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Isolation of self Printing paste from Plant Seeds and Its Application in Simultaneous Burn-out and Screen Printing technique

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Abstract
Printing pastes containing eco-friendly galactomannan gum and safety natural dye were isolated simultaneously in one step process from tara plant seeds using sodium hydroxide solution. The effect of concentrations of sodium hydroxide on the rheological properties of the isolated printing pastes were thoroughly investigated. Technological evaluation of the obtained pastes to act as screen printing paste and burn-out style paste to be used in printing five different blends as well as pure wool was achieved. The results were evaluated via measuring the % loss in weight, K/S of the coloured area and tensile strength for the printed area.
The results obtained reviles that all the isolated pastes are characterized by non-Newtonian pseudoplastic behaviour, and its apparent viscosity depends on the concentration of sodium hydroxide and also on the time of storing. The prepared pastes could be used successfully as a screen printing paste and burn-out paste simultaneously. The % loss in weight increases by increasing sodium hydroxide concentration and/or the portion of wool in the blend. The K/S of the printed area depends on the nature of the component of the blend and higher on protenic fabrics than that of cellulosic.
Unique colour and attractive texture could be achieved using the current technique. It is also found that as the concentration of sodium hydroxide increases, the % loss in tensile strength increases specially for woolen blends, however the decreases is not high and satisfactory for industrial application.
Key words: Galactomannan, natural dye, burn-out, printing, rheology, blends.

I. Introduction

Burn-out styles, as the name suggests, this seems to be rather a drastic process in that it involves the destruction of all, or at least part of the fabric in the printed areas of the pattern(1). This technique was developed in France in the early twenties of the last century and was extremely popular in fashion design (2). The principle entails the use of print paste containing an agent that is capable of dissolving or destroying the fabric in the printed areas during subsequent processing (1,3). The effect can be employed alone or in conjunction with printed head-colours. There are principally two types of burn-out pastes namely an acid paste and an alkali paste. The former destroy cellulosic fibers, nylon, cellulose acetate and triacetate. While the second destroy the protenic fibers (4). In the fashion industry, fabric with a burn-out pattern is known as devore (5).

Concern for environment has, therefore, created an increasing interest in natural dyes. It is believed that natural dyes are more friendly to the environment than synthetic dyes (6). Tara plant seeds are composed of three components namely hull, endosperm and germ. They contain both eco-friendly galactomanan gum and eco friendly natural dyes(7,8).

The current work aims to isolate both the galactomannan gum and natural dye from tara seeds simultaneously in one step process using different concentrations of sodium hydroxide to achieve a self printing paste. Evaluation of the obtained self printing paste and its utilization as a printing paste as well as burn-out paste was my goal. This was conducted to achieve a unique colour and texture in a different blended fabrics, viz, Wool/Nylon (60/40), Wool/Polyester (55/45), Wool/polyester (35/65), Cotton/Polyester (50/50), linen/Polyester as well as Wool fabric 100%.

II. EXPERIMENTAL

2.1 Materials

2.1.1 Substrates:

- The following fabrics were selected and used in the current work
- Wool (100%) of 210 g/m2supplied by Misr Company for Spinning and Weaving, Mehalla El-Kubra, Egypt.
- Wool/nylon blend (60/40) of 165 g/m2 supplied by Misr Company for Spinning and Weaving.
- Wool/Polyester blend (55/45) of 165 g/m2 Supplied by Misr Company for Spinning and weaving.
- Wool/Polyester blend (35/65) of 256 g/m2 Supplied by

- Cotton/polyester blend (50/50) of 239 g/m2 Supplied by Misr Company for Spinning and Weaving also
- Linen/ polyester blend (80/20) of 155 g/m2 Supplied by El-Kamah, Cairo- Egypt.

2.1.2 Plant seeds:

- Dry clean seeds of tara were obtained from tara shrub. They were kindly supplied by El-Khavage Farm at El- Khatatba, Menufia, Egypt. The seeds are composed of three components namely hull, endosperm and germ and obtained from ripe pods (9). The latter is rich by pyrogaaol tannin (10-11). The gum is collected in the endosperm and composed mainly of galactomannan at a ratio of mannose to galactose is 3:1 (9,11, 12,13)

2.1.3 Chemicals:

- Sodium hydroxide was of laboratory grade chemicals and non ionic detergent namely CV-ET ® was of Technical grade chemical.

2.2 Methods:

2.2.1 Preparation of the burn- out coloured printing paste:

A printing pastes which are able to act as burn-out and at the same time to print a coloured area on the remaining fabric after the removal of the burnt area could be isolated from tara seeds as follows:

The seeds were crushed mechanically and sieved to remove the germ. The hull and endosperm were soaked in different concentrations of sodium hydroxide solutions (1,2,3,4,5,7,15 and 25 %) and left overnight to yield a coloured viscous mass. The latter was purified through separation from other insoluble components of hull and endosperm by filtration through a mucilein fabric. The purified coloured viscous masses so obtained were used as self printing pastes for printing the aforementioned six fabric samples without any other additives.

2.2.2 Printing:

All of the blended fabrics were printed using the self printing pastes via screen, i.e. flat screen printing technique.

