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PRESENT STATUS AND FUTURE PLANS OF THE DEVELOPMENT OF THE SYNTHETIC FIBRE INDUSTRY IN EGYPT 1/

by

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COTTON STILL ON THE TOP

Until about 20 years ago, , the world's textiles were made almost exclusively of the natural fibres, wool, silk and native or modified cotton, whereby cotton has the lions share.

It became evident after the last world war, that the natural resources could no longer satisfy the rapidly increasing demand for textile fibres. Therefore, synthetic fibres were evolved in order to satisfy this demand, and to-day the three major groups of these, namely the Polyamides, the Polyesters and the Polyacrylonitriles, account between themselves for about 28 % of the total world fibre production. However cotton is still by far the most important fibre, and this will be the situation for many years to come especially in Egypt since we have one of the best cottons in the world, and its production is more than sufficient for our consumption.

The natural fibres have some outstanding properties which are still very much appreciated by the customers, and the one property which is in everybody's mind is the wearing comfort of the garments, made of these fibres. This is due

to the high water regain , which for cotton is in the region of 8 % and for wool even 20 % . The figures for the synthetic fibres are about 10 times lower. However also in this case has the medal two sides and with this I mean that the natural fibres have some properties which compare unfavourably with those of the synthetic fibres.

WORLD PRODUCTION OF TEXTILE FIBRES IN 1000 TONS.

	1966	1967	1968		1970		1980	
	tons	tons	tons	%	tons	%	tons	%
COTTON	11.130	11.280	11.450	57	11.600	54	12.580	42
WOOL	1.640	1.468	1.524	7	1.600	7	1.800	6
REGENERATED CELLULOSICS	3.208	3.207	3.500	17	3.500	16	3.700	12
SYNTHETICS	2.479	2.963	3.750	19	4.800	23	12.000	40
TOTAL	18.477	18.918	20.224	100	21.600	100	30.080	100

These are mainly the crease recovery properties or more generally the easy care properties. However, stimulated by the rapid growth of the synthetic fibres, research then set in on a wide scale the world over in an endeavour to improve the easy care properties of cotton or blends and the finishing techniques as they are known to day have reached a high state of perfection. It is now possible to impart to fabrics made of cellulosic fibres, alone or in combination with synthetics, dimensional stability, form and shape memory, pleasing handle, water repellency, etc.

However, the price for these advantages is high and has to be paid in terms of:

1-Loss of tearing and tensile strength.
2-Reduced abrasion resistance and therefore reduced life of a garment.
3- Tendency to grey during the washing operation due to soil redeposition.
4- Increased tendency to soil during wear.
5- Adverse effects on the properties of some dyeings, particularly light and rubbing fastness.
6- Comparatively high processing cost.

Research laboratories are working hard to overcome these disadvantages using various finishing processes and techniques.

SYNTHETIC FIBRE PRODUCTION

Since man-made fibres have appeared on the market, they have never ceased for gaining a more and more important place and to day, they have reached considerable poundages which , in some parts of the world , have become bigger than those of natural fibres.

Man -made fibres can be classified into two different categories:

- Cellulosic fibres such as Viscose Rayon, Cellulose Acetate etc.. which now have been in the market for many years
- Chemical fibres , more recent, but the increase of poundages of which now is more consequent Among these fibres the more noticeable are Polyamides, Polyesters and Polyacrylics.

THE IMPORTANCE OF PRODUCTION OF SYNTHETIC FIBRES IN EGYPT

- To fulfil higher level of living.
- To overcome the lack in raw materials from natural sources either of plant or animal origin.
- To satisfy consumer's demands from new and fancy yarns for better adaptation and recent fashions.
- For different end uses in tire cords , ropes, fish nets, oil filters etc..
- To save a part of cotton planting soil for planting seeds for food.

In Egypt Nylon 6 (Perlon L) production started in Misr Rayon Co in Kafr El Dawar plants on 1958 . The capacity of production was as follows in tons/year.

	1958	1965	1978
CONTINUOUS FILAMENTS	45	275	550
STAPLE FIBRE	75	500	800
TEXTURED YARN	75	150	225

Continuous filaments are produced in different deniers ranging between 15 to 200 , including mono filaments as well as multifilaments.

Staple fibre is also produced in different deniers 3, 4,5 and 6.

TECHNICAL APPLICATION OF THE POLYCONDENSATION OF AMINE CAPROIC ACID:

The process of polycondensation i.e.: the charge of monomer water soluble compounds that could be spun from a molten state is made use of in the technical manufacture of polyamides. Technically the term polymerisation is applied to such a process without any relation between the term of the kinetics of the reaction.

