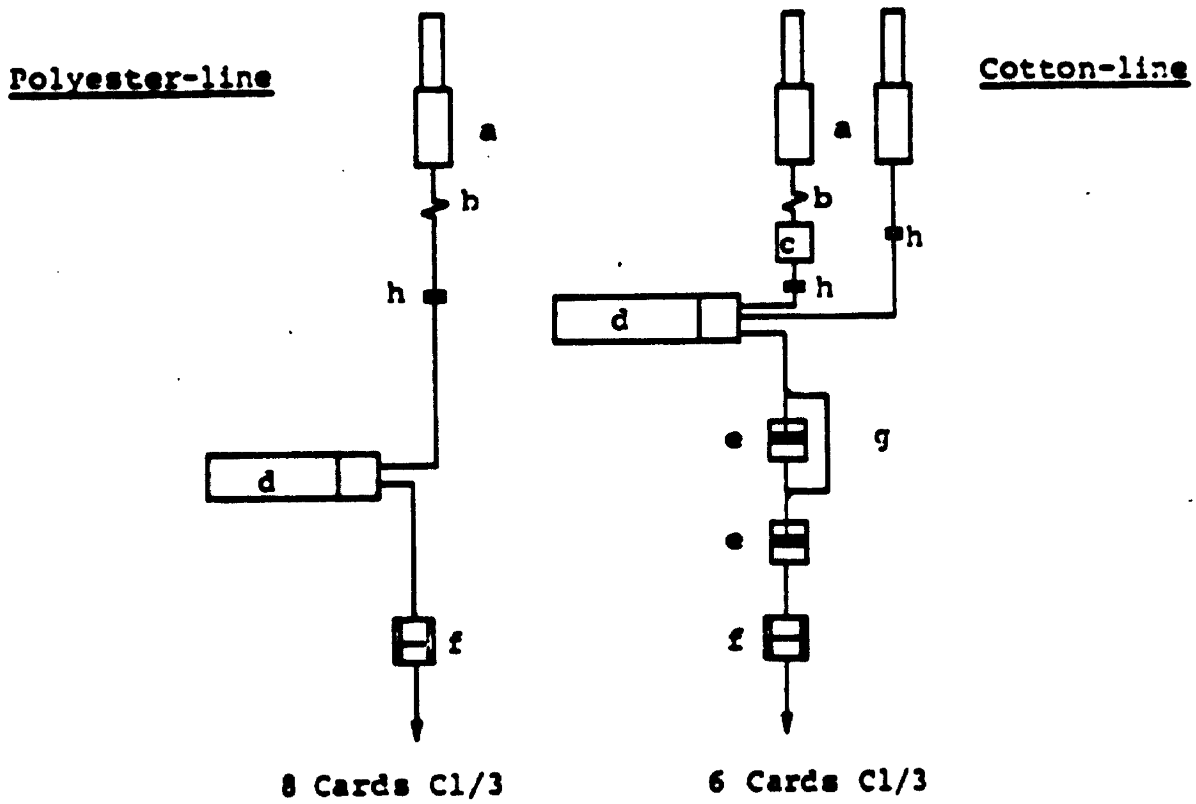
Cotton:	approx. 170 kg/h
Polyester:	approx. 234 kg/h

5. **Layout proposal:**

   To be established after receipt of detailed building plans.

Composition of Blowroom Machines

(schematic working diagram)



Code	Machines
a	3 Roller blending openers "Rotopic" B2/3
b	- Permanent magnets
c	1 Mono cylinder cleaner B4/1
d	2 "Aeromix" B7/2
e	2 ERM-cleaners B5/5
f	2 Flockfeeders A7/2
g	- By pass
h	- Fans

Berechnungsgrundlagen zum Spinnereiprojekt für
Basis of calculation to spinning mill project for

MINISTRY OF COMMERCE AND INDUSTRY
KUWAIT
STATE OF KUWAIT

1.4/114 2709
HIN22 15.2.78

Spinnpl. Spinning sched. Plan de marche Plan de marcha Produktionsplan Production sched. Plan de prod. Plano de prod.

Machines	Count delivered			Doubling	Draft	Twist T/m	Twist T/"	Processing speed m/min	Calcul. production per unit g/h kg/h	Efficiency %	Plant production per unit g/h kg/h	Waste total %	Total production required kg/h	Calculated production units
BLEND														
RINGSPINNING FRAME	14.7	68.027	40.173										337.0	
YARN COUNT 1	14.7	68.027	40.173	1	33.33	922	23.42	13000	12.4	94.6	11.7	2.2	337.0	26[illegible]03.4
SPEED FRAME	490.0	2.041	1.205	1	0.88	44	1.12	1200	801.8	81.6	654.3	1.0	34[illegible].4	526.4
DRAWFRAME 3RD PASSAGE	4.4	.230	.136	8	8.64			250	65.2	89.1	58.1	.6	347.8	6.0
DRAWFRAME 2ND PASSAGE	4.7	.213	.126	8	8.00			250	70.5	88.6	62.5	.6	349.9	5.6
DRAWFRAME 1ST PASSAGE	4.7	.213	.126	6	6.26			250	70.5	84.1	59.3	.6	352.0	5.9
SYNTHETIC														
PRE-DRAWFRAME	4.8	.209	.124	6	6.66			250	71.7	85.5	61.3	.6	230.2	3.8
HIGH PRODUCTION CARD	5.3	.189	.111		120.75				30.0	97.0	29.1	.6	231.6	8.0
FLOCK FEEDER INCL. FAN									250.0	97.0	242.5			1.0
AEROMIX									500.0	97.0	485.0			.5
ROLLER BLENDING OPENER									250.0	97.0	242.5			1.0
BLOWROOM TOTAL												.3	233.0	
RAW MATERIAL REQUIRED													233.7	

Berechnungsgrundlagen zum Spinnereiprojekt für
Basis of calculation to spinning mill project for

MINISTRY OF COMMERCE AND INDUSTRY
KUWAIT
STATE OF KUWAIT

114/114 2709
HIN22 15.2.78

Spinnpl. Spinning sched. Plan de marche Plan de marcha | Produktionsplan Production sched. Plan de prod. Plano de prod.

Machine	Count delivered (tex)	(g/m)	(g/m)	Doubling	Draft	Twist (T/m)	(T/")	Processing speed (m/min)	Calcul. production per unit (g/h, kg/h)	Efficiency (%)	Pract. production per unit (g/h, kg/h)	Waste total (%)	Total production required (kg/h)	Calculated production units
C O T T O N														
COMBER	5.1	.194	.115	4				220	28.2	92.2	26.0	19.0	123.9	4.8
RIBBON LAP MACHINE	64.0	64.000	64.000	6	6.00			60	230.4	75.8	174.6	1.0	153.0	.9
SLIVER LAP MACHINE	64.0	64.000	64.000	20	1.66			60	230.4	80.8	186.2	.5	154.5	.8
HIGH PRODUCTION CARD	5.3	.189	.111		120.75				28.0	97.0	27.2	3.5	155.3	5.7
FLOCK FEEDER INCL. FAN									250.0	97.0	242.5			.7
ERM-CLEANER									500.0	97.0	485.0			.3
ERM-CLEANER									500.0	97.0	485.0			.3
AEROMIX									500.0	97.0	485.0			.3
MONO CYLINDER CLEANER									500.0	97.0	485.0			.3
WASTE OPENER									50.0	97.0	48.5			.2
ROLLER BLENDING OPENER									250.0	97.0	242.5			.6
BLOWROOM TOTAL												5.0	160.9	
RAW MATERIAL REQUIRED													169.4	

Données de base pour projet de filature pour
Bases de calculo del proyecto de hilanderia para

MINISTRY OF COMMERCE AND INDUSTRY
KUWAIT
STATE OF KUWAIT

114/114 2709
HIN22 15.2.78

Maschinendaten Machine specificat. Caractéristiques des machines Datos de máquinas — Preise Prices Prix Precios

Machine	Units per machine	Number of machines	Total units	Degree of exploitation %	Model	Drafting arrangement	Package size at delivery in mm	Sales price per machine SFR	Sales price total SFR
BLEND									
RINGSPINNING FRAME	612	48	29376	98.1	G0/2	R2R36	GAUGE: 70 RING: 45 TUBE: 230	208,620.-	10,013,760.-
SPEED FRAME	108	5	540	97.5	F1/1A	F2R36	BOBBIN DIAMETER: 165 LIFT: 305	197,930.-	989,650.-
DRAWFRAME 3RD PASSAGE	2	3	6	99.8	D0/2		CAN DIAMETER: 450 HEIGHT:1070	52,690.-	158,070.-
DRAWFRAME 2ND PASSAGE	2	3	6	93.3	D0/2		CAN DIAMETER: 450 HEIGHT:1070	52,690.-	158,070.-
DRAWFRAME 1ST PASSAGE	2	3	6	98.9	D0/2		CAN DIAMETER: 450 HEIGHT:1070	52,690.-	158,070.-
SYNTHETIC									
PRE-DRAWFRAME	2	2	4	93.9	D0/2		CAN DIAMETER: 450 HEIGHT:1070	54,250.-	108,500.-
HIGH PRODUCTION CARD	1	8	8	99.5	C1/3RL		CAN DIAMETER: 600 HEIGHT:1200	120,650.-	965,200.-
CARD FEEDING SYSTEM AEROFEED		8						9,570.-	76,560.-
CARDING TOTAL									1,041,760.-
FLOCK FEEDER INCL. FAN	1	1	1	96.1	A7/2			66,700.-	66,700.-
AEROMIX	1	1	1	48.0	D7/2			106,700.-	106,700.-
ROLLER BLENDING OPENER	1	1	1	96.1	B2/3			65,160.-	65,160.-
PNEUMATIC CONVEYANCE		1			A4				7,830.-
CONTROL OF BLOWROOM MACHINERY		1			A6				34,780.-
BLOWROOM TOTAL									281,220.-

Données de base pour projet de filature pour Bases de calculo del proyecto de hilandería para	MINISTRY OF COMMERCE AND INDUSTRY KUWAIT STATE OF KUWAIT	114/114 2709 HIN22 15.2.78

Maschinendaten Machine specificat. Caractéristiques des machines Datos de máquinas | Preise Prices Prix Precios

