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# Effect of Surfactants on Enzymes Behaviour in Desizing Process

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**Abstract:- This paper aims to use amylase enzyme in desizing process in addition to nonionic surfactants in a view to study the effect of the former on the role of enzyme in desizing process. The raw cotton fabrics were treated with amylase enzyme and nonionic surfactants in order to obtain the best results of surfactants and enzymes, after that we study the treatment time to obtain the best condition of desizing treatment.**

## I. INTRODUCTION

Cotton is the most widely used of fabrics. In 1976, the consumption of natural fibers was 8,081.4 thousand metric tons, whereas that of cotton only was 3,389 thousand metric tons.

Cotton was a combination of properties- durability, easy wash ability, and comfort that have made it desirable for summer clothes, work clothes, towels and sheets.

About 65% of the cotton used for textiles is made into woven fabric. The purpose of the sizing process is making to form coating of strong and elastic film around the cotton fiber to stand the tension during weaving and prevent the fiber from breaking. The surface coating of sizes are stiff, hard and less absorbent to water [(5)].

Textile processing is an industry that traditionally has used a lot of harsh chemicals and energy. Due to the ever-growing costs for water and energy. investigations are done to make conventional chemical textile processes by environment-friendly substances and economically attractive bioprocesses using enzymes [(1)] .

Desizing is the process further removing the size around the warp yarn before weaving. The purpose of this process is to facilitate the penetration of dyes and chemicals in wet processing operations.

Starch is widely used as a sizing agent, because it is cheap and based on natural, sustainable raw materials [(6)]. Starch and its derivatives is most sizing agent that used in sizing process [(5)].

Enzymes is used to remove starch sizes from the warp yarn. this is one of the oldest enzyme applications.[(6,2-3)]Amylases are enzymes which hydrolyses starch molecules and give diverse products, including dextrin's and smaller polymers composed of glucose units [(4,8)].

## II. EXPERIMENTAL WORK

### *A. Materials and Dyestuff*

- *Fabric*:
  Pure cotton woven fabrics (157g/m$^2$) (yarn count 20/1) from Nile Textile industry.

- *Enzyme:*
  Amylase enzyme (chemical composition aqueous solution of Alpha- amylase enzyme) produced by Advanced chemical processing company

- *Surfactants :*
  Nonionic surfactants ( chemical composition : Highly solid concentrated fatty easter condensate with emulsifier ) was produced by Advanced chemical processing company and used throughout this study- Egypt

- *Dyes:*
  Reactive dye (reactive dye ME4BL 195) was produced Garima dye chemistry located in India Hydrogen peroxide $H_2O_2$ , stabilizer , dispersing agent was produced by GB.(German Basic chemical products) – Germany

### *B. Technical Procedures*

- *Effect of Surfactants Concentration*
  The undesized cotton fabrics were treated with different concentrations of surfactants (0.5%,1%,1.5%,2%) while the enzyme concentration is constant 1 % at pH 7 using L:R 1:20, at 70°C for 45 min. the fabric were dried and dyed with 3 % reactive dye, 30 gm salt, 20 gm $Na_2O_3$ L:R 1:20 at 60 °C for time 60 min.

- *Effect of Enzymes Concentration*
  The undesized cotton fabrics were treated with different concentrations of enzymes( 0.5%,1%,1.5%,2%) while the surfactants concentration is constant (1%) at pH 7 using L:R 1:20, at 70°C for 45 min. the fabric were dried and dyed with 3 % reactive dye, 30 gm salt, 20 gm $Na_2O_3$ L:R 1:20 at 60 °C for time 60 min.

- *Effect of Time Concentration*
  Different treatment time were applied(15 min, 30 min,45min,60 minand 75 min) for treating cotton/polyester blended fabrics. The fabric were dried and dyed with 3 % reactive dye ,30 gm salt, 20 gm $Na_2O_3$ L:R 1:20 at 60 °C for time 60 min.

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*C. Measurements*

➢ *Determination of Desizing Rate*

Desizing Rate was determined according to Egyptian standards ( E.S :663/2002) Determination of Total starch or Gum size and filling in cotton or viscose rayon yarn and fabric , Egyptian organization for standardization and quality.

$$\text{Desizing rate \%} = \frac{\text{rate of fabric containing starch} - \text{rate of sample containing starch after desizing}}{\text{rate of fabric containing starch}}$$

➢ *Color Strength:*

Color strength: The color strength (K\S) of was measured with aspectrophotometer, ultra scan pro. The used spectrophotometer was of model ICS-Texicon Ltd., Kennestside Park, Newbury, Berkshire RG 145TE, England.

## III. RESULT AND DISCUSSION

The main aim of the present work is to discuss the effect of surfactants on the role of enzyme to achieve the goal for samples of raw cotton fabric. The non-ionic surfactant increased the rate of the enzymatic reaction by the disturbing the structure of cellulose which is illustrated in results of loss of weight and K/S

*A. Effect of Surfactants Concentration*

In figures 1,2 : the raw cotton fabric were desized with different concentration of surfactants as said and adding 1% amylase enzymes.

The desized cotton fabric were evaluated for both a) loss in weight and K/S which illustrated in figure 1, and Figure 2

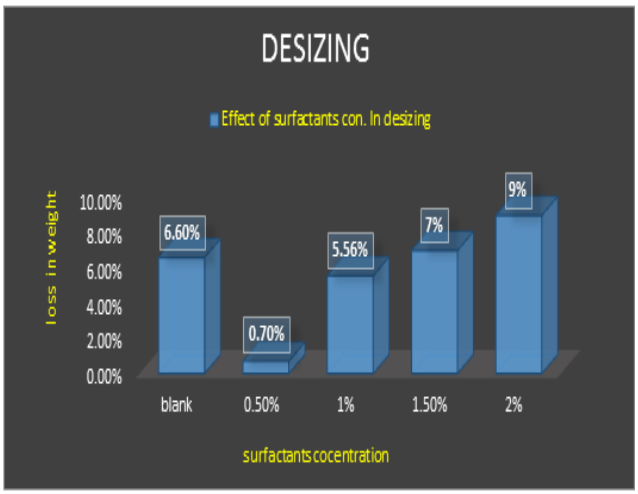


Fig 1:- Effect of nonionic surfactants concentration on loss in weight

The raw cotton fabric were desized with different concentration of surfactants as said and adding 1% amylase enzymes . The percentage of weight loss is showed in figure (1)

We can easily from illustrate from figure (1) that increasing the concentration of surfactants while the enzyme is constant is accompanied by increasing in the percentage of the loss in weight.

AS it clear from the data of figure (1) that treating cotton fabric with different concentration of enzymes is accompanied by loss in weight. This phenomena holds true in all concentration of surfactants use. This means clear that their was a directly proportional relation between the concentration of surfactant used and weight loss , by increasing the concentration of surfactant it was found that percent of loss in weight increased in all ranges studied . It also found that the highest loss in weight was **9 %** by using 2% surfactants and 1% enzyme to the enzyme reaction.

When comparing the new method and the traditional one. It can be illustrated that the loss in weight is 9% by adding 2% surfactants, 1% enzyme ( the new method) while in the traditional way The loss in weight **was 6.6 %** by adding 2% enzyme without surfactants.

This means that saving almost half the concentration of enzyme is accompanied by loss in weight 2.4 % only and this value can be acceptable for decreasing the concentration of enzyme which become so expensive now days

Nonionic surfactants play an important role in desizing process and affects starch concentration in the fabric , It was found also that as the concentration of surfactants increase in combination with enzyme the % loss in weight increase too and percent of starch in fabric decrease.

This phenomena due to, three different explanations

1- Surfactants increase enzyme stability and prevent denaturation of enzymes By adding non-ionic surfactants the contact of enzyme with the air–liquid interface reduced due to the surface activity of the surfactant
2- surfactants could affect the structure of the substrate and make it more accessible for enzymatic reaction through
- altering the cellulose's properties
- disturbing the structure of cellulose
- (reduction the degree of crystallinity), making the substrate more accessible to the enzyme,

3- Micelle formation of surfactants could enhance the partitioning of the enzyme into the surfactant micelles, and lead to reduce of free enzyme available for hydrolysis [8].

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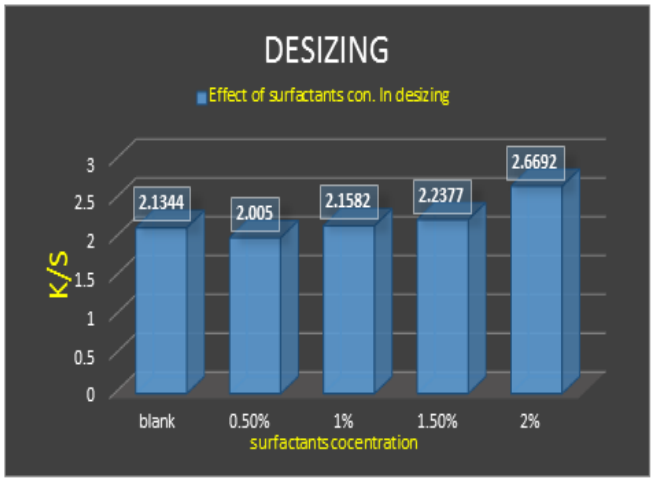


Fig 2:- Effect of nonionic surfactants concentration on K/S.

The samples were desized under enzymes and surfactants were under go dyeing with reactive dye .results of K/S showed in result figure 2

Figure (2) illustrate that increasing the concentration of surfactants while the enzyme is constant is accompanied with increasing in k/S.

k/S increase by adding the surfactants to reach to **2.6692** by adding 2% surfactants and 1% enzyme to the enzyme reaction. When comparing the new method and the traditional one , we can illustrat that k/S is **2.6692** by the new method while the traditional way the k/S is **2.1344** by adding 2% enzyme without surfactants.

This mean that adding surfactants to enzyme plays an important role in increase the latter efficacy to increase its role not only in desizing but in dyeing and uptake By using the new treatment the K/S increase by almost 25%.

That is may be due to the role of surfactants which swell the fibers and increasing the wettability of yarns and hence increase the fabric uptake to absorb and react with more and more dye molecules ending in increasing in the k/s. Also it may be due to the decrease in starch concentration in the fabric which was an important barrier for water dye and molecule.

*B. Effect of Enzymes Concentration*

In this part we study to the effect of use different concentration of enzymes while the surfactants was constant in which the raw cotton fabric were desized with different concentration of enzymes (0.50%,1%,1.5%, 2%) and adding 1% nonionic surfactants.

The desized cotton fabric were evaluated for both a) loss in weight and K/S which illustrated in figure3, and Figure 4.

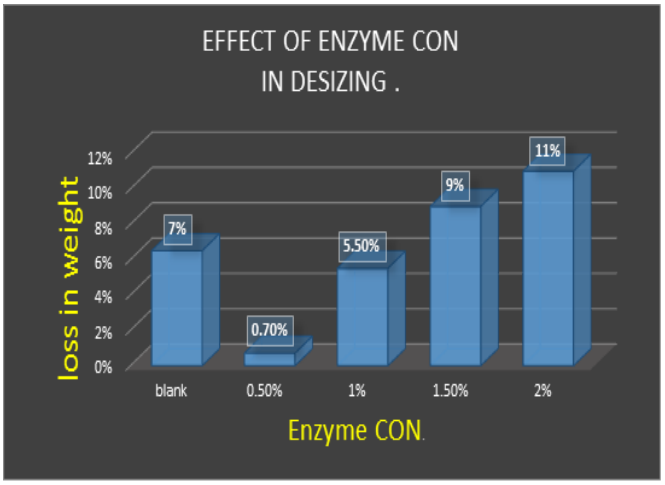


Fig 3:- Effect of Enzyme concentration on loss in weight)

The raw cotton fabric were desized with different concentration of amylase enzymes as said in experimental work and adding 1% surfactants amylase enzymes . The percentage of weight loss is showed in figure (3).

Figure (3) illustrate that increasing the concentration of enzyme while the surfactants constant ,is accompanied by increasing in the percentage of the loss in weight in all ranges studied .

AS it clear from the data of figure (3) that treating cotton fabric with different concentration of enzymes is accompanied by loss in weight. This phenomena holds true while the surfactants concentration is constant. It is also clear that there was directly proportional relation between the concentration of enzyme and percent of weight loss, by increasing concentration of enzyme the weight loss increased too. It also found that the highest percent loss in weight was found to be **11 %** by adding 2% enzyme and 1% surfactants to the enzyme reaction. When comparing the new method and the traditional one we can easily found that percent of loss in weight is **11%** by adding 2% enzyme 1% surfactants (The new method) while it was 6.6 % in the traditional method.

This means that percent of loss in weight in the new method is higher than the traditional one by almost with 5.5%. This is a high percentage comparing with the traditional one. While increasing desizing enzyme concentration, desizing rate is getting higher this Is because using high concentration of enzymes that means more enzymes make impurities on the fabric hydrolyze into small molecule substances. These can be removed thoroughly from the fiber surface by employing surface active agents. Ended in highly removal of starch ended in that cotton become more easily adsorb dye molecule [9].

By adding surfactants to the enzyme, surfactants increase the partitioning of the enzymes partials and leads to more enzymes become free and attack with the starch.

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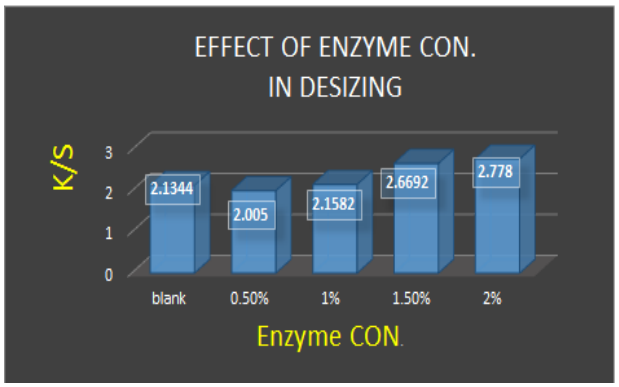


Fig 4:- Effect of Enzyme concentration on K/S)

The samples were desized under enzymes and surfactants were under go dyeing with reactive dye .results of K/S showed in result figure (4)

Figure (4) illustrate that increasing the concentration of enzymes while the surfactants constant is accompanied with increasing in k/S.

k/S increase by adding the surfactants to reach to **2.778** by adding 1% surfactants and 2% enzyme to the enzyme reaction. When comparing the new method and the traditional one ,we can illustrate that the highest k/S is **2.778** was acquired by adding 1% surfactants and 2% enzyme ( the new method) while in the traditional way the k/S is **2.1344** by adding 2% enzyme without surfactants.

