Rieter yarn

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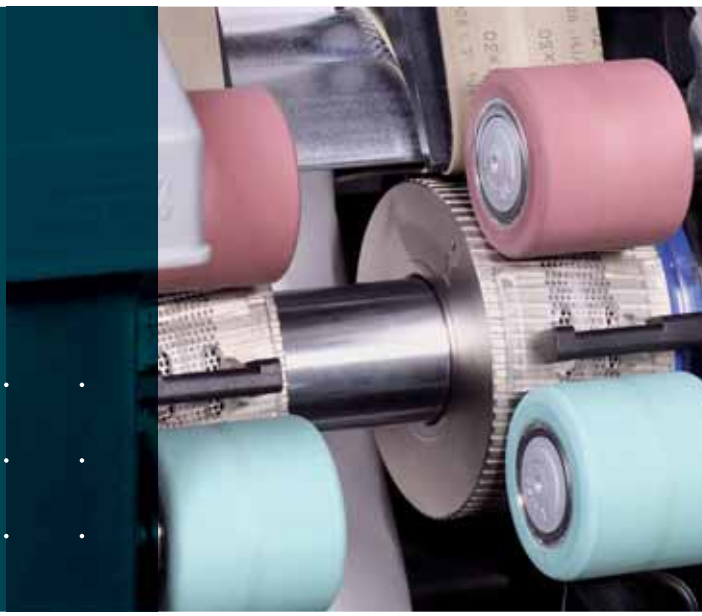
Comfort through COM4®
New potential in downstream processing



New potential in downstream processing with COM4®

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Rieter Machine Works Ltd. in Winterthur/Switzerland has been engaged in the development of compact spinning technology for several years, and in 1995 became the first manufacturer to launch the relevant, fully-developed spinning machines on the market.

The innovative compacting process involves compressing the fibres by means of a vacuum during spinning. The yarn as a whole is more compact, protruding marginal fibres are more tightly integrated and the fibre content itself is utilized more effectively than is the case with conventional ring-spun yarns. This results in various advantages of COM4® yarn, such as
- Low hairiness and
- Higher strength

These are very important, especially for the subsequent stages of the textile process, in terms of technical implementation, economics and also qualitative aspects right through to the end product. Alongside the continuous technical development of the ComforSpin process, it was therefore only logical and consistent that Rieter should also concern itself closely with the processing characteristics and the potential applications of the new COM4® yarn. Trials have been and are being planned and conducted not only in-house, but also with customers and with partners in the downstream processing and textile machinery industries. The results have been arrived on the basis of extensive series of tests over prolonged periods with a wide range of raw material qualities and yarn counts. Reference can therefore now be made to informative, statistically supported results and broad-based practical experience in the various downstream processes of winding, twisting, weaving, knitting and finishing. The findings which have been made will be presented and analyzed here.

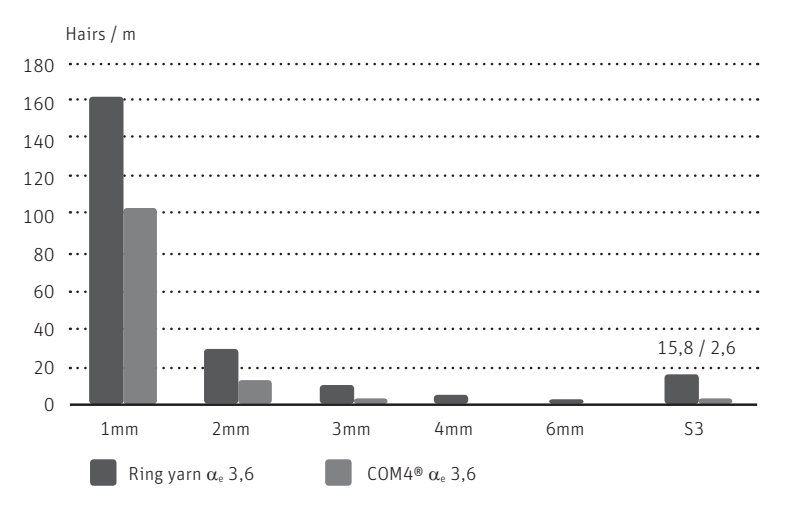


Fig. 1 Reduced yarn hairiness, 100% CO, Ne 40

COM4® IN WINDING OPERATIONS

Every ring spinning process is followed by a winding process in which the yarn is rewound from the cop on to a cross-wound package. Generally speaking, yarn is napped on guide elements, in this case on those of the winders, and its hairiness thus increases, i.e. short, loosely incorporated fibres are gathered up into neps. Rewinding has a negative impact on the structure of the yarns. The centrifugal force arising from the winding speed on the one hand, and the maintenance of the machine on the other, play a crucial role in the extent of the damage caused. Loss of quality of this kind is characteristic of conventional ring spun yarns and is accepted as a fact of life by downstream processors.

Series of yarn measurements conducted inhouse have shown that the hairiness of COM4® yarns on the cop is up to 50% lower than that of comparable ring-spun yarns (using Zweigle S3).

