Hygienic Super Absorbent Terry Towel

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Abstract

In this study the piles of hundred percent cotton yarn were given processing treatment like scouring and bleaching as usual and then forward was treated with citric acid and sodium hypophosphite with certain percentage due to which more spores get open up which facilitate cross linking in yarn thus providing more room to accommodate the solution (water) within it. This superabsorbent fibers act as hydrophilic networks that absorb and retain huge amount of water. This mechanism of increasing absorbency by means of chemical modification based on the introduction of the additional hydrophilic group which enhance the introduction of water within hydroxyl group of cellulose molecules.

Key-words-Saf-Superabsorbent fibers, FSC-Free Swell Capacity, WRV-Water Retention Value, CA-Citric Acid, SB-Scoured & Bleached.

"1.Introduction"

In our day to day life the products which we are using are not giving that quality and comfort as it is expected so an attempt was made to give the comfort property to the product so that it can perform well. It has been found that absorbency is a factor playing important role in product ranging from diaper to surgical sponge. The transportation of water in this fiber is accompanied by capillary action with any swelling action of fibers. This desired need showed the path for the development of superabsorbent fibers which absorb water to 100 times then its own weight further this lead the application of superabsorbent in various fields such as feminine care products like baby diapers and hospitals disposable.

The primary function (1) of superabsorbent is not to increase absorbent capacity but to immobilize the fluid and prevent it from being squeezed out under pressure. They do not make the fabric feel harsh even at high level. Superabsorbent fabric will absorb many times own weight under pressure and they will retain the absorbed liquid when subjected to pressure. They swell many times as they absorb fluids and they extract moisture from non aqueous fluids, whether that is gas or liquid.

Absorbency depends mainly (2) on osmotic pressure, ionic impulsion and elasticity of the polymers .Thus super absorbents are cross linked network of hydrophilic polymers with high capacity for water uptake. The absorbency of superabsorbent depends not only on the nature and density of the hydrophilic group but also on the density of cross linking forming the three dimensional network. It is used to lock in wetness and keep it away from the skin which minimizes rash and irritation and provide consumers with comfort, and peace of mind.

This research (3) explores fundamental physics, chemistry and engineering principles to understand how liquids wet, permit/flow, and reside in the nanoporous fibrous structure so as to develop a product which can be used for industrial application and commercial application.

In addition to (4, 5, and 6) the reactivity of specific hydroxyl groups, it is possible to develop a profile of availability of hydroxyl in the amorphous regions of the fiber and on the surface of crystalline regions. The most homogeneous distribution of crosslink's and the most efficient use of formaldehyde are obtained in aqueous process where the reagent can swell and diffuse into the fiber before curing occurs. (7)

A correlation between (8) absorbency (water retention) and structural characteristics of cellulose fibers has been reported by Krassig, IE retentionα1/(crystallinity) -orientation) 2 based on this theory a reduction of crystalline regions and lower degree of orientation of cellulose molecules should be favorable to achieve improved absorbency. The degree of affinity that exists between water molecules and long chain molecules in the fiber determines the uptake of aqueous fluids in the polymer network. This phenomenon is called absorbency and it can be employed mechanically by entraining fluid in the fibrous material. Absorbency follows capillary mechanism in which transportation of fluid to the superabsorbent take place via capillary action and its rate depends upon granular size of the particle,polarity,crosslink distribution, surface energy and particle porosity

Where as in diffusion coefficient is decided by degree of croslinking and (9) maintain the linear proportion. This type of mechanism can be further classified based on size of fluid molecules and diffusion rate controlling factor.

In this work an attempt has been made to study the pile yarn of terry towel with different concentration of citric acid in the presence of catalyst like sodium hypophosphite for making this terry fabric super absorbent.

"2.Experimental"

2.1.Materials.

2.1.1.Chemicals. Citric acid [C6H8O7]was procured from Chemine Enterprises(Sangli) and Sodium Hypophosphite was brought from Amrutlal bhura ,Princess street.(Mumbai) for increasing the absorbency of pile yarn. Sodium Hydroxide and sodium carbonate were taken from Desmo export (Mumbai) for carrying out scouring, Hydrogen Peroxide and sodium hexa meta phosphate was taken from Chemical laboratory, D.K.T.E, (Ichalkaranji) for carrying out bleaching.

2.1.2.Yarn. Grey yarn of different count like $2/12^s$,$2/16^s$,$2/20^s$,$2/24^s$ were procured from Padmavati Textile,(Ichalkaranji),this doubled yarn were spun into single yarn of required tpi like3.5, 5, 7 & 9 on two for one twister in Spinning workshop of DKTE,(Ichalkaranji).

