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STUDIES ON SILICONE FINISHING OF KNITTED FABRICS

A PROJECT REPORT

Submitted by

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BONAFIDE CERTIFICATE

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STUDIES ON SILICONE FINISHING OF KNITTED FABRICS

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INTERNAL EXAMINER **EXTERNAL EXAMINER**

ABSTRACT

Silicones play a significant role in the finishing of many types of textile fabrics. With the ample acceptance of silicone finishing, there is a lot of variety of silicones for imparting/influencing specific properties of fabrics. Amongst these silicones, we have choose three varieties to study their effect on the fabric properties, different types of knitted structures. We have tested these fabrics for various properties like circular bending specific hand value, air permeability, abrasion, stiffness, drape, etc. before and after silicone finishing. The process parameters, testing conditions and the fabric properties have been recorded, analyzed, studied and reported.

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. INTRODUCTION

.1. WHY FINISHING REQUIRED?

'otton fibers undergo various mechanical, chemical processes starting from its ginning, pinning, sizing, desizing, mercerizing, dying, etc., on the way to become the ıbric/garment. Cotton loses its nature and becomes harsh to touch or feel as the hemicals used are sometimes strong alkalis, which strongly react with cotton molecules. lence it becomes necessary to add reasonable finish to long-lasting feel or smoothness to ıe fabrics/garments. For this, the silicones serve the exact purpose here, which meets all ıe requirements as a finishing chemical with excellent durability, softness, etc., as its ıolecular versatility helps processors to meet different tastes of customer by providing nooth, buttery, silky, limpy, wet, leathery, etc, finishes.

.2. FINISHES APPLIED ON COTTONS

he various finishes applied on the cottons are as follows:
ingeing, scouring, bleaching, immunising of cotton fabrics, brushing, tentering, ıercerising, shearing, beetling, sizing, softening, glazing, embossing, napping, antislip nishes, crease resistant finish, anti bacterial/mildew finish, sanforisation, flame proof nish, water proof finish, water repellent finish, etc.

.3. SOFTENERS IN TEXTILE INDUSTRY - AN OVERVIEW

he assessment of fabric quality and its performance in actual end use is of crucial ıportance. Fabric handle is extremely important in the selection of the fabric by the ınsumer. Traditionally, fabric handle is important for assessment of the fabric quality ıd its importance in the appeal and marketability of textiles is well recognized.

Softeners are the surface-active agents with a long chain hydrophobic part and a short chain hydrophilic water solubilising group. They form a film of high tenacity on the material they wet. The hydrophilic part may be cationic, anionic or non ionic in nature.

The following are the characteristics of the softeners:

1. An effective softener must be readily dispersible or miscible in water and rapidly absorbable by the material so that uniform deposition can occur with in a relatively short treatment time.
2. Exhaustion should take place in about 5 min time for it to be effectively and economically acceptable.
3. It must impart softness, fluffiness and lubrication to the treated fabric and should reduce static build up especially in the case of hydrophobic fibers.
4. The treated fabric should retain its ability to absorb water in subsequent uses like bath towels used for drying the bodies or other surfaces.
5. It should not adversely affect the shade and hue of dyed and printed fabrics.
6. It should not exert a corrosive effect on metal equipments use for its application.
7. It should not produce unpleasant odour in the fabric and should not produce skin irritation when in contact with human skin.
8. The fabric tear strength and other mechanical properties ties should not be affected to a large extent.

2. REVIEW OF LITERATURE

2.1 SILICONES

2.1.1 SILICONES – A BRIEF HISTORY

Kipping, an English Chemist is widely considered as father of silicone chemistry. He used $SiCl_4$ with various magnesium based organometallic compounds, invented by Victor Grignard in 1900 in his studies.

Dr. James Frankin Hyde, popularly known as the real inventor of silicones is a Harvard trained chemist; working for Corning, a pioneer in glass technology, he knew the Kippings works in organosilicone chemistry and was particularly intrigued by Kippings' remark that diethlidichorosilane had produced "glue like' materials.

Rochow, also known as father of commercial silicones is guided by Kipping and Hydes works. Rochow, an organochemist from General Electricals, then made an attempt to make resins called methyl silicones. The process of the production of silicones form the method that he produced is called 'Rochow's direct synthesis of silicones' which paved the way for the commercial success, the modern chemistry of silicones and its derivatives.

2.1.2 SILICONES – A BOON TO TEXTILE INDUSTRY

Silicones are organoploy siloxanes having a backbone of silicones-oxygen-silicone atom. Silicones obtained from sand reacts with methyl chloride in a direct synthesis process to form chloromethane silanes, which react with water during the hydrolysis. A final polycondensation process produces siloxanes of varying structure according to process performed. Since this is tetravalent two sites are available on each silicone of the siloxane chain.

The silicone compounds which are based in PDMS (poly dimethyl silicone) backbone are called functional silicones, which are chemically/modified to offer specific reactive sites for binding with the fabric surface.

These reactive sites can be of any functionality and includes functions such as hydroxyl (-OH) amine (-RNH2), carboxy (-COOH), epoxy (CH2CHO), methyl hydrogen (SIH) and others. R is determined by the nature and type of the cross linkage system. It can be hydrogen, organic radical or silyl radical can contain single or multiple reactive groups like vinyl, alkoxy or reactive groups like amino, epoxy and carboxy depending on the feel required for particular fabric, value of n, m varies mainly with the type of product and desired molecular weight.

And thus silicones play a major role in modifying the properties of the fabrics to suit specific market requirements, which offer longer lasting, permanent surface modifications to the textile fabric. Although the process of the fabric is simple, the actual mechanisms are complex and are being understood.

2.1.3 AMINO-MODIFIED SILICONES

Amino modified silicones are well recognized as premium fabric finishing agents as they not only provide and surpass but also improve many fabric physical properties. The desired feel is based on the amino groups, silicone backbone and group end reactivity. The superior finishing offered by silicone (amino modified) compounds are due to low molecular interactions, