Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2016, 8(8):958-964

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Optimization of Tonality of the Viscose Fabrics Treated by Using Clay Nanoparticles

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ABSTRACT

The requirement of today industry is the production of desired product with less energy consumption. In textile industry, dyeing and finishing sectors consume the highest amounts of water and energy. Viscos yarns, which are one of the man-made fibers, have great effect of textile industry and it is widely used in clothing sector. On the other hand, in order to achieve a new method of dyeing, a new medium that could play an effective role as a cofactor in absorbing dye particles is needed. Treated clay nanoparticles are between among the mediums that poses such ability. Since, dyeing viscose fabrics have major constraints, improving the tonality of viscose fabrics which are treated with clay nanoparticles in order to be used in shawl production had been studied in the current study. For this purpose, viscose fabrics, which were washed with different values of clay nanoparticles' concentration, have been treated. Thereafter, the treated viscose fabrics were dyed under the direct reactive, sulfur and dispersants dying process. Meantime, designing the dyed fabrics for being used in shawl production was also studied. Findings of the study shows that the viscose fabrics which were treated with values more than 0.5 % (o.w.b) of clay nanoparticles can improve the tonality of treated fabrics and as a consequence prevents its wastage during the Dyeing wastewater treatment.

Keywords: Clay nanoparticles, viscose fabric, shawl, tonality.

INTRODUCTION

In 2003, the use of color absorbents such as clay nanoparticles compared to other processes that improved tonality, such as increasing the activity of the polymers, have higher ease and convenience. Another advantage is related to this feature that adsorbents such as clay nanoparticles are used as a multi-functional compound. For example, clay nanoparticles may bring other properties such as strength, fire resistance and UV absorbers for textile products. While the presence of color absorbers such as clay nanoparticles due to the economic interests have high importance.

The uses of clay nanoparticles also in order to upgrading tonality of disperse and acid dye in the production of polypropylene Nano-composites have been studied and reported. (1)

In 2012, this study was trying to improve the staining properties of polyester fibers by the use of Corona technique and coating with clay nanoparticles. For this purpose, polyester fabric in two different voltages and with a four-time mode has been completed under the control of corona. Suspension of nanoparticles of clay /dimethyl form amide was prepared at three per cent variety for polyester coating sample. Samples by the use of basic dyes were colored in three different colors. The results showed the dyeability of polyester fiber in dyeing with Basic Dye. (2)

In 2013, a research was done in which nanoparticles were used as materials. In this study, the effect and impact of plasma with nitrogen gas that was followed by clay Nano towards the light resistance of cotton materials was evaluated. Results showed that clay nanoparticles are effective radiated resistance for cotton materials. Increasing and strengthening the radiation resistance of samples is due to the primary clay Nano degradation which leads to the formation of the characters or in a way which can prevent the transmission of heat, energy and oxygen between light, fire and cotton materials. (3)

In 2005 the study of absorbing dye by the nanoparticles of clay, is useful not only for dyeing and the loss of dye effluent, but also to determine the absorption behavior of clay nanoparticles to chemicals like Nano-anionic, cationic and anionic.

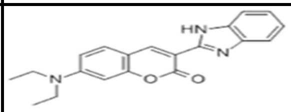
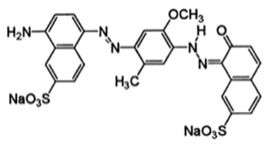
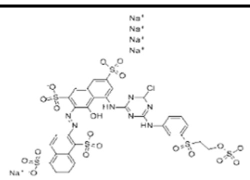
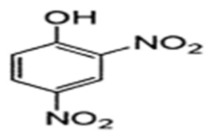
Clay nanoparticles due to the high specific surface area and the presence of strong van der Waals forces have very strong attraction through ionic interactions with different dyes. In a way that van der Waals forces and hydrophobic interactions were assessed as the two main sources for the promotion of absorbing the dyes by clay nanoparticles. The ionic absorbed dyes by the clay nanoparticles also play an important role in this regard (4).