2.2.3 Fixation:

Fixation of the printed samples was expedited by steaming at 120 oC for 15 minutes.

2.2.4 Washing:

The fixed fabrics were given a hot rinse at 50-60 oC till the hydrolyzed fabric components (Wool, nylon, polyester) is removed, neutralized with dilute acetic acid, rinsed with cold again and finally dried.

2.2.5 Analysis and Measurements:

- Determination of the rheological properties: The rheological properties of the prepared self printing pastes were measured at 25oC using rheomat-15, Zurich, Switzerland.
- The colour strength (K/S): The color strength of the printed samples expressed as K/S was evaluated by light reflectance technique(14) . All the printed samples were measured using a Hunter Lab UltraScan PRO instrument. The K/S values represented are a mean of readings for each sample.
- The % loss in weight: The % loss in weight was estimated via measuring the weight of the fabric before and after printing and washing based on the dry weight, using the following formula:

$$\% \text{ loss in weight} = (A-B)100/A$$

Where A and B are the weights of the same dry area before and after printing and washing respectively.

- Tensile strength: Tensile strength of the burn-out printed area was measured using Instron 3345 according to ASTM D3822 at National Res. Centre, Cairo, Egypt.

III. RESULTS & DISCUSSION

Development of eco-friendly products and technologies in textile printing has been the subject of several recent investigations (15-17). Current investigation is carried out as an integral part of the aforementioned investigations. Hence, research was designed to establish conditions under which coloured natural thickener could be isolated from plant seeds namely tara seeds. The coloured thickener or in a more strict scientific sense, galactomannan gum along with natural dye could only be obtained from the crushed tara seeds only when NaOH solution was used for swelling, dissolution and isolation of the optainedcoloured paste. For this reason, the effect of sodium hydroxide solution at different concentrations on the rheological behavior of the isolated galactomannan coloured paste was studied.

Hence, self-printing pastes containing galactomannan gum and natural dye isolated from the crushed tara seeds were prepared according to the procedure indicated in the experimental section using different concentrations of sodium hydroxide solutions. The rheological properties of the isolated pastes were measured at 25oC using Rheomat-15. Figures 1,2 and Tables I,II illustrate the data obtained.

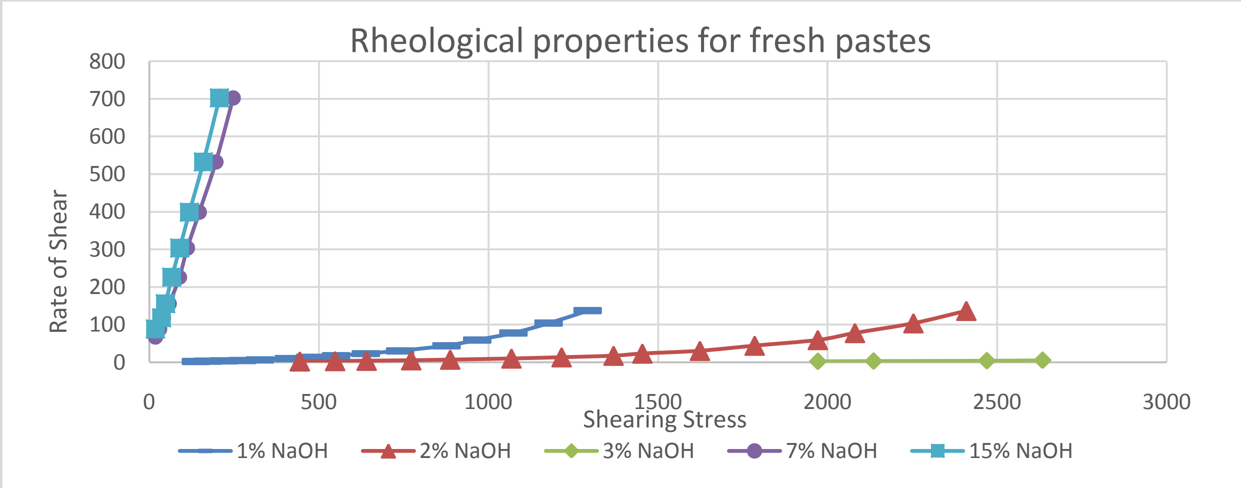


Figure 1: Effect of Different concentrations of NaOH on the rheological properties of the fresh galactomannan tara pastes.

