ESSEGOMMA

TECHNICAL BULLETIN

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Multifilament Polypropylene Yarns

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ESSEGOMMA

THE REASONS FOR A TECHNICAL BULLETIN

The aim of the above technical bulletin is to provide users with exhaustive information about the main technical characteristics of the polypropylene continuos filament yarn in order to make the most of its use.

In the following pages, a wide range of issues will be addressed with a view to emphasising the benefits and the limits of polypropylene yarns with respect to other fibres.

If you have any queries regarding the use of the ESSEGOMMA yarns, please, do not hesitate to contact our Technical and Development Centre who will be happy to supply any information and assistance you may require.

ESSEGOMMA

PROPERTIES OF THE ESSEGOMMA YARNS

CHEMICAL-PHYSICAL PROPERTIES

CHEMICAL COMPOSITION

Isotactic Polypropylene (monopolymer)

CHEMICAL RESISTANCE

The polypropylene yarn is particularly resistant from a chemical standpoint, especially as regards its ability to resist the action of alkali and acids at room temperature.

TABLE N. 1

ACIDS	Concent.	Temperature	Time (h.)	Residual Tenacity
Sulphuric acid	98%	20° C	120	100%
Nitric acid	40%	20° C	120	90%
Formic acid	75%	20° C	96	100%
ALKALIS				
Caustic soda	35%	20° C	216	96%
Potassium hydroxide	40%	20° C	96	90%
Ammoniac	15%	20° C	216	95%

(Source: M.Ahmed - polypropylene fibres-Science and Tecnology)

Substances likely to eat into polypropylene c.f. yarns are highly oxidising agents, such as hydroperoxide, fuming nitric acid, halogens and chlorosulphonic acids.

Other chemical substances that act on the ESSEGOMMA yarns include specific organic solvents, such as chlorate compounds, coal chemicals and aliphatic hydrocarbons which, in the event of prolonged contact, produce a swelling and softening reaction.

When brought to high temperatures, some aromatic solvents dissolve yarns: see the following table for a thorough description on how organic solvents impact on our yarn filaments.

TABLE N. 2

Residual tenacity (%) of the ESSEGOMMA yarns when immersed in solvents, with respect to their initial value.

	For 24 hours		For 8 hours	
SOLVENT	30° C	70° C	BOILING TEMPERATURE	
Benzene	90	90	95	(80° C)
Toluene	90	85	0	(110° C)
Xylene	90	85	dissolving	(136° C)
Methylene chloride	100	- -	100	(40° C)
Chloroform	100	- -	95	(61° C)
Trichloroethylene	95	90	60	(87° C)
Carbon tetrachloride	90	85	85	(77° C)
1.1- 2.2 tetracloroetano sym-tetrachloroethane	- -	- -	dissolving	(146° C)
Acetone	100	- -	100	(56° C)
Methyl alcohol	100	- -	100	(65° C)
Ethanol	100	100	100	(78° C)
Isopropyl alcohol	- -	- -	100	(82° C)
N-Butanol	- -	- -	90	(116° C)
Ethyl acetate	100	- -	100	(77° C)
Burning oil	- -	- -	85	(119° C)
White spirit	100	100	100	(87° C)
Dimethylformamide	95	95	dissolving	(167° C)
Pyridine	100	100	Highly shrinkable	(152° C)
	100	90	90	(115° C)

As a conclusion, the ability of the ESSEGOMMA yarns to withstand chemical agents is far greater than that of any other man-made fibres, including nylon and polyester, as shown in Summary Table n.3.

TABLE N. 3

Resistance	Strong Acids	Weak Acids	Strong Alkalis	Weak Alkalis	Organic Solvents
Essegomma yarns	excellent	excellent	excellent	excellent	Good
Cotton	none (1)	poor to heat	mediocre	good	Good
Wool	none at H_2OSO4	excellent	poor	poor to heat	Good
Acetate	decomposing	poor (2)	saponifying	saponifying	poor (3)
Polyamide	poor	good	good	excellent	poor (4)
Polyester	poor (5)	excellent	poor (6)	excellent	
Polyacrylic	good (8)	excellent	good	excellent	

(1) None in solvents subject to heat of dilution and concentrated cooling products

(2) None in specific organic acids such as acetic acid

(3) Dissolves in acetone and in glacial acetic acid

(4) Poor in phenol, creosol and chloroform

(5) None in sulphuric acid

(6) Reduced in hot conditions, average in cold conditions

(7) Poor in some phenolic compounds

(8) Poor in sulphuric acid

With reference to Table 2, and following lab tests during which some polypropylene-made clothes underwent a series of dry-wash cycles, we caution against subjecting these garments to dry cleaning; the following sign should be affixed to the label.

Fungus and Bacteria Resistance

The ESSEGOMMA yarns are resistant to fungus and bacteria and are remarkably well tolerated by (vegetable) tissues, provided no special stabilisers or additives are added as they may alter the above characteristics while migrating on the outside.

