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Effect of Alternative Scouring Agents on Mechanical Properties of Cotton/Polyester Blend Fabric

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ABSTRACT

This research comprises of six alternative agents at various concentrations of 1-5% used as scouring agents with NaOH as control on cotton/polyester blend fabric. The scoured samples were bleached, and mercerized. The suitability and reliability of the agents were evaluated for some mechanical properties of the treated fabric. Safety and cost analysis of the alternative agents were investigated. The experimental results showed that 3% liquid NH_3, 5% NH_4OH and 3% $(COOH)_2$ improved the breaking load (12.35-13.11kgf) more than the control (12.06kgf). The other agents competed with the control. 2% NH_4OH revealed a better breaking extension (14.14%) than the control (13.28%) and the other alternatives were favourably ranking with the control. The dry crease recovery property displayed all the alternative agents in the following order: 3% liquid NH_3, 5% CH_3CH_2OH and 5% $(COOH)_2$, 2% $(NH_4)_2C_2O_4$, 5% CH_3COOH and 5% NH_4OH with far higher values (106-82%) than the control (73^0). The linear densities of the alternative agents were higher than the control. The alkalinity and acidity (pH) of the alternative agents after the scouring process were environmentally friendly in comparison with the highly alkaline NaOH (control), thus unfriendly. The cost analysis revealed some of the alternative agents far cheaper than NaOH. This implies that the alternative agents are suitable and reliable as impurity-removing (scouring) agents. The alternative agents improved the mechanical properties of the pretreated fabric far better than the control. Therefore the alternative agents could be employed in the textile industry and commercially as scouring agents so that the world could be a better and safe place for everybody.

KEYWORDS: *alternative scouring agents, cheap, mechanical properties, reliable, safe, suitable.*

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I. INTRODUCTION

In our world today, fashion has now been the watch word for everyone. Men, women, children, both great and small all desired to look good. Everyone seems to be on designers' cloth, shoes, bags and hat. All these are products of textile materials. Therefore, there is a need to improve in the qualities of textile materials in order to meet up with the demand for textile products by the teeming world population *T*his has made several researchers [1, 2, 3, 4, 5, 6, 7, and 8] and many others to modify fibrous or textile materials to meet the needs of changing life style and fashion desires of people. The modifications are achieved by new development in production processes and chemical treatments. The changes in the qualities and properties can impact positive and/or negative response of the fabrics to chemical treatments which can in turn modify the mechanical and dyeing properties of the fabric [9, 10, 4, and 11]

*T*his work is interested on the effects of alternative scouring agent on cotton/polyester blend fabric. There are several amounts and kinds of impurities contained in various cuts and pieces of fabric. These vary with the type and source of the fibre/fabric, condition of preliminary treatments, storage and transportation [12]. This author and [13] reported that natural fibres and fabrics especially cotton and wool contain oil, fat, waxes, protein and mineral matters such as pectin, pentose and some colourants. Synthetic fibres/fabric contains oily substances acquired during spinning, weaving, finishing, and storage and transportation processes [14]. These impurities impaired the outward appearance and hygienic properties of the fabrics and moreover impede the mechanical properties, penetration of reagents and dyes into the fabrics [12].

*T*he removal of these impurities from textile materials by alkali is termed as scouring. The scouring process removes almost all undesirable impurities. When applied to grey goods, scouring removes substances that have adhered to the fibres during production of yarn or fabric, such as dirt, oils and any sizing or tint applied to warp yarns to facilitate weaving. The scoured sample appear soft, smooth, strong, slightly thicker, brighter and highly absorbent which can be dyed and finished uniformly [13]. *T*his scouring process in presence of oxygen and at higher concentration and or temperature may result in serious shrinkage swelling and oxycellulose formation which damages the fibre/fabric and affect the mechanical properties [12] and [15]. There is no much work on other alkalis or alternative agents suggested.

*T*he commercial process of scouring employs a 2% sodium hydroxide (NaOH) at boil for about 60minutes [12]. When the waste water from such a scouring process is released, it has effect on the soil and water bodies. [16] reported that pH should be one of the basic traditional parameters to be regularly monitored in waste waters. For example, [17] concluded that an important factor affecting soil fertility is soil pH. Soil pH affects the health of microorganism in the soil and controls the availability of nutrients in the soil solution. Strongly acidic soils (pH less than 5.5) hinder the growth of bacteria that decompose organic matter in the soil. This result in a buildup of undecomposed organic matter which leaves important nutrients such as nitrogen in forms that is unusable by plant [17].

