

### Background Information BCF Technology

## 99 % higher efficiency – things you need to know about carpet manufacturing

Carpet manufacturing is a handicraft with an ancient tradition. It is assumed that the Babylonians were already weaving fibers 3000 years before Christ. Today, new carpets are presented at the various international trade fairs and markets – each distinct in terms of their pattern, their color and the end-customer properties.

Over the past 50 years, the importance of various raw materials used in the carpet industry has changed dramatically. Up until the 20<sup>th</sup> Century, natural materials were predominantly used – such as plant fibers made from cotton or coconut or fibers of animal origin including wool and silk, for example. Currently, natural products only make up approximately 12 percent of all the raw materials deployed, while manmade raw products constitute 88 percent. Manufacturers of manmade yarns use polypropylene, polyamide and polyester in their products.

Either filament yarn or spun yarns can be used to manufacture carpet yarn. The latter are produced using manmade staple fibers and are usually combined with natural fibers. Spinning filament yarns has manifested itself as the prevalent method for producing carpet yarn: it is more cost-effective to manufacture and the finished carpet is lower-maintenance, more robust and more hypoallergenic.

Manufacturing filament yarn requires the polymer to be melted in an extruder and pressed through spinnerets. In the case of spun-dyed yarn, the dye is added prior to extrusion using a metering unit. Downstream to the spinning system – the filament bundle, which generally comprises 144 individual filaments and has an overall titer (unit of measure for determining the fineness of the manmade fibers and given in “tex” or, more commonly, in “dtex”) of between 1000 and 3000 dtex – is drawn using godets (driven rolls that act as yarn guides or take-off devices); hence creating a strong and extremely thin filament material. In the subsequent process step, the yarn is textured (physical and/or chemical manipulation of the smooth filament yarn with the aim of giving the yarn textile properties) and cooled on a cooling drum. To this end, it acquires the properties essential for processing it into carpet (volume and bulk) and is transformed from smooth filament yarn into bulked continuous yarn (BCF= **bulk**ed **co**ntinuous **f**ilament). Subsequently, the yarn is tangled using a tangling unit (for tangling the filament yarns) in order to keep the tangled multifilament together for further processing and finally the yarn is taken up. The take-up speed, which is dependent on the polymer and titer, is 3000m/min for standard polypropylene yarn.

The BCF carpet yarn systems in the Oerlikon Neumag product portfolio are called S5, S3, Sytec One and S+. Each of these is customized to the specific requirements of various client groups. The S5, S3 and S+ are three-end systems, whereby the S5 is Neumag's to date most-sold BCF system. The single-filament Sytec One is particularly flexible. The latest S+ standard machine is the successor to the S5 and S3 systems and unites their benefits in a fast and simple-to-operate machine with proven components. Thanks to a straight yarn path and increased spinning height, it reaches higher production speeds. Compared to the S5, this results in an increase in productivity of 10 percent at

Page 2 1300 dtex and an increase in productivity of up to 40 percent at 2100 dtex. Furthermore, a redesigned winder mechanism enables an efficiency increase of up to 99 percent.

## Following the manufacture of the BCF yarn

Optionally, the BCF yarn can either be cabled or twisted. In this step, a yarn is twisted or several yarns, also of different thicknesses, are brought together and plied. In this way, the yarn receives greater bulk and the carpet acquires a denser appearance. To ensure that the cabling or twist effect is durable, the yarn is treated with heat and steam within the context of a thermosetting process.

To manufacture carpets, the yarns are either woven or tufted. Woven carpets require three yarns, so-called warps, in order to form the carpet including the product's upper surface and the backing material. If manufacturers wish to produce carpets with a fleecy surface – so-called velvet-pile carpets – the woven loops are cut open, evenly sheared and fixed by applying a latex layer to the reverse of the carpet.

In the case of tufting, which was first invented in the USA, the yarns are needled through a needle bar into a prefabricated backing material, for instance a fabric or a nonwoven, and form a series of loops. In the case of loop-pile carpet, these loops are left as they are. However, the loops are cut off using a blade in the case of a velvet-pile carpet. Tufted carpets must also always be stabilized with a binder coating made of latex and a secondary carpet backing.

To produce a colored carpet, makers can choose between various methods depending on the polymer and the manufacturing technique used: dyes can be added during the spinning process or the yarn or the entire carpet can be printed or dyed as a single piece. In the case of the piece dyeing process or printing the carpet, the yarn is manufactured from raw white polyester or polyamide and the carpet is predominantly produced using the tufting process. With this method, manufacturers can respond to short-term customer color requirements.

## Applications

We distinguish between three different applications: the residential sector, the public sector and the automotive sector, whereby the residential sector makes up the largest share, for which carpets are supplied as wall-to-wall carpeting or rugs. In the public sector, carpets must above all be particularly friction- and flame-resistant. However, the automotive applications are the most challenging, as the carpet manufactured from spun-dyed yarn has to be very closely shorn and hence irregularities become quickly apparent. With a three-quarters share of the market, demand is dominated by tufted carpets. Furthermore, artificial turf, bath mats or carpets made from needled felt are additional applications.