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## SYNTHESIS, CHARACTERIZATION AND APPLICATION OF SOME NEW HOT BRAND BISAZO REACTIVE DYES ON VARIOUS FIBRES

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### ABSTRACT

The aim of the present study was to synthesize new dyestuffs based on 4,4'-methylene-bis(*o*-nitro aniline) derivatives in order to achieve good dyeing and fastness properties. The use of 4,4'-methylene-bis(*o*-nitro aniline) (**1**) as tetrazo component and ten different acid compounds as coupling components furnished a series of ten novel bisazo reactive dyes (**5a-j**), which were characterized by elemental analysis and different spectrometric technique like UV-Vis, IR and <sup>1</sup>H NMR. The dyeing performance of these dyes was assessed on silk, wool and cotton fabrics. The dyed fabric showed moderate to very good light fastness and good to excellent washing and rubbing fastness properties. The dye bath exhaustion and fixation were found to be good and acceptable.

**Key words:** 4, 4'-methylene-bis (*o*-nitro aniline), Bisazo reactive dyes, Cotton fabrics; Fastness propertie, Exhaustion; Fixation.

### INTRODUCTION

Reactive dyes are coloured compounds which contain one or two groups capable of forming covalent bonds between a carbon and phosphorus atom of the dye ion or molecule and oxygen, nitrogen or sulphur atom of the hydroxyl, an amino or a mercapto group of the substrate. Such covalent bonds are formed with the hydroxyl group of the cellulose fibre, with the amino, hydroxyl and mercapto group of the protein fibre and with the amino group of polyamides [1]. These dyes are generally used on higher value clothes, which are normally mercerized [2]. Reactive dyes containing cyanuric chloride molecule play an important role in the synthesized dyes. It is a key component in the dyestuff having two reactive groups in their structure, which gives good fixation yields, excellent wet fastness, brilliant shades and simple application techniques in textile printings.

It can also be easily understood that dyes with two reactive groups give a good fixation yield than dyes with one reactive group for it one of the two dye-fibre bond is hydrolyzed and one is still left for fixation [3, 4]. They give excellent solubility, higher degree of fixation, good levelling and good to excellent fastness properties. Ayyangar et al [5, 6] reported that bisazo dyes are tinctorially stronger than mono azo dyes. Patel et al [7-10] synthesized bis azo reactive dyes giving good fastness properties on various fibres.

The objectives of the current investigation were to synthesize and evaluate tinctorially strong, bright reactive dyes which could be applied to cotton by exhaust dyeing method. To these effect ten hot brand bis azo reactive dyes (**5a-j**) were synthesized by coupling a series of diazotized bisazo methylene derivative with various *m*-toluidino cyanurated coupling components.

### MATERIALS AND METHOD

All of the chemicals and various coupling components used were of commercial grade and were further purified by recrystallisation and redistilled before use. The solvents used were spectroscopic grade. Melting points were determined by open capillary method and are uncorrected. Purification of the dyes was carried out by TLC [11]. The visible absorption spectra were recorded on a Beckman DB-GT Grating

Spectrophotometer. The elemental analyses were carried out on a Carlo Erba Elemental Analyser 1108. Infrared spectra were recorded on a Perkin-Elmer model 881 spectrophotometer scanning between 4,000 to 400 cm<sup>-1</sup> using KBr pellets. PMR spectra on a Bruker DRX-300 (300 MHz FTNMR) instrument using TMS as internal standard and DMSO as solvent. The light fastness was assessed in accordance with BS: 1006-1978 [12]. The rubbing fastness test was carried out with a Crockmeter (Atlas) in accordance with AATCC-1961 [13] and the wash fastness test in accordance with IS: 765-1979 [14].

