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The effect of washing on the Performance Characteristics of Wideband Textile Microstrip Antennas

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Abstract

In this paper the design , fabrication and measurement of three wide band textile patch antenna is presented. The substrate of the designed antenna were made by wool ,corduroy & jeans textiles materials while the radiating element and ground plane was made by thin film copper foil. The copper foil was pasted by using synthetic resin adhesive on the textile material. The effect of washing on its performance characteristics were experimentally studied using these wide band antennas.

Keywords: Microstrip wearable textile antenna, textile based substrate, radiation pattern. Impedance measurement.

I. INTRODUCTION

Now a days flexible textile antenna has an increasing high demand for the requirement of protective garments [1,2].The integration of electronics into textile starts a new age of smart protective clothing. In future garments will not only protect

the human body against the worse condition of environment, it also give data about the wearer's condition of health and environment [3].Future garments will provide continuous data about a person's condition ,which are very valuable medical inputs. This input data can also be a tool to decide on the operation of rescue work. So wireless communication with the environment needs textile antennas. While flexibility and comfort are issues, antenna should be made fully embedded into garments[4].Textile materials are biodegradable. Here three wideband rectangular microstrip antennas made of three different textile materials (wool ,corduroy & jeans)were designed , fabricated and tested . The effect of washing on these textile antennas performance characteristics were experimentally carried out in this paper.

II. ANTENNA DESIGN

Here three rectangular microstrip antennas using three different types of substrates were designed. The three different substrates are wool ,corduroy & jeans. In order to achieve desired thickness we made the substrate using a stack of textile material. The textile materials were pasted using synthetic resin adhesive. Adhesive resin has limited effect on the high frequency performance of the anisotropic conductive adhesive (ACA) flip-chip joint[5]. So resin adhesive was used . For antenna design purpose the copper foil was cut in proper dimension . Width , length , feeding position and desired substrate thickness are given Table 1. This rectangular copper foil was pasted on the textile substrate. Another Copper foil with dimension 120mm X 120mm was pasted on the other side of the substrate which acts as a ground plane. The adhesive used was synthetic resin adhesive. After pasting the copper foil, heavy pressure was applied on the top of the microstrip structure for removing the air gap in between the textile material and copper foil. Fig 1 shown textiles antennas made by three textile substrates.

III. EFFECT OF WASING ON TEXTILE ANTENNA

Here three wideband rectangular microstrip antennas made of three different textile materials (wool ,corduroy & jeans)were designed. Table 1 shows the width ,length & feeding position of these three rectangular patch antennas & substrates thickness.

TABLE-1

Width & length and feeding position of the rectangular patch , substrate thickness & measured S11 plot

Name of the Subst-rate	Width (W) mm	Length (L)mm	Feeding position	Thickness (h) mm	Measured S_{11} plot
Jeans	34	43.5	X=0,Y= - 8	2.45	Fig:-2
Wool	35	44	X=0,Y= - 8	2.55	Fig:-3
Corduroy	33.5	42.5	X=0,Y= - 9	2.55	Fig:-4

The effect of washing on textile antennas performance were experimentally investigated. As human being use these textile antennas ,they need to wash and clean these wearable antennas. Hence proper investigation of washing on antenna performance is great important. For that purpose the antennas were immersed into water and washed properly .After washing the antennas were dried on the sunlight. The impedance properties of the antennas were measured by vector network analyser. The measured result from Fig 2 to Fig 4 indicates that all these antennas are wide band. The impedance properties for both condition before and after washing of those antennas were measured by vector network analyser and the measured comparative studies of both condition (before and after washing) were shown in fig:- 2 to fig:- 4.

