

SOFT COTTON KNITTING YARN WITH AIR-JET TECHNOLOGY

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ABSTRACT

The article deals with the development of the commercial application of air-jet yarns. The main focus is then placed on the analyses of the Rieter air-jet Com4jet® yarn characteristics and the way its structure may be adapted to meet the current market demands. Attention is also paid to the economic benefits of the adapted production and downstream processes.

AIR-JET SPINNING HISTORY

Air-jet spinning is both an old and a young spinning method. The textile world has known this technology for decades. First it was the so called jet spinning system introduced to the market. The technology created the yarn twist with air in two steps, with two separate spinning nozzles. It was used e.g. for PC blends for bed sheeting in the US and 100% PES applications.

The yarn strength was high, the touch of the yarn was crispy, harsh compared to the established ring and open-end yarns. But the productivity was impressive and the new technology was accepted in certain applications like bed sheeting where the high washing resistance was more important than the touch.

The next step was the Vortex spinning system with one twist area, one spinning tip. Production speed reached 350 and 400 m/min, the touch of the yarn was softer compared to the Jet yarn before. Thus the technology got market shares in new applications.

RECENT DEVELOPMENT IN AIR-JET YARN APPLICATION

Over the last years the air-jet spinning technology has got major markets shares in the viscose application. The touch was now based on the new technology – introduced in 2003 first time - softer than open yarn, slightly harsher compared to ring yarn. This was appreciated by the market because viscose fabrics out of ring yarn always have the tendency to be limp.

MARKET SITUATION

Since mid of 2013 the viscose boom has been stagnant. Overcapacities in the fibre and yarn market lead to a deep crisis for the fibre and yarn manufactures. And this

time it is not a short downswing the viscose market is known for. The outlook is that the market will be weak for 1 or even 2 years.

Investment of big fibre manufactures and investments in the air-jet technology are stopped or minimum postponed for a longer time.

Existing air-jet spinning mills start to transfer their production to new applications, new markets, new air-jet yarns. But what are the alternatives to viscose Ne 30 yarns?

NEW MARKET REQUESTS

FINE VISCOSE YARNS

There are several trends air-jet spinners are looking for. One is still viscose but for fine and extreme fine yarn counts. The Ne 30 is history, even with Ne 40 it is difficult to earn money. Mills are looking for Ne 60 and Ne 80 out of micro Tencel or micro Modal for women underwear. This is a challenge for the fibre preparation and the whole pre-process. Best opening of the fibres, adapted production rates on card and draw frames as well cleaning and maintenance together result in a suitable sliver quality.

PES BLENDS

Also new blends like PES/CV and CO/PES in the yarn counts Ne 30, Ne 40 and Ne 45 are in the focus of the air-jet spinners. Both blends are for knitting and weaving applications. Or 100% CO combed for Ne 30, Ne 40, Ne 50 and even finer are on the agenda of the spinning mills.

FOCUS ON THE SOFTNESS OF THE AIR-JET YARNS AND FABRICS

However, over the whole application range there is a general request from the market. All air-jet yarns must be softer, the fabric touch must be as close as possible to the touch of a ring fabric. But still it has to retain the outstanding pilling and wash resistance. Combined with the need to be more competitive, the production must be at the same time more economical. There is the machine supplier in charge to offer and develop solutions for and with the customers and their customers.

THE RIETER Com4jet® YARN

YARN CHARACTERISTICS

The air-jet spinning method provides Com4jet® yarns with their special structure. Air-jet yarns are characterized by parallel fibres creating the core which is covered by twisted fibre ends on the yarn surface (Figure 1). The differentiation of the yarn structure then lies mainly in low hairiness formed by short fibres, openness of the

yarn structure and medium yarn tenacity. These features are then responsible for high pilling and wash resistance, clear and even structure of air-jet fabrics but also lower tear strength.

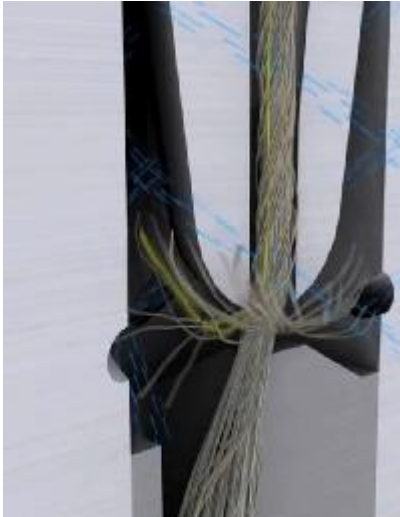


Figure 1

DEVELOPING Com4jet® YARN WITH SOFT CHARACTER

To reach the target of a soft air-jet yarn we were in a dilemma. From the conventional spinning systems it is well known that a softer yarn can be reached by reduced twist. Reduced twist results in lower strength. But for ring and ring compact yarns having the highest tenacity of all yarns a loss, i.e. a reduction of some tenacity to get a softer feel, is possible. The softness of such ring and compact yarn is indicated by a higher hairiness.

