

Evaluation of Re-dyeability of Cotton Fabric after Microwave Aided Reactive Dye Stripping

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Abstract

Reactive dyes cannot be stripped satisfactorily from cellulosic materials due to the formation of covalent bonds between dye and fiber. This study was undertaken using yellow reactive dye on cotton fabric and dye stripping was carried out using microwaves radiations and normal heating in dyeing machine. Cellulose fabric was first unevenly dyed with Reactive Yellow Dye, later chemical stripping was done by varied concentration of stripping chemicals along with the application of microwaves. Optimized conditions of time and concentration of the stripping agents used in stripping system was determined in a couple of attempts and quality was assured by tear and tensile strength test. Furthermore, efficiency of stripping method was tested by calorimetric data using spectraflash spectrophotometer. K/s values of both dyed and stripped cotton was used to calculate the yield. Data was analyzed statistically by standard error of mean. Though with the increase of concentration of stripping chemicals and temperature, stripping percentages were improved; processing damage to the fabric such as losses in strength, weight and pilling resistance ratings was found. Microwave treated samples retained their strength.

Experimental Design

Step 1	
Acid hydrolysis with microwave irradiation	1%, 2% and 3% solution of sulfuric acid were prepared, and 0.5 g of cotton fabric dyed with reactive yellow was weighed and dipped in the solution and each solution was heated in the microwave for 30,60,90 and 120 seconds respectively.
Basic hydrolysis with microwave irradiation	50g/L, 70g/L and 90g/L solution of sodium hydroxide were prepared, and 0.5 g of cotton fabric dyed with reactive blue was weighed and dipped in the solution and each solution was heated in the microwave for 30,60,90 and 120 seconds respectively.
2 nd and 3 rd steps in microwave	
Reduction with microwave irradiation	The acid-treated cotton was immersed in reduction solution. Each sample was heated for 30, 60, 90 and 120 seconds and then stripped fabrics were rinsed in hot water for 5 minutes. The dithionite-treated sample was then neutralised in 0.2 ml/L acetic acid prior to warm rinsing and air drying.
Oxidation with microwave irradiation	The acid -treated fabric was immersed in oxidation solution containing 1 M hydrogen peroxide (35% Vols), 1.2 g/L sodium hydroxide, 1.8 g/L sodium carbonate and 7 g/L sodium silicate, at liquor-to-goods ratio of 15:0.5 and each sample was heated in microwave for 30, 60, 90 and 120 seconds respectively, followed by water rinsing and air drying.

2 nd and 3 rd steps in dyeing machine			
Normal Reduction in dyeing machine		The HYDROLYSED cotton was immersed in reduction solution. The bath temperature was raised to 80 C, and fabrics were treated at this temperature for 30 minutes, before raising the temperature to 100 C and further treating for 1 hour. The treatment bath was then cooled to 50 C, and the stripped fabrics were rinsed in hot water for 5 minutes. The dithionite-treated sample was then neutralised in 0.2 mL/L acetic acid OR NaOH prior to warm rinsing and air drying.	
Normal Oxidation in dyeing machine		The hydrolysed fabric was further treated with oxidation solution for 60 minutes at 85 C in dyeing machine, followed by water rinsing and air drying.	
Acidic Hydrolysis		Basic Hydrolysis	
Experiment name	Steps performed	Experiment name	Steps performed
1A	Microwave Hydrolysis Normal Reduction Normal Oxidation	1B	Microwave Hydrolysis Normal Reduction Normal Oxidation
2A	Microwave Hydrolysis Microwave Reduction Microwave Oxidation	2B	Microwave Hydrolysis Microwave Reduction Microwave Oxidation
3A	Normal Hydrolysis Microwave Reduction Microwave Oxidation	3B	Normal Hydrolysis Microwave Reduction Microwave Oxidation
4A	Normal Hydrolysis Normal Reduction Normal Oxidation	4B	Normal Hydrolysis Normal Reduction Normal Oxidation
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Results and Discussions



BEST STRIPPING PERCENTAGE

- stripping percentage
$$= \frac{\frac{K}{S} \text{ OF ORIGINALLY DYED FABRIC} - \frac{K}{S} \text{ OF STRIPPED FABRIC}}{\frac{K}{S} \text{ of originally dyed fabric}} \times 100$$
- EXPERIMENT 1A, HYDROLYSIS 3% SULFURIC ACID, TIME IN MICROWAVE 120SECONDS, % **99.14**
- EXPERIMENT 2A, HYDROLYSIS 3% SULFURIC ACIS, TIME IN MICROWAVE 120 SECONDS, % **99.55**
- EXPERIMENT 1B, HYDROLYSIS 90G/L SODIUM HYDROXIDE, TIME IN MICROWAVE 120 SECONDS, % **99.56**
- EXPERIMENT 3B, HYDROLYSIS NORMAL 90G/L SODIUM HYDROXIDE, , % **99.36**

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