The difference is even more pronounced after the rewinding process: the difference in hairiness before and after winding as an indicator of yarn damage is up to 70% lower on COM4® yarns than on conventional ring-spun yarns (using Uster UT4, Fig. 1); this is a result of the tight fibre integration. A comparison of the frequency of sloughing neps shows a similar picture. The number of neps in COM4® yarns increases by 10% to 20% as a result of the winding process, that in comparable ring-spun yarns by 40% to 50% (Figs. 2 and 3). The considerable efforts made in spinning preparation, carding and combing operations to reduce nep counts are nullified by the process itself in the case of conventional ring spun yarn. Since the neps produced by sloughing can no longer be eliminated in the subsequent processing stages, the new COM4® technology will attract widespread interest. Obvious irregularities are cleared out of the yarn on the winding machines. Here the choice of the correct clearer systems and thresholds is crucial for the final quality of the yarns. The cut requires optimum yarn piecing to prevent the join itself from being identified as a thick place in the yarn or an uneven place after dyeing. Poor yarn piecings are especially obtrusive and disturbing in fine, uniform yarns. Generally speaking, the conventional systems supplied by all winder manufacturers can be used for joining COM4® yarns. Rieter therefore maintains close contacts with leading manufacturers of clearing and splicing systems, and in the context of joint projects has evolved special machine settings which achieve good results under mill conditions.

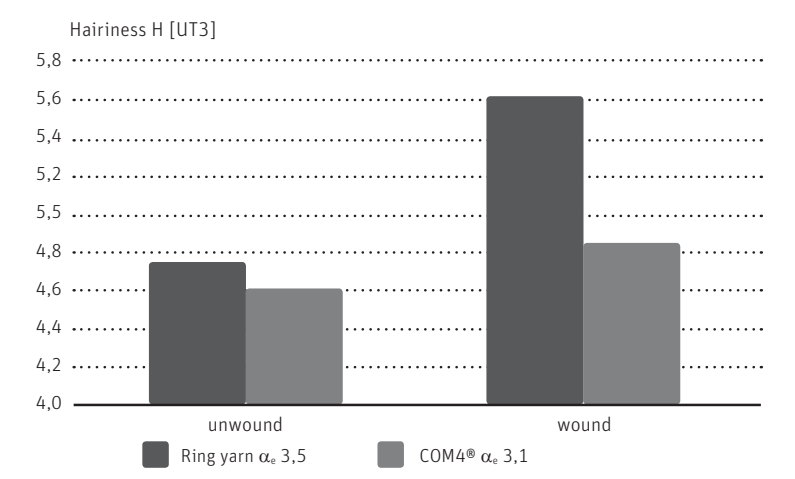


Fig. 2 Smaller increase in hairiness as a result of the rewinding process, 100% CO, Ne 30

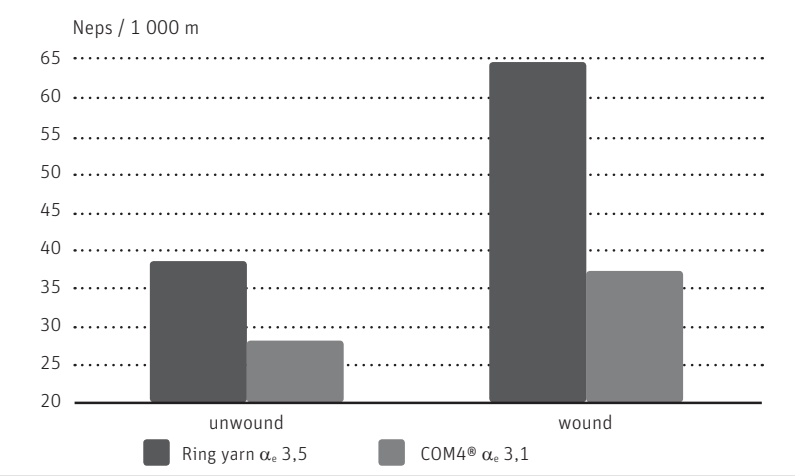


Fig. 3 Smaller increase in nep count as a result of the rewinding process, 100% CO, Ne 30

COM4® IN TWISTING OPERATIONS

Ply yarns are used in textile fabrics to produce clear-cut structures, lower hairiness and/or higher strength, which cannot be guaranteed by single yarns. Due to their improved structure and high utilization of fibre content, COM4® yarns already achieve strength values in single yarns which are comparable with those of conventional ringspun ply yarns. This enables ply yarns to be replaced in suitable articles and thus represents a significant cost saving.

At the same time COM4® ply yarns can also be produced much more economically. Studies have shown that COM4® yarns achieve the same strength values as conventional ring-spun yarns with 20% less twist. The lower the twist factor of the single yarn, the fewer twists are needed to produce the ply yarn. Production times and thus costs are reduced. When COM4® yarns are used, singeing can be dispensed with due to the reduction in hairiness resulting from the spinning process. In single and ply yarn production this means raw material savings on the order of 6–10% and the elimination of the rewinding process which is necessary to remove the singeing dust. For twisting mills these possibilities mean genuine increases in productivity and lower manufacturing costs. Further potential is provided by the wide range of creative development opportunities, e.g. for soft, high-strength or new crepe plies.

