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SYNTHESIS, CHARACTERISATION AND DYEING PROPERTIES OF NOVEL BIFUNCTIONAL SULPHATOETHYLSULPHONE (SES) AZO REACTIVE DYES BASED ON 1, 4-DIPHENYLENEDIAMINE

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ABSTRACT

A series of five new homo bifunctional azo reactive dyes containing two anionic sulphatoethylsulphone (SES) derived from 1,4-diphenylenediamine as a tetrazotised component was prepared by coupling to 4-nitroanilino cyanurated acids (H-acid, J-acid, Laurent acid, Tobias acid and Gamma acid). The structures of the synthesised dyes were characterised and confirmed by melting point, UV-visible spectroscopy and FT-IR spectroscopy. The synthesised dyes were applied on cotton and nylon 6,6 fabrics under typical exhaustion process o assess their washing, light and perspiration-acid and alkaline fastness properties. The percentage exhaustion and percentage fixation of the synthesised dyes on cotton and nylon 6,6 fabrics were very good.

Keywords: *bifunctional azo reactive dyes, cotton fabrics, Dyeing, Reactive dyes, Nylon 6,6 fabrics*

INTRODUCTION

Reactive dyes are textile organic colourants having one or two reactive groups capable of reacting covalently between carbon and phosphorus atom of the dyes and oxygen, nitrogen or sulphur atoms of the fibre (Bradbury *et al*; 2007, Ahmad *et al*; 2012a). Reactive dyeing systems have become the most important discovery in the colouration industry in the last century. Ever since they were discovered, diminishing era for the demand of other dye class set in (Chen *et al*; 2005, Banchero *et al*; 2013). Reactive dyes constitute a very important class for dyeing cellulosic and polyamide fibres and a very high rate of growth is predicted in future (Chinta and VijayKumar, 2013, Castaldo *et al*; 2017). Their major advantages are superior wet fastness properties and high brightness of colour (Banu *et al*, 2013).

The earlier dyes synthesised were however, fixed onto the cellulose by an alkaline treatment at times at a higher temperatures. Hence, as a result of this, the earlier dyes form esters and ethers with cellulose (Akanranta and Agiri, 2012). These dyes were found to have the following setbacks – lots of dyes wasted due to hydrolysis; could not be applied to cotton/polyester blends as the disperse dye meant for the polyester component decomposes at high temperature of application and due to the high alkalinity required, some of the dyes could not be applied onto the substrate (Chavan, 2001, Chen *et al*; 2015).

Divyesh *et al*; (2009) and Fang *et al*; (2018) confirmed that it is necessary to increase the fixation properties of the reactive dyes by building bifunctionality into the dye as an efficient method of improving the application properties of the dye. It is implicit that dyes with two reactive groups provides a higher fixation yield than dyes with one reactive group because if one of the two dye-fibre bonds is hydrolysed, one reactive group is still left for fixation (El-Zawhry *et al*; 2007, Dixit *et al*; 2010). The bifunctional azo reactive dyes are more valuable than the mono azo reactive dyes, as they are more tinctorally stable and potentially more economic than mono azo reactive dyes (Dubrovski and Golob, 2009, Farha, *et al*; 2010 and Patel *et al*; 2011).

Ahmad *et al*; (2012) and Patel and Kashav, (2011) opined that most interest has recently shore-up in the dyes containing sulphatoethylsulphone (SES) reactive groups, which give deep colours on various textile fabrics than the dyes containing only one reactive group. The curiosity implicit in this approach was to synthesised a range of high temperature dyes for exhaust dyeing with substantially improved dyeability, high exhaustion and high fixation in comparison with the conrresponding conventional monofunctional azo reactive dyes – this is the most important characteristics of bifunctional azo reactive dyes (Patel *et al*; 2001, Patel *et al*; 2010, Patel *et al*; 2011, Duan *et al*; 2018).

The researcher now report the Synthesis, Characterisation and dyeing properties of five novel homo bifunctional sulphatoethylsulphone (SES) azo reactive dyes containing 1,4-diphenylenediamine as a tetrazotized component prepared by coupling to 4-nitroanilino cyanurated acids (H-acid, J-acid, Laurent acid, Tobias acid and Gamma acid). The synthesised dyes were characterised using FT-IR, UV-visible absorption spectra, and the percentage exhaustion, percentage fixation and the fastness properties (washing, light and perspiration) were assessed.

