Development of a New Scouring Methodology for the Textile Industry

[1]U G Samudrika Wijayapala, [1]D K A S Dharmasena, [1]D M N Bandara, [1]M A I Chathuranga, [1]K S Rajapakshe

Abstract

Scouring is one of the most important processes in fabric formation in the textile industry. The main function of scouring is the removal of hydrophobic impurities in fabrics made out of natural fibers. Normally scouring is done after the sizes are removed in the desizing process. Three main scouring methods can be identified in the current textile industry. Alkaline scouring, Bio scouring, Solvent scouring are those three main methods with the alkaline scouring being the traditional and widely used method. In this research the drawbacks of the existing scouring methods have been discussed under three main aspects which are efficiency, economy and environmental friendliness. Neither of the above three scouring methods satisfy all these three aspects, at least up to a reasonable level. In order to achieve all these three objectives concurrently, development of a new process by combining existing methods was focused on in this research. This approach has not been followed in the past. Under this project, combining of Alkaline scouring with Bio scouring and Solvent scouring were separately considered as the approach of the research. Widely used Alkaline (NaOH) scouring method has been chosen as the reference method and aspects of this method were compared with experimental results. Recipes were developed according to general requirements of combining agents and tested with 100% cotton twill fabric and results were analyzed. Within all tested recipes the most suitable combination was finalized with necessary conditions in order to achieve better results in terms of efficiency, economic and environment friendliness compared to the reference methodology.

Key words: Scouring, desizing, environment, textile industry, solvent scouring

1. Introduction

Scouring process can be considered as one of the most important pretreatment processes in textile wet processing. The main objective of the scouring process is to improve the absorbency level by removing all types of hydrophobic matters present in the substrate while having the minimum damage to the substrate. Desizing and bleaching are the upstream and downstream processes respectively for the scouring process. These three processes (desizing, scouring and bleaching) are carried out in a sequence and have influence on top of each other. In the field of scouring, three well known scouring methodologies are available; namely Alkaline, solvent and bio scouring. Each of these methodologies has their own inherent advantages as well as disadvantages. Out of these three methodologies, Alkaline/traditional scoring process is widely used on an industry scale and the main chemical ingredient used is Sodium hydroxide.

Even though, there are number of new developments and innovations in the scouring arena, by combining pretreatment processes and by introducing environmental friendly chemicals such as enzymes, no one has achieved efficient, economical and environmental friendly factors up to a reasonable level. In this research, drawbacks of existing methodologies are categorized and discussed with regard to the three main parameters, economy, environmental friendliness and efficiency. Some processes are better in one factor while not achieving the other two. As an example, alkaline scouring has high efficiency but is not good in economy and in environmental friendly aspects.

[1] Department of Textile and Clothing Technology, University of Moratuwa , Moratuwa. *samu@uom.lk*

The growing environmental protection needs among producers and high demand for lower cost products have created an environment for scouring processes to achieve above objectives.

2. Methodology

2.1 Approach for Combination of Processes

Neither of the three main scouring methodologies accomplishes efficient, economical and environmental friendliness parameters simultaneously. In this research, in order to achieve the three key parameters simultaneously a new methodology for scouring was defined by combining two of the three existing methodologies. This approach has not been used in any recent development, hence making it unique. In order to simplify the comparison of results alkaline scouring process has been kept as the standard because in the present context, it is the most widely used method at an industry scale. Bio scouring process shows better results in the environment friendly area, trials were carried out with other two methodologies (Alkaline scouring and Solvent Scouring).Recipes were developed to obtain required quality and tested with 100% cotton twill fabric and results were analyzed.

2.2 Chemical Selection

The logic behind the approach is related to the chemical structure of cotton. The outermost layer or the cuticle consists of a thin waxy layer which prevents the scouring agents to enter the inner layers of the cotton fiber. Both solvent (perchloroethylene) and sodium hydroxide are capable of dissolution of this wax layer and allow the enzyme (PerizymeBsc) to reach the primary wall of the cotton. The primary wall consist of pectins which holds the other hydrophobic matters together such as proteins , hemicelluloses, fatty acids etc. The enzyme is responsible

for degradation of the pectins present in the primary wall and releasing the hydrophobic matter.

Even though the combination of bio scouring and solvent scouring was not compatible, combination of bio scouring and alkaline scouring process shows better results compared to the reference methodology. Within all tested recipes, the most suitable combination was finalized with necessary conditions in order to achieve better results in terms of efficiency, economy and environment friendliness compared to the reference methodology.

