Spinning system
Man-made fibers

Unique Solutions for Processing Man-Made Fibers

Innovative technology throughout the system

Man-Made Fibers

Market development

As population growth and prosperity increase, so does the consumption of fibers across the globe. While this holds true for all staple fibers, the use of man-made fibers such as cellulosic staple fibers and synthetic staple fibers is growing particularly quickly. The consumption of cellulosic staple fibers is expected to double to 10 million tons by 2030 while the consumption of synthetic staple fibers is expected to grow by 48% to 28 million tons compared to 2015 (Fig. 1).

Estimates assume that 45% of the fibers will be processed in their pure state. 55% will be spun to blended yarns. Man-made fibers and blends make up a large part of typical applications in our daily lives (Fig. 2). The most popular blend is a mix of cotton and polyester.

Fiber consumption in million tons

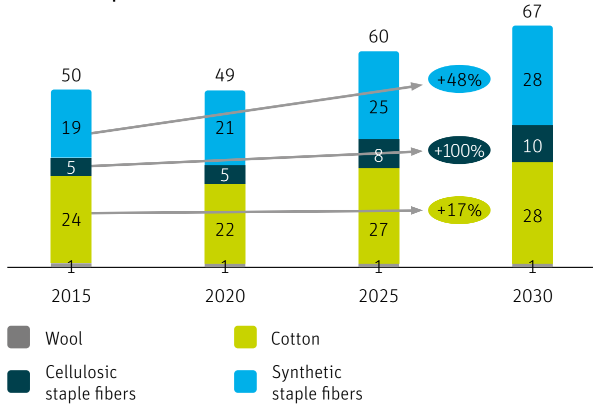


Fig. 1: The consumption of man-made fibers is expected to increase in the coming years.

Typical applications of cotton, man-made fibers and their blends

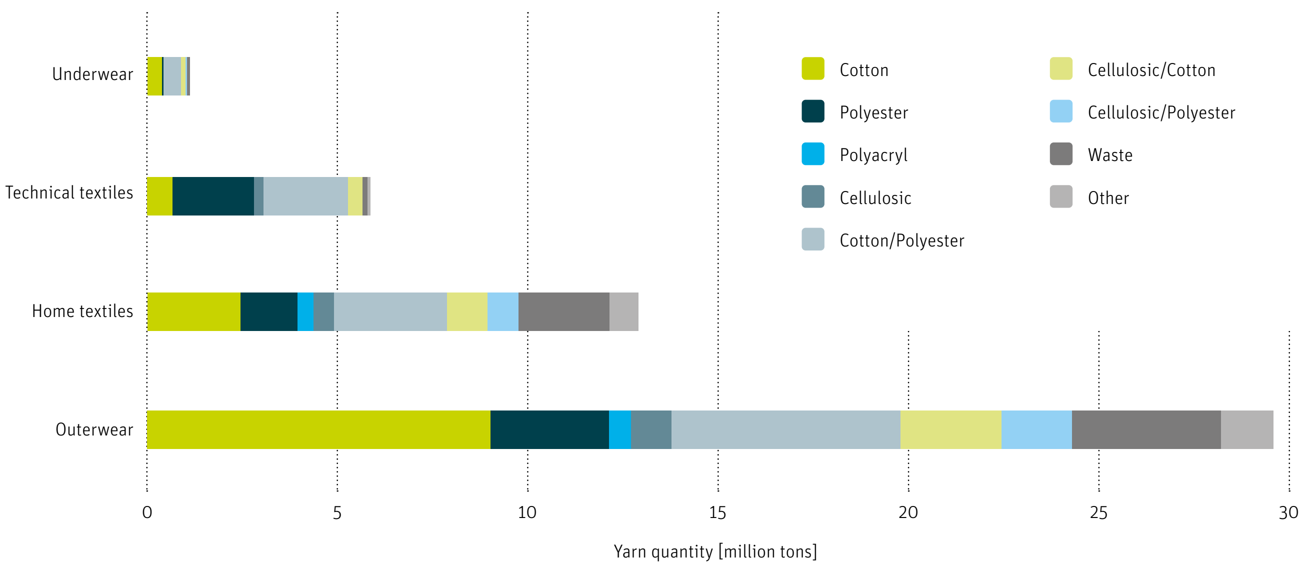


Fig. 2: Man-made fibers and blends account for 57% of the applications.