MATERIALS AND METHODS

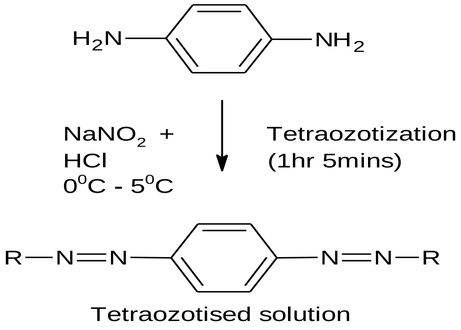
The chemicals used were purchased from Weifang Senya Chemical Company Limited, China. 1,4- phenylenediamine , 4,4-diaminodiphenylsulphone, 2,2-benzidinedisulphonic acid, 4,4'-diaminodiphenylmethane, Cyanuric chloride, H-acid, J-acid, Laurent acids, Tobias acid, Gamma acid. The melting points were determined by open capillary method. The IR and UV-visible absoption spectra were recorded using FT-IR (Perkin-Elmer Spectrum RXIFT-IR Spectrometer and Perkin-Elmer Lambda 25 UV-visible spectrophotometer (at the wavelength of maximum absorption (λ_{max}) at the Kharazmi University, Bureau of International Scientific Cooperations, Department of Organic Chemistry, Tehran, Iran. Applications and evaluation of fastness properties were carried out according to the standard methods in Chemical Processing Laboratory, Department of Polymer and Textile Engineering, Ahmadu Bello University, Zaria - Nigeria.

METHODS

The synthesis of the bifunctional azo reactive dyes involves four (4) steps which are cyanuration of the acids, condensation of the cyanurated acids, tetrazotisation of the intermadiates and the coupling of the tetrazotised intermediates with the condensed cyanurated acids (Patel *et al*., 2011).

Procedure for Tetrazotization of Intermediates

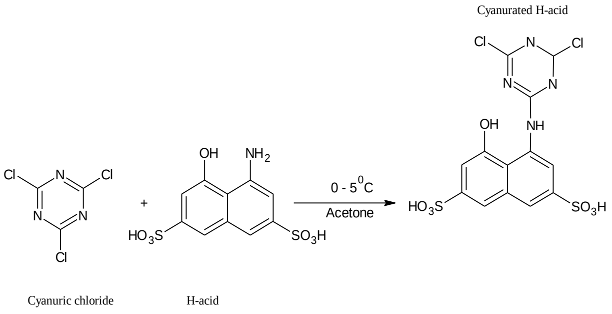
1,4-phenylenediamine (0.54g, 0.005mol) was suspended in distilled water (60ml) and hydrochloric acid (0.36g) was added dropwise to the well stirred suspension. The mixture was gradually heated up to 70°C, till clear solution was obtained. The formed solution was gradually cooled to below 5°C in an iced bath, then already cooled (0-5°C) $NaNO_2$ (0.6g in 4ml H_2O) was added over a period of 30mins with continuous stirring. The stirring was continued for one (1) hour, maintaining the temperature of 0-5°C with positive test for nitrous acid with starch iodide paper. After completely destroying the excess of nitrous acid with the required amount of sulphamic acid, the clear tetrazonium solution –X at 0-5°C obtained was used for next coupling reaction. The reaction is hown in scheme 1:



Scheme 1: Tetrazotization of 1,4- phenylenediamine

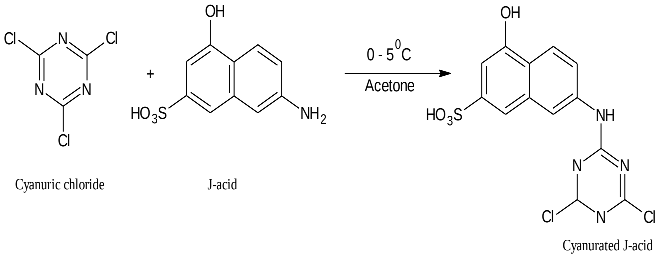
Procedure for cyanuration of the acids

Cyanuric chloride (1.85g, 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 (3.19g, 0.01mole) in aqueous sodium carbonate solution (10% w/v) was then added in small lots for 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 4h. The cyanurated H-acid solution was used for subsequent coupling reaction as shown in scheme 5:

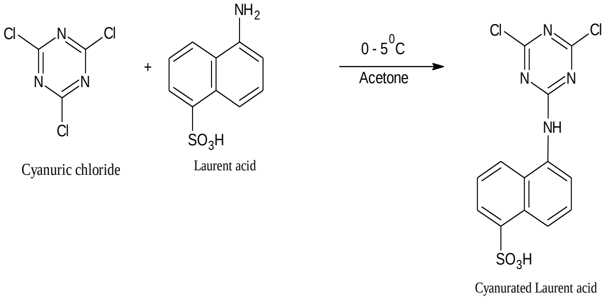


Scheme 2a: Cyanuration of H-acid

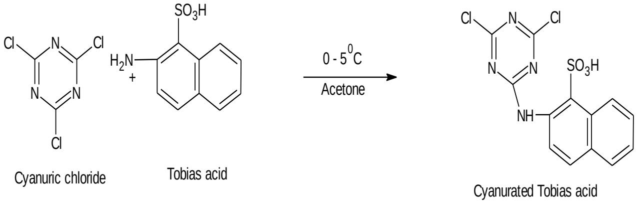
The same procedure (method) was followed to cyanurate J-acid, Laurent-acid, Tobias-acid and Gamma-acid in scheme 2b, 2c, 2d and 2e respectively as shown below.



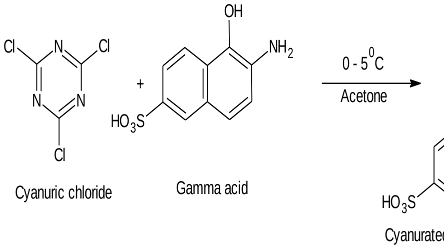
Scheme 2b: Cyanuration of J-acid



Scheme 2c: Cyanuration of Laurent acid



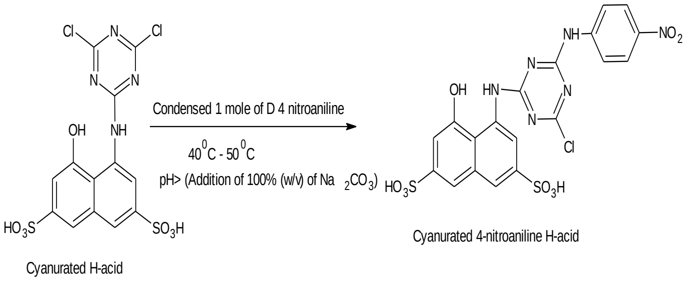
Scheme 2d: Cyanuration of Tobias acid



Scheme 2e: Cyanuration of Gamma-acid

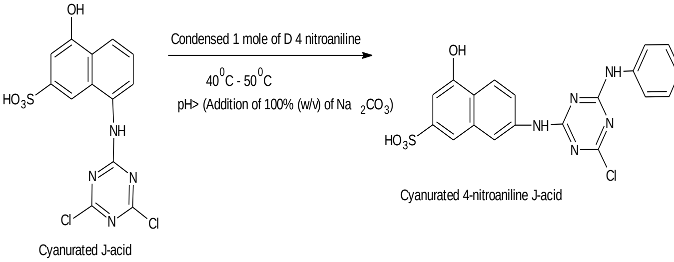
Procedure for condensation of the cyanurated acids

The temperature of ice-cooled well stirred solution of cyanurated H-acid, (4.67 g, 0.01 moles) was gradually raised to 45°C for 30min. To this cyanurated H-acid, the 4-nitro aniline (1.39 g, 0.01 moles) was added slowly at same temperature, during a period of 30 min, maintaining the pH neutral by simultaneous addition of sodium bicarbonate solution (1%w/v). After the addition was completed, stirring was continued for further 3h. The cyanurated 4-nitroanilino H-acid solution thus obtained was subsequently used for further coupling reaction as shown in scheme 1.

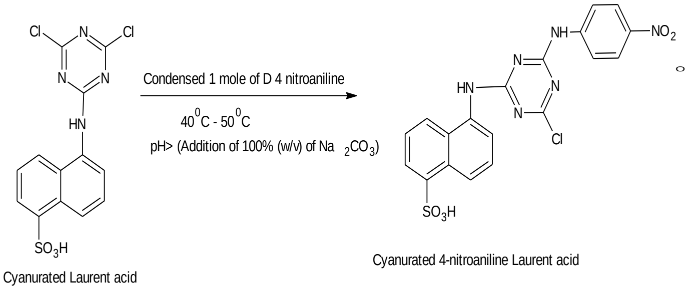


Scheme 3a: Condensation of cyanurated H-acid

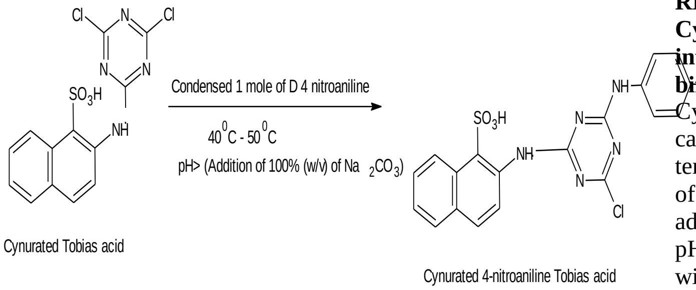
The same procedure (method) was followed for the condensation of cyanurated J-acid, Laurent-acid, Tobias-acid and Gamma-acid in scheme 3b, 3c, 3d and 3e respectively.