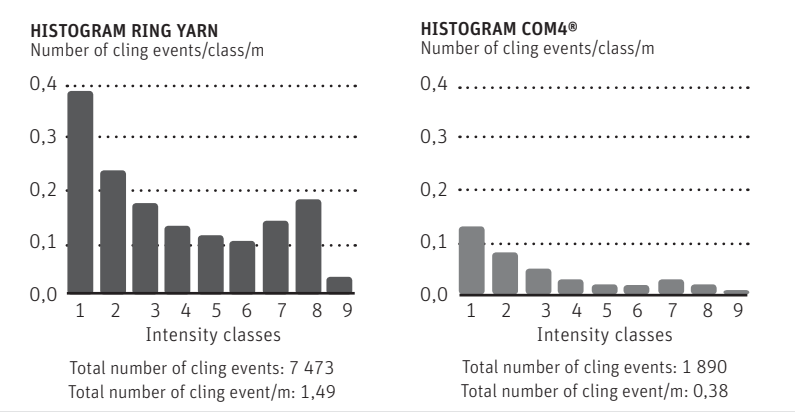


Fig. 4 Fewer instances of clinging, 100% CO, Ne 60

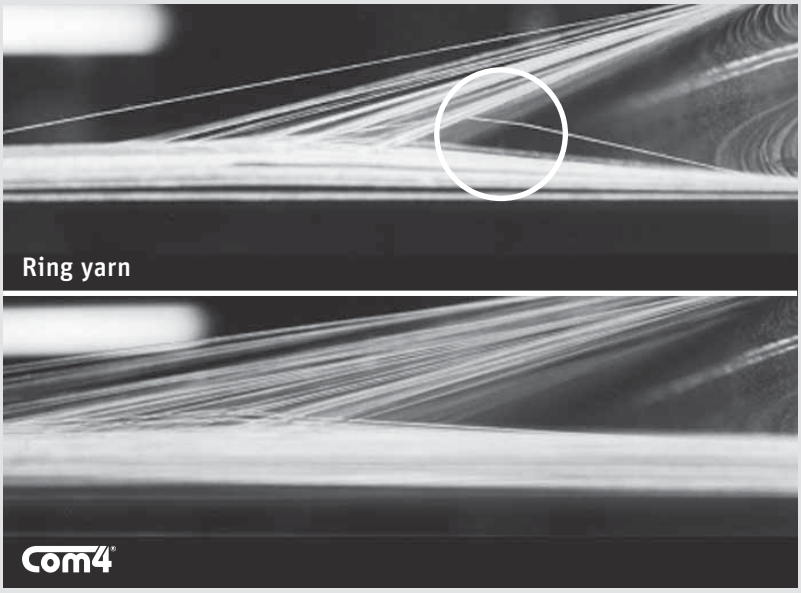


Fig. 5 Reduced clinging tendency in the dry dividing zone of the sizing machine

COM4® IN SIZING OPERATIONS

Sizing is usually an essential process for preparing warps made from staple fibres for the weaving operation. The strength of warp yarn is increased and its hairiness reduced by applying starch or acrylate-based sizes. Complicated processes have to be performed at the finishing stage to remove these applications from the fabric again.

Series of tests conducted at the FIT (Federal Institute of Technology) in Zurich to ascertain the clinging tendency of yarns revealed a significantly lower clinging tendency in terms of quantity and quality for warps made from COM4® yarns compared with those made from ringspun yarns (Fig. 4). Pictures from the dry dividing zone of the sizing machine confirm these findings. The improvement in separability of the warp can be seen very clearly (Fig. 5).

The behaviour of COM4® yarns with a reduced degree of sizing has been analyzed in close cooperation with partners from the textile and textile machinery industries.

The following three warps, each 600 metres long, were produced for this project:
1st warp: ring-spun yarn
2nd warp: COM4® yarn
3rd warp: COM4® yarn with 10% less twist

Reliable and informative results were obtained with a total of more than 2 000 000 picks (Fig. 6). In a practical trial it proved impossible to weave ring-spun yarns economically with reduced sizing. Comparative findings therefore refer to ringspun yarns with conventional levels of sizing application. With a relative reduction in the degree of sizing of 50%, equivalent to a reduction in filling from 14% to 7%, COM4® yarns record significantly better running properties with fewer thread breaks than comparable ring spun yarns. Another version was tested using COM4® yarns with 10% less twist. These showed a further slight improvement in processing properties. Thread break frequency in the instances referred to was always less than 4 stops per 100 000 picks. A further relative reduction to 25% of the original degree of sizing (an effective level of 3,5%) resulted in a rapid increase in thread break frequency in the article tested (shirting poplin). The following conclusions can be drawn from these results:

- Reduced cost of sizing agent
  In these studies this amounts could be minimised to more than 40% of total sizing costs.
- Cost savings in waste water treatment
  Some 50% of the total chemical oxygen demand (COD) loads in finishing operations is due to washed-out sizing agent and other substances present.

Each weaver must decide individually on the optimum degree of sizing, taking into account yarn characteristics, fabrics and machines, even when COM4® yarns are being used. The goal is always a compromise between optimum running properties and sizing costs. Various experiments are currently in progress with a view to dispensing entirely with sizing in the case of suitable fabrics.