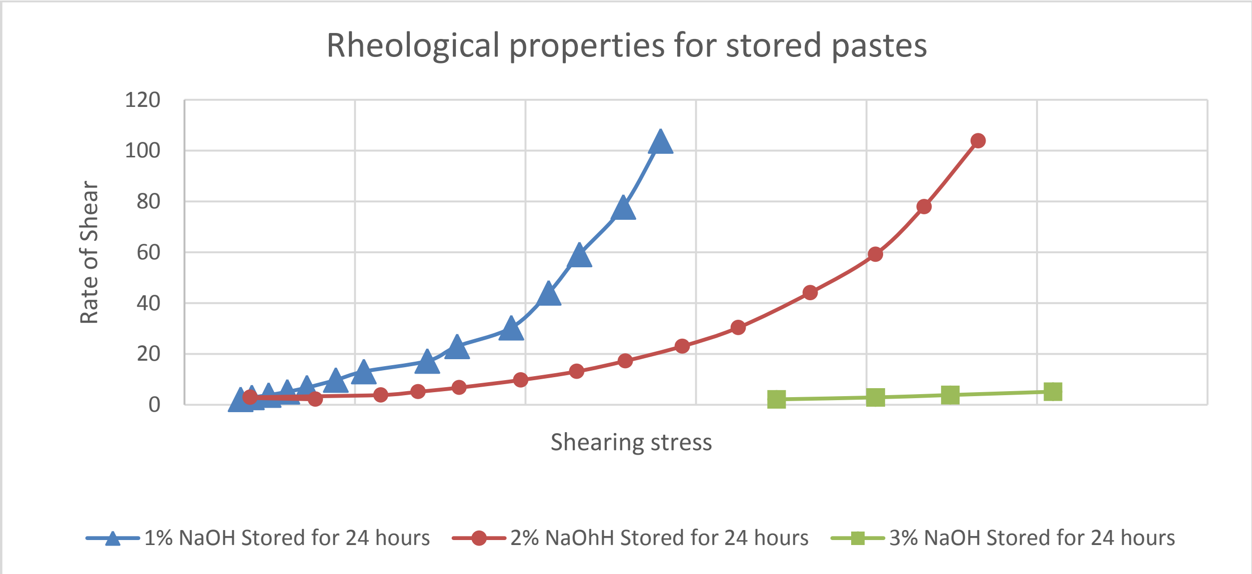


Figure 2: Effect of Different concentrations of NaOH on the rheological properties of the galactomannan tara pastes after storing for 24 hours.

It is clear from Fig 1 that the concentration of sodium hydroxide has a remarkable effect on the rheological characteristic of the obtained colored pastes. Where the rheograms of the pastes prepared using relatively low concentrations of sodium hydroxide i.e. 1,2 and 3 % are characterized by a curve concave towards the rate of shear axis and the up and down- flow curves are coincident which indicate that these pastes are characterized by a non-Newtonian pseudoplastic behavior this means that if the viscosity (resistance to flow) of these pastes is measured using a large applied force (Shearing stress) which causes a high velocity of flow (shear rate) the apparent viscosity is less than that of the same paste determined with a smaller force and a slower rate of flow (9) Figure1 also depict that as the concentration of NaOH increases from 1 to 3, the rheograms are shifted far from the rate of shear axis indicating an increase in the apparent viscosity. For example at a rate of shear of 5.139 the latter increases from 53.28 to 150.24 to 512.54 poise by increasing NaOH concentration from 1 to 2 to 3, respectively.

Table I: Effect of different concentrations of NaOH on the apparent viscosity in poise of galactomannan tara gum pastes:

Rate of shear	Apparent viscosity on using			Rate of shear	Viscosity on using 7% NaOH	Rate of shear	Viscosity on using 15% NaOH
	1% NaOH	2% NaOH	3% NaOH				
2.18	62.79817	203.4679	904.2936	67.18	0.087615	88.41	0.066621423
2.927	58.93065	187.0858	729.6344	88.41	0.115372	117.9	0.099830365
3.851	56.87873	166.3698	641.3088	117.9	0.116455	155.6	0.100835476
5.139	53.27885	150.2464	512.5433	155.6	0.126093	225.9	0.097255423
6.779	48.06019	130.8618	-	225.9	0.130279	303.3	0.098318497
9.771	42.03255	109.2846	-	303.3	0.122915	399	0.098345865
13.12	36.1029	92.65777	-	399	0.122932	532.1	0.099556474
17.26	31.88528	79.31634	-	532.1	0.122778	702.3	0.097778727
23.03	27.70083	63.12983	-	702.3	0.117329	-	-
30.38	24.33377	53.44404	-	-	-	-	-
44.1	19.86757	40.48027	-	-	-	-	-
59.22	16.32067	33.28875	-	-	-	-	-
77.92	13.7731	26.70534	-	-	-	-	-
103.9	11.33147	21.68787	-	-	-	-	-
137.1	9.426258	17.57433	-	-	-	-	-

Table II: Apparent viscosity in poise of the isolated pastes using different concentrations of NaOH after storing for 24 hours at different rates of shear:

Rate of shear	Apparent viscosity in poise on using		
	1% NaOH stored for 24 hours	2%NaOH stored for 24 hours	3% NaOH stored for 24 hours
2.18	75.35779817	175.8348624	796.2798165
2.927	67.35223779	65.48001367	692.2172873
3.851	63.9885744	1.3066736	583.0070112
5.139	58.60673283	133.1971201	495.4932866
6.779	52.91045877	118.7446526	-
9.771	45.39555828	100.8781087	-
13.12	40.06783537	87.64939024	-
17.26	41.24449594	74.87485516	-
23.03	34.71515415	63.36734694	-
30.38	31.5437788	53.44404213	-
44.1	24.21360544	41.59773243	-
59.22	19.55707531	34.2134414	-
77.92	16.51514374	27.82969713	-
103.9	13.43965351	22.39942252	-

On increasing the concentration of sodium hydroxide to 7,15 % or 25 % the opposite holds true and the rheograms are shifted near the rate of shear axis indicating a decrease in the apparent viscosity at any specific rate of shear (see Table I).

