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DYEING OF WOOL WITH REACTIVE DYES FROM A CHARGED SOLVENT SYSTEM

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ABSTRACT

A method of dyeing wool with reactive dyes from a charged perchlorethylene solution is described. The charge consists of water, glycerol, sodium dodecylbenzenesulphonate and lauryl monoethanolamide. By dyeing at 100°C for 20 min in the charged system, the fastness properties of such dyeings were found to be similar to those carried out in aqueous medium.

KEY WORDS

Wool – reactive dyes – perchlorethylene – emulsion – glycerol – dyeing.

INTRODUCTION

Solvent processes for the finishing of textile fibres have been employed for many years. Until recently, however, when active research was undertaken by a number of research workers and dyestuff manufacturers, *solvent dyeing* of textiles had been attempted by a few research workers only[1,2]. The reason for this increased attention is undoubtedly coupled with the growing shortage of water throughout the world. Water is becoming scarcer because of the increase in population and per capita consumption and existing sources are being polluted by effluent from an ever growing industry.

Purification of heavily polluted effluent is still tedious and expensive and water will therefore have to be substituted by solvents for dyeing and finishing which can be easily and economically recovered. For this purpose a solvent must, however, comply with requirements such as an appropriate boiling point, low latent heat of evaporation, low specific heat, easy purification, non-inflammability, low toxicity, low surface tension and a competitive price[3]. A solvent fulfilling these requirements for dyeing and finishing is perchlorethylene. Less energy is therefore needed to heat and distill a perchlorethylene solution and the textile fabric will be wetted-out easily and thoroughly.

Wool, when wetted-out, has an ionic character and is therefore dyed with ionic dyes from an aqueous medium. These ionic dyestuffs are, however, insoluble in perchlorethylene and the only method by means of which wool can be dyed from a solvent system is the Solvent/Tenside/Water system as described by Mecheels[4]. The water in the solvent system is essential because it dissolves the dye and swells

7,5% SDBS and 5,0% LEA were the optimum concentrations for the production of a satisfactory dyeing (see Table III).

When dyeing from a charged solvent system the charge should be kept to a minimum because a large amount of water, with a high specific heat and high latent heat of evaporation, increases the cost of heating, drying and distillation. Table IV shows that a minimum charge of 50% (o.w.f.) was necessary to obtain a level dyeing. A charge of 40% (o.w.f.) resulted in an unlevel dyeing because the dye was insufficiently dissolved and insufficient wetting of the wool might be a second factor.

The deepest dyeing (a low Y-value) was obtained from a charge of 50% (o.w.f.) because the hydrophilic dyestuff would favour the glycerol-water phase rather than that of the fibre phase at higher charge concentrations.

Addition of acid to aqueous dyebaths usually promotes exhaustion of the dye onto the fibre and it was therefore necessary to investigate the influence of acid during dyeing from a charged solvent system. Fabrics were treated in lM-acetate buffers, rinsed, dried and then dyed from a charged solvent system containing 35% water, 15% glycerol, 7,5% SDBS, 5% LEA and the pH adjusted to the respective pH-value of the buffered cloths. Table V shows that the addition of acid had no significant influence upon the resultant dyeings except for a slight increase in covalent fixation at pH 5,5. The increase in covalent fixation does not justify the increase in cost.

Aqueous dyeing of wool with reactive dyes is normally held at the boil for 1 hr to obtain a high degree of covalent fixation. Table VI, however, shows almost complete exhaustion and a satisfactory high level of covalent fixation when dyeing from a charged solvent sytem after only 20–30 minutes dyeing.

Figures 1–4 show that the same amount of dye, expressed in K/S values*, was taken up by the fibre during dyeing from the charged solvent system and an aqueous medium. Lanasol Blue 3G (Fig. 3) showed an even higher absorption of dye in the higher concentration regions when dyed from the solvent medium. The graphs obtained deviate from linearity for the higher dyestuff concentrations but this is known to be the case[12].

A number of reactive dyes was applied from the charge given in Table VII at a 5% dyestuff level for 20 min at a 100°C in order to evaluate the applicability of the charge. The same dyes were also dyed in the normal way from an aqueous medium for 1 hr at the boil for purposes of comparison. These dyes and the results obtained are listed in the Appendix.

The colour difference values (ΔE) were small, showing that dyeings similar in depth of shade to aqueous dyeings could be obtained by dyeing from the charged solvent system given in Table VII. Covalent fixation values were higher for the dyeings obtained by dyeing from the charged solvent system to those dyed from an aqueous medium. The wet fastness properties of both solvent and aqueous dyed

*K/S = a function of the dye concentration on the fibre; derived from reflectance data and calculated from the Kubelka-Munk-equation[12].

