

A COMPARATIVE STUDY ON THE EFFECT OF LIQUOR RATIO OF ACID AND NEUTRAL(POWDER) ENZYME ON DENIM GARMENTS

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Abstract

Young people as well as older people have now great passion for the denim cloth. Today jeans are available in many colors and designs. In this study we tried to reveal the difference in between two types of cellulase enzymes acid and neutral (powder) enzyme. To do this, denim samples were collected and prepared according to the recipe of equal amount of enzyme by varying the liquor ratio. Basically there were no differences found in between acid and powder enzyme on different fastness properties like rubbing, washing, perspiration, light fastness test. But there was a significant difference in weight loss%. Acid enzyme exhibited little bit more enzymatic effect than powder enzyme and it also showed more weight loss % . But the neutral enzyme required less money rather than acid enzyme and no need to control pH, easy to use. Moreover, lower liquor ratio gave higher abrasion. Acid enzyme gave more back staining than neutral enzyme.

Keywords: Acid enzyme, neutral (powder) enzyme, enzyme effect, weight loss%, liquor ratio, cost comparison, etc

Introduction

Denim is very strong, stiff and hard wearing woven fabric [Razzaque, 2004]. It is cotton and twill weave fabric that uses colored warp and white weft yarn and used for jeans, work clothes and casual wear. Young people as well as older people have now great passion for the denim cloth. Today jeans are available in many colors and designs [Khan, 2011]. Denim is normally dyed with indigo, vat and sulfur dyes [Grieve & Schaub, 2006]. Among these, indigo share is 67%. Indigo dyes are used for fashion dyeing; in denim, fibers dyed with indigo are not included in fiber-transfer examinations, remains surface dyeing [Khan, Mondal and Uddin, 2011]. Different value adding processes like industrial washing makes the denims not only look beautiful but also impart some functional properties to the garments [Sarkar & Khalil, 2014]. Among different techniques of garments washing, enzyme is chosen to fade color from all over the garments in a regular manner and to polish the surface of the fabric [Rahman, 2013]. Enzyme wash is done on the garments made from heavy fabrics like denim. Cellulase enzyme is used for this type of wash. This cellulase enzyme hydrolyses the projecting hairy cotton fibers of the garments fabric surfaces and also removes color. For neutral cellulase enzyme liquor p^H should be between 6 to 7 and for acid cellulase enzyme pH should be between 4.5 to 5.5. If liquor pH is between 4.5 to 5.5 then the possibility of back stain increases [Kashem, 2008]. Here we reported the comparison between the acid and neutral enzyme based on different washing fastness tests and enzymatic effect as well as cost. Moreover, the impact of liquor ratio on denim garments was also investigated. These enzyme processes are frequently used in large volume in our country basically in garments washing industry. But there was a very inadequate research in this field. So this research would be helpful tools for our entrepreneur for selecting enzymes and minimize costing.

Material & Methods

Materials

100% cotton standard denim garments (trousers) were used. These comprised indigo dyed denim fabric, GSM 345, twill weave 3/1, construction $72 \times 52 / 9 \times 9$, warp way black combination shade and weft way white. Garments were desized using the given recipe. Then the denim garments were washed using acid enzyme (TEXZYME 3000L) and neutral enzyme (TEXZYME PD) separately. Denim trousers were collected from Jeans Culture Ltd. Dhaka, Bangladesh.

Methods

Desizing Treatment

Denim trousers were desized using anti back staining agent and desizing agent. This pretreatment was conducted in liquor containing desizing agent (Biode 1.0 g/l) and anti back staining agent (LP 0.5 g/l) and material to liquor ratio 1: 10 in a small scale front loading industrial washing machine (Ngai Shing, model-NS 2205, Hong Kong). This treatment was carried out at temperature 60°C for 15 min. After desirable time the liquor was dropped out. Then treated denim trouser were rinsed two times.

Enzyme Treatment

Desized denim trouser were treated with using acid and neutral enzyme separately. In case of acid enzyme we had to use acetic acid to maintain pH in the range of 4.5-5.5 but for neutral enzyme did not use acetic acid. This process was conducted water containing TEXZYME 3000L (1.0 g/l), LP (0.5 g/l) and TEXZYME PD (1.0 g/l), LP (0.5 g/l) in a front loading washing machine (Ngai Shing, model-NS 2205, Hong Kong) separately. This enzyme treatment was carried out at different liquor ratio (1:10, 1:15 and 1:20) at temperature 45°C for 20 min. Then the treated denim trousers were rinsed twice with clean water.