Machines	Units per machine	Number of machines	Total units	Degree of exploitation	Model	Drafting arrangement	Package size at delivery in mm	Sales price per machine	Sales price total
COTTON								SFR	SFR
COMBER	1	5	5	95.3	E7/4		CAN DIAMETER: 450 HEIGHT:1070	132,680.-	663,400.-
RIBBON LAP MACHINE	1	1	1	87.6	E4/1A		LAP WIDTH: 300	100,790.-	100,790.-
SLIVER LAP MACHINE	1	1	1	83.0	E2/4A		LAP WIDTH: 250	84,270.-	84,270.-
COMBING MACHINERY TOTAL									848,460.-
HIGH PRODUCTION CARD	1	6	6	95.2	C1/3RL		CAN DIAMETER: 600 HEIGHT:1200	120,650.-	723,900.-
CARD FEEDING SYSTEM AEROFEED		6						9,570.-	57,420.-
CARDING TOTAL									781,320.-
FLOCK FEEDER INCL. FAN	1	1	1	66.4	A7/2			66,700.-	66,700.-
ERM-CLEANER	1	1	1	33.2	B5/5			39,100.-	39,100.-
ERM-CLEANER	1	1	1	33.2	B5/5			39,100.-	39,100.-
AEROMIX	1	1	1	33.2	B7/2			106,700.-	106,700.-
MONO CYLINDER CLEANER	1	1	1	31.5	B4/1			22,510.-	22,510.-
WASTE OPENER	1	1	1	16.6	B2/3			65,160.-	65,160.-
ROLLER BEFIDING OPENER	1	1	1	63.0	B2/3			65,160.-	65,160.-
PNEUMATIC CONVEYANCE		1			A4				16,110.-
CONTROL OF BLOWROOM MACHINERY		1			A6				50,440.-
BLOWROOM TOTAL									470,980.-
TOP ROLLER GRINDING MACHINE									82,880.-
CARD GRINDING EQUIPMENT									14,590.-
BLEND									
MILL GRAND TOTAL									15,107,330.-

Projekt für Project for Projet pour Proyecto para MINISTRY OF COMMERCE AND INDUSTRY KUWAIT STATE OF KUWAIT — 114/114 2709 HIN22 15.2.78

Aufwand Expenditure Besoins Necesidades — **Kosten Costs Coût Costes**

Machines	Workers for production	Workers for maintenance	Installed power for machines kW	Inst. power for illumination kW	Inst. power for air conditioning kW	Floor space m²	Costs for auxiliary material per year SFR	Costs for accessories SFR	Costs of waste per kg yarn SFR	Wages costs per kg yarn SFR	Electric power costs per kg yarn SFR	Costs of auxiliary mat. per kg yarn SFR	Capital costs per kg yarn SFR	Manufacturing costs per kg yarn SFR
BLEND														
RINGSPINNING FRAME	20.7	2.02	104.0	60.2	190.5	3403	178126	222803						
YARN COUNT 1	20.7								.0101	.2979	.0427	.1002	1.0162	1.4671
SPEED FRAME	2.2	.35	61.5	8.3	13.9	780	15789	96505	.0088	.0328	.0024	.0106	.1183	.1729
DRAWFRAME 3RD PASSAGE	.6	.03	16.5	1.6	3.2	150	2827	11400	.0035	.0083	.0007	.0019	.0189	.0353
DRAWFRAME 2ND PASSAGE	.7	.03	16.5	1.6	3.2	150	2827	11400	.0036	.0096	.0007	.0019	.0189	.0347
DRAWFRAME 1ST PASSAGE	.7	.03	16.5	1.6	3.2	150	2827	9120	.0036	.0096	.0007	.0019	.0187	.0345
SYNTHETIC														
PRE-DRAWFRAME	.4	.02	11.0	1.3	2.3	120	1805	9720	.0023	.0055	.0005	.0013	.0136	.0232
HIGH PRODUCTION CARD	.6	.18	63.2	2.2	7.8	208	16547	4320	.0094	.0101	.0023	.0089	.0934	.1241
CARD FEEDING SYSTEM AEROFEED													.0070	.0070
CARDING TOTAL	.6	.18	63.2	2.2	7.8	208	16547	4320	.0094	.0101	.0023	.0089	.1004	.1311
FLOCK FEEDER INCL. FAN			11.1	.4	1.4	35	442				.0004	.0003	.0068	
AEROMIX			11.9	.3	1.3	45	167				.0004	.0003	.0107	
ROLLER BLENDING OPENER			8.9	.7	1.3	100	250	2700			.0003	.0005	.0084	
PNEUMATIC CONVEYANCE													.0007	
CONTROL OF BLOWROOM MACHINERY													.0032	
BLOWROOM TOTAL	.8	.02	31.9	1.4	4.0	180	859	2700	.0072	.0109	.0011	.0011	.0298	.0501

Projekt für Project for Projet pour Proyecto para

MINISTRY OF COMMERCE AND INDUSTRY
KUWAIT
STATE OF KUWAIT

114/114 .2789
HIN22 15.2.78

Aufwand Expenditure Besoins Necesidades — Kosten Costs Coût Costes

Machines	Workers for production	Workers for maintenance	Installed power for machines kW	Inst. power for illumination kW	Inst. power for air condit. kW	Floor space [illegible] m²	Costs for auxiliary material per year SFR	Costs for accessories SFR	Costs of waste per kg yarn SFR	Wages costs per kg yarn SFR	Electric power costs per kg yarn SFR	Costs of auxiliary mat. per kg yarn SFR	Capital costs per kg yarn SFR	Manufacturing costs per kg yarn SFR
C O T T O N														
COMBER	.7	.15	23.0	1.2	3.6	110	16180	9500	.1075	.0110	.0008	.0084	.0643	.1920
RIBBON LAP MACHINE	.3	.02	2.9	.3	.6	32	1251	2760		.0042	.0001	.0007	.0103	.0153
SLIVER LAP MACHINE	.1	.02	2.9	.6	1.0	60	567	6700		.0015	.0001	.0006	.0101	.0123
COMBING MACHINERY TOTAL	1.1	.19	28.8	2.3	5.2	222	1799[illegible]	17960	.1075	.0167	.0010	.0097	.0847	.2196
HIGH PRODUCTION CARD	.4	.13	47.4	1.7	5.8	156	12410	3240	.0408	.0069	.0017	.0067	.0701	.1262
CARD FEEDING SYSTEM AEROFEED													.0053	.0053
CARDING TOTAL	.4	.13	47.4	1.7	5.8	156	12410	3240	.0408	.0069	.0017	.0067	.0754	.1315
FLOCK FEEDER INCL. FAN			11.1	.4	1.4	35	442				.0004	.0003	.0068	
PRE-CLEANER			7.2	.1	.7	14	125				.0002	.0001	.0039	
PRE-CLEANER			7.2	.1	.7	14	125				.0002	.0001	.0039	
AEROMIX			11.9	.3	1.3	45	167				.0004	.0003	.0107	
MONO CYLINDER CLEANER			2.2	.1	.3	14	42				.0001		.0024	
WASTE OPENER			8.9	.7	1.3	100	250				.0003	.0005	.0081	
ROLLER BLENDING OPENER			8.9	.7	1.3	100	250	2700			.0003	.0005	.0084	
PNEUMATIC CONVEYANCE													.0015	
CONTROL OF BLOWROOM MACHINERY													.0046	
BLOWROOM TOTAL	.7	.04	57.4	2.4	7.0	322	1401	2700	.0695	.0098	.0019	.0018	.0503	.1333
B L E N D														
EXPENDITURE GRAND TOTAL	23.9	3.04	1454.7	84.6	246.1	5841	253496	391948						
MANUFACTURING COSTS GR. TOTAL														
YARN COUNT 1									.2663	.4181	.0557	.1460	1.5452	2.4313

MINISTRY OF COMMERCE AND INDUSTRY
KUWAIT
STATE OF KUWAIT

114/114 2709
HIN22 15.2.78

Berechnungsgrundlagen zum Spinnereiprojekt
Basis of calculation to spinning mill project
Données de base pour projet de filature
Bases de calculo del proyecto de hilanderia

Randbedingungen
Marginal conditions
Conditions marginales
Datos basicos

Stundenlohn für Bedienungspersonal	Stundenlohn für gelerntes Personal	Stundenlohn für ungelerntes Personal	Leistungsfaktor	Reservepersonal	Strompreis
Hourly wage for machine tenders	Hourly wage for skilled personnel	Hourly wage for unskilled personnel	Productivity factor	Personnel in reserve	Cost of electric power
Coût horaire pour personnel servant	Coût horaire pour personnel specialisé	Coût horaire pour personnel auxiliaire	Facteur d'exploitation	Personnel reserve	Prix de courant electrique
Salario hora del personal a las machinas	Salario hora del personal cualificado	Salario hora del personal no cualificado	Factor de productividad	Personal de reserve	Precio de la energia electrica
sFr.	sFr.	sFr.		%	sFr./kWh
4.05	6.40	2.75	.75	10	.014

Gebäudekosten	Gebäudeunterhalt pro Jahr	Anzahl Schichten pro Tag	Betriebsstunden pro Jahr	Zoll, Steuern etc. in % des Maschinenpreises	Kapitalzins
Building costs	Yearly building maintenance	Number of shifts per day	Operating hours per year	Customs, sales tax etc. in % of machine price	Capital interest
Frais de bâtiment	Entretien du bâtiment par an	Nombre d'equipes par jour	Nombre d'heures de travail par an	Frais de douanes etc. en % du prix des machines	Interêt du capital
Costo del edificio	Costo anual de mantenimiento del edificio	Numero de equipos por dia	Horas de trabajo pro año	Aduana, impuestos etc. en % del precio de las maquinas	Interes del capital
sFr./m²	%			%	%
480	1.5	3	6000		6.00

Amortisation der Maschinen in Jahren	Amortisation des Zubehörs in Jahren	Amortisation des Gebäudes in Jahren	Umrechnungskurs	Rohmaterial	Stapellänge
Depreciation for machinery in years	Depreciation for accessories in years	Depreciation for building in years	Exchange rate	Raw material	Staple length
Amortissement des machines en années	Amortissement des accessoires en années	Amortissement du bâtiment en années	Taux de change	Matière première	Longueur des fibres
Amortizacion de las maquinas en años	Amortizacion de los accesorios en años	Amortizacion de el edificio en años	Cotizacion del cambio	Materia prima	Longitud de fibra
			1 sFr. =		
8	5	20		65 % SYNTHETIC 35 % COTTON	– 40 MM – 1 3/32 "

Bemerkungen Remarks Remarques Observaciones

DELIVERY F.O.B. EUROPEAN PORT OF OUR CHOICE, WITHOUT INSURANCE, SEA-PACKED, ERECTION HOURS INCLUDED, RETURN FLIGHT TICKETS AND DAILY ALLOWANCE FOR OUR ERECTORS TO YOUR ACCOUNT.

