ABSTRACT

The growth of the electronic industry and the widespread use of electronic equipment in communications, computations, automations, biomedicine, space, and other purposes have led to many electromagnetic interference (EMI) problems as systems operate in close proximity. It is likely to become more severe in the future, unless proper EMI control methodology and techniques are used to meet the electromagnetic compatibility requirements. Hence, there is a pressing need to control and shield electrical components from these kinds of unwanted electromagnetic wave emissions. There are many approaches for imparting protection against EMI, such as metal materials, Al-Mg alloy and polymeric composites. Metal materials had good Electro Magnetic Shielding Effectiveness (EMSE) since they could reflect or conduct the free electrons. However, the conventional metallic shields in the form of bulk sheets impose weight penalties, stiffness and metal plating coatings, powders or fibers in filled polymer composites or coatings suffer from poor wear or scratch resistance.

The woven and knitted fabrics are very suitable for conductive materials, because of their structural order and ability to flex and conform to most desired shapes, offer a great opportunity to develop a new generation of multifunctional textile materials. Hence it has been attempted to the studies on copper, stainless steel and glass core yarn woven and knitted fabric for electromagnetic shielding applications in this present work.

In this present research work, the copper, stainless steel, copper with stainless steel, copper with glass, copper with stainless steel and glass core yarns, 2 and 3 ply of yarns, and fabrics were produced with various parameters to analyse the Electromagnetic Shielding Effectiveness. In order to analyse the effect of knitted fabric parameters on electromagnetic shielding effectiveness, Taguchi Design and ANOVA were used. From the produced copper core yarn different types of plain, rib and interlock knitted fabrics were produced by using knitting machine. In order to improve the electromagnetic shielding effectiveness of copper core yarn woven fabrics, nano silver finishing was given. The copper core fabrics were treated by nano silver particles with various levels of concentration, temperature and curing time. The Factorial Design was adopted for the optimum sample size.

In this research, the electromagnetic shielding tester was designed and developed, which is suitable for measuring the electromagnetic shielding effectiveness of textile materials from 500MHz to 12GHz. The effect of the size of the test sample, the geometry of the test setup, and the parameters of the source of electromagnetic radiation were analyzed and optimized by Taguchi design and ANOVA. The modified electromagnetic shielding tester showed good EMSE results than the network analyzer measurement (MIL – STD-285) in the High frequency range of 8-12 GHz.

The present study indicates that a substantial proportion of the tenacity component is being generated from the interaction of copper core and sheath of polyester and cotton. The core component individually shares a very small proportion of tenacity, and the sheath component contributes the majority. With increased friction spinning drum speed and copper core content, the tenacity of the copper core yarn increases. The copper core with polyester materials (sheath) showed good tenacity than copper core with cotton (sheath) materials.

The present study indicates that there is strong significant difference between the tensile strength of warp direction and weft direction of core yarn fabric and ply yarn fabric. The flexural rigidity and bending modulus of core yarn fabrics increase with an increase in core content. Copper with Stainless steel core yarn fabric, Copper with Glass core yarn fabric, Copper with Stainless steel and Glass filament core yarn fabrics have excellent abrasion resistance than copper core yarn fabrics and Ply yarn fabric.

With an increase in warp density, weft density, cover factor in woven fabrics, wales density, course density, tightness factors, aerial density in knitted fabrics, an increase in Electromagnetic shielding effectiveness was observed for both woven and knitted fabrics produced. Finer yarn count, twill weave, double layer conductive fabric, 3 ply of cotton copper yarn fabric, 45^0 Lay-up angle copper core yarns fabric, Interlock fabric structure and finer diameter of copper filament have better electromagnetic shielding effectiveness. ANOVA also shows the dominant effects of copper wire diameter and knitted fabric structure as compared to tightness factor and thickness. The electromagnetic shielding effectiveness of silver nano finished fabrics were improved by approximately 20 to 55% that of the untreated copper core yarn fabrics.

The copper, stainless steel, glass, copper with stainless steel, copper with glass, copper with stainless steel and glass core yarn fabrics and ply yarn fabrics have better electromagnetic shielding effectiveness in the frequency range of 200 MHz to 4000 MHz. Hence these fabrics can be used to shield the household appliances, FM/AM radio broadcasts wireless phone, cellular phone, computers, buildings, secret rooms and various electronic gadgets that operate up to 4000 MHz frequency.