However, the use of ammonium oxalate by [2 and 3] has proved to produce better mechanical properties on bast fibre than the traditional sodium hydroxide. Further findings by [18] prove the use of the alternative agents for scouring with improved dying properties than the commercial NaOH. These findings contributed a part to the birth of this present work.

The specific objectives are to determine the optimum alternative scouring agents with:

- Little or no damaging effects on the cotton/polyester blend fabric by evaluating some mechanical properties like breaking load, breaking extension, linear density and dry crease recovery.
- Friendly effects on the environment by monitoring the pH of the liquor before and after the scouring process.
- To evaluate the cost implications of the alternative scouring agents with respect to the usual sodium hydroxide by cost analysis.
- Thus, this research aim at improving on the quality of Nigerian made fabrics and safety of the environment which is in line with the vision of repositioning of Nigeria, that is "vision 20:20:20"

II. EXPERIMENTAL

2.1 Sample Collection and Preparation

The sample cotton/polyester blend fabrics were obtained from Funtua Textile Company Ltd. in Katsina State Nigeria. The samples were cut into pieces with dimension 10cm length by 10cm width and kept in the laboratory before treating chemically.

2.2 Methods

The cotton / polyester blend fabrics were scoured, bleached and mercerized according to standard methods as described below.

2.2.1Scouring Process:

- Scoured by the standard method described by [12] and [15].
- Using 1%, 2%, 3%, 4% and 5% NaOH w/v (as control) fabrics were separately immersed and boiled for 1 hour for each solution.
- pH was monitored before and after the process for both control and alternative agents
- The process was repeated using the alternative agents –NH_4OH, $(HN_4)_2C_2O_4$, $(COOH)_2$, CH_3COOH, liquid NH_3 and CH_3CH_2OH each at the various concentrations of 1 to 5% separately.

2.2.2 Bleaching Process:

- Scoured samples were bleached using 4g/l $NaClO_2$ solution according to the procedure described by [12].

2.2.3 Mercerization Process:

- The bleached samples were mercerized with 22% NaOH below 5^0C for 45 minutes in accordance to standard methods of [12] and [15].

2.3 Evaluation of the effect of alternative scouring agents
2.3.1. Determination of Breaking Load and Breaking Extension:

- These were evaluated in accordance with British Standard Method and American Standard for Testing Materials using tensometric tester (model 220D) [19] and [20].

2.3.2 Determination of Linear Density

The expression proposed by [19, 21, and 20] and used by [22] was employed. It is defined as mass (g) per unit length (m). For the evaluation of linear density, the stretched samples were cut at both ends removing the masking ends. The remaining 5cm portions were weighed and recorded as mass of fabric then employed in the calculation of the linear density.

$$\text{Linear Density} = \frac{\textit{Mass (g)} \times 1000}{\textit{Breaking Elongation (mm)}} \ \textit{(tex)}$$

2.3.3. Determination of Dry Crease Recovery:

- The method described by [19 and 20] was also adapted for this evaluation.
- "Shirley" loading device (DL 28) and "Shirley" crease recovery tester (SDL 3A) was calibrated and used for this evaluation.

2.3.4 Determination of cost Implication of the Alternative Scouring and Control Agents.

Market survey of the cost of the alternative scouring and mercerizing agents was carried out in comparison with that of the control. Three different chemical shops in Jos, Kano and Bauchi all in Nigeria were involved. The average costs were calculated and the costs per 1 ml or 1g were evaluated for comparison.

III. RESULTS AND DISCUSSION

3.1 Effects of alternative Scouring agents, Bleaching and Mercerizing Processes on the Physical Properties of the Cotton/Polyester Blend Fabric.

*T*he following changes were observed during and after the scouring and mercerization processes of the cotton/polyester blend fabric with alternative agents.

3.1.1 Scoured Samples

During scouring, the scouring liquor or solution kept changing from colourless solution till after scouring to a slightly yellowish solution for all the alternative agents used and NaOH (control). This implies that purification has taken place. It is believed and is a known fact that during scouring with 2% NaOH, the oil and fat at boiling will be hydrolyzed to glycerol and alkali salt of the fatty acid:

$$\begin{array}{lll} CH_2\,CO.O\,C_{17}H_{35} & & CH_2OH \\ CHCO.OC_{17}H_{35} + 3NaOH & \longrightarrow & CH.OH + 3C_{17}H_{35}COONa \\ CH_2CO.O\,C_{17}H_{35} & & CH_2OH \qquad\quad \text{Soap} \\ \text{Oil or fat} & & \text{Glycerols} \end{array}$$

Scheme 1: Hydrolysis of fat or oil by Sodium hydroxide

The soaps formed at boiling; promote the emulsification of wax-like substance and unsaponifiable fats [12]. The alkali hydrolyzes proteins, and their molecules are broken along peptide links with the formation of alkali-soluble, amino acids [12, 23 and 24]. Pectin and lignin substances are also hydrolyzed; their molecules are gradually destroyed and converted to soluble salts. Mechanically adhered dirt are loosened and held in suspension.

