8. Fundamentals of Yarn Technology

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Learning objectives

On completion of this topic you should be able to:

- understand and apply the definitions for different yarn count systems
- convert between yarn count systems
- explain the effect of moisture on yarn count results
- describe the effect of twist on certain yarn and fabric properties
- explain the importance of surface twist angle and of selecting the right twist factor for different yarns
- calculate the twist contraction
- apply the basic rules that apply to twist measurements

Key terms and concepts

Yarn definition, Yarn types, Direct and indirect yarn count systems, Twist and its effect on yarn strength, Relationship between twist, twist factor and yarn count, Twist concentration and contraction, Twist-untwist method

Introduction to the topic

A yarn is a relatively strong and flexible assembly of fibres or filaments, with or without twist. It is an important intermediate product between fibres and fabrics. The inter-relationships between the structure and properties of fibres, yarns, and fabrics are illustrated in Figure 8.1.

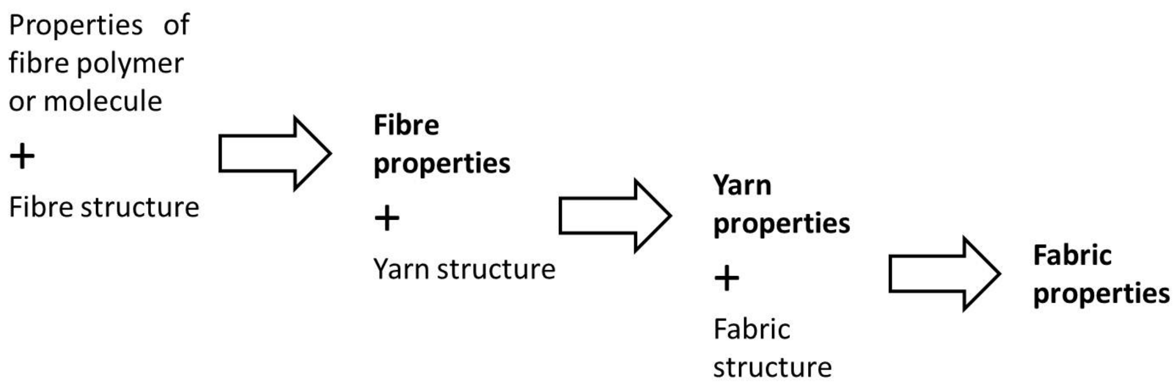

Figure 8.1 Interrelations of fibres, yarns, and fabric structure and properties. Source: Wang (2000).

Yarn technology deals with the manufacture of various types of yarns consisting of different fibres and fibre arrangements, and the properties of these yarns. The fundamentals of yarn technology cover basic topics on yarn count, twist, yarn structures, and yarn types.

8.1 Yarn types and structures

Many different types of yarn can be manufactured for different end uses. The two most common types of yarn are **staple spun yarn** and **continuous filament** yarn.

A staple spun yarn, also known as staple yarn or spun yarn, is made from staple fibres, i.e. fibres of limited and relatively short length. Staple fibres may be divided into two categories, namely, short and long staples. Short staple refers to fibres of less than about 50 mm long, whereas long staple describes those longer than about 50 mm inches. Natural fibres such as cotton and wool are typical examples of short staple and long staple respectively. Manufactured filaments can be cut or stretch-broken into short lengths to become either short staple or long staple fibres.

A continuous filament yarn is normally produced in a chemical plant. It is a yarn composed of one or more filaments that run essentially the whole length of the yarn. If there is only one filament in the yarn, then it is called a mono-filament yarn. A multi-filament yarn consists of many filaments.

Most yarns are used in singles or plied forms.

A singles yarn is the simplest continuous strand of textile material, either as a single staple spun yarn, a mono or multi-filament yarn, or a composite yarn consisting of staple fibres and continuous filaments. A plied yarn is formed by twisting together two or more singles yarns. A cable and cord yarn consists of many plied yarns (or plied and single yarns) twisted together.

A graphical depiction of the various forms of yarn structures is given in Figure 8.2.

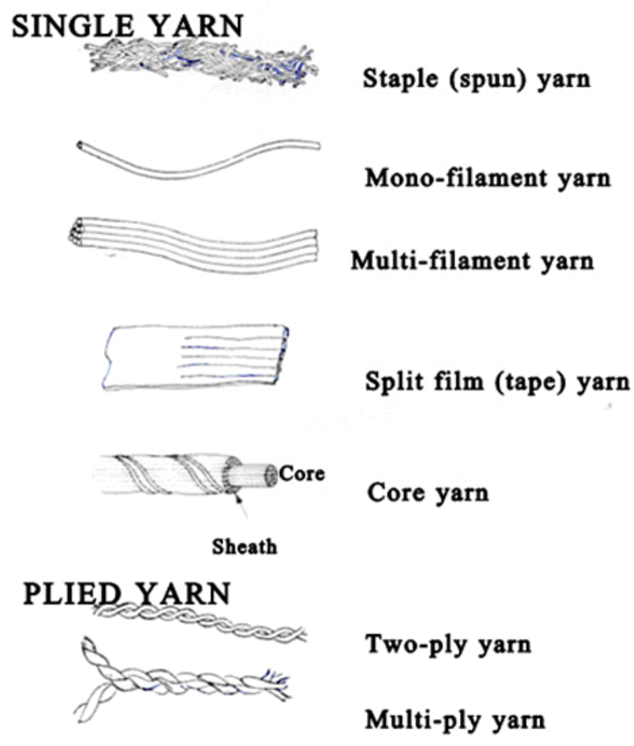

Figure 8.2 A sketch of different types of yarns. Source: Wang (2000).