This may be due to the nature of surfactants which reduce the degree of crystallinity, making the substrate more accessible to the enzyme, and the surfactants increase the partitioning of the enzyme and reduce the percentage of starch. In this case the desizing rate getting higher and the fabric become more smooth, clean and hence adsorb more dye molecules ending with increase the K /S of fabric.

*C. Effect of Time Concentration*

In order to adjust the best condition of applying the surfactants with enzymes the raw cotton fabric were desized with 2% surfactants ,1% amylase enzymes with different times enter values of ( 15, 30,45min,60 and 75 min) . The desized cotton fabric were evaluated for both a) loss in weight (Figure5) and B) K/S ( Figure ııb)

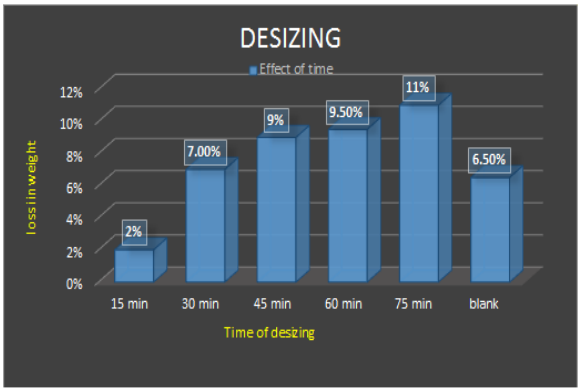


Fig 5:- Effect of desizing time on loss in weight

The raw cotton fabri were desized with amylase enzymes and surfactants for different times as said in experimental work. The percentage of weight loss is showed in figure (5)

The figure (5) illustrate that increasing time of desizing( using 2% surfactants and 1% enzyme) is accompanied by increasing the weight loss. The percentage of weight loss was found to be **7.5%** ( during 30 min Desizing) and **11%** ( during 75 min desizing ) When comparing the new method and the traditional one , we can easily illustrated that the loss in weight is **6.5 %** by using 2 % enzyme without surfactants during 45 min in the blank fabric.

As the previously said using the surfactants with enzyme caused opening up to the fabric structure and making some movement in chains of the fabrics making the fabrics more accessible to the enzyme molecule and hence enhance the desizing treatment.

With increasing the time of treatment the effect of surfactants on enzymes was found to be increased too, ending in increasing in the desizing rate.

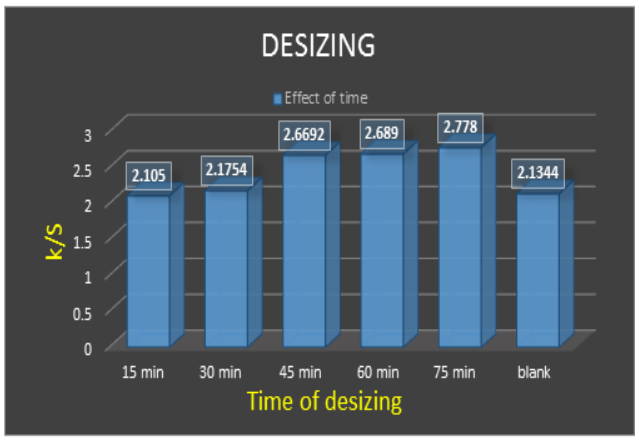


Fig 6:- Effect of desizing time on k/S

The samples were desized under enzymes and surfactants for different times were under go dyeing with reactive dye .results of K/S showed in result figure (4)

The figure (6) illustrate that increasing time of desizing ( using 2% surfactants and 1% enzyme) is accompanied by increasing in the k/S value.

The k/S values were found to be **2.1754** (during 30 min Desizing) and **2.778** ( during 75 min desizing ) When comparing the new method and the traditional one It can be conduced that the K/S is **2.1344** by using 2 % enzyme without surfactants during 45 min in the blank fabric .and this is may be due to the opening up of the structure of fabric as discussed before.

## IV. CONCLUSION

The effect of surfactants on enzymes Behaviour in Desizing process were studied. Measuring loss in weight after desizing showed that Using the nonionic surfactants with enzyme increases the rate of desizing which accompanied by increasing in color strength of fabric after dyeing.

Using the nonionic surfactants with enzyme decrease the time of desizing until to reach the half of time of traditional method. This percentage accepted to apply this method in the factory.

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