A Study on the Effect of Caustic Potash Treatment Upon Weight Loss and Tenacity of Various Pak-Made and Imported Polyester Staple Fibres

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Summary: The effect of different concentrations of caustic potash ((KOH) upon Pak-Made (Polylene and Terylene) and imported (Teijen, Eslan, Three Guns and Kuraray) brands of polyester staple fibres revealed that the weight loss increased and tenacity decreased by increasing the concentration of KOH. Furthermore imported brands showed superiority over indigenous polyesters because they showed high resistance against alkali treatment.

Introduction

Polyesters has been defined by Federal Trade Commission (USA) in its act as "A manufactured fibre in which the fibre forming substance is any long chain synthetic polymer composed of at least 85% by weight of an ester of a substituted aromatic carboxylic acid, including but no restricted to terephthalate units, and para substitutional hydrobenzoate units" [1-3]. Commercial production of polyester (Polyethylene terephthalate) is a two step process. Terephthalic acid (HOOC- -COOH) reacts with ethylene glycol ($HO(CH_2)_2OH$) to form bis (2-hydroxyethyl) terephthalate (BHET), which is condensation polymerized to polyethylene terephthalate (i.e. polyester) with the elimination of ethylene glycol. Molten polymer is extruded through a dia (spinnerts) forming filaments that are solidified by air cooling. Which are then cut to specific lengths using a radial multiple cutter [1].

Ever since it was made polyester retains pride of place among synthetic fibres. Its fast acceptability is due mainly to its remarkable dimensional stability, high tensile strength, high resistance to attack by chemicals (except caustic alkalies), good durability and immunity to attack by insects, fungi, bacteria and moth. Potassium hydroxide (caustic potash) is used in different kinds of washing soaps and effects directly the wearing life of polyester fabrics. Previously some authors [3,4] stated that the polyester staple fibre has good resistance to weak alkalies but is degraded by strong alkalies, the resistance is further reduced with the increased temperature. The polyester staple fibre when left in strong solution of caustic alkalies for long time loss its strength [5], and when the concentration of alkalies is increased the weight loss of the PET fibres increased [1,6]. For example when polyester fibre is treated with 10 percent caustic soda for a longer period of time, the loss in strength recorded was 6 to 30 percent [7,8].

Due to its properties and multi dimensional uses, polyester consumption rate has increased very rapidly all over the world. Pakistan produced 338 thousand tones of polyester staple fibre during the last financial year and earned a foreign exchange of 335 million dollars by the export of synthetic textiles [9]. However to meet the present very large demand from local market, polyester fibre is still being imported in bulk quantities, in spite of huge supplies from the installed manufacturing units. The objective of the present study is to asses the worth of local made fibre for its working life as compared to the imported fibres by treating them with caustic potash, as cuastic treatment of washing adversely effect the strength of polyester cloth.

Results and Discussion

Effect on weight

The results pertaining to the loss in weight after KOH treatment are presented in Fig. 1. Which shows that at 10% KOH treatment the highest value of loss in weight (0.91%) was observed for Polylene followed by Kuraray, Terylene, Eslan,