8.2 Yarn count

Yarns are manufactured in different sizes for different purposes. They can be quite thick, or they can be very thin. Since by their very nature textile yarns are soft and 'squashy', the thickness of a yarn cannot be easily measured by yarn diameter. But textile yarns are often sold on a weight basis, so it is natural to express the size of a yarn in terms of its weight or mass. The two basic ways of doing this are by indicating either how much a given length of yarn weighs (the direct system) or what the length of yarn will be in a given weight (the indirect system). These two broad yarn count systems are expressed below:

$$Direct\ yarn\ count = \frac{Weight\ of\ yarn}{Given\ length},$$

$$Indirect\ yarn\ count = \frac{Length\ of\ yarn}{Given\ weight}$$

Because a textile yarn is a very slender assembly of tiny fibres, the weight of a yarn in a given length will invariably be very small while the length of a yarn in a given weight will be quite large. Consequently, the yarn count figures would tend to be either incredibly small (direct system) or large (indirect system) unless special units are used. Over the years, many different units have been used in different sectors of the textile industry and the commonly used ones are described in the following sections.

Direct count systems

The direct systems are based on the weight or mass per unit length of yarn. Some typical direct systems are given below, together with their definitions. Please note that while the weight unit is gram, different lengths are used in the definitions.

Tex (g/1000m)
This is the mass in gram of one kilometre, or 1,000 metres, of the yarn.

For example, if one thousand meters of yarn weigh 20 grams or one hundred meters of the yarn weigh 2 grams, the yarn would be 20 tex. On the other hand, if 100 metres of yarn weigh 5 grams, then the count of the yarn will be 50 tex.

Decitex dtex (g/10,000m)
This is the mass in gram of 10 kilometres, or 10,000 metres, of the yarn. It is a smaller unit than tex (1 tex = 10 dtex), and is usually used for fibres and filament yarns.

For example, a 167 dtex polyester filament would weigh 167 grams for every 10,000 meters of the filament.

Kilotex ktex (g/m)
This is the mass in gram of one metre of the product. It is a much larger unit than tex (1 ktex = 1,000 tex), and is usually used for heavy products such as slivers and tops.

For example, if a sliver weighs 5 grams per metre, then the count of this sliver would be 5 ktex.

The tex system (tex, ktex, dtex) is the preferred standard system. By definition,

1 ktex = 1,000 tex = 10,000 dtex

Denier (g/9,000m)
Denier is also used extensively in the textile industry, particularly for manufactured fibres and silk. It is the mass in gram of nine kilometres, or 9,000 metres, of the product.

By definition,

1 dtex = 0.9 denier

If a 300 denier yarn is made up of 1.5 denier individual filaments, there will be a total number of $\frac{300}{1.5} = 200$ filaments in the yarn.

Indirect count systems

Indirect count systems are not as straightforward as the direct ones. In the early history of yarn manufacture, different spinners, often geographically and culturally isolated from one another, devised their own ways of measuring yarn thickness. Consequently, there are numerous indirect count systems that have been, and continue to be, used in the industry. Some examples are given below, together with the mass and length conversions:

Commonly used:

- Metric (N_m)	metres/gram
- English Cotton (N_{ec})	No. of 840 yard hanks per pound
- Worsted (N_w)	No. of 560 yard hanks per pound

The metric count (Nm) is relatively straightforward. It is the length in metre of one gram of the product. For example, if one gram of yarn measures 40 metres, then the metric count of this yarn would be 40 Nm.

Similarly, if one pound of cotton yarn measures 1,680 yards, or two hanks of 840 yards, the English cotton count of this yarn will be 2 $N_{ec.}$ Please note that a hank of yarn is an unsupported coil consisting of wraps of yarn of a certain length.

The conversions between different units will be discussed later.

You may wonder how the strange length units such as 840 yard hank and 560 yard hank came about. The first mass-production spinner, the spinning-jenny, was able to spin yarns simultaneously onto several bobbins and filled the bobbins up at the same time. The bobbins were changed after 840 yards of cotton yarns were wound onto them. To estimate the thickness of the yarns, the spinner simply counted how many full bobbins were needed to balance a weight of one pound. For example, if 6 bobbins were needed to make up one pound, the yarn would be called a 6s yarn. Similarly a 20s worsted yarn means one pound of this yarn would fill up 20 bobbins, each with 560 yards of yarn wound on.