TABLE VI

CHROMATICITY COORDINATES, EXHAUSTION VALUES AND COVALENT FIXATION VALUES OBTAINED AFTER DYEING WOOL WITH DIFFERENT DYES FOR INCREASING PERIODS OF TIME AT THE BOIL

TIME (Mins)	DYE	CHROMATICITY COORDINATES			% EXHAUSTION	% COVALENT FIXATION
		x	y	Y		
0	2% Lanasol Red 6G	0,570	0,331	31,63	98,71	68,00
10		0,570	0,333	31,33	99,43	79,43
20		0,571	0,332	30,52	99,55	82,77
30		0,573	0,330	29,73	99,57	81,36
40		0,571	0,332	29,97	99,52	81,30
50		0,573	0,333	29,81	99,48	83,77
60		0,572	0,331	29,09	99,41	82,98
0	2% Reactofil Brilliant Red 2B	0,548	0,296	29,46	94,64	73,44
10		0,544	0,294	29,00	97,45	81,36
20		0,548	0,297	27,67	98,71	82,89
30		0,547	0,297	27,61	98,44	82,62
40		0,547	0,297	27,57	97,93	82,11
50		0,547	0,291	25,96	97,75	82,19
60		0,538	0,293	28,07	98,87	84,39
0	2% Levafix Brilliant Yellow E–3G	0,475	0,473	13,96	98,40	73,81
10		0,477	0,470	13,44	98,99	84,65
20		0,475	0,470	13,14	99,57	87,28
30		0,478	0,469	12,99	99,14	87,66
40		0,478	0,468	12,90	99,23	88,17
50		0,479	0,469	12,73	99,20	89,16
60		0,475	0,471	13,65	98,81	81,59
0	2% Reactolan Red 2GL	0,564	0,319	31,84	99,76	94,84
10		0,564	0,320	29,94	99,85	95,68
20		0,562	0,320	28,79	99,96	95,23
30		0,561	0,319	29,81	99,93	95,01
40		0,559	0,320	30,61	99,90	94,97
50		0,552	0,321	33,09	99,92	95,38
60		0,557	0,320	30,64	99,95	95,79

TABLE VII

COMPOSITION OF CHARGE FOR SOLVENT DYEING OF WOOL
[LIQUOR TO WOOL RATIO – 10:1 (v/w)]

REAGENTS	CONCENTRATION %
Water	35
Glycerol	15
SDBS	7,5
LEA	5

All percentages are calculated on the weight of wool

samples were similar. The values were, however, lower than those found in the literature. This was due to the fact that neither the samples dyed from solvent nor those dyed from aqueous medium were rinsed after dyeing. Rinsing was omitted to simplify the experimental procedures.

SUMMARY AND CONCLUSIONS

It was found that water could not be completely substituted by glycerol but of some 100 reactive dyes used 90% could be dyed successfully to a 5% level if 15% Glycerol (o.w.f.) was added to the charge. The dyeings had similar wet fastness properties, slightly higher covalent fixation values and a depth of shade similar to that of dyeings from an aqueous medium. Dyeing time at a 100°C was only 20 min.

Details of pilot plant dyeings, with a LFM-12 Solvent Dyeing Machine [13], based on the described charged solvent system will be published in due course.

ACKNOWLEDGEMENT

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THE USE OF PROPRIETARY NAMES

The fact that chemicals with proprietary names have been used in this investigation in no way implies that there are not others as good or even better.