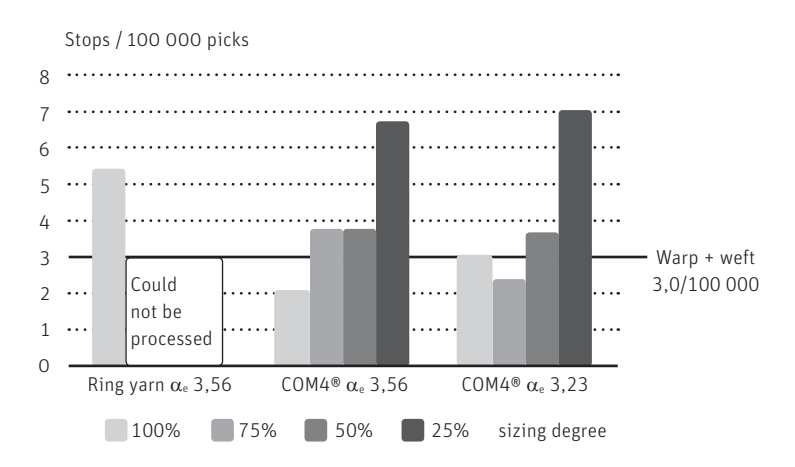


Fig. 6 Improved running properties with reduced application of size, 100% CO, Ne 50

COM4® IN WEAVING OPERATIONS

The results presented in the chapter on sizing have shown that higher machine efficiency can be achieved through lower thread break frequencies when COM4® yarns are used. This is equally applicable to weaving operations. Studies conducted at ITV Denkendorf have shown that a 1% improvement in machine efficiency creates value amounting to 1 000,– EUR per weaving machine per annum. Any additional costs of COM4® yarn are thus offset entirely or in part in weaving operations alone.

In addition to economic aspects, COM4® yarns offer above all qualitative benefits in woven articles:

- More clear-cut contours in sophisticated fil-a-fil fabrics
- The possibility of replacing ply yarns by COM4® single yarns

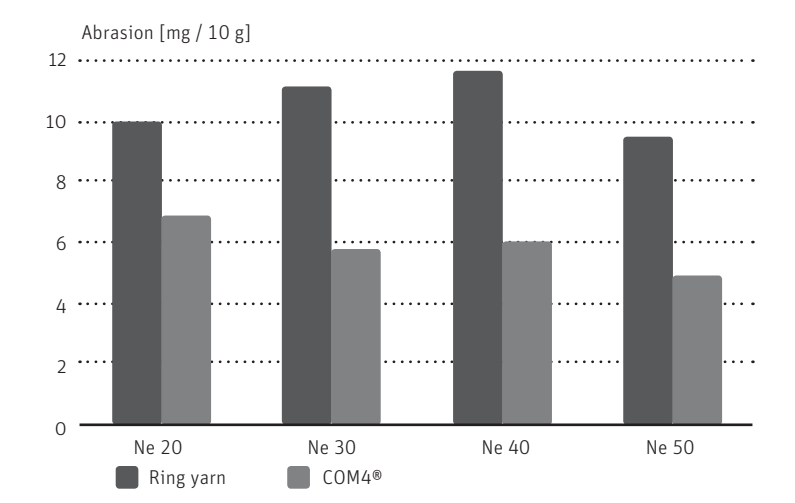


Fig. 7 Reduced fiber abrasion in downstream processing, 100% CO

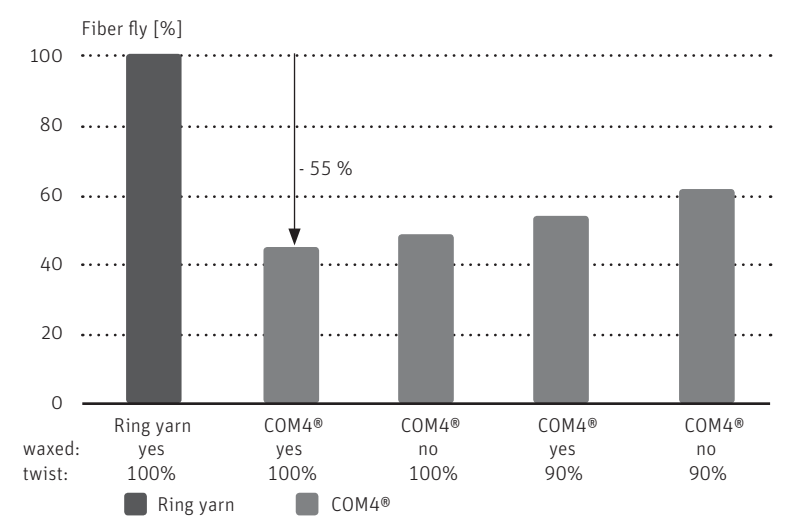


Fig. 8 Lower fiber fly and less foreign fibres 100% CO, Ne 36

- Manufacture of high-quality velvets. An especially attractive surface is produced due to the trouble-free opening of the fabric pile
- Reduction in the number of warp beams. The reduction in fibre fly enabled a customer to manufacture, for example, a two-colour striped shirting poplin with one warp beam instead of two as hitherto, since the article's susceptibility to extraneous fibres was largely eliminated by the yarn being used
- Development of new qualities, new creative scope for product developers and designers