Yarn count conversion

It is often necessary to make conversions between different yarn count systems. For this purpose, the following mass (weight) and length conversions are needed:

1 yard (yd)	= 0.9144	m
1 pound (lb)	= 0.4536	kg
1 ounce (oz)	= 1/16	lb
1 dram 9dr)	= 1/16	oz
1 grain (gr)	= 1/7000	lb

Worked Examples

Question:
What is the conversion factor between worsted count (Nw) and tex ?

Answer:
According to definition, one worsted count (Nw) = one 560 yard hank per pound, or

$$1\ Nw = \frac{1 \times 560\,yard}{pound}$$

Since 1 yard (yd) = 0.9144 m and 1 pound (lb) = 0.4536 kg, the above equation becomes,

$$1\ Nw = \frac{1 \times 560 \times 0.9144\,m}{453.6\,g} = \frac{512.064\,m}{453.6\,g} = \frac{1.12892\,m}{g}$$

Therefore, for a yarn of Nw worsted count, each gram of this yarn would measure 1.12892 times Nw meters. Since tex is the mass in gram of a 1,000 meters of yarn, we need the number of grams in 1000 m of the yarn.

$$No\ of\ grams\ per\,1000\,m\,(tex) = \frac{1000}{1.12892\ Nw} = \frac{885.8}{Nw}$$

The above equation can also be written as: $Nw = \dfrac{885.8}{tex}$

So the conversion factor is 885.5.

Question:
If a yarn is 20 tex, what is the worsted count of this yarn?

Answer:
Using the conversion factor given above, the worsted yarn count is:

$$\frac{885.8}{20} = 44.3\,Nw.$$

Conversion between other count systems can be worked out in a similar way. Table 8.1 lists commonly used conversion factors. You may try to work them out yourself.

Table 8.1 Factors for yarn count conversion. Source: Wang, 2006.

	DIRECT COUNT		**INDIRECT COUNT**	
	To Tex	To Denier	To Metric Count (Nm)	To Worsted Count (Nw)
From Tex		$9 \times Tex$	$\frac{1000}{Tex}$	$\frac{885.8}{Tex}$
From Denier	$0.111 \times denier$		$\frac{9000}{denier}$	$\frac{7972}{denier}$
From Metric count (Nm)	$\frac{1000}{Nm}$	$\frac{9000}{Nm}$		$0.8858 \times Nm$
From Cotton count (Nec)	$\frac{590.5}{Nec}$	$\frac{5135}{Ne}$	$1.693 \times Nec$	$1.5 \times Nec$
From Worsted count (Nw)	$\frac{885.8}{Nw}$	$\frac{7972}{Nw}$	$1.129 \times Nw$	

Yarn count and moisture content

Regardless of the yarn count system used, it is necessary to measure the weight and length of a yarn in order to determine its count. But most fibres, particularly natural fibres such as wool, absorb moisture from atmosphere. The weight of the yarn will be different at different moisture level. The water content in textiles can be expressed as either **moisture content** or as **regain**. Their definitions are:

$$\text{Re}\,gain\,(R) = \frac{Mass\,of\;\;absorbed\;water\;in\,specimen\,(W)}{Mass\,of\;\;dry\,specimen\,(D)} \times 100$$

$$Moisture\,content\,(M) = \frac{Mass\,of\;\;absorbed\;water\,in\,specimem\,(W)}{Mass\,of\;\;original\,undried\,specimen\,(W+D)} \times 100$$

From these definitions, the conversion between regain (R) and moisture content (M) can be worked out according to the equation below:

$$M = \frac{R}{1+R}$$

In commercial transactions, the mass to invoice is worked out on the basis of an agreed conventional regain level, not on the actual regain of the yarns (or other textiles) being traded. This is very important. Because, in the absence of an agreed conventional regain level, smart sellers may take advantage of the moisture absorption property of their textiles and rip the buyers off with large quantity of water in their products. The conventional regain levels, to be used for calculation of the legal commercial mass, have been established by national or international standards. These commercial regain values are purely arbitrary values arrived at for commercial purposes for interested parties, and they often vary from fibre to fibre and from country to country. The conventional regain rates used in Australia for some fibres are given in Table 8.2.

Table 8.2 Conventional regain rate for selected fibres. Source: Wang, 2006.

Fibre	Conventional regain (%)
Wool and hair fibres	
Combed (worsted)	18.25
Carded (woollens)	17
Silk	11
Polyester	
Staple fibre	1.5
Continuous filament	1.5

Conditioning the whole lot of yarns or other textile materials to the conventional regain rates given above is not practical, because of the time required etc. In calculating the commercial mass to invoice for a lot, the following procedures are often followed:

(1) Extract a sample of mass (gw) from the lot (whose total gross weight is GW)
(2) Determine the dry weight (dw) of the sample by oven drying to completely evaporate the moisture contained in it
(3) Calculate the commercial mass to invoice (cw), based on a conventional regain R%, by means of the formula:

$$cw = GW \times \frac{dw}{gw} \times \frac{100 + R\%}{100}$$

The following example illustrates this point.