*T*hus it is expected and assumed that NH_4OH, $(NH_4)_2C_2O_4$, liquid NH_3 will decompose the impurities in a similar manner. So also will CH_3COOH, CH_3CH_2OH and $(COOH)_2$ being organic components and the impurities are mostly organic components "like dissolves like". *A*t the end of the scouring process, the fabric samples were cleaner, texture improved and there were little decrease in the dimension of both length and width of the treated fabrics. This agrees with the reports of [12, 23 and 24] as the effect of scouring on fabrics. This is expected to improve the mechanical and dyeing properties.

3.1.2 Bleached Samples

When the scoured samples were immersed in the bleaching solution of $NaClO_2$, it was observed that the cloudy colour changed to slightly faint yellowish colour for all the fabric samples scoured with the various agents. This indicates that pigments and any remaining impurities were removed. This was confirmed by the appearance of the fabric samples. The fabrics became whiter and brighter than the unbleached after bleaching and drying.

$$NaClO_{2(aq)} \xrightarrow[\text{heat}]{H^+} Na^+_{(aq)} + ClO_2^-{}_{(aq)}$$

$$ClO^-_{2(aq)} \longrightarrow Cl^-_{(aq)} + 2[O]$$

Scheme 2: Formation of the atomic oxygen for bleaching with sodium chlorite

Mercerized Samples

The bleached fabrics were mercerized with 22% NaOH. All the samples swell and gradually untwist and became smooth, soft, lustrous and glossy. This is reported by [12 and 25] to be as a result of chemical, physico-chemical and structural modifications on the fabric by the concentrated alkali. These changes are believed to result into improved properties.

3.2 Effects of NaOH (control) and Alternative Scouring Agents on Mechanical Properties of Mercerized Cotton/Polyester Blend Fabric.

The scouring process with the alternative agents and NaOH recorded some effects on the breaking load, breaking extension, linear density and dry crease recovery properties of the mercerized cotton/polyester blend fabric.

3.2.1 Effect of the Scouring Agents on the Breaking Load of Mercerized Cotton/Polyester Blend Fabric

The breaking load describes the force that can break the fabrics on application of force. Fig. 1 and Table 1 show that 3% liquid NH_3, 5% NH_4OH and 3% $(COOH)_2$ scoured fabrics recorded better breaking load (13.11kgf, 13.10kgf and 12.35kgf respectively) than the control NaOH scoured fabric (12.06kgf) and the untreated fabric sample (9.75kgf).

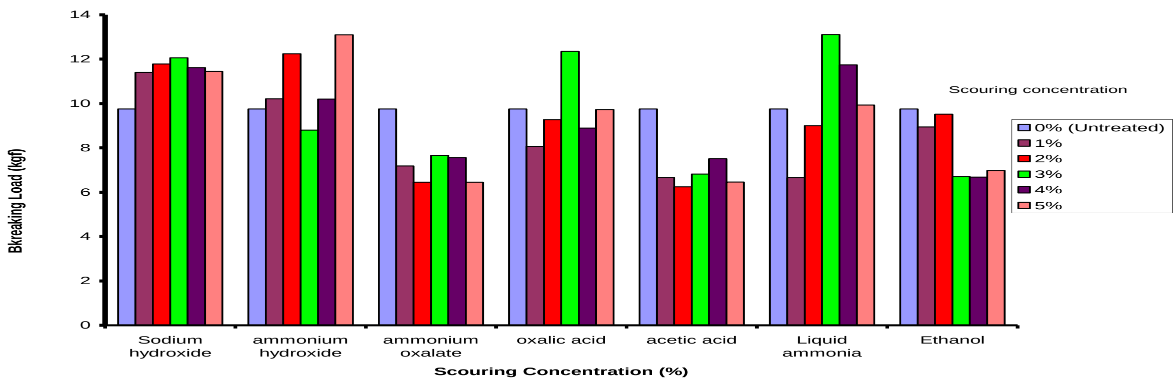

Figure. 1 Effect of NaOH (control) and alternative scouring agents on Breaking Load of Mercerized Cotton/Polyester blend fabric

Table 1: Optimum breaking load of the effect of Scouring Agents on mercerized cotton/polyester blend fabric