It is also clear from figure 1 that the rheograms obtained on using 7 and 15 % of sodium hydroxide is nearly straight line, i.e. these pastes is nearly characterized by Newtonian solutions. Where their apparent viscosity is nearly constant by changing the rate of shear as it is clear from Table I. While on using a concentration of 25 % NaOH, the paste is too fluid to be measured under the current conditions.

Figure 2 and Table II represent the effect of storing of the isolated pastes for 3 days on the rheological properties and on the apparent viscosity of the pastes prepared using 1,2 and 3 % sodium hydroxide solutions.

On comparing figures 1 and 2 we can easily illustrate that all the three pastes under investigations did not affected by storing for 3 days, where all the three pastes still characterized by non-Newtonian pseudoplastic characteristic after storing. However the location of the rheograms with respect to the rate of shear axis is changed in the apparent viscosity upon storing. It seems that the apparent viscosity at any specific rate of shear depends on: (1) the concentration of NaOH, (2) the rate of shear, and (3) the time of storing.

On comparing Tables I and II it is obvious that both the concentration of sodium hydroxide as well as the time of storing had a remarkable effect on the apparent viscosity of the isolated pastes.

At relatively low concentration of NaOH, i.e. 1% the viscosity increases, while at relatively higher concentrations, i.e. 2 and 3 the apparent viscosity decreases. This phenomenon holds true at any specific rate of shear. For example, the paste prepared using 1% NaOH at a rate of shear 2.18 sec-1 . Increases from 62.79 poise to 75.35 poise. While pastes prepared using 2 and 3 % decreases from 203.46 to 175.83 and from 904.29 to 796.27 respectively at the same rate of shear.

The increase in the apparent viscosity for the pastes prepared by relatively low concentration of sodium hydroxide (1%) by storing may be due to the formation of van der Waals forces and/or hydrogen bonding between the galactomannan chains formed during storing. While the decreases in the apparent viscosity at relatively higher concentrations (i.e. 2 and 3) may be due to hydrolytic molecular cleavage of mannose chains under these relative sever conditions, hence the apparent viscosity at any specific rate of shear decreases(18,19).

Utilization of the isolated pastes in colouration and burn-out style printing technique:

As it has been previously reported the main aim of the present work is to isolate self-printing pastes (containing thickener, natural colour and natural mordant) from tara seeds to be used simultaneously in colouration and burn-out printing style for different blended fabrics.

To achieve this different self-printing pastes were prepared using different concentration of sodium hydroxide viz. 1,2,3,7,15 and 25 % and used in printing 6 different blended fabrics comprise cotton/polyester, linen/polyester, Wool/Polyester, Wool/nylon and pure Wool for the sake of comparison. Via screen printing technique. After printing, and drying, the printed goods were subjected to steaming at 120oC for 15 minutes followed by washing thoroughly to remove the burn-out portion of the blend, the thickener and unfixed colour. After washing and drying the fabrics were assessed for measured % loss in weight, K/S as well as tensile strength. Given below the results obtained along with their appropriate discussion.

Table III and Fig 3 represent the effect of sodium hydroxide concentration in the burn-out printing pastes on the hydrolysis and decomposition of the different fabrics. It is clear from the data of this table that the % loss in weight found to be depend on both the concentration of sodium hydroxide as well as the nature of fabrics which constitute the blend.

It is clear from the data of Table III that complete decomposition for the fabrics, under investigation, was achieved at a concentration of 25% NaOH for the pure Wool fabric. While the blended fabrics were damaged by various ratios depending on both NaOH concentration and the nature of the blend constituent, which achieve the burn out feature. When we have a look on the data of Table III and Fig.3 we can easily illustrate that we can achieve different textures on the blended fabrics.

Table III: Effect of Sodium hydroxide concentration in the burn-out printing paste on the hydrolysis of the fabrics expressed as % decrease in weight.

Blend used	Weight of m^2	% decrease in weight via burn-out printing using natural colour containing NaOH concentration of					
		1%	2%	3%	7%	15%	25%
Wool %	210	5.36	12.60	13.02	31.37	38.20	-
Wool/Nylon(60/40)	165	5.60	14.77	14.83	35.99	40.12	64.15
Wool/Polyester (55/45)	165	4.54	11.96	12.01	29.15	35.13	61.43
Wool/Polyester (35/65)		4.02	10.30	12.03	27.04	34.10	42.75
Cotton/ polyester (50/50)	239	1.49	1.84	2.13	2.30	2.52	3.85
Linen/Polyester (80/20)	160	1.63	2.07	2.99	2.51	2.73	4.01

