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Investigation of the Effect of Coating Method on the Radiation Shielding Properties of Terry Cotton Fabric

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Abstract- There is an increasing attention addressing the compliance with sanitary regulations all over the medical institutions. Consequently emerged along with a parallel interest over the medical gowns, as being a side branch of medical textiles. Medical gowns are the most important item among the surgical garments. Terry cotton fabric is a kind of fabric used especially for medical hospital clothes. Terry cotton fabrics are two varieties; 63% cotton, 37% polyester and 50% cotton, 50% polyester.

In this study, terry cotton fabrics were used for coating method processing; fabrics also were covered in the single and double face. Barite is penetrated into the terry cotton fabric with coating methods by using barite at different rates. According to data obtained the most appropriate covering method, barite type was determined. The effect of radiation exposure on the coating type was investigated. The results of the experiments showed that barite impregnation significantly increases the radiation absorption capability of the fabric. It was found that the radiation absorption capability of the coated fabric was higher than that of the impregnated fabric.

Keywords: *terry cotton fabric, radiation shielding, barite, coating.*

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I. Introduction

Radiation is a phenomenon which is readily available in nature and our daily lives [1]. The use of radiation for various purposes has become widespread in modern societies. It puts at biological risk to all living things [2]. Today radiation is used for different purposes in basic science, medicine, agriculture, industry and military field [3].

Obtained radiations from various radioisotopes are used in many branches of physics, chemistry, and biology. Nowadays, increasing number of nuclear power plants should have been taking preventive measures against harmful rays by considering the increase in radiation emitting devices [4-5].

In fields such as medicine, scientific research, agriculture and industry, many live things exposed to radiation rays for treatment and meeting the needs. It is extremely important to protect these radioactive rays, which are countless harms to the human body [6]. People working in such areas need to wear armor clothes to keep their health. Nowadays, shielding clothes are very heavy because they are produced from lead plates in general, and they are not preferred because they are hard regarding using. Although lead is a very good radiation shielding, it gives great harm to human health. For this reason, humanity has been directed to alternative phenomena that have the feature of radiation shielding and do not harm health [7]. Barite ($BaSO_4$) is the most known barium mineral with radiation shielding properties [8]. It is white, opaque or semi-transparent. Bleached barite together with sulfuric acid is used as the emitter in the production of white lead paint due to its weight. The grain size of barite is very important. Barite has a feature that makes gamma rays harmless. For this reason, barite is used in a hospital. In addition to these features, barite has other positive features. However, in this study, X-ray retention of barite and radiation protection properties are emphasized.

The desired properties can be added to ordinary fabrics by using the coating method in fabrics [9]. The main purpose of the coating process is to coat each region of the fabric in equal amounts [10]. The main purpose of this study is to obtained barite-coated terry cotton fabric and investigation radiation shielding properties of this fabric.

For this basic purpose, it is possible to divide the studies made into subgroups as follows.

- Producing barite-coated fabric by penetrating barite on terry cotton fabric.
- Obtaining of Radiation processing coefficient of the obtained fabrics (RPC).
- Evaluation of the obtained results.

II. Materials and Method

The purpose of this study is to analyze the effects of coating type on the radiation absorption properties of terry cotton fabric.

a) Terry Cotton Fabric

The reason behind the focus on terry cotton fabric in this project is that it is fabric commonly used in a lab coat and lab apparel production. Terry cotton fabric is a plain weave fabric consisting of a mixture of

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polyester and viscose. Features of terry cotton fabric are given in Table 1.

Table 1: Features of Terry Cotton Fabric

Terry Cotton Fabric Features	Frequency (per/cm)	Yarn Number (Nm)	Knitted Report	C_1 (curl ratio)	Fiber Type	Weight (g/m²)
Weft	38	60		%7,5	PES	172
Warp	110	100		%4,3	Viscose+PES	

b) Preparation of Barite Coatings

Terry cotton fabric samples were produced by impregnation and coating method. In the impregnation method, the solution prepared between 2 bar pressure cylinders was poured, and the fabric sample was processed by the foulard process. The case of coating application, barites, and coating chemicals were added to the mixtures prepared for use at different ratios. The template prepared for use in the cover is stretched in different permeable fabrics such as a gas cloth, a tulle or silk, and then the application is carried out. The coating is applied to single and double surfaces of fabrics. In this way, it has been tried to produce fabrics with optimum properties by producing samples with different properties.

c) Image Processing Experiment

Digital X-ray films of specimens shot by penetration of barite with coating and impregnation method were taken under the supervision of special radiologists in Meddem Hospital. Obtained X-ray film images were processed using Matlab program. In X-ray films belonging to fabrics, parts were taken from three different points. Obtained images are digitized by the Matlab program. Obtained images are 8-bit images in Grayscale, and the images can only have a color value between 0-255. 0 is the black color, 255 is the white color. The fact that it is close to 0 value means that it can not hold the X-ray, it is close to the value 255 it shows that it holds the X-ray [11,12].

