Study of Monoazo Acid Dyes Based on Phenol System and their Application

J. H. Tandel[1], A. G. Mehta[2]

[1]Chemistry Department, B.P. Baria Science Institute Navsari - 396445 (India)

[2]Chemistry Department, P.T. Sarvajanik College of Science, Surat- 395 001 (India)

Abstract: ***3- [(2-methyl-6-Chloro-4- quinolinyl) amino] phenol (II) used as a coupling component was prepared by the condensation of 2-methyl-4,6-dichloroquinoline[1] (I) and 3- aminophenol. Fourteen Acid dyes (III a-n) were prepared by coupling (II) with various diazo component (R a – n). These dyes were applied on silk,wool and nylon fabrics. The study of exhaustion and the absorbance at specific λ_{max}(nm) of acid dyes, their application on various fabrics.***

Keywords: Silk, wool and nylon fabric, diazocomponent

1. Introduction

The synthesis of acid dyes based on 4-hydroxy-1-methyl-2-oxoquinoline **[1]**, 4-hydroxy-1-phenyl-2-oxoquinoline **[2]**, 4-hydroxyquinoline-[1,2-b]-4-oxoquinazoline **[3]**, N-[3-hydroxyphenyl]-8-quinolinesulfonamide **[4]**, 3-[(2,6-dimethyl-4-quinolinyl)amino] phenol **[5]** systems have been very recently reported. Many of the acid dyes containing azo and sulphonic acid group are closely related structurally to the direct cotton colours and there is no clear dividing line between those suitable for protein fibres and those which will dye cellulose well.

2. Literature Survey

The art of dyeing textile materials has been practiced for nearly 5000 years. Natural dyes, such as indigo, tyrian purple, alizarin and logwood were used exclusively until the discovery of Mauve or Mauveine by W. H. Perkin in 1856. Individual dyes also play a part in the manufacture of colour lakes, which are used as pigment, printing inks and for colouring plastics. Disazo and polyazo dyes containing sulfonic acid groups are also frequently used in the above applications.

3. Problem Definition

Colour has been playing a dominant role in the life of man from time immemorial. Even in the prehistoric times, the ancestors of man must have noticed (perhaps with or without understanding) the abundance of multitude of colours worn by nature.The vast expanse of the blue sky on a cloudless day or acres and acres of land crowned with chlorophyll-dominated green coloured vegetation or even an infinite variety of plants and trees, bearing flowers and fruits of varied colours of an almost innumerable combination of yellow, red and blue hues in different depths and shades.

4. Methodology

Preparation of 3- [(2-methyl - 6- chloro -4- quinoliny) amino] phenol (II)

A mixture of 2-methyl - 4- dichloro quinoline (2.120 g 0.01 mole) and m - amino phenol (1.09 g,0.01 mole) was refluxed with glacial acetic acid (40ml) on a sand bath using an air condenser for four hours. The reaction mixture was cooled to room temperature and poured over ice and was neutralized with ammonia solution (20%) the product was filtered, washed with water, dried and crystallized from aquous alcohol,yield 75% m.p >300^0 C.

Preparation of 4- R- azo -3-[(2-methyl-6-chloro-4-quinolinyl)amino] phenol (III a- n)

A clear solution of (ll) (1.24 g, 0.005 mole) in acetone (30 ml) and sodium hydroxide (15 ml, 10%) was cooled below 50C in an ice-bath. To this well stirred solution diazo-solution was added drop wise over a period of 10-15 minutes, maintaining the pH between 7.5 and 8.0. The stirring was continued for two hours at 0 to 50C. The reaction mixture was heated at 60^{0}C, and sodium chloride was added until the coupled mass was precipitated. It was stirred for an hour, filtered and washed with a small amount of sodium chloride solution (5% w/v). The dye was dried at 80^{0}C to 90^{0}C, extracted with DMF and precipitated by diluting. The DMF extract with acetone. A yellow dye thus obtained was filtered, washed with acetone and dried to 60^{0}C, yield 86 % m.p. >300^0 C.

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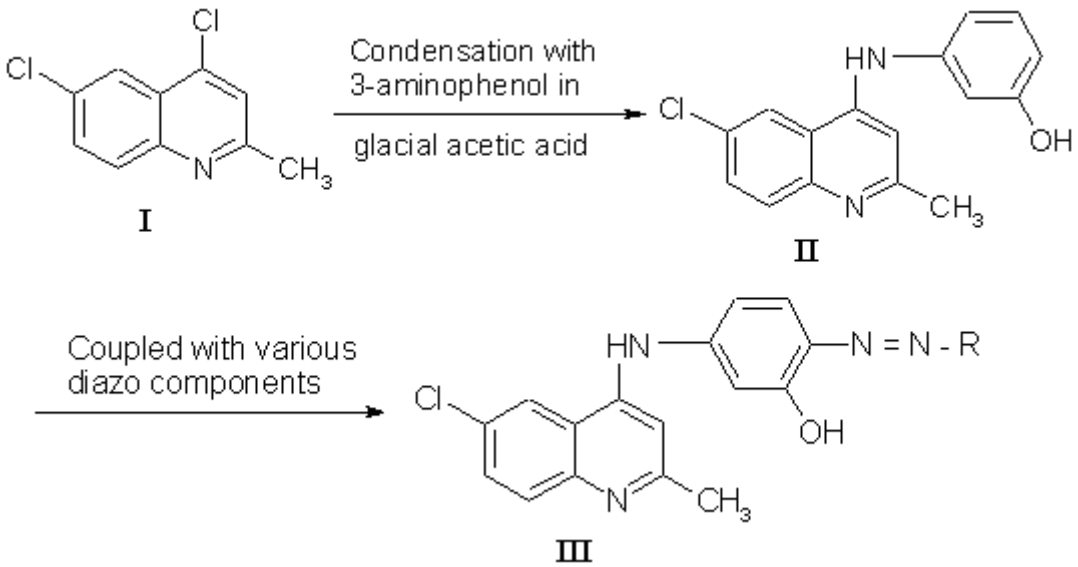