### Synthesis of 4, 4'-methylene-bis(*o*-nitro aniline) (**1**) [15]

*o*-Nitro aniline (13.9 g, 0.1 mole) was dissolved in water (125 ml) and 36.5% hydrochloric acid (25 ml) at 50 °C. The reaction mixture was then reacted with 3% aqueous formaldehyde (35ml) solution at 60 °C with stirring for an hour and neutralized with 10% sodium hydroxide, yellowish precipitate of compound (**1**) was filtered, washed with hot water, dried and recrystallized from acetic acid. Yield 85%, m.p. 190°C, IR (KBr):  $\nu_{\max}$  (cm<sup>-1</sup>) 3515, 3425 (Asym. and sym., N-H stretching), 2945 (C-H stretching), 1185, 1040 (Asym. and sym., S=O stretching). 1522, 1342 (Asym. and sym., N=O stretching). Elemental analysis: Found C-54.10%; H-4.12%; N-19.35%; C<sub>13</sub>H<sub>12</sub>O<sub>4</sub>N<sub>4</sub> (MF requires C-54.17%; H-4.20%; N-19.44%). <sup>1</sup>H NMR (DMSO-d<sub>6</sub>) (chemical shift in  $\delta$  ppm): 3.24  $\delta$  (4H, s, -NH<sub>2</sub>), 1.23  $\delta$  (2H, s, -CH<sub>2</sub>), 7.12  $\delta$ -7.93 $\delta$  (6H, m, Ar-H).

### Tetrazotisation of 4, 4'-methylene bis-*o*-nitro aniline (**2**)

Compound (**1**) (1.44 g, 0.005 mole) was suspended in H<sub>2</sub>O (60 ml). Hydrochloric acid (0.36 g) was added dropwise to this well stirred suspension. The mixture was gradually heated up to 70°C, till clear solution obtained. The solution was cooled at 0-5°C in an ice bath. A solution of NaNO<sub>2</sub> (0.6 g) in water (4 ml) previously cooled to 0°C, was then added over a period of five minutes with stirring. The stirring was continued for an hour, maintaining the same temperature, with positive test for nitrous acid on starch iodide paper. After just destroying excess of nitrous acid with required amount of a solution of sulphamic acid the clear tetrazo solution (**2**) at 0-5°C was obtained and used for subsequent coupling reaction.

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### Preparation of *m*-toluidino cyanurated H-acid (4a)

This involves two steps.

#### (i) Preparation of cyanurated H-acid (3a)

Cyanuric chloride (1.85 g, 0.01 mole) was stirred in acetone (25 ml) at a temperature below 5°C for a period of an hour. A neutral solution of H-acid (3.19 g, 0.01 mole) in aqueous sodium carbonate solution (10% w/v) was then added in small lots in about an hour. The pH was maintained neutral by simultaneous addition of sodium carbonate solution (1% w/v). The reaction mass was then stirred at 0-5°C for further 4 hours then clear solution was obtained. The cyanurated H-acid solution (3a) was used for subsequent coupling reaction.

#### (ii) Condensation with *m*-toluidine

The temperature of ice-cooled well stirred solution of cyanurated H-acid (3a) (4.67 g, 0.01 mole) was gradually raised to 45°C for half an hour. To this cyanurated H-acid the *m*-toluidine (1.07 g, 0.01 mole) was added dropwise at same temperature, during a period of 30 minutes, maintaining the pH neutral by simultaneous addition of sodium bicarbonate solution (1%w/v). After the addition was completed, stirring was continued for further 3 hours. The *m*-nitro anilino cyanurated H-acid solution (4a) thus obtained was subsequently used for further coupling reaction.

#### Preparation of the dye 5a

To an ice cold and well stirred solution of (4a) (5.53 g, 0.01 mole) a freshly prepared solution of tetrazo solution (2) as previously prepared was added dropwise over a period of 10-15 minutes. The pH was maintained at 7.5 to 8.5 by simultaneous addition of sodium carbonate solution (10% w/v). During coupling the purple solution was formed. The stirring was continued for 3-4 hours, maintaining the temperature below 5°C. Sodium chloride (12g) was then added and the mixture was stirred for an hour. The solid violet dye (5a) separated out was filtered washed with minimum amount of acetone and dried at room temperature. Yield 82 %.