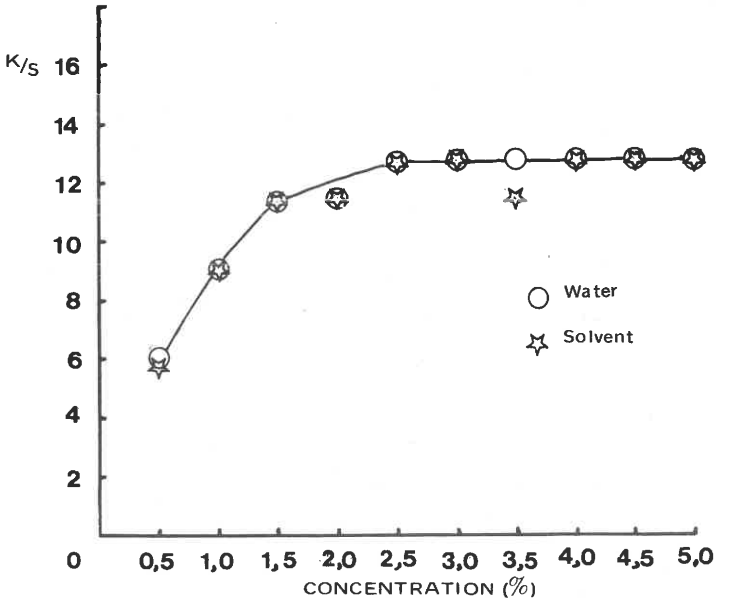

FIGURE 1 – LANASOL RED 6G

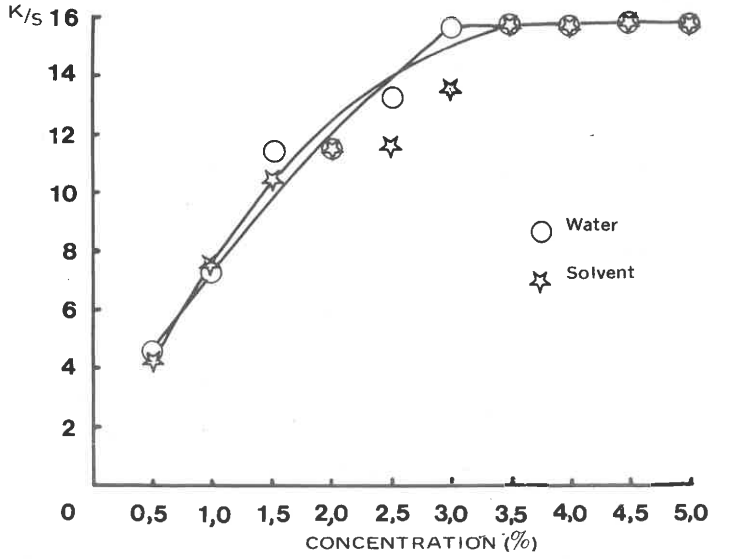

FIGURE 2 – VEROFIX BLUE GGL

AT INCREASING CONCENTRATIONS OF DYE

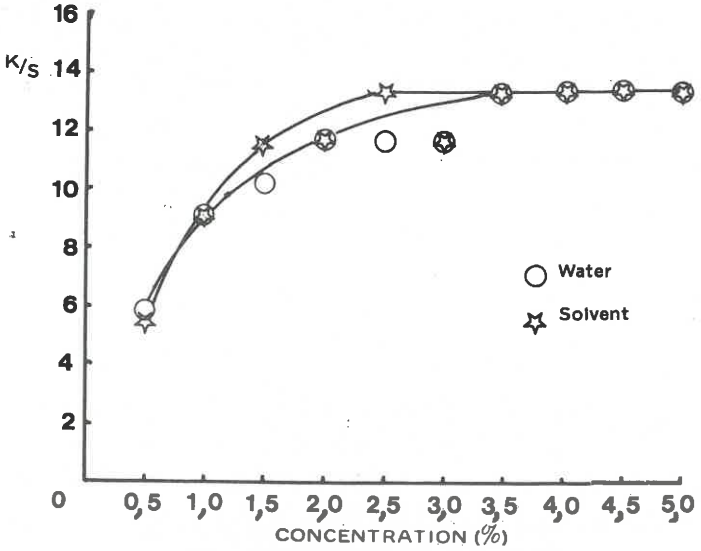

FIGURE 3 – LANASOL BLUE 3G

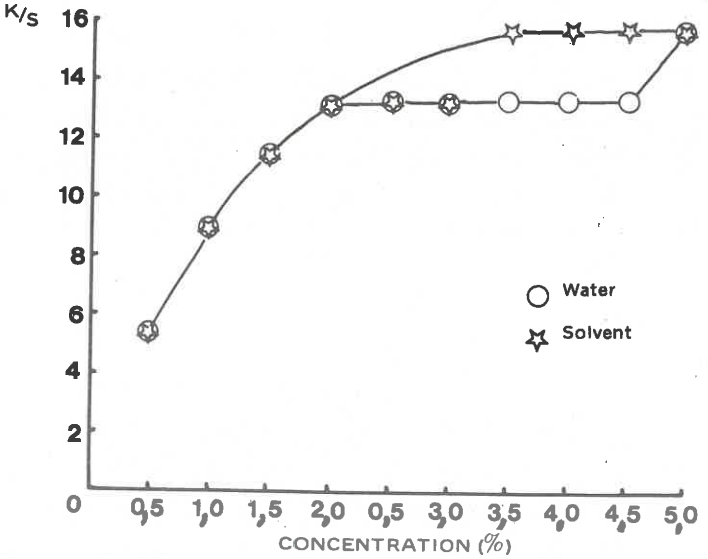

FIGURE 4 – LEVAFIX BRILLIANT SCARLET E–3B

DYESTUFF	CHROMATICITY COORDINATES						ΔE	% COVALENT FIXATION		FASTNESS TO ALKALINE PERSPIRATION						FASTNESS TO WASHING			
	Solvent Medium			Aqueous Medium				Solvent Medium	Aqueous Medium	Solvent Medium			Aqueous Medium			Solvent Medium		Aqueous Medium	
	x	y	Y	x	y	Y				Staining of cotton	Staining of wool	Change in colour	Staining of wool	Staining of cotton	Change in colour	Staining of wool	Change in colour	Staining of wool	Change in colour
Levafix Brilliant Red E-2B	0,597	0,357	63,16	0,597	0,356	61,27	0,563	88,60	88,41	1	2 – 1	4	1	2	4 – 3	5 – 4	4 – 3	4	4
Levafix Brilliant Yellow E-3G	0,595	0,387	23,19	0,595	0,387	23,24	0,063	86,89	75,57	3	3 – 2	5 – 4	3	3 – 2	5 – 4	5 – 4	5	4	5
Levafix Turquoise Blue E – G	*	*	*	0,417	0,282	35,26	*	*	65,97	*	*	*	3 – 2	3 – 4	4 – 3	*	*	4	3
Levafix Yellow E–RL	0,605	0,372	12,20	0,605	0,369	10,79	2,425	82,96	61,26	2	2 – 3	3	2 – 1	2	3	4	2	4 – 5	2 – 1
Levafix Yellow E–3RL	0,605	0,371	11,89	0,606	0,368	10,70	2,071	84,61	68,95	2	3 – 2	3 – 2	1 – 2	2	3 – 2	4	2	4 – 3	2 – 1
Verofix Blue GG	0,440	0,286	20,66	0,437	0,284	22,01	0,576	92,17	83,57	4 – 3	2	3	5 – 4	3	3	4	2	5 – 4	2
Verofix Blue GGL	0,435	0,283	21,30	0,434	0,282	21,13	0,074	93,04	86,24	3 – 4	3	3	4	4 – 3	4	4	3	4 – 5	3