EXPERIMENTAL SECTION

Used Materials

In order to dyeing the viscose samples in this study were used from four types of chemical dyes, clay Nano, and other chemicals and viscose fabrics with the following characteristics. Chemical dyes include reactive dyes, direct dyes, disperse dyes, sulfur dyes and their details are given in Table 1.

Table 1) Consumer dye Profile

Chemical dye	Specifications	Chemical structure	Construction Country
Disperse dye	CI Disperse Yellow 82, CI 551200, CAS 12239-58-6		India
Reactive dye	CI Direct Blue 151, CI24175, CAS 110735-25-6,773.7, C34H25N5Na2O10S2, Copper Blue 2R, Direct Blue Light Fast R, Direct Copper Blue 2B		Iran
Direct dye	CI Reactive Red 1, CI18158, CAS 17752-85-1,717.38, C19H9Cl2N6Na3O10S3, Reactive brilliant Red XB		Korea
Sulfur dyes	CI Sulphur Black 1, CI53185, CAS 1326-82-5, Sulphur Black 2BR, Sulphur Black B2RN, Sulphur Black BN, Sulphur Black BRN, Sulphur Black RN, DuasynThiocarbon CMR, Duasyn Thiocarbon GA, Duasyn Thiocarbon LP		China

Clay Nanoparticles are the product of leader Company of Iranian from Iran, Mashhad.

In addition to chemical dyes, it was also used from other Chemical materials in this research that was mentioned in Table 3.

Table 3) Specifications of fabrics and the used materials

Name	Specifications	Country Construction	Construction companies
Detergent	Under the brand name of rucogen DEN	Iran	Company Rudolf
acetic acid	Chemical formula: ch³cooh, molecular weight: g / mol 60, purity 0/99% <	Germany	Company merck
Sodium Chloride	Nacl, purity: 0/99% <,	Iran	Company Rudolf
100% viscose fabrics	The weft yarn 30.1 La, the warp yarn 30.2 La, weft density14, warp density 21	Iran	Silver Weave

The Used Equipment and Devices

Ben Marie is a French word which means water bath and is taken from its equivalent to English. This device is used for gradual and stable heating to the solutions in a certain time interval.

The scanning electron microscope made by a Netherland Company, is modeling from the Model of SEM PHENOM Prox. Scanning electron microscope is located on fibers and determining the size of particles on the surface of the fiber. Samples processed with clay nanoparticles, is collected by the SEM microscope.

Operations

Washing: Washing operations are conducted to separate the waste and impurities out of viscose raw samples by the weighing of one gram, 1% sodium carbonate, 3% of detergent and water volume 8/57 cc that the final total volume is 60 cc and over 20 min with temperature of 60° c is placed on the heater and after finishing operations, we would dry the intended samples.

Treating and processing with clay nanoparticles: for the suspension of nanoparticles clay soaked in impregnation baths, various amounts of clay Nano concentrations (1.5, 1 and 0.5 %) based on the volume of water (owb) at 40 ° c and over 10 minutes in an ultrasonic bath were used for suspension baths containing clay nanoparticles. Each of samples of viscose fabrics were washed separately and in bathroom containing different amounts of clay particles (0.5, 1, 1.5) were produced and at the temperature of 40 ° c and within 40 minutes, were under the control of immersion operation and samples were coded according to table 4.

Table 4) viscous samples treated with clay nanoparticles

(Owb) Clay Nano Particles (%)	Viscous samples
0	V-0
0.5%	V-1
1%	V-2
1.5%	V-3

Washing and drying viscous samples treated with nanoparticles of clay: viscous samples treated by immersion method, has been repeated several times by a washing process and pads were dried at ambient air temperature.