Challenges in processing

There are many varieties of man-made fibers. All of them have processing challenges that differ from those of natural fibers. The most important challenges for processing in the short staple spinning mill are the fiber finish, material faults, the electrostatic charge and the risk of heat-induced damage. The fiber finish is applied to the fibers to enable them to even be spun at all. This can lead to persistent deposits, to excessive wear or, if unevenly applied, to problems in the process.

Imperfect material in the form of fiber packages can disrupt the process and cause faults in sliver, roving and yarn or increases the number of ends down in spinning. The electrostatic charge can lead to adhesion, fiber lapping at cylinders and aprons or improper sliver formation.

Synthetic fibers carry the risk of heat induced damage which limits production speed. Due to heating, the fibers adhere even more tightly to the technological elements.

Rieter continuously develops innovative technology components and solutions for the processing of man-made fibers and blends throughout the entire spinning process.

Opening and Blending of Man-Made Fibers in the Blowroom

If man-made fibers are processed pure, the blowroom line is conceivably short and essentially consists only of opening and possibly blending. The machines of the Rieter blowroom contain many elements that are made of stainless steel to prevent deposits from the fiber finish. So called S-modules allow the degree of opening and the process steps to be individually adapted to the raw material.

Gentle opening of the fibers

Man-made fibers need no cleaning. However, the degree of opening must be adapted to the man-made fibers being processed. Bulky polyester requires a less intensive opening because the fibers are less compacted. Viscose fibers, on the other hand, are highly compacted, which necessitates more intensive opening.

The machines of the Rieter blowroom line VARIOline are modular, and configuration is tailored to the specific needs of the raw material. For example, the UNImix B 72 or the UNIstore A 79 can be easily converted from a cleaning module (R-module) to an opening module (S-module). In addition, it is possible to bypass e.g., the S-module of a UNImix B 72 in order to achieve exactly the degree of opening that is optimal for further processing (Fig. 3). In the case of viscose two opening modules are usually required, whereas in the case of polyester only one is needed. In addition, the right choice of clothing has a positive effect on the degree of opening.

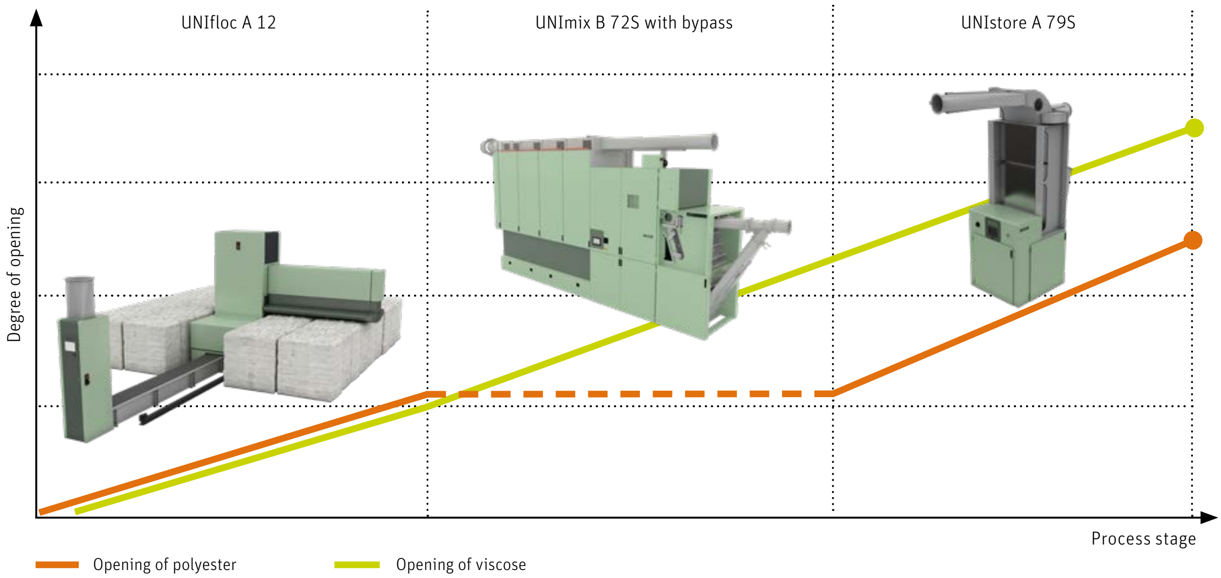


Fig. 3: Different opening degrees and process steps are required depending on the raw material.

