Effect of Treated Natural Dyed Knit Mesh Material

By: Dr. Jayalakshmi I.
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Nature expresses itself in a wide spectrum of colours all around as. It was the result of the quest of man for beauty of colouring his body which made him discover the colouring matter from natural sources such as plants and animals. The discovery of synthetic dyes in the second half of the nineteenth century pushed the old Indian traditional art of dyeing textiles with natural dyes.

Natural dyeing is one of age old practice to dye textile materials. The natural dyes obtained from natural resources are non-pollutant, non allergic, ecofriendly, shade rich and warm. They are soft in colour, cool to eyes and are harmless to the body and pollution free. Natural dyes are soft, delicate and give harmonized pastel shades of natural colours obtained from renewable resources The use of natural dyes amongst craftsmen is increasing due to its unique characteristics.

Apparel is one of the basic necessities of human civilization along with food, water, and shelter. The apparel industry reflects lifestyles of people and shows their social and economic status. At present, it is amongst the fastest growing industry segment and is also the second largest foreign exchange earner for the country. The apparel industry accounts for 26% of exports. India presently has entered the second phase of growth and is witnessing a massive rise in the domestic demand. Keeping the above points in mind a study on "Effect of Treated Natural Dyed Knit Mesh Material" was conducted to apply the selected natural dyes in conjuction with mordants, wash and to analyse its performance of the treated natural dyed knit material objectively and subjectively.

Methodology

Selection of Fabric

The fabric selected for the study was hundred per cent cotton bleached knitted mesh fabric of 76.72's count.

Selection of Natural Dyes

The four natural dyes that were selected for the study are Rose (R), Hibiscus (H), Beetroot (B) and Henna (He) with two per cent concentration.

Selection of Mordants

The mordants selected for the study was chemical mordants namely Sodium Sulphate(S), Alum(A), Ferrous Sulphate(F), Potassium Dichromate(P), Stanus Chloride(Sc) and Copper Sulphate (C). This was used in one per cent concentration.

Selection of Mordanting Techniques

Simultaneous mordanting was selected for the study.

Pilot Study

Preparation of Dye Solution

The natural dye sources such as leafs of henna, petals of rose, and hibiscus, skin of beetroot were taken based on the weight of the material to be dyed in two per cent concentration. This was taken in mixie with a little amount of water, grinded to form a thick dye paste and mixed with 1:40 M:L ratio and boiled for 1 hour maintaining a temperature of 60°C to extract the dye.

Preparation of Mordant Solution

The mordant solution was prepared in one per cent concentration based on the weight of the fabric and soaked in little quantity of water for 15 minutes.

Dyeing Procedure

The prepared dye was taken in two per cent concentration based on the weight of the knitted fabric. To the above solution one per cent sodium sulphate mordant was added to which the pre-wetted mesh knit fabric was steeped and boiled for half-an-hour, maintaining a temperature at 60°C. After half-on-hour the mesh fabric was taken, rinsed in soft cold water and dried.

Similarly, the procedure was followed to dye the mesh knitted fabric with Beetroot, Henna, Hibiscus and Rose using mordants such as copper sulphate, Alum, Potassium Dichromate, sodium sulphate, ferrous sulphate, stanus chloride, in simultaneous mordanting technique, thus resulting finally in 24 dyed samples.

The nomenclature of the dyed samples are R+S, R+A, R+F, R+P, R+Sc, R+C, H+S, H+A, H+F, H+P, H+Sc, H+C, B+S, B+A, B+S, B+P, B+Sc, B+C, He+S, He+A, He+F, He+P, He+Sc and He+C.

Dyeing Parameters

S. N	Parameters	Proportion
1	Type of fabric	100% bleached knitted mesh fabric
2	Natural dyes	Rose, Hibiscus, Beetroot, Henna
3	Dye concentration	2%
4	M:L	1:40
5	Dye extraction time	1 hour
6	Dye extraction temperature	100°C
7	Mordants	Sodium Sulphate, Alum, Ferrous Sulphate, Potassium Dichromate, Stanus Chloride, Copper Sulphate.
8	Mordant concentration	1%
9	Mordanting technique	Simultaneous mordanting

Visual Evaluation

The natural dyed samples were cut into small pieces stuck on a paper and kept for visual evaluation. The evaluation was carried amongst five hundred adolescent boys and girls for good colour yield, absorbency, brilling in colour and general appearance. Based on the results obtained six final samples such as R+S, R+F, H+P, H+C, He+P and He+C were selected for the final study.