Following the above procedure other reactive dyes (5b-j) were synthesized using various *m*-toluidino cyanurated coupling components such as J-acid (4b), N-methyl-J-acid (4c), N-phenyl-J-acid (4d), Bronner acid (4e), Gamma acid (4f), K-acid (4g), Tobias acid (4h), Peri acid (4i) and Laurent acid (4j) respectively.

All the synthesized dyes and characterization data were recorded in Table - 1.

## RESULTS AND DISCUSSION

### Preparation of dyes

4, 4'-methylene-bis (*o*-nitro aniline) (1) was tetrazotised satisfactorily at 0-5°C by sodium nitrite and HCl. In order to determine the end point of diazotization, it was essential to check the presence of unreacted diazo component on TLC by sampling the diazotization mixture. The diazonium salt solution was used immediately since this decomposed on standing, even when cold. Subsequent coupling reactions took place readily on adding the resulting diazonium salt continuously to the solution of coupling component. However 80-85% yield of the dye was usually obtained by careful addition of the diazonium salt solution at 0-5°C to a solution of the coupling component in sodium bicarbonate. The pH of the reaction mixture was

adjusted to approximately 7.5-8.5 by addition of 10% sodium carbonate solution slowly below 5°C.

### Dyeing of fibre

The dyeing of fibres was carried out according to literature reported procedure [16]. These dyes gave pink, red, orange and yellow hues with brighter and deeper shades with high tinctorial strength and excellent levelness on the fabric. The variation in the hues of the dyed fabric results due to the alternation in the coupling components.

### Physical properties of the dyes

The purity of all the dyes was checked by TLC using *n*-butyl acetate: methanol: water (7.5: 2.0: 0.5 v/v) as the solvent system. When absorbed on silica gel-G plates, the dyes produced orange-yellow colours. The R<sub>f</sub> value of all the dyes are shown in Table 1.

### Spectral properties of the dyes

Absorption maxima of dyes 5a-j are shown in Table - 4. As far as absorption maxima are concerned, λ<sub>max</sub> value is directly proportional to the electronic power of the substituents in the coupled ring system. The value of the logarithm of the molar extinction co-efficient (log ε) of the dyes (In both medium) were in the range of 4.12-4.65, consistent with their high intensity of absorption. The introduction of electron donating or electron attracting groups at suitable positions in the coupled ring affect the absorption characteristics of the dyes.

Compound 5b have λ<sub>max</sub> value 465 nm but 5c have λ<sub>max</sub> 482 nm due to the introduction of auxochrome like -CH<sub>3</sub> group in 5c which increase the absorption maxima towards longer wavelength hence increase in the depth of shade. So there is a difference in λ<sub>max</sub> is about 17 nm between 5b and 5c. Compound 5d having λ<sub>max</sub> 495 nm, so there is a difference between 20 nm between the λ<sub>max</sub> value of 5d and 5b due to the introduction of phenyl ring which causes resonance effect for deepening of colour. Compound 5g have same structure as 5a but lower λ<sub>max</sub> than 5a because the vicinity of -NH- and -SO<sub>3</sub>Na group in 5g hence electron oscillation is fast in 5g as compared to 5a. Other compounds such as 5h, 5i and 5j have lower λ<sub>max</sub> than 5a and 5b due to the bathochromic effect of -OH group in 5a and 5b compounds which increase the wavelength and shift the absorption towards higher wavelength.