Precision blending in the 1% range

Blends containing various types of fiber materials are particularly popular and are found in an increasing number of applications. To produce a yarn from different fiber materials, the right blend ratio is crucial. The precision blender UNIblend A 81 (Fig. 4) sets the highest standards for multi-component blends. Raw-material ratios are mixed to a great degree of accuracy. A deviation in the blending ratios of less than 1% is guaranteed. Very rare and expensive fibers, dyed cotton or extreme blends (e.g. 98% to 2%) can be economically processed into special yarns. Only as much expensive material is used as is needed to ensure the functionality of the yarn. Raw-material costs are reduced as a result and a constant yarn quality is guaranteed.

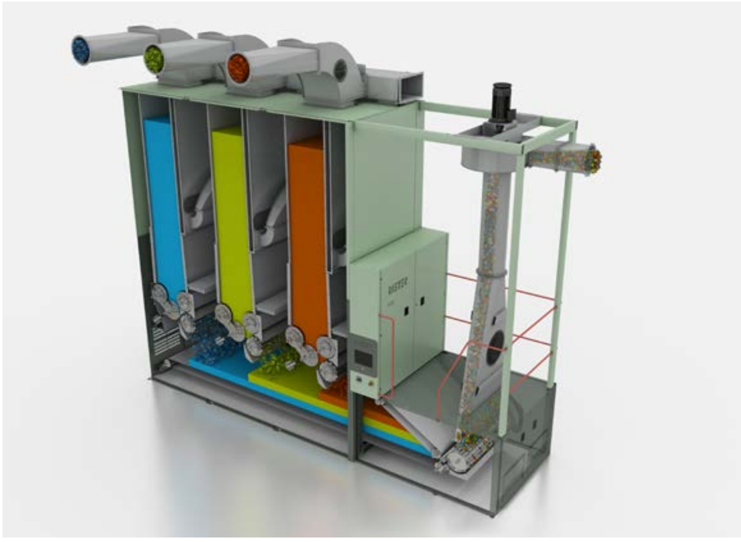


Fig. 4: Perfect blending ratios with the UNIblend A 81.

Ideal mixing in the smallest space

For small lots, the mixing bale opener B 34 is ideal. Thanks to its flexibility it is particularly popular in spinning mills where space is limited and where the assortment changes frequently. It can be equipped with an integrated opening unit (S-version) for man-made fibers or a cleaning unit (R-version) for natural fibers.
For thorough mixing of the metered fibers, the UNImix B 72 and B 76 are the right choice (Fig. 5). The 3-point mixing in one machine provides the best mixing result in the smallest possible space.

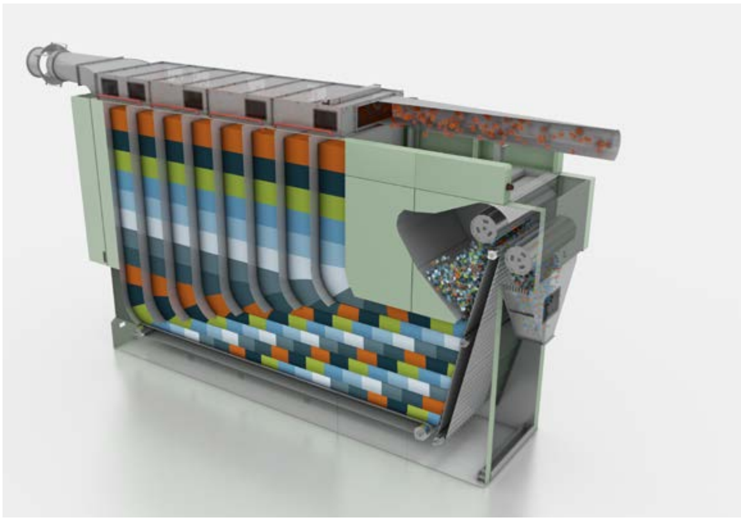


Fig. 5: The UNImix for optimal mixing in the smallest space.