Verofix Orange 3GL	0,608	0,373	14,80	0,608	0,373	15,44	1,049	95,70	95,93	3	3	4	2 – 3	3	4	4	4 – 5	4	4
Verofix Orange GL	0,607	0,368	11,15	0,606	0,368	11,04	0,360	96,26	91,63	3	3	5	3	3 – 4	4	4	4	4	4
Verofix Red BBL	0,579	0,349	42,30	0,578	0,348	39,69	1,00	93,39	94,89	1 – 2	2	4	2	4	4	5	4	4	4
Verofix Red BB	0,579	0,349	41,46	0,578	0,348	39,70	0,671	92,50	92,57	2	3	4	2	3 – 4	4	5 – 4	4 – 5	5 – 4	3 – 4
Verofix Red GGL	0,595	0,357	58,39	0,595	0,357	60,30	0,582	97,35	97,12	3	3 – 4	3 – 4	3	4	4 – 5	4 – 5	4	5 – 4	3
Verofix Scarlet R	0,604	0,362	83,12	0,604	0,362	84,74	0,397	84,70	76,93	3	3	4	3	3	4 – 3	4	4 – 5	4 – 5	4
Verofix Yellow 5GL	0,595	0,387	25,01	0,595	0,387	25,10	0,099	96,60	83,86	4 – 3	3	3 – 4	4 – 3	4	4	4 – 5	4	4	4
Verofix Yellow 3GL	0,596	0,387	23,34	0,595	0,386	22,13	1,379	96,87	93,88	4 – 5	4 – 3	4 – 3	4	4 – 3	4 – 3	4 – 5	4	4	3 – 4
Verofix Yellow R	0,602	0,384	23,31	0,601	0,384	22,3	1,294	95,07	94,70	4	3	4	4	3	4 – 3	4	4	4	4 – 3
Cibacron Pront Orange-Brown 3R	0,579	0,354	39,22	0,580	0,354	39,37	0,075	82,93	78,13	2	2 – 3	3 – 4	2	3 – 2	3	4 – 3	2 – 3	4	2 – 3
Cibacron Pront Yellow 4R	0,603	0,381	19,47	0,602	0,381	18,35	1,552	84,61	83,81	3	3	4	3	3 – 4	3 – 4	4 – 5	2 – 3	4	3 – 2
Cibacron Pront Turquoise G	0,436	0,299	60,36	0,426	0,291	44,08	3,381	54,44	76,03	2	4 – 3	3 – 2	3	3	4	5 – 4	3 – 2	5 – 4	4 – 3
Cibacron Pront Scarlet 3R	0,601	0,361	68,59	0,602	0,361	70,80	0,609	80,74	79,14	2 – 1	2	3 – 4	2 – 1	2 – 3	3 – 4	4	4	4	4
Cibacron Pront Orange G	0,606	0,372	12,79	0,606	0,372	13,06	0,493	77,73	45,16	4 – 3	3	4	3 – 2	3	3	4 – 5	4	4 – 5	3 – 2

(Appendix Contd.)