Example:
Suppose a lot of worsted yarn is to be shipped to a buyer, and the gross weight of lot is 1000 kg. We now need to work out the commercial mass to invoice for the lot of yarn.

Answer:
We first extract a small sample (say 500 grams) from the lot. After oven drying of this small sample, the dried mass becomes, say, 450 grams. For worsted yarn, the conventional regain rate is 18.25% according to Table 8.2. Therefore, the commercial mass to invoice should be:

$$1000 \times \frac{450}{500} \times \frac{100 + 18.25}{100} = 1064.25\,(kg)$$

This suggests that the merchandise is actually drier than the conventional value. Had 1000 kg been used as the mass to invoice, the supplier would have been at a loss.

You may try to work out the actual regain of this lot of yarn using the values given in this example.

8.3 Yarn twist

Twist is the number of turns per unit length (cm, m or inch). In the manufacture of staple fibre yarns, twist is inserted into the fine strand of fibres to hold the fibres together and impart the desired properties to the twisted yarns. Without twist, the fine strand of fibres would be very weak and of little practical use. A change in the level of twist also changes many yarn properties, such as strength and softness. This section discusses the nature of yarn twist, the effect of twist on yarn properties, as well as twist measurement.

Nature of twist

Types of twist

There are two types of twist: real twist and false twist.

(1) Real twist
To insert a real twist into a length of yarn, one end of the yarn needs to be rotated relative to the other end, as indicated in Figure 8.3(a).

Spun yarns usually have real twist, which holds the fibres together in the yarn and provides strength..

(2) False twist
When inserting false twist into a length of yarn, both ends of the yarn are clamped, usually by rollers, and twist is inserted with a false twist device between the clamping points, as indicated in Figure 8.3(b).

If the yarn is not traversing along its axis, the twist will be in opposite directions above and below the false twister. If the false twister is removed, the opposite twists will cancel out one another, leaving no real twist in the length of yarn. If the yarn is traversing along its axis, then the section of the yarn moving away from the false twister would have no net twist, as indicated in Figure 8.3(b).

False twisting is a very important phenomenon, which has considerable practical implications in yarn technology. False twisting is featured in many key processes that we will discuss later, including woollen ring spinning, open-end rotor and friction spinning, air jet spinning, and filament yarn texturing.

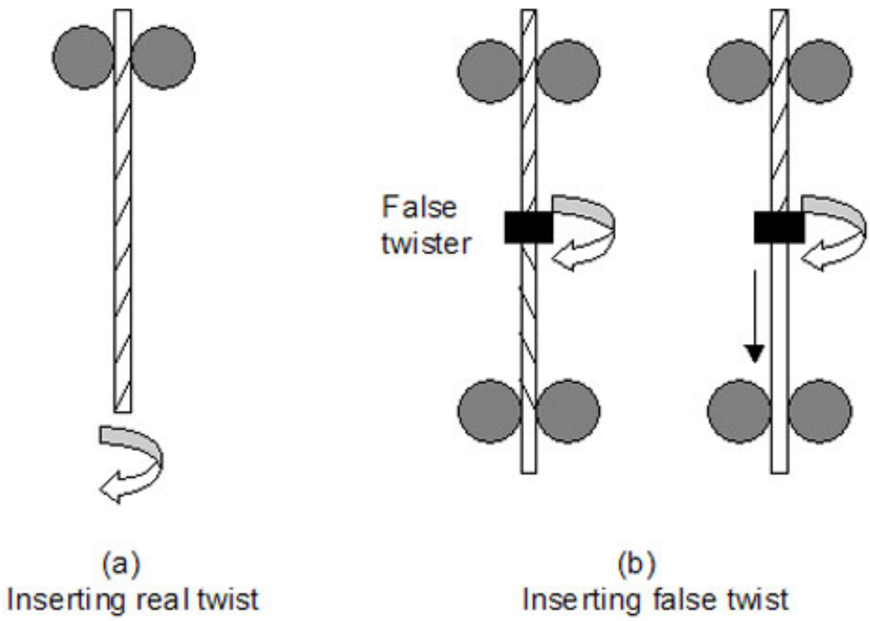

Figure 8.3 Real twisting and false twisting. Source: Wang, 2006.

Twist direction

A twist can be either in Z direction or S direction as indicated in Figure 8.4, depending on the orientation of the surface fibre in relation to yarn axis.

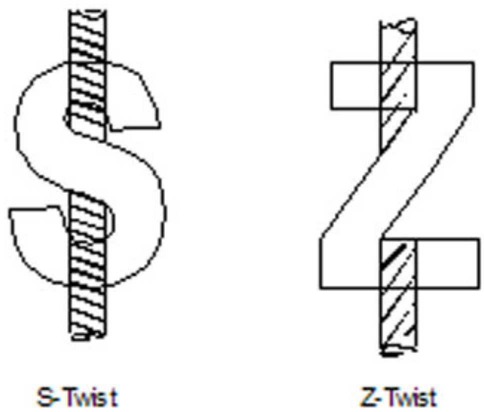

Figure 8.4 Twist direction. Source: Wang, 2006.