Card C 80 for Man-Made Fibers

Polyester requires less intensive treatment. Therefore, wider settings, coarser clothing and lower speeds are usually selected than for processing cotton. In addition, Rieter has developed special card clothing to achieve the highest possible quality also for man-made fiber applications.

The high-performance card C 80 achieves excellent quality values at highest production for all yarn applications. With the longest pre- and post-carding zone, the opening intensity can be optimally adjusted. Man-made fibers are gently opened and distributed at the pre-carding zone to achieve maximum performance for active carding through the working flats. The largest active carding area with its 40 working flats and 1.5 m working width contributes to maximum performance (Fig. 6). With the integrated grinding system IGS, the sliver quality is maintained at a high level during the complete wire lifetime.

The patented closed in-feed system with pressure control provides a precise batt weight at the card feed, considering the raw materials and their characteristics. The result is a minimal variation [CV%] of the batt weight and a stable card feed at highest production.

Man-made fibers with strongly lubricating fiber finish tend to contaminate fiber guiding elements. The web bridge must be cleaned frequently to maintain the quality level. The patented C 80 web bridge can be cleaned very fast by just sliding it out without any tool. This is just one example of many other solutions that reduce maintenance time.

Stepped rollers on the card delivery compress the sliver. With bulky raw material, this compression leads to up to 20% higher filling of the can and to better running performance. With 10 cards, this lowers the manufacturing costs by CHF 2 400 per year.

The development of the coiler CLEANcoil-PES with a new type of coating offers unique advantages in coiling of man-made fiber sliver. Even with critical polyester fibers, the cleaning cycle can be extended by at least 100%. This leads to more consistent sliver and yarn quality.

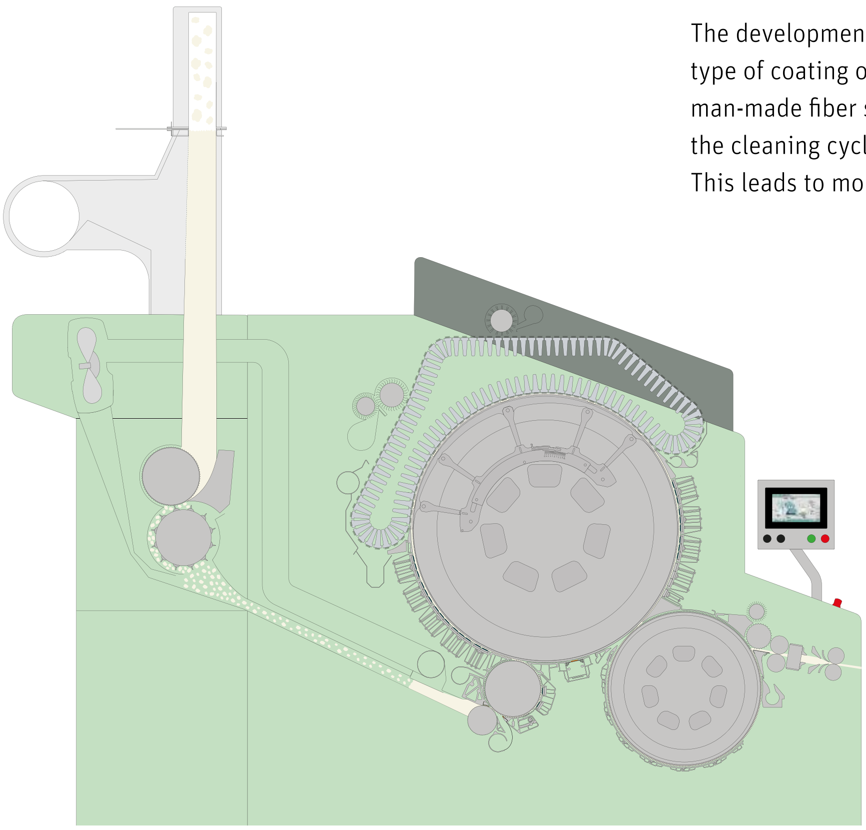


Fig. 6: Cross-section of the card C 80 to process man-made fibers.