Rieter Machine Works Ltd. No. 2709
Winterthur/Switzerland Ministry of Commerce and Industry
~~Kuwait~~

Conditions of Sale

Re: Estimate/XXXXXConXXXXXX No. 2709 dated 15th February 1978

1. Prices:
Our prices are quoted net, without any deductions, for delivery

f.o.b. European port of our choice, without insurance.

The prices are based on current production costs. In case of a substantial increase of the latter up to the time of delivery, especially in case of war or major currency changes, we reserve the right to charge for additional costs.

2. Payment:

100% of the order value, covered by an irrevocable Letter of Credit established in our favour with a first class Swiss bank and confirmed by the latter with the order. The Letter of Credit must permit the following payments:

20% as down-payment against presentation of simple receipt

80% balance, against presentation of forwarding agent's receipt or Swiss warehouse receipt.

Interest on delayed payments will be charged at the rate of 8 per cent p.a. from due date.
All banking fees in connection with Letters of Credit, bank guarantees, documentary collections, negotiations of documents as well as possible stamp fees, etc., in your Country as well as in Switzerland are always for your account.

3. Time of Delivery:
Ex works, as far as can be foreseen at present

commencing approximately 8 months after receipt of correct Letter of Credit and clarification of all technical details.

4. Packing: for sea transport included

5. Erection: Erection hours included, return flight tickets and daily allowance for our erectors to your account

For the rest our "General Conditions of Sale and Delivery" apply, representing an integral part of this Estimate/XXXXXXXXXX if no other arrangement is explicitly stated above.

RIETER MACHINE WORKS LIMITED

RIETER MACHINE WORKS LTD. WINTERTHUR SWITZERLAND

YOUR REFERENCE	OUR REFERENCE	CH-8406 WINTERTHUR
	Hin/fl-500000-1	15th February 1978

Computer-ESTIMATE

No. 2708

(Investment study, Plant B)

Ministry of Commerce and Industry

Kuwait

State of Kuwait

Complete spinning plant to produce 672 kg/h blended yarns of average count Ne 30

TELEPHONE: 052 - 88 21 21 TELEGRAMS: RIETERCO WINTERTHUR TELEPRINTER: 7 62 41

No. 2708
Ministry of Commerce and Industry
Kuwait

The technical basis of this estimate

1. **Raw material to be processed:**

Various cotton:	Staple length	24 - 30 mm
	Micronaire	3.5 - 4.5 ug/" (range)
		4.2 ug/" (average)
Polyester fibres:		1.5 den., 40 mm

2. **Range of counts:**

   To be clarified

3. **Planned yarn production:**

   Blends of 65% Polyester/35% combed cotton, average count Ne 30 with an hourly production of 672 kg/h.

4. **Raw material requirements:**

   Cotton: approximately 338 kg

   Polyester: approximately 466 kg

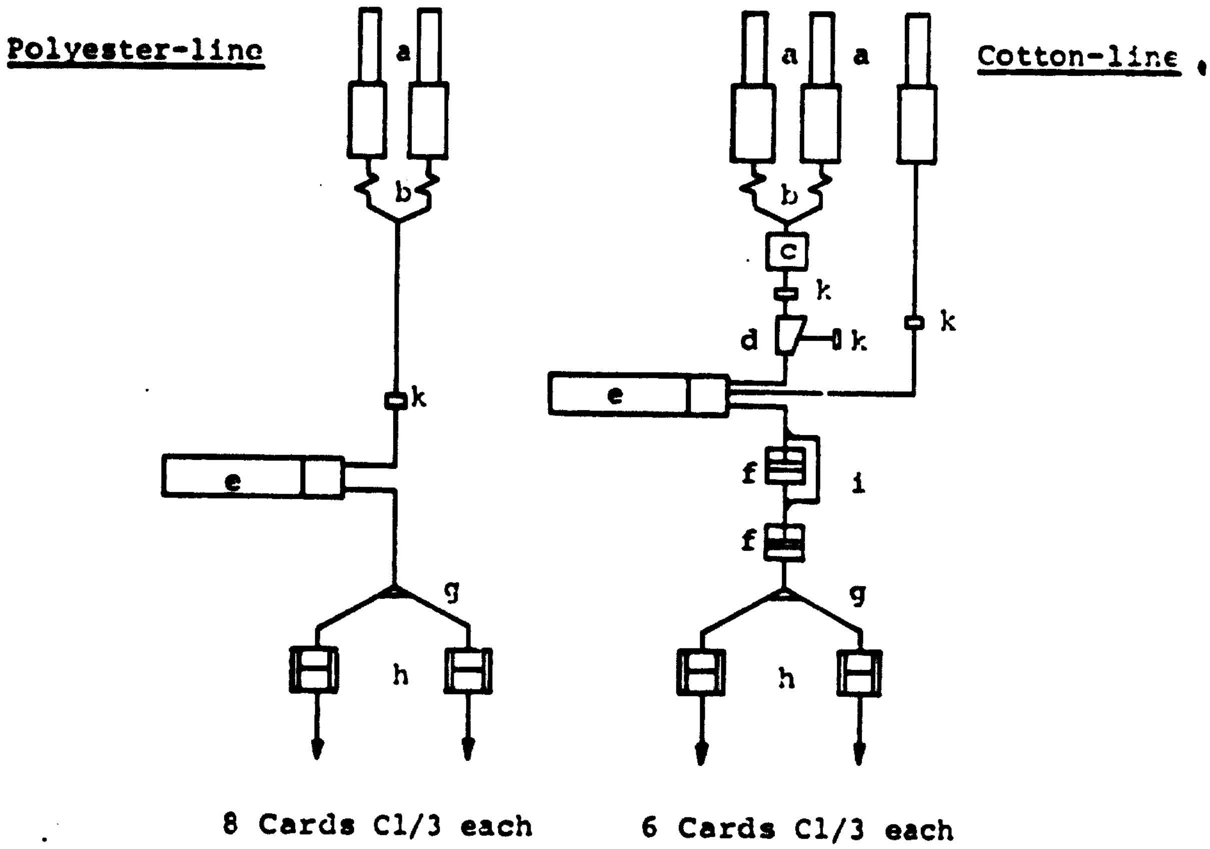
5. **Layout proposal:**

   To be established after receipt of detailed building plans.

Rieter

Composition of Blowroom Machines

(schematic working diagram)



Code	Machines
a	5 Roller blending openers "Rotopic" B2/3
b	- Permanent magnets
c	1 Mono cylinder cleaner B4/1
d	1 Dust extractor unit
e	2 "Aeromix" B7/2
f	2 ERM-cleaners B5/5
g	2 Two-way-distributors
h	4 Flockfeeders A7/2
i	- By pass
k	- Fans

Berechnungsgrundlagen zum Spinnereiprojekt für
Basis of calculation to spinning mill project for

MINISTRY OF COMMERCE AND INDUSTRY
KUWAIT
STATE OF KUWAIT

114/114 2708
HIM22 15.2.78

Spinnpl. Spinning sched. Plan de marche Plan de marcha Produktionsplan Production sched. Plan de prod. Plano de prod.

Machines	Count delivered (Nm)	(g/m)	(g/m)	Doubling	Draft	Twist (T/m)	(T/")	Processing speed (m/min)	Cal. production per unit (g/h, kg/h)	Efficiency (%)	Pract. production per unit (g/h, kg/h)	Waste total (%)	Total production required (kg/h)	Calculated production units
B L E N D														
RINGSPINNING FRAME	19.6	51.020	30.130										672.0	
YARN COUNT 1	19.6	51.020	30.130	1	29.59	808	20.52	13000	18.9	92.4	17.5	2.2	672.0	38400.0
SPEED FRAME	580.0	1.724	1.018	1	7.76	40	1.02	1200	1044.0	78.9	823.7	1.0	686.8	833.8
DRAWFRAME 3RD PAS AGE	4.5	.222	.131	8	8.71			250	67.5	88.9	60.0	.6	693.7	11.6
DRAWFRAME 2ND PASSAGE	4.9	.204	.121	8	8.00			250	73.5	88.4	65.0	.6	697.9	10.7
DRAWFRAME 1ST PASSAGE	4.9	.204	.121	6	6.00			250	73.5	83.8	61.6	.6	702.1	11.4
S Y N T H E T I C														
PRE-DRAWFRAME	4.8	.209	.124	6	6.66			250	71.7	85.5	61.3	.6	459.1	7.5
HIGH PRODUCTION CARD	5.3	.189	.111		120.75				30.0	97.0	29.1	.6	461.9	15.9
FLOCK FEEDER INCL. FAN									250.0	97.0	242.5			1.9
AEROMI									500.0	97.0	485.0			1.0
ROLLER BLENDING OPENER									250.0	97.0	242.5			1.9
BLOWROOM TOTAL												.3	464.7	
RAW MATERIAL REQUIRED													466.1	

Berechnungsgrundlagen zum Spinnereiprojekt für
Basis of calculation to spinning mill project for

MINISTRY OF COMMERCE AND INDUSTRY
KUWAIT
STATE OF KUWAIT

114/114 2708
HIN22 15.2.78

Spinnpl. Spinning sched. Plan de marche Plan de marcha — Produktionsplan Production sched. Plan de prod. Plano de prod.