Dyeing: In this stage, at first, one-gram samples produced from viscose fabric and then pre-washing was done in order to remove fat and starch of fabric. In this study, four types of chemical dyes have been used with varying amounts of clay nanoparticles. However, due to the same dyeing samples, Baths test was conducted, the Baths conditions described in Table 5:

Table 5) Terms of dyeing bath

(Owf) 2%	Saturation required
10 g / L	Sodium Chloride
100 °c	Temperature
50 cc	Water
70:1	L: R
30 min	period of time

RESULTS AND DISCUSSION

The Results of Scanning Electron Microscope Images (SEM)

In order to assess the uniformity and showing dispersion in different forms of nanoparticles of clay in the structure of viscose fabrics was used of SEM analysis to determine the amount of clay nanoparticles and samples with magnification of 2000 ×, 5000 × , 10000 ×, 20000 × were analyzed. As you can see by changing the percentage of clay nanoparticles and changing of the focus of microscope, the particle size has changed. It seems that increasing amount of clay nanoparticles means the more amount of Nano sized particles.

SEM image shows clay nanoparticles, which represents the formation of nanoparticles clay with sizes between 4/52 to 8/83 nm that has the highest percentage of frequency.

Figures of, Figure 2 - A Figure 3 - B, Figure 4 – C, Figure 5 - D, Figure 6 - E, Figure 7 - F, Figure 8 - G, Figure 9 - H, Figure 10 - I, Figure 11 - J, Figure 12 - k, Fig. 13 - L, Figure 14 - M, Figure 15 - N, form 16 - O, Figure 17 - P represent the pictures of sem.

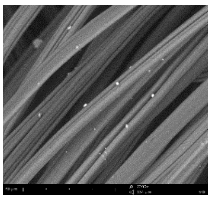
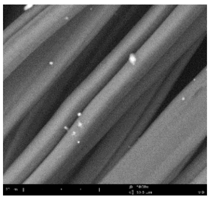
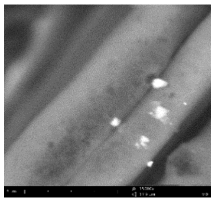
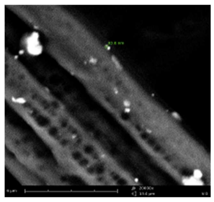





Figure 5 D **Figure 4 - C.** **Figure 3 - B** **Figure 2 - A**

Figures of (Figure 2 -A), (Figure 3b), (Figure 4 c), (Figure 5 d) are raw samples to be compared with processed samples. As can be seen, the raw sample contains no clay Nano. Scanning electron microscopic images of V-0 with a resolution of 2000 × (Figure 2 -Alf) and a resolution of 5000 × (Figure 3b) and a resolution of 10000 × (Fig. 4 - c) and with a resolution of 20000 × (Fig. 5 - d)

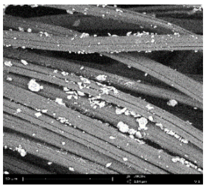
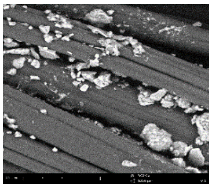
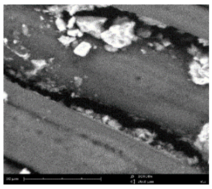
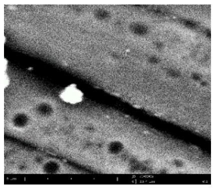





Figure 9 - H **Figure 8 - G** **Figure 7 – F** **Figure 6 - E**

The sample of (Figure 6 C) in Figure of (Figure 2 - a) in comparison with raw sample has clay Nano therefore latency textile operations were carried by nanoparticles of clay. Scanning electron microscopic images of V-1 with a resolution of 2000 × (Figure 6 -S) with a resolution of 5000 × (Figure 7 (c)) and with a resolution of 10000 × (Fig. 8 - g) and a resolution of 20000 × (Fig. 9 - h)