APPENDIX

CHROMATICITY COORDINATES, COVALENT FIXATION VALUES, ALKALINE PERSPIRATION AND WASHING FASTNESS OF WOOL SAMPLES DYED FROM AQUEOUS AND CHARGED SOLVENT SYSTEMS

DYESTUFF	CHROMATICITY COORDINATES						ΔE	% COVALENT FIXATION		FASTNESS TO ALKALINE PERSPIRATION						FASTNESS TO WASHING			
	Solvent Medium			Aqueous Medium				Solvent Medium	Aqueous Medium	Solvent Medium			Aqueous Medium			Solvent Medium		Aqueous Medium	
	x	y	Y	x	y	Y				Staining of cotton	Staining of wool	Change in colour	Staining of wool	Staining of cotton	Change in colour	Staining of wool	Change in colour	Staining of wool	Change in colour
Reactofil Blue 2GL	0,466	0,297	30,86	0,463	0,306	21,42	3,413	61,72	60,84	2 – 3	3	4	2 – 3	3	4 – 5	4	4 – 3	4	4 – 3
Reactofil Blue 2 RLD	0,463	0,300	18,99	0,476	0,308	18,06	0,612	85,99	78,46	2 – 3	3	4	2	2 – 3	4 – 3	4 – 5	4	4	4 – 3
Reactofil Brilliant Red GL	0,595	0,356	65,19	0,594	0,355	63,54	0,489	84,57	68,98	2	2 – 3	4	3 – 2	3 – 4	3 – 4	4	3	5 – 4	4
Reactofil Brilliant Red 2B	0,590	0,353	59,02	0,586	0,350	67,56	2,403	83,91	71,68	3	3 – 4	4 – 3	3	3 – 4	3 – 4	5 – 4	3 – 4	5 – 4	3 – 4
Reactofil Brilliant Yellow 4GL	0,597	0,385	21,71	0,596	0,385	21,38	0,571	77,98	53,65	4 – 3	4 – 3	4 – 3	3 – 4	3 – 4	4 – 3	4 – 5	4 – 3	4 – 5	4 – 3
Reactofil Turquoise Blue GL	0,446	0,306	77,15	0,441	0,302	70,33	1,183	87,20	79,68	3 – 4	4 – 3	4	3 – 4	4	4	4 – 5	3 – 4	4 – 5	4
Reactofil Yellow RL	*	*	*	0,602	0,379	16,65	*	*	25,74	*	*	*	2 – 3	3	2 – 3	*	*	4	3
Lanasol Scarlet 2R	0,603	0,362	87,81	0,604	0,362	87,90	0,109	81,52	53,52	3	2 – 3	3	2 – 1	2	4 – 3	5 – 4	4	5 – 4	4 – 3
Lanasol Blue 3G	0,456	0,295	18,45	0,457	0,297	18,51	0,071	80,00	66,14	2	2 – 3	3	3 – 4	3	3	4	2	4	3 – 2
Lanasol Red G	0,588	0,382	65,92	0,594	0,355	65,29	0,079	95,19	83,05	2 – 3	4	4	3	4	3	4 – 5	3	5	5 – 4
Lanasol Red 5B	0,556	0,341	27,88	0,556	0,341	28,76	0,397	83,70	70,13	1	1 – 2	3	2 – 1	2	3	5 – 4	4	4 – 5	2 – 3
Lanasol Yellow 4G	0,594	0,387	23,63	0,595	0,387	24,94	1,416	87,18	69,35	3 – 4	3	3	3 – 4	3	4	5 – 4	4	5 – 4	4 – 5
Lanasol Blue 3R	0,436	0,276	20,43	0,433	0,274	20,84	0,195	79,55	62,87	2 – 3	1	3	3	2	3	5	2	5 – 4	3
Lanasol Orange G	0,606	0,368	10,39	0,606	0,369	11,19	1,562	82,27	57,89	2 – 3	2	3	3	2 – 3	4	5	4	4	4 – 5
Lanasol Red 6G	0,568	0,332	29,37	0,567	0,332	30,27	1,226	82,29	74,69	2 – 3	2	4 – 3	4 – 3	3 – 2	3	4	3 – 4	4	4
Levafix Blue E-3R	0,488	0,317	16,74	0,487	0,316	16,69	0,047	86,43	83,39	2	3 – 2	4 – 3	3 – 2	4 – 3	3	4	3 – 2	5 – 4	4
Levafix Brilliant Blue E – B	0,430	0,277	22,36	0,432	0,277	23,49	3,414	83,33	73,88	4 – 3	2	4	3	2 – 3	4 – 3	4 – 5	4 – 3	4 – 5	2 – 3
Levafix Brilliant Red E-4B	0,583	0,350	50,88	0,583	0,350	46,20	1,593	87,32	76,59	2	2	4 – 3	2 – 3	3	3	4 – 5	4	4 – 5	4
Levafix Brilliant Red E – G	0,600	0,359	81,18	0,602	0,359	78,74	0,477	68,53	77,24	1 – 2	2	4	1 – 2	1 – 2	4	4	4 – 3	4	3 – 4
Levafix Brilliant Scarlet E-3B	0,599	0,359	71,75	0,598	0,358	65,64	1,699	70,68	74,22	2	4	3 – 4	1 – 2	2	4 – 3	5 – 4	4 – 3	4 – 5	4