Draw Frames (R)SB-D 50 and (R)SB-D 26 with Special Solutions

The autoleveler draw frames (R)SB-D 50 and (R)SB-D 26 were specially developed for high productivity through high delivery speed. The complete sliver run up to the coiler was constructed according to the latest technological advances to achieve this increased performance. The perfect sliver guidance is particularly important with bulky material. This is made possible by a power creel with a bigger size of the guiding funnels.

Rapid release to prevent hard laps

Fiber lapping is a common problem with man-made fibers. An immediate release of the top rollers – during the breaking of the machine – prevents the formation of a large, hard lap. That permits an easy and quick lap removal without using a knife. It preserves the roller cover and ensures the quality and productivity of the machine. The roller cots can be adapted to the processing requirements for man-made fibers. In addition, the big top rollers with cleaning lips keep the formation of laps at a very low level.

Precise sliver coiling thanks to CLEANcoil-PES

During the processing of man-made fibers and blends, finishing agent deposits occur on parts of the underside of the coiler. The consequences are diminished quality values, displaced sliver or the necessity of frequent cleaning. The polyester coiler CLEANcoil-PES solves the problem with a special surface coating. When processing polyester, the cleaning cycle can be extended by 100% or more compared to the standard coiler, depending on the type and amount of finish applied (Fig. 7). CLEANcoil-PES ensures, even with critical man-made fiber types, high can content amounts, cleanly coiled sliver and thus trouble-free running of the sliver in the subsequent process.

		Cleaning cycle	
Spinning mills with critical PES types	Polyester type	Standard coiler	CLEANcoil-PES
Mill 1	38 mm/1.4 dtex	0.5 hours	4 hours
Mill 2	44 mm/1.3 dtex	1 hour	8 hours
Mill 3	51 mm/1.3 dtex	8 hours	16 hours
Mill 4	38 mm/1.3 dtex	2 – 4 hours	8 hours

Fig. 7: The coiler CLEANcoil-PES extends the cleaning cycle on the draw frame significantly depending on the fiber used.

Reliable sliver separation

When processing fibers with high fiber-fiber abrasion, as it is often the case with synthetic fibers, active sliver separation is necessary for a trouble-free can change. Here the (R)SB-D 50 and (R)SB-D 26 excel with an innovative solution. A deliberately produced thin place in the main drafting zone is conveyed downwards to the coiler plate and breaks at can change. The solution does not require additional mechanics as with conventional sliver separation devices and therefore requires no maintenance.

Easy change of settings

Many years of experience show that optimization occurs when something is easy to adjust. For that reason, the coiler plate speed can be changed directly on the display and the setting is reproducible at any time. A trial with different coiler speeds with 100% viscose for air-jet spinning shows, that the optimal speed of the coiler reduces the yarn clearer cuts on the J 26 by up to 18% (Fig. 8).

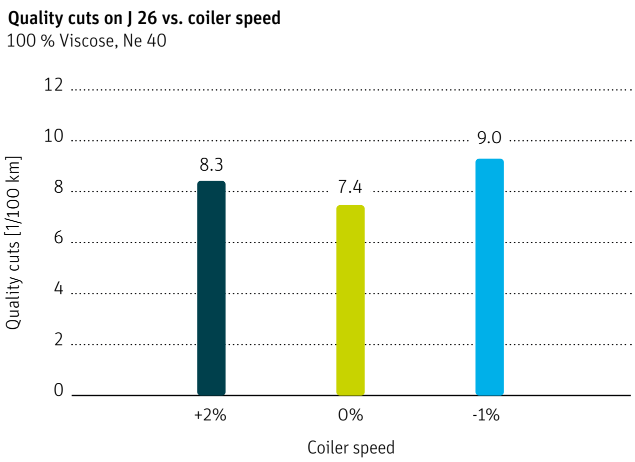


Fig. 8: The optimally set speed of the coiler on the draw frame reduces the yarn clearer cuts on the air-jet spinning machine by 18%.

Fig. 9: Coiler CLEANcoil-PES with special coating for processing 100% polyester.

Man-Made Fiber Features of the Roving Frame F 40/F 20

The advanced drive technology of the roving frame F 40/F 20 ensures the best roving quality for the ring spinning machine, also when processing man-made fibers.

Thanks to the stepless speed adjustment of the infeed creel and its octagonal rollers, the sliver is evenly guided from the can to the drafting system to avoid any false draft or slippage. This ensures an optimal feeding for the subsequent drafting process.