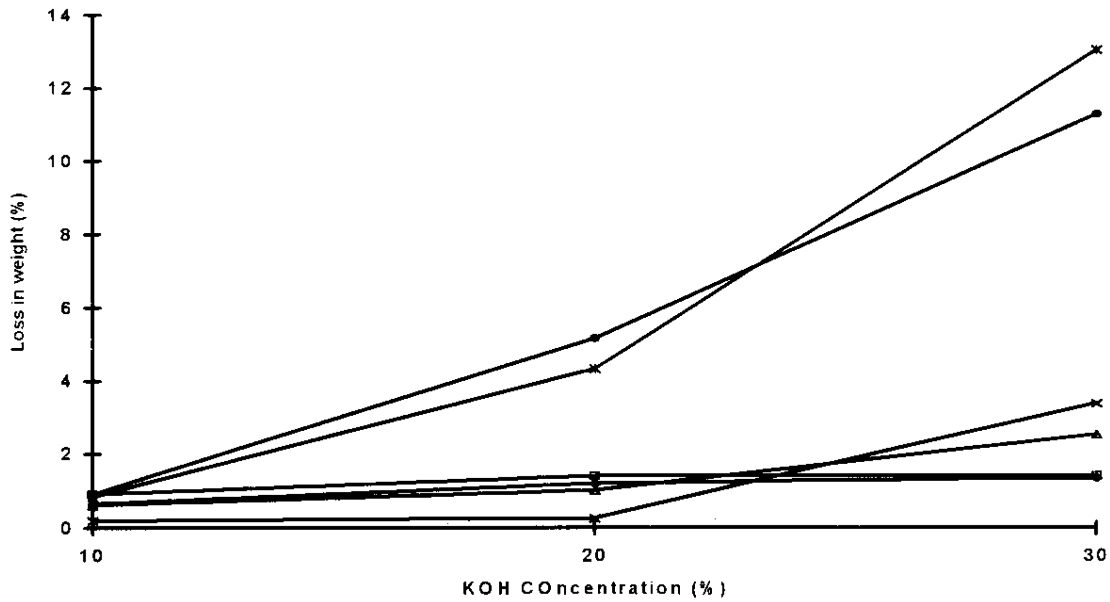

Fig. 1: Loss in weight after KOH treatment.

Teijen and three guns with their mean values 0.90, 0.85, 0.65, 0.62 and 0.20 percent respectively. After 20 percent potassium hydroxide treatment the maximum loss in weight (5.17%) was recorded again for polyene followed by Terylene, Kuraray, Eslan, Teijen and three guns having mean values 4.34, 1.40, 1.20, 1.00 and 0.20 percent respectively. With 30 percent KOH treatment the maximum loss in weight (13%) was recorded for Terylene followed by Polylene, Three Guns, Teijen, Kurary and Eslan with their mean value as 11.25, 3.37, 2.53, 1.40 and 1.35 percent respectively.

The above results clearly indicates that the weight loss increased by increasing the KOH concentration, which completely agrees with the findings of Song et al., [6], who states that the weight loss of polyester staple fibre increases with increasing alkali concentration. Similarly Stout [4] also reported that Dacron polyester fibres has good resistance to weak alkalies, but is degraded by strong alkalies at high temperature.

Effect on tenacity

The statistical analysis of data pertaining to the effect of potassium hydroxide on tenacity presented is in Fig. 2. Which revealed highest value of tenacity 7.34 grams per denier is for polylene followed by 6.94, 6.81, 6.67, 6.45 and 6.15 grams per denier for Three Guns, Kuraray, Teijen, Eslen and Terylene respectively for control i.e. without KOH treatment.

With 10 percent KOH treatment the maximum effect of potassium hydroxide was observed in Kuraray (6.75 g/d) followed by Terylene, Three Guns, Eslan, Polylene and Teijen with their respective mean values 6.11, 5.56, 5.53, 5.35 and 5.07 grams per denier.

After 20 percent KOH treatment the highest tenacity 6.39 g/d was recorded for Kuraray followed by 6.22, 5.39, 4.96, 4.86 and 4.69 grams per denier for Three Guns, Eslan, Polylene, Teijen and Terylene respectively. While after 30 percent KOH treatment the best value of 6.21 grams per denier was again recorded for Kuraray followed by 6.20, 5.07, 4.86, 4.55 and 3.60 grams per denier for Three Guns, Eslan, Polylene, Teijen and Terylene.

The above results and graphs indicates that all brands of polyester staple fibres show more or less the similar trend that the tenacity is decreased by increasing the concentration of potassium hydroxide concentration. These results get some