(Appendix Contd.)

DYESTUFF	CHROMATICITY COORDINATES						ΔE	% COVALENT FIXATION		FASTNESS TO ALKALINE PERSPIRATION						FASTNESS TO WASHING			
	Solvent Medium			Aqueous Medium				Solvent Medium	Aqueous Medium	Solvent Medium			Aqueous Medium			Solvent Medium		Aqeuous Medium	
	x	y	Y	x	y	Y				Staining of cotton	Staining of wool	Change in colour	Staining of wool	Staining of cotton	Change in colour	Staining ofq wool	Change in colour	Staining of wool	Change in colour
Cibacron Pront Red G	0,596	0,356	69,64	0,600	0,357	84,90	4,099	65,86	67,54	1	2 – 1	3 – 4	1	2 – 3	3 – 4	4 – 5	4 – 3	4	4 – 3
Cibacron Pront Golden Yellow 2R	0,607	0,373	14,33	0,606	0,374	14,62	0,353	83,30	71,95	2 – 3	3 – 4	3 – 2	3	4 – 3	3 – 2	4 – 5	3 – 4	4 – 5	3 – 4
Cibacron Pront Blue 3R	0,423	0,265	22,25	0,424	0,267	21,32	0,344	77,78	68,43	2 – 3	2	4 – 3	4 – 3	3	3	4	3	4	4 – 3
Cibacron Pront Yellow 4G	0,596	0,386	22,70	0,596	0,386	23,37	0,753	88,79	73,95	3 – 4	4 – 3	3 – 4	4	4	4	4 – 5	4	4 – 5	4
Cibacron Brilliant Yellow 3G	0,594	0,387	24,13	0,594	0,387	24,59	0,499	76,92	65,38	3	3	4 – 5	3 – 4	4	4	4 – 5	4	5	4
Cibacron Brilliant Red 2GB	0,598	0,358	78,73	0,599	0,358	75,54	0,822	73,75	74,82	1	1 – 2	3 – 2	1 – 2	2 – 1	4 – 3	5	2	4 – 5	2
Cibacron Brilliant Red 3BP	0,588	0,352	54,67	0,589	0,352	55,43	0,281	74,42	60,83	1	2	4	1 – 2	2	4	3	3	4 – 5	3
Cibacron Brilliant Orange G	0,573	0,374	51,43	0,572	0,371	47,44	1,168	78,92	60,54	3	3	3	3	2 – 3	2	4	3 – 4	4	3 – 4
Cibacron Brilliant Orange 2G	0,575	0,373	53,25	0,576	0,373	52,19	0,238	78,17	64,98	1	3 – 2	3	2	3	2 – 3	4	3 – 4	4 – 5	4
Cibacron Brilliant Blue FBRP	0,256	0,233	11,16	0,263	0,239	10,97	0,288	81,21	66,91	2	2 – 1	3 – 4	3 – 2	3	3 – 4	4 – 5	2	4 – 5	2
Cibacron Brilliant Blue BRP	0,255	0,231	10,60	0,258	0,235	10,66	0,167	79,41	69,70	2	2	3 – 2	2 – 3	3	3	4	1	4	2
Cibacron Brilliant Red 3BD	0,546	0,305	18,04	0,546	0,305	18,11	0,040	74,23	60,52	1	1 – 2	3 – 4	1	2	4	3 – 4	3	4 – 3	3 – 4
Cibacron Brilliant Red 3B	0,564	0,311	20,69	0,573	0,309	22,83	1,118	76,97	66,34	1 – 2	2	4	1	2	4	5	3 – 4	4 – 5	3
Cibacron Brilliant Red B	0,541	0,302	18,09	0,553	0,303	20,13	1,029	83,79	79,08	1	2	4	2	3	3 – 4	4	3	4 – 5	3
Cibacron Blue 3GA	0,266	0,271	10,56	0,267	0,270	10,95	0,182	77,27	70,81	2	2 – 3	3 – 2	3	3	3 – 2	4	2	4	2 – 3
Cibacron Yellow R	*	*	*	0,550	0,402	65,29	*	*	64,28	*	*	*	1	3	4	*	*	4	3 – 4
Cibacron Turquoise Blue GE	0,230	0,309	36,69	0,222	0,291	27,65	2,158	78,48	68,52	3 – 2	3 – 4	3	3	4 – 3	3 – 2	5	4 – 3	4	3 – 4
Cibacron Scarlet RP	0,583	0,324	25,60	0,587	0,326	27,37	0,966	88,51	75,72	2 – 1	2	4	3 – 4	2 – 3	3 – 4	4	4	4 – 3	4