2.3 Recipe Development
2.3.1 Reference recipe

One recipe solely from NaOH was used as the reference recipe throughout the project.

Table 1: Recipe-1

M.L.R	NaOH	teapol	temp	time	pH
1:50	4%	2g/l	90-95	1 hr	12.3

2.3.2 Recipes developed

The following recipes were developed under the combination of alkaline scouring and bioscouring process.

Table 2: Recipe -3 combinations

	1 bath				2 bath			
	Re. 3-A	Re. 3-B	Re. 3-C	Re. 3-D	Re. 3-E		Re. 3-F	
					1st	2nd	1st	2nd
MLR	1:50	1:50	1:50	1:50	1:50	1:50	1:50	1:50
Pectenese	2g/l	2g/l	2g/l	2g/l	0	2g/l	0	2g/l
NaOH	0.5	2	0.5	2	0.5	0.2	2	0.2
Temp	65-75	65-75	40-50	40-50	90	60	90	60
Teapol	2g/l	2g/l	2g/l	2g/l	2g/l	2g/l	2g/l	2g/l
pH	9.2	11.6	9.6	11.2	9	8.4	10.8	8.5

The following recipe was developed under the combination of solvent scouring and bio scouring process.

Table 3: Recipe-3

MLR	Pectenese	Temp	Teepol
1:30	2g/l	40-50	2g/l

2.3.1 Testing

The following tests were carried out in order to evaluate the results towards the set objectives.

2.3.1.1 Weight loss

Under this test oven dry weight of the fabric sample was measured before and after the scouring process and the difference was taken as the weight loss. This would be taken as a value of the degree of scouring which gives the amount of unwanted matters removed.

2.3.1.2 Tensile strength

Instron Universal Tester (Model No. J4525) was used to measure the tensile strength of the samples in this project. Test standard followed is BSEN ISO 13934.

2.3.1.3Absorbency test

Standard drop penetration test was carried out for the absorbency. The absorbency test standard is AATCC-79-2000.

2.3.1.4 COD and BOD

These two tests were carried out for the residuals of the scouring process and used to measure environmental impact.

2.3.1.5 Whiteness test

This test was carried out to test the whiteness achieved after scouring. Spectrometer (Color Eye 218 OUV) and Color Eye QC software were used to measure the whiteness.

2.3.1.6 pH test

pH values of all residuals were measured by using a digital pH meter.

3. Results& Discussion

The recipe which was defined by combining alkaline and solvent scouring process did not give favorable results and tends to degrade the fabric. Hence that approach was discarded.

The main aspects that should be considered after scouring are weight loss, absorbency, strength loss, whiteness index, pH value of the recipes and environmental parameters (Bio chemical Oxygen Demand (BOD) of the effluent). After investigating the above aspects the following results were obtained.

3.1Weight Loss

According to the results recipe 3-B has the highest value in weight loss. None of the recipes have achieved considerably lower value than the reference value. Being a measurement of the degree of scouring higher weight loss can be considered as a higher efficiency of the scouring process.

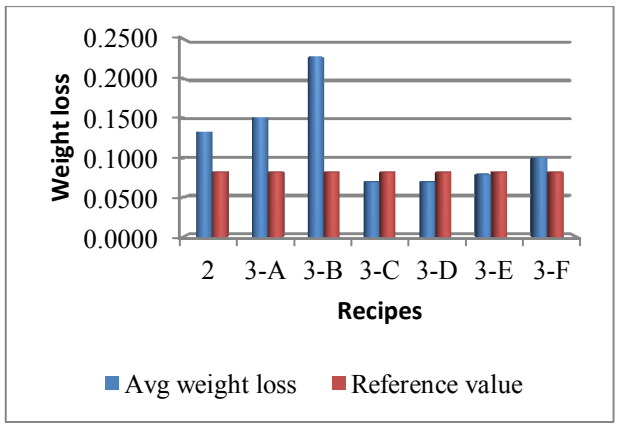

Figure 3.1: Data comparison for weight loss

3.2 Absorbency Test

Shorter time indicates better absorbency which indicates higher efficiency of scouring. Comparison of the averaged values with the reference value are shown in graph, in the figure 3.2.