Hydro Extracting and Drying Processes

Enzyme washed denim trousers were squeezed to a wet pick-up of 70% at 200 rpm for 3-4 min in laboratory scale hydro-extractor machine (Zanussi, Roaches International Limited, England), then dried at 75°C for 35-40 min in a steam drier (Opti-Dry, Roaches International Limited, England). Treated denim trousers were then evaluated through different fastness properties, physical properties and visual observations.

Testing and Analysis

All treated denim trousers were conditioned in 65% Relative humidity (RH%) and 20°C for 24 h before testing according to BS EN 20139 and ASTM D1776.

- Weight loss (%) in fabric / GSM was calculated from the difference in fabric weight before and after the treatment according to ASTM D 3776.
- Rubbing fastness of samples were evaluated by crock meter machine according to ISO 105X12 standard
- Washing fastness of samples were evaluated by Lavdenometer machine according to ISO 105C06C2S standards.
- Perspiration of samples were measured according to ISO 105-EO4

- Light fastness of samples were measured by Xenont/Beta⁺ according to ISO 105BO2
- EPI and PPI were measured manually by using needle and counting glass.
- Enzymatic effects were observed visually.

Results and Discussions

Effect of enzyme wash on weight loss %:

The changes of weight loss % after washing by using acid and neutral enzyme at varying liquor ratio in the fabric are shown in figure 1

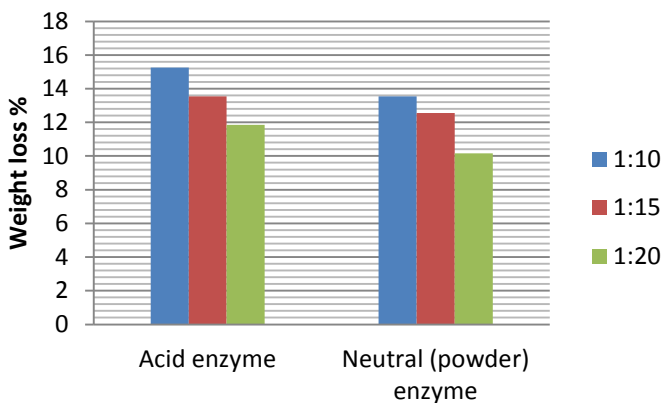


Figure1: Effect of enzyme wash on weight loss %

This is due to frictional differences of fabrics and liquor ratio. Lower liquor ratio exerted more friction on fabrics and result in higher weight loss %. It is clear from figure 1 that weight loss % depends on which types of enzyme was used for washing. Here acid enzyme gave more weight loss% than neutral enzyme. Moreover, figure 1 indicated clearly that lower liquor ratio led to more weight loss%.

Rubbing fastness, light fastness, washing fastness (color change and color staining), perspiration fastness test result

There was no differences observed in rubbing fastness [Figure 2], light fastness [Figure 3], washing fastness color changing [Figure 4], washing fastness color staining [Figure 5], perspiration fastness [Figure 6] between acid and neutral enzyme by varying liquor ratio for denim garments. It was suggested that liquor ratio has no influence on the following results.