Machines	Count delivered			Doubling	Draft	Twist		Processing speed	Calc. production per unit	Efficiency	Pract. production per unit	Waste total	Total production required	Calculated production units
COTTON														
COMBER	5.1	.194	.115	4				220	28.2	92.2	26.0	19.0	247.2	9.5
RIBBON LAP MACHINE	64.0	64.000	64.000	6	6.00			60	230.4	75.8	174.6	1.0	305.3	1.7
SLIVER LAP MACHINE	64.0	64.000	64.000	20	1.66			60	230.4	80.8	186.2	.5	308.4	1.7
HIGH PRODUCTION CARD	5.3	.189	.111		120.75				28.0	97.0	27.2	3.5	309.9	11.4
FLOCK FEEDER INCL. FAN									250.0	97.0	242.5			1.3
ERM-CLEANER									500.0	97.0	485.0			.7
ERM-CLEANER									500.0	97.0	485.0			.7
AEROMIX									500.0	97.0	485.0			.7
MONO CYLINDER CLEANER									500.0	97.0	485.0			.6
WASTE OPENER									50.0	97.0	48.5			.3
ROLLER BLENDING OPENER									250.0	97.0	242.5			1.3
BLOWROOM TOTAL												5.0	321.1	
RAW MATERIAL REQUIRED													338.1	

Données de base pour projet de filature pour
Bases de calculo del proyecto de hilandoria para

MINISTRY OF COMMERCE AND INDUSTRY
KUWAIT
STATE OF KUWAIT

114/114 2708
HIN22 15.2.78

Maschinendaten Machine specificat. Caractéristiques des machines Datos de máquinas — Preise Prices Prix Precios

Machines	Units per machine	Number of machines	Total units	Degree of utilization	Model	Drafting arrangement	Package size at delivery in mm	Sales price per machine	Sales price total
								SFR	SFR
BLEND									
RINGSPINNING FRAME	612	64	39168	98.0	G0/2	R2P36	GAUGE: 70 RING: 45 TUBE: 230	208,620.-	13,351,680.-
SPEED FRAME	108	8	864	96.5	F1/1A	F2R36	BOBBIN DIAMETER: 165 LIFT: 305	197,930.-	1,583,440.-
DRAWFRAME 3RD PASSAGE	2	6	12	96.3	D0/2		CAN DIAMETER: 450 HEIGHT:1070	52,690.-	316,140.-
DRAWFRAME 2ND PASSAGE	2	6	12	89.5	D0/2		CAN DIAMETER: 450 HEIGHT:1070	52,690.-	316,140.-
DRAWFRAME 1ST PASSAGE	2	6	12	95.0	D0/2		CAN DIAMETER: 450 HEIGHT:1070	52,690.-	316,140.-
SYNTHETIC									
PRE-DRAWFRAME	2	4	8	93.6	D0/2		CAN DIAMETER: 450 HEIGHT:1070	54,250.-	217,000.-
HIGH PRODUCTION CARD	1	16	16	99.2	C1/3RL		CAN DIAMETER: 600 HEIGHT:1200	120,650.-	1,930,400.-
CARD FEEDING SYSTEM AEROFEED		16						9,570.-	153,120.-
CARDING TOTAL									2,083,520.-
FLOCK FEEDER INCL. FAN	1	2	2	95.8	A7/2			66,700.-	133,400.-
AEROMIX	1	1	1	95.8	B7/2			106,700.-	106,700.-
ROLLER BLENDING OPENER	1	2	2	95.8	B2/3			65,160.-	130,320.-
PNEUMATIC CONVEYANCE		1			A4				21,680.-
CONTROL OF BLOWROOM MACHINERY		1			A6				66,940.-
BLOWROOM TOTAL									459,040.-

Données de base pour projet de filature pour
Bases de calculo del proyecto de hilandería para

MINISTRY OF COMMERCE AND INDUSTRY
KUWAIT
STATE OF KUWAIT

114/114 2708
HIN22 15.2.78

Maschinendaten Machino specificat. Caractéristiques des machines Datos de máquinas — Preise Prices Prix Precios

Machines	Units per machine	Number of machines	Total units	Degree of exploitation %	Model	Drafting arrangement	Package size at delivery in mm				Sales price per machine	Sales price total
C O T T O N											SFR	SFR
COMBER	1	10	10	95.1	E7/4		CAN	DIAMETER:	450	HEIGHT:1070	132,680.-	1,326,800.-
RIBBON LAP MACHINE	1	2	2	87.4	E4/1A		LAP	WIDTH:	300		100,790.-	201,580.-
SLIVER LAP MACHINE	1	2	2	82.8	E2/4A		LAP	WIDTH:	250		84,270.-	168,540.-
COMBING MACHINERY TOTAL												1,696,920.-
HIGH PRODUCTION CARD	1	12	12	94.9	C1/3RL		CAN	DIAMETER:	600	HEIGHT:1200	120,650.-	1,447,800.-
CARD FEEDING SYSTEM AEROFEED		12									9,570.-	114,840.-
CARDING TOTAL												1,562,640.-
FLOCK FEEDER INCL. FAN	1	2	2	66.2	A7/2						66,700.-	133,400.-
CRP-CLEANER	1	1	1	66.2	B5/5						39,100.-	39,100.-
CRP-CLEANER	1	1	1	66.2	B5/5						39,100.-	39,100.-
AERONIX	1	1	1	66.2	B7/2						106,700.-	106,700.-
MONO CYLINDER CLEANER	1	1	1	62.9	B4/1						22,510.-	22,510.-
WASTE OPENER	1	1	1	33.1	B2/3						65,160.-	65,160.-
ROLLER BLENDING OPENER	1	2	2	62.9	B2/3						65,160.-	130,320.-
PNEUMATIC CONVEYANCE		1			A4							17,760.-
CONTROL OF BLOWROOM MACHINERY		1			A6							79,990.-
BLOWROOM TOTAL												634,040.-
TOP ROLLER GRINDING MACHINE												82,330.-
CARD GRINDING EQUIPMENT												14,590.-
B L E N D												
MILL GRAND TOTAL												22,634,170.-

Projekt für Project for Projet pour Proyecto para	MINISTRY OF COMMERCE AND INDUSTRY KUWAIT STATE OF KUWAIT	114/114 2708 HIN22 15.2.78

Aufwand Expenditure Besoins Necesidades — Kosten Costs Coût Costes

Machines	Workers for production	Workers for maintenance	Installed power for machines kW	Inst. power for dimensioning kW	Inst. power for air condit. kW	Floor area incl. gangways/reserve m²	Costs for auxiliary material per year SFR	Costs for accessories SFR	Costs of waste per kg yarn SFR	Wages costs per kg yarn SFR	Electric power costs per kg yarn SFR	Costs of auxiliary mat. per kg yarn SFR	Capital costs per kg yarn SFR	Manufacturing costs per kg yarn SFR
BLEND														
RINGSPINNING FRAME	35.2	2.70	1708.8	80.3	286.5	4530	237502	297178						
YARN COUNT 1	35.2								.0101	.2496	.0294	.0670	.6795	1.0356
SPEED FRAME	4.1	.56	98.4	13.2	22.3	1248	25263	154808	.0080	.0302	.0019	.0085	.0950	.1454
DRAWFRAME 3RD PASSAGE	1.3	.06	33.0	3.2	6.4	300	5655	22800	.0035	.0090	.0007	.0019	.0190	.0341
DRAWFRAME 2ND PASSAGE	1.4	.06	33.0	3.2	6.4	300	5655	22800	.0036	.0097	.0007	.0019	.0190	.0349
DRAWFRAME 1ST PASSAGE	1.5	.06	33.0	3.2	6.4	300	5655	10240	.0036	.0103	.0007	.0019	.0188	.0353
SYNTHETIC														
PRE-DRAWFRAME	.9	.04	22.0	2.5	4.6	240	3770	19440	.0023	.0062	.0005	.0013	.0136	.0239
HIGH PRODUCTION CARD	1.1	.35	126.4	4.4	15.6	416	33093	8640	.0094	.0094	.0023	.0089	.0937	.1237
CARD FEEDING SYSTEM AEROFEED													.0071	.0071
CARDING TOTAL	1.1	.35	126.4	4.4	15.6	416	33093	8640	.0094	.0094	.0023	.0089	.1008	.1308
FLOCK FEEDER INCL. FAN			22.2	.7	2.7	70	804				.0004	.0003	.0068	
AEROMIX			11.9	.3	1.3	45	167				.0002	.0001	.0054	
ROLLER BLENDING OPENER			17.0	1.4	2.7	200	500	5400			.0003	.0005	.0084	
PNEUMATIC CONVEYANCE													.0010	
CONTROL OF BLOWROOM MACHINERY													.0031	
BLOWROOM TOTAL	1.6	.04	51.9	2.4	6.7	315	1551	5400	.0072	.0108	.0009	.0009	.0247	.0445

Projekt für Project for Projet pour Proyecto para MINISTRY OF COMMERCE AND INDUSTRY
KUWAIT
STATE OF KUWAIT

114/114 2708
HIN22 15.2.78

Machines	Workers for production	Workers for maintenance	Installed power for machines kW	Installed power for illumination kW	Installed power for air condition kW	Floor space incl. gangways/reserve m²	Costs for auxiliary material per year SFR	Costs for accessories SFR	Costs of waste per kg yarn SFR	Wages costs per kg yarn SFR	Electric power costs per kg yarn SFR	Costs of auxiliary mat. per kg yarn SFR	Capital costs per kg yarn SFR	Manufacturing costs per kg yarn SFR
C O T T O N														
COMBER	1.3	.29	46.0	2.3	7.2	220	32359	19000	.1075	.0104	.0008	.0084	.0645	.1916
RIBBON LAP MACHINE	.6	.05	5.8	.7	1.2	64	2502	5520		.0042	.0001	.0007	.0103	.0153
SLIVER LAP MACHINE	.3	.03	5.8	1.7	2.1	160	1134	11400		.0022	.0001	.0006	.0102	.0131
COMBING MACHINERY TOTAL	2.2	.37	57.6	4.7	10.5	444	35995	35920	.1075	.0168	.0010	.0097	.0850	.2200
HIGH PRODUCTION CARD	.8	.26	94.8	3.3	11.7	312	24820	6480	.0408	.0069	.0017	.0068	.0703	.1265
CARD FEEDING SYSTEM AEROFEED													.0053	.0053
CARDING TOTAL	.8	.26	94.8	3.3	11.7	312	24820	6480	.0408	.0069	.0017	.0068	.0756	.1318
FLOCK FEEDER INCL. FAN			22.2	.7	2.7	70	884				.0004	.0003	.0068	
PRE-CLEANER			7.2	.1	.7	14	125				.0001		.0019	
PRE-CLEANER			7.2	.1	.7	14	125				.0001		.0019	
AEROMIX			11.9	.3	1.3	45	167				.0002	.0001	.0054	
MONO CYLINDER CLEANER			2.2	.1	.3	14	42						.0011	
WASTE OPENER			8.9	.7	1.3	100	250				.0002	.0003	.0040	
ROLLER BLENDING OPENER			17.8	1.4	2.7	200	500	5400			.0003	.0005	.0084	
PNEUMATIC CONVEYANCE													.0008	
CONTROL OF BLOWROOM MACHINERY													.0037	
BLOWROOM TOTAL	1.2	.05	77.4	3.4	9.7	457	2093	5400	.0695	.0083	.0013	.0012	.0340	.1143
B L E N D														
EXPENDITURE GRAND TOTAL	51.3	4.55	2336.3	123.8	386.8	8870	381052	596706						
MANUFACTURING COSTS GR. TOTAL														
YARN COUNT 1									.2663	.3672	.0411	.1100	1.1650	1.9496