It is worth noting that twist direction affects fabric properties. For example, Figure 8.5 shows two identical twill-weave fabrics with the warp yarn having different twist directions. Fabric A will be more lustrous than fabric B, because light reflected by fibres in the warp and weft is in the same direction. Fabric A will be softer while fabric B firmer, because in Fabric B, the surface fibres on the warp and weft in the region of contact are aligned in the same direction and they may 'get stuck' inside each other and reduce the mobility of the intersection. On the other hand, for fabric A, the surface fibres on the warp and weft in the region of contact are crossed over, and they can move about easily. The freedom of movement at the yarn intersections is crucial for fabric softness.

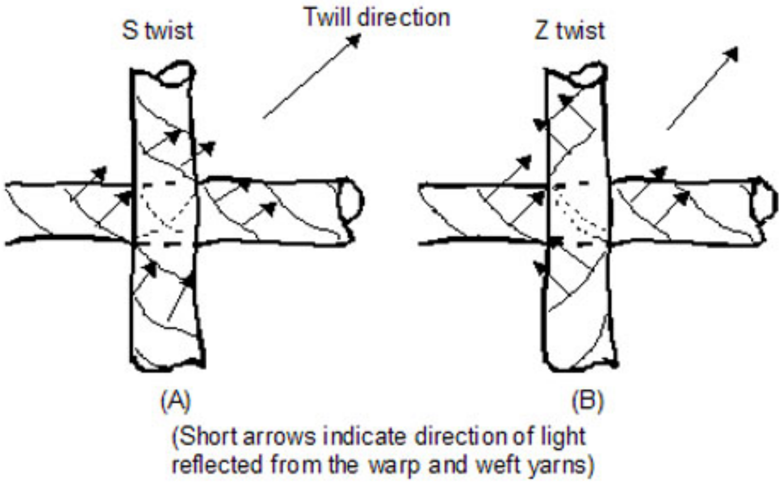

Figure 8.5 Effect of twist direction on fabric properties. Source: Wang, 2006.

Self-locking effect

Because of twist in a yarn, the fibres on yarn surface take a roughly helical configuration around the yarn. When the yarn is under tension, these surface fibres are also under tension. However, because of the helical configuration, part of the tension is diverted radially, which creates a radial pressure. The radial pressure tends to pack the fibres together, increasing the normal force between them, and so increasing their frictional resistance to slipping past each other. The more tension is applied to the yarn, the more it locks together, hence 'self-locking'. An analogy is, when you wind a string around your arm, as you pull the string along the arm and away from each other, the string bites deeper and deeper into the flesh.

Without twist, there won't be any self-locking effect to prevent fibre slippage. Consequently the yarn would have no strength. But too much twist in a yarn can actually weaken the yarn, as explained in the following section.

Effect of twist level on yarn strength

The level of twist is usually expressed in number of turns per metre (tpm). Number of turns per inch or twist per inch (tpi) is also used in the industry.

More twist gives greater radial component to any applied tension, so increases resistance of fibres to slip and the strength of yarn increases as a consequence. This is depicted by the '**coherence curve'** in Figure 8.6.

On the other hand, if a bundle of parallel filaments is twisted, the twist will put the individual filaments under torsional stress. This stress weakens the filaments and the strength of the filament would decrease as the level of twist increases. This is depicted by the **'obliquity curve**' in Figure 8.6.

For staple fibre yarns, these two curves combine to give the actual **'twist-strength curve'** for a staple fibre yarn as shown by the heavy line in Figure 8.6.

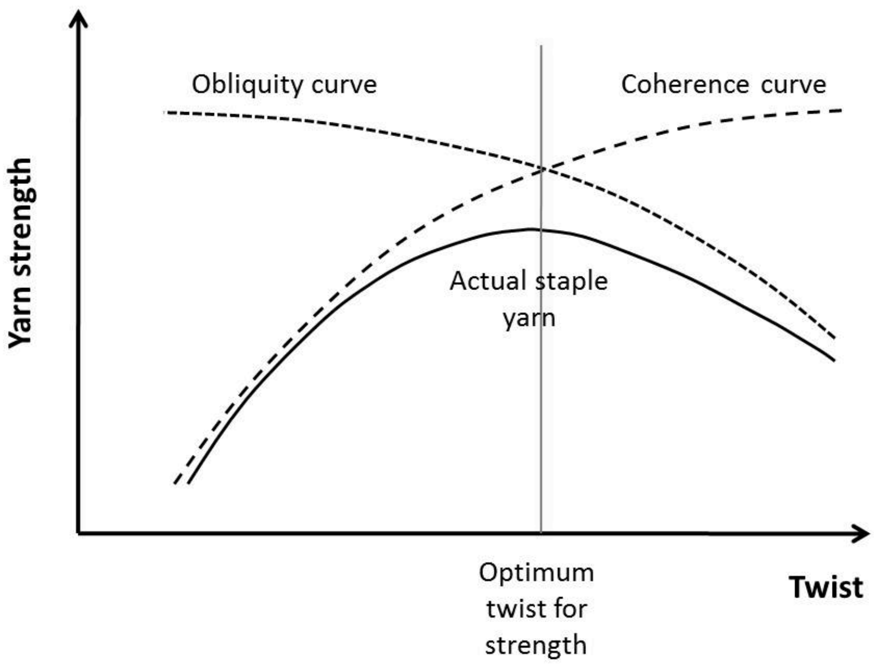

Figure 8.6 Effect of twist level on the strength of staple (spun) yarn.
Source: Wang, 2006.