For Compounds III a-n R=
a. T acid h. S-acid
b. H acid i. Peri acid
c. Gamma acid j. K-acid
d. 1,7-Cleaves acid k. C-acid
e. J-acid l. Tobias acid
f. 1-Amino-2-naphthol-4-sulphonic acid m. Chicago acid
g. Bronner acid n. Laurent acid

5. Application of acid dyes

The most significant assistance in the application of acid dyes to provided by the acid added to the dye-bath. Many acid dyes will not exhaust at all on polyamide fibres unless the dye-bath has been acidified. The light and wash fastness properties of the dyed patterns were studied and determine the exhaustion properties of all acid dyes. These dyes were applied on various fabrics like silk,wool and nylon gave shows a variation in shades like brown, yellow and grey on shades card.

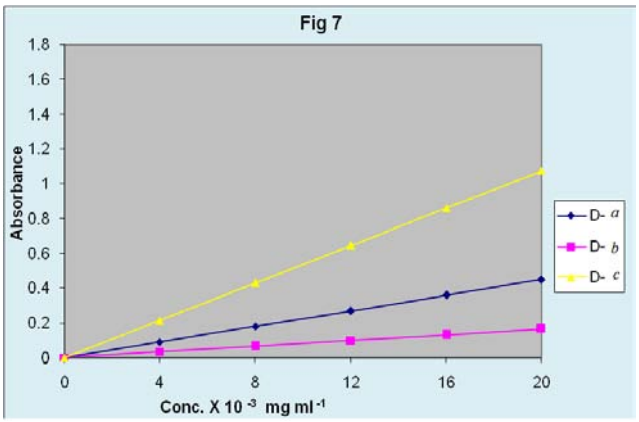
6. Calibration study

a) Preparation of the dye solution
The solution of the dye was prepared in water. The solution contained 0.1 g of dye in 100 ml of solution. Details of preparing solutions are given below. The dye (0.1g) was made into a paste in minimum quantity of water. To this paste, boiling water was added with stirring to obtain a clear solution. The cooled solution was diluted to 100 ml with water. The concentration of the dye solution was estimated colourimetry.

b) Colourimetric estimation :
This would require a calibration curve for the dye. Calibration curve was prepared by plotting respective absorbance against known concentration of dye in solution. From the absorption spectrum of the solution of a given dye, the position of λ_{max} absorption was noted. At this wavelength absorbances of different solutions containing 4 x 10^{-3}, 8 x 10^{-3}, 12 x 10^{-3}, 16 x 10^{-3} and 20 x 10^{-3} mg of dye per ml of solution were measured.

Calibration of Acid Dyes & Absorbance at Specified λ_{max} (nm).

Dye No.	*λ_{max} (nm)*	*Absorbance of the dye solution*				
		Concentration x 10^{-3} (mg. ml^{-1})				
		4	*8*	*12*	*16*	*20*
D-a	429	0.19	0.38	0.57	0.76	0.95
D-b	443	0.09	0.18	0.27	0.36	0.45
D-c	416	0.08	0.16	0.24	0.32	0.4
D-d	423	0.04	0.08	0.12	0.16	0.2
D-e	506	0.091	0.182	0.273	0.364	0.455
D-f	420	0.121	0.242	0.363	0.484	0.605
D-g	480	0.09	0.18	0.27	0.36	0.45
D-h	421	0.036	0.072	0.108	0.144	0.18
D-i	520	0.033	0.066	0.099	0.132	0.165
D-j	420	0.215	0.43	0.645	0.86	1.075
D-k	427	0.055	0.11	0.165	0.22	0.275
D-l	510	0.075	0.15	0.225	0.3	0.375
D-m	420	0.175	0.35	0.525	0.7	0.875
D-n	532	0.285	0.57	0.855	1.14	1.425



Calibration curve

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7. Results and Discussion

Monoazo acid dyes using 3- [(2 -methyl -6-Chloro- 4 -quinolinyl) amino] phenol as coupling component have been synthesized and their dyeing performance on silk,wool and nylon has been evaluated. The light fastness of the dyes can be ranked fair to good and wash fastness can be ranked very good to excellent.

8. Conclusion

The results reveal that the percentage dye-bath exhaustion of monoazo acid dyes based on 3- [(2 -methyl -6-Chloro- 4 -quinolinyl) amino] phenol is between 87% and 75%. The light fastness of the dyes can be ranked fair to good and wash fastness can be ranked very good to excellent . Visual observation of the dyed patterns mounted on shade cards shows a variation in shades like brown, yellow and grey.

9. Scope

The brilliancy and beauty of the shades and excellent wash fastness reveal that some of the acid dyes would prove to be useful dyes for dyeing silk fabrics. important discovery led to the preparation of a large number of other acid dyestuffs by the sulphonation of the basic dyestuffs from which they are derived. The Nichlson method of sulphonating dyestuffs is of great practical importance and can be applied to most classes of dyes.

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Author Profile

Dr. Jitendra H.Tandel received the B.Sc and M.Sc degrees in Chemistry from B. P. Baria Science Institute, Navsari and Veer Narmad South Gujarat University during Year 1991 and 1995 respectively. He received Ph.D degree in year 2008 from Veer Narmad South Gujarat University Under Guidance of Dr. Arvind G. Mehta.I Serving in B. P. Baria Science as a Associate Professor from Since last 20 year. He published two research paper during his academic year2016.

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