Scouring Agent	Concentration of scouring Agent (%)	Breaking load (Kgf)
Liquid NH3	3	13.11
NH_4OH	5	13.10
$(COOH)_2$	3	12.35
NaOH	3	12.06
CH_3CH_2OH	2	9.52
$(NH_4)_2C_2O_4$	3	7.66
CH_3COOH	4	7.51
Untreated	0	9.75

This implies that these alternative agents removed impurities without affecting the sample. The other alternative agents: $(NH_4)_2C_2O_4$ (7.66kgf) and CH_3COOH (7.51kgf) were slightly below the control and appreciably lower than the untreated, indicating damage on the fabric. This disagrees with the previous work of [2 and 3], where $(NH_4)_2C_2O_4$ improved the breaking load of kenaf fibre. This may be as a result of different source of textile materials used.

3.2.2 Effects of Scouring Agents on Breaking Extension of Mercerized Cotton/Polyester Blend Fabric

Breaking extension is the percentage extends at which fabric stretch before breaking on application of force [24 and 26]. With reference to Fig. 2 and Table 2, it is observed that 2% NH_4OH scouring improved the breaking extension by 14.14% than the 2% NaOH control 13.28% breaking extension. Other alternatives like 3% $(COOH)_2$ and 4% liquid NH_3 (13.27% and 12.56% breaking extension respectively) competed favourably with the control. These alternative agents and 2% CH_3CH_2OH (10.98%) improved the breaking extension far better than the untreated fabric sample, 10.81% breaking extension. It indicates that these agents are friendly to fabric as impurity- removing agents. Although $(NH_4)_2C_2O_4$ (10.77%) and CH_3COOH (10.36%) breaking extension are close to that of untreated sample indicating little damage to the fabric, it may also be as a result of incomplete removal of the impurities by the $(NH_4)_2C_2O_4$ and CH_3COOH agents.

3.2.3 Effect of Scouring Agents on the Linear Density of Mercerized Cotton/Polyester Blend Fabric

Linear density determines the fineness or coarseness of a fabric. Fine fabrics have high linear densities and are less damaged [15 and 20]. It is defined as mass per unit length, i.e.

$$\text{Linear density} = \frac{\text{Mass (g)} \times 1000 \text{ (tex)}}{\text{Breaking Extension (mm)}}$$

Fig. 3, shows that NaOH (control) Scoured fabrics at various concentration has linear densities lower (range from 3.632 - 4.780 tex) than the untreated fabric (5.153 tex). This implies that NaOH scouring did not improve the fineness of the fabric.

This may be due to loss in weight brought about by the removal of impurities present in the fibre during the process. This will lead to decrease in mass per unit length of the scoured fabric. As for the alternative scouring agents, Fig. 3 shows improved linear densities as compared to the untreated and the control samples respectively. This means that the alternative agents did not damage the fabric rather has improved on the fineness of the fabric and did not suffer weight loss. Table 3 shows the optimum linear density of the scouring agents. It is observed that 3% CH_3COOH scoured fabric recorded the highest linear density (6.327 tex), followed by 2% $(NH_4)_2C_2O_4$ (6.272 tex), 5% CH_3CH_2OH (6.09 tex). 1% $(COOH)_2$ (5.921 tex), 1% liquid NH_3 (5.672 tex), 1% NH_4OH (5.23 tex). All these are higher than the control and the untreated fabric samples. This suggests that the impurities were removed from the fabric by the agents without affecting the surface of the fabric. There was no much loss in weight of the fabric during the scouring process. This implies that these alternative agents could replace or substitute the commercial scouring agents (NaOH). This observation agrees with the work of [22], were $(NH_4)_2C_2O_4$ proved to be better retting agents on Kenaf fiber than NaOH with respect to linear density.

3.2.4 Effect of Scouring Agents on Dry Crease Recovery of Mercerized Cotton/ Polyester Blend fabric

For any textile to be used in clothing, it must be flexible and capable of being crease and be comfortable to wear [27]. If textiles are to retain a good appearance, the textile must have good crease shedding properties, which is recovery from unwanted crease that occur in used and during laundering [27]. The alternative agents in Fig. 4 and Table 4 prove to be better scouring agents for cotton/polyester fabric compared to the NaOH control and the untreated fabric. The order is 3% liquid NH_3 (106°), 5% CH_3CH_2OH (106°), 5% $(COOH)_2$ (99°), 2% $(NH_4)C_2O_4$ (95°), 5% CH_3COOH (87°), 5% NH_4OH (82°), 3% NaOH (73°) and 0% untreated fabric (50°).

