Vortex Spinning Process | Principle of Vortex Spinning System

Introduction:

Vortex Spinning is hailed as a revolutionary new technology it can also be viewed as a natural development in the technology of fasciated yarn production. From the earliest inception of fasciated yarns it was evident that there were limitations, which precluded its wide acceptance.

Murata Vortex spinning technology is a modified form of jet spinning which has attracted a lot of attention because of its advantages over ring spinning, open end and air-jet spinning. It has a high productivity rate, its yarn structure is similar to ring yarn, low hairiness and most important; it is possible to use a wider fiber length range to spin a wider yarn size production rage for 100% cotton. An increasing number of industries are introducing vortex spinning since it's suitable for spinning rayon yarn that as moderate anti pilling property and softness. Of late, it's being highly evaluated because its capable of producing polyester products requiring luxurious luster

Vortex spinning

Vortex spinning systems provide yarn with different structures and properties. Each system has its limitations and advantages in terms of technical feasibility and economic viability. The Murata vortex spinning based on the air jet spinning technology used for a wider range of fiber length. The vortex spun yarn has a two-part structure (core and sheath). In the vortex system, drafted fibers are introduced into a spindle orifice by an air vortex. While entering and passing through the orifice, fibers are twisted by the swirling air. It can deliver yarn at up to 400 mpm.

Vortex spinning, which adopts high speed airflow to insert twist into the yarn, is one of the most promising technological innovations in the textile industry. In vortex spinning, the dynamic behavior of the fiber inside the nozzle, which involves fiber-airflow interaction and fiber-wall contact, plays an important role in the twist insertion process.

Twist Insertion Process of Vortex Spinning:

In the twist insertion process of spinning a staple yarn, a strand of fibers is held on one end while the strand length is made to rotate on its axis. The rotation of the strand causes the fibers to adopt helical forms and increase the number of turns of twist. With the insertion of the twist, the fibers are packed together to-form a continuous yarn with special structure and properties. The conventional ring spinning, which uses revolutionary mechanical part to insert twist into the yarn, is currently the most widely used spinning technique. Although ring spinning has the widest spinnable count range, its disadvantages such as low production speed, long processing procedure, and high energy consumption, have limited its productivity and process economy.

Comparatively, the vortex spinning technique utilizes high speed airflow to insert twist into the yarn. This greatly increases the rotational speed of the fiber strand, which can be as high as 200, 000 turns/min. This technique not only increases the production speed and shortens

the processing procedure, but also lowers the cost and energy consumption involved in the yarn production. In the global background of energy shortage and manpower cost rising, the vortex spinning technique is one of the most promising technological innovations in the textile industry. In the vortex spinning system, as shown in (Figure 1), the spinning part is composed of an air-jet nozzle and a hollow spindle with a yarn passage through it. The fibers coming from the front rollers are held together and twisted with the action of the high speed airflow inside the nozzle. Fibers that whirl around the hollow spindle tip attach to the core fibers by wrapping onto them and yarn with a similarly real-twisted structure is formed. The formed yarn is then delivered out of the nozzle through the yarn passage of the hollow spindle with the drag of the delivery rollers and fed to the winding part. The most featuring characteristic of the vortex spinning is that it is capable of spinning 100% cotton fibers at very high speed (450m/min) and the produced yarn has a structure much similar to the ring spun yarn.

Principle of Vortex Spinning:
In the MVS system a sliver is fed directly to a 4-line drafting unit. Figure 8 shows a MVS spinning unit. When the fibers leave the front roller of the drafting device, they are drawn into a fiber bundle passage by air suction created by the nozzle. The fiber bundle passage consists of a nozzle block and a needle holder. The needle holder has a substantially central, longitudinal axis and a guide surface that twists relative to the longitudinal axis (Figure 2). A pin-like guide member associated with the needle holder protrudes toward the inlet of the spindle (Figure 3).

Figure 1
Following the fiber passage, fibers are smoothly sucked into a hollow spindle. Twist insertion starts as the fiber bundle receives the force of the compressed air at the inlet of the spindle. The twisting motion tends to propagate from the spindle toward the front rollers. This propagation is prevented by the guide member which temporarily plays a role as the center fiber bundle. After fibers have left the guide member, the whirling force of the air jet separates fibers from the bundle. Since the leading ends of all fibers are moved forward around the guide member and drawn into the spindle by the preceding portion of fiber bundle being formed into a yarn, they present partial twist and are less affected by the air flow inside the spindle. On the other hand, when the trailing ends of the fibers which have left the front rollers move to a position where they receive the powerfully whirling force of the nozzle, they are separated from the fiber bundle, extend outwardly and twine over the spindle. Subsequently, these fibers are spirally wound around the fiber core and formed into a vortex spun yarn as they are drawn into the spindle (Figure 4).

Figure 2. (a) plan view, (b) front view, (c) side view, and (d) perspective view of the needle holder

Figure 3. Needle holder with the guide member
The finished yarn is wound on a package after its defects have been removed. During the yarn formation, as the twist propagation is prevented by the guide member, most of the fibers do not receive the false twist. Besides, the fiber separation from the bundle occurs everywhere in the entire outer periphery of the bundle. This results in a higher number of wrapper fibers in the yarn. That’s why vortex spun yarns present much more wrapper fibers

than air jet spun yarns, and their yarn structure is similar to ring yarns represents an idealized structure of vortex spun yarn.