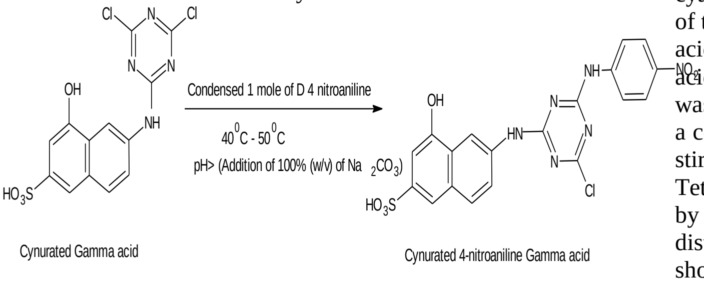
Scheme 3b: Condensation of cyanurated J-acid



Scheme 3c: Condensation of cyanurated Laurent-acid



Scheme 3d: Condensation of cyanurated Tobias-acid

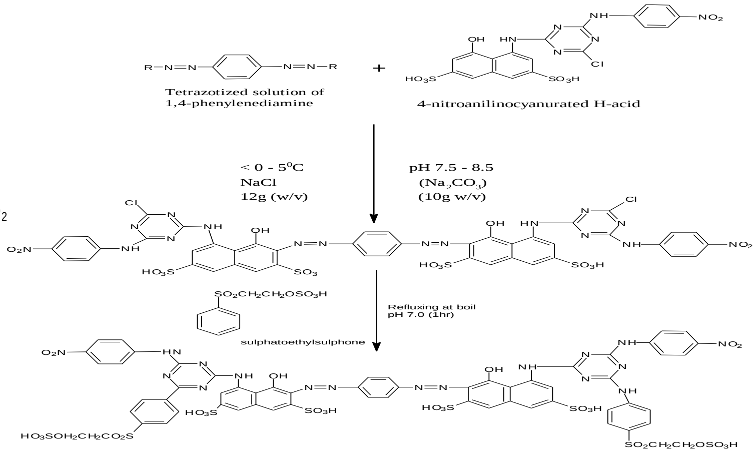


Scheme 3e: Condensation of cyanurated Gamma-acid

Procedure for synthesis of dyes DB$_1$

Dye DB$_1$ was synthesised by addition of the previously prepared fresh tetrazotized solution of 1,4-phenylenediamine dropwise over a period of 10 – 20 min. to the well stirred ice-cold 4-nitroanilino cyanurated H-acid solution. There was the simultaneous addition of sodium carbonate solutions (Na_2SO_3) (10% w/v) to maintained pH 7.5 – 8.5 and stirring was continued for 3 – 4h at a constant temperature below 0 – 5°C, then sulphatoethylsulphone (2.86g, 0.01mol) was added dropwise over 15min. with continuous stirring and reflux at boil for 1h, then salted and stirred for further 1h. The solid violet precipitate was filtered, washed with little amount of acetone and dried at room temperature to give dye DB$_1$ (molecular weight 1756.05g, yield 56%, 365°C).

Following the procedure above the other bifunctional sulphatoethylsulphone (SES) azo reactive dyes DB$_2$ (3b), DB$_3$ (3c), DB$_4$ (3d) and DB$_5$ (3e) were synthesised using the various cyanurated coupling components such as J-acid, Laurent acid, Tobias acid and Gamma acid respectively as shown in Table 1.



