Study on Optimum Strength Twist Coefficient of Glass Fiber Yarn

Glass fiber products have excellent performance of inorganic non-metallic materials, with non-combustible, high temperature, electrical insulation, high tensile strength, good chemical stability and other excellent performance, In particular, some of the glass fibers have a higher strength than the same thickness of the wire, making it the ideal reinforcement material. Therefore, glass fiber has been widely used in transportation, transportation, construction, environmental protection, petroleum, chemical, electrical, electronics, machinery, aviation, aerospace, nuclear energy, weapons and other fields. In order to give full play to the characteristics of high strength glass fiber, many experts and scholars have done a lot of research, Many countries begin developing higher strength glass fiber. For example, after the 1980s, France, Japan has announced the production of RT high-strength glass fiber, Russia subsequently developed into BM high-strength glass fiber, their strength is higher than E glass fiber 30% to 40%, mainly used in aerospace, aviation, missiles and other military fields. It was also from the glass fiber friction performance aspects, to achieve the purpose of maintaining the strength of glass fiber. This article start from the glass fiber yarn twist design，to study the relationship between twist and strength of glass fiber yarn and explore the best strength of glass fiber yarn twist factor to improve the strength of ordinary glass fiber yarn, so that the fabric has a higher tensile properties.

Experimental principles and methods

Experimental principle

Glass fiber textile is divided into two series of untwisted structure and twisted structure, In the twisted structure of glass fiber products, glass fiber strand, single or multiple strands twisted into yarn for the first time after the merger, two or more single yarns are combined by a second twist to make strands, two or more strands are made again or multiple times to twist the cable. According to the yarn fracture mechanism, the yarn strength increases with the increase of twist, and then decreases with the increase of twist. The twist at the highest yarn strength is called the critical twist, and the corresponding twist factor is the critical twist factor.

In general, the physical strength of the single yarn, elongation, initial modulus and other physical indicators and yarn processing in the twist size and distribution are closely related. In recent years, many domestic books and journals have literature that, for two or more shares of more than two yarns combined twist to form the best twist of the choice of twist, Whether it is based on the twist of the twist yarn after the single yarn twist changes in the situation, or to the fiber in the curve of the curve and any point on the curve of the curvature, torsion, from the spool vertical distance and the deviation of the axle angle analysis strand structure and the physical properties of the relationship, the common conclusion is: When the twist factor of a strands is a single yarn twist factor multiplied by the square root of the number of strands of the strand, which can get the best strength of the strands. Calculating the twist factor of 2 ~ 6 strands for $1.414\alpha_0, 1.732\alpha_0, 2.000\alpha_0, 2.236\alpha_0, 2.450\alpha_0$ (α_0 is the single yarn twist factor). But the above conclusions and the actual use of the twist coefficient is very

different. According to the experiment, the maximum strong twist coefficient of cotton 27.8tex3 ~ 6 strands is $1.042\alpha_0, 1.006\alpha_0, 0.978\alpha_0, 0.957\alpha_0$ respectively.

Experimental materials and methods

Experimental materials

The experimental material is provided by Shanghai Hong Shen company CC9 double shares 33tex $\times$ 2 glass fiber yarn, No. #A; Shanghai Langjian Industrial Fiber Co., Ltd. provides CC9 double strand 33tex $\times$ 2 $\times$ 2 glass fiber yarn, No. #B.

Experimental apparatus

Y331 electric twist testing machine, YG (B) 021D single yarn strength machine, YG026B type electronic fabric strength machine.

Experimental methods

First testing # A yarn structure and performance, and then add a different yarn twist, and test its strength when the different twist so that Yarn strength obtained the highest critical twist. Then two with critical twist yarn were plied and reverse twisting, twisting strands twist factor values were 0.9,1.0,1.1,1.2,1.3 times the yarn twist factor. They were tested different twist strands strength, maximum strength obtained when the strand twist; Finally, different twist of glass fiber yarn woven into the fabric to observe the glass fiber yarn twist on the fabric of the strong impact. Glass fiber yarn breaking strength and elongation at break determination method are using GB / T7690.3-2001, Determination of breaking strength and breaking elongation of glass fiber fabrics are using GB / T7689.5-2001.

Experimental results and analysis

The best strong twist factor of glass fiber yarn

Test # A original yarn twist, 4.6 twist / 10cm, on this basis, additional twist, and then test its different twist under the glass fiber single yarn strength, the results shown in Table 1.