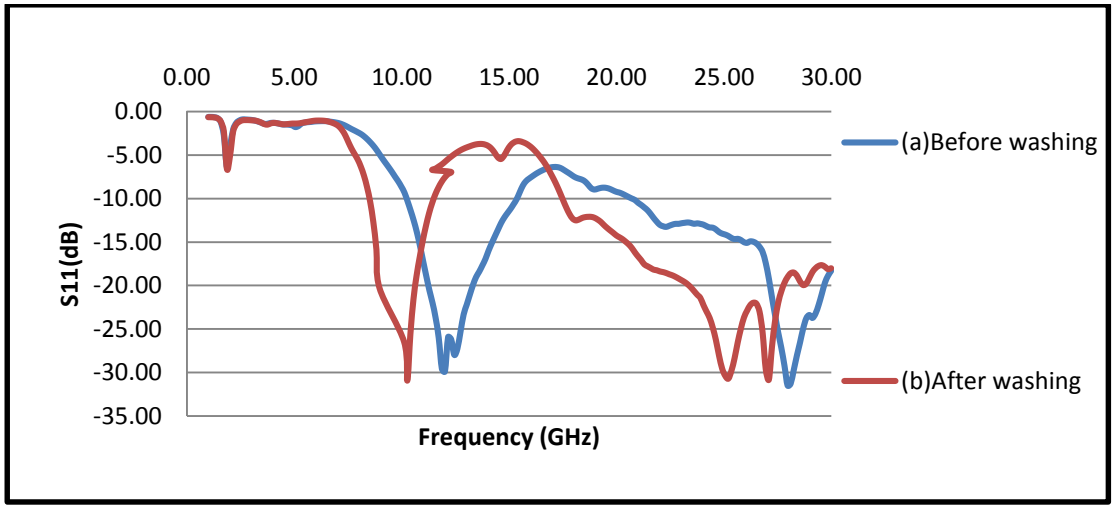

Fig:-2 Measured S11 plot of jeans antenna (a) before washing (b) after washing.

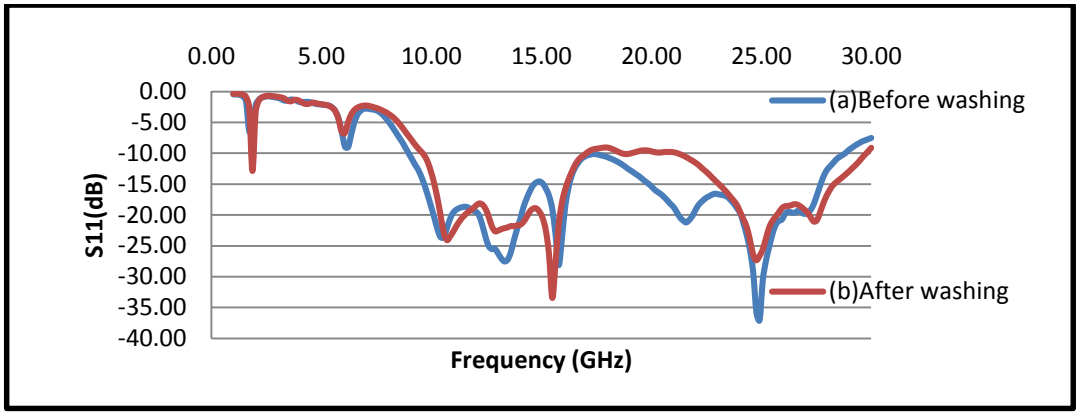

Fig:-3 Measured S11 plot of wool antenna (a)before washing (b) after washing.

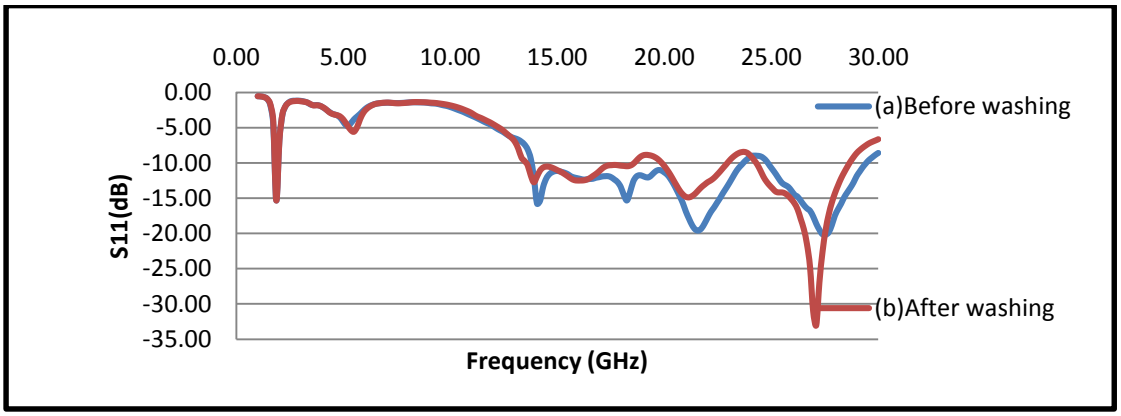

Fig:-4 Measured S11 plot of corduroy antenna (a)before washing (b) after washing

Fig:- 3 & Fig:- 4 indicate that the resonance frequency remains more or less same for before and after washing of textile antennas. But in Fig:- 2 it is observed that due to washing ,the resonance frequency shifted.

Effect of washing on Radiation Characteristics:-

Radiation pattern were measured for both two condition before and after washing of textile antennas. In each case the pattern is measured at measured resonant frequencies .Fig 5 to Fig 7 show the radiation pattern for all two cases of before washing antennas with reference to the after washing antennas respectively.