The above assertion is utterly relevant when considering that the intrinsic properties of the polypropylene c.f. yarn enable it to resist micro organisms with no need for specific additional setting.

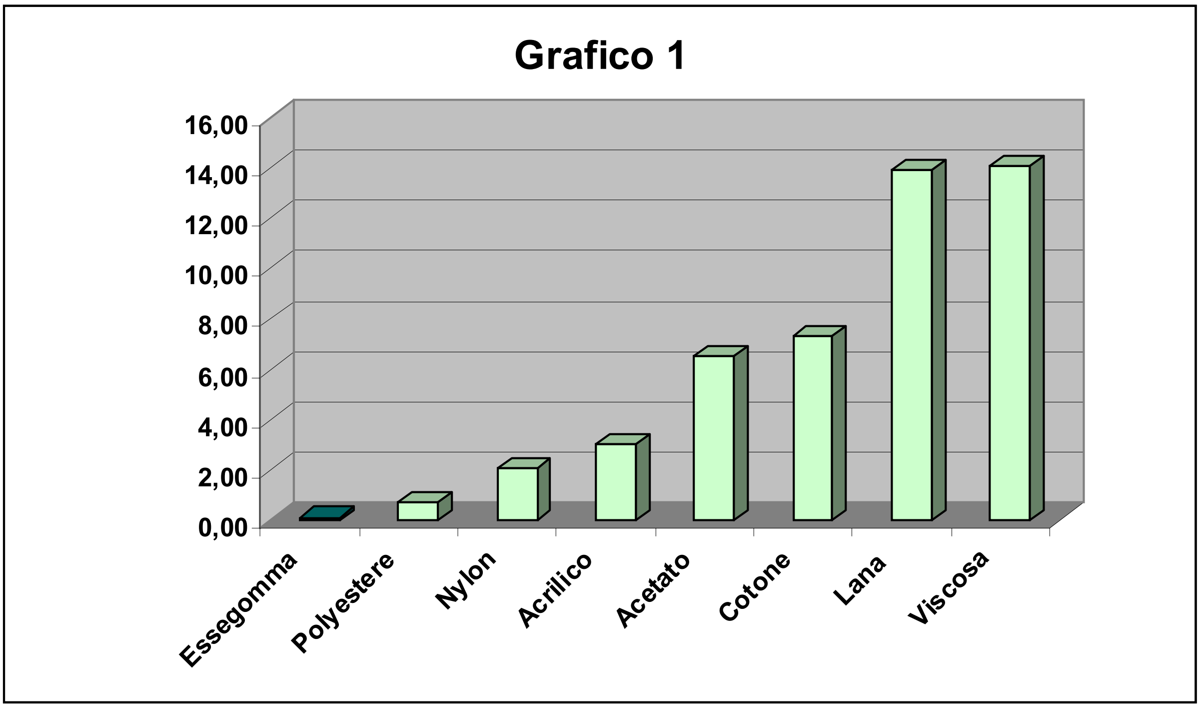
TABLE N. 4

Resistance	Moth	Mould
ESSEGOMMA yarns	excellent	excellent
Cotton	mediocre	mediocre
Wool	none	none
Acetate	excellent	good
Polyamide	excellent	excellent
Polyester	excellent	excellent
Acrylic	excellent	excellent

Humidity Absorption

Polypropylene is a paraffin hydrocarbon, which means it is impervious to water.

Under normal circumstances, the amount of humidity that polypropylene can hold is irrelevant if compared to other natural or synthetic fibres. (See Chart).



Essegomma	Polyester	Nylon	Acrylic	Acetate	Cotton	Wool	Viscose
0,13	0,72	2,10	3,00	6,50	7,30	13,90	14,10

Thanks to propylene's ability to withstand humidity, the ESSEGOMMA yarns have similar physical properties in both dry and wet conditions.

However, note that the above condition does not apply indiscriminately to all types of polypropylene yarns. In fact, filaments must be treated with additional substances that will alter the structure of polypropylene for certain yarns in order to withstand all the above conditions.

SPECIFIC GRAVITY

Polypropylene's specific gravity may vary according to its degree of crystallinity; as to c.f. yarns, spinning and ironing may affect it considerably.

The base value usually considered is 0.91 g/cubic centimetre, a value which can be safely extended to the whole c.f. yarn range manufactured in our facilities.

At any rate, the polypropylene yarn is the lightest textile fibre currently available on the market.