MINISTRY OF COMMERCE AND INDUSTRY
KUWAIT
STATE OF KUWAIT

114/114 .2705
HIN22 15.2.73

Berechnungsgrundlagen zum Spinnereiprojekt
Basis of calculation to spinning mill project
Données de base pour projet de filature
Bases de calculo del proyecto de hilanderia

Randbedingungen
Marginal conditions
Conditions marginales
Datos basicos

Stundenlohn für Bedienungspersonal	Stundenlohn für gelerntes Personal	Stundenlohn für ungelerntes Personal	Leistungsfaktor	Reservepersonal	Strompreis
Hourly wage for machine tenders	Hourly wage for skilled personnel	Hourly wage for unskilled personnel	Productivity factor	Personnel in reserve	Cost of electric power
Coût horaire pour personnel servant	Coût horaire pour personnel specialisé	Coût horaire pour personnel auxiliaire	Facteur d'exploitation	Personnel réserve	Prix du courant électrique
Salario hora del personal aux machines	Salario hora del personal cualificado	Salario hora del personal no cualificado	Factor de productividad	Personal de reserve	Precio de la energia electrica
sfr. 4.05	sfr. 6.40	sfr. 2.75	.75	% 10	sfr./kWh .014

Gebäudekosten	Gebäudeunterhalt pro Jahr	Anzahl Schichten pro Tag	Betriebsstunden pro Jahr	Zoll, Steuern etc. in % des Maschinenpreises	Kapitalzins
Building costs	Yearly building maintenance	Number of shifts per day	Operating hours per year	Customs, sales tax etc. in % of machine price	Capital interest
Frais de bâtiment	Entretien du bâtiment par an	Nombre d'équipes par jour	Nombre d'heures de travail par an	Frais de douanes etc. en % du prix des machines	Intérêt du capital
Costo del edificio	Costo anual de mantenimiento del edificio	Numero de equipos por dia	Horas de trabajo pro año	Aduanas, impuestos etc. en % del precio de las máquinas	Interes del capital
sfr./m² 480	% 1.5	3	6000	%	% 6.00

Amortisation der Maschinen in Jahren	Amortisation des Zubehörs in Jahren	Amortisation des Gebäudes in Jahren	Umrechnungskurs	Rohmaterial	Stapellänge
Depreciation for machinery in years	Depreciation for accessories in years	Depreciation for building in years	Exchange rate	Raw material	Staple length
Amortissement des machines en années	Amortissement des accessoires en années	Amortissement du bâtiment en années	Taux de change	Matière première	Longueur des fibres
Amortizacion de las maquinas en años	Amortizacion de las accesorias en años	Amortizacion de el edificio en años	Cotización del cambio	Materia prima	Longitud de fibra
8	5	20	1 sfr. =	65 % SYNTHETIC 35 % COTTON	= 40 MM = 1 3/32 "

Bemerkungen Remarks Remarques Observaciones

DELIVERY F.O.B. EUROPEAN PORT OF OUR CHOICE, WITHOUT INSURANCE, SEA-PACKED, ERECTION HOURS INCLUDED, RETURN FLIGHT TICKETS AND DAILY ALLOWANCE FOR OUR ERECTORS TO YOUR ACCOUNT.

Conditions of Sale

Re: Estimate / ~~Order Confirmation~~ No. 2708 dated 15th February 1978

1. Prices:
Our prices are quoted net, without any deductions, for delivery

f.o.b. European port of our choice, without insurance.

The prices are based on current production costs. In case of a substantial increase of the latter up to the time of delivery, especially in case of war or major currency changes, we reserve the right to charge for additional costs.

2. Payment:

100% of the order value, covered by an irrevocable Letter of Credit established in our favour with a first class Swiss bank and confirmed by the latter with the order. The Letter of Credit must permit the following payments:

20% as down-payment against presentation of simple receipt

80% balance, against presentation of forwarding agent's receipt or Swiss warehouse receipt.

Interest on delayed payments will be charged at the rate of 8 per cent p.a. from due date.
All banking fees in connection with Letters of Credit, bank guarantees, documentary collections, negotiations of documents as well as possible stamp fees, etc., in your Country as well as in Switzerland are always for your account.

3. Time of Delivery:
Ex works, as far as can be foreseen at present

commencing approximately 8 months after receipt of correct Letter of Credit and clarification of all technical details.

4. Packing: for sea transport included

5. Erection: Erection hours included, return flight tickets and daily allowance for our erectors to your account

For the rest our "General Conditions of Sale and Delivery" apply, representing an integral part of this Estimate / ~~Order Confirmation~~ if no other arrangement is explicitly stated above.

RIETER MACHINE WORKS LIMITED

COPY

ANNEX 10

PRODUCTION COSTS FOR CERTAIN FABRICS IN SAUDI ARABIA AND NIGERIA

Sulzer Brothers of Winterthur, Switzerland, have made two studies of production costs for certain fabric types in developing countries. Sulzer is a very large producer of shuttleless looms and offer limited consulting service on fabric formation as part of their marketing service. The first attached report, No. 6504, entitled Feasibility Study for Thobe-cloth/Kuwait, is a copy of the study which they made for Saudi Arabia in November, 1977. Since the study was obtained March 3 in Winterthur, Switzerland, a detailed analysis is not possible but the information is of value because it represents a study of the cost of producing a polyester cotton fabric in the Gulf Area.

The Saudi Arabian project was designed to produce Thobe cloth, which is some type of Saudi Arabian dress cloth in both white and dyed forms. The cloth is reasonably similar to the possible fabric estimated in the body of the present dishdasha study. The details of the two fabrics are shown below:

	DISHDASHA Dishdasha-Kuwait	Thobe-Saudi Arabia
Yarn	cc (Ne) 40	cc (Ne) 45
Weight	113 g m^2	110 g m^2
Fabric Construction		
Warp	35 / cm	67 / cm
Fill	35 / cm	
Fiber Content	65-35 Polyester-Cotton	67-33 Polyester-Cotton
Fabric Width	91.4 cm	90 cm
Finishing		
Mercerization	No	Yes
Resin Treated	Yes	Yes

Actually the Kuwait fabric was based on a preliminary examination of one dishdasha fabric and a careful analysis of the fabric by a competent laboratory has shown that the dishdasha fabric was a 2 ply yarn which would make the yarn as woven a nominal 60 cc (Ne) yarn. A quick analysis has shown that a Thobe fabric of the indicated construction would weigh 140 g per m^2. Therefore, assuming the fabric weight is correct, either the yarn count should be higher or the fabric construction is incorrect. The greatest difference between the two fabrics is in warp density. From a fabric manufacturing standpoint increased warp density does not increase fabric manufacturing cost except for the increased cost of the yarn. The greatest cost in actual fabric manufacturing is the cost of the weft insertion.

The Saudi Arabian plant was designed to produce 3,231,000 linear meters of fabric using imported yarn. Weaving was three widths per loom and similar to our projections. Looms were identical and Sulzer estimated that 36 looms would be required based on an 89% efficiency. We were somewhat more conservative and used a loom efficiency of 80%. Thus, our plant in this respect is more conservative than the Sulzer estimate.

Since the Thobe plant was based on imported spun yarn the only yarn winding requirement was for rewinding yarn from the creeling operation. They also indicated that it might be necessary to rewind the weft or fill yarn. This may or may not be necessary depending upon the ability to purchase the proper yarn.

The warping area assumes that the creel would be a 640 position creel while our estimates are based on a larger creel which would require more floor space. For the size of the Thobe plant the warping area would be run on one shift basis. As a result warping costs, because of the small plant size, will be high.

In the finishing area the chief differences are in the Thobe provision for mercerizing. Although some dishdasha fabrics are mercerized, we were not certain that this would be necessary for all fabrics and hence did not provide these facilities. We also did not provide any facilities for dyeing.

In regard to the building size, they have provided a large area for yarn storage. Since we will be using yarn from an integrated mill rather than imported yarn, the storage area for 3 months yarn supply will not be necessary. They have estimated a weaving area of 970 m^2 for 36 looms which would correspond to 6400 m^2 for our proposed plant. We have provided fabric storage space in a separate facility. Their finishing area is more complex in view of the greater number of functions and, therefore, it is difficult to form an accurate comparison with our plant.

The chief difference in the building area, disregarding size, is the cost. Using Bureau data on building costs, the 7,600 m^2 plant should cost approximately 532,000 KD. Their estimate for the building is 22,255,000 Swiss francs or 3,225,000 KD based on 1 KD = 6.9 Swiss francs. This would mean that the building costs would be equivalent to 424 KD per m^2 which is substantially higher than our estimate based on Bureau recommendations.

In the personnel area, since they are using only a small plant and have more complicated processing departments, their personnel requirements are high. In the weaving area they used a weaving load of 18 looms per weaver. We assumed that we would start with about a 10 loom load and that with experience we could build to about 20 looms per weaver. Our costs are based on this latter load so that our costs are comparable.

For labor costs they have assumed costs substantially higher than similar costs recommended for Kuwait. For example, the class corresponding to maintenance workers or craftsmen suggest a yearly cost of 5070 KD whereas the estimated costs in Kuwait would be 2520 KD.

In the import yarn area for 45 cc yarn they are estimating a price of 1.16 KD for purchase in the Far East which translates to about 1.30 KD per Kg. Our estimated cost of production, including a 15% ROI, is about 1.10 KD per Kg.

In summary, the plant costs for Thobe fabric are relatively high because of the low utilization of much of the equipment. In addition, from Bureau suggested building costs, their building cost estimates appear to be excessive. In areas where direct comparisons can be made, such as weaving, our projections appear to be comparable. In the finishing area our projections are much more optimistic which are in part a result of our less complicated process but possibly also because of our lack of detailed experience in these particular areas.

The plant layout attached is also for the Thobe plant in Saudi Arabia.

The second study which they have provided is for a plant of 106 loom capacity, approximately half of our proposed dishdasha fabric plant, to produce drill, shirting and suiting. The plant estimate was for Nigeria. Although we have not yet considered these products, three of the four fabrics are polyester cotton. Since we have not estimated similar fabrics for Kuwait we have not examined their proposal in detail. It was noted that the shirting fabrics are for 45 cc (Ne) polyester cotton yarns which approximate quite closely our proposed yarn plant for 40 cc yarn. Our plant could make this yarn with only minor adjustments and the construction of our proposed yarn plant and weaving plants would give us abilities to provide similar fabrics. This study would thus be of value in the future.