Creasing and crease recovery may be explained theoretically on a structured molecular level. When fabric structure is bent into a crease, [21 and 27] suggested that two things can happen; the cross-link may break and reform at new position. On removal of the load, there will be no recovery. Alternatively, the cross-links may be strained without breaking. Under this condition, there would be a recovery on removing the load and no crease will result. In view of this, fibres with lower crease recovery angle in this study might have been weakened more than those with higher dry crease recovery angle, resulting in the breakage of the cross-links and little recovery. However, scouring has drastically improved the crease recovery property compared to the original sample. This is possible because the impurities have been removed making it more flexible.

3.2.5 Effect of Alternative Scouring Agents and control (NaOH) on pH of Scouring Liquor of Cotton/Polyester Blend Fabric

It was observed that reactions between the cotton/polyester fabric and scouring agents actually occurred for each of the scouring agent.

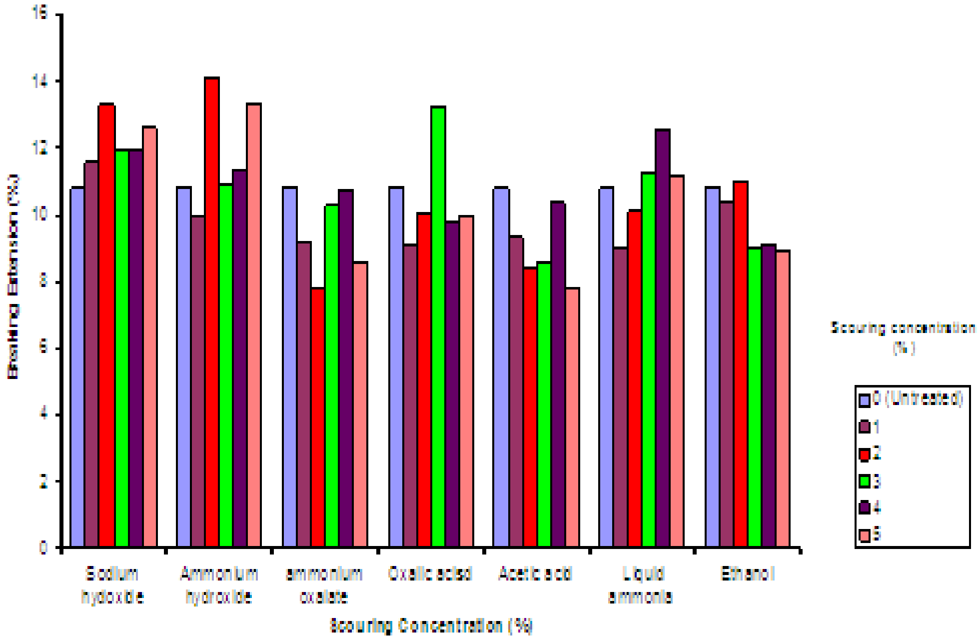

Figure. 2 Effect of NaOH (control) and alternative scouring agents on Breaking Extension of Mercerized Cotton/Polyester blend fabric

This indicates that each reagent has its peculiar trend, although in most cases, there is decrease in pH at the end of the process. This could be in addition to the degree to which the agents are being consumed or used and also the degree of dissociation of the agents in solution for the extent of the reaction.

Table 2: Optimum breaking extension of the effect of Scouring Agents on mercerized cotton/polyester blend fabric

Scouring Agent	Concentration of scouring Agent (%)	Breaking extension (%)
NH_4OH	2	14.14
NaOH	2	13.28
$(COOH)_2$	3	13.27
Liquid NH_3	4	12.56
CH_3CH_2OH	2	10.98
$(NH_4)_2C_2O_4$	4	10.77
CH_3COOH	4	10.36
Untreated	0	10.81