Fig. 10: Easy setting of the drafting system thanks to the electronic drafting system drive.

With the optional electronic drafting system drive, both the main- and the break draft can be adjusted to the properties of man-made fibers on the machine's touchscreen in no time (Fig 10).

Continuous monitoring of the roving tension at three spinning positions by means of optical or non-contact sensor technology guarantees highest roving quality during the entire bobbin build-up (Fig. 11).

The doffing process has been optimized to ensure a reliable tear-off process that meets the high tenacity of man-made fibers. This helps to reduce operator workload and increase overall efficiency. This ideal preparation of the doffing process thus lays the foundation for an efficient start of the next bobbin build-up.

Fig. 11: Sensor technology guarantees highest roving quality during the entire bobbin build-up.

Man-Made Fiber Package for Ring Spinning

Man-made fibers and their blends with cotton are commonly processed on ring spinning machines. In general, ring spinning is very flexible compared to other spinning processes and reacts less sensitively to fiber finish deposits which is a common challenge when processing man-made fibers. Thanks to an additional drive unit for the middle bottom roller, positioned in the middle of the machine, only Rieter can offer long ring spinning machines also for man-made fibers: The ring spinning machine G 37 with semi-electronic drafting system drive and the G 38 with fully electronic drafting system drive can be equipped with up to 1 824 spindles.

There are some technology elements on the ring spinning machine that have been specially developed for the characteristics of man-made fibers and special settings that should be considered. One of these technology elements is the bottom roller with a diameter of 30 mm. It helps to reduce the build-up of fiber lapping.

High tenacity requires special solutions

Due to their high tenacity, synthetic fibers cause higher part wear during processing. This can be mitigated by installing separators with reinforced front edges. These edges help to protect the separators from the fiber ends in the event of an ends down and increase the life cycle of the parts significantly.

The high tenacity of synthetic fibers also poses challenges in terms of reliable detachment during the cop change process. If the detachment is unsuccessful, this can result in dragged yarn and a series of ends down, which affects yarn quality and efficiency. For this reason, a special SERVOgrip with a knife has been developed that reliably cuts off the yarn during the doffing process and prevents yarn breaks during start-up (Fig. 12).

Fig. 12: SERVOgrip with knife for secure yarn separation by a cut, closed (left side) and open (right side).

Correct settings improve yarn quality

Furthermore, the correct setting of the drafting system is important for yarn quality. The width of the drafting zone as well as the appropriate cradle nose bar and top apron should be defined according to the fiber length and the draft resistance of the raw material. For man-made fibers up to a cut length of 38 mm, the use of the stepped nose bar in combination with the specific active cradle without pin (Fig. 13) improves yarn quality. With an active cradle, the top aprons are tensioned by a spring-loaded leading edge. Variations in apron tension are automatically compensated. It also permits lower cradle spacing for better guidance of the fibers, resulting in better yarn quality.

Fig. 13: The specially designed stepped nose bar in combination with the active cradle without pin increases the quality of man-made fiber yarns.

Tailor-made rings and travelers

Synthetic fibers do not self-lubricate the way cotton does and have a lower melting point. These properties are addressed by the oblique ORBIT ring and its corresponding traveler in various surface finishes, which were specifically developed for spinning synthetic fibers. They guarantee smooth guiding properties and have a good heat diffusion to prevent melting spots. The ORBIT ring/traveler system handles the fibers very gently thanks to the large contact area between ring and traveler, as well as the reduced targeted surface pressure.

Compacting technology with wider application range

While it is less common, man-made fibers can also be processed on compact-spinning machines. An important feature is the further developed sieve drum which is available as a standard on the compact-spinning machine K 48 and as an option on the K 47. The latest coating has improved the durability of the sieve drum 20-fold compared to the previous series. The application range covers 100% cotton as well as blends with viscose and polyester.

Fig. 14: Better durability of sieve drum thanks to an improved coating.

Rotor Spinning of Man-Made Fibers

Rotor spinning has its undisputed advantages when spinning short fibers, e.g., cotton with a high short-fiber content or recycled fibers. Due to the rotor technology, blends of longer and shorter fibers can be handled more easily than with other spinning technologies. In combination with recycled cotton, polyester fibers can serve as supporting fibers which – due to their longer staple – help when processing high amounts of short fibers. Thanks to the high evenness of rotor yarn, it is also interesting to process 100% polyester, mainly for technical applications.