The Radiation Image Processing Numerical Value (RIPNV) is calculated by the program. For the RIPNV to be independent of the selected area, this value is divided into the image area calculated by the program and Radiation Processing Coefficient (RPC) is obtained.

d) Radiation Shielding Experiments

Radiation shielding experiments of the prepared fabrics were carried out in the Gama Spectroscopy Laboratory of the Department of Physics.

The linear absorption coefficient (μ) is calculated by the following equation [13].

$$I = I_o e^{-\mu x} \quad (1)$$

I_o radiation intensity before interaction with substance,

I radiation intensity after interaction with substance,

x the thickness of the material,

μ linear absorption coefficient

III. Results and Discussion

a) Result of Images Processing Experiment

Digital images are used to calculate radiation image processing numerical values (RIPNV) using software developed concerning the histogram method, and then radiation shielding image processing coefficient (RPC) was obtained. Table 2 shows the RIPNV and RPC values obtained from terry cotton fabric which was not treated.

Table 2: RIPNV and RPC Values Obtained from Untreated Terry Cotton Fabric

RIPNV (1)	RIPNV (2)	RIPNV (3)	RIPNV Mean	RPC
0,74	0,77	0,71	0,74	0,0091

Comparison Graphic of RPC of terry cotton fabrics is given Figure 1.

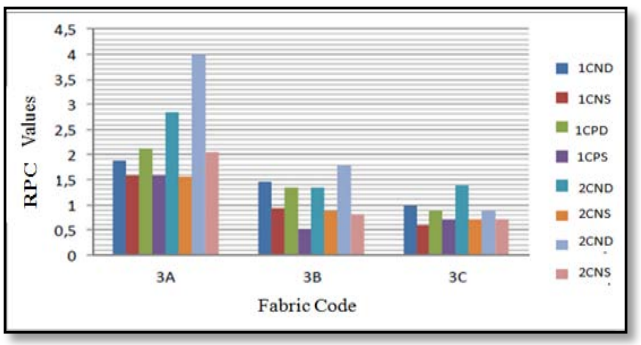

Fig. 1: Comparison Graphic of RPC of Terry Cotton Fabrics

RPNV and RPC value result for the impregnated terry cotton fabrics is given Figure 2.

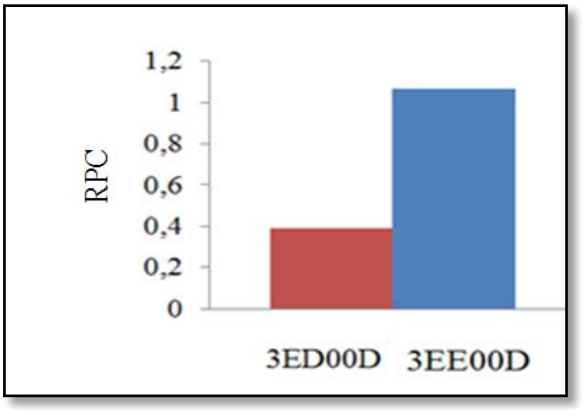

Fig. 2: RIPNV and RPC Value Results for the Impregnated Terry Cotton Fabrics

b) Results of Radiation Shielding Experiment

Radiation absorption coefficient of untreated terry cotton fabrics is given Table 3.

Table 3: Radiation Absorption Coefficient of Untreated Terry Cotton Fabrics

μ (cm^{-1}) 662 keV	μ (cm^{-1}) 1173 keV	μ (cm^{-1}) 1332 keV
0,2413	0,1880	0,1596

Radiation absorption coefficient of barite-coated terry cotton fabric is given Figure 3.

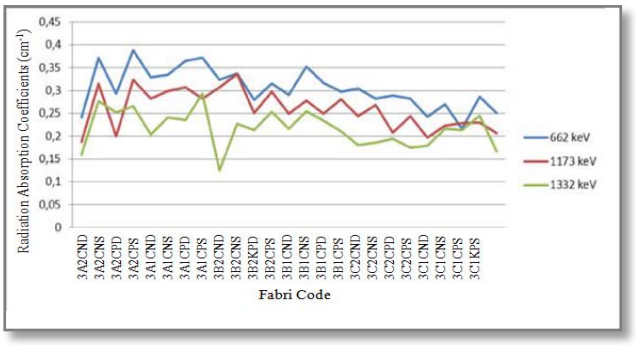

Fig. 3: Radiation Absorption Coefficient of Barite-coated Terry Cotton Fabric

IV. Conclusion

The methods used ensured barite-impregnated/coated fabric production as a result of barite penetration into terry cotton fabric.

- ✓ The results of the experiments showed that barite impregnation significantly increases the radiation absorption capability of the fabric.
- ✓ It was found that the radiation absorption capability of the coated fabric was higher than that of the impregnated fabric.
- ✓ It was observed that increased barite ratio also improves radiation shielding properties.
- ✓ It was also found that double-sided coating increases radiation shielding properties when compared to single-sided coating.
- ✓ An agreement between the experimental values and the values obtained using image processing method was found.
- ✓ It was concluded that the barite coated fabric used in this study could be utilized in the production of lab coats and other protective apparels for that personnel who are exposed to radioactive settings.

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References Références Referencias

1. F. Türkmen, N. Kun, G. Yaprak, Radioactivity properties of some natural stones produced in our country and seen in america - far east markets, IV. Marble Symposium Notification Book, 22-25 March, 2013 İzmir-Turkey.
2. Y. Esen, E. Orhan, A. Kurt, Experimental investigation of compressive strength and physical properties of concrete produced with ground barite, e-Journal of New World Sciences Academy, 6 (2011) 1281-1290. ISSN: 1308-7231.
3. C. Başyiğit, Ş. Kılınçarslan, B. Çomak, Assessment of Concrete Compressive Strength by Image Processing Technique, Suleyman Demirel University, Graduate School of Natural and Applied Sciences, 16 (2012) 82-88. ISSN: 1300-7688.
4. Ş. Kılınçarslan, C. Başyiğit, T. Molla, S. Sancar, Protected Ecological Constructions from Radioactive Rays, Politeknik Journal, 4 (2011) 93-99.
5. Ş. Kilinçarslan, İ. S. Üncü, İ. Akkurt, K. Günoğlu, F. Akarslan, S. Coşkunsu, Determination of Radiation Shielding Properties of Fabrics using Image Processing Method, Acta Physica Polonica, 132 (2017) 1171-1172.
6. E. Kaplan, E. Koç, Fabric Coating Techniques and investigation of Coated fabric properties, II.Textile Technologies and Textile Machinery Congress, 8-12 February, 2007 Gaziantep-Turkey.
7. Ş. Kılınçarslan, İ. Akkurt, İ. S. Üncü, F. Akarslan, Determination of Radiation Shielding Properties of Cotton Polyester Blend Fabric Coated with Different Barite Rate, Acta Physica Polonica A, 129 (2016) 878-879.
8. İ. Akkurt, C. Başyiğit, Ş. Kılınçarslan, B. Mavi, The shielding of γ-rays by concretes produced with barite, Progress in Nuclear Energy, 46 (2005) 1-11.

9. A. R. Horrocks, S. C. Anand, Handbook of Technical Textiles, The Textile Institute, CRC Pres, England, 2000.
10. Y. Bulut, V. Süar, General properties and performance tests of fabrics produced by coating or lamination techniques, The Journal of Textiles and Engineer, 15 (2008) 5-16.
11. Ş. Kılınçarslan, T. Molla, F. Akarslan, İ. Akkurt, Investigation of Different Origin Type Fabrics of Radiation Shielding, 7th International Advanced Technologies Symposium (IATS'13), 30-1 November, 2013 Istanbul-Turkey.
12. B. Çomak, A. Beycioğlu, C. Başyiğit, Ş. Kılınçarslan, Use of Image Processing Techniques in Concrete Technology, 6th International Advanced Technologies Symposium (IATS'11) 16-18 May, 2011 Elazığ-Turkey.
13. İ. Akkurt, C. Başyiğit, Ş. Kılınçarslan, B. Mavi, Radiation shielding of concretes containing different aggregates, Cement and Concrete Composites, 28 (2006) 153-157.