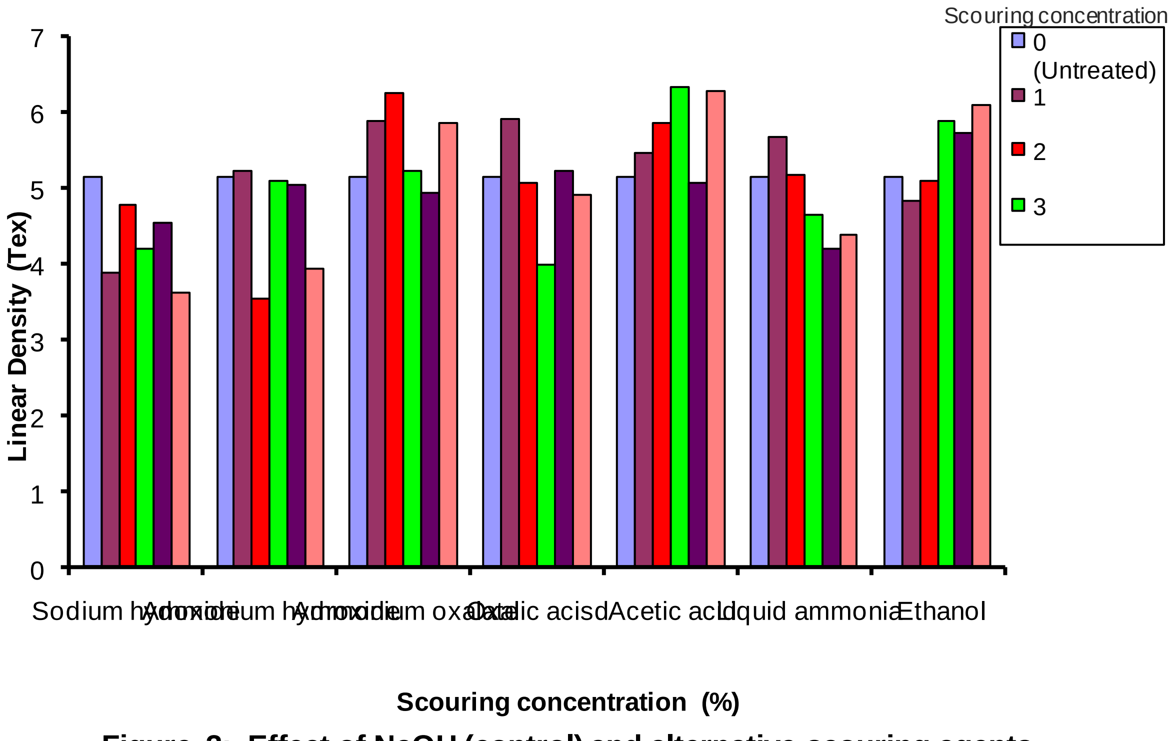

Figure. 3: Effect of NaOH (control) and alternative scouring agents on Linear Density of Mercerized Cotton/Polyester blend fabric

Table 3: Optimum Linear density of the effect of Scouring Agents on mercerized cotton/polyester blend fabric

Scouring Agent	Concentration of scouring Agent (%)	Linear density (Tex)
CH_3COOH	3	6.327
$(NH_4)_2C_2O_4$	2	6.272
CH_3CH_2OH	5	6.094
$(COOH)_2$	1	5.921
Liquid NH_3	1	5.672
NH_4OH	1	5.23
NaOH	2	4.78
Untreated	0	5.153