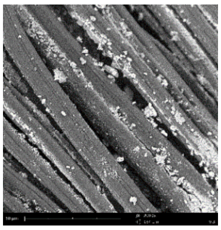
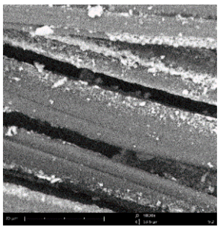
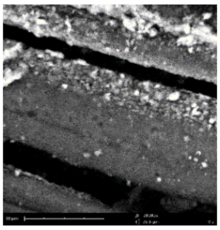
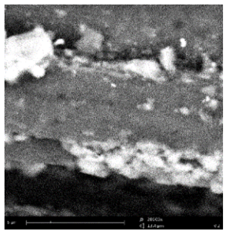





Figure 13 - I **Figure 12 - H** **Figure 11- G** **Figure 10 – F**

The first sample (Figure 10 - c) in Figure (Figure 2 - a) in comparison with raw sample have clay Nano, therefore latency textile operations were carried by nanoparticles of clay. Scanning electron microscopic images of V- 2 with a resolution of 2000 × (Figure 10 - f) and with a resolution of 5000 × (Fig 11- g) and a resolution of 10000 × (fig. 12- h) and a resolution of 20000 × (Figure 13 – i

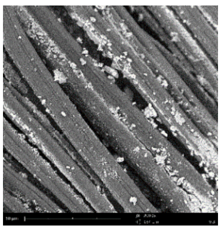
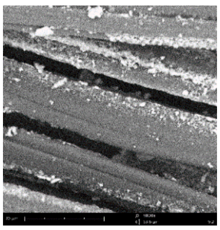
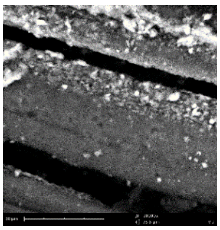
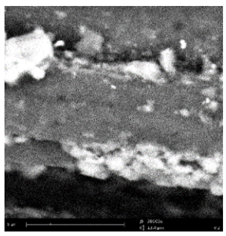





Figure 17 – M **Figure 16 - L** **Figure 15 - K** **Figure 14 - J**

The sample of (Figure 14 - j) in Figure of (Figure 2 - a) in comparison with raw sample has clay Nano, therefore latency textile operations were carried by nanoparticles of clay. Scanning electron microscopic images of V- 3 with a resolution of 2000 × (Figure 14 j) and a resolution of 5000 × (fig.15 - k) and a resolution of 10000 × (fig. 16 - l) with a resolution of 20000 × (Figure 17 - m).

Evaluation of Light Fastness of Dyed Samples

In order to assess the stability against the light of treated samples with different concentrations of clay nanoparticles and then dyed with chemical dyes of reactive, direct, disperse and sulfur, which are used based on standard test method of ISO 105-BO1. For this purpose, a sample is irradiated with 10,000 watt xenon lamp at a distance of 8 cm for 72 hours. Evaluation with water criteria is graded from one to eight in which number one representing the lowest stable upon light and number eight represents the highest stability against light.

Table 7) the image of stabilization against light of treated and dyed viscous samples

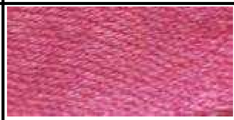
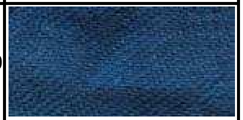
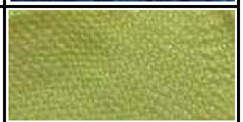
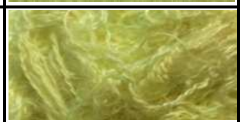
Row	Cloth	Sample Issue	The sample form	Sample Issue	The sample
1	Radiation intact	ControlVR-0		WitnessVM-0	
2	Viscose fabrics	VR-0		VM-0	
		VR-1		VM-1	
		VR-2		VM-2	
		VR-3		VM-3	
		WitnessVS-0		WitnessVD-0	
		VS-0		VD-0	
		VS-1		VD-1	
		VS-2		VD-2	
		VS-3		VD-3	

