TECHNICAL AND MEDICAL TEXTILES – A CHALLANGE TO THE KNITTING INDUSTRY

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Technical and medical textiles are highly important today and their importance is steadily increasing. Estimates say that consumption of textile materials increases 3.3 % per annum up to 2005 and 3.8 % per annum in the period of 2006 to 2010, in average. Quantity of textile materials used for these products is expected to rise to 23.6 million tons by 2010 (Fig. 1) and the total value of finished products can reach 127 billion US Dollars in that year, calculated on prices valid in 2002. Even today, about one third of total consumption of textile raw materials is used to make these products.

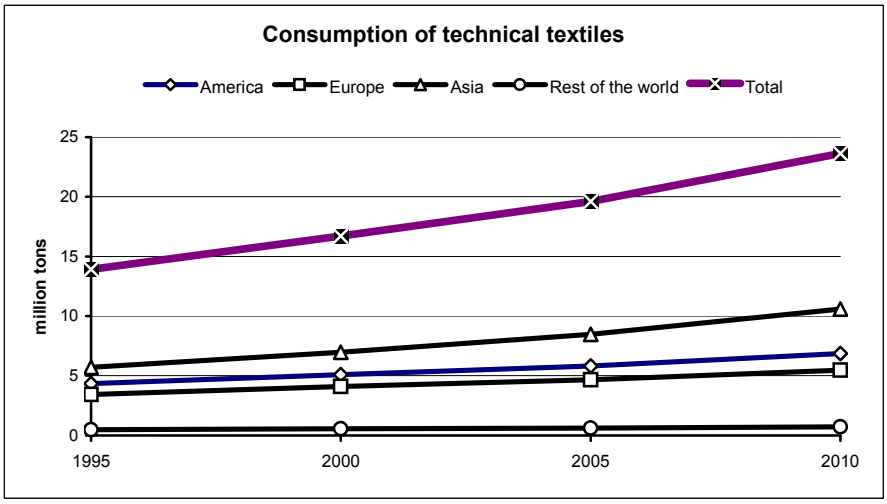

Fig. 1

The range of technical and medical textiles is extremely wide. The following groups of products can be included in this category:

- textile materials used as reinforcing materials of composites,
- rigid and elastic nets,
- textiles used in various cars and other vehicles,
- protective clothes,
- industrial textiles used in machine building,
- filters,
- packaging materials,
- textile materials used in the building industry,
- geotextiles,
- textiles used in the agriculture and food processing,
- textile materials in driving and conveyor belts,
- bandages, textiles used in therapeutical and hospital equipment,
- military applications.

Fig. 2 demonstrates the consumption of most important sectors of technical textiles.