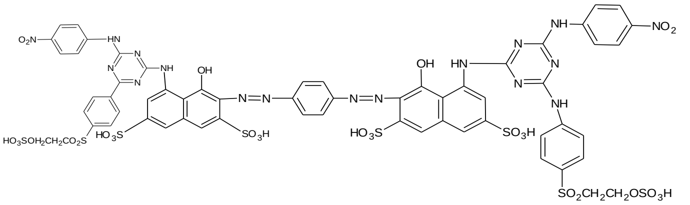
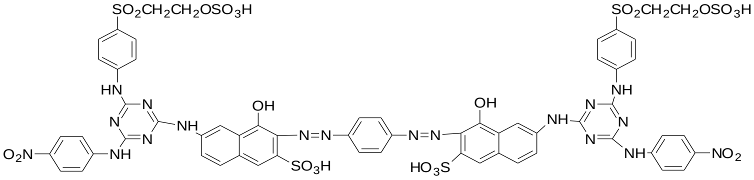
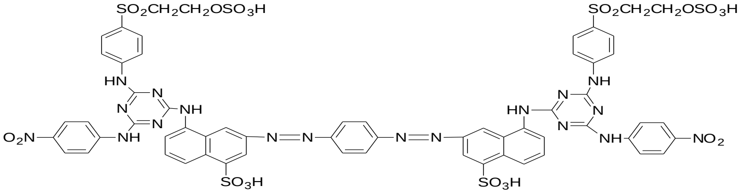
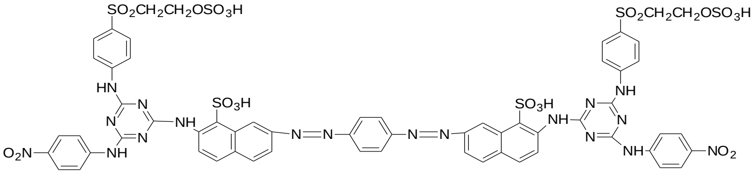
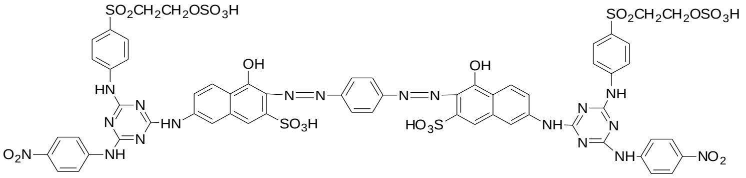
Scheme 4a: Synthesis of dye DB$_1$

RESULTS AND DISSCUSSION

Cyanuration, condensation and tetrazotisation, of the intermediates and synthesis of the bifunctional sulphatoethylsulphone (SES)

Cyanuration of the acids as shown in Schemes 2a-2e was carried out by stirring cyanuric chloride in acetone at a temperature below 0-5°C for an hr, then a neutral solution of H-acid [in aqueous solution of $NaCO_3$ (10% w/v)} added in small lots over an hr while maintaining a constant pH by adding 1% w/v $NaCO_3$ at a temperature below 0-5°C with continuous stirring for 4h until a clear solution was obtained. In schemes 3a-3e the condensation of the cyanurated acids was carried out by raising the temperature of the ice-cold well stirred cyanurated acids [(H-acid(3a), J-acid(3b), Laurent acid(3c), Tobias acid (3d) and Gamma acid (3e)] gradually to 50°C over 30 minutes, 4-nitroaniline was added in small lots over 30 minutes while maintaining a constant pH by adding 1% w/v $NaHCO_3$ with continuous stirring for 5h to obtain the 4-nitroanilino cyanurated acids. Tetrazotisation of 1,4-diphenylenediamine was carried out by using HCl (0.36g at 70°C/NaNO2(0.6g in 4ml of distilled water at 0-5°C) until a clear solution is achieved as shown in scheme 1 and coupling with various cyanurated coupling components such as 4-nitroanilino cyanurated H-acid, J-acid, Laurent acid, Tobias acid and Gamma acid respectively as shown in sheme 4, then sulphatoethylsulphone (2.81g, 0.01mol) was added dropwise over 15minutes with continuous stirring and reflux at boil for 1h, then salted and stirred for further 1h. The solid violet precipitate was filtered, washed with little amount of acetone and dried at room temperature to give DB$_1$(3a), DB$_2$ (3b), DB$_3$ (3c), DB$_4$ (3d) and DB$_5$ (3e) The dye filtered, washed and dried at room temperature.