The modern spinning technology of the fully automatic rotor spinning machine R 70 is advantageous when processing any raw material. With its redesigned BYpass function, it features efficient and selective extraction of impurities. Some elements and features can be specifically highlighted for the processing of man-made fibers.

Optimal fiber flow and efficient rotor cleaning

When processing man-made fibers, one challenge is the adhesion of the fibers to the opening roller. They need more force from the airflow to release from the opening roller. The technology element SPEEDpass optimizes the fiber flow by increasing the airflow, without higher negative pressure, and extracts dust. All fibers run out of the opening roller directly into the rotor groove.

Another challenge are the deposits in the rotor groove. To cope with this, the rotor groove is thoroughly cleaned before each piecing (Fig. 15) and when needed at doffing by the robot. These features result in long production times with high and stable yarn quality.

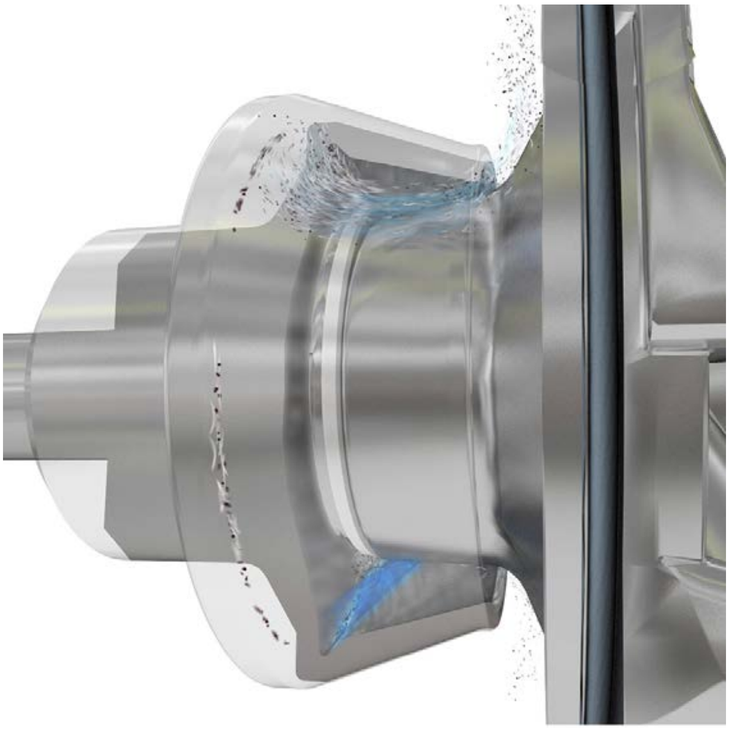


Fig. 15: The rotor spinning machine R 70 ensures intensive rotor cleaning at each piecing.

High yarn quality at high speeds

With different CHANNELpass elements, the opening can be customized for cotton, polyester and viscose spinning (Fig. 16). The transition area between the opening zone and the fiber-guiding channel can be adjusted. Adapted to the fiber properties, optimum fiber flow is achieved for best yarn quality.

The risk of thermic fiber damage to synthetic fibers is reduced with the R 70 thanks to the “Cool Nozzle Technology”. The nozzle is the critical point that heats up the most and poses the risk of fiber damage. The spinning box of the R 70 is designed for better heat dissipation from the nozzle. Rieter technology thus increases the potential for higher speeds compared to other solutions.

Fig. 16: CHANNELpass version for cotton, polyester, and viscose

Air-Jet Spinning Strong in Viscose

Air-jet spinning is the dominant choice for processing cellulosic fibers – mainly viscose – and their blends with cotton. The high productivity and the low yarn conversion costs of viscose make it an attractive raw material for spinning mills. In addition to its special yarn properties, like less fluff and fly in knitting and weaving, it is also popular in downstream industries. End users particularly appreciate the excellent pilling resistance and wash resistance of the finished products.

Fig. 17: The air-jet spinning machine J 26 processing 100% viscose.