TABLE N. 5

Fibre	Specific Weight (g/cm3)
ESSEGOMMA yarns	0,91
Polyamide	1,14
Polyacrylic	1,17
Cellulose acetate	1,32
Wool	1,33
Polyester	1,38
Jute	1,48
Viscose Rayon	1,52
Cotton	1,54
Glass	2,54

The specific gravity of the c.f. yarn will determine the weight of the finished product. Any yarn with a light specific gravity means a higher metric yield and considerable manufacturing cost savings. Polypropylene filaments definitely fall within this category. In other words, the ESSEGOMMA yarns can boast a covering power much greater than that of any other filament. In this regard, it is reasonable to assert that polypropylene ''covers'':

- an extra 25% with respect to Nylon and Acrylic
- an extra 54% with respect to Polyester
- an extra 65% with respect to Viscose

TECHNICAL FEATURES

Polypropylene posseses high insulation properties. As shown in the table below, the ESSEGOMMA yarns have a permittivity/resistivity ratio not found in other materials.

Since polypropylene absorbs no water whatsoever, it retains good electrical properties, regardless of moisture in the atmosphere.

TABLE N. 6

Electrical Properties of Various Yarns

Fibre	Constant at 65% RH	Dielectric	Volume resistivity (SL CM)	Dielectric Strength (KV/mm)
	1 KC/s	100 KC/s		
Cotton	18,0	6,0	10^7-10^{12}	5-8
Rayon Viscose	8,4	5,3	10^{11}-10^{13}	25-50
Acetate	3,5	3,3	10^{11}-10^{13}	20-35
Wool	5,5	4,6	- -	- -
Nylon	3,7	2,9	10^{14}-10^{15}	20-35
Polyester	2,3	2,3	10^{19}	18-25
ESSEGOMMA yarns	1,7	1,7	7-10^{19}	25-45

FRICTION

YARN-TO-METAL (CERAMIC)

YARN-TO-YARN

A previous knowledge of the coefficient of friction is of great importance for synthetic filaments, as it determines the choice of the machines to be used as well as pre-settable manufacturing parameters.

Friction characteristics are just as important as they play a significant part, among other things, in the finishing touch and aspect of the product made from the above c.f. yarn.

Polypropylene's frictional force against smooth surfaces (metal, ceramic) is rather high when compared to other filaments. Friction is drastically reduced if, instead of sliding over a polished surface, the yarn rolls over a slightly roughened surface. As a result, the number of contact points between the filament and the metal (ceramic) decreases and the interaction between both bodies diminishes accordingly.

The coefficient of friction of the ESSEGOMMA yarns, fibre-to-fibre, is extremely high, probably owing to the fact that as the filaments press against each other, their surface undergoes a slight plastic deformation, thus increasing mutual adhesion in the process. Friction, either yarn-to-yarn or yarn-to-metal, depends mostly on the filament's aspect, bearing in mind the following scheme:

Filament's Aspect	Coefficient of Friction (from 1 to 10)
Parallel, smooth	10
Intermingled, smooth	9
Twisted, smooth	8
Parallel, lofty	7
Intermingled, lofty	6
Twisted, lofty	5
Taslan	4
Parallel texturised	3
Intermingled texturised	2

Note that the coefficient of friction of polypropylene may be altered by passing appropriate products over its surface for extra polish.

ABRASION RESISTANCE

Our yarns are particularly resistant to wear and tear. Only dry nylon has superior characteristics, a condition which humid nylon cannot reproduce, as its resistance to abrasion is cut down by 30%, while that of polypropylene remains unaltered. Abrasion resistance depends on the filament section (round, triangular, hollow….). Moreover, it increases proportionally to dpf (denier per filament) reduction.

Electrostatic Storage of Discharges

Two different bodies rubbing against each other invariably lead to electrostatic separation, and sometimes, a potential difference measured in thousands of volts is recorded between the two. This voltage depends on the type of clothes being rubbed just as much as on their resistivity.

The above condition is essential both for clothing and furnishing applications. Polypropylene tends to produce electrostatic charges having a negative potential, as opposed to that of nylon and polyester which are oppositely charged. At any rate, the absolute value of the potential stored by the ESSEGOMMA yarns is always lower than that accumulated by nylon and polyester.

Technical and Thermodynamic Properties

Even though isotactic polypropylene is generally credited with a 167°C melting temperature, it follows the pattern of all crystal polymers and starts softening at lower temperatures. Therefore, a softening temperature averaging 140°C has been agreed upon.

The polypropylene yarns being subject to a heat treatment occurring at temperatures well above 140°C may generate irreversible alterations in the crystalline structure of the c.f. yarn, thus modifying its mechanical properties in the process.

Values for the major thermal and thermodynamic properties of polypropylene are reported below:

Melting Point: 167° C

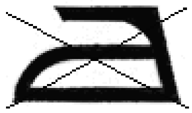
Softening Point: 140° C

Specific Heat: 0.5 cal/g° C

Thermal Diffusion Coefficient: 10 cm q./s

Heat of Fusion: 2.1 + _ 0,3 Kcal/mol

The above information emphasises the need for the yarn to be subjected to delicate heat treatments, both during the finishing step and while handmade textiles are being used. This is the case of pure silk for example. We suggest affixing the NO IRONING sign to the labels



and caution against exceeding a safety temperature of 100°/110°C during finishing.