In general for the manufacture of polyamides two main polymerization processes are used.

1- The non continuous polymerisation process under pressure in autoclaves.

2- The continuous polymerisation process without pressure in V.K, tubes.

The autoclave polymeristion is the cold process and generally used for Nylon 66:

For caprolactam polymerisation (Nylon 6) the continuous polymerisation in V.K. tubes is generally used but autoclave polymerisation is also used.

(A) Autoclave - pressure polymerisation

In this process the monomeric material dissolved in 10 - 40 % water is put into an autoclave which is maintained at a temperature higher by 20 -40 °C than the melting point of the polyamide. The dissolution water evaporated at this temperature and boiling at a pressure of 10-25 atmosphere in the autoclave , after attaining the required polymerisation temperature of 250 °C to 280°C , the excess pressure and water released & pure nitrogen is introduced into the autoclave to provide an inert atmosphere, because the polyamides are very sensitive to traces of oxygen at this high temperature . The monomers are thus polymerised , the polymer is left at the reaction temperature and pressure for the required time. after which the change is then emptied by applying a high pure Nitrogen pressure. The melt is pressed through a small slit and is casted in cold water to form a band of polyamide which is cut into small pieces called chips

(B) Continuous polymerisation of polyamide building compound in VK tubes without pressure : It is given by the following process.

One or more of the polyamide forming compound in solid , dissolved or molten state are continuously fed in definite amount to a long tube which is maintained at a high temperature in this tube without the application of pressure and by the addition of necessary activator and stabiliser,

the monomeric units are polymerised. After attaining the high polymer conditions the polymer is [illegible] removed from the reaction tube and is processed in the required form either [illegible].

The degree of polymerisation is [illegible] by the following
- The quantity of acid.
- The quantity of water.
- The temperature of polymerisation
- The time of polymerisation
- The pressure subjected on the polymer .

The degree of polymerisation D.P. can be measured by measuring the viscosity of the polymer.

POLYMERISATION SYSTEM IN MISR NYLON PLANT (Zimmer Project)

The polymerisation systems used in Misr Nylon plant are of the continuous type There are two units of polymerisation : 1- Staple fiber polymerisation unit
2- Filament polymerisation unit.

I. STAPLE FIBER POLYMERISATION

As mentioned this process is carried out according to the continuous non-pressure system of polymerisation in VK tubes. The Caprolactam is molten in a melter which is jacketed and steam-heated and kept at 80 °C .

From the melter the molten lactam is pumped through a filter into a mixer which can hold a charge up to 1500 Kg. To the molten lactam in the mixer which is also jacketed and steam heated are added the calculated amount of initiator (water) and stabiliser (acetic acid) to get the required degree of polymerisation. Also to the lactam in the mixer is added the dulling agent which is a dispersion of Ti O2 in lactam . The mixer is provided with a stirrer for mixing the chemicals added and the lactam.

II. FILAMENT POLYMERISATION

It is the same as the staple fibre polymerisation but it is not designed for direct spinning,only to form a [illegible] of highly polymerised polyamide which is then cut into chips.In this system the prepolymerisation is much elongated and is composed of a big number of tubes,also this system is provided with a vacuum stage to help in the removal of water of condensation,and to remove most of the non-reacted monomer from the formed polyamide and so help to form a high degree of stabilisation plus uniformity of chain lengths of the formed polyamide.

The so formed polyamide is pumped from a spinning head unit through a fine slit of 3-4 mm thickness in the form of a cable. This cable is cooled in a bath of running water and then cut into chips. The chips are gathered in a tank called the chips container then washed to remove the non-fiber forming low molecular weight compounds; after wasing, the chips are dried in a rotating vacuum dryer till the moisture content of the chips is below 0.1 % . The chips are then spun into filament by the melt spinning process.

MELT SPINNING PROCESS(Star Melters in the old project)

The melt spinning process is the main process usually used for the production of the fine filaments of perlon of high quality. The melt process is delicate and requires many critical conditions in order to attain a good production

First of all the chips that will be melt spun must be good stabilized with minimum content of low molecular weight compounds and only traces of water content 0.08 %.

The principle of the method is that the chips are remelted on a melting surface which is called the melting star. The molten polyamide is pumped by a gear pump into the spinnerette through which it comes out as fine molten filaments, after leaving the spinnerette the filaments solidify in air and the cooled filaments are directed through a channel to winding [illegible] where they are taken on spools after taking suitable spinning finish to avoid static charge [illegible].

