MILANO RIB KNITTED FABRIC AND ITS COMPOSITE FOR ELECTROMAGNETIC SHIELDING APPLICATIONS IN ENGINEERING

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Abstract- The EMSE(electromagneticshielding effectiveness) of MilanoRib knittedstructure and its composite formwere studied in this paper. Milano Rib knitted fabric produced in this study was composed of cotton yarn and copper wire while the composite fabric was composed of aramid yarn, polypropylene yarn and copper wire. 7G semi-automatic flat knitting machine was used to knit the fabrics and a laboratory type hot press was used to form the composites. ASTM D 4935 coaxial test fixture was used for electromagnetic shielding effectiveness (EMSE) tests in 27-3000 MHz frequency band.As a result of the study, Milano rib composite form was found successful having a shielding performance of 20-40dB.

Index Terms- Composite, Electromagnetic Shielding, Milano Rib, Weft Knitted.

I. INTRODUCTION

A growing need exists for suitable materials that can act as a shield and limit the effects of electromagnetic energies.unfortunately, concerns also exist regarding the potential health hazards [1-3].
To shield and limit against EMI and ESD, conductive polymer composites have begun to replace metals for various shielding applications. However, conductive polymers have rigid characteristics owing to their chemical confirmation of benzene rings, making their manufacture difficult. a few studies have reported konductive knitted fabrics reinforced composites as electromagnetic shielding effectiveness (EMSE) and ESD materials. [4-6].

Traditional shields are based on the use of stiff metallic materials with well-known electromagnetic properties. Plastics with a metallic coat or with metal fibres injected during the molding stage are used also. But they are still not flexible. Recently attention has been paid to light weight and flexible materials, such as textiles covered with conductive layer. These materials, owing to their flexibility, durability, ease of manufacturing and application, are considered promising for shield of electro-magnetic radiation. [7,8].

II. EXPERIMENTAL APPROACH

A. MATERIAL

For this study, Ne 20/2 cotton / 0.15 mm copper wire were used to form the conductivehybrid yarn for the Milano rib fabrics and for its composite Aramid yarn, Polipropilen yarn and 0.15 mm copper wire were used to form the hybrid yarn. To compose the hybrid yarns a laboratuary twist machine was used as seen on Figure 1.



Figure 1.Laboratuary twist machine.

Then conductive hybrid yarns were formed into knitted structures using a 7gauge flat knitting machineas seen on Figure 2.



Figure 2. 7gauge flat knitting machine as seen on Figure 2.

For Milano rib knitted fabric reinforced composites; Aramid/PP/ 0.15 mm copper wire were used as conductive hybrid yarn. The course density of fabric was 3 loop/cm and wale density was 3 loop/cm. (Figure 3 and 4).

In Figure. 3 the Milano rib knitted structure and in Figure 4 stitch notation of the fabric can be seen.

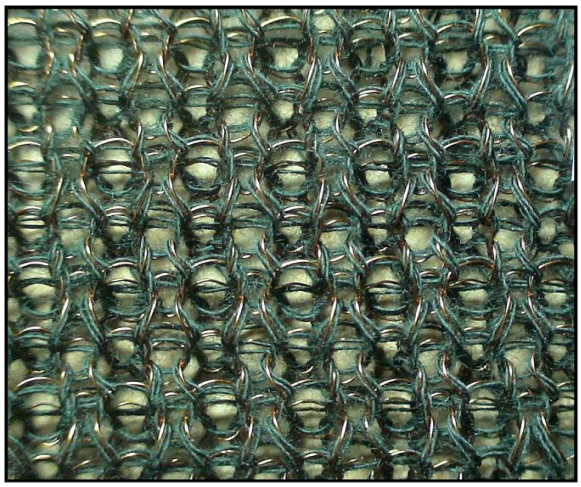

Figure 3.The Milano rib structure.