### IR and <sup>1</sup>H NMR spectra of dyes

The IR spectra [17] of dyes (5a-j) in general show characteristic broad band at 3400-3505 cm<sup>-1</sup> indicating O-H and N-H stretching vibration of amino and hydroxyl group. The band at 2990-3015 cm<sup>-1</sup> shows C-H stretching vibration of methyl group. The bands at 1540-1560 cm<sup>-1</sup>, 1365-1405 cm<sup>-1</sup>, 815-855 cm<sup>-1</sup> are due to the C-N stretching vibration of cyanuric chloride molecule. Azo group is confirmed by the stretching vibration at 1590-1625 cm<sup>-1</sup>. The sulfone-sulfonate and chloro group is confirmed by stretching vibration at 1030-1160 cm<sup>-1</sup> and 760-780 cm<sup>-1</sup>. The nitro group (both asym. and sym. stretching vibration) is confirmed at 1360-1520 cm<sup>-1</sup> (Table - 2). The <sup>1</sup>H NMR spectra [18] of representative dye showed all the signals (Table - 3).

### Exhaustion and fixation study

The percentage dyebath exhaustion and fixation of the dyed fabrics was determined according to the known method [8].

**Table-1** Characterization table of dyes (5a-j)

Dye No.	Various	Molecular Formula	Mol. Weight gm/mole	Yield (%)	% C	% H	% N	<sup>a</sup> R <sub>F</sub> Value	
					Found	Found	Found		
					Req.	Req.	Req.		
<b>5a</b>	H-acid ( <b>4a</b> )	C <sub>53</sub> H <sub>34</sub> O <sub>18</sub> N <sub>16</sub> S <sub>4</sub> Cl <sub>2</sub> Na <sub>4</sub>	1474	82	43.11	2.25	15.11	0.42	
					43.18	2.32	15.20		
<b>5b</b>	J-acid ( <b>4b</b> )	C <sub>53</sub> H <sub>36</sub> O <sub>12</sub> N <sub>16</sub> S <sub>2</sub> Cl <sub>2</sub> Na <sub>4</sub>	1270	75	50.06	2.80	17.58	0.38	
					50.12	2.86	17.65		
<b>5c</b>	N-methyl J-acid ( <b>4c</b> )	C <sub>55</sub> H <sub>40</sub> O <sub>12</sub> N <sub>16</sub> S <sub>2</sub> Cl <sub>2</sub> Na <sub>2</sub>	1298	78	50.81	3.04	17.20	0.45	
					50.89	3.11	17.27		
<b>5d</b>	N-phenyl J-acid ( <b>4d</b> )	C <sub>65</sub> H <sub>44</sub> O <sub>12</sub> N <sub>16</sub> S <sub>2</sub> Cl <sub>2</sub> Na <sub>2</sub>	1422	80	54.83	3.03	15.71	0.36	
					54.90	3.12	15.76		
<b>5e</b>	Bronner acid ( <b>4e</b> )	C <sub>53</sub> H <sub>36</sub> O <sub>10</sub> N <sub>16</sub> S <sub>2</sub> Cl <sub>2</sub> Na <sub>2</sub>	1238	75	51.34	2.82	18.02	0.34	
					51.42	2.93	18.10		
<b>5f</b>	Gamma acid ( <b>4f</b> )	C <sub>53</sub> H <sub>36</sub> O <sub>12</sub> N <sub>16</sub> S <sub>2</sub> Cl <sub>2</sub> Na <sub>4</sub>	1270	85	50.02	2.78	17.58	0.38	
					50.12	2.86	17.65		
<b>5g</b>	K-acid ( <b>4g</b> )	C <sub>53</sub> H <sub>34</sub> O <sub>18</sub> N <sub>16</sub> S <sub>4</sub> Cl <sub>2</sub> Na <sub>4</sub>	1474	85	43.13	2.25	15.12	0.40	
					43.18	2.32	15.20		
<b>5h</b>	Tobias acid ( <b>4h</b> )	C <sub>53</sub> H <sub>38</sub> O <sub>4</sub> N <sub>16</sub> Cl <sub>2</sub>	1034	80	61.50	3.61	21.60	0.42	
					61.57	3.70	21.68		
<b>5i</b>	Peri acid ( <b>4i</b> )	C <sub>53</sub> H <sub>36</sub> O <sub>10</sub> N <sub>16</sub> S <sub>2</sub> Cl <sub>2</sub> Na <sub>2</sub>	1238	78	51.33	2.85	18.02	0.40	
					51.42	2.93	18.10		
<b>5j</b>	Laurant acid ( <b>4j</b> )	C <sub>53</sub> H <sub>36</sub> O <sub>10</sub> N <sub>16</sub> S <sub>2</sub> Cl <sub>2</sub> Na <sub>2</sub>	1238	75	51.35	2.83	18.03	0.38	
					51.42	2.93	18.10		