With air-jet yarns the same way cannot be taken, it is a different story.

During the first development stage we decided to increase the hairiness of the air-jet yarn. Higher delivery speed is a well-known method to do it, combined with slightly lower spinning pressure. Also with other additional equipment we were able to get hairiness which was even higher compared to ring yarn. But the result in the fabric was a shock.

The yarn with the highest hairiness resulted in the harshest touch, end user and textile people judged it. But why is an air-jet yarn with higher hairiness not softer compared to the standard air-jet yarn. Microscopic photos and further investigation showed us that the above described process changes did alter the structure of the yarn. It was, more or less, the same structure like before and the mere increase of hairiness did not lend the yarn the soft character.

The goal changed then and efforts were directed to establishing production setting and components modifying the character of the yarn, i.e. opening its structure, which is finally the factor which accounts for the softness of the produced fabric. We started developing a new spin tip for the soft yarn application - a spin tip with a smaller diameter and a special surface. In combination with reduced spinning pressure, higher delivery speeds and different spinning tension we get a yarn with the required yarn character to produce fabrics whose touch comes close to ring fabrics.

To sum up, the “soft” Com4jet[®] yarn maintains its special low hairiness which makes it a leading yarn technology for lowest pilling, highest wash resistance and fabric evenness but the yarn body structure is more open and this gives the resulting fabric the required soft character.

Com4Jet[®] YARN AND FABRIC EVENNESS

Evenness is another aspect of the Com4Jet[®] yarn that contributes to the acceptability of the fabric – though at first sight and with microscopic analyses it may not seem so. It is a clear fact that within the range of all spinning technologies, the Com4jet yarn mass unevenness ranks behind the ring yarns. It is mainly formed by regular short-wave unevenness (Figure 2).

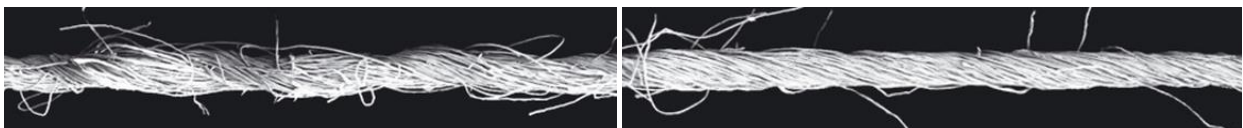


Figure 2: Com4Jet[®] yarn

Ring compact yarn

Interestingly enough this typical unevenness turns into a real advantage when it comes to fabric construction. It is partly consumed by the voluminosity of the yarn, partly by the phenomenon known from the computer bitmap graphics where regular small dots are perceived within the context as perfectly regular. The same happens with Com4jet fabric which surprisingly gives the highest fabric evenness out of all spinning technologies. It shows that there is not a direct relation between this particular yarn unevenness and the fabric unevenness. The practical results show without exception the fabric evenness is higher than such that we could have derived out of the yarn figures.

ECONOMY OF THE PROCESS

Additionally, as a bonus of the soft yarn production process, we manage to reduce the conversion costs for the air-jet yarn. The decreased spinning pressure results in savings in air pressure costs. Even combined with delivery speeds which are higher than for standard air-jet yarns at 460 m/min, the conversion costs are significantly reduced for the new set up.

The figures are not negligible. The costs to produce pressure air for soft yarn production can be reduced by 20%. At the same time the productivity of the machine due to increased delivery speed can be increased by 20%, i.e. 350 kg more yarn per single Rieter air-jet machine per single day.

DOWNSTREAM PROCESSING

The knitting trials with Com4Jet soft yarns were carried out and the grey fabric was inspected by end user and textile experts. The result was promising. Even in the grey fabric the feel with the new set up was different, it was much softer.

In cooperation with experts from the dyeing and finishing we optimized the recipe for the soft air-jet fabric. It started with bleaching – where higher temperature and shorter times were used. The dyeing process was also adapted – less dye agents for dark colours.

With standard machine equipment, standard chemicals but adapted recipes and processes we could improve further the soft touch of the air-jet fabric. And the costs for the dyeing and finishing are comparable to the standard process for ring fabrics.

NEXT STEPS

Rieter now introduces the soft yarn application step by step into the market.

Air-jet spinning is the formula one in textile. The fibres, the blow room and carding, the draw frames, the air conditioning have a tremendous influence on the performance of the end spinning. This is a fact which has to be considered to be successful with an air-jet project.

Ring and open end yarns cannot be replaced 1:1 by an air-jet yarn. Knitting and weaving construction, recipes for bleaching, dyeing and finishing must be also adapted. Here, we from the machine supplier side have to go together with our customers and their customers to make soft Com4jet[®] yarn successful in the market.