COM4® IN KNITTING OPERATIONS

High strength is not needed in knitting to the same extent as in weaving; it is not one of the requirements specified for a knitting yarn. Nor is the low hairiness of COM4® yarns a priority for processing in all cases; the covering capacity of the yarn was initially regarded as a drawback in the end product. The significantly improved pilling values and wear behaviour however are now seen as crucial advantages. Current fashion calls for smooth fabrics with an elegant appearance and clear loop structures. This is a requirement of downstream knitting processors, especially in the top-quality bracket. The low hairiness of COM4® yarn has a positive impact on fibre abrasion in loop formation (Fig. 7). The abrasion of COM4® yarns in the count ranges shown is some 40% lower than in the ring-spun yarns used; this is a result of the continuous compacting of the fibre structure during spinning. This results not only in better running properties but above all in reduced fibre fly. Even with the elimination of wax and/or reduction of twist COM4® yarn shows less fibre fly as the comparable ring-spun yarn (Fig. 8). As expected thus improved quality of the articles.

Opportunities arise for new patterns in warp knitting as in weaving. Since the fibre fly produced with conventional ring-spun yarns meant that they could only be processed to a limited extent in combination with filaments (standing ends and filler yarns at most), COM4® yarns now offer the possibility of manufacturing new products, especially in the field of body-contact textiles.

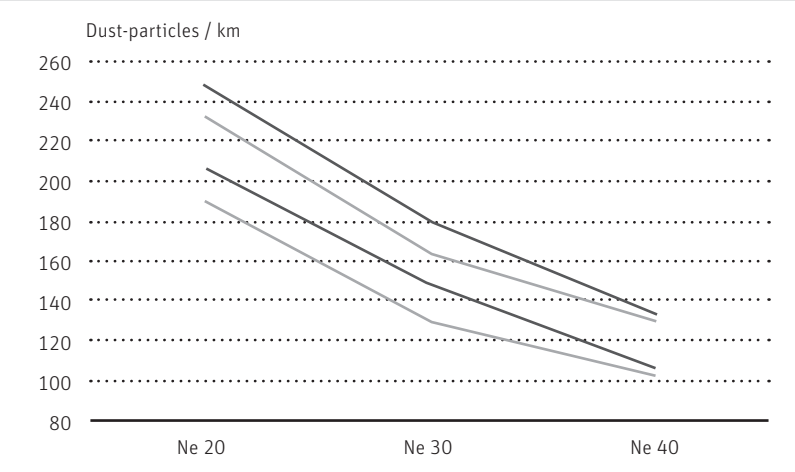
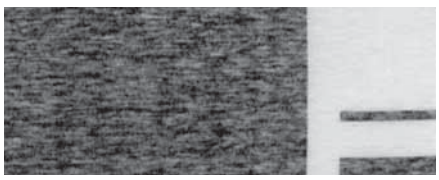


Fig. 9 Fewer dust particles in the yarn, 100% CO



Ring yarn

COM4®

Fig. 10 Higher dye penetration in knits: back of a printed single jersey

The following advantages are evident for the knitting sector:

- Reduced knitting defects, fewer thread breaks, better quality. The reduction in fibre fly eliminates the danger that this will combine with oil and be knitted into the fabric; articles on neighbouring machines are much less subject to contamination by extraneous fibres and/or fibres of other colours.
- Improved wear behaviour. In particular, the much improved pilling values in the final article are a convincing criterion for using COM4® yarns.
- Reduced wear on guide elements, needles and sinkers; extended machine operating lives as a result of the vacuum prevailing during compacting (Fig. 9), the residual dust content (silicon particles < 0,5 mm) in COM4® yarns is some 10% lower than in ring-spun yarns; this results in less soiling of the knitting elements and longer cleaning intervals.
- Optimized running properties. Lower hairiness means that waxing can be dispensed with; yarn tension is lower, permitting undisturbed loop formation (no fibre entanglement).

COM4® IN FINISHING OPERATIONS

Test series will in future increasingly be expanded to include finishing themes and problems. To date we know of no significant differences between ring-spun and COM4® articles in pretreatment and finishing operations. The same formulations and machines are used. In prints COM4® wep-knit fabrics display better dye penetration (Fig. 10). As with singed knits, they display clear-cut contours, and there is no congestion of the printing screens by fibres. The surface of the COM4® yarn is dyed more intensively with the same quantity of dyestuff, and printed and piece-dyed articles display higher colour brilliance.