Figure 8.6 indicates that for staple fibre yarn, increasing the twist level will increase yarn strength to a maximum level, beyond which further increase in twist will reduce yarn strength.

It should be noted that for continuous filament yarn, the obliquity curve applies. In other words, twisting a continuous filament yarn only reduces the yarn strength, regardless of the twist level used. If a continuous multi-filament yarn is twisted, the reason for the twist is to keep the individual filaments pressed together, not for strength.

Twist angle

This is the angle of fibres to yarn axis, and this angle varies throughout yarn, from zero at centre to maximum at yarn surface. The fibres on yarn surface are the most important because they bind the others into the yarn (refer to the self-locking effect discussed earlier).

While it is not common practice to measure the yarn twist angle, the surface twist angle made by the fibres in the surface of the yarn relative to its axis is a very important parameter. It determines the essential yarn characteristics such as yarn softness, yarn bulk etc, which in turn govern many essential fabric properties. The following example illustrates the point.

In Figure 8.7, yarn 1 and yarn 2 have the same twist level – one turn each. But the surface fibre on the thicker yarn is obviously stretched more to accommodate this twist. This would mean the thicker yarn is more closely packed. As a consequence, yarn 2 will not be as soft as yarn 1. In other words, even though the twist level is the same in these two yarns, the yarn characteristics are quite different. Therefore, we can not simply use twist level to represent yarn character. However, the surface twist angles of yarn 1 (θ_1) and yarn 2 (θ_2) are different. They can better reflect the yarn characteristics, regardless of the difference in yarn thickness.

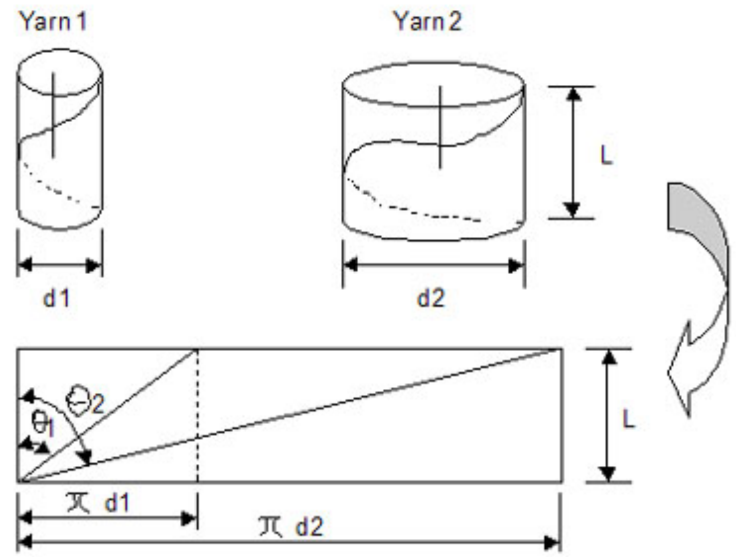

Figure 8.7 Two yarns of the same twist level, but different surface twist angles.
Source: Wang, 2006.

Twist factor (twist multiplier)

This is a very important factor that relates to the angle of twist helix the surface fibres have in a yarn. As we will see later, this factor is very important for a spinner because of the following reasons:

- Like surface twist angle, it governs the yarn characteristics
- It is used to work out the twist to use in spinning, in order to maintain the same surface twist angle and similar yarn characteristics when the yarn count is changed. The twist worked out from twist factor is also needed for setting up the spinning machine.

Twist factor is related to yarn count and the twist level in a yarn. This relationship is expressed in different ways for different yarn count systems.

For the tex system:

$$Twist\ (turns\ per\ metre) = \frac{Twist\ Factor\ (K_t)}{\sqrt{tex}}$$

For the metric count (Nm) system (the twist factor for the metric count system is also known as **alpha metric - α_m**):

$$Twist\ (turns\ per\ metre) = Twist\ \ Alpha\,(\alpha_m)\,\sqrt{Nm}$$

For English cotton (Nec) count system:

$$Twist\ (turns\ per\ inch) = Twist\ \ Factor\,(K_e)\,\sqrt{Nec}$$

For worsted count (Nw) system:

$$Twist\ (turns\ per\ inch) = Twist\ \ Factor\,(K_w)\,\sqrt{Nw}$$

Please note the unit for twist is also different in the above expressions of twist factor. In addition, twist factor is also known as twist multiplier, twist alpha, or twist coefficient.