A new spinning project in the form of screw melter was erected on 1972 of a capacity of 800 Kgs /day. It is also from Zimmer.

STRETCHING PROCESS (Zinser [illegible])

The filaments coming out from the spinning machines are wound on spools. These filaments have a very high [illegible] ability or elongation and very low strength. This is mainly because the polyamide filaments are cooled suddenly and the molecules are [illegible] with definite order or [illegible], and an important requirement for fiber forming compounds is that the molecules should be arranged parallel to the fibre axis.

So the polyamide filaments are subjected to stretching process which has the

main purpose of arranging the molecules in a definite orientation along the fibre axis.

By this cold stretching process polyamide filaments could be stretched up to 400 % . The filament after stretching has a low denier and high tensile strength.

After stretching, the production is divided into three parts:

1- The monofilament yarns are packed on metallic cops without twisting
2- Normal yarns of denex 33, 44, 78 etc are subjected to twist, that differ from one another according to end use. After twisting the wash bobbins are thermosetted, conditioned and coned on plastic or paper cones after giving a suitable coning oil.
3- The third part is used for producing textured yarn.

STAPLE FIBRE PROCESSING

The molten polymer is pumped through spinnerettes from which the filaments are taken off and collected on spools. Spools are conditioned for about 24 hrs in an atmosphere of 20 °C [illegible], and 45 % relative humidity, then put on a creel , and yarns are collected to form a tow. The tow is stretched, washed, finished with suitable oils to get rid of any static charge occurrence then squeezed and dried: After this the tow is crimped in the stuffing box. The crimped tow is thermosetted in an autoclave at 120 °C , then cut in the Gru Gru Cutter to give the wanted fibre length. The fibres are withdrawn by air and compressed in the form of bales.

PACIFIC CONVERTER SLIVER using the Pacific Converter , in which the tow is to be cut into different fibre lengthes after which the fibres are subjected -if wanted- to one or more intersecting process to get a very fine and well oriented sliver.

Staple fibres in the various forms are used for blending with wool and with other fibres according to end uses

PRODUCTION OF TEXTURED YARN (HE TYPE)

The market of textured yarn has been opened to synthetic fibres due to the fact that their peculiar structure allow them, when treated in some conditions of heat and twist, tobe given interesting properties of elasticity, bulk etc.. which distinguish them clearly from normal flat yarns with limited elasticity.

The important development of textured yarns has been done specially in polyamides, and more recently in polyesters. It seems, at the moment, that Nylon producer textured filaments are developing in two extreme parts of the market:

- Heavy denier yarns for carpets, and
- Very fine denier yarns for panty-hoses.

In Egypt we did not begin the first yet, but already began the second since 1960, using false twisting machines from HEBERLEIN

TEXTURIZING : In this process the yarn is subjected to a very high twist while it is running through a heated box then re-twisted in the opposite direction, that is why it is called false twist. The produced yarn may be S twisted or Z twisted according to the direction of the running spindle.

New machines from AKCT are now in use since 1972 , The FTF 440 type , which are electronically controlled with minimum percentage of deviations.

DOUBLING: As S -twisted yarn is doubled with a Z twisted according to the direction of the running spindle to give a yarn free from torque.

SKEINING/: The doubled yarns are wound in the form of skeins on skeining machines. skeins are subjected to steaming process for a short time.

DYEING: The skeins are dyed by the normal way of dyeing Perlon using selected acid dyes. Disperse, direct and Metal complexes dyes are also used.

Precautions are to be taken in dyeing the textured yarn since the dye affinity of the yarn is greatly affected by any deviation in the preceding processes , polymerisation, stretching , false twisting etc. That is why suitable levelling agents are to be added as well as a suitable method of dyeing should be followed.

Scholl and Barriquand machines are in use.

CONING: The dyed skeins are dried and coned on paper or plastic cones using a suitable coning oil. Schweiter precision cone winders are in use.

P O L Y E S T E R PROCESSING IN MISR RAYON C°

Production of polyester set yarn started in MISR RAYON C° in 1972. The flat yarns that imported from different sources are texturized and set using FTF 440 ARCT machines.

The produced bobbins in the soft form are dyed in a Barriquand dyeing machine. Disperse dyestuffs are usedfollowing the normal method of dyeing of PES . Since starting this new production some problems appeared either in texturising or in dyeing .

In dyeing, the problems exist in:

- The presence of broken filament.
- The suitable softness of the bobbins.

In dyeing , the problems are mainly in

- The appearance of oligomers specially in the innermost layers of the bobbins.
- The dye affinity difference when using certain types of disperse dyes.
- The section of levelling and dispersing agent in the presence or absence of carrier.