Soda Wash

The selected six natural dyed knitted mesh materials were subjected to soda wash to impart rough finish by a washing treatment to the fabrics.

Mechanical Tests

Fabric GSM

GSM is the fabric mass per unit area expressed either as GSM (grams per square meter).The fabric to be tested is cut using GSM cutter and weighted using electronic balance and measured in grams per square meter.

Bursting Strength

Bursting strength is the strength of multidirectional flow of pressure. The bursting test composite strength of both warp and weft yarns simultaneously and indicate the extent to which a force can with stand a bursting type of force with the pressure being applied perpendicular to the surface of the fabric.

Abrasion Resistance

Abrasion is one aspect of wear the rubbing away of the component fibres and yarns of the fabric. Wear is the amount of deterioration of a fabric due to breaking, cutting or removal of fibres.

Stiffness

The stiffness is the bending length of the fabric that will bend under its own weight to a definite extent.

Crease Recovery

Crease recovery is measured quantitatively in terms of create recovery angle.

Colour Measurement

The Kubelka-Monk equation (established 1931) defines a relationship between spectral reflectance (R in %) of the sample and its absorption (K) and scattering (S) characteristics, for samples with opacities greater than 75%.

Colour Fastness Tests

Colour Fastness to Light

Colour fastness of textile materials to day light is of considerable importance. Datylight exposure of textile materials is an easiest method of determining colour fastness to light.

Colour Fastness to Washing

The change in colour of the treated test specimen was evaluated with the help of grey scale.

Colour Fastness to Crocking

This test is designed to determine the degree of colour that may transfer from the surface of coloured textiles to other surfaces by rubbing. It is applicable to textiles made from all fibres in the form of yarn or fabric whether dyed, printed, or otherwise coloured.

Selection, Construction and Wear Study of Kid's Garment

Short top for the age group of 5-6 years was constructed. A wear study was conducted for thirty days and opinion regarding comfort, bleeding of colour, irritation to the skin, brilliancy in colour was collected and recorded.

Results and Discussion

Visual Evaluation of Natural Dyed Samples in Pilot Study

Visual evaluation result showed that samples dyed with Rose, Hibiscus, Beetroot, Henna , although should good colour yield, brilliancy, and general appearance, six samples namely R+S, R+F, H+F, H+C, He+ P and He+ C were selected, because these samples exhibit higher ratings.

Colour Fastness Tests

The overall colour fastness to sunlight, washing, dry rubbing, wet rubbing, dry pressing, and wet pressing for all the 24 samples were rated from excellent to above average. The six samples namely RS, RF, HF, HC, He P, and He C were rated excellent for all colour fastness tests and hence were selected for the final study.

Mechanical Tests

For the mechanical tests ten consecutive random samples of grey and treated samples were taken, tested and the results were recorded from Table I – VIII

Table I: Fabric GSM (Gm/Sq.Cm)

S. No.	Samples	Mean	S.D.	CV%	Loss or Gain over original	% Loss or Gain over original	't' Test	
1.	Original	201.18	0.0789	0.0392			General	Paired
2.	R + S	200.28	0.2781	0.1388	-0.90	-0.45	9.8459**	8.7142**
3.	R + F	200.18	0.1033	0.0516	-1.00	-0.50	24.3332**	30.0000**
4.	H + P	200.08	0.0789	0.0394	-1.10	-0.55	31.1821**	33.0000**
5.	H + C	200.10	0.0816	0.0408	-1.08	-0.54	30.0826**	54.0000**
6.	He + P	200.17	0.1059	0.0529	-1.01	-0.50	24.1820**	23.3077**
7.	He + C	200.11	0.0994	0.0497	-1.07	-0.53	26.5576**	35.6667**

KEY; ** - Significant at one per cent level

From Table I, the fabric weight of all the treated samples decreased considerably when compared with their original mean. Least loss was found in RS by 0.45 per cent and maximum loss of 0.55 per cent was found in HP sample.