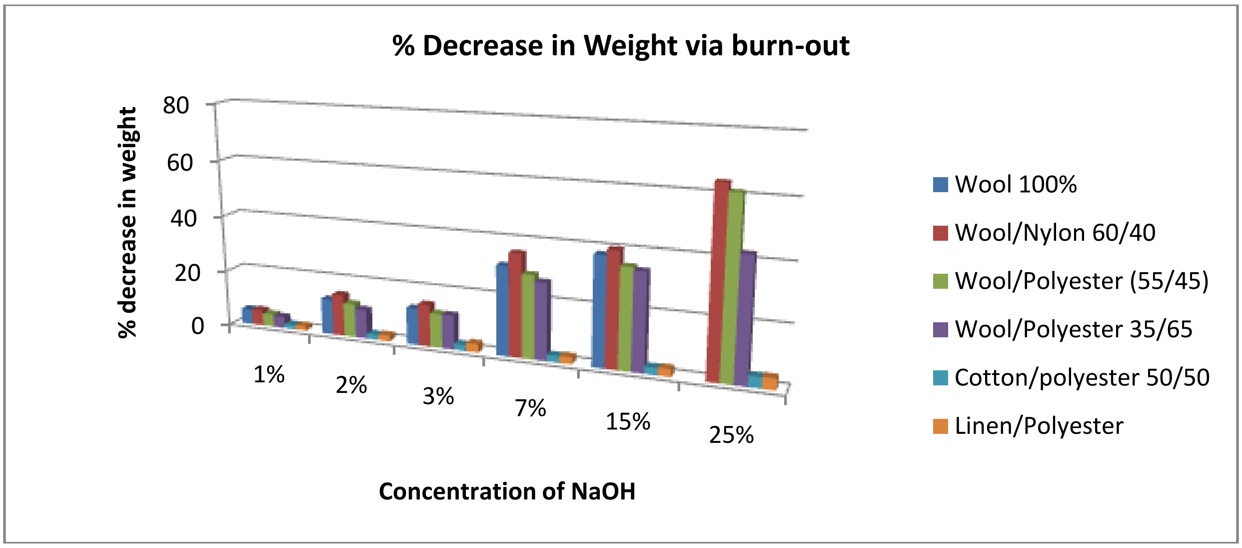
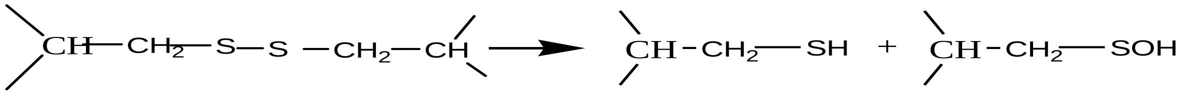


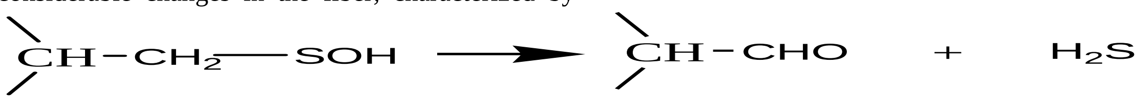
Figure 3: Effect of Sodium hydroxide concentration on the hydrolysis of the fabrics expressed as % decrease in weight.

It is also clear from the data of Table III that, irrespective of the nature of the blended fabric used, increasing the concentration of NaOH in the paste is accompanied by an increase in the % loss in weight. However the magnitude of the % decrease in weight depends on the nature of the component of the blend. Where, the magnitude of the % decrease in weight increases by increasing the protenic portion in the blend, and decreased by increasing the cellulosic portion. For example in case of using Wool/nylon (60/40), the % decrease in weight varies from 64.15 to 40.12 to 35.99 to 14.83 to 14.77 to 5.60 on using a pastes containing 25,15,7,3,2 and 1% of NaOH respectively. While in case of cellulosic blends, i.e. cotton/Polyester (50/50) or linen /Polyester (80/20), the % decrease in weight were found to be unremarkable when compared with the wool blends.

The current data is expected since, it is well known that alkali hydrolyze wool while cotton is stable in alkaline medium. In fact 5% solution of caustic soda will completely dissolve wool at the boil. With alkali, cysteine is readily attacked and possibly arginine, histidine and serine [20].



The resulting sulphenic acid is unstable in an alkaline medium and decomposes with the formation of an aldehyde and hydrogen sulphide. Thus, alkalies cause considerable changes in the fiber, characterized by the destruction of cysteine linkages and by subsequent transformation of the decomposition products [21,22].



Hence, the blends containing high % of wool fabric were affected greatly by the current burn-out alkaline self-printing pastes. So, we can achieve a highly desired fashionable designs on using different concentrations of NaOH in printing blended fabrics containing wool fabric, where we can achieve both different coloured shades as well as different and attractive textures in the printed fabrics as a result of the loss in weight caused in printed area.

While in case of cellulosic as well as polyester portions of the blends, it is well known that they have greater stability for alkali. Where a solution of 20 % of NaOH is used to mercerized cotton, making it stronger, smoother and hard acquiring a greater affinity for dyes (23).

Also, at room temperature, polyester has good resistance to weak alkalis and fair resistance to strong alkalis. This resistance is reduced with increased temperature (24).Hence, the current data (of table III) concerning the slight decrease in weight (with respect to both cotton/polyester and linen/ polyester) is in complete conformation with the previous studies (23,24).