2.1.3.Fabric.yarns made(10) with low tpi and citric treatment helps to make the end product with significantly higher cost effectiveness namely high grades soft and absorbent weaving yarns of 100% cotton(Ne12-16, Nm 20-27, tex 35-50) for high pile terry cloth article in pile warp and weft. Jacquard woven 250 g/sq.m fabric weight of towel with best result. Terry towel was produced on terry loom having reed space of 34", reed count of 28 in weaving workshop, DKTE,(Ichalkaranji).

2.2 Characterization.

The absorbency test of the yarn was carried out by few tests like sinking, free swell capacity, water retention value (Distilled & Saline) and Draves method in DKTE, (Ichalkaranji). The test of absorbency was carried out according to ASTM961standards.

2.3Testing methods

The standard test methods are followed which are as below

- Sinking test
- Free swell capacity
- Water retention value(Distilled & Saline)
- Draves Test.

2.3.1.Method

Scouring was carries out with MLR= 1: 30, bath was heated at 90°c for 2hrs followed by bleaching with H2O2(50%) and stabilizer(sodium hexa metaphosphate) at 90°C temperature and kept for 2hrs followed by cold wash, hot wash and cold wash.

After this processing ,treatment with citric acid(10% owf) and sodium hypophosphite (5%) with 1:30 MLR were given to improve the absorbency.

2.4.Absorbency increasing agent.

The grey yarn were twisted to obtain low tpi yarn which was scoured, bleached and then treated with citric acid with an concentration of 5%,10%,12.5% & 15%. This citric acid and sodium hypophosphite increases the cross linkage in cotton cellulose.

The test was carried out on yarn and the best result was selected for the manufacturing of terry towel fabric, out of this only one concentration ie 10% for citric acid and 5% for sodium hypophosphite was selected, which gave the best result for increasing the absorbency of terry towel.

2.5 Application of citric acid.

Gray yarn was scoured and bleached and then treated with citric acid 5%, 10%, 12.5% and 15% and sodium hypophosphite with2. 5%, 5%, 6.7%, 7.5% with 90^0 temperature and 60 minutes.

Similarly the yarn which showing the best result with 10% concentration of citric acid and 5% conc. Of sodium hypo-phosphite with 5 tpi were taken to manufacture terry towel. This grey terry towel was scoured, bleached and then treated with citric acid with 10% conc.

1	Count	2/12^s, 2/16^s, 2/20^s, 2/24^s.
2	Tpi	3.5, 5, 7, 9.
3	Citric acid conc.	5%, 10%, 12.5%, 15%.
4	Sodium hypophosphite	2.5%, 5%, 6.25%,7.5%.

"3.Result and Discussion"

3.1 For the qualitative assessment of absorbency, cotton samples (yarn and piles) were treated with citric acid and sodium hypochloride as a mordant which increases the cross linkages in cellulose. Untreated cotton shows less intake of water. Sinking, WRV and FSC for terry fabric were carried out by using of 1gm treated and untreated sample.

For 5 tpi & 10 % conc.

3.1.Sinking Test

Table 1. Effect of citric acid in presence of sodium hypo phosphite on sinking test.

resultant count	Conc. (%)	Treatment	Sinking Test (Sec)
6	SB	Untreated	3.21
	10%	Treated	1.67
8	SB	Untreated	3.46
	10%	Treated	1.82
10	SB	Untreated	3.71
	10%	Treated	1.97
12	SB	Untreated	3.68
	10%	Treated	2.1