Table II: Bursting Strength (Kg/Sq.M)

S. No.	Samples	Mean	S.D.	CV%	Loss or Gain over original	% Loss or Gain over original	't' Test	
							General	Paired
1.	Original	207.50	0.8969	0.4322				
2.	R + S	204.14	0.0516	0.0253	-3.36	-1.62	11.8269**	11.7945**
3.	R + F	204.09	0.1449	0.0710	-3.41	-1.64	11.8689**	12.7586**
4.	H + P	204.71	0.0876	0.0428	-2.79	-1.34	9.7903**	10.1285**
5.	H + C	204.19	0.1287	0.0630	-3.31	-1.60	11.5520**	10.8159**
6.	He + P	204.99	0.1449	0.0707	-2.51	-1.21	8.7363**	9.0330**
7.	He+ C	204.16	0.0843	0.0413	-3.34	-1.61	11.7243**	11.9557**

KEY; ** - Significant at one per cent level

From Table II, the bursting strength of all the treated samples decreased considerably when compared with their original mean. Least loss was found in H+P by 1.21 per cent and maximum loss of 1.64 per cent was found in R+F sample.

Table III: Abrasion Resistance (In %)

S. No.	Samples	Mean	S.D.	CV%	Loss or Gain over original	% Loss or Gain over original	't' Test	
							General	Paired
1.	Original	7.3160	0.0126	0.1729				
2.	R + S	5.1780	0.1034	1.9962	-2.14	-29.22	64.9238**	63.4583**
3.	R + F	5.1210	0.0321	0.6274	-2.20	-30.00	201.0277**	167.5296**
4.	H + P	5.1390	0.0375	0.7307	-2.18	-29.76	173.7435**	191.6742**
5.	H + C	5.1130	0.0149	0.2923	-2.20	-30.11	355.8166**	347.8421**
6.	He + P	5.0840	0.0499	0.9822	-2.23	-30.51	137.0245**	121.1264**
7.	He+ C	5.1370	0.0327	0.6361	-2.18	-29.78	196.6515**	209.9987**

KEY; ** - Significant at one per cent level

From Table III, the abrasion resistance per cent of all the treated samples decreased considerably when compared with their original mean. Least loss was found in R+S by 29.22 per cent and maximum loss of 30.51 per cent was found in H+P sample.

Table IV: Fabric Stiffnss- Warp (In Inch)

S. No.	Samples	Mean	S.D.	CV%	Loss or Gain over original	% Loss or Gain over original	't' Test	
1.	Original	2.41	0.0994	4.1263			General	Paired
2.	R + S	1.46	0.0699	4.7891	-0.95	-39.42	24.7126**	20.9336**
3.	R + F	1.61	0.0994	6.1766	-0.80	-33.20	17.9888**	24.0000**
4.	H + P	1.44	0.0516	3.5861	-0.97	-40.25	27.3750**	37.2587**
5.	H + C	1.15	0.0707	6.1488	-1.26	-52.28	32.6542**	33.9454**
6.	He + P	1.46	0.0699	4.7891	-0.95	-39.42	24.7126**	27.8132**
7.	He + C	1.19	0.0994	8.3565	-1.22	-50.62	27.4329**	22.8750**

KEY; ** - Significant at one per cent level

From Table IV, the warp bending length of all the treated samples decreased considerably when compared with their original mean. Least loss was found in R+F by 33.20 per cent and maximum loss of 52.28 per cent was found in H+C sample

Table V: Fabric Stiffnss- Weft (In Inch)

S. No.	Samples	Mean	S.D.	CV%	Loss or Gain over original	% Loss or Gain over original	't' Test	
1.	Original	3.16	0.0699	2.2127			General	Paired
2.	R + S	2.61	0.0994	3.8101	-0.55	-17.41	14.3073**	13.7025**
3.	R + F	2.14	0.0699	3.2673	-1.02	-32.28	32.6197**	40.8910**
4.	H + P	2.25	0.0850	3.7771	-0.91	-28.80	26.1487**	21.0000**
5.	H + C	2.14	0.0516	2.4131	-1.02	-32.28	37.1080**	35.1006**
6.	He + P	2.33	0.0675	2.8968	-0.83	-26.27	27.0078**	31.8812**
7.	He+ C	2.18	0.0919	4.2153	-0.98	-31.01	26.8384**	25.2103**

KEY; ** - Significant at one per cent level

From Table V, the weft bending length of all the treated samples decreased considerably when compared with their original mean. Least loss was found in R+S by 17.41 per cent and maximum loss of 32.28 per cent was shared between R+F and H+C samples.

Table VI: Crease Recovery-Warp (In Degree)

S. No.	Samples	Mean	S.D.	CV%	Loss or Gain over original	% Loss or Gain over original	't' Test	
1.	Original	88.50	3.3747	3.8133			General	Paired
2.	R + S	79.50	3.6893	4.6407	-9.00	-10.17	5.6921**	5.0138**
3.	R + F	82.00	2.5820	3.1488	-6.50	-7.34	4.8374**	6.0908**
4.	H + P	75.00	3.3333	4.4444	-13.50	-15.25	9.0000**	7.3636**
5.	H + C	71.00	3.1623	4.4539	-17.50	-19.77	11.9659**	13.0236**
6.	He + P	72.50	2.6352	3.6348	-16.00	-18.08	11.8168**	16.0000**
7.	He+ C	72.00	2.5820	3.5861	-16.50	-18.64	12.2794**	11.0000**

KEY;** - Significant at one per cent level

From Table VI, the warp crease recovery angle of all the treated samples decreased considerably when compared with their original mean. Least loss was found in R+F by 7.34 per cent and maximum loss of 19.77 per cent was found in H+C sample.

Table VII: Crease Recovery – WEF(In Degree)

S. No.	Samples	Mean	S.D.	CV%	Loss or Gain over original	% Loss or gain over original	't' TEST	
1.	Original	97.50	2.6352	2.7028			General	Paired
2.	R + S	88.50	2.4152	2.7291	-9.00	-9.23	7.9619**	6.1942**
3.	R + F	91.50	2.4152	2.6396	-6.00	-6.15	5.3079**	6.0000**
4.	H + P	87.00	2.5820	2.9678	-10.50	-10.77	9.0000**	9.0000**
5.	H + C	82.50	2.6352	3.1942	-15.00	-15.38	12.7279**	14.2302**
6.	He + P	83.00	2.5820	3.1108	-14.50	-14.87	12.4286**	12.4286**
7.	He + C	84.50	3.6893	4.3661	-13.00	-13.33	9.0673**	9.7500**

KEY; ** - Significant at one per cent level

From Table VII, the weft crease recovery angle of all the treated samples decreased considerably when compared with their original mean. Least loss was found in R+S by 6.15 per cent and maximum loss of 15.38 per cent was found in H+C sample. The statistical't' analysis results of GSM, bursting strength, abrasion resistance, warp and weft stiffness, warp and weft crease recovery proved that they are significant at one per cent level.

The mean GSM, bursting strength, abrasion resistance, warp and weft stiffness, warp and weft crease recovery of the six treated dyed samples are representated graphically from Figure 1 to Figure 7.

