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Calculation of Dyestuffs and Auxiliaries for Effective Wet Processing Technology

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Abstract
Wet processing technology (Dyeing) is known as much valuable process for increasing the attractiveness of the textile material and that is very much costly as well as time consuming. So it is very important to take caution to calculate the accurate amount of auxiliaries (Caustic soda-NaoH, Soda ash-Na_2Co_3, Salt- NaCl etc) and dyestuff should be taken to get quality dyed fabric (appropriate shade, even shade). We know, the process by which a textile material change its color as well as properties (physical, chemical properties) in wet condition that is known as wet processing technology (pre-treatment, dyeing/printing and after treatment) pretreatment involved desizing, scouring, bleaching and after treatment involved washing, neutralization as well as to impart some stabilizing, textural and functional effect of finishing. At the initial stage of calculation, needs to calculate the lap deep before go for bulk productions. For this a lots of work is done in the dyeing laboratory. In the dyeing lab, lab dip or sample is developed by the dyeing master. Lab dip plays an important role in shade matching & this is an important task before bulk production.
Keywords: Chemical (auxiliaries) calculation, Dyestuff calculation, Achieve accurate shade offered by buyer.

1. Introduction

Wet processing (dyeing) plays crucial rule in the textile world for imparting the coloring substance to make it more attractive for users. Complete wet processing needs some different stages. In all the stages the materials (fibers, yarns, fabrics etc) are to treat with various chemicals. As a result there can be probabilities to take the wrong amount of chemicals and dyestuffs that will make the huge damage of the materials. So to avoid this problem it's necessary to calculate the accurate amount of chemicals as well as dyestuffs to use during the process for achieving the excellent result. For this way reprocess will be reduced and excellent result will be found. To accomplish all the process (pretreatment, dyeing/printing and after treatment first) of all the material should be weighted and processed with certain amount of chemical and dyestuffs that are found by required calculation according to recipe.

1.1 Equipments needed for Recipe calculation:

1. Microprocessor pH Meter
2. Digital pipette
3. Digital Weighting Meter with Glass Box (Explorer, USA)

1.1.1 Calculation for Lab Deep:

Recipe Calculation Formula:

Required Dye = (Shade percentage (%) x Weight of the fabric in gram (gm) /percentage (%) of Stock solution.
Or,
Required solution = $F_w S_p / C_s$

Where ,
$\mathbf{F_w}$ = weight of fabric, yarn, or fiber
$\mathbf{S_p}$ = shade percentage
$\mathbf{C_s}$ = concentration of stock solution

For calculating required amount of auxiliaries (chemicals) the formula is as below :
Required amount of solution (mls) = (Gram/liquor required x Weight of substrate x Liquor ratio) / (10 x concentration (%) of stock solution)

For addition of auxiliaries in solids form such as salt, soda the formula is :
Salt in gram/ liquor = (Required amount (%) x Sample weight x Liquor Ratio) / 1000

Conversion formula from percentage to gram/ liquor is as below :
Gram/liquor = Required amount (%) x 10 .
If alkali concentration is given then the formula to calculate this in gram/liquor is as follows:
Required amount of solution (mls) = (Gram/liquor required x Weight of substrate x Liquor ratio) / (10 x concentration (%) of stock solution)
Or,
Required amount of solution (mls) = (Required amount (%) x Weight of substrate x Liquor ratio) / (Concentration (%) of stock solution)

For Example:
Recipe:
Dyes:
1. Rema Blue RR = 1.122%
2. React Red KHW = 2.014%
3. React Yellow KHW = 1.486%

- Salt = 70%
- Soda Ash (concentration.20%) = 5 gram/liter
- Caustic Soda = 1.32%
- M: L = 1:8
- Sample Weight. = 5 gram
- Stock Solution (In percentages) = 1

Therefore, recipe calculation for dyes and auxiliaries in gram/liter will be as follows:
For dyes:
We know,
Required Dye = (Shade percentage (%) x Weight of the fabric in gram (gm)/percentage (%) of Stock solution.

Calculation of dyestuff will be,
for,
1. Rema Blue RR = (1.12 2x 5)/1=5.61 g/l
2. React Red KHW = (2.014 x 5)/1= 10.07 g/l
3. React Yellow KHW = (1.486 x 5)/1= 7.43 g/l.

For auxiliaries:
We know,
Salt in gram/liter = (Required amount (%) x Sample weight x Liquor Ratio) / 1000
Required Salt = (70 x 5 x 8)/1000 = 2.8 gram.

For Soda ash (concentration 20%) :
We know ,
Required amount of solution (mls) = (Gram/liquor required x Weight of substrate x Liquor ratio) / (10 x concentration (%) of stock solution)
Required amount of soda ash in C.C. = (5 x 5 x 8) / (10 x 20) = 1.0

Extra Water required:
= M:L – (required water to make solution of dyes & auxiliaries) = (5 x 8) – [(5.61+10.07+7.43) + (1.0+0.12)]
= 40 – 24.112
= 15.77 (Salt is added in solid form)

Objectives of the study:
The aims of this study scheme are to develop the formula to calculate required amount of auxiliaries as well as dyestuffs to getting the proper result. As we know vast amount if water are to use for coloration including pretreatment, dyeing and after treatment process and the water become waste. So, to reduce the use of this scare resource (water) and to save the environment from polluted water a technology should be developed. The authors tried to find out the technology by which textile material can be dyed without water.

Methodology:
Quality dyed textile material with low cost is highly needed. So that production personnel are trying their best to develop new formula to make proper dyeing in low cost as well as rapidly. This research based on the practical experience in the production field (dyeing) as well as secondary data.

Conclusion:
Dyeing process still is the mystery for all due to its verity of nature. Because same recipe as well as same amount dyes and auxiliaries produces different shade in the textile material (fiber, yarn and fabric). So it is very necessary to develop the formula to use the appropriate amount of dyes and auxiliaries. As a result proper dyed fabrics can be made; on the other hand cost and time will be minimized. Large amount of research input is needed for system integration.

References:
(1) Trotman. E. R., Dyeing and Chemical Technology 01' Textile Fibres, Sixth Edition. John Wilcy and Sons, New York, 1984
(2) Bhardwaj, H.C. & Jain, K.K., "Indian Dyes and Industry during 18th-19th Century", *Indian Journal of History of Science* ***17*** *(11): 70-81, New Delhi: Indian National Science Academy.*
(3) Hans-Samuel Bien, Josef Stawitz, Klaus Wunderlich "Anthraquinone Dyes and Intermediates" in Ullmann's Encyclopedia of Industrial Chemistry 2005 Willey-VCH, Weinheim: 2005.
(4) Hunger, K., ed. (2003). Industrial Dyes, Chemistry, Properties, Applications, Weinheim: Wiley-VCH.
(5) Zollinger, H. (2003). Color Chemistry. Synthesis, Properties and Applications of Organic Dyes and Pigments, 3rd ed. Weinheim: Wiley-VCH.
(6) Simon Garfield (2000). *Mauve: How One Man Invented a Color That Changed the World*. Faber and Faber, ISBN 0-393-02005-3
(7) Kulkarni. S. V. et al.. Textile Dyeing Opera- rions, Noycs Publications, Park Ridge, N. J., 1986
(8) Wylcs. D. H., Functional Deign of Coloration Machines in Engineering in Textile Coloration. Dyers Company Publication Trust, Bradford, England 1983

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