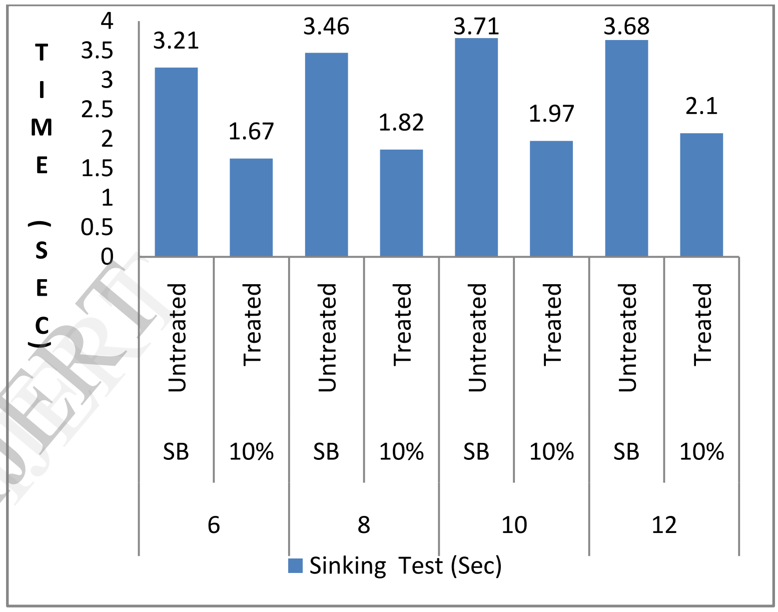


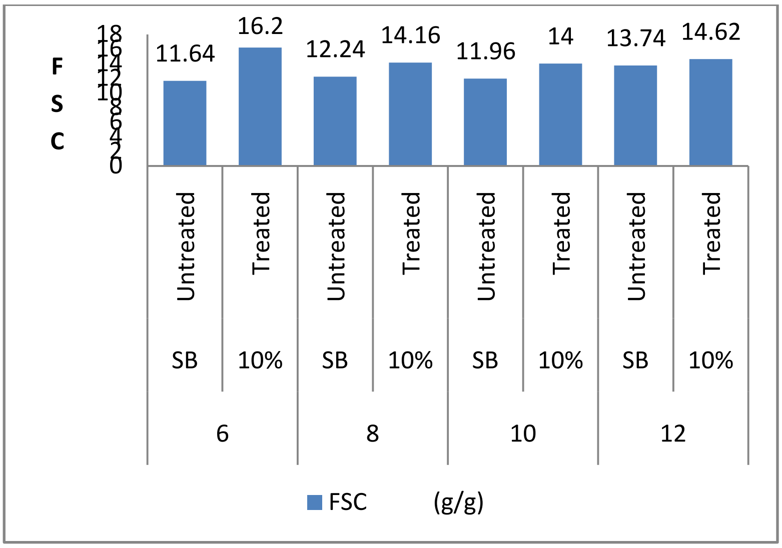
Figure 1. Effect of citric acid in the presence of sodium hypo phosphite on sinking test

Sinking test was carried out by taking 1gm sample and time to sink the sample at the bottom of the beaker filled with water was noted. The more the absorbency of the treated sample, the lesser the time it takes to go to the bottom, while the untreated sample took more time to touch the bottom of the beaker.

3.2.Free swell capacity

"**Table 2.**Effect of citric acid in presence of sodium hypo phosphite on Fsc"

resultant count	Conc.	Treatment	FSC (g/g)
6	SB	Untreated	11.64
	10%	Treated	16.2
8	SB	Untreated	12.24
	10%	Treated	14.16
10	SB	Untreated	11.96
	10%	Treated	14
12	SB	Untreated	13.74
	10%	Treated	14.62



" **Figure2.**Effect of citric acid in presence of sodium hypophosphite on fsc of terry towel"

FSC was calculated by taking 1gm of sample inserted in to tea bags and then dipped in water for 30 minutes. After 30 minutes, water was allowed to soak for 10 minutes. When the drops stop falling from the tea bags the weight (w1) was measured and (w2) was the weight of the dry sample (1gm).

So FSC = (w1-w2)/w2

Thus it was found that more the value of the FSC, the more the water gets accumulated in the cotton yarn. Thus for treated sample, the cotton yarn swells free and show more amount of water accumulation. While for untreated sample, this FSC shows less value, which shows less swelling, less accumulation of the cotton sample.

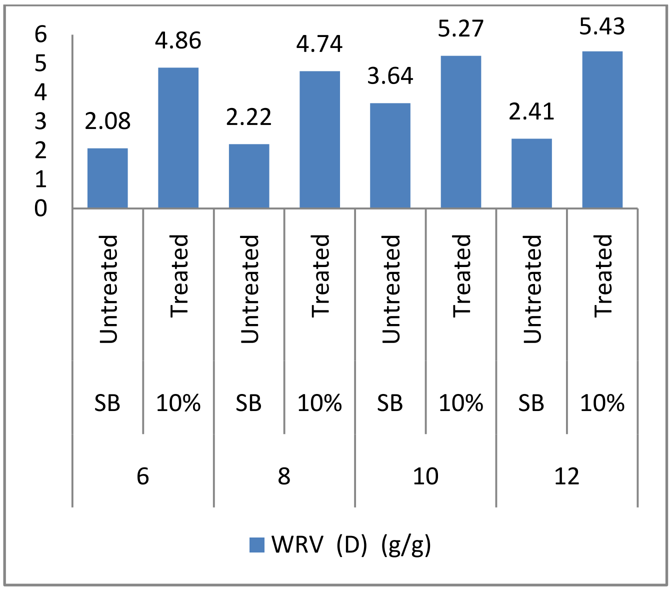
3.3Water retention value(Distilled)

After going through several experimental work table 5 shows the optimum result obtained when the sample was treated with citric acid in the presence of catalyst like sodium hypophosphite. The best result was obtained for 2/20s count yarn with a 10 % chance. of citric acid and 5% of sodium hypophosphite. The same procedure was carried out of one gram sample was dipped in distilled water for some time and then it was put in centrifuge equipment where the sample was revolved for 10 minutes, due to which the water from the sample was thrown out and the weight of sample (w1) was measured ,the difference between the weight gives the value of water retention.