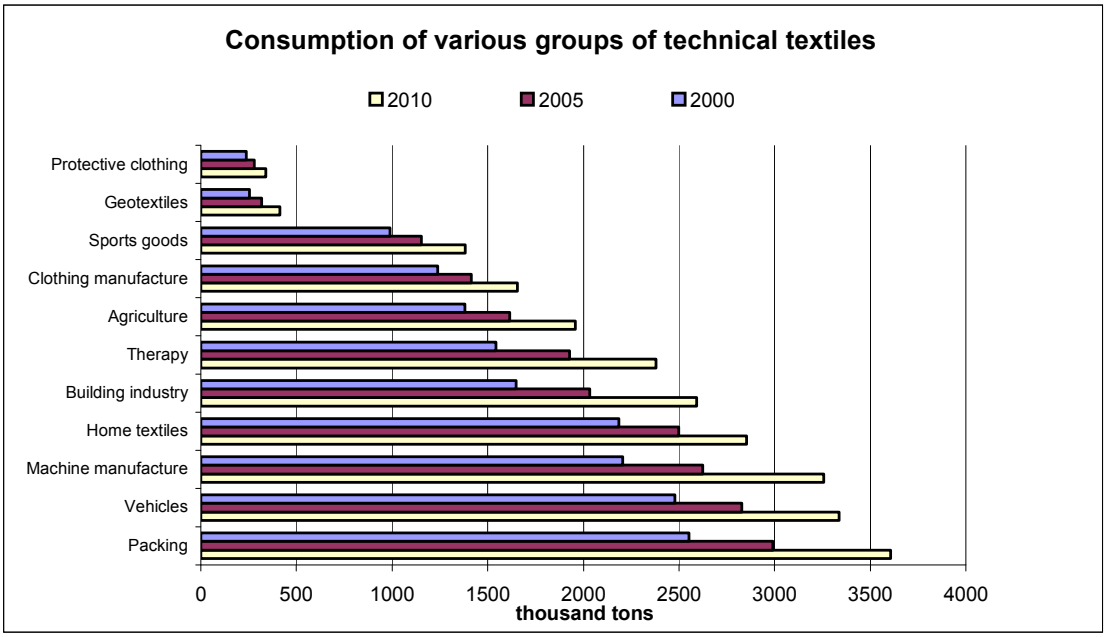

Fig. 2

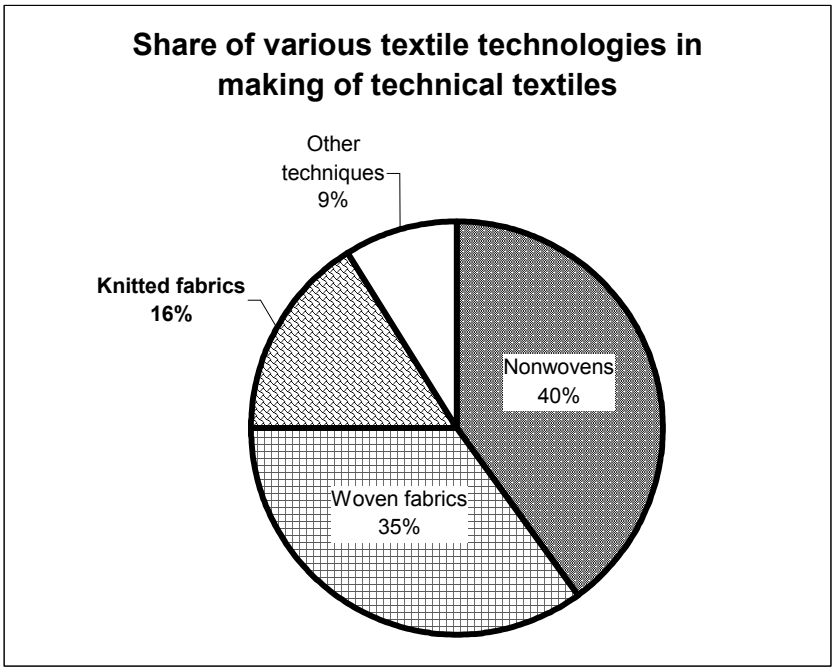

Fig. 3

Every textile sector takes part in production of such products, including spinning, weaving, knitting, crocheting, braiding, the nonwoven sector, etc. This lecture deals with the role of the knitting industry and gives a survey over the most important products used on these fields.

To emphasise the importance of the knitting industry here is all the more topical because production of traditional knitted garments in the European textile industry is being driven into the background, their production is being transferred to Eastern countries, and their place in

the European countries with old tradition in the textile industry is going to be taken over by products which require particularly high brain work. To develop such products requires high-level theoretical knowledge as well as technical and technological skills. The importance of knitting on this field can be well demonstrated on Figure 3: 16% of all textile products used as technical textile is knitted product.

Warp knitted fabrics and products

No doubt that perhaps warp knitting plays the most important role among technical and medical textiles, including tricot, raschel and crochet knitting. Stitch bonding machines can be ranged also with warp knitting. These machines make normally flat fabrics. A less known member of the knitting machine family is the circular warp knitting machine, often called also knit braiding machine. This is available mainly in small diameters (2 to 7 inches with 3 to 200 needles) to make tubes of various sizes

Nets are traditional products of raschel machines. They can be found everywhere like packing materials, one can meet them on sports grounds and buildings, as well as in vehicles, but they are used in great quantity in the agriculture and fishing, and, moreover, they play important role also in therapy. Raschel-knitted nets have a very important advantage: they do not contain knots which would make their moving more difficult and in some application – like, e. g. in therapy – would be uncomfortable. Nets can be produced on up-to-date raschel machines with extremely high productivity and in very large width. Fabrics with various net constructions and made of various materials – according to their end-use – are applied also as sieves, filters, grids.

Tubular nets can be produced on double needle-bar raschel machines. These products serve e. g. as sacks without side seams, fishing nets, protecting covers for cylindrical objects, etc. Circular warp knitting machines can also be used for making tubular nets with smaller diameters (14 to 30 mm) and to manufacture of cords with or without core. Using a bundle of metal wires as core and cotton yarns as covering, insulated cable can be made in this way. This is similar to braided cable covering but here it is knitted.

An interesting application of knitted net is the snow-chain for cars. Instead of assembled metallic chain-links this structure is made of very strong and wear-resistant raschel net. This is much lighter and much easier to store than the conventional metallic snow-chain and the fact that there are no knots in it means that this product does not harm either the tire or the road surface.