In front of these problems and others our RESEARCH LABORATORIES are working hard to find the solutions. We are gaining experience day by day and trying to be in contact with the outerdour experts from developed countries in these fields.

NEW PROJECTS FOR SYNTHETIC FIBRES IN EGYPT .

The following are under studies :

- A project for producing Polyester staple for blending with cotton and other fibers.
- A project for producing Poly-acrylic fibers .
- Expansions in the Misrnylon plants to increase the production of :
  - High stretch yarn Misrlanca
  - Polyester set yarn.
  - Fancy yarns.

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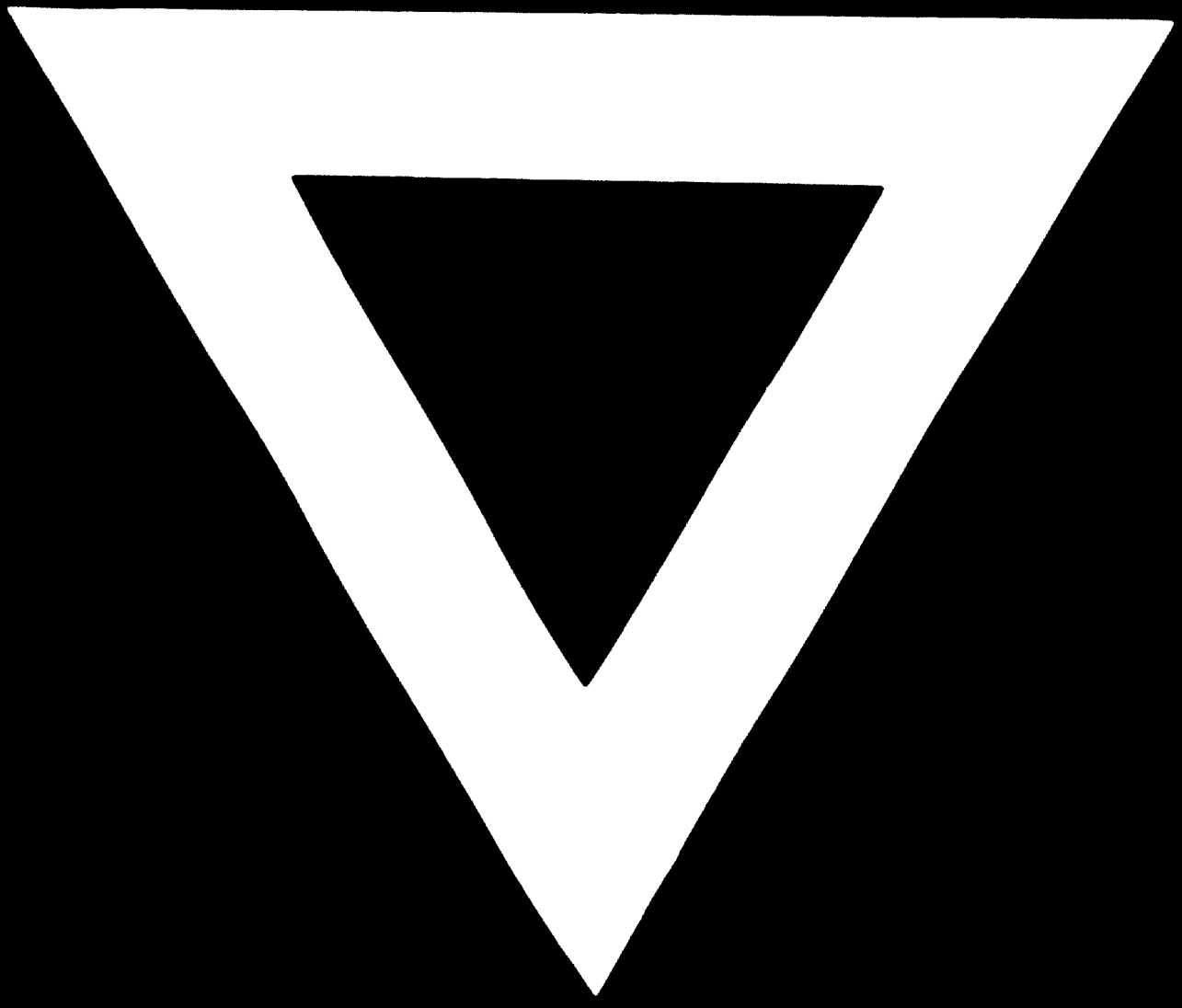

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