Preliminary Project No. 6504 and Feasibility Study for Thobe-Cloth / Kuwait

by

SULZER BROTHERS LTD.
Winterthur /Switzerland
9/Textile Machinery Division
Planning Department

1. **Introduction**

The first part of this study is based on a production of 36 Sulzer Weaving Machines, which will weave local dress cloth (Thobe). The following departments are envisaged:

- Yarn Storage
- Weaving preparation
- Weaving
- Finishing
- Cloth inspection
- Storage for finished cloth

The following Feasibility-Study is based on this Preliminary-Project. It shows the estimated investments and the expected fixed and variable costs.

A further chapter gives a survey over an integrated knitting department.

2 Article Data

Article	Thobe
Material	33 % Cotton
	67 % PES
Yarn count warp and weft	Ne 45/1
Density (finished) warp ends/cm	55
Density (finished) weft picks/cm	29
Type of weave	L 1/1
Weaving in warp	4 %
weft	3 %
Width (cm) in reed	100
raw	97
finished	90
Weight finished g/running meter	
- warp	67.67
- weft	39.20
- total	106.87
Weight finished g/m2	110.18

3 Production Data and Yarn Requirements

3.1 Working Times

Hours/shift	7.5	
Shifts/day	3	(22.5 hours)
Days/year	280	
Hours/year	6 300	

3.2 Production Data

The following data are according to our experience:

Type of Sulzer weaving machine (SWM)	130 ES E 10
Number of widths	3
Width in reed	3 x 100
Speed RPM	258
Efficiency	89 %
Number of picks/SWM and h	13 777
SWM production m/h	3 x 4.75 = 14.25
Number of SWM	36

<u>Production of all SWM</u>

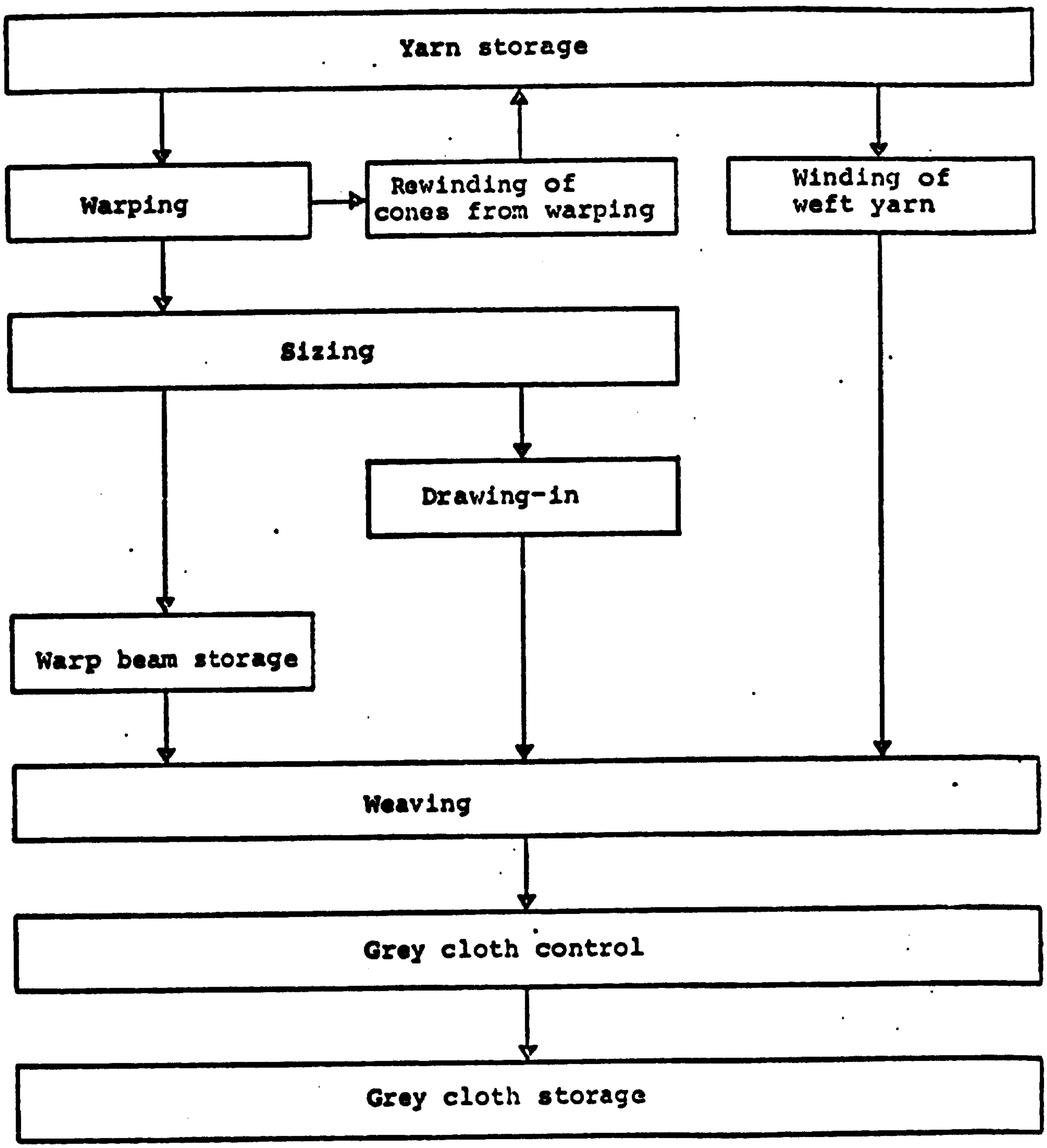
m/hour	513
m/day	11,542.5
m/year	3,231,900.--

3.3 Yarn Requirements

Based on article and production data we have calculated the following yarn requirements (including 5 % waste):

Yarn in kg per		hour	day	year
Ne 45/1	warp	36.54	822.19	230,213
Ne 45/1	weft	21.17	476.28	133,358
Total		57.71	1,298.47	363,571

4. Material Flow Weaving Preparation and Weaving



5. Necessary Production Machinery and Equipment (weaving preparation and weaving)

Following the material flow the most important capacities will be discussed:

5.1 Yarn Storage

Because all yarn has to be imported, the yarn storage should have a capacity for at least a three-month period.

Yarn consumption/day	1,298.47	kg
Quantitiy of yarn in stock	90,893	kg
Capacity/pallet	140	kg
Number of pallets	650	
Degree of utilization	80 %	
Required capacity (pallets)	812	

5.2 Winding Department

5.2.1 Winding of weft yarn

If the make-up of the bought yarn does not comply with the requirements of the weaving department, the weft yarn has to be rewound. To fulfill this operation, about 48 spindles are necessary.

5.2.2 Winding of Rests

Assuming that 6 % of the yarn, used in the warping department have to be rewound, one needs therefore about 6 spindles.

All together about 54 spindles (1 machine with 60 spindles) have to be installed.
These spindles have to run 3 shifts per day.

We have supposed, that the make-up of the bought cross-wound cones complies with the requirements of the warping department.

5.3 Warping Department

With one warping machine the whole production can be warped without any difficulty during one shift. The working width of the beaming machine should be 180 cm. We propose the installation of a V-creel with a capacity for 640 cross wound cones.
For each warp beam 12 back beams have to be prepared.

5.4 Sizing Department

Because only single yarns are used, the warps have to be sized. The working width of the sizing machine should be 180 cm (same width as the warping machine). The beaming machine has to be equipped for 130" half beams.

5.5 Weaving

The whole project is based on a capacity of

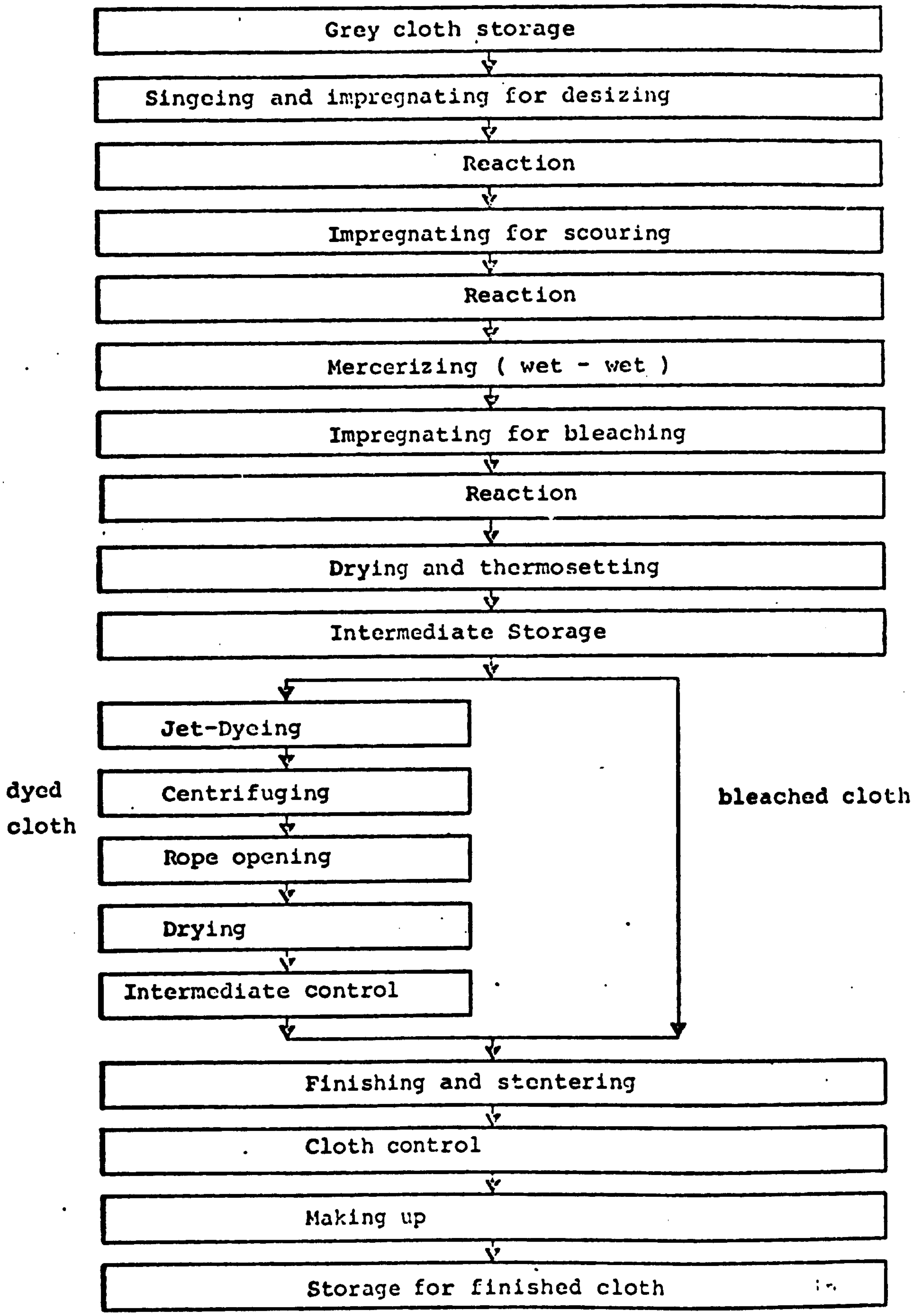
36 Sulzer weaving machines
SWM 130 ES E 10.

