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Friction-spinning technology for technical speciality yarns

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Introduction

The main reason for the worldwide establishment of the DREF friction spinning technology (Fig. 1) in its typical market fields, which for the most part can be found in market gap products, is the high flexibility in the ranges of raw materials and yarn application fields. Savings in preparation, high efficiency combined with high production speeds are resulting in return-on-investment periods of 9 months - 2 years.

Application fields in the technical range (Fig. 2)

Core yarns for technical textiles in the filter, coating, automotive, aircraft, outdoor-textiles, and protective clothing range are of steadily increasing importance, especially through the unique possibility, that these yarns are produced in one operation on DREF spinning machines.

A decisive reason for the increasing importance of DREF friction spinning is the troublefree, economic and quality increasing spinning process of special fibres such as Aramid fibres coming from various producers in Europe and overseas, carbon fibres, glass fibre blends, PVC fibres and other flame retardant fibres, which are of great interest concerning special yarn constructions, e.g. the layer technique. Depending on the required yarn and

production parameters also the application of various yarn cores such as high-tenacity filaments, glass fibre filaments, carbon fibre and aramid filaments, steel, copper and other metallic wires etc. is of essential importance.

DREF 2: coarse yarn counts from Nm 0.25 - Nm 8 (4 000 - 125 tex)

DREF 3: medium yarn counts from Nm 5 - Nm 30 (200 - 33 tex).

DREF 2

Practical example: special core yarns for conveyor belts etc.:

DREF yarns and their production in the range of Nm 1 - 3.8 with high-tenacity PES filament cores or Aramid cores which make up to 85 % of the total yarn count have the following advantages when compared to conventional systems:

- better cohesion of the minimum fibre portion with the filament and therefore better further processing;
- more regular covering of the fibres around the filament during the spinning process which results in a more even compact yarn;
- higher production speed, higher efficiency due to higher bobbin weights (8 - 10 kg).

Raw materials:	
DREF 2	DREF 3
<p>All types of man-made fibres like PES, PAC, PP, PA, viscose, etc. and their blends in the following dtex and staple range: 1.7-17 dtex, 10-120 mm</p> <p>Exception: PP and PA fibres from 10-60 mm and 1.7-6.7 dtex. In blends a minor percentage (up to 30%) of PP and PA fibres, i.e. coarser and longer fibres, can be spun.</p> <p>Special fibres like Aramid, PAC, PVA, PVC, carbon and glass fibres and blends thereof.</p> <p>Natural fibres like flax, linen, jute in blends (homogeneous or separate feeding) with cotton or any synthetic fibre and 100% wool as well as wool blends.</p> <p>Animal hair like goat and horse hair in blends with other fibres.</p> <p>Waste fibres like cotton, wool and other fibre wastes as well as regenerated, substandard fibres and waste clippings, selvedge waste, filament waste.</p> <p>Various filament cores (multi, monofibrillated, high-tenacity or texturized filaments), metallic wires, plied yarns, waste filaments, as well as special filaments such as carbon, glass and Aramid filaments, as possible cores for DREF 2 yarns.</p> <p>Sliver weight range: 5-30 g/m (no drafting passage).</p>	<p>Core components (staple fibres and filaments): Man-made fibres such as PES, PA, PAC, PP, viscose, etc.</p> <p>Special fibres such as Aramid (Kevlar, Nomex, Apyell, Arenka, Kermel, Karvin, Konex, etc.), PVC and carbon fibres, cotton in blend with synthetic fibres, etc.</p> <p>various filaments (multi, mono, high-tenacity or texturized filaments), elastomeric filaments, metallic wires, carbon, glass and Aramid filaments</p> <p>Sheath components (staple fibres): pure carded cotton, synthetic fibres and special fibres as indicated for the core.</p> <p>Fibre fineness 0.6-3.3 dtex, Standard staple lengths 30-60 mm drafter silver weight range: 2.5-3.5 g/m</p> <p>The surface of DREF 3 yarns only consists of fibres. Besides of staple fibre yarns also core yarns with an absolutely centric and 100% covered core can be produced with the DREF 3 friction spinning machine.</p>

Practical example: base fabrics for filter felts

The tendency to substitute expensive monofilaments by spun DREF core yarns with identical parameters of tenacity, elongation and better textile surface characteristics is existing especially in this application field. Important producers of felts in the chemical, filtration and paper industry have introduced the DREF friction spinning technology.