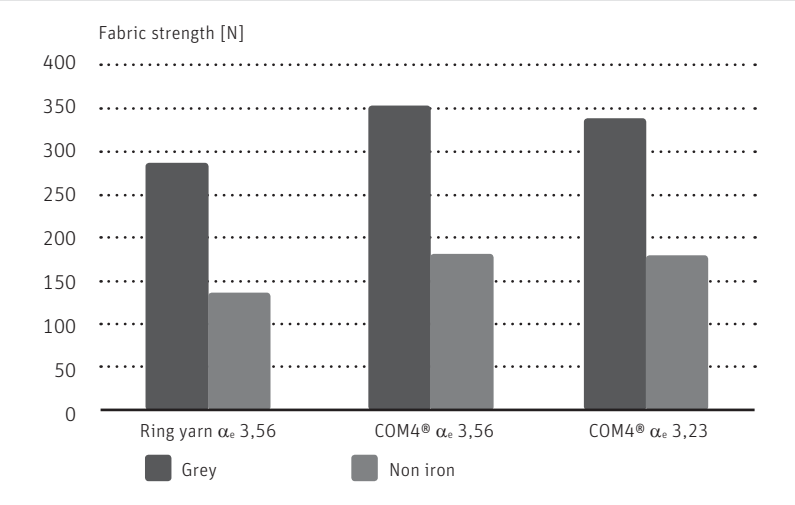


Fig. 11 Higher fabric strength, 100% CO, Ne 50

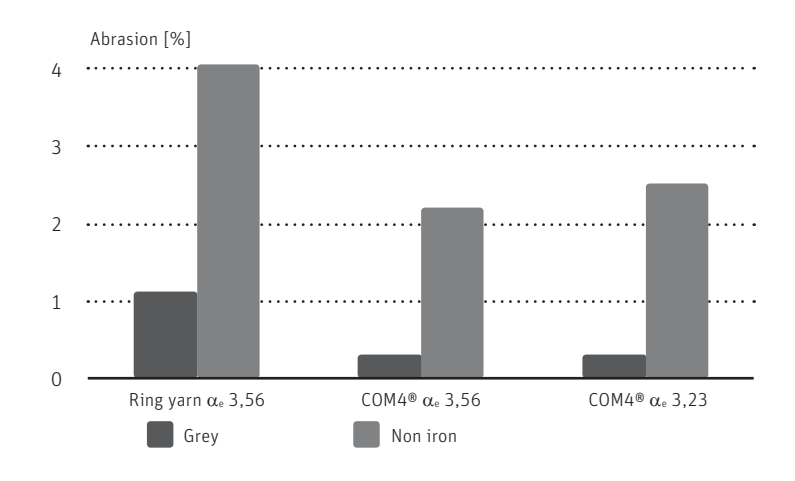


Fig. 12 Improved abrasion resistance in the textile fabric, 100% CO, Ne 50

High yarn strength is a characteristic feature of COM4® yarns, of course, and is evident as an advantage through all processing stages to wear behaviour. This is regarded as a great advantage by ready-to-wear manufacturers, especially in shirting fabrics with non-iron finish, since losses in strength of up to 50% can arise from the use of synthetic resin (Fig. 11). Statements regarding pilling tendency in knits and abrasion resistance in weaves and the resulting durability of an article can be based on measurements of weight loss after a defined number of abrasion turns (Martindale, Fig. 12). Consumers are aware of this especially on very exposed areas of garments, such as shirt collars and cuffs. COM4® yarns also display better wear behaviour here.

NEW RIETER COM4® YARNS FOR NEW FIELDS OF APPLICATION

Rieter has progressively extended its market lead in the compact segment with the ComforSpin machine in recent years due to the outstanding COM4® yarn quality. Integrated solutions and simple modifications enable the range of ComforSpin technology to be expanded and novel COM4® yarns to be created, such as COM4®light, COM4®twin, COM4®vario and COM4®core.

Ring yarn

COM4®light

Fig. 13 Comparison of conventional ring yarn and COM4®light

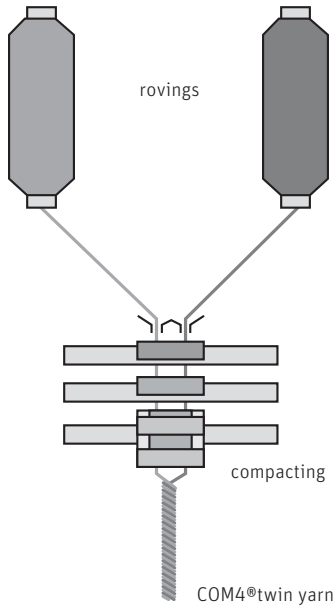
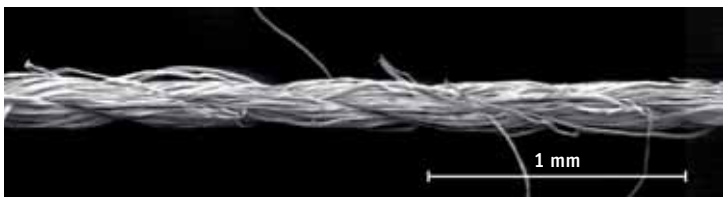


Fig. 14 Principle of COM4®twin process

COM4®twin yarn



COM4® 2-ply yarn

Fig. 15 The yarn structure of a COM4®twin yarn is distinctly different from a COM4® ply yarn

COM4®LIGHT

With the suction unit COM4®light Rieter has developed technological components to create a yarn, with hairiness and tenacity positioned between the conventional ringspinning yarn and the classical COM4® yarn. For knitting a slightly higher yarn hairiness is often required. The interchange of the suction inserts and some minor setting changes are quick and easy. The costs and time for the conversion are the lowest of all compact systems.

