

Hairiness of Yarn and Cop in Ring Spinning

Yarn and cop hairiness can affect spinning efficiency, package quality and downstream processing performance. This technical information provides an overview of hairiness in ring spinning, including its appearance, measurement methods, common causes and practical corrective measures for troubleshooting and process optimization.

1. Appearance

1.1 Yarn hairiness

Yarn hairiness refers to an excessive number of long fibers protruding from the yarn surface.

1.2 Cop hairiness

Cop hairiness refers to an excessive number of fibers protruding beyond the diameter of a full cop. Additional fibers may adhere to these protruding fibers and form larger fiber accumulations, commonly referred to as “snouts.” A considerable proportion of these accumulations detaches during rewinding.

This phenomenon occurs sporadically and depends on the fiber characteristics. Yarns with a high degree of hairiness, as described in Section 1.1, generally also produce hairy cops. However, cop hairiness may also occur when the yarn itself appears relatively smooth.

1.3 Variations

The variation in hairiness within an individual cop and between cops produced from the same yarn is an important characteristic. Significant variation can cause problems in downstream processes and may result in visible streaks in the finished fabric.

Depending on the fiber properties, yarn twist and processing conditions, yarn hairiness generally increases during each subsequent process. The greatest increase normally occurs during rewinding, when hairiness may increase by a factor of two to five.

Applying wax to knitting yarn during winding can considerably reduce hairiness.

2. Measuring methods

In addition to the traditional blackboard method, the following instruments can be used to measure yarn hairiness:

- Shirley Yarn Hairiness Tester
- Toray Tester
- ITV yarn hairiness measuring instruments (Zweigle G 565)
- Uster Tester 3 and Uster Tester 4

These instruments use different measuring principles. Therefore, the resulting values are not directly comparable.

3. Effects of hairiness

Hairiness creates problems for following operations:

- Sizing: adjacent yarns may become entangled.
- Warping: increased dust formation and entanglement between warp yarns may occur.
- Rewinding: hairiness can make it more difficult to locate the yarn end on automatically doffed cops and may interfere with cop preparation.
- Yarn tension: hairiness may increase yarn tension during rewinding.
- Weaving: warp yarns may become entangled, and dust formation may increase. Hairiness can also affect weft insertion, particularly on air-jet looms.

These problems cannot always be attributed exclusively to hairiness. Hairiness may be one of several contributing factors and should therefore be evaluated together with the relevant process conditions.

4. Causes of hairiness

Hairiness is rarely caused by a single parameter. In most cases, several influencing factors occur simultaneously, making it more difficult to select the appropriate corrective measures.

A measure that reduces hairiness under one set of conditions may increase it under different conditions. The individual causes should therefore be identified before corrective action is taken. The troubleshooting table on the following pages provides an overview of possible causes, underlying reasons and recommended corrective measures.

Hairiness and production neps frequently occur together. The transition from individual protruding fibers to fine neps consisting of entangled fibers is gradual. Hairiness measuring instruments do not distinguish between individual fibers and production neps.

Source: Hattenschwiler/Eb, Quality in Staple Fiber Spinning, Melliand, 1987.

5. Troubleshooting

There is no single corrective measure that can successfully eliminate every form of hairiness. Hairiness may also occur only temporarily, depending on the material and process conditions.

The following table lists possible causes, underlying reasons and recommended corrective measures. Each case should be analyzed individually before any adjustments are made.

Possible causes and corrective measures

Cop hairiness	Yarn hairiness	Possible cause	Reason	Corrective measure
x	x	Cotton or fiber quality	- Fiber stiffness - Hooked fibers	- No direct corrective measure; check the other possible causes listed in this table. - The problem may occur only temporarily.
x	(x)	Anti-balloon rings Yarn guides	- Incorrect centering causes variations in yarn tension. - Rough surfaces may damage or roughen the yarn.	- Correct the centering. - Replace damaged or worn components.
x		Cop diameter	Protruding fibers on the cop are caught and removed by the traveler. If the cop diameter is unsuitable, this effect is considerably reduced.	- Set the cop diameter to the minimum ring diameter minus 4 mm. - Use a snout breaker.
x	(x)	Electrostatic charge	Electrostatic charge causes individual fibers to stand away from the yarn surface. The polarity of the charge is not significant.	- Increase the relative air humidity. - Install an electrical bypass for insulated ring rails.
(x)	x	Traveler yarn passage / traveler shape	- A narrow yarn passage roughens the yarn. - A damaged or constricted yarn passage may clamp and roughen the yarn, resulting in neps.	- Use a traveler with a larger yarn passage. - Shorten the traveler replacement interval.
	x	Yarn tension too high	Worn traveler surfaces may come into contact with the yarn and roughen it.	Shorten the traveler replacement interval.
x		Yarn tension too low, with hairiness occurring mainly at the conical base while the conical top normally remains unaffected.	Traveler weight is too low: - Fiber binding at the spinning triangle is insufficient. - The yarn balloon rubs strongly against the anti-balloon ring or strikes the balloon separator. - Twist transmission to the spinning triangle is insufficient.	Increase the traveler weight. If necessary, select a different traveler type.
	x	Yarn twist	- Knitting yarns tend to exhibit greater hairiness because of reduced fiber binding. - A high yarn twist may cause individual fibers to protrude from the yarn surface.	No corrective measure related to yarn twist is generally possible.

Cop hairiness	Yarn hairiness	Possible cause	Reason	Corrective measure
x	x	High speed	Higher yarn-balloon forces increase friction at the anti-balloon ring. Increased air resistance may also loosen individual fibers from the yarn structure.	- Reduce spindle speed. - Increase spinning tension by using a heavier traveler.
x	x	Climate too dry		Increase the relative air humidity while monitoring the risk of lap formation.
x		Deformed cops	The snout breaker can no longer function effectively.	No direct corrective measure is possible.
(x)	x	Traveler profile	- With dr and udr profiles, the cleaning effect provided by the f-profile is not available. - Yarn tension is lower with dr and udr profiles than with the f-profile. - The f-profile may generate production neps, which can occasionally contribute to hairiness.	- Use an f-profile. - Use a heavier traveler. - Use a dr-profile if production neps occur.
	x	Neps	Neppiness and hairiness are closely related. In many cases, the observed fiber accumulations are production neps.	- Improve fiber preparation. - Prevent the formation of production neps. - Check all yarn guiding points. - Change the traveler wire profile from f to dr or, if necessary, to udr or r.
x	x	Excessive fiber parallelization	Insufficient binding of the fibers within the yarn structure.	No general corrective measure.
x	x	Ring centering	Incorrect ring centering causes uneven yarn tension.	Recenter the rings and spindles.
x	x	Ring condition	A rough ring surface reduces the traveler's braking effect and may result in irregular traveler running.	Replace worn rings. Heavier travelers may improve performance only if the rings across the entire spinning frame are worn evenly. Be aware that the number of yarn breaks may increase.
x	x	Spinning triangle too wide	The fibers are not adequately captured and bound into the yarn structure.	- Use a narrower condenser. - Move the top roller forward on the delivery cylinder to improve twist transmission up to the clamping line. - Be aware that this setting may increase top-roller cover wear when processing highly twisted yarns.
x	x	Stiff fibers	Stiff fibers are insufficiently flexible and therefore tend to protrude from the yarn structure. This occurs particularly with rayon and certain polyester fiber types.	No direct corrective measure is generally available.
	x	Inadequate preparation	The proportion of neps or trash is too high.	- Improve the carding effect. - Introduce an additional doubling passage. - Increase the degree of combing.