Practical example: asbestos cement felts, filter cartridges and filter fabrics (dry and wet)

DREF PP yarns with PA filament cores in the yarn count range of Nm 0.5 - 4 are more and more utilized for the production of asbestos cement felts. Besides the economical production of filter yarns out of bleached cotton for medical purposes and filter yarns out of PP, PA and viscose fibres there is also the advantage of a specific yarn construction, i.e. the solid core and the soft sheath are ideal for the filter effect.

Practical example: protective gloves

(flame-, stab- and cutproof) for iron and steel industries, foundries, forge works and the automobile industry out of yarns consisting of Aramid fibres and glass filament (Table 2).

Table 2 Comparison protective gloves (Fig. 3)

Kevlar out of yarn Nm 4/2	Conventional (leather, PVC coated, asbestos)
utilisation period: 100 h (utilisation tests carried out by an important car manufacturer in Europe)	utilisation period: 2 h
Price: DM 40,—	DM 15,— to 20,— (for good, lined asbestos gloves)
Heat transmission: up to 400 °C heat-resistant, constant heat transmission (reliable protection)	up to 700 °C heat-resistant (asbestos gloves), however rapid and sudden heat transmission (high danger of burning)

Insiders inform that within the next 5 years this market will be covered with about 10 % Kevlar fibres and Kevlar fibre blends, that means about 1 700 tons of Kevlar fibres for protective gloves.

Practical example: flame retardant woven blankets for hospitals etc.

An important blanket producer in Europe is spinning DREF 2 yarns Nm 3 - 4 at 200 m/min out of torn PVC filaments and substandard chlorofibres using a substandard PES filament as yarn core which make 3 % of the total yarn.

These yarns are directly processed on weaving machines (3.3 m reed width) and the fabrics are subsequently raised in 7-8 raising passages on raising machines.

Filling yarns for military and camping blankets as well as for the carpet, packaging and cable industries:

Practical example: filling yarns for the cable industry

A substantial amount of textile thread is used as filling and cushioning material to protect heavy electrical cables. In a heavy-duty 13 ampere cable, for example, there are three strands of wire (+/-/earth) and these are encased in a tough protective sheath of PVC or synthetic rubber.

For the production of such a cable, as many as nine strands of bulky yarn are cabled with the wires to ensure a protectively cushioned core and a round cross-section.

This filling material is necessary but it is also costly. Now a completely new type of yarn is being used. It is made of low-grade recycled waste materials of various kinds and, as the physical properties such as tensile strength etc. are not particularly critical, even very short fibres may be used combined with a filament core.

Quite spectacular cost savings have been achieved in the production of these coarse yarns, by spinning them on DREF 2 up to max. 200 m/min.

The particular advantage of this process is the special construction of the opening system. Even strands of woven fabrics may be fed into it, which can be directly spun to coarse yarns when combined with sheath slivers. These coarse yarns meet the requirements of the cable producers.

A leading cable manufacturer in Western Europe has found this is a process that offers an appealing potential in terms of appreciable cost savings and simplicity of production.

Practical example: (secondary carpet backing)

Of PP yarns and PP tape core with the following advantages compared to conventional jute backing:

- Rotproof, odourless, high tenacity, flame-resistant, non-hygroscopic, resistant to bacteria and insects, electrically insulating (for the core yarns consisting preferentially of twistless, unfibrillated or fibrillated polypropylene tape cores sheathed with staple fibres, substandard or waste filaments may be used for the core thread)
- Constant tenacity throughout the length and good performance in downstream processing.