The table below will provide a better insight into the main differences between polypropylene and other filaments:

Fibre	Melting Point° C	Softening Point° C
Acetate	255	245
Polyamide 66	260	235
Polyester	250	230
Polyacrylic	breaking down	220
Polyamide 6	215	180/190
POLYPROPYLENE	169	140
Polyethylene	125	120

The possibility for fabrics to catch fire accidently, especially in the furnishing industry, is now a matter of considerable interest owing to the adoption of stricter fire regulations in relation to the use of furnishing clothes in public places. The ESSEGOMMA yarns support flame-proof additive treatment. Yet, polypropylene's intrinsic properties are such as to give it the advantage over the remaining filaments.

OXYGEN INDEX (LOI)

Oxygen Index shall refer to the lowest oxygen content, expressed as a proportional unit of volume, in a mixture of oxygen and nitrogen able to complete combustion under standard conditions as set forth in Standard ASTM D 2863 – 74.

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LOI VALUES FOR SOME FIBRES

Traditional Fibres

Acrylic fibres	18 - 20
Polyamide fibres	20 - 22
Polyester	20 - 23
POLYPROPYLENE	18 -20
P.V.A.	20
Rayon	17 - 20
Cotton	17 - 20

IGNITION TEMPERATURE

Tests were carried out by throwing the samples over a hot plate and by recording at what temperature combustion began. The various fibres registered the following values:

FIBRES	° C
Cotton	400
Acetate	525
Nylon 6	530
Triacetate	540
Acrylic	560
POLYPROPYLENE	520
Wool	600 ca.
Wool fibres (casein)	625
Teklan (vinyledene)	690

FLAME PERFORMANCE OF VARIOUS FIBRES

Glass and Asbestos	Do not catch fire, do not burn; no flame propagation

Polyvinyl chloride	Burns as long as it stays in the flame without spreading it
Polyesters	Hard to be set on fire; no flame propagation
Nylon 6 6 and 6	As above, although they melt and form droplets that may spread the flame
Wool and Silk	Quite slow at catching fire; may spray the flame
Acetate	Catches fire quite easily, although it melts and impedes flame propagation
Acrylic	Catches fire easily and spreads the flame very quickly
Viscose	Very quick at catching fire, spreads the flame just about as swiftly
ESSEGOMMA YARNS	DRAW BACK AND MELTS AS THE FLAME APPROACHES; PUT OUT UPON ITS REMOVAL

HEAT INSULATION

The insulation properties of a piece of cloth depend on the amount of air that passes through the fibres and on the heat-transfer coefficient of the yarn. The amount of air in the fabric depends in turn on the structure and appearance of the filament. The heat-transfer coefficient is an intrinsic characteristic closely associated with the material from which the yarn was originally made.

The ESSEGOMMA yarns feature the lowest heat-transfer coefficient ever with respect to that of other synthetic and natural fibres, as shown in the table below, where heat-transfer coefficients are expressed according to the value assigned to the heat-transfer coefficient of air.

POLYPROPYLENE	6.0
Vinyl chloride fibres	6.4
Polyester	7.0
Wool	7.3
Acrylic	8.0
Cellulose acetate	8.5
Viscose	11.0
Polyethylene	13.0
Cotton	17.5

The polypropylene yarn can be rightly regarded as the warmest filament of the whole range of synthetic and natural yarns, a prerogative of wool until not so long ago.

Tenacity and Stretching

Tenacity: the stress a yarn sample subjected to a stretching load can withstand without tearing

Standard tenacity 3/4 gr./den

Mean tenacity 4/5 gr./den

High tenacity > 5,5 gr./ den

Stretching: an increase in length or in width as a result of the yarn sample breaking (%)

Fastness of Colours

Our yarns are subject to a mass-dyeing process which makes use of pigments purchased from handpicked highly skilled suppliers. In addition to ensuring excellent colour evenness, this dyeing process also guarantees unparalleled stability. Fastness measurements referred to the scale of greys (maximum value: 5) are reported below for the ESSEGOMMA yarns:

Washfastness	5
Perspiration fastness	4/5
Sea water fastness	5
Solvents (perchloroethylene-trielina)	4/5
Gas (fastness)	5
Iron fastness	5
Dry cleaning fastness	4/5

The above values apply to the vast majority of colours (for more details and specific requests, please, contact our Quality Assurance Office).

RESIDUAL SHRINKAGE

In boiling water

In the air

After undergoing a heat treatment, our filaments tend to shrink. This pattern is the result of a slackening action prompted by the finishing temperature and certainly not by the amount of moisture in the room in which treatment takes place. It basically means that slackening as a result of steam or warm air can produce the same effect.

Residual shrinkage following immersion in boiling water is a relevant fact worth reminding for filling purposes during the making of fabrics (crossdyeing), and while textiles are being used (washing). Warm air-residual shrinkage is just as significant, especially when fabrics are to be subjected to a finishing process, such as drying or passing through a clip stenter for instance.