Choice of twist factors

Yarns intended for different end uses have different characteristics. Since twist factor (like surface twist angle) determines yarn characteristics, the choice of twist factor is often governed by the intended use of the yarns. If maximum yarn strength is of the utmost importance, one would obviously choose the optimum yarn twist (see Figure 8.6) and the optimum twist factor for strength. However, the end-use of yarn may be such that other properties may be more important. For example, a yarn to be used for weft or for hosiery may be required to be soft and bulky and therefore a low twist factor is used. A yarn to be used for the production of voile or crepe fabric will necessitate the use of a high twist factor. If one considers staple yarns for the production of plied or cabled sewing threads then soft twisted single yarns are used and this results in the highest strength in the final thread. Another important feature to consider is that the productivity for spinning yarns of lower twist factor is higher. For these reasons, the majority of yarns are spun with a twist factor lower than the optimum twist factor for maximum strength. Table 8.3 shows the twist factor most commonly used for the various worsted yarns.

Table 8.3 Twist factors most commonly used. Source: Bona (1994).

Worsted Yarns	Tex count $K_t \ (\sqrt{tex} \ \times tpm)$	Metric count $K_m \ (\frac{tpm}{\sqrt{Nm}})$ (alpha metric - α_m)
Knitwear	1700	54
Soft	2000	63
Medium	2300	73
Strong	2600	82
Extra strong	2900	92

Please note these are reference values only, and the recommended values vary from source to source.

Once a twist factor is chosen, the level of twist required for the yarn can be calculated for a given yarn count. This twist level is then used to set up the spinning machine for yarn production.

Twist distribution in spun yarns

If someone twists your head, it is your neck that suffers most. That is because the neck is a 'thin' place and offers little resistance to being twisted. By analogy, if a yarn of varying thickness is twisted, it is usually the thin spot in the yarn that gets twisted the most. Invariably, yarns spun from staple fibres (e.g. wool, cotton) are not perfectly uniform, and there are thick and thin spots along the yarn length. This variation in yarn thickness will lead to variation in the twist level along the yarn length, because twist tends to accumulate in the thin place.

The fact that twist tends to accumulate in the thin spot along the yarn has several important implications:

- It exacerbates the variation in yarn linear density. While variation in yarn linear density is the fundamental cause of twist variation, concentration of twist in the thin places will make those places even thinner, exacerbating the problem of yarn unevenness.
- It improves the evenness of a fibre assembly during "drafting against twist". In the drafting stage of woollen ring spinning, the woollen slubbing is drafted while twist is inserted into the slubbing (drafting against twist) to control fibres during drafting. Because twist tends to accumulate in the thin spots, the fibres in thin regions in the slubbing are more difficult to draft than those in the thick places, which have less twist. As a result, the thick places are drafted more than the thin places, thus improving the evenness of the drafted material. This is depicted in Figure 8.8.

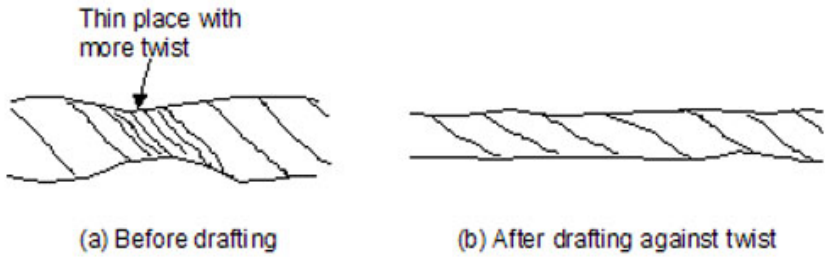

Figure 8.8 'Drafting against twist' improves evenness. Source: Wang, 2006.

- It has implication for twist measurements:

  Because the twist level varies along the yarn length, the twist measured at a short length of yarn may not reflect the true average twist of the yarn. Standard test procedures should be followed to measure the yarn twist accurately.

Twist contraction

When a bundle of parallel fibres is twisted, the distance between the two ends of a fibre will decrease, particularly for fibres near the surface of the twisted bundle. As a result, the overall length of the twisted bundle is shorter than its length before twist insertion. The reduction in length due to twist insertion is known as twist contraction.

The following formula is used to calculate the amount of twist contraction:

$$\%\,contraction = \frac{L_o - L_f}{L_o} \times 100\%$$

where Lo = original length before twisting
Lf = final length after twisting

It should be noted that because of twist contraction and the associated change in length, the count of a yarn will change slightly when twist in the yarn is changed. Twist contraction increases yarn count (tex), because the weight of the yarn is distributed over a shorter length. The following formula can be used

$$N_f = \frac{N_o}{1 - C}$$

where No = count (tex) before twisting
Nf = count (tex) after twisting
C = %contraction

Twist measurement

Twist measurement is a routine test for yarns. Because of the variation in twist along yarn length as discussed earlier, care should be taken in measuring the twist of staple spun yarns. Some basic principles are discussed here.