<sup>a</sup>Determined by TLC using n-butyl acetate:methanol:water (7.5: 2.0: 0.5 v/v) solvent system on Silica gel-G F<sub>254</sub> TLC plate.

**Table-2** IR spectra of dyes (5a-j)

Dye No.	IR (KBr): ν <sub>max</sub> (cm <sup>-1</sup> )
<b>5a</b>	3400-3505 (O-H & N-H), 3015 (C-H), 1555, 1385, 845 (C-N), 1605 (N=N), 1160, 1030 (S=O, asym. & sym.), 1525, 1360 (N=O, asym. & sym.), 775 (C-Cl).
<b>5b</b>	3420-3505 (O-H & N-H), 2995 (C-H), 1540, 1405, 840 (C-N), 1605 (N=N), 1165, 1045 (S=O, asym. & sym.), 1525, 1345 (N=O, asym. & sym.), 770 (C-Cl).
<b>5c</b>	3410-3490 (O-H & N-H), 3005 (C-H), 1550, 1380, 825 (C-N), 1615 (N=N), 1155, 1050 (S=O, asym. & sym.), 1525, 1340 (N=O, asym. & sym.), 760 (C-Cl).
<b>5d</b>	3415-3500 (O-H & N-H), 2990 (C-H), 1545, 1385, 855 (C-N), 1595 (N=N), 1170, 1045 (S=O, asym. & sym.), 1540, 1355 (N=O, asym. & sym.), 765 (C-Cl).
<b>5e</b>	3410-3490 (O-H & N-H), 3025 (C-H), 1540, 1375, 835 (C-N), 1600 (N=N), 1150, 1015 (S=O, asym. & sym.), 1515, 1340 (N=O, asym. & sym.), 775 (C-Cl).
<b>5f</b>	3405-3510 (O-H & N-H), 3005 (C-H), 1550, 1375, 840 (C-N), 1590 (N=N), 1190, 1045 (S=O, asym. & sym.), 1540, 1355 (N=O, asym. & sym.), 760 (C-Cl).
<b>5g</b>	3405-3495 (O-H & N-H), 2995 (C-H), 1560, 1385, 845 (C-N), 1605 (N=N), 1182, 1035 (S=O, asym. & sym.), 1535, 1350 (N=O, asym. & sym.), 770 (C-Cl).
<b>5h</b>	3415-3505 (O-H & N-H), 3010 (C-H), 1542, 1380, 835 (C-N), 1615 (N=N), 1175, 1045 (S=O, asym. & sym.), 1530, 1342 (N=O, asym. & sym.), 772 (C-Cl).
<b>5i</b>	3425-3490 (O-H & N-H), 2990 (C-H), 1530, 1365, 830 (C-N), 1600 (N=N), 1170, 1062 (S=O, asym. & sym.), 1520, 1348 (N=O, asym. & sym.), 765 (C-Cl).
<b>5j</b>	3405-3495 (O-H & N-H), 2995 (C-H), 1540, 1385, 815 (C-N), 1595 (N=N), 1155, 1024 (S=O, asym. & sym.), 1522, 1342 (N=O, asym. & sym.), 780 (C-Cl).