The ESSEGOMMA yarns are subject to a heat treatment during the manufacturing cycle, where:

1. Twisted yarn filaments can be heat-treated to set the twists and limit shrinkage during subsequent fillings (thermofixing).
2. As spinning is progressing and upon customer's request, non-twisted yarn filaments can undergo a heat treatment designed to monitor residual shrinkage (although this process is not as precise as thermofixing).

If the heat treatment does not go beyond a safety temperature of 110°C, there should be no specific problems during finishing, drying or washing.

As to cleaning, by hand or in washing machine, no specific precautions are to be taken. Polypropylene can be easily washed in lukewarm water with washing powder and softener with no substantial changes (recommended temperature: 40°/60°).

REPLACING OTHER FIBRES WITH THE ESSEGOMMA YARNS

INTRODUCTION

The ''covering'' power of a cloth also depends on other factors, ranging from the count used to specific weight. Now, let's take two cylindrical bodies of a same length L and equal to diameter D; their weight will be expressed by:

$$P_1 = \frac{D}{4} L \pi \gamma_1$$

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$$P_2 = \frac{D^2}{4} L \pi \gamma_2$$

As a result, the weight of both elements is directly proportional to their specific weight. If, on the other hand, we want their weight to be equal, the following equation should read as follows:

$$D_1^{\,2} \gamma_1 = D_1^{\,2} \gamma_2$$

Now, let’s find out about the specific weight of each fibre to identify which is the appropriate count to be used. The table below reproduces the specific weight allotted to each fibre, expressed in gr/cm3:

ESSEGOMMA yarns	**0,91**
Nylon	**1,14**
Acrylic	**1,17**
Acetate	**1,32**
Wool	**1,33**
Polyester	**1,38**
Viscose	**1,52**
Cotton	**1,54**

The table shows that polypropylene is the fibre with the lightest specific gravity (this is the only floating fibre), meaning that choosing the ESSEGOMMA yarns in place of other fibres is greatly beneficial in terms of yield.

Covering Power: Definition

In a flat fabric, the threads that make it up are arranged (both in weft and in warp) next to each other to form a number of threads per centimetre. The number of threads per centimetre obviously relies on their diameter. Therefore, if a yarn made from a specific fibre is to be replaced by a polypropylene yarn, both threads will need to be identical in diameter.

Count Computing

A den. count is a measure of the fineness of a yarn expressed as the weight (in grams) of a given length (9.000 m), i.e.:

T den = 1.000.000 S y

where 1.000.000 is the length expressed in cm

S is the yarn section in cm^2

y is the specific weight in $grams/cm^3$

Based on the assumption that both threads must be equal in diameter (and thus have the same section S) to have the same covering power, it can be asserted that both counts are directly proportional to their own specific gravity.

To make things easier, let's say we want to replace a 330 den polyester yarn with a polypropylene filament:

polyester specific weight = 1,38

count = 330 d tex

polypropylene specific gravity = 0,91

The count for the ESSEGOMMA yarn, featuring the same diameter, can be retrieved from the following formula:

T. p.p. = Tpes 0,91/1,38 = 216 den

METRIC YIELD

With respect to other fibres, the ESSEGOMMA yarns have a substantially superior yield. The following table provides a list of yields, taking polypropylene's 100 as a fixed parameter.

POLYPROPYLENE	**100**
Nylon	**79**
Acrylic	**76**
Acetate	**68**
Wool	**67**
Polyester	**65**
Viscose	**59**
Cotton	**58**

A higher yield enables the making of fabrics with a smaller number of kg. of yarn (where the covering power is unchanged).

C.f. yarns are usually sold in € / kg.

To better assess the advantages of a change, the €/kg cost should be turned into €/km.

Of course, polypropylene clothes will be lighter, while retaining the same covering power. Pursuing the above example, we will have:

Polyester den 230 in 1 kg., that is Km. (1000/330) 10=Km. 30,30

ESSEGOMMA yarns den 217 in 1 kg., that is Km. (1000/210) 10= Km. 46,08

Table of Equivalent Counts

Essegomma Yarns		Nylon		Acrylic		Acetate		Wool		Polyester		Viscose		Cotton	
Den	Km/kg	Den	Km/kg	Deb	Km/kg	Den	Km/kg	Den	Km/kg	Den	Km/kg	Den	Km/kg	Den	Km/kg
66.6	150	84.4	118.41	115.38	115	98.04	102	101.5	101.5	102.56	97.5	112.98	88.50	51.78	87.50
77.7	129	97.7	102.27	98.9	99	114.37	87.43	87	87	119.65	83.57	131.82	75.86	44.38	75
127.7	78	161.1	62.07	60.2	60	187.9	53.22	52.96	52.96	196.57	50.87	216.57	46.17	27.01	56.65
166.6	60	211.1	47.37	46.15	46	245.1	40.8	40.6	40.6	256.41	39	282.48	35.40	20.71	35
222.2	45	281.1	35.57	34.62	34.62	326.8	30.6	30.45	30.45	341.87	29.25	376.64	26.55	15.53	26.25
333.3	30	422.2	23.68	23.08	23.08	490.2	20.4	20.3	20.3	512.82	19.5	564.96	17.70	10.36	17.50
400	25	506.6	19.74	19.23	19.23	588.23	17	16.92	16.92	615.38	16.25	677.96	14.75	8.63	14.58
444.4	22.5	562.2	17.79	17.31	17.31	653.6	15.3	15.23	15.23	683.75	14.63	753.3	13.28	7.77	13.13
500	20	633.3	15.79	15.38	15.38	735.28	13.6	13.53	13.53	769.23	13	847.45	11.80	6.90	11.67
600	16.67	760	13.16	12.82	12.82	882.35	11.33	11.28	11.28	923.07	10.83	1016.94	9.83	5.75	9.72
800	12.5	1013.3	9.87	9.62	9.62	1176.46	8.5	8.46	8.46	1230.76	8.13	1355.93	7.38	4.31	7.29
1166.6	8.57	1477.7	6.77	6.59	6.59	1715.68	5.83	5.8	5.8	1794.86	5.57	1977.4	5.06	2.96	5
1666.6	6	2111.1	4.74	4.62	4.62	2450.97	4.08	4.06	4.06	2564.1	3.9	2824.85	3.54	2.07	3.5
2500	4	3186.6	3.16	3.08	3.08	3676.46	2.72	2.71	2.71	3846.15	2.6	4237.28	2.36	1.38	2.33
3000	2.33	3800	2.63	2.56	2.56	4411.76	2.27	2.26	2.26	4615.38	2.17	5084.74	1.97	1.15	1.94
5000	2	6333.3	1.58	1.54	1.54	7532.94	1.36	1.35	1.35	7692.31	1.3	8474.57	1.18	0.69	1.17

THE EFFECTS OF LIGHT EXPOSURE ON THE ESSEGOMMA YARNS

Electromagnetic radiation always acts on the bodies absorbing it. Polypropylene as such is very sensitive to certain wavelengths across the UV spectrum, so much so that very short exposure times to radiations result in substantial degradation.

Those wavelengths that are deemed critical for polypropylene belong to the solar emission spectrum. As a consequence, the exposure of polypropylene garments to light will lead to fast degradation, leading in turn to a loss of fibre tenacity followed by complete destruction.

In the past, this situation brought rather unpleasant surprises to polypropylene yarn users. Fortunately, additives can now be added to polypropylene (''UV stabilisers'') so as to neutralise the degrading effects due to solar radiation.

Solar radiation energy is measured by means of a pyranometer, the resulting unit of energy being called ''Langley''.

One **Langley** is equal to 1 gram-calorie per square centimetre

Other units of measurement include:

Watt/m2 (w/m2) for irradiation

Joule/m2 (J/m2) for radiation

Irradiation expressed in Watt is the amount of energy per second radiation.

Radiation expressed in Joule/m2, or in Langley, is the amount of energy over a specific period of time. Thus

1 Langley = 41,840 Joule/m2 = 1 ly

The pyranometer measures the total intensity thus radiated. Two basic methods have been devised to retrieve data in connection with photodegradation resistance:

- direct exposure to atmospheric agents
- exposure in an artificial yarn aging apparatus.

DIRECT EXPOSURE

In this case, direct radiation is of paramount importance, even though weather conditions at large (rain, wind, humidity, temperature and the degree of pollution in the air), or altitude, may affect the results either by accelerating degradation or by slowing it down.

Therefore, various exposure effects may occur with the sample absorbing the same amount of energy, reason for which the place of exposure should always be mentioned.

ARTIFICIAL YARN AGING APPARATUS

In order to figure out how polypropylene reacts when exposed to solar radiation, apparatuses that simulate the emission of solar radiation through Xenon lamps have been engineered: these devices are commonly referred to as:

- Xenotest (150, 450, 1200)
- Weatherometer (WOM)
- Others

They are used to subject thread samples to accelerated weathering conditions over short or long periods of time and to record the ensuing effects.

To get a better understanding, let's take an example:

In a Weatherometer (WOM) Ci 35, with a specific radiation of 0.5 w/m2 at 340 nm and a relative humidity of 65%, where black panel temperature reaches 47°C (simulating direct solar exposure)

- the mean life of polypropylene thread samples with 6 denier per filament and no anti-UV stabiliser averages 330 hours
- the mean life of the ESSEGOMMA yarns, featuring the same denier count and stabilised with anti-UV agents, averages 1000 hours
- the mean life of the ESSEGOMMA yarns for outdoor use, being subject to strong anti-UV stabilising treatments, is in excess of 2500 hours.