Table 8) values of stability in the light viscose samples treated with various chemical dyes

Sample Code	Reactive	straight	Dispersing	Sulphurous
V -0	6	2	5	4
V -1	7	7	7	5
V -2	5	5	3	6
V -3	4	2	2	5

Evaluation of the Wash Fastness of Dyed Samples

To evaluate the washing fastness, the samples treated with different concentrations of clay nanoparticles and dyed with sulfur, reactive, direct and disperse dyes under the washing operation process based on the standard test method of ISO 150-CO1 was mentioned, evaluation was done by grey criteria grading from one to five, where the number 1 represents the lowest stability in the washing fastness and the number five represents the highest stability in it and rinse with the conditions set forth in Table 9 and the color values in the dyeing wastewater compared to dyeing wastewater control samples were studied and compared.

Table 9) washing stability of dyed fabrics

owf 1%	Sodium carbonate 10%
owf 3%	Detergent 3%
60 ^{o}c	Temperature
30: 1	L: R
min 20	period of time

Table 10) image of stabilization results from the action of washing and dyeing of viscose samples

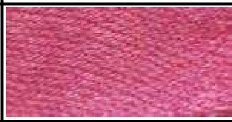
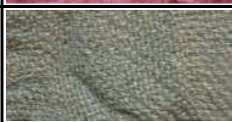
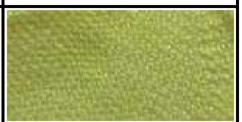
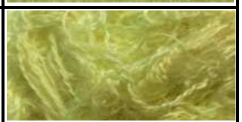
Row	Cloth	Sample Issue	The sample	Sample Issue	The sample
1	Unwashed	Control VR-0		Witness VM-0	
2	Viscose fabrics	VR-0		VM-0	
		VR-1		VM-1	
		VR-2		VM-2	
		VR-3		VM-3	
		WitnessVS-0		WitnessVD-0	
		VS-0		VD-0	
		VS-1		VD-1	
		VS-2		VD-2	
		VS-3		VD-3	

Table 11) Values of stability in washing viscous samples treated with various chemical dyes

Sample Code	Reactive	straight	Dispersing	Sulphurous
V -0	3	2	5	4
V -1	4	4	4	4
V -2	5	5	3	5
V -3	4	2	4	4

CONCLUSION

In this study, clay nanoparticles were used in order to improve viscose fabric dyeing that was evaluated by the use of SEM clay Nano microscope. Evaluation of curing by the SEM sample of fabric with nanoparticles of clay was coated in order to show that the treated viscose fabrics have clay nanoparticles which are distributed by uniformly on the fabric. Fabrics treated with nanoparticles of clay with four chemical dying of reactive, direct, disperse and sulfur dyes were stained, the results of light fastness examples of polyester viscose fabrics at 72 hour showed strict changing of color shift and viscose fabrics showed those changes much sooner. In other words, viscose fabric is dyed at temperature of 100˚c. Viscous samples compared to control samples are much pallor.

The results of the evaluation of fastness of v-0 with treated samples have lighter waste water in other words less color comes out of sample. Evaluation between the treated fabrics showed that the greater the amount of clay Nano, the further it improved its color stability, which means VR-1, has 0.5% nanoparticles and has more colored residue.
It is suggested that in future research instead of using nanoparticles, they should use other particles and, the researchers also proposed that in order to continue their research and their improvement should be used of different clay nanoparticles.

With regards to the God who gave me this ability that I can do this research with the help of him. It’s necessary to appreciate the unsparing efforts of the excellent professors, Doctor Ali Nazari and Mr. Seyed Javad Derakhshan that supported me and gave me their helps and kindness, special thanks to their assistance, that helped me in this research, I appreciate them all.

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