**Table - 3** <sup>1</sup>H NMR spectra of dyes (5a-j)

Dye No.	<sup>1</sup> H NMR (DMSO-d <sub>6</sub> ) (chemical shift in δ ppm)
<b>5a</b>	2.32 (2H, s, -CH <sub>2</sub> ), 1.25 (6H, s, -CH <sub>3</sub> ), 3.60 (2H, s, -OH), 4.75 (4H, s, -NH), 7.05-8.12 (20H, m, Ar-H).
<b>5b</b>	2.25 (2H, s, -CH <sub>2</sub> ), 1.32 (6H, s, -CH <sub>3</sub> ), 3.58 (2H, s, -OH), 4.82 (4H, s, -NH), 6.95-8.05 (22H, m, Ar-H).
<b>5c</b>	2.40 (2H, s, -CH <sub>2</sub> ), 1.20 (6H, s, -CH <sub>3</sub> ), 3.62 (2H, s, -OH), 4.65 (2H, s, -NH), 2.58 (6H, s, N-CH <sub>3</sub> ), 6.98-8.22 (22H, m, Ar-H).
<b>5d</b>	2.15 (2H, s, -CH <sub>2</sub> ), 1.18 (6H, s, -CH <sub>3</sub> ), 3.68 (2H, s, -OH), 4.80 (2H, s, -NH), 6.90-8.15 (32H, m, Ar-H).
<b>5e</b>	2.30 (2H, s, -CH <sub>2</sub> ), 1.28 (6H, s, -CH <sub>3</sub> ), 4.68 (4H, s, -NH), 6.95-8.05 (24H, m, Ar-H).
<b>5f</b>	2.35 (2H, s, -CH <sub>2</sub> ), 1.32 (6H, s, -CH <sub>3</sub> ), 3.62 (2H, s, -OH), 4.85 (4H, s, -NH), 6.92-8.10 (22H, m, Ar-H).
<b>5g</b>	2.28 (2H, s, -CH <sub>2</sub> ), 1.20 (6H, s, -CH <sub>3</sub> ), 3.52 (2H, s, -OH), 4.72 (4H, s, -NH), 7.05-8.10 (20H, m, Ar-H).
<b>5h</b>	2.42 (2H, s, -CH <sub>2</sub> ), 1.35 (6H, s, -CH <sub>3</sub> ), 4.75 (4H, s, -NH), 7.10-8.15 (26H, m, Ar-H).
<b>5i</b>	2.32 (2H, s, -CH <sub>2</sub> ), 1.25 (6H, s, -CH <sub>3</sub> ), 4.70 (4H, s, -NH), 6.95-8.10 (24H, m, Ar-H).
<b>5j</b>	2.38 (2H, s, -CH <sub>2</sub> ), 1.22 (6H, s, -CH <sub>3</sub> ), 4.62 (4H, s, -NH), 7.08-8.16 (20H, m, Ar-H).

**Abbreviations:** s, singlet; d, doublet; t, triplet; m, multiplet.

**Table - 4** Exhaustion and fixation data of dyes (5a-j)

Dye No.	Shade on dyed fibre	$\lambda_{\max}$ nm (water)	$\lambda_{\max}$ nm (H <sub>2</sub> SO <sub>4</sub> )	Log $\epsilon$ (Water)	(% )Exhaustion			(% ) Fixation		
					S	W	C	S	W	C
<b>5a</b>	Purple	530	512	4.65	69.55	66.37	69.62	89.14	90.39	87.38
<b>5b</b>	Yellow	465	442	4.32	67.95	70.90	73.02	90.50	93.08	87.64
<b>5c</b>	Light orange	482	475	4.38	72.40	67.22	70.57	91.30	91.48	86.43
<b>5d</b>	Red	495	480	4.12	75.65	66.72	64.28	87.40	88.42	87.44
<b>5e</b>	Yellow	450	422	4.22	69.95	64.55	68.22	89.90	85.97	86.62
<b>5f</b>	Dark Yellow	460	462	4.18	78.05	70.80	65.02	86.16	88.00	90.73
<b>5g</b>	Light Purple	510	505	4.55	72.10	67.55	68.07	85.14	91.78	88.87
<b>5h</b>	Yellow	435	405	4.60	69.00	71.20	66.62	88.41	89.60	83.16
<b>5i</b>	Light Yellow	430	415	4.35	74.05	65.10	72.00	87.40	84.48	86.48
<b>5j</b>	Yellow	442	425	4.32	67.65	64.12	67.90	93.00	88.88	89.83