Polyester samples, with a denier count of about 6 den. per filament, have also been subjected to the same test conditions. Their mean life did not go beyond 400-500 hours.

Mean life shall refer to the time of exposure in a weatherometer (WOM) required to cut down tenacity by 50% with respect to the initial value.

The impact solar radiation has on threads also relies on the fineness of a yarn, meaning that very fine threads are all the more sensitive to UV degradation.

It is thus extremely important to inform the manufacturer about the intended use of the product to select the most appropriate UV stabilisation method.

CORRELATION BETWEEN EXPOSURE TESTS IN ARTIFICIAL YARN AGING APPARATUSES AND EXPOSURE TESTS TO DIRECT SOLAR RADIATION

With reference to the weatherometer Ci 35, an attempt at assessing the time of exposure in Kly will now be made.

A closer look at the solar radiation spectrum and the emission spectrum of the Xenon lamp of the weatherometer Ci 35 shows that both curves of spectrum are almost similar, with radiation being set to 0.5 W/m2 for a 340 nm wavelength.

Because the portion of the spectrum concerned with photodegradation is the one comprised between 340 and 420 nm (ultraviolet rays), and knowing that this portion represents 4-6% of total radiation, it is possible to go back approximately to the equivalence between weatherometer hours and Kly.

If it represents 4% of total radiation, total irradiation will then be about 7200 KJ/m2 for one hour of exposure.

as 1 ly = 41.840 KJ/m2

$$1Kly = \frac{41840}{7200} = 6$$ hours of exposure in a weatherometer

Considering that the ultraviolet rays section potentially represents from 4 to 6% of total radiation, it can be said that

1 Kly = from 6 to 9 hours of exposure in a weatherometer

Therefore, it is reasonable to assume that a year of exposure in Italy (120 Kly per year) corresponds to 700-1000 hours of exposure in the weatherometer Atlas Ci 35, where radiation is 340 nm, i.e., 0.5 W/m2.

Note that the above values are based on THEORY rather than practice. What can be said beyond reasonable doubt is that the exposure test in a weatherometer is undoubtedly valid to establish a comparison as to the ability of various threads, with different degrees of stabilisation, to resist photodegradation.

ESSEGOMMA has always used anti-UV stabilisers and proposes two different stabilising formulas:

- standard, for indoor and clothing applications
- high, for outdoor use and the car industry.

Fastness of Colours

The ESSEGOMMA yarns are mass-dyed. In other words, pigments are introduced in neutral polypropylene fibres to be subsequently mixed with polypropylene during the extrusion process.

Pigments are mixed inside the yarn and can not be broken by the fibre, also preventing colours being washed away.

The impact of light on the pigments may produce slight dyeing variations, although these are rather unsubstantial as ESSEGOMMA takes great pride in selecting dyeing manufacturers that produce pigments with high light fastness properties (for special requests, contact our QA department).

Properties of Textiles Made from the Essegomma Yarns

Washability

At any rate, garments made from polypropylene are easy to clean. They can be hand or machine-washed and they need very little powder and energy, as good results can be achieved at low temperatures. Even if the most sophisticated washing programmes are used inadvertently or for convenience, the ESSEGOMMA yarns won't be affected in the least.

It is also worth stressing that mass dyeing characteristics make it possible to wash polypropylene coloured clothes along with garments made from other fibres, with no risk of fading.

Stain Removal and Cleaning

Various methods to remove the most commons stains are reported below:

- **Non-Greasy Marks**

Prepare a solution by pouring half a spoonful of any standard washing powder into a cup of hot water. Wet a sponge or dip a cloth in the solution and pass it over the stained area, before drying immediately with a soaking tissue. Proceed from the outside of the spot and move towards the inside. Once the spot is removed, sprinkle the area with clean water to remove possible powder traces likely to permeate the fabric and produce another mark if not cleaned. Avoid the use of stain removers.

- **Oil or Grease Spots**

Butter, oil, lipstick spots and the like must be removed with acetone. Once the mark has been removed, apply a solution of washing powder to the fabric and rinse off with clean water exactly as for stains that are soluble in water.

- Special Marks

Some marks require the application of a special treatment.

Nail varnish marks, for instance, require the use of a solvent. Rubber and cement stains are removed with oil of turpentine (turpentine). Once the mark is removed, apply a solution of washing powder and rinse off with clean water.

Stain-Resistant Treatment

The ESSEGOMMA furnishing fabric does not get dirty easily and requires no special stain-resistant treatment (Scotchgard). This single feature makes the use of polypropylene the preferred choice for furnishing applications, not only because finishing cost savings are considerable, but above all, for its unparalleled performance during use.

DRYABILITY AND TRANSPIRABILITY

If polypropylene is renowned for its water-repellent qualities, it is mainly due to a higher drying velocity with respect to that of other threads and a strong ability to endure the action of perspiration and vapour. This is the reason why polypropylene is widely used in the making of sports outfits.