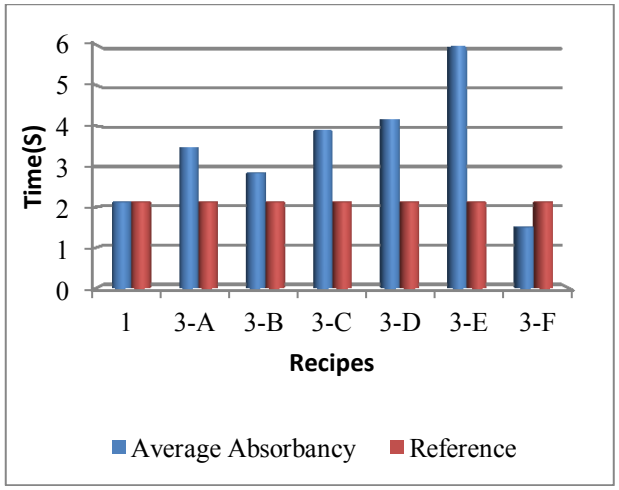

Figure 3.2: Data comparison for absorbency

3.3 Strength Test

According to these results, tensile strength of all the developed recipes are lower than the strength of the reference recipe. Recipe 3-B shows the highest strength which is much closer to the reference value. The rest of the recipes are even lower in terms of strength when compared with the reference recipe.

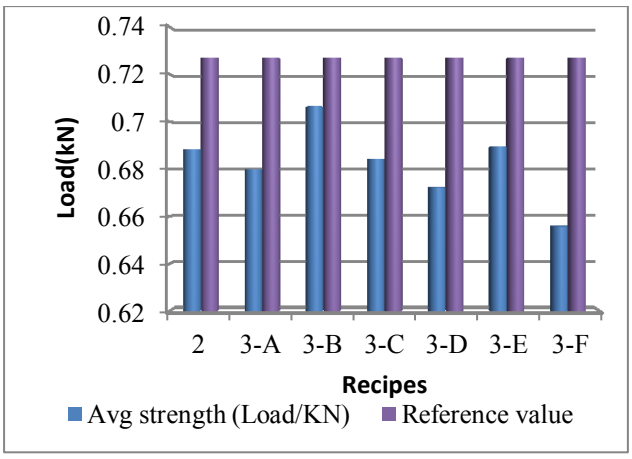

Figure 3.3: Data comparison for strength

3.4 pH Test

According to these results pH of all the developed recipes are lower than the pH of the reference recipe. Recipe 2 shows the lowest pH. It is very close to neutral value and recipe 3-B has the highest pH value among the other developed recipes.

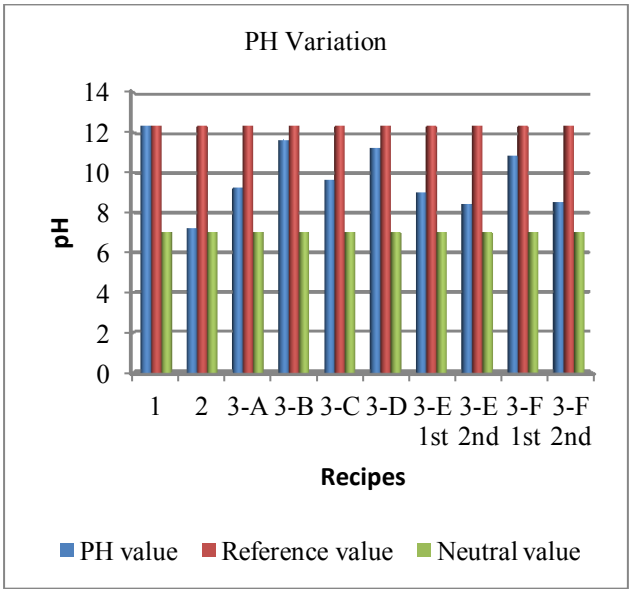

Figure 3.4: Data comparison for pH

3.5 BOD Test

Normally before measuring the BOD value of a solution, it is required to have an idea of its rough BOD value. Since these recipes are new it was not practical to predict rough BOD values, so two BOD ranges were selected for each recipe. The final BOD value was taken as the one with higher value.