Sampling rules

The following rules should be observed when measuring yarn twist:

a. Tests should not be limited to a short length of the yarn package

b. Beware of "operator bias" - tendency to select either thicker or thinner regions. Taking samples at fixed intervals along the yarn length will reduce the bias

c. Discard first few metres from package. Being a free end, it could have lost twist

d. Remove yarn from side of package, not over end. Removing yarn over end will change the twist level in the yarn

e. Tension in yarn during test. eg, For singles worsted yarns: 5 $\pm$ 1 mN/tex.

Principles of measuring methods

The two common methods used in twist measurement are **straightened fibre method** and **untwist/retwist** method.

(1) Straightened fibre method (Figure 8.9)
This method involves counting of the number of turns required to untwist the yarns until the surface fibres appear to be straight and parallel to yarn axis. This method is mainly used for ply and continuous filament yarns.

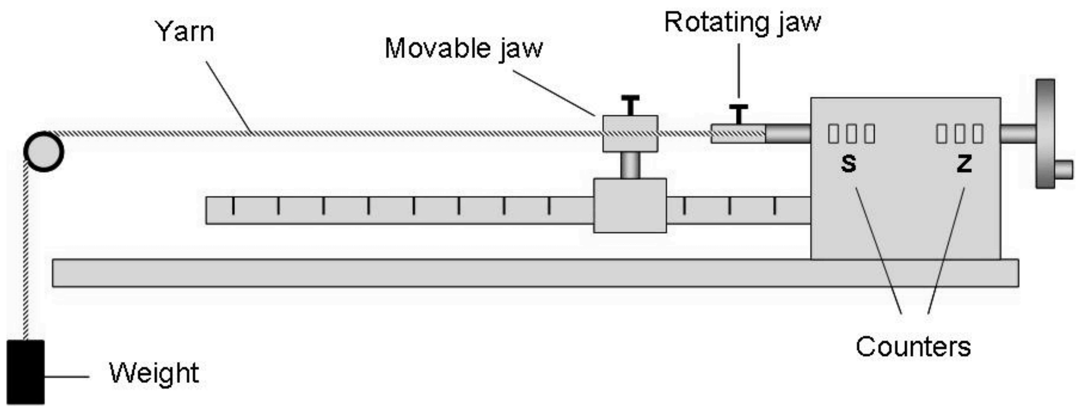

Figure 8.9 Yarn twist tester (straight fibre method)

(2) Untwist - Retwist Method (Figure 8.10)
This is the common method used for staple fibre yarns. It is based on twist contraction (hence also known as twist contraction method).

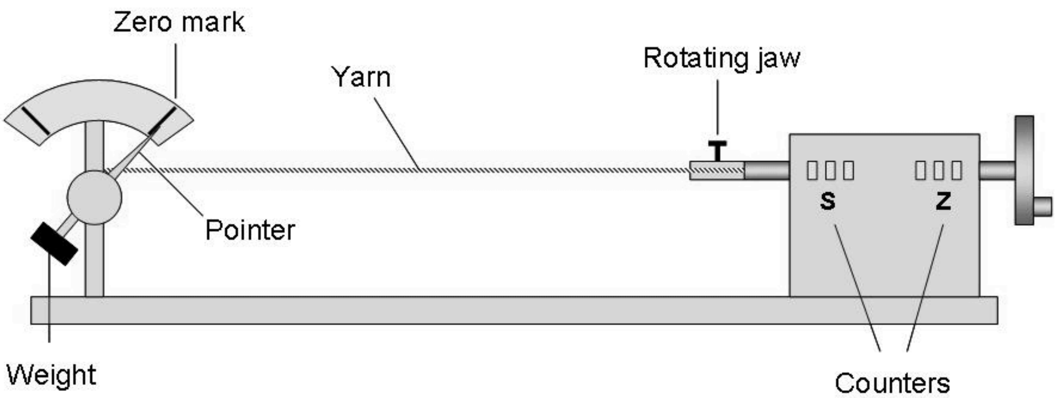

Figure 8.10 Yarn twist tester (untwist-retwist method)

For this method, it is assumed that the contraction in length, due to insertion of twist, is the same for both direction of twist (S and Z). Suppose we want to measure the twist level in a yarn with Z twist, the yarn is first untwisted (by a twist tester), and a counter on the twist tester will record the number of turns. During untwisting, the yarn would increase in length from its original length L to a new length L'. If the operation is continued, the yarn would have its twist completely removed first and then twisted up again in S direction. As the yarn gets twisted, its length will decrease (twist contraction) from L' towards its original length L. When its original length is reached, the total number of turns received by the yarn, as recorded by the counter on the twist tester, would be equal to twice the twist in the original yarn (with a length of L).

Automatic twist testers are now available, such as the Zweigle automatic twist tester.

Readings

1. Yang, S. and Humphries, W., 2001. Application of Sirolan Yarnspec in the Chinese Domestic Wool Industry. Presented at the International Wool Textile Organisation, Technology and Standards Committee, Shanghai, China, May 2001. CSIRO Textile Fibre and Technology, Geelong, VIC.

References

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