- Retention of the textile surface character
- Good cohesion between sheath fibres and core
- Better dimensional stability and bonding with the adhesive
- Clean, i.e. dustfree process, hence clean product
- Low production costs and a more suitable product compared to jute yarn which is being progressively replaced owing to the unstable material price and deteriorating quality due to shortages on the jute market.

DREF 3**Outdoor textiles**

- Canvas fabrics for tents, tarpaulins, awnings, covering fabrics for furniture.

Most important advantages in comparison to the conventional canvas yarn:

- Core yarns with 100 % filament increase the quality of end-product (at a production of a yarn 125 tex and PES filament 550 dtex, i.e. 44 % filament ratio a 100 % covering is possible)
- Utilization of DREF 3 core yarns in weft (single yarn)
- Required yarn parameters like high strength, CV % Uster and elongation can be guaranteed by means of using high-tenacity filament cores.
- Elimination of the plying process for weft yarns where the warp yarn construction depends on governmental directions (e.g. warp yarns have to be plied in case of military tents etc.).

Practical example regarding yarn spinning costs on the basis of a DREF 3 24-head machine (Table 3):

Table 3

Garn = yarn, mit = with, hochfest = high-tenacity, Bw-Ummantelung = cotton sheath, Qualität kardiert = carded, prod. Geschwindigkeit = spinning speed, Spulengewicht = bobbin weight, Kanneninhalt/Kern = can volume/core, Mantel = sheath, Streckenbandgewicht = drafter sliver weight, hergestellte Garnmenge = produced yarn quantity, Jahr = year, Betriebsstunden = working hours, Abschreibungszeitraum = depreciation period, Zinssatz = capital interest p.a., Platzbedarf = floor space, Platzkosten = cost of space, Stunden = hours, Stromverbrauch = power consumption, Ersatzteile pro Spinnstelle = spare parts per spinning head, Stundenlohn = wage per hour, aufgrund dieser Daten wurden nachstehende Spinnkosten errechnet = from these data the following spinning costs were calculated, Betriebskosten = operating costs, Kapitalkosten = capital costs, Lohnkosten = wage costs, Gesamtspinnkosten = total spinning costs/kg yarn.

*) Note: The wage costs are apportioned to the number of spinning heads attendable per person. In practice the operator can easily look after the preparatory operations too (carding, drafter passage, can change etc.) with the spinning capacity employed here.

Technical textiles (Fig. 4)

- Protective clothing for military and civil application
 - Fire blockers for the aircraft industry (seat and floor areas)
 - Elastic and bielastic fabrics for the automotive industry (interior).
- Main advantages of DREF 3 elastomeric core yarns compared to the conventional type:
- higher spinning speeds (up to 200 m/min) as well as production of speciality yarns in only one operation
 - 100 % covering of the elastomeric core with sheath fibres offers the following advantages:
 - * higher protection factor in flame retardant fabrics
 - * no damage of elastomeric core in coating processes
 - besides the quality improvement less yarn manufacturing costs compared to conventional processes
 - Base fabrics for technical felts
 - Filter fabrics, tubes
 - Substrates for synthetic leather for the automotive and aircraft industries.
 - Interlinings for outerwear
 - Agricultural-technical products like e.g. sun shade mats for greenhouses etc.
 - High-tenacity - yarns for transport, conveyor belts, etc.

Conclusion

These are only a few examples of special products based on practical experiences with customers, spinning trials etc., which are known.

In the technical sector in particular there is much information which understandably is not passed on, wherever the interest of authorities or bulk consumers or monopolies of manufacturers are concerned.

The great demand for core and multicomponent yarns, the increasing number of suppliers of Aramid and flame retardant fibres, the strict directions for institutional use, for garments and environmental protection indicate that technical yarns with textile and high-performance properties are of steadily increasing importance.

The DREF friction spinning technology - as practical experience has shown - is one of the few alternatives in both qualitative and economical respect.

Fig. 1 DREF 2 coarse yarn spinning (above), DREF 3 multi-component fibre spinning (below) (courtesy Textilmaschinenfabrik Dr. Ernst Fehrer AG, Wegschelder Str. 15, A-4021 Linz)