COM4®TWIN – SPIN-TWISTED YARN ON COMFORSPIN MACHINES

COM4® yarns feature significantly improved stress-strain behavior as well as reduced hairiness compared with conventional ring-spun yarns. These properties open up new areas of application and use for so-called spin-twisted yarns. Rieter has further developed the spin-twist process for ComforSpin machines to the volume production stage. The yarns produced using this method are marketed as COM4®twin yarn. In the conventional manufacture of ply yarn, ring-spun yarns twisted in the “Z” and “S” direction are doubled with “S” and “Z” twist in the opposite direction, i.e. some of the higher single yarn twist is canceled out by the lower double yarn twist. This results in a change in appearance and yarn structure, a softer yarn, higher yarn bulk and a significantly reduced tendency to snarl compared with a single yarn of the same count. In the COM4®twin process (Fig. 14), on the other hand, a so-called spin-twist is already produced with the twist of the resulting yarn count during spinning. The improvement in stress-strain behavior is due to fiber compacting. Yarn twist can also be reduced to improve bulk. This process creates a new yarn structure (Fig. 15).

The yarn values of COM4®twin yarns with this different structure are equal or even superior to those of conventional ply yarns. Optimum compacting and twist in the same direction in the spin-twisted yarn result in virtually complete integration of the fibers in the yarn structure. This creates outstanding sloughing resistance in the yarn and superior pilling resistance in the fabric. Doubling, twisting, and in some cases also singeing are eliminated in COM4®twin and thus make the yarn extremely attractive in economic terms for many applications. Besides substitution for conventional ply products, high-quality new articles are also produced in the fine underwear and shirting sector up to Ne 160/2 with COM4®twin yarns.

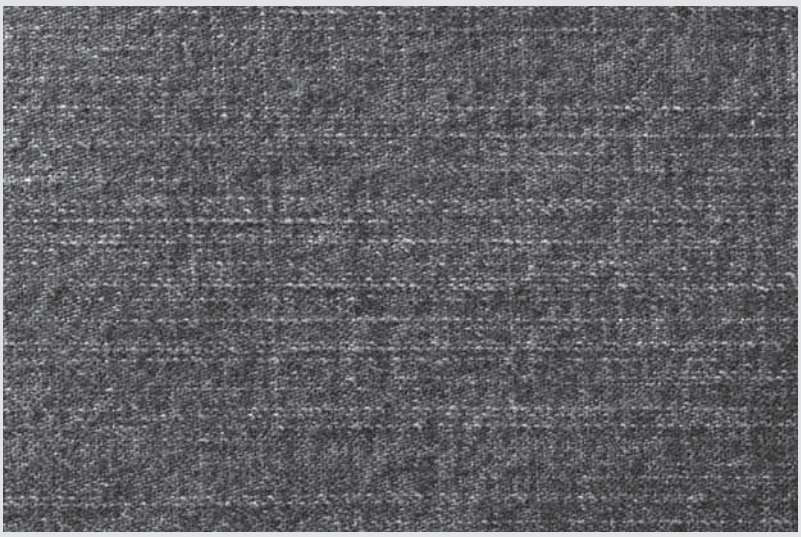


Fig. 16 Multi-count effects are suitable for fashionable denim fabrics

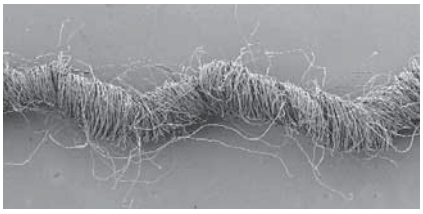
What is true for COM4® yarns is also true for COM4®twin yarns: the clean structure in the yarn is also visible in the end product. However, since the fabric appearance and luster of these yarns are not comparable with single yarns or conventional ply yarns, new fabrics, woven or knitted, can be developed – providing an opportunity for creative designers and niche suppliers.

VARIOSPIN DEVICE FOR PRODUCING COM4® VARIO YARNS

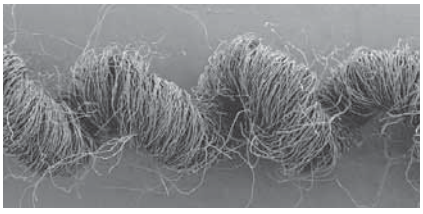
A wide variety of fancy yarns have become established primarily in the home textiles sector, especially for furnishing fabrics and denim, as well as in other garment segments. For some time it has been possible to produce discreet effects with built-in devices on most newly developed ring spinning machines. Complicated ancillary devices are still required on ring spinning machines to produce effects featuring large increases in mass and short lengths or distances.

With VARIOspin Rieter has developed an integrated fancy yarn device as an option for the G 33 ring spinning machine and the K 44 ComforSpin machine. The drafting system cylinders of the current generation of machines, which can be individually actuated and leveled with inverters, are designed for slub yarn, multi-count, multi-effects and multi- twist effects with mass increases of up to 200%. This covers the majority of market requirements for fancy yarns (Fig. 16). On Rieter ring spinning machines the drafting system cylinders are driven from both sides of the machine on machine sizes of 624 spindles and more. This ensures the uniform creation of effects throughout the machine – regardless of machine length.

The effect data are entered at the PC with the Windows-based VARIOspinDATA program. VARIOspinDATA has been developed for effect data management and system organization for Rieter rotor and ring spinning machines. Up to 700 different effect lengths with 3 varying mass increases can be programmed for each effect data record. The basic yarn length between effects can be allocated to each individual effect. The data records are transferred to the machine control system via a serial interface. The program provides for easy visualization of the fancy yarns. An interface to commercial visualization tools is provided for the virtual display of fabrics. Up to 18 data records can be stored on the ring spinning machine by means of the "Setting Manager".