On these machines three widths can be woven side by side. The production is calculated in chapter 3.2 .

5.6 Grey Cloth Control

With two inspection machines the whole production can be controlled during two shifts.

6. Material Flow Finishing



7. Necessary Production Machinery and Equipment in the Finishing Department

Following the material flow the most important capacities will be mentioned:

7.1 Pretreatment

1 Impregnating station,
consisting of 1 singeing machine and
1 compartment for impregnating for desizing

2 Reaction station
used after impregnating for desizing and after impregnating for scouring and after impregnating for bleaching.

1 Pad Rol Pretreatment plant
used for impregnating for scouring and for impregnating for bleaching.
This equipment consists of 3 compartments for washing and 1 compartment for impregnating.

1 Mercerizing machine (wet - wet)
consisting of 1 compartment for washing, 1 compartment for impregnating, 1 compartment for stabilising and 1 compartment for neutralising and washing.

The working width of the equipment in the pretreatment department should be at least 160 cm.
These machines could also process cloth woven 2 widths side by side on the 130" weaving machine.

1 <u>Stenter frame for drying and thermosetting</u>

Because the weight of the cloth is not heavy, drying and thermosetting can be done in one run. With the proposed 4 field stenter frame one attains the required production without difficulties.

7.2 2 <u>Jets (Dyeing machines)</u>

For dyeing and washing after dyeing with a capacity of about 280 kg cloth each.
With a process duration of five hours per load, the jets will run with an efficiency of 76 %, if 100 % of the cloth will be piece dyed.

1 <u>Centrifuge</u>

1 <u>Rope opener</u>

1 Stenter frame for drying the cloth after rope opening and for finishing and stentering the cloth at the end of the whole finishing process. This stenter frame has to be equipped with a padder.
For working with high flexibility we propose to install also a padder in front of the other stenter frame, mentioned in chapter 7.1 .

1 <u>Inspection table</u>

for the intermediate control of the dyeing quality.

2 <u>Inspection tables</u>

With two inspection machines who whole production can be controlled.

8. Layout Description

The proposed layout (drawing no. 1 617 491 includes the capacities described in chapters 5 and 7.
The building is based on column centerline distances of 7.62 x 21.23 m, as used in prefabricated standard buildings. The building has a length of 144.78 m and a width of 52.46 m.
The floor requirements for the mill are as follow:

Yarn storage	970.6	m2
Weaving preparation	1,294.2	"
Weaving	970.6	"
Grey cloth inspection and finishing	2,264.8	"
Cloth inspection and storage for finished cloth	647.1	"
Service tract	1,447.8	"
Total	7,595.1	m2

If the capacities have to be extended in the future, the area of the yarn storage could be used as a weaving room, a new yarn storage can be built outside, most capacities of the finishing department would be sufficient if one would work three shifts instead of two as calculated now.

Ancillary facilities, such as

- intermediate storages for chemicals and dye-stuffs
- air conditioning
- vacuum plant
- compressed air
- energy distribution
- laboratory
- workshop
- offices
- WC's
- first aid room

have to be located in the service tract.
Outside of the described building have to be erected:

- main chemical and dye-stuff storage
- main workshop
- main storage for spare parts
- water treatment
- boiler house
- oil tanks
- water tanks

9. Estimated Investment for Machinery, Equipment, Building and Installation

The indicated prices are our approximate standard prices and are in no way binding. They are not based on special offers for this project and have to be judged accordingly.

9.1 Approximate Investments for Machinery and Equipment

Department Machinery Equipment	Quantity	Approx. investments excl.: transportation incl. erection incl. training	Possible Suppliers
Yarn Storage			
Shelves to pallets			Kempf/CH
Pallets			Krebs/CH
Transport equipment			Kempf/CH, Lansing Bagnall/GB
Scale			Buser/CH
TOTAL 1		152,000.--	
Preparation to Weaving			
Winding machine	1		Mettler/CH Schlafhorst/D
Warper with V-creel	1		Benninger/CH
Sizing equipment	1		Zell/D, Sucker/D
Reaching in equipment (semi automatic)	1		Zellweger/CH
Tying machine	2		Zellweger/CH
Warp beam storage			Steinemann/CH
Transport equipment			
Storage equipment			
Workshop			
TOTAL 2		1,812,000.--	

Department Machinery Equipment	Quantity	Approx. investments	Possible Suppliers
Weaving			
SWM 130 ES E 10	36		Sulzer/CH
Transport means	-		
Workshop			
Laboratory			
Vacuum cleaning system			Sulzer/CH
TOTAL 3		6,048,000.--	
Finishing			
Inspection machines	3		Maag/CH, Menschner/D
Singeing and impregnating machine	1		Osthoff/D, Benninger/CH
Pad Roll	1		Benninger/CH
Mercerizing machine	1		Benninger/CH
Stenter frame, padder	2		Brückner/D, Artos/D
Jet	2		Scholl/CH
Centrifuge	1		Möhlmann/D
Rope opener	1		Meier/D
Laboratory	1		Scholl/D
Chemical storage	1		
Dye-stuff storage	1		
Sewing machine	3		Dohle/D
TOTAL 4		8,732,000.--	

Department Machinery Equipment	Quantity	Approx. investments	Possible Suppliers
Cloth control, Making up, Storage finished Cloth			
Inspection machines	2		Maag/CH, Menschner/D
Making up machine	1		Mengen/D
Bale press	1		Autefa/D
Shelves to pallets			Kempf/CH
Pallets			Krebs/CH
Transport equipment			Kempf/CH, Lansing Bagnall GB
Scale			
TOTAL 5		280,000.--	

T O T A L 15,023,000.--

9.2 Approximative Investments for Building and Installation

The approximative investments for pre-fabricated buildings, including ventilation, and/or air conditioning, electric installation, steam, water and compressed air supply and sanitary installations will be about

Sfr 22,255,000.--

9.3 Approximative Expenses for Transportation

The approximative expenses for transportation will be about

Sfr 800,000.--

9.4 Summary of Investments

Machinery and equipment	Sfr 15,023,000.--
Buildings and installation	Sfr 22,255,000.--
Transportation	Sfr 800,000.--
Total	Sfr 38,078,000.--

10. Energy Requirements (kW installed)

Department	Machinery	Quantity	kW installed p. machine	kW installed total
Preparation to weaving	Winding machine	1	11	11
	Warping machine	1	11	11
	Sizing machine	1	18	18
	Warp beam storage	3	10	30
	Monorail	1	2	2
Weaving	SWM	36	2.6	93.6
Finishing	Inspection machine	3	3	9
	Impregnating station	1	22	22
	Reaction station	1	8	8
	Pad Roll	1	34	34
	Mercerizing machine	1	27	27
	Stenter frame, padder	2	100	200
	Jet	2	17	34
	Centrifuge	1	11	11
	Rope opener	1	3	3
	Sewing machine	3	2	6
Cloth control, making-up	Inspection machine	2	3	6
	Making-up machine	1	4	4
	Bale press	1	4	4
Ancillary facilities	Lighting	-	-	270
	Vacuum plant	1	33	33
	Compressed air	1	18	18
	Air conditioning	-	-	250
	Cooling (if necessary)	-	-	280

11. Personnel Requirements

These tables are based on average European standards and should be regarded purely as a guideline.
The exact personnel requirements depends upon

- the technical knowledge of the management
- the adaptability and willingness of machine operators and assistants.

In this calculation we have not considered any reserve personnel, as we are not thoroughly familiar with the conditions in Saudi Arabia, e.g. absenteeism, duration of holidays etc.

Job Description	Shift 1	2	3	day	Total
Conclusion					
Management				6	6
Preparation to weaving	2	2	2	11	17
Weaving department	6	6	4	3	19
Grey cloth control	3	3			6
Finishing department	17	17		2	36
Finished cloth control/storage	3	3		2	8
Ancillary services	5	5	2	2	14
Total	36	36	8	26	106

Job Description	Shift 1	2	3	day	Total
<u>Management</u>					
Mill manager				1	
Assistant				1	
Purchase/sales				1	
Secretary				2	
Production program				1	6
<u>Preparation to Weaving</u>					
<u>General</u>					
Foreman				1	
Mechanic				1	
Intermediate storage				1	
Room cleaner				1	4
<u>Yarn Storage</u>					
Store keeper				1	1
<u>Winding Department</u>					
Winder	1	1	1		
Transport	1	1	1		6
<u>Warping</u>					
Warper				1	
Creeler				1	2
<u>Sizing</u>					
Sizer				1	
Assistant to the sizer and size cooking				1	2

Job Description	Shift 1	Shift 2	Shift 3	day	Total
Reaching-in Department					
Drawer				1	
Harness preparation and reed cleaning				1	2
TOTAL Preparation to weaving					
General				4	4
Yarn storage				2	2
Winding department	2	2	2		6
Warping department				2	2
Sizing department				2	2
Reaching-in department				2	2
Weaving Department					
Staff					
Weaving manager				1	
Clerk				1	2
Weaving Room					
Overlooker	1	1	1		
Weaver	2	2	2		
Transport (weft carrier and cloth doffer) and cleaning	1	1	1		
Oiler				1	
Warp gaiter	1	1			
Warp tying	1	1			17
Grey Cloth Control					
Inspection	2	2			
Transport	1	1			6

Job Description	Shift 1	2	3	day	Total
Finishing Department					
Manager finishing				1	
Production planer and disponent				1	2
Finishing					
Foreman	1	1			
Singeing and impregnating	1	1			
Pad roll	1	1			
Mercerizing machine	2	2			
Stenter frame	4	4			
Jet	1	1			
Dyeing kitchen	1	1			
Centrifuge and rope opener	1	1			
Laboratory, chemical storage	2	2			
Transport	2	2			
Intermediate control	1	1			34
Finished Cloth Control/Storage					
Inspection	2	2			
Making up				1	
Transport	1	1			
Storage				1	8
Ancillary Services					
Maintenance	3	3			
Electric	1	1	1		
Gateman	1	1	1		
Surroundings				2	14

12. Pre-Feasibility-Study

This pre-feasibility-study is based on the preliminary project as described in the chapters 2 - 11 of this report.