(Appendix Contd.)

DYESTUFF	CHROMATICITY COORDINATES						ΔE	% COVALENT FIXATION		FASTNESS TO ALKALINE PERSPIRATION						FASTNESS TO WASHING			
	Solvent Medium			Aqueous Medium				Solvent Medium	Aqueous Medium	Solvent Medium			Aqueous Medium			Solvent Medium		Aqueous Medium	
	x	y	Y	x	y	Y				Staining of cotton	Staining of wool	Change in colour	Staining of wool	Staining of cotton	Change in colour	Staining of wool	Change in clour	Staining of wool	Change in colour
Cibacron Scarlet 4GP	0,607	0,366	10,99	0,607	0,366	11,17	0,372	89,76	69,05	1 – 2	3	3 – 2	1 – 2	2	3	4 – 5	4 – 3	4 – 5	3
Cibacron Scarlet 2G	0,546	0,305	18,11	0,581	0,327	25,82	–	69,61	68,13	–	–	–	2 – 1	3	3	–	–	4	4
Ramazolan Yellow GL	0,485	0,467	11,69	0,485	0,468	10,75	1,011	78,36	78,57	3	2 – 3	4	3 – 4	3	4	4 – 5	4	4	4 – 3
Ramazolan Brilliant Blue R	0,321	0,311	41,29	0,227	0,299	30,80	2,293	56,73	23,40	2 – 3	4 – 3	3	2 – 3	4 – 3	3	4 – 5	2	4	3 – 4
Ramazolan Brilliant Blue B	0,250	0,216	10,43	0,249	0,220	10,96	0,383	70,78	36,36	4 – 3	3	4	3	2	2	3 – 4	3 – 2	3	3 – 2
Ramazolan Red F3B	0,551	0,310	26,27	0,547	0,305	18,72	4,393	50,00	67,33	3	2	4	2 – 3	2	4	4 – 5	4 – 3	5 – 4	3
Ramazolan Orange GG	0,561	0,395	66,77	0,559	0,398	66,22	0,356	85,07	74,63	3	3 – 4	4 – 3	4	4 – 3	3 – 4	4 – 5	4 – 3	4	4 – 3
Ramazolan Orange GR	0,585	0,366	56,51	0,588	0,358	45,98	3,116	66,35	82,12	3	3	3	3 – 2	3	4	5	3	5	3
Ramazolan Red R	0,579	0,318	21,98	0,573	0,317	21,27	0,361	82,13	78,20	3	2	2	4 – 3	4 – 3	4	4 – 5	3 – 4	4 – 5	3 – 4
Ramazolan Yellow RR	0,534	0,424	80,71	0,532	0,424	77,23	0,689	58,00	74,75	3	3 – 4	4	4	4	4	4 – 5	4	4 – 5	4 – 5
Ramazolan Yellow G	0,508	0,455	11,06	0,503	0,457	9,86	1,578	69,00	61,04	3	3 – 4	4	3 – 4	3 – 4	4	4 – 5	4	4 – 5	4
Reactolan Orange GL	0,692	0,261	41,69	0,584	0,360	43,18	3,993	97,18	94,79	3 – 4	4 – 3	4	3	4	4	4 – 5	4 – 5	4 – 5	4
Reactolan Red 2GL	0,669	0,243	21,167	0,568	0,320	21,665	5,381	97,86	96,77	3 – 4	3 – 4	4	4 – 3	4	4	4 – 5	4	4 – 5	4 – 3
Reactolan Yellow R	0,670	0,305	10,89	0,668	0,307	10,80	0,736	93,67	93,65	4 – 3	4	4 – 5	4 – 3	4	4 – 5	5 – 4	4 – 5	5 – 4	4
Reactolan Yellow 3GL	0,656	0,315	11,16	0,657	0,315	12,07	2,631	96,94	95,77	4 – 5	4 – 5	4 – 5	4 – 5	4 – 5	4	5 – 4	4 – 5	4 – 5	4 – 5
Lanafix Turquoise Blue AG	*	*	*	0,220	0,267	16,63	*	*	56,04	*	*	*	1 – 2	3 – 2	4	*	*	4 – 5	3
Lanafix Brilliant Blue AR	0,245	0,197	11,19	0,242	0,190	9,69	1,061	88,86	70,03	4 – 5	4 – 3	4	4	4 – 3	3 – 4	4 – 5	4	4	3 – 4
Lanafix Brilliant Sky Blue AG	*	*	*	0,232	0,209	13,37	*	*	56,16	*	*	*	4	4	5 – 4	*	*	4 – 5	4
Lanafix Red B	0,546	0,317	18,09	0,536	0,316	16,60	0,678	84,46	78,11	2	2	3 – 4	1 – 2	1 – 2	3	4	4	4	3
Lanafix Brilliant Flavine 10G	0,434	0,428	11,79	0,430	0,431	11,14	0,759	83,50	76,50	4 – 3	3	3	4	3	3	4 – 5	4	4 – 5	4