Extended yarn



Relaxed yarn

Fig. 17 Elastic ring-spun core yarn

COM4®CORE COMPACTED ELASTIC CORE-SPUN YARNS

Elastic core yarns (Fig. 17) have been used to date primarily in foundation garments, swimwear and hosiery, as well as sportswear. They are now also being used increasingly in ladies' and men's outerwear as well as in leisurewear. Given today's possibilities for manufacturing very fine yarns, there are almost no limits to the expansion of the range. In addition to the improvement in wear properties and wearing comfort, better shape retention and greater robustness are especially worth mentioning.

The Rieter core yarn system can be used on Rieter ring spinning and ComforSpin machines (G and K generations). This system enables core yarns of perfect quality to be manufactured. New and hitherto impracticable sectors in terms of yarns and end products can therefore be penetrated.

On conventional ring spinning machines an additional roving guide ensures precise and faultless integration of the filament in the break draft zone. On ComforSpin machines precise guidance of the roving is ensured by the compacting zone. Combination with the filament takes place immediately before the nip roll. Guidance of the filament over the feed roller can be adjusted exactly by means of a centering screw.

The roving stop mechanism ensures immediate interruption of roving feed in the event of a filament break. This prevents yarn from being produced without filament. Lap formation on the top delivery rollers or the delivery cylinder is also prevented. The selective display, which first provides the operator with an overview and then guides him step-by-step to the spindle with the end down, facilitates rapid and efficient fault elimination. In order to obtain yarn of the required elasticity, drafting can be adjusted with infinite variation via the separate feed roller drive. Special guide elements provide gentle guidance and feeding of the filament. This ensures its optimum integration.

The Rieter core yarn system (Fig. 18) enables to work with a roving traverse mechanism. This results in more uniform wear of the top rollers of the drafting system, and thus longer intervals between grinding. This enormously increases machine running time without maintenance stops.

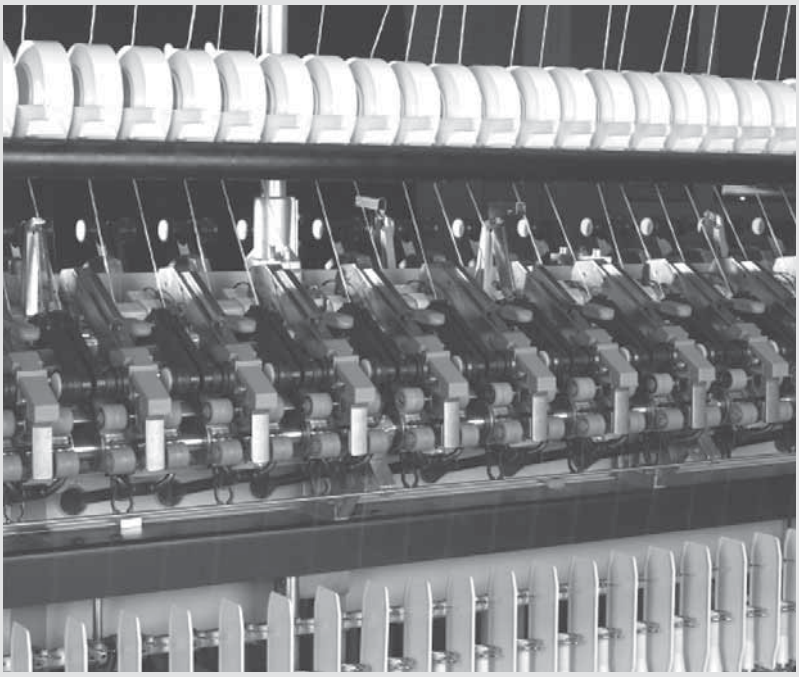


Fig. 18 COM4® spinning machine with core yarn system

Advantages of COM4® yarns at a glance:
- Better cross-wound package quality
- Manufacture of innovative, soft ply yarns
- Substitution of ply yarns by single yarns
- Reduced use of sizing agent
- Reduced waste water pollution due to less use of chemicals
- No gassing of yarns/twists and singeing of textile fabrics
- Improved running properties and quality in downstream processing
- Higher efficiency in weaving and knitting
- Innovative potential for article development
- Improved wear behaviour for consumers

CONCLUSION

The positive response from the market has confirmed that with ComforSpin Rieter has developed a new yarn manufacturing process which will enjoy ever increasing acceptance in the near future. It offers innovative textile companies the opportunity to distinguish themselves from rivals in the top quality segment.

Compact yarns are characterized primarily by reduced hairiness and higher strength. Because all fibers in the yarn compound are optimally integrated, compact yarn achieves a high utilization coefficient. Rieter has examined in detail the running and processing properties of the yarns and made spinners, weavers and knitters aware of the advantages of these yarns through intensive advertising. COM4® yarn is now a well-known brand in the textile market.

Rieter, the systems supplier, has expanded its expertise in compact spinning with the novel COM4® yarns, such as COM4®twin, COM4®vario and COM4®core yarns. These yarns offer new possibilities for spinning mills to the benefit of their customers.

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