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Potential of High Performance Ring Spinning Based on Superconducting Magnetic Bearing

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Abstract : Due to the best quality of yarn and the flexibility of the machine, the ring spinning process is the most widely used spinning method for short staple yarn production. However, the productivity of these machines is still much lower in comparison to other spinning systems such as rotor or air-jet spinning process. The main reason for this limitation lies on the twisting mechanism of the ring spinning process. In the ring/traveler twisting system, each rotation of the traveler along with the ring inserts twist in the yarn. The rotation of the traveler at higher speed includes strong frictional forces, which in turn generates heat. Different ring/traveler systems concerning with its geometries, material combinations and coatings have already been implemented to solve the frictional problem. However, such developments can neither completely solve the frictional problem nor increase the productivity. The friction free superconducting magnetic bearing (SMB) system can be a right alternative replacing the existing ring/traveler system. The unique concept of SMB bearings is that they possess a self-stabilizing behavior, i.e. they remain fully passive without any necessity for expensive position sensing and control. Within the framework of a research project funded by German research foundation (DFG), suitable concepts of the SMB-system have been designed, developed, and integrated as a twisting device of ring spinning replacing the existing ring/traveler system. With the help of the developed mathematical model and experimental investigation, the physical limitations of this innovative twisting device in the spinning process have been determined. The interaction among the parameters of the spinning process and the superconducting twisting element has been further evaluated, which derives the concrete information regarding the new spinning process. Moreover, the influence of the implemented SMB twisting system on the yarn quality has been analyzed with respect to different process parameters. The presented work reveals the enormous potential of the innovative twisting mechanism, so that the productivity of the ring spinning process especially in case of thermoplastic materials can be at least doubled for the first time in a hundred years. The SMB ring spinning tester has also been presented in the international fair “International Textile Machinery Association (ITMA) 2015”.

Keywords : ring spinning, superconducting magnetic bearing, yarn properties, productivity
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