Printing:

An economic eco-friendly printing pastes containing a natural dye and galactomannan gum could be obtained from crushed tara seeds using different concentrations of sodium hydroxide and used as self coloured paste.

The latter was used in printing the aforementioned blended fabrics as burn-out printing style via screen printing technique. After printing, drying, steaming at 120oC for 15 minutes. The printed goods were washed thoroughly to remove, the thickener, the unfixed colours, the alkali burn-out and hydrolyzed fabric portions as well as the excess alkali. After washing and drying, the fabrics were assessed for measuring the K/S of the coloured area. The results obtained are represented in figures 4 and 5.

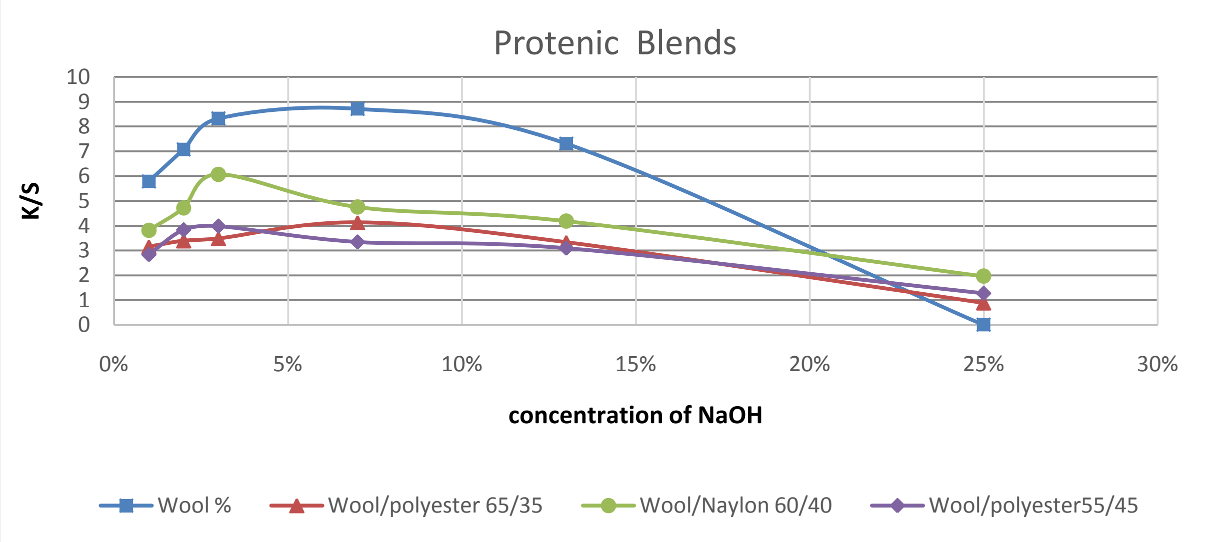


Figure 4: The effect of different concentrations of NaOH on the K/S of Wool fabrics and its blends.

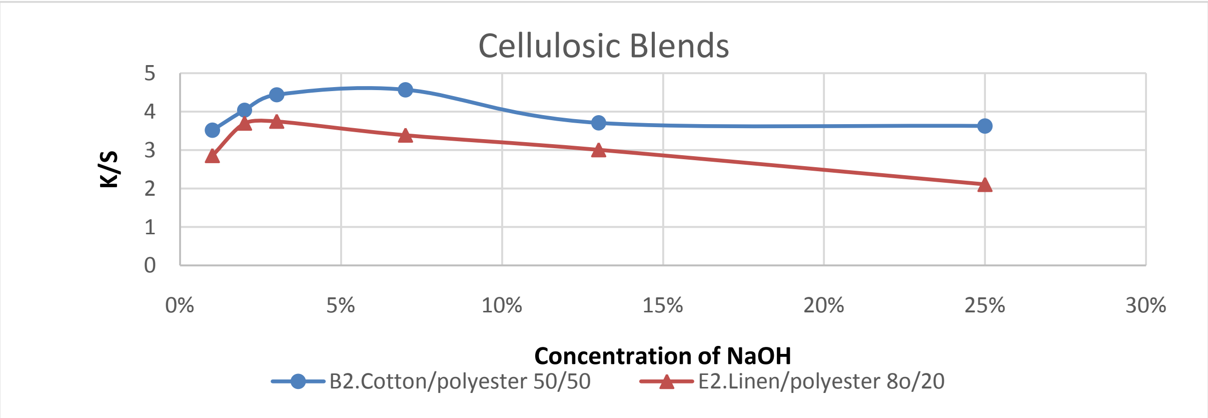


Figure 5: The Effect of different concentrations of NaOH on the K/S of Cotton/polyester and Linen/polyester blends.

Sodium hydroxide solution was used for swelling, dissolution and isolation of the gum from the endosperm of tara seeds which sticked with the hull. Sodium hydroxide molecules can extract the dye and the natural mordant which are concentrated in the hull of the seeds.

It is clear from the data of figure 4 and 5 that the K/S of the printed goods depends on: (a) the concentration of NaOH and (b) on the constitution of blended fabric.