**Abbreviations:** S-Silk, W-Wool, C-Cotton

**Table - 5** Fastness properties of dyes (5a-j).

Dye No.	Light fastness			Wash fastness			Rubbing fastness					
	S	W	C	S	W	C	Dry			Wet		
							S	W	C	S	W	C
<b>5a</b>	6	3-4	5	5	4	3-4	4	4	4-5	5	5	3-4
<b>5b</b>	4-5	5	3-4	3	4-5	3	5	3	3	3-4	3-4	4
<b>5c</b>	5	5-6	6	4	3	4-5	3	3-4	3	4	4	4-5
<b>5d</b>	4	6	4	3-4	4	5	4-5	5	3	3	3-4	5
<b>5e</b>	4-5	4	3	4	3-4	4	3	4-5	3-4	3-4	4	3
<b>5f</b>	3	3-4	5	3-4	5	4	4	5	3	4-5	4-5	4
<b>5g</b>	3	6	5	4-5	3	3-4	5	4	4-5	4	4	4-5
<b>5h</b>	5-6	3	4-5	4	4-5	5	5	4-5	5	5	5	3
<b>5i</b>	4	5-6	3	5	4-5	4	3-4	3	3	4-5	4-5	4-5
<b>5j</b>	5-6	5	4-5	3	4	4	3-4	4	4-5	3	5	5

**Abbreviations:** S-Silk, W-Wool, C-Cotton

**Light fastness:** 1-poor, 2-slight, 3-moderate, 4-fair, 5-good, 6-very good.

**Wash & Rubbing fastness:** 1-poor, 2-fair, 3-good, 4-very good, 5-excellent.

The percentage exhaustion of 2% dyeing on silk fabric ranges from 67-78% for wool fabric ranges from 64-72% and for cotton fabric ranges from 64-73 % and the percentage fixation of 2% dyeing on silk fabric ranges from 85-93%, for wool fabric ranges from 84-93% and for cotton fabric ranges from 83-90 % (Table - 4).

From the data summarized in Table - 4 showed that dye **5f** exhibit maximum exhaustion on silk fibre, dye **5h** exhibit maximum exhaustion on wool fibre and dye **5b** exhibit maximum exhaustion on cotton fibre. While for fixation dye **5j** exhibit maximum fixation for silk fibre, **5b** exhibit maximum fixation for wool fibre and **5f** exhibit maximum fixation for cotton fibre.

#### Fastness properties

The light fastness of all the dyes rating 3-6 for silk, wool and cotton fabrics, which shows light fastness moderate to very good for silk, wool and cotton. The wash fastness and rubbing fastness of all the dyes rating 3-5 for silk, wool and cotton fabrics, shows wash fastness and rubbing (dry and wet) fastness of all the dyes good to excellent (Table - 5).

#### CONCLUSION

A series of hot brand bisazo reactive dyes based on 4, 4'-methylene-bis (*o*-nitro aniline) have been synthesized by conventional method. The main advantage of bisazo dyes is that they contain two reactive groups, if one is hydrolyzed then other is still left for fixation and also it is used as a substitute against benzidine dyes having carcinogenic properties. These dyes give mostly purple, red, orange and yellow colour shades on different fabrics having good fastness properties. The remarkable degree of levelness after washing indicates the good penetration and affinity of these dyes to the fabrics. Exhaustion and fixation of these dyes are very good and indicate that the dyes have good affinity and solubility with the fabrics.

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