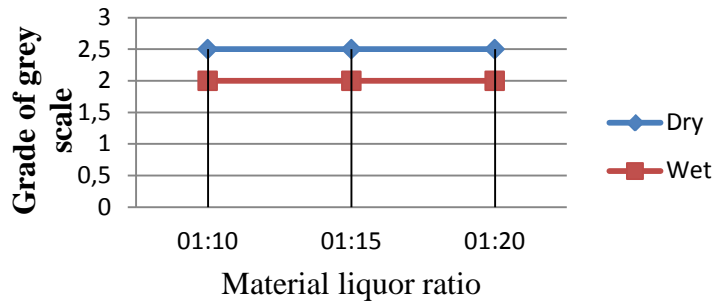


Figure 2: Rubbing fastness test result in dry and wet stage

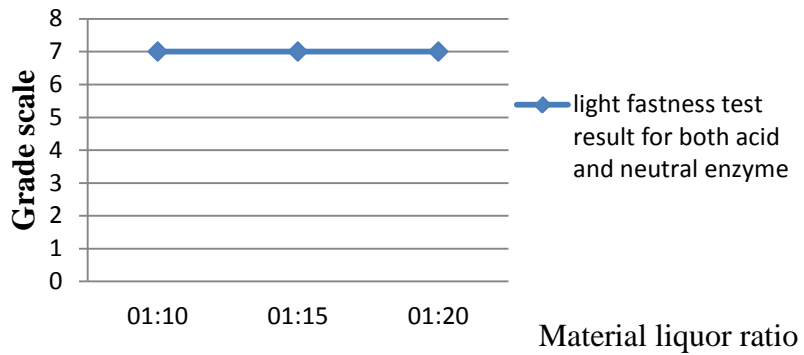


Figure 3: Light fastness test result for both acid and neutral enzyme

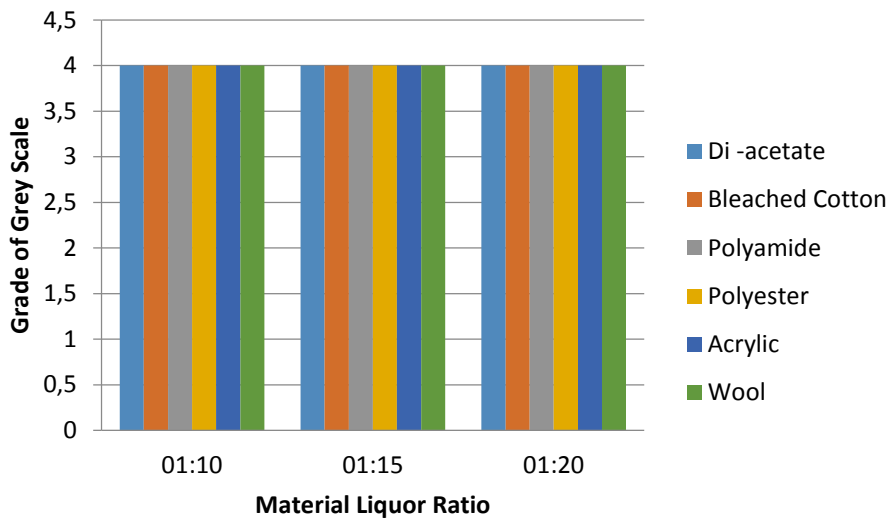


Figure 4: Washing fastness (color change) test result for both acid and neutral enzyme

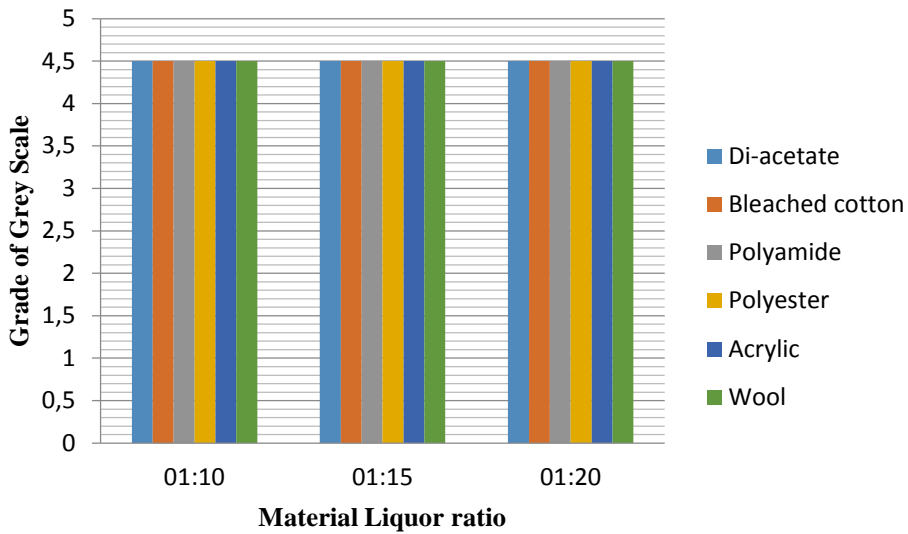


Figure 5: Washing fastness (color staining) test result for both acid and neutral enzyme