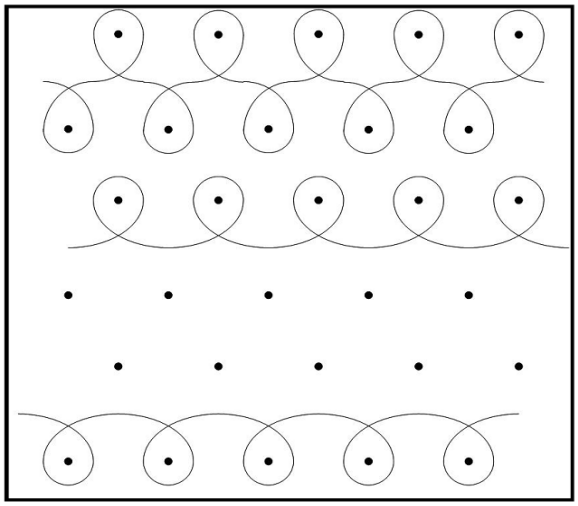

Figure 4.Stitch notations of Milano rib fabric.

Milano rib knitted fabric reinforced composites were achieved by compression molding technique using a laboratory hot pres. The last form of pressed composite can be seen on Figure 5.

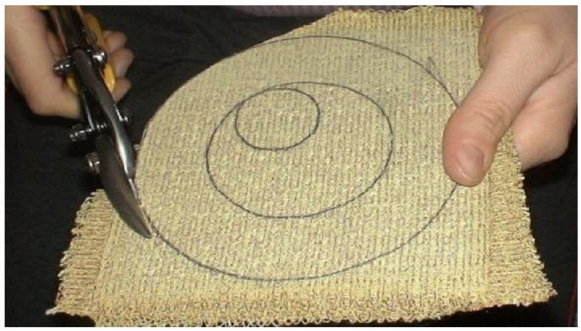

Figure 5. Last form of pressed composite

B. METHOD

A flanged coaxial test fixture referring to ASTM D 4935 was used for determining the electromagnetic shielding effectiveness (EMSE) of test samples (Figure 6).Sample holders of the test specimen is shown on Figure 7.



Figure 6.Flanged coaxial test fixture referring to ASTM D 4935.



Figure 7.Sample holders on flanged coaxial test fixture referring to ASTM D 4935.

III. RESULTS AND DISCUSSION

The Milanorib fabric has a poor shielding performance as 10-20 dB especially in high frequencies. But the composite form has a good shielding performance than its fabric as a shielding value of 30 dB especially in the frequency range of 750-2000 MHz. Inthe frequency range of 2500-3000 MHz, the composite form has a shielding performance of 30-40 dB (Figure 8).

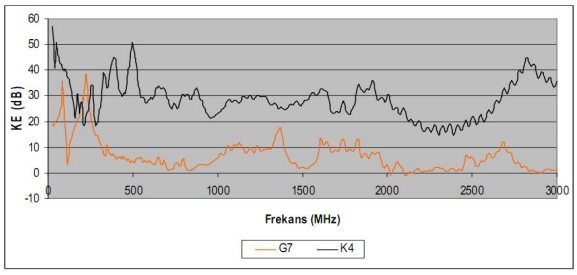

Figure 8. EMSE values of Milano fabric and itscomposite.

The composites' surface was all covered with polypropylene and the composites had an elastic character as seen on Figure 9.

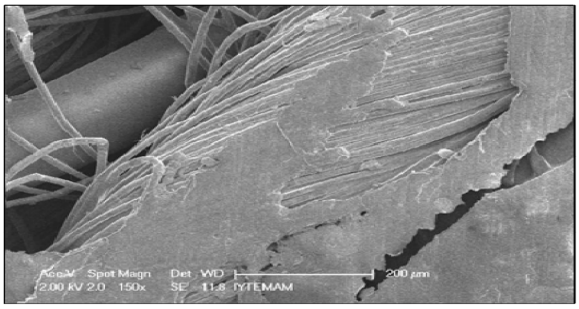

Figure 9. SEM Appearance of the composite form.

CONCLUSIONS

The composite form of Milano fabric is more effective than its fabric form especially in high frequencies. The composite form has a shielding performance of 20-40 dB in the frequency range of 2500-3000 MHz. So that, composite form reinforced with weft knitted Milanorib fabric can be used for many electromagnetic shielding applications in the frequency range of 500-3000 MHz.In future, composites reinforced with Milanorib fabrics or combinations of any other structures can be improved as shielding panels for civil engineering applications.

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