(Appendix Contd.)

DYESTUFF	CHROMATICITY COORDINATES						ΔE	% COVALENT FIXATION		FASTNESS TO ALKALINE PERSPIRATION						FASTNESS TO WASHING			
	Solvent Medium			Aqueous Medium				Solvent Medium	Aqueous Medium	Solvent Medium			Aqueous Medium			Solvent Medium		Aqueous Medium	
	x	y	Y	x	y	Y				Staining of cotton	Staining of wool	Change in colour	Staining of wool	Staining of cotton	Change in colour	Staining of wool	Change in colour	Staining of wool	Change in colour
Primazin Brilliant Yellow 3GL	0,499	0,461	11,21	0,501	0,461	11,29	0,294	86,93	84,43	3	3	4	2	2	3	4 – 5	4	4 – 5	3
Primazin Yellow GRL	0,523	0,434	84,54	0,568	0,381	59,86	3,294	74,00	57,40	3	3	3	3	3	4 – 3	4 – 5	4 – 3	4	4 – 3
Primazin Scarlet 2G	0,577	0,332	26,10	0,577	0,335	27,91	0,955	86,61	60,89	2	2	3	1	1	3 – 2	4	3	4 – 3	3
Primazin Brilliant Red 3B	0,537	0,309	17,49	0,523	0,311	15,09	1,054	88,98	90,44	2	3	3 – 4	1	2 – 3	3	4 – 5	3	4	2
Primazin Bordeaux BL	0,393	0,309	8,45	0,390	0,313	8,79	0,441	85,12	63,81	3	3 – 2	3	2	2 – 3	3 – 2	4 – 3	3	3 – 4	2
Primazin Brilliant Violet RL	0,353	0,281	9,01	0,349	0,299	8,34	0,983	89,06	71,09	1 – 2	2	3	1	2	3	4 – 5	3	4	3
Primazin Blue 3RL	0,310	0,281	7,51	0,314	0,279	7,96	0,377	81,54	67,69	1 – 2	1 – 2	3	1	1 – 2	3 – 2	4	3	4	3
Primazin Brilliant Blue BL	0,268	0,241	9,64	0,271	0,246	9,47	0,189	86,25	63,25	2	2	3	1	1	3	4	3 – 2	4 – 3	2
Primazin Turquoise Blue GL	*	*	*	0,226	0,280	21,74	*	*	67,10	*	*	*	3	4	3	*	*	5 – 4	4
Primazin Brilliant Green 6BL	*	*	*	0,238	0,322	22,82	*	*	77,18	*	*	*	3	4	3	*	*	4 – 5	3
Primazin Yellow-Brown GL	0,515	0,387	29,08	0,516	0,390	29,30	0,076	75,66	59,21	2	2	3 – 4	2	2	3	4	3 – 2	4 – 3	3 – 2
Primazin Brown RL	0,486	0,339	13,02	0,480	0,336	12,90	0,085	71,50	60,00	1	2	3	2	3	3	4 – 5	3	4 – 5	3
Primazin Brilliant Red 2B	*	*	*	0,546	0,309	16,50	*	*	75,87	*	*	*	1	2	2 – 3	*	*	4 – 3	2 – 3
Primazin Brilliant Blue RL	0,282	0,233	8,51	0,268	0,227	8,27	0,852	89,39	63,47	2 – 1	1	3	2 – 1	1	3	3	3	3	2
Primazin Brilliant Pink B	*	*	*	0,495	0,304	12,85	*	*	62,64	*	*	*	1	2	2 – 3	*	*	4	3

(Concentration of dye = 5% (o.w.w.) in all cases)

*Indicates incompatability from the charged solvent system

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