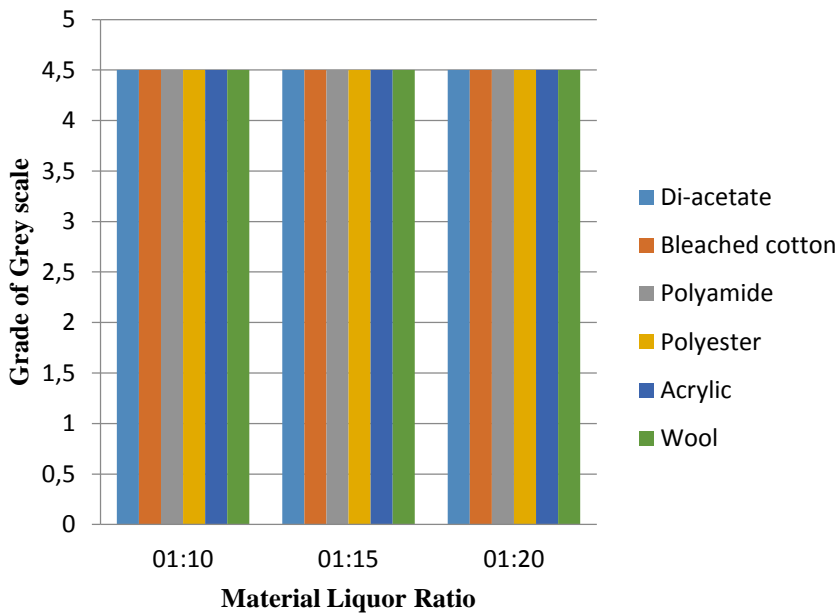


Figure 6: Perspiration fastness (Alkaline solution) test result for both acid and neutral enzyme

EPI and PPI counting:

There was negligible change in PPI between the pre wash sample and after wash sample. But there was no significant differences in EPI as well as PPI between the acid and neutral enzyme by varying liquor ratio for denim garments shown in **Table 6**

Sample Developed by Cellulase Enzyme	Material Liquor Ratio	EPI and PPI
Pre wash		72×52
Acid (Liquid)	1:10	72×55
	1:15	72×55
	1:20	72×54
	1:10	72×54
Neutral (Powder)	1:15	72×54
	1:20	72×53

Table 6. EPI and PPI

Visual observation

By visually we observed that lower liquor ratio led to more enzymatic effect. Acid enzyme gave more back staining than neutral enzyme. The enzymatic effect of acid enzyme was little bit higher compared to neutral enzyme process.

Cost comparison:

Figure 7 was represented the cost (Bd taka) of acid and neutral enzyme process. It was significantly visualized that neutral enzyme process requires lower cost than acid enzyme. On the contrary, acid enzyme needs more back staining agent which adds more expense to the process. Moreover, neutral enzyme process is more economical as its market value is cheaper. Here cost comparison was made by using 1 g/l enzyme, 0.6 g/l anti-back staining agent water containing 100 L.

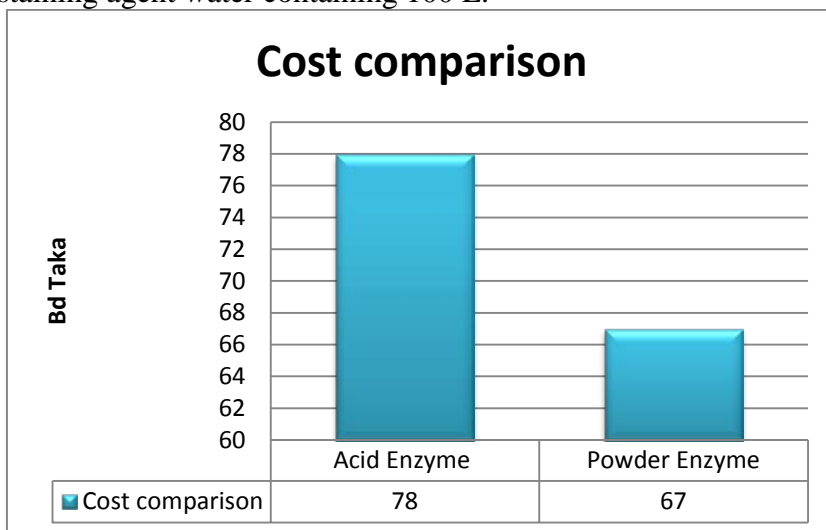


Figure7: Cost calculation for both acid and neutral enzyme

Conclusion

In this study, we tried to explore the difference between two types cellulase enzyme and their effects on denim trousers in terms of various physical properties & cost analysis. The result was very positive for neutral enzyme process than acid enzyme. It required less expense than acid enzyme. Weight loss % was low compared to acid enzyme process. We didn't observed any change in fastness properties between acid and neutral enzyme process. The liquor ratio has no influence on fastness properties but played a vital role in weight loss %. This study also reveal that lower liquor ratio gave more enzymatic effect.

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