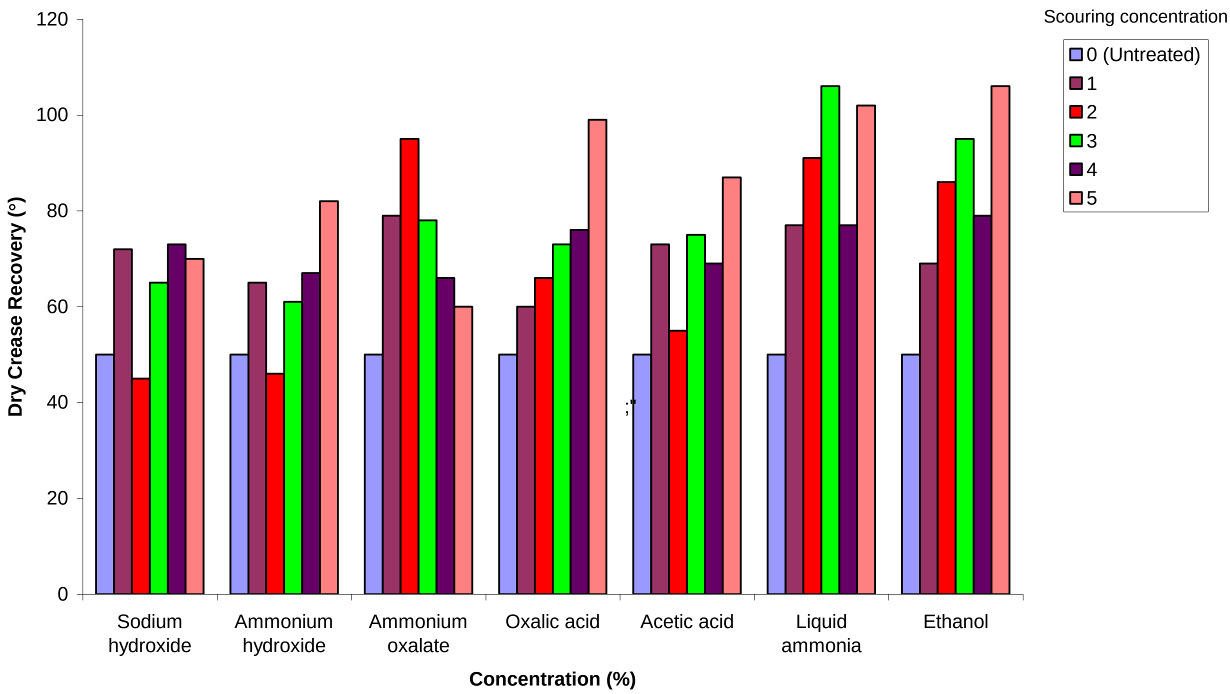

Figure 4 : Effect of NaOH (control) and alternative scouring agent on Dry Crease Recovery of Mercirized Cotton/Polyester blend fabric

Table 4: Optimum Dry Crease Recovery of the effect of Scouring Agents on Mercerized Cotton/Polyester Blend Fabric

Scouring Agent	Concentration of scouring Agent (%)	Dry crease recovery (°)
Liquid NH_3	3	106
CH_3CH_2OH	5	106
$(COOH)_2$	5	99
$(NH_4)_2C_2O_4$	2	95
CH_3COOH	5	87
NH_4OH	5	82
NaOH	3	73
Untreated	0	50

Table 5: pH Range for the effect of Scouring Agents before and after Scouring Process of Cotton/Polyester Blend Fabric

Scouring Agents	pH range before scouring	pH range after scouring
NaOH	12.442 - 12.78	10.30 - 10.90
Liquid NH_3	11.34 - 10.76	9.07 - 10.75
NH_4OH	10.08 - 10.22	7.50 - 8.45
CH_3CH_2OH	5.70 - 7.90	6.30 - 7.40
$(NH_4)_2C_2O_4$	5.14 - 6.15	4.67 - 5.38
CH_3COOH	2.20 - 2.88	1.99 - 2.91
$(COOH)_2$	1.37 - 1.81	1.28 - 1.67

Table 6: Average Cost of Alternative Scouring and Mercerizing Agents and Control Agent NaOH

Agents	Quantity ml or g	Average Rate (₦)	Average Rate per (₦)
$(COOH)_2$	500g	4,650	9.30
$(NH_4)_2C_2O_4$	500g	3,975	7.95
NaOH (control)	500g	2,750	5.50
NH_4OH	2,500ml	5,225	2.90
CH_3COOH	2,500ml	3,750	1.90
NH_3	2,500ml	4,000	1.60
CH_3CH_2OH	2,500ml	3,750	1.50

Assuming 1g is equivalent to 1ml

Table 5 shows the pH ranges after scouring for each agent. At the start of NaOH scouring process the pH ranges from 12.44-12.78 (Table 5) and decreased at the end of the process to pH ranges of 10.20-10.90. This is highly alkaline and very unfriendly to the soil and aquatic lives when such a solution is released to the environment. The high alkalinity is as a result of high degree of dissociation of NaOH and thus high concentration of OH^- ions preset in the medium (scheme 3).

$$NaOH_{(aq)} \xrightarrow{H_2O} Na^+_{(aq)} + OH^-_{(aq)}$$

Scheme 3: Ionization of ammonium hydroxide

*L*iquid NH_3 initially recorded a pH range of 11.34-10.76 and after the scouring process dropped to a range of 9.07-10.75 (Table 5). Despite the high pH values, it is less harmful when compared to NaOH. This is because it is a weak base (only a small percent of the molecules dissociated to form OH^-). Although the basic properties of NH_3 contains no OH but accepts a proton from the solvent H_2O, producing OH^- [28]:

$$NH_{3(g)} + H_2O_{(l)} \longrightarrow NH_3 \, . \, H_2O_{(aq)}$$

$$NH_3 \, . \, H_2O_{(aq)} \rightleftharpoons NH_4^+{}_{(aq)} + OH^-_{(aq)}$$

Scheme 4: Ionization of ammonia

*L*iquid NH_3 will ionize to a limited extend in solution to liberate NH_4^+ and OH^-. Hence, liquid NH_3 is a weak alkali [29]. Therefore, as a weak base, the concentration of OH^- is very low. Thus, NH_3 will have minimal effect on the environment. *A*t the beginning of NH_4OH scouring, the pH ranges from 10.08-10.22 (Table 5) for the various scouring concentrations (1-5%). As scouring progressed, the impurities absorbed and reacted for the cleansing process leading to a decline in pH value up to a range of 7.50-8.45 for the various concentrations of NH_4OH. These pH value, although slightly alkaline is within the optimal range of a suitable soil pH (7-8) for plant growth and streams/lakes pH (6-9) for aquatic lives [16], thus NH_4OH is more friendly than NaOH as far as environmental activities are concerned:

$$NH_4OH_{(aq)} \overset{H_2O}{\rightleftharpoons} NH_4^+{}_{(aq)} + OH^-_{(aq)} \text{ (a weak base)}$$