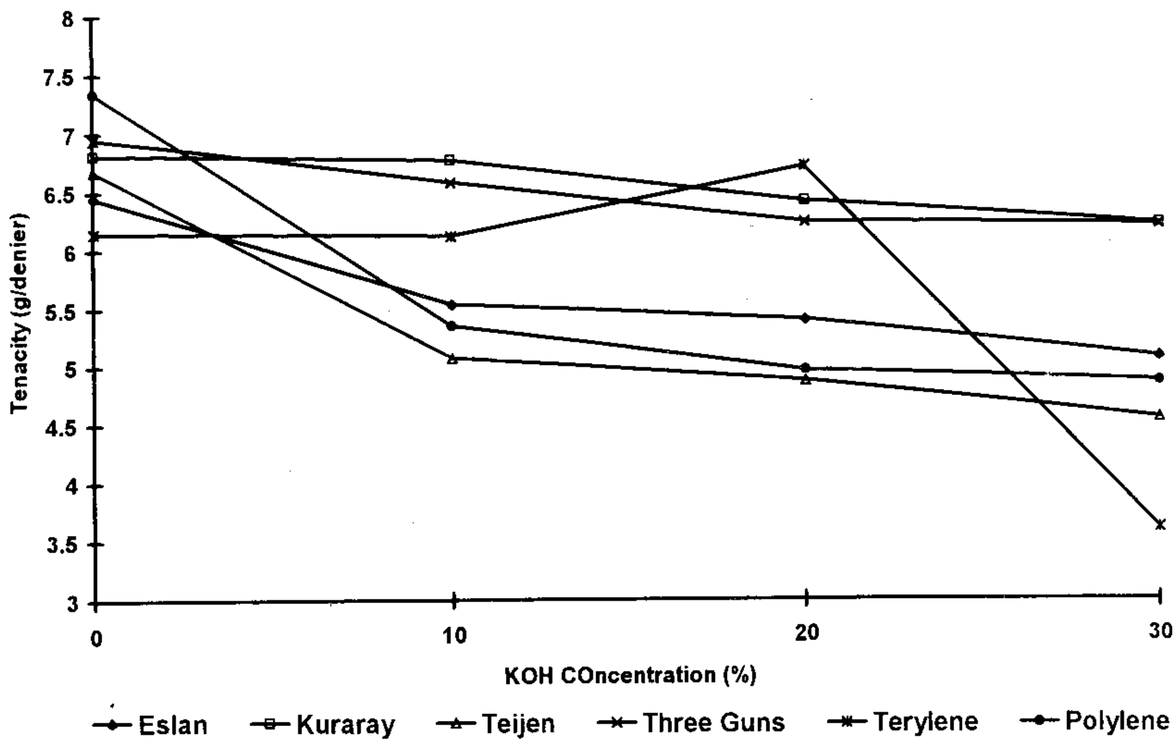

Fig. 2: Effect on tenacity after KOH treatment.

support from previous workers [1,7,8] who concluded that the polyester staple fibre when left in strong solutions of caustic alkalies for long time loses strength and this loss is increased by increasing the concentration of alkali. Furthermore as polyester staple fibre is manufactured by different companies and every manufacturer has its own system and techniques. The difference in the quality among various brands of polyester depends upon the quality control of the fibre production as well as the fabrication of final product [3].

Experimental

The different brands of polyester samples viz. Polylene (NFL-Pakistan), Terylene (ICI-Pakistan), Teijen (Japan), Eslan (S. Korea), Three Guns (Taiwan) and Kuraray (Japan) were collected from the manufacturing units directly or from different textile processing units.

Five gram samples of each polyester fibre immersed in conical flasks containing 10,20 and 30 percent KOH (w/v) concentrations. Flasks were placed in vacuum oven for three hours at 50°C. After treatment with KOH solution the samples were placed in hot air oven at 100°C for 10 minutes for drying. The net loss of weight in percentage was measured.

The methods of ASTM D-2101 [10] was adopted to determine tenacity on "Fafograph Automatic Strength Testing Machine", manufactured by Textechno Herbert Stein, W. Germany.

Conclusion

In the light of the finding of the present study it can be concluded that the imported brands of polyester staple fibres offer good resistance to the alkali treatment, while locally made polyester fibre need some more improvements in this regards.

The present study also revealed that the polyester fibre (especially local brands) are degraded significantly by increasing the concentration of alkali, so it is suggested that the fabrics made from polyester should either be dry-cleaned or washed with mild soap or detergent. Use of strong soap which contain high proportion of caustic should be avoided.

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