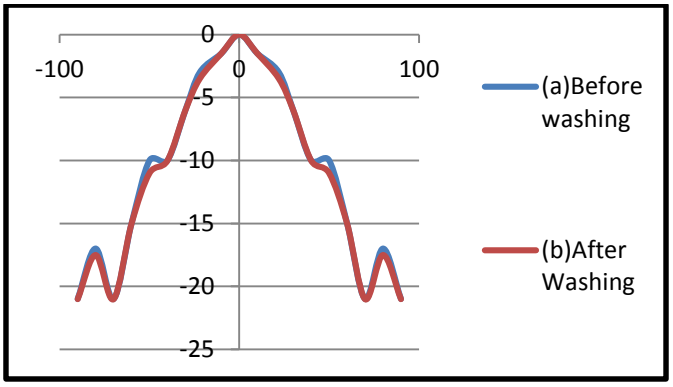

Fig:-5 Measured E-plane radiation pattern of wool textile antenna at 10GHz (a) Before washing(b)After washing.

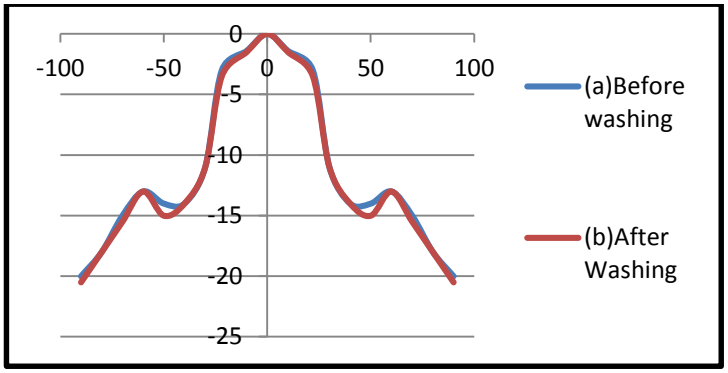

Fig:-6 Measured E-plane radiation pattern of jeans textile antenna at 11GHz (a) Before washing(b)After washing.

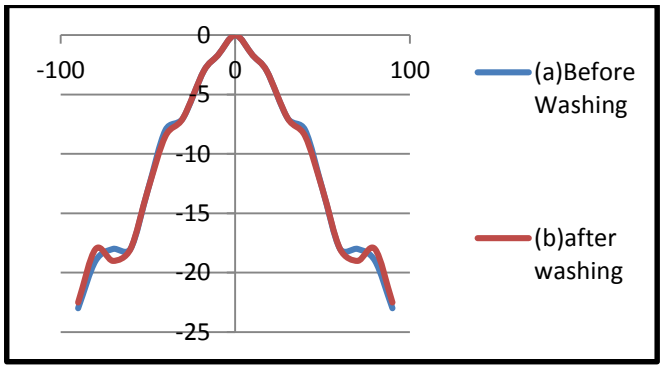

Fig:-7 Measured E-plane radiation pattern of corduroy textile antenna at 1.8GHz (a) Before washing(b)After washing.

VI. CONCLUSIONS

The use of commercial textiles (wool ,corduroy & jeans) antenna substrate at microwave frequency range for the design and fabrication of wearable wide band smart protective textile micro strip antennas has been demonstrated. In this paper an experimental investigation has been carried out using three kinds of textile antennas in order to get their impedance and radiation characteristics for both before and after washing conditions. The experimental result shows that the resonant frequency and radiation pattern remains more or less same for both before and after washing of the antennas. Experimental verification of these antennas validate that these textile biodegradable low-cost substrate antennas performance remains almost same after washing the antennas.

REFERENCES

[1] Bivas Roy; Partha Pratim Sarkar; Santosh Chowdhury;" Wideband Rectangular Wearable Jeans Antenna"Microwave And Optical Technology Letters / Vol.55:1270–1273, No. 6, June 2013.

[2] Hertleer, C.; Rogier, H.; Vallozzi, L.; Van Langenhove, L., "A Textile Antenna for Off-Body Communication Integrated Into Protective Clothing for Firefighters ", Antennas and Propagation, IEEE Transactions on : 2009 , Page(s): 919 - 925

[3] Hertleer, C.; Rogier, H.; Van Langenhove, L., "A Textile antenna for protective clothing," Antennas and Propagation for Body-Centric Wireless Communications, 2007 IET Seminar on 2007 , Page(s): 44 – 46

[4] Klemm, M.; Troester, G.," Textile UWB Antennas for Wireless Body Area Networks", Antennas and Propagation, IEEE Transactions on 2006 , Page(s): 3192 – 3197

[5] Gang Zou, Hans Grönqvist, and Johan Liu, "Theoretical Analysis of RF Performance of Anisotropic Conductive Adhesive Flip-Chip Joints," IEEE Transactions on Components and Packaging Technologies, Vol. 27, No. 3, pp.546-550, September 2004