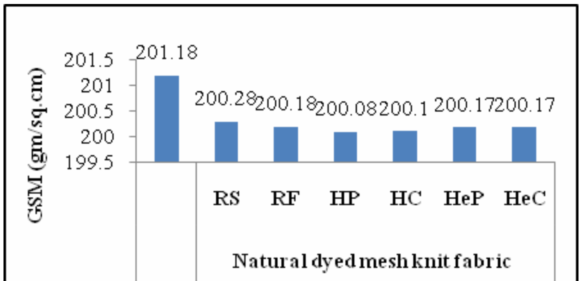

FIGURE : 1 FABRIC GSM

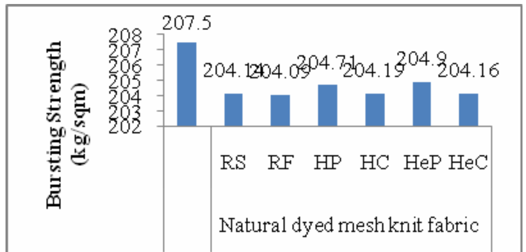

FIGURE: 2 BURSTING STRENGTH

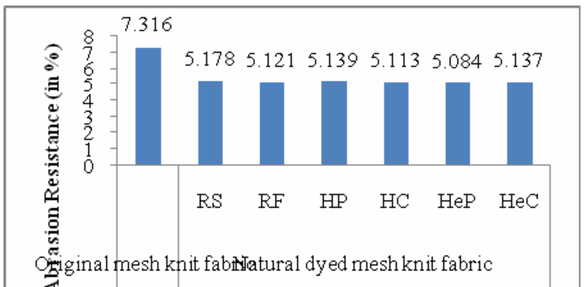

FIGURE:3 ABRASION RESISTANCE

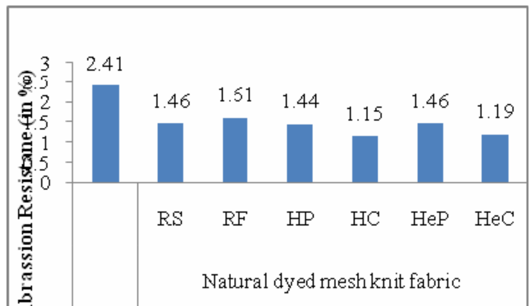

FIGURE : 4 FABRIC STIFFNESS -WARP

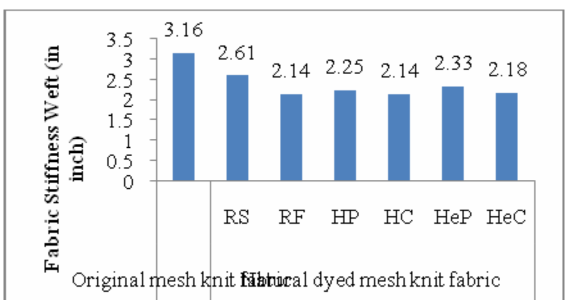

FIGURE: 5 FABRIC STIFFNESS - WEFT

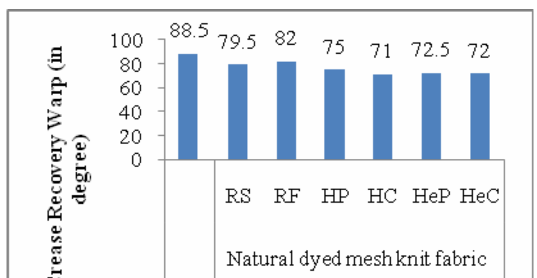

FIGURE : 6 CREASE RECOVERY - WARP

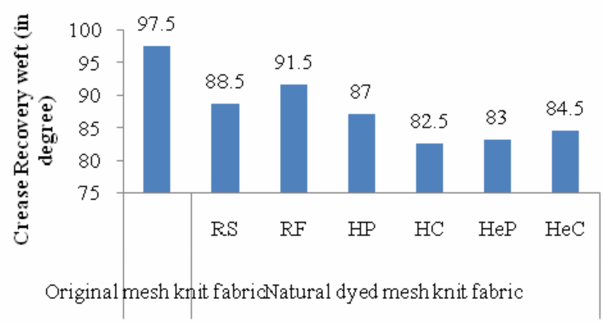

FIGURE: 7 CREASE RECOVERY -WEFT

Table VIII: Analysis for Mechanical Tests Using One Way ANOVA

S. No.	Mechanical Test	Mean	DF	SS	MS	CV%	'F' Value
1.	Fabric GSM (gm/sq.cm)	200.3000	6	1.861200	0.310200	0.03	106.4412**
2.	Bursting Strength (kg/sq.m)	204.8257	6	18.101943	3.016990	0.04	561.6738**
3.	Abrasion Resistance (in %)	5.4411	6	8.211694	1.368616	0.39	2971.5600**
4.	Fabric Stiffness – Warp (in inch)	1.5314	6	2.117371	0.352895	2.21	308.7833**
5.	Fabric Stiffness – Weft (in inch)	2.4014	6	1.665371	0.277562	1.71	164.6554**
6.	Crease Recovery – Warp (in degree)	77.2143	6	496.857143	82.809524	2.05	33.1238**
7.	Crease Recovery – Weft (in degree)	87.7857	6	341.857143	56.976190	1.10	61.3590**