Irrespective of the nature of blended fabrics, the K/S increases by increasing the concentration of sodium hydroxide in the paste reaches to a maximum after which it decreases. Pastes extracted using 3% NaOH seems to be the best one since it acquires the highest K/S and characterized also by the best rheological properties compared with the other pastes as it is clear from its highest apparent viscosity at any specific rate of shear.

Sodium hydroxide solution was used for swelling, dissolving, and isolation of both the gum and the natural colour from the hull of tara seeds which sticked with the endosperm. So sodium hydroxide molecules can extract the natural dye from the seeds. By increasing the concentration of NaOH, its efficiency to extract the colour increases too until a concentration of 3%. Increasing the concentration more than 3%; i.e. to 7, 13 or 25 % has a bad effect on both the viscosity and on the composition of the natural colour itself. Where a remarkable decrease, in K/S was obtained on using these concentrations.

It seems that the natural colour of tara seeds is unstable in relatively high alkalinity, i.e. at a concentration of 7 or more; which may decompose some of colour molecules.

It is also clear from figures 4 and 5 that wool and its blends display higher K/S values compared with cellulose blends, i.e. cotton and linen fabrics. This is rather expected since tara is rich in pyrogallol tannic (9). It has been reported (10,11), that tannins present in natural dyes are high molecular weight compounds containing phenolic hydroxyl groups which enable them to form effective crosslinks between proteins such as wool and silk, where they form three types of bonds namely:

(i) Hydrogen bond: which is formed between phenolic hydroxyl groups of tannins and the free amino and amides groups of proteins.
(ii) Ionic bond: it is formed between suitable charged anionic groups of the tannin and cationic groups on the protein.
(iii) Covalent bond: it is formed by interaction of any quinon or semi-quinon group present in tannic with any suitable reactive groups in the protein.

However, in case of cellular, the tanins could form only two types of bonds as follows:

(i) Hydrogen bonds: which is formed between phenolic hydroxyl groups of tanins and the hydroxyl groups of cellulose.
(ii) Covalent bond: which may be formed by the interaction of quinone or semi-quinone groups present in tannins with suitable functional groups in the cellulose.

Based on the foregoing, it may be concluded, that the self-coloured printing paste isolated from tara seeds, could successfully be applied without any type of additions to protonic or cellulosic blends.

Never the less, the shade is only differ depending on the % of protenic and/or cellulosic portion in the printed blend.

It may concluded from all of the above data that, the most suitable concentration of NaOH in order to extract both, the galactomannan and natural colour from tara seeds was found to be 1,2 and 3%. However the best to obtain the highest viscosity and also the highest K/S was found to be 3%.

Furthermore, the effect of storing of the extracted printing pastes prepared using 1,2 and 3% for 24 hours was also investigated. The results of K/S obtained are represented in Figure 6. A,B and C for pastes prepared using 1,2 and 3% respectively.

It is clear from Figure 5 that in all cases, i.e. for all the investigated blends irrespective the concentration of NaOH used there is a decrease in the K/S by storing of the pastes for 24 hours. However, the magnitude of % decrease depends on both the concentration of NaOH used and also in the composition and nature the blended fabric.