TEXTILE TECHNOLOGIES

THERMAL TEXTURISING

Being thermoplastic, the polypropylene c.f. yarn can be subject to texturising heat treatments designed to swell the filament and give curl to the fibres (crimping), including:

* false twist and loftiness in warm air
* a texturised spun yarn looks smoother and has a bigger covering power

The memory temperature is to be set between 120/130°C (depending on treatment duration and machine type).

TWISTING

To promote technological improvements and cost reductions, the use of a double twister is strongly recommended. To optimise the twisting process, we suggest close supervision of tensions which ought to be as consistent as possible.

In order to prevent the filament from curling on the unrolling device, twist setting should take place either in an autoclave or an oven, at low temperatures to provide the yarn with extra residual shrinkage. (See Thermofixing).

Winding and Warping

As with any other synthetic fibres during winding, the ESSEGOMMA yarns require the traversing device to perform an appropriate crossing motion to ensure proper winding so avoiding several coils being pulled out. The use of 0.15/0.20 g/den tensions is recommended.

In "defilé" warping, we recommend:

a) to make sure that textiles form a central arrangement over the creel and check out the distance between the yarn guide and the yarn winder;

b) to make sure that take-off tensions, at a prescribed speed, are kept constant and below 0,15 g/den;

c) to ascertain that the upper backing plate (or plates) whirl(s) slowly as the yarn passes by to maintain cleaning properties and avoid metal etchings;

d) to use yarn guides constructed from sturdy materials with a silk-like surface so that the yarn does not cut into them.

In sectional warping, make sure that the cone carries out proper sloping movements inside the drum of the warping machine.

Weaving

To achieve good weaving results, warp yarns (ring-spun) must feature the following tensions:

THREADS	TORSION
From 177 den to 467 den	**250 tors./m + thermofixing**
From 711 den to and beyond	**120 tors./m + thermofixing**

When the threads are particularly short or in order to obtain a particular aspect and finish or in a particularly dusty place (cotton manufacturing), or if two warp yarns interfere, higher tensions must then be used. For instance, 80 den 450 tors./m; 233 den 350 tors./m; 355,5 den 300 tors./m.

Conditions in the weaving room must be kept constant, above all, temperature which should not drop below 21-22°C.

We recommend a relative humidity of 60-65%, although substantial variations are possible without affecting workability in the least. Hand skills are important: what makes a continuous yarn delicate is because it is made from very fine filaments which require gentle care so that they do not break while being handled. Even if a yarn with one or several broken filaments will not break, the fibres will tend to form ''retentions'', mingling with nearby threads and generating inconsistencies in the texture.

This is why a weaver always watches for the warp (working behind the loom) so that he can step in as soon as he spots a ''broken filament''.

Recommendations:

a) suppress possible laid lines and limit warp contacts with loom devices to the minimum;

b) watch for the motion so that the pitch occurs without tearing; the opening should be just large enough to let the shuttle or replacement device through;

c) make sure that all points the warp comes in contact with are appropriately serviced (heddle loops, reeds, shuttle, shuttle box threshold).

THERMOFIXING

Advocating specific technical processes is not within our scope, as they greatly depend on customer's equipment and on the type of material to be thermofixed.

However, we usually come forward with the following suggestions:

a) C.F. YARNS

There is no need to submit those yarns that do not require extra shrinkage during the finishing step to a complete thermofixing process.

Ropes for fishing nets or industrial stitching must have compensated torsions to avoid curling during the manufacturing step, although thermal control is not absolutely necessary. Also warp and twisted yarns must have their torsion set, even though they should provide for residual shrinkage so that the product can be subject to full fixing.

b) TEXTILES

For fabrics, knitted patterns and nets, thermofixing must take place at a 100/120°C temperature, with the use of steam being preferred. Residual (controlled) shrinkage should be provided for in the course of setting.

Thermal control is performed to ensure:

- resistance to stitching (with less creep from the wefts over the threads)
- loop and knot resistance
- better aspect and stronger cloth following the re-entry of both the weft and the warp
- smoothed out fabrics

DYEING THE ESSEGOMMA SPUN TEXTILES OR LOOPS AND OTHER FIBRES

Any fabric or knitted pattern made from ESSEGOMMA raw or mass-dyed yarns (crossdyeing-resistant) and other fibres can be dyed through the processes usually employed with other fibres.

UNION CLOTH FINISHING

No copper salts should be used to evolve and set the dye. Likewise, heat treatments at temperatures close to 140°C (softening point) should be avoided to prevent excessive shrinkage, fibre hardening and a loss of mechanical properties.

The drying temperature should not exceed 90°C. To increase the drying action, the duration of the treatment should be increased accordingly. A heat and vapour treatment on either a calendaring machine or a clip stenter at a temperature between 60° and 90° C produces a smoother finish, while a treatment at a higher temperature produces a stiffer garment.

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