Containing elastic yarns (rubber or elastane) the raschel- or circular warp knitted net can be used also as elastic surgical dressing or covering of meats like roll-ham.

In addition to knit decorative trimmings and tapes, crochet knitting machines can be used also to make elastic and rigid bandages, carrying bands, tapes and straps.

Technical textiles should produce in many times with great strength but little extensibility in one or more directions. Knitted structures are usually stronger and stretch less lengthwise (in wale direction) and they

are weaker and stretch more crosswise (in course direction). This can be equalize by using weft insertion on warp knitting machines. This can be completed by lengthwise inserted warp ends to reduce the extensibility and to increase the strength of the fabric in that direction. Choosing proper structure and yarns the same strength and extensibility can be reached in both directions. “Biaxial” fabrics are made in this way. If, however, the strength and stretch of the fabric should be the same diagonally as lengthwise and crosswise, this can be reached by laying on additional diagonal ends, rising both from right and from left. This complex structure of yarn sheets are stitched through by compound needles and fixed together by warp knitting technique. The result is the so called “multiaxial” structure for the manufacture of which special machines have been developed.

Double needle-bar raschel machines have been used since long time in that way that the fabrics knitted on each needle bars are linked together by yarns on their inner sides. Cutting up these linking yarns plush fabric can be made which is very well known as upholstery fabric. This technique has been used in recent times to make spacer fabrics where the two fabric surfaces are linked by relatively thick synthetic monofilament yarns. This yarn is much more rigid than the one used for plush fabrics, thus it is able to keep distance between the two fabric layers, but, at the same time it is flexible and elastic and works as a spring. The outer surfaces can have different structures and patterns, extending the applicability of the product. These fabrics can reach today 60 mm thickness. Changing the structures on certain places, a fabric with parts of different characters and sections with different thickness can be made, giving chance to produce “fashioning” in three dimensions. The fields of application of this promising new technique are subjects of development nowadays. Such products can substitute foam materials in car seats or beds but can be used also as filter materials or in making composites for boats or other vehicles. In an other variant of this technique not rigid monofilaments but conventional yarns are used for linking the two fabric surfaces. The hollow between the two fabrics here can be filled up with synthetic foam or sand to make insulators or special composites.

A further variant of warp knitting technique is that where nonwoven fabric and, if necessary, also additional yarn sheets are led to the needles which join these layers with the technique of needle stitching. These composite fabrics are used in many fields as building or insulation materials, geotextiles, in the machine engineering, shipbuilding, etc.

Circular knitted fabrics

Circular knitted fabrics have been used as backing material for artificial leathers since long time, and they are used for this purposes also today. Important advantage is the high productivity of the knitting machines used for this production and also the extensibility of the fabric which enables to make flexible sheets easy to shape.

Furniture upholstery is another important end-use for circular knitted fabrics. They are easy to decorate with various patterns and can be made with various surfaces. Not only in homes, offices and other buildings but also on vehicles can be seen these fabrics on seats, chairs, couches, etc. According to statistics, West European car factories use textiles for upholstery in 35 % of the seats, 19 % of them are covered with circular knitted fabrics (Fig. 4). This is a very important market.

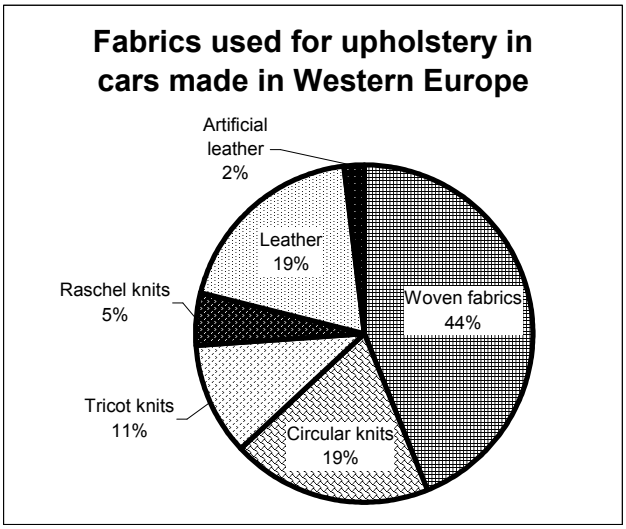

Fig. 4

A newer development for circular knitting machines is to make spacer fabric with rigid monofilaments, for similar end-uses as mentioned above.