Scheme 5: Ionization of ammonia hydroxide

With references to Table 5, the initial pH of CH_3CH_2OH at the start of scouring was 5.70-7.90 for the various concentrations of the agent. As scouring progressed, the pH changed to a range of 6.10-7.40. This pH range will be friendly because it falls within the pH ranges of the soil and aquatic system on disposal to the environment:

$$CH_3CH_2OH_{(aq)} \xrightarrow{H_2O} CH_3CH_2^+{}_{(aq)} + OH^-_{(aq)}$$

Scheme 6: Ionization of ethanol

Table 5 showed an initial pH range of 5.14-6.15 for $(NH_4)_2C_2O_4$ scouring process and decreased to a range of 4.67-5.38. This is a weak acid as seen also in the partial dissociation below:

$$(NH_4)_2C_2O_{4(aq)} \overset{H_2O}{\rightleftharpoons} NH_4OH_{(aq)} + (COOH)_{2(aq)}$$

Scheme 7: Ionization of ammonium oxalate

It will not have an adverse effect on disposal on the soil or aquatic body.

The pH range at the start of scouring for CH_3COOH was 2.20 - 2.88 it changed with a pH range of 1.99 - 2.91 at the end of the scouring process (Table 5). Although this pH range is very acidic but being a weak acid and an organic acid, it may not affect the environment much (soil and aquatic body). It also dissociates partially:

$$CH_3COOH_{(aq)} \overset{H_2O}{\rightleftharpoons} CH_3COO^-_{(aq)} + H^+_{(aq)}$$

Scheme 8: Ionization of ethanoic acid

Oxalic acid is another weak acid. At the beginning of the scouring (see Table 5), the pH ranged from 1.37 - 1.81 and decreased from 1.28-1.67. This indicates that it is an acidic solution but may not show pronounced acidic properties because it dissociates partially, thus a weak acid:

$$HOOC - COOH_{(aq)} \rightleftharpoons HOOC - COO^-_{(aq)} + H^+{}_{(aq)}$$

Scheme 9: Ionization of oxalic acid

It may not have any harmful effects on the environment on disposal.

3.2.6 Cost Implication of the Alternative Scouring and Control Agents

Market survey of the cost of the alternative agents was carried out in comparison to that of the control. This was done using chemical shops in Jos, Kano and Bauchi all in the Northern Nigeria. NaOH, $(NH_4)_2C_2O_4$, $(COOH)_2$ are in solid form while CH_3CH_2OH, CH_3COOH, NH_4OH and Liquid NH_3 are in liquid state. Therefore it is assumed that 1 g is equivalent to 1 ml or vice versa. From Table 6, the average rate per ml or g for the alternative scouring agents ranged from ₦ 9.30 – ₦1.50 with the control agent costing ₦5.50. This shows that only $(COOH)_2$ and $(NH_4)_2C_2O_4$ that cost (₦9.30 and ₦7.95 respectively) higher than the control. That notwithstanding since in some quality parameters evaluated, the $(COOH)_2$ and $(NH_4)_2C_2O_4$ recorded far better improvements than the control. Furthermore considering the hazardous effect of the control on the environment, still makes $(COOH)_2$ and $(NH_4)_2C_2O_4$ a better substitute for NaOH. All other alternative agents cost far less than the control and have improved the quality performance of the treated cotton/polyester blend fabric. These agents are also environmentally friendlier than the control. Therefore, there is need for the embracement of these alternative agents industrially and commercially. This will go a long way to improve the economy and satisfy the fashion desire of the populace.

IV. CONCLUSION

The effects of alternative scouring agents on the mechanical properties of treated cotton/polyester blend fabric in some cases are much better than those of the industrial and commercial scouring agents (NaOH). Also in some cases these alternative agents compared favorably with the control. The pH and the cost of the alternative agents are friendlier to the environment than the control and even cheaper respectively. Therefore, these alternative agents could be employed as scouring agents industrially and commercially.
It is recommended that the alternative scouring agents be adapted in the textile industry and commercially.

V. ACKNOWLEDGEMENT

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