FSC = (w1-w2)/w2

"Table 3.Effect of citric acid in presence of sodium hypo phosphite on WRV(D)"

resultant count	Conc.	Treatment	WRV (D) (g/g)
6	SB	Untreated	2.08
	10%	Treated	4.86
8	SB	Untreated	2.22
	10%	Treated	4.74
10	SB	Untreated	3.64
	10%	Treated	5.27
12	SB	Untreated	2.41
	10%	Treated	5.43



"Figure3. Effect of citric acid in presence of sodium hypophosphate on WRV(D)"

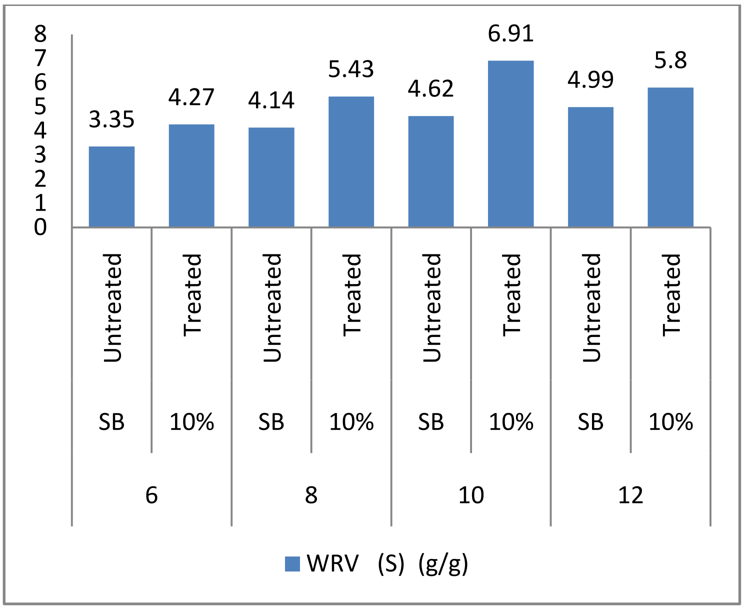
It has been found from Figure 3 that one gram sample which was treated with 10% citric acid and 5% sodium hypophosphite for 12 count show very good results, the ability of sample to retain water increase a lot which show the cross linking effect has taken place in treated sample where as in untreated sample could not hold water for a long time when it was subjected to centrifugal action observed due to rotation of cotton terry fabric.

3.4 Water retention value(Saline water)

Here 1 gm sample was dipped in saline water having normal salinity of 90%. After going through so many experiment table 4 shows the optimum result where the sample was treated with 10% citric acid along with 5 % sodium hypophosphite Both treated and untreated sample was revolved in centrifuge similarly as per previous and difference in weight was calculated which gives the value for of water being retained in the cotton sample.

"Table 4. Effect of citric acid in Presence of sodium hypo phosphite on WRV(S)"

resultant count	Conc.	Treatment	WRV (S) (g/g)
6	SB	Untreated	3.35
	10%	Treated	4.27
8	SB	Untreated	4.14
	10%	Treated	5.43
10	SB	Untreated	4.62
	10%	Treated	6.91
12	SB	Untreated	4.99
	10%	Treated	5.8



"Figure 4. Effect of citric acid with sod hypophosphite on WRV(S)".

Though the effect observed in saline water was not as good as compared to distilled water but it was found less amount of water retain in other count of yarn except the yarn with 2/20^{s} count here again the same sample was tested by centrifuge method where the rotation of the beam throw the water apart from the sample due to its revolution and the as per the holding capacity if pile yarn water was retain in the sample which states that under centrifugal force it does not allow the water to get out from the interstices of yarn.

"4.Conlusion"

It is sure that in the New era, superabsorbent fibers will occupy an important place. Many researchers are attempting to widen the use of superabsorbent such as for absorbing water in household goods, food products and medical devices. This superabsorbent fibers offer exciting prospects for the development of new textile product both for existing market and completely new markets. This superabsorbent with its cross linked hydrophilic polymers is used primarily in disposable baby diapers but this still are used in adult incontinence as well as in feminine hygiene products. Super absorbent materials are the versatile, natural, biodegradable and renewable ones that have many commercial applications.

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