The product of a circular knitting machine is a tube which can be used directly in this form. Its diameter is determined by the machine diameter and can be only several millimetres. Artificial blood vessels, orthopaedic bandages, household aids are typical end-uses.

To knit small diameter tubes or cords with core or to cover cables this is a very good technique. Thin cords which are used as decorative “yarns” or materials of trimmings or for carpets can be made in this way, too. Also “Auer”-type incandescent burners for gas-lamps are made on circular knitting machines. Larger diameter machines are also often used to make tubular nettings and tubes for various end-uses.

Flat knitted fabrics

Considering technical and medical textiles, the main feature of the V-bed flat knitting machine is its ability to produce fully fashioned pieces, even in three dimensions. This enables to knit objects which can be built in composites of complicated shapes or they can be used in themselves for special purposes.

Flat knitted fabrics in tubular *and* fashioned forms are used, for example, in the furniture industry to make chair or seat covers. The knitted fabric is more or less elastic by its nature but this can be increased when using elastic yarns. Thus, the seat cover fits perfectly even to the most complicated solid forms and adopts the form-changes during use without producing creases.

Another field where three-dimensional fashioning plays important role is manufacture of therapeutic equipment. Elastic supports fitting to

foot, ankle, knee, elbow, even support stockings can be made completely in one piece, with firm edges on an appropriate flat knitting machine. Also “pockets” can be knitted in for stiffening plates, if necessary.

We can read news on successful experiments with flat knitting machines on which not only weft yarns but also warp yarns are led in the fabric, to make biaxial structures for special industrial purposes.

Raw materials

Traditional textile materials have great importance on this field but technical textiles are very often manufactured of non-conventional materials. These textiles often play special roles, requiring special features which can be fulfilled only by special raw materials, mainly synthetics. In addition to the very well known old polyamide, polyester, polypropylene, elastane fibres, etc., we meet also in knitted fabrics with heat resistant and chemically resistant meta-aramide and polyphenilene-sulfide (PPS) fibres, extremely strong para-aramide fibres and high-tenacity polyethylene fibres, heat-resistant polyimide fibres, strong and heat-resistant phenol-derivative fibres, and with many others which are developed for very special purposes.

Among textile materials used by doctors the very hygroscopic calcium alginate and the carboxi-metil-cellulosic (CMC) fibre can play important role in wound treatment. There is another fibre which can be seen in the body with X-rays. If surgical wipes are made with this fibre, they can be discovered later if a wipe remains in the body during operation. Textile fibres containing silver particles help to eliminate electrostatic charges and make the garment more healthy and preclude provoking of smell of sweat with impeding micro-organisms to settle down on the garment. Another fibre type which also has anti-microbial effect is the combination of some conventional fibre (like cotton, wool, viscose or something else) and of entomolin extracted from the crust of a special species of crabs. Having also haemorrhage controlling effect, this fibre with entomolin content can be used in surgery, too.

To eliminate electrostatic charge is very important in many industrial end-uses. It exists for example a bicomponent fibre which has a polyester shell and an electrically conductive core and can be used for manufacture of textiles with conductive feature.

Many sorts of technical textiles, also knitted ones, are made of glass fibres, carbon fibres, metallic fibres. An example for the latter one is the thin copper wire covered by silver which is combined with cotton yarn or polyester filament yarn to manufacture electrically conductive fabrics for intelligent garments or against electro-smog. Fine stainless steel wires can be used to make fabrics for protective clothes, filters, etc. Carbon fibres are usual raw materials of some composites but they can be also knitted with special techniques.

* * *

The above listed examples show that knitting technique is available to produce many interesting structures which, choosing the right material,

enables manufacturing of a large variety of technical and medical textiles, not only garments. Technical and medical textiles are largely spreading and offer plenty of opportunities for innovation and product development. But this requires conscious work and high level professional knowledge and skill. Here it is not enough to create a fashionable, good-looking pattern or style. To work out technical textiles requires serious engineering work since the product must meet precisely determined requirements. The behaviour of the raw materials and the knitted structures towards the circumstances of use must be very well known. But not less well known must be the machines and the technology which are to be used to manufacture this material to create a fabric with the required features. It is very important to formulate the requirements very precisely and to know very well the materials, the machine abilities and the technology. It is not possible to start the development work at a guess.

The Hungarian knitting industry is in possession of this intellectual capital and proficiency which enables it to join this international tendency. A number of Hungarian factories are active on this field already today and as member of the European Union we do hope that close connection can be established between the Hungarian brain capacity and the highly developed Western European textile industry.

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