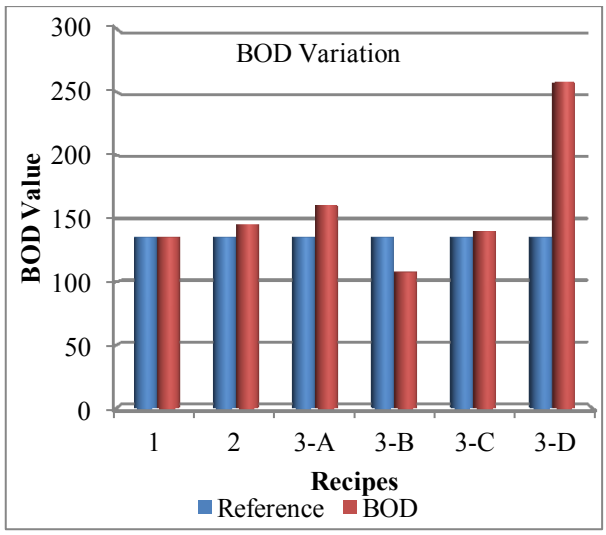

Figure 3.5: Data comparison for BOD – sample volume 244ml

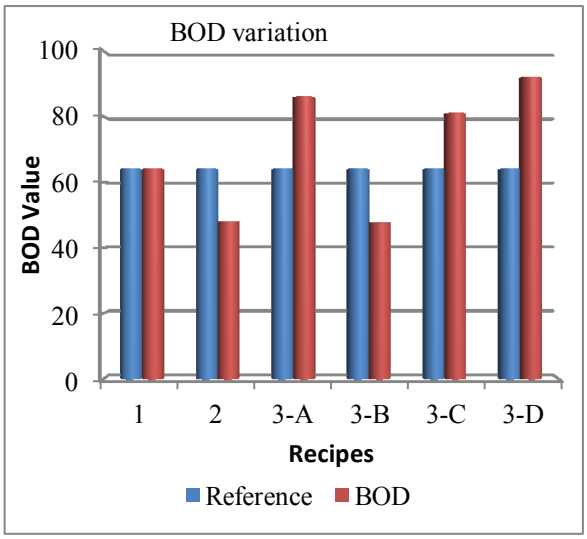

Figure 3.6: Data comparison for BOD – sample volume 360ml

3.5 Whiteness test

Whiteness test was carried out for scoured samples after scouring. According to these results whiteness index (WI) of all the developed recipes are lower than the Whiteness index of the reference recipe. Recipe 3-B shows the highest WI value which is closer to the reference value. Rests of the recipes are lower in terms of whiteness compared to the reference recipe.

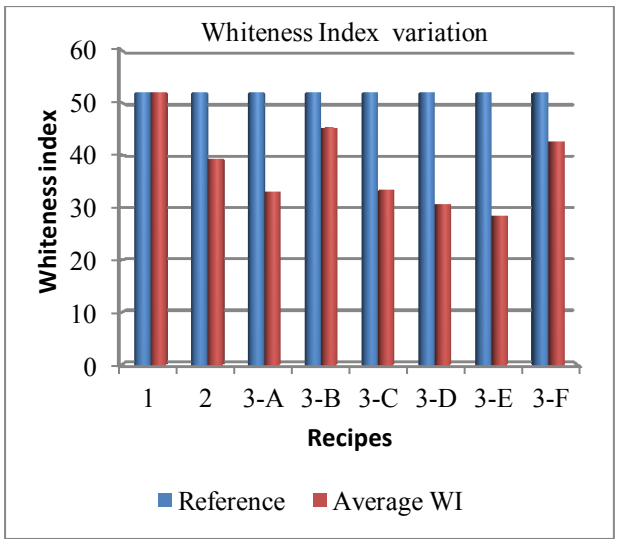

Figure 3.7: Data comparison for whiteness index

4. Conclusion

Since recipe 3-B is showing better results in weight loss, tensile strength and absorbency test, it can be concluded that 3-B is the best recipe in the case of degree of scouring which covers the efficiency factor. And in case of pH and BOD, 3-B is showing very good results compared to the reference values. Therefore it is clear that 3-B has been able to achieve the environmental friendliness factor as well. In recipe 3-B the temperature range is reduced from 90 to 60°C and the amount of NaOH used is reduced by 50% compared to the reference alkaline recipe. Besides, the enzyme that was used in this recipe is not an expensive one as well. Therefore considering the economical factor, it is obviously showing better results. Since recipe 3-B is achieving all the three parameters (efficiency, environmental friendliness and economy) it can be concluded that the scouring method developed through combining bio scouring and alkaline scouring under the 3-B recipe parameters is a better scouring methodology.

Table 3.1: The recommended scouring recipe

MLR	1:50
pectinase	2g/l
NaOH	2g
Temp	65-75^{0}C
Teapol	2g/l
pH	11.6

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