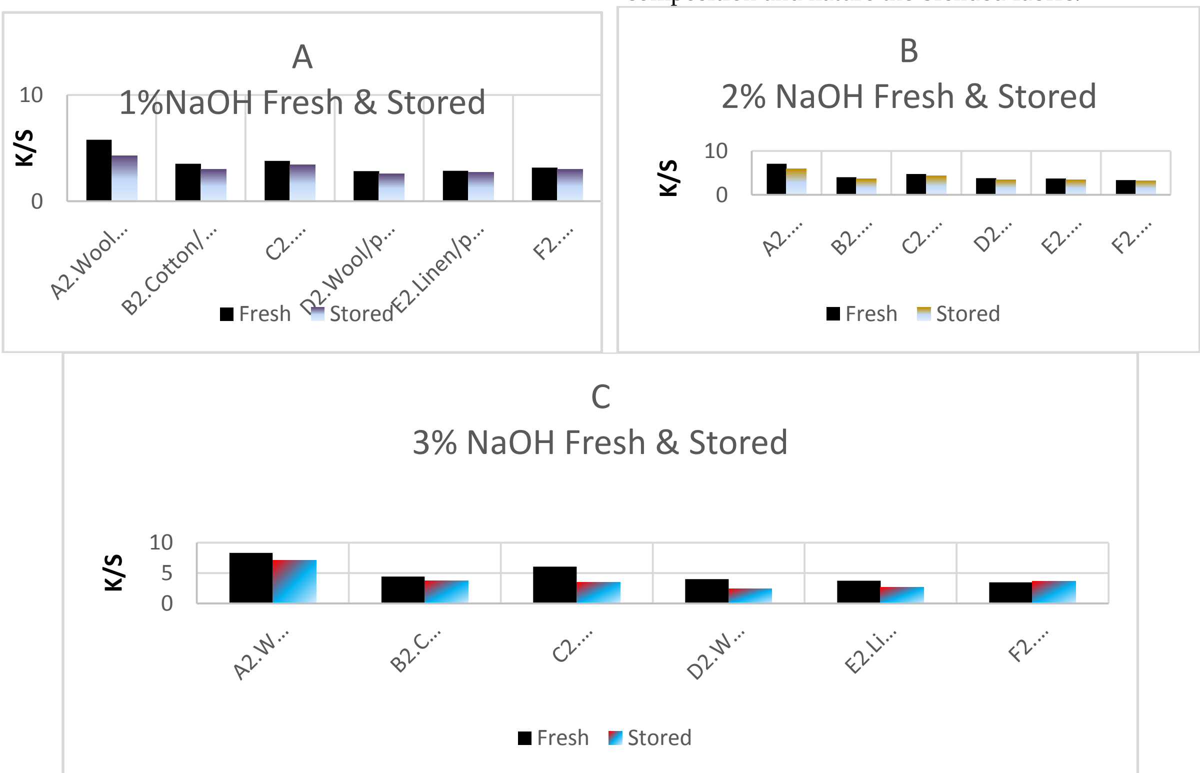


Figure 6(A,B&C): Comparison between the effect of storing pastes containing 1,2,& 3 % NaOH on the K/S of the blended fabrics.

Tensile strength

Table IV represent the effect of burn-out printing under the current technique using different pastes isolated using 1,2 and 3% of sodium hydroxide on tensile strength.

It is clear from the data that subjecting the current blends to burn-out printing style using pastes containing different amount of sodium hydroxide has a remarkable effect on the tensile strength of the blend. However, the magnitude of effect depends on the nature of the component of the fabric.

Table IV: Effect of storing the pastes treated with1,2&3 % NaOH on the Tensile strength of the printed blends.

Fabric used	Concentration of NaOH used in paste preparation							
	Blank		**1%**		**2%**		**3%**	
	Stress	**Strain**	**Stress**	**Strain**	**Stress**	**Strain**	**Stress**	**Strain**
Wool %	**0.528**	25.001	**0.525**	25.500	**0.378**	15.500	**0.382**	18.250
Cotton/ polyester (50/50)	**3.435**	6.750	**3.263**	7.000	**3.229**	7.250	**3.115**	6.750
Wool/Nylon(60/40)	**0.686**	20.250	**0.407**	22.750	**0.376**	21.250	**0.269**	21.250
Wool/Polyester (55/45)	**1.836**	19.000	**1.772**	19.500	**1.756**	19.000	**1.598**	17.750
Linen/Polyester (80/20)	**1.177**	10.500	**1.167**	9.750	**0.623**	10.250	**0.577**	11.000

Stress: stress at auto break (kgf/mm2)
Strain: at auto break (%)

In all cases, regardless of the nature of the blend, the tensile strength of original blend, i.e. before subjecting to burn-out printing is higher than the printed blend. As the concentration of sodium hydroxide increases, the magnitude of decrease in tensile strength was increases too. However, the % decrease in tensile strength increases by increasing the % of protenic portion, the opposite holds true in case of cellulosic blends.

For example in case of wool/nylon, it decreases from 0.686 kgf/mm2 to 0.407 kgf/mm2 to 0.376 kgf/mm2 to 0.269 kgf/mm2, while in case of cotton/polyester (50/50) it decreases from 3.435 kgf/mm2 to 3.265 kgf/mm2 to 3.229 kgf/mm2 to 3.115 kgf/mm2 for the original blend and after printing with pastes containing 1,2 and 3% sodium hydroxide respectively.

The data of table IV is expected since it is well known that sodium hydroxide has a remarkable effect on both wool and nylon and a less effect on cellulosic and polyester fabrics.

IV. Conclusion

- Both eco-friendly galactomannan gum and safety natural dye could be isolated successfuly from tara seeds simultaneously in one step process using different concentrations of sodium hydroxide.
- The isolated pastes are characterized by non-Newtonian pseudoplastic behavior, and its apparent viscosity depends on the concentration of sodium hydroxide as well as time of storing.
- The isolated pastes could be used successfully as screen printing pastes and burn-out paste simultaneously.
- The effect of burn-out printing pastes on the hydrolysis and decomposition of different blended fabrics was found to be depending on the concentration of sodium hydroxide in the paste and also on the nature of the components of the blend.
- Increasing the concentration of sodium hydroxide in the paste is accompanied by an increase in the % loss in weigh. The % decrease in weigh increased by increasing the wool portion in the blend and follows the order: Wool/nylon 60:40> wool 100% > Wool/polyester 55:45 > Wool/polyester 35/65 > Linen/polyester 80:20 > Cotton/ polyester 50:50.
- The most optimum concentrations of sodium hydroxide in order to extract both natural colour and galactomannan gum was 3%.
- The self coloured printing pastes isolated could successfully be applied to print both protenic and/or cellulosic fabrics. However, the K/S on protenic fabrics is higher than that of cellulosic one.
- Unique colour and attractive texture could be achieved using the current technique depending on the nature and constituent of the blend.
- As the concentration of sodium hydroxide increases the % loss in tensile strength decreases, specially for woolen blends. However the % decrease in tensile strength is not high and satisfactory for industrial application.

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