KEY;** Significant at one per cent level

From the results obtained from Table VIII, for fabric GSM, R+S gained highest weight followed by H+P sample. He+P had the highest strength during bursting followed by R+F sample. R+S showed good per cent of resistance towards abrasion where as He+P had the least per cent towards in abrasion. There was an increase in warp bending length for RF sample, followed by H+C samples.

Similarly R+S sample increase in weft bending length followed by H+C sample. For warp and weft crease recovery R+F showed good per cent of crease recovery angle as where H+C had the least per cent in crease recovery angle.

Statistically, the ‘F’ results proved that the fabric GSM, bursting strength, abrasion resistant, warp and weft bending length, warp and weft crease recovery angle were significant at one per cent level.

Colour Measurement

The K/S value for all the six samples are shown below with its graph. The L, a, b, c, h values for the three types of absorbers at ILL 1, D65-10, ILL 2 A-10and ILL 3 F02-10(CWF) are displayed.

R + S Dye:

TABLE IX : K/S VALUE

DYED FABRIC SAMPLES	WAVE LENGTH	K/S VALUE
R+ S	750	78.3

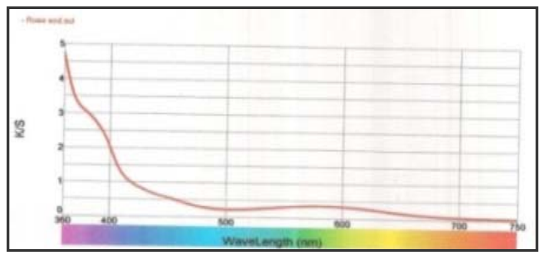

Figure 9: K/S for R+S

TABLE IX a: COLOUR MEASUREMENT

S.NO	ABSORBERS	L*	a*	b*	C*	h*
1	ILL 1 D65 – 10	74-74	-6.68	11.62	13.40	119.91
2	ILL 2 A-10	74.79	-0.53	9.49	9.50	93.18
3	ILL 3 F 02- 10(CWF)	74.07	-4.61	12.02	12.87	110.96

R+F Dye:

TABLE X : K/S VALUE

DYED FABRIC SAMPLES	WAVE LENGTH	K/S VALUE
R+ F	750	29.0

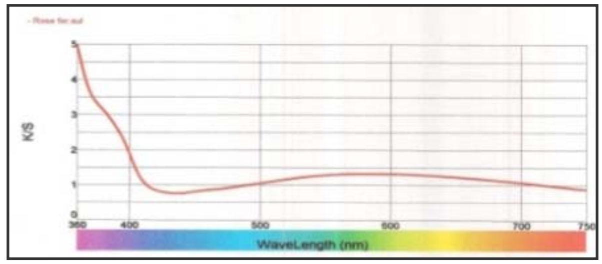

Figure 10: K/S for R+F

TABLE X a: COLOUR MEASUREMENT

S.NO	ABSORBERS	L*	a*	b*	C*	h*
1	ILL 1 D65 – 10	56.16	1.16	-8.88	8.95	277.42
2	ILL 2 A-10	55.62	-0.66	-9.43	9.46	266.02
3	ILL 3 F 02-10(CWF)	55.61	1.13	-10.57	10.63	276.09

H+P Dye:

TABLE XI: K/S VALUE

DYED FABRIC SAMPLES	WAVE LENGTH	K/S VALUE
H+ P	750	35.5

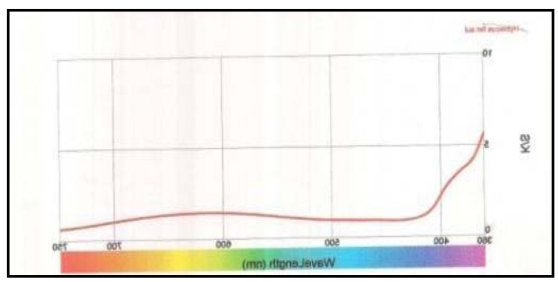

Figure 11: K/S for H+P

TABLE XIa: COLOUR MEASUREMENT

S.NO	ABSORBERS	L*	a*	b*	C*	h*
1	ILL 1 D65 – 10	56.87	-3.75	-5.82	6.92	237.22
2	ILL 2 A-10	56.01	-4.39	-7.41	8.61	239.36
3	ILL 3 F 02- 10(CWF)	56.10	-2.49	-7.50	7.91	251.61

H+C Dye:

TABLE XII : K/S VALUE

DYED FABRIC SAMPLES	WAVE LENGTH	K/S VALUE
H+ C	750	42.9

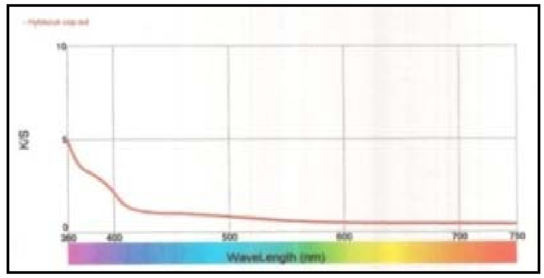

Figure 12: K/S for H+C

TABLE XVII a: COLOUR MEASUREMENT

S.NO	ABSORBERS	L*	a*	b*	C*	h*
1	ILL 1 D65 – 10	66.26	3.22	12.29	12.70	75.33
2	ILL 2 A-10	67.43	5.30	13.64	14.63	68.77
3	ILL 3 F 10(CWF)	67.17	2.10	13.94	14.10	81.44

He+P Dye:

TABLE XIII : K/S VALUE

DYED FABRIC SAMPLES	WAVE LENGTH	K/S VALUE
He+ P	750	73.6

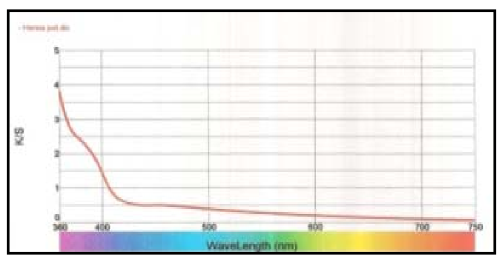

Figure 13: K/S for He+P

TABLE XIII a: COLOUR MEASUREMENT

S.NO	ABSORBERS	L*	a*	b*	C*	h*
1	ILL 1 D65 – 10	75.73	4.40	5.40	13.15	70.46
2	ILL 2 A-10	77.05	7.07	13.98	15.67	63.17
3	ILL 3 F 02- 10(CWF)	76.52	2.88	13.75	14.05	78.15

He+C Dye:

TABLE XIV : K/S VALUE

DYED FABRIC SAMPLES	WAVE LENGTH	K/S VALUE
He+ C	750	43.6

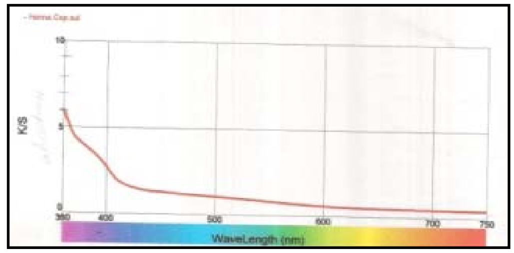

Figure 14: K/S for He+P

TABLE XIV a: COLOUR MEASUREMENT

S.NO	ABSORBERS	L*	a*	b*	C*	h*
1	ILL 1 D65 – 10	62.86	5.27	13.05	14.07	68.02
2	ILL 2 A-10	64.30	7.88	14.73	16.71	61.85
3	ILL 3 F 02- 10(CWF)	63.75	3.62	14.92	15.35	76.35

The natural dyes which are available in wide range of colours are most suitable for dyeing textiles, as the dye stuffs produce various shades. The environmental lobby is supportive of using natural dyes as they are seen to be exploiting renewable resources, causing minimum pollution to the environment and less risk to human health.

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