Table1: Synthesized of bifunctional Sulphatoethylsulphone (SES) Azo Reactive dyes Structures with IUPAC names

Dye No.	IUPAC Name	Structures of the Synthesized Bi- functional azo reactive Dyes
DB_1	3,3ˈ-(1,4-phenylenebis(diazene-2-1-diyl)bis(4-hydroxy-5-((4-nitrophenyl)amino)-6-((4-((2-(sulfooxy)ethyl)sulfonyl)phenyl)amino)-1,3,5-triazin-2-yl)amino)naphthalene-2,7disulfonic acid)	
DB_2	3,3'-(1,4-phenylenebis(diazene-2,1-diyl))bis(4-hydroxy-6-((4-((4-nitrophenyl)amino)-6-((4-((2-(sulfooxy)ethyl)sulfonyl)phenyl)amino)-1,3,5-triazin-2-yl)amino)naphthalene-2-sulfonic acid)	
DB_3	3,3'-(1,4-phenylenebis(diazene-2,1-diyl))bis(5-((4-((4-nitrophenyl)amino)-6-((4-((2 (sulfooxy)ethyl)sulfonyl)phenyl)amino)-1,3,5-triazin-2-yl)amino)naphthalene-1-sulfonic acid)	
DB_4	7,7'-(1,4-phenylenebis(diazene-2,1-diyl))bis(2-((4-((4-nitrophenyl)amino)-6-((4-((2 (sulfooxy)ethyl)sulfonyl)phenyl)amino)-1,3,5-triazin-2-yl)amino)naphthalene-1-sulfonic acid)	
DB_5	3,3'-(1,4-phenylenebis(diazene-2,1-diyl))bis(4-hydroxy-7-((4-((4-nitrophenyl)amino)-6-((4-((2-(sulfooxy)ethyl)sulfonyl)phenyl)amino)-1,3,5-triazin-2-yl)amino)naphthalene-2-sulfonic acid)	

Physical and Visible Absorption Spectroscopic Properties of Dye

The visible absorption spectroscopic properties of the dyes were recorded in DMF and water. From the data reported in Table 2, it is apparent that the (λ_{max})value depends on the coupling components used. The colour change observed for each dye is due to the oscillation of electrons and the presence of additional substituent. The shift in λ_{max} of the synthesized bifunctional azo reactive dyes in different solvents (solvatochromism) is as a result of the solvatochromic effects emanating from changes in dielectric constant of the solvent. The measurement of λ_{max} in DMF and water indicated that λ_{max} of the intermolecular charge transfer bonds exihibit a remarkable red shift on transfer from non-polar to polar solvent. This behaviour can be attributed to the polar excited states of the synthesised bifunctional azo reactive dyes are stabilized by polarization interactions forces as the polarisability of the solvent increases (Abd El- Aal and Koraierm, 2000).

Table 2: Physical Characteristics of the bifunctional Sulphatoethylsulphone (SES) Azo Reactive dyes

Dye No.	Mol.Wt (g/mol)	Mt.Pt (^oC)	Yield (%)	DMF λ_{max}	Water (λ_{max})	ε_{max}inDMF $x10^41Mol^{-1}cm^{-1}$
DB_1	1756.05	347-348	56	495	452	6.59
DB_2	1596.14	335-337	82	480	472	1.47
DB_3	1564.15	325-327	69	461	461	3.27
DB_4	1564.15	316-318	74	495	468	1.82
DB_5	1596.14	320-322	78	526	502	9.47

The visible absorption maxima of the synthesised bifunctional azo reactive dyes fall within the visible region (400-700nm) of the electromagnetic spectrum which showed that the synthesised bifunctional azo reactive dyes are colourants with high commercial integrity. The values of the molar extinction coefficient (ε) that were determined by Beer-Lambert's law are in the range of 14705.12-94704.13mol^{-1}cm^{-1} which is an indication of high absorption intensity of the synthesised bifunctional azo reactive dyes in DMF respectively. However, the synthesised bifunctional azo reactive dyes have the same chromophoric functionalities, but different in the bridging groups. The presence of electron donating or electron attracting (withdrawing) groups at the suitable position of the coupler ring affects the absorption characteristics of the synthesised bifunctional azo reactive dyes. Meanwhile, comparing the λ_{max} of the synthesised bifunctional azo reactive dyes DB_1, DB_2, DB_3, DB_4 and DB_5 in DMF showed that their nature of their coupling components (cyanurated 4-nitroanilino H-acid, cyanurated 4-nitroanilino J-acid, cyanurated 4-nitroanilino Laurent-acid, cyanurated 4-nitroanilino Tobias-acid and cyanurated 4-nitroanilino Gamma-acid) are very significant in the context of colour change (Patel *et al*; 2012). However, dye DB_1 was obtained by tetrazotising 1,4 phenylenediamine and coupling with cyanurated 4-nitroanilino H-acid and refluxing with sulphatoethylsulphone which absorbed at 495nm while DB_2 which is obtained by tetrazotising 1,4 phenylenediamine and coupling with cyanurated 4-nitroanilino J-acid and refluxing with sulphatoethylsulphone which absorbed at 480nm, in the same solvent hence there was a hypsochromic shift of 15nm. Dye DB_3 was obtained by tetrazotising 1,4 phenylenediamine and coupling with cyanurated 4-nitroanilino Laurent acid and refluxing with sulphatoethylsulphone which absorbed at 461nm, dye DB_3 shifted hypsochromically by 34nm and 19nm when compared with DB_1 and DB_2 respectively. When cyanurated 4-nitroanilino Tobias acid was employed as the coupling component and couple with a solution of tetrazotising 1,4 phenylenediamine and refluxing with sulphatoethylsulphone, dye DB_4 which absorbed at 495nm. Comparing dye DB_4 with dye $DB_{1,}$ DB_2 and $DB_{3,}$ there was 0nm shift for $DB_{1,}$ 10nm bathochromic shift for DB_2 and 34nm bathochromic shift for DB_3 respectively. Dye DB_5 was obtained by tetrazotising 1,4 phenylenediamine and coupling with cyanurated 4-nitroanilino Gamma acid and refluxing with sulphatoethylsulphone which absorbed at 526nm, comparing dye DB_5 with dye $DB_{1,}$ DB_2 , $DB_{3,}$ and $DB_{4,}$ all the dyes shifted bathochromically 31nm for DB1, 46nm for DB2, 65nm for DB3 and 31nm for DB4 respectively. All the shifts experienced are as a result of introduction of electron donating groups or electron withdrawing groups in the dye moiety.