J 26 with new features

The air-jet spinning machine J 26 offers several unique features for processing viscose. The new spinning nozzle housing "Z+1 High Speed" with a reshaped fiber feeding element ensures high yarn tenacity and production speed at the same time. The delivery speed can be increased to 480m/min for 100% viscose Ne 30 without a loss in yarn quality. With 19 cN/tex, the yarn strength is the same as with the existing "Z-1" housing with a 17% lower delivery speed of 400 m/min (Fig. 18). This reduces the yarn conversion costs because the air pressure for twisting remains the same at a higher production speed. The J 26 is also well suited for processing blends with polyester: cotton with a proportion of up to 50% polyester and viscose with a proportion of up to 80% polyester.

J 26 with new spinning nozzle housing "Z+1 High Speed"
100% viscose, 1.3 dtex, Ne 30

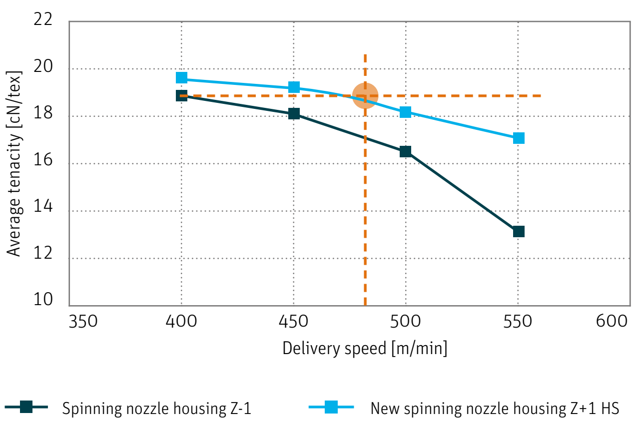


Fig. 18: High yarn tenacity and production speed thanks to the new spinning nozzle housing "Z+1 HS".

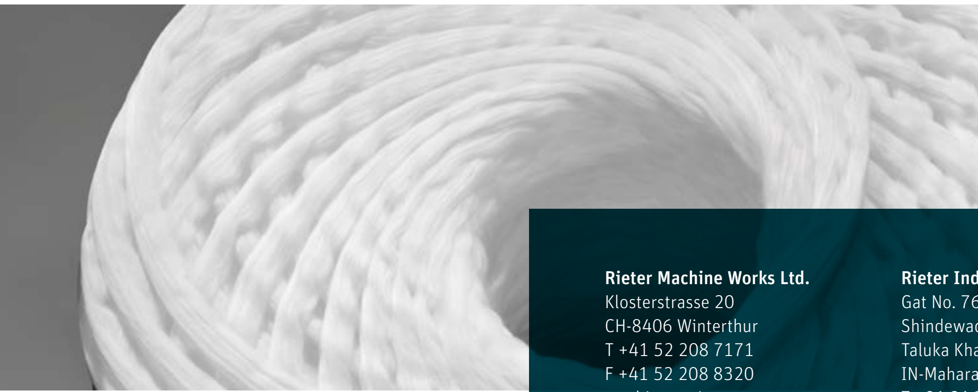
Simplified handling and easy operation

In addition to increased productivity, the operation has been simplified thanks to the option of opening the housing of the spinning nozzle. This means the nozzle and the housing can be cleaned easily and effectively without having to remove the ceramic spinning tip (Fig. 19). This results in fewer red lights and a reduced workload for operators. Spinning mills report a 50% reduction in operating time per event and red lights that are active for only 5 to 11 seconds compared to 25 to 45 seconds with a closed spinning nozzle housing.


Fig. 19: Easy cleaning thanks to the option of opening the spinning nozzle housing.

Best package quality for downstream processes

Both the rotor spinning machine R 70 and the air-jet spinning machine J 26 offer pneumatic package damping for uniform package quality and efficient unwinding for downstream processes. Packages containing man-made fiber yarns, especially viscose yarns, tend to be very hard with even harder edges. This results in an unstable unwinding with yarn breaks. To prevent the yarn from breaking, the density is kept consistent over the complete package build-up. With the unique stroke respiration, the edges become softer – the secret for best unwinding performance. The optimized winding enables a 20% higher package weight with man-made fiber yarns at the same diameter. This results in higher machine efficiency thanks to 20% fewer doffings. Weaving and knitting machines also benefit from less handling and less stops.



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