12.1 Approx. Investments in Sfr

Item	Description in years			Total
	5	10	20	
Buildings, incl. installation - air conditioning - electricity - water - steam etc. - transport			22,255,000	
Machinery, incl. erection and training		15,023,000		
Transport for machinery		800,000		
Furniture		50,000		
Motor vehicles and trucks	200,000			
Preliminary expenses	500,000			
Contingency (10 %)	70,000	1,587,300	2,225,500	3,882,800
T o t a l	770,000	17,460,300	24,480,500	42,710,800

12.2 Salaries and Wages

Groupe	% *) from personnel	Number of employees	Wages Sfr/ year	Total Wages Sfr/ year
1 (highly skilled)	10	11	35,000	385,000
2 (skilled)	70	73	20,000	1,460,000
3 (unskilled)	20	22	15,000	330,000
	100	106		2,175,000
Reserve	10 % of groupes 2 and 3			179,000
T o t a l				2,354,000

*) according to our experience

12.3 Expenses for Yarn

Quality	33 % Cotton, 67 % PES
Yarn-count	Ne 45/1
Quantity	363,571 kg
Price	8.-- Sfr/kg (estimated price for purchase in Far East)
Estimate expenses for yarn	2,908,568 Sfr/year
CIF (8 %)	233,000 Sfr/year
Total	3,141,568 Sfr/year
	4,461,027 SR /year

12.4 Cost of Operation for One Year

	Sfr
Depreciation and interest (1 % p.a.)	
- Buildings (20 years)	1,285,226
- Machinery (10 years)	1,842,061
- Motor vehicles, preliminary expenses (5 years)	158,620
	3,285,907
Salaries and wages	2,354,000
Raw material (yarn CIF)	3,141,568
Electricity	800,000
Water	100,000
Oil	100,000
Chemicals, dye stuffs	320,000
Spare parts	85,000
Packing material	80,000
Postages, telegrams, telephones	10,000
Motor running expenses	80,000
Travelling	40,000
Medical expenses	10,000
Insurance (1 %)	38,000
Interest on working capital (1 %)	100,000
Total Sfr	10,544,475
Total SR	14,973,155

12.5 Unit Cost of Production Per Meter

With a yearly production as foreseen in this pre-feasibility study 3,231,900 meters (page 3) and the relative yearly cost of operation and production (page 27), namely, Swiss Francs 10'544'475 at a rate of exchange of 1.- Sfr. = 1.42 SR, amounting to SR 14'973'155.--

$$\text{Cost per meter} = \frac{\text{SR } 14'973'155.\text{--}}{3{,}231{,}900 \text{ meters}}$$

= **SR. 4,63 per meter**

12.6 Conclusion

It must be investigated locally whether a cost price of SR. 4,63/m. for mercerized Thobe material is attractive, bearing in mind the profit margin which must be included and the handling margins of dealers.

The cost of production may be reduced if:

- The capacity of the plant is increased, since a more efficient utilization of the finishing department will be possible.

- Building costs could be reduced. The estimated costs in this pre-feasibility study may be on the high side. It would be an advantage if you could investigate locally the cost of the building as described on page 11 and shown in the attached layout drawing No. 1 617 491.

13. <u>Final Remarks</u>

We trust that this study will serve as an objective basis for further discussions on this project and our planning office will be ready for further planning work.

Encl.:

Layout Drawing No. 1 617 491

Winterthur, February 21st, 1978

SULZER BROTHERS LTD.

9/Textile Machinery Division

Planning Engineer

W. Huber

Head of Planning Department

B. Streng

9/Textile Machinery Department
Office for Production Economics
9014 Ha/wei

Winterthur, November 29., 1977

KUWEIT

Cost and profitability Projections

Data of fabric

Type of cloth		Drill	Shirting plain	Shirting dobby	Suiting dobby
Yarn count	warp	16	45	45	34/2
Ne	weft	12	45	45	34/2
Threads per inch					
(finished)	warp	64	128	128	74
	weft	40	74	74	52
Grey width	inch	61	46	46	64.2
Reed width	inch	65	49.2	49.2	68.9
Material		Cotton	PE/Cotton	PE/Cotton	PE/Viscose

SWM Machine specification

Type SWM	130" ES E10	110" ES E 10	110" VSD KT	153" VSD KT
Processing speed ppm	237	298	250	214
Number of widths	2	2	2	2
Picks per yard	1412	2623	2623	1834
Theoretical production/ machine/yard/hour	20.14	13.63	11.44	14.00
Efficiency in %	75	80	75	75
Effective production / * machine/yards/hour	14.20	10.25	8.06	9.86
Required production/ hour in yards	476.63	273.40	172.11	221.00
Necessary weaving machines	33.40	26.54	21.15	22.30
Proposed weaving machines	34	27	22	23
Machine hours per year	6750	6750	6750	6750
Eff. output/fabric/yards	3 260 000	1 868 000	1 197 000	1 531 000
" " " /metres	2 981 000	1 708 000	1 094 000	1 400 000

* Effective production yards/hour = according to your instruction: 94 % machine utilisation are included.

Raw materials:

	Drill		Shirting plain Shirting dobby		Suiting dobby
Weight kg/run. meter	0.265		0.123		0.279
	Warp	Weft			
Yarn consumption/kgs	421 000	369 000	344 670		390 700
Yarn wastage:			Shirt. plain	Shirt. dobby	
Weaving + weav. preparation	4,5 %		3,0 %	4,0 %	6 %
	Warp	Weft			
Yarn consumption/kgs	440 840	386 350	356 750		415 530
Yarn wastage:					
Spinning	15 %		8,6 %		5,3 %
	Warp	Weft			
Yarn consumption/kgs	518 640	454 530	390 320		438 790
Price raw material / kg $	1.45	1.40	1.50		1.40
Raw material costs $	752 030	636 340	585 330		614 300

Sizing material; Colours and chemicals

- **Sizing material:**

Article: Drill, Shirting plain, Shirting dobby:			
Production/year:	1 364 000 kgs		
Sizing materials:	0,16 . kg	$	218 000

- **Colours and chemicals:**

Processing:	$	50 000
Dying :	$	2 750 000
Total	$	2 800 000

Personnel expenses

	Number of personnel	Wages per year total $
Spinning, doubling	116	137 100
Weaving preparation	61	76 200
Weaving	58	68 600
Cloth inspection	14	16 800
Processing	68	85 000
Staff	54	239 000
Engineering	52	416 000
Total	423	1 038 700
Costs of fringe benefits 30 %		311 600
Other reserves 10 %		104 000
TOTAL WAGES	$	1 454 300

Consumption of accessories and machine spare parts:

		$
- Spinning		73 000
- Weaving preparation		29 000
- Weaving		17 000
- Cloth inspection		1 500
- Processing		120 000
- Staff		5 000
- Maintenance		3 000
	Total $	248 500
Packing materials	$	20 000

Power charges:

Cost of current per 1 kWh: $ 0.04

- Spinning		100 000
- Weaving preparation		23 200
- Weaving		63 400
- Cloth inspection		2 000
- Processing		95 000
- Air conditioning		180 000
- Light		70 000
- Others		2 000
	Total $	535 600

<u>Water charges:</u>	($ 0.20 /m3)	$	104 000
<u>Steam charges:</u>		$	164 000

<u>Buildings</u> (approx):

Spinning, weaving preparation, weaving room cloth inspection, processing, maintenance, office:

22 600 m2 = 243 000 sqft.

	$
New building cost $ 40 per sqft.	9 720 000
Depreciation over 20 years	486 000
Interest 8 % per year, average 4.2 %	408 200
Maintenance	44 800
Fixed costs for buildings	939 000

Investment costs (machinery, auxiliary facilities) (C + F Port Harcourt)		$
Spinning		7 658 600
Weaving preparation		3 231 500
Weaving		12 956 500
Cloth inspection		459 500
Processing		10 170 700
Auxiliary facilities		10 192 600
Total machinery, etc.	$	44 669 400
Investment costs for building	$	9 720 000
Investment total	$	54 389 400

Amortisation and interests (machinery, aux. facilities)		
Depreciation 10 years		4 466 940
Interest 8 %, average 4.4 %		1 965 460
Total	$	6 432 400

<u>Production costs / year:</u>

	$
Raw material (US-price + 20%)	2 588 000
Personal expenses	1 454 300
Colours and chemicals	2 800 000
Stores, spares and packing materials	268 500
Sizing materials	218 000
Power charges	535 600
Steam charges	164 000
Water charges	104 000
General Mill Expenses	72 000
Insurance (0.5 of investment costs)	272 000
Less yarn sales	- 76 000
Total direct costs without capital costs/year $	**8 400 400**
Fixed costs of buildings, incl. maintenance/year	939 000
Capital costs of machinery and auxiliary facilities / year	6 432 400
Total fixed costs per year $	**7 371 400**
Total production costs per year $	**15 838 500**

Exchange rate: 1 US $ = 2.285 SFr.

Cloth sales / year:

	Production/yards (finished)	Sales/yard $	Sales total $ 1000
Drill	3 031 300	2.00	6 062.6
Shirting plain	1 747 800	2.56	4 474.4
Shirting dobby	1 094 600	2.76	3 021.1
Suiting dobby	1 405 500	3.94	5 537.7
Total	7 279 200 yards	$	19 095.8

Less sales expenses 2 % on cloth sales	-	382.0
Net sales per year:	$	18 713.8

PROFIT / year:

Profit before depreciation & interest/year (Net sales - direct costs - maintenance of buildings)	$	10 268.6
Depreciation buildings and machinery/year	$	4 952.9
Profit before interest/year	$	5 315.7
Interest buildings and machinery/year	$	2 373.7
Profit after interest/year	$	2 942.0

Cash flow: (Depreciation + profit)	$	7 894.9

Cost Department

J. Kravarik F. Hausner