Table 1 # A single yarn twist and strong relationship

Sample	Original twist / twist · (10CM) −1	Additional twist / twist · (10CM) −1	Real twist / twist (10CM) −1	Single yarn strength / cN
1	4.6	0	4.6	1263
2	4.6	3.4	8	2183
3	4.6	5.4	10	2590
4	4.6	6.4	11	2615
5	4.6	7.4	12	2833
6	4.6	8.4	13	2722
7	4.6	9.4	14	2626
8	4.6	11.4	16	2617

When the twist strength is small, the strength of the glass fiber yarn increases as the twist increases. Increased to 12 twist / 10cm, the strength reach the maximum, which is 2833cN. When the single yarn twist of the glass fiber is increased, the strength not only does not increase, and will gradually increase with the twist increase. Thus, according to the relationship between the twist and the twist factor,

the #E single yarn is calculated as the optimum strong twist factor of 12 twist / 10 cm.

The best strong twist factor for glass fiber strands

Glass fiber single yarn at twist 12 twist / 10cm get the maximum yarn strength results. Taking two 12-twist / 10cm glass fiber yarn and then twisted together, the twist is twisted in the opposite direction to the twist of the single yarn. The degree of twist of the strands is determined based on the empirical data of the actual twisted yarns of the yarns and the yarns of the individual yarns, the twist of the strands is calculated from the twist factor of the strands. For example, the twist factor of the strands and the single yarn is 1: 1, the twist factor of the strands = 97.5 x 1.1 = 107.3, the twist of the thread = 9.3 twist / 10 cm. Respectively, on the degree of different twist of glass fiber double strand strength test, the relation of twist and strong (Table 2).

The twist factor ratio of the strands to the single yarn	Twist / twist of the strands (10cm) -1	Breaking strength /N
0.9	7.6	38
1	8.5	57.5
1.1	9.3	61.6
1.2	10.2	56.5
1.3	11.1	54

As can be seen from Table 2, the twist-strength curve is convex, and when the

twist factor ratio of the strands and the single yarn is 11, the twist of the strands is 9.3 twist / 10 cm, the strength of the strands is maximum, 61.6N.

Glass fiber strand strength of the strong impact on the fabric

Glass fiber yarns with different twist yarns were woven into glass fiber fabrics on a laboratory prototype to test their warp strength. The test results are shown in Table 3. To make the results comparable,in the weaving process using the same reed number, the fabric of the same organization, the same density. The fabric sample 1 was woven using #A, and the fabric sample 3 was woven with #B, and the twist and strength of the above two yarns were tested. The yarns of the woven sample 2 and the sample 4 were kneaded in a laboratory with #A and then twisted together.

Table 3 different twist structure of the glass fiber fabric strength

Item	Sample 1	Sample 2	Sample 3	Sample 4
Glass fiber yarn	#A	#ATwisted and stranded	#B	#ATwisted and stranded
Yarn fineness / tex	33tex×2	33tex×2 ×2	33tex×2 ×2	33tex×2 ×2
Single thread twist / twist (10cm) −1	4.6	10	11	12
Strand twist / twist (10cm) −1	—	8	11.6	9.3

Single yarn strength / cN	1263.2	2590	2615	3833
Strong strength /N	—	47.83	56.70	61.60
Fabric organization	plain weave	plain weave	plain weave	plain weave
Fabric warp density / root · (10cm) −1	80	80	80	80
Fabric warp strength / N	346	1334	1473	1544
Fabric elongation /%	2.02	4.96	5.14	5.34

As can be seen from the data in Table 3, the strength of the fabric increases with the strength of the yarn, and the strength of the yarn changes with the twist structure.

Because the fabric of sample 4 was experimentally obtained with the best strength twist of glass fiber yarn weaving. The fabric strength of 1544N, 5% is higher than the 1473N of sample 3, 15.7% higher than that of sample 2. It shows that the twist structure of 33tex × 2 × 2 glass fiber yarn numbered #B has not yet reached the

best; Specimen 4 The yarn used for the fabric was twice as thick as that of the sample 1, However, due to the use of a reasonable twist yarn, the strength of the fabric is 3.5 times higher than that of the sample 1. It is shown that the reasonable twist structure can effectively improve the strength of the glass fiber fabric.

Conclusion

Experiments show that the glass fiber yarn twist and strong relationship and other fibers, With the first twist is increased to improve strength, when the critical value is reached, the yarn strength decreases as the twist increases. Using reasonable yarn twist can increase the glass fiber yarn strength, thereby increasing the strength of glass fiber fabric, glass fiber effectively play the role of high-strength properties.