Infra-red spectral study

The Infra-red Spectral of all the dyes DB_1, - DB_5 revealed that O-H and N-H showed stretching vibration at 3561cm-^{1}-3371 cm-^{1}, C=H showed stretching vibration at 2955cm-^{1}, C-N showed stretching vibration at 1574cm-^{1}, 1305cm-^{1}, 1464cm-^{1}, N=N showed stretching vibration at 1597cm-^{1}, S=O showed stretching vibration at 1150cm-^{1}, 1060cm-^{1} (asym. And sym), N=O showed stretching vibration at 1495cm-^{1}, 1411cm-^{1}, 1335cm-^{1}, C-Cl showed stretching vibration at 784cm-^{1} and SO_3H showed stretching vibration at 841cm-^{1} respectively as showed in Table 3.

Table 3: IR of the bifunctional Sulphatoethylsulphone (SES) Azo Reactive dyes

Dye no	IR(KBr) cm^{-1}
DB_1	3561 (O-H), 3031(N-H), 2920 (C-H), 1431, 1307 (C-N), 1585 (N=N), 1161, 1051 (S=O), 1306 (N=O), 782 (C-Cl), 840 (SO_3H)
DB_2	3439 (O-H), 3371 (N-H), 3073 (C-H), 1413, 1366 (C-N), 1597 (N=N), 1156, 1046 (S=O), 1304 (N=O), 636, 755 (C-Cl), 1134 (SO_3H)
DB_3	3395 (O-H), 3240 (N-H), 2955, 2915 (C-H), 1495 (C-N), 1597 (N=N), 1150, 1067 (S=O), 1495, 1411 (N=O), 752 (C-Cl), 845 (SO_3H)
DB_4	3442 (O-H), 3245 (O-H), 2919 (C-H), 1460, 1329 (C-N), 1597 (N=N), 1269 (S=O), 1304 (N=O), 659,692 (C-Cl), 994 (SO_3H)
DB_5	3501 (O-H), 3095 (N-H), 3013 (C-H), 1473, 1330 (C-N), 1560 (N=N), 1272 (S=O), 1309 (N=O), 648 (C-Cl), 845 (SO_3H)

Dyeing of fibres

The synthesized dyes DB_1, DB_2, DB_3, DB_4 and DB_5 were applied on cotton and nylon 6,6 fabrics using exhaustion method and depth of shade, 2% (Patel *et al*, 2012). A mild alkaline conditions, pH 8.0-9.0 (Na_2CO_3) 0.4ml of 10%w/v) was used for the dyeing of cotton fabrics while a weakly acidic conditions [(acetic acid-1,5ml of 10%w/v, Nacl-4ml of 10%w/v, distilled water-14.4ml)] was used for the dyeing of nylon 6,6 fabrics at 1:50 liquor-ratio for the dyeing of both fabrics (Patel, et al; 2013)

Exhaustion and fixation study

The percentage exhaustion of 2% dyeing on cotton fabric showed from 627% to 85%, where dye DA_3 give maximum exhaustion of 85% and minimum exhaustion of 62%, for nylon 6, 6 fabric showed from 75% to 96% where dye DA_3 give maximum exhaustion at 96% and dye DA_2 gives minimum exhaustion of 75%. The percentage fixation of 2% dyeing on cotton fabric showed from 65% to 85 %, where dye DA_3 give a maximum fixation of 85% and dye DA_4 give minimum fixation of 65%, for nylon 6, 6 fabric showed from 75% to 95% where dye DA_3 and DA_5 give maximum fixation of 95% and dye DA_2 gives minimum fixation of 75% as showed in Table 4. From the result, all the synthesized dyes have good values of percentage exhaustion and fixation that is expected due to the rapid diffusion of the dye molecule within the fibres under dyeing condition and physical as well as chemical interaction of polar groups present in diazo, coupler and bridging components.

Table 4: Exhaustion and fixation study of the bifunctional Sulphatoethylsulphone (SES) Azo Reactive dyes on cotton and Nylon 6,6 fabric

			Exhaustion (%)		Fixation (%)	
Dye No	Shade on cotton	Shade on nylon 6,6	Cotton	Nylon 6,6	Cotton	Nylon 6,6
DB_1	Brown	Brown	85	86	72	90
DB_2	Lightorange	Orange	65	75	70	75
DB_3	Yellow	Yellow	72	96	85	85
DB_4	lightorange	Orange	65	80	65	79
DB_5	Yellow	Yellow	62	90	72	95

Fastness properties

The data for the fastness properties to washing (IS 765-1979 (Patel *et al.*, 2011), fastness properties to light (BS: 1006-1978 (Patel *et al.*, 2011) and fastness properties to perspiration – alkaline and acidic (Khazaei *et al.*, 2013) are recorded in Table 4. From the result the synthesised dyes showed satisfactory performances to fastness properties to washing (between 4-5), fastness properties to light (between 4, 4-5, 6) and fastness properties to perspiration – alkaline and acidic (between 3-4, 4). This is an indication of good dye penetration and excellent affinity, cross linking between the dye and the fibre (Patel, et al; 2002, Patel, et al; 2010). The good to excellent fastness properties exhibited by the fabrics to washing, light and perspiration is an indication of stable bond formed between the fibres and the dye and is an attribute that these dyes will be commercially viable.

Table 5: Fastness properties of the bifunctional Sulphatoethylsulphone (SES) Azo Reactive dyes on cotton and Nylon 6,6 fabrics

					Perspiration fastness			
Dye No	**Wash fastness**		**Light fastness**		**Alkaline**		**Acidic**	
	Cotton	**Nylon 6,6**	**Cotton**	**Nylon 6,6**	**Cotton**	**Nylon 6,6**	**Cotton**	**Nylon 6,6**
	Cc	cc	Cc	Cc	cc	cc	Cc	Cc
DB_1	4	5	5-6	6	3-4	3	4	3
DB_2	4-5	4	5-6	5	3-4	3	3-4	4
DB_3	4-5	5	4	4-5	3-4	4	4	4
DB_4	4	4	4-4	5	3-4	3-4	4	4
DB_5	4-5	4	5	4-5	3-4	4	3-4	4

cc=colour change

Fastness properties to washing: 1-poor, 2-moderate, 3-fair, 4-very good, 5-excellent

Fastness properties to light: 1-poor, 2-slight, 3- moderate, 4- fair, 5- good, 6- very good, 7-high, 8- very high

Fastness properties to perspiration – alkaline and acidic: 1-poor, 2-fair 3-good, 4-very good

CONCLUSION

Bifunctional Sulphatoethylsulphone (SES) azo reactive dyes were synthesised with 4- nitroanilino cyanurated acids- (cyanurated 4-nitroanilino H-acid, cyanurated 4-nitroanilino J-acid, cyanurated 4-nitroanilino Laurent-acid, cyanurated 4-nitroanilino Tobias-acid and cyanurated 4-nitroanilino Gamma-acid) as coupling components and reacting with tetrazotised solutiuon of 1,4-phenylenediamine. However, the visible absorption spectra of the dyes showed maximum absorption (λ_{max}) in the range of 400-700nm. The dyes recorded brown. Purple, orange and yellow colours on cotton and nylon 6,6 fabrics. The difference in colour of the dyes may be attributed to both the nature and position of the substituent. The dyes gave a satisfactory performance of exhaustion and fixation efficiency on cotton and nylon 6,6 fabrics. The fastness properties to washing, fastness properties to light and fastness properties to perspiration – alkaline and acidic of the dyes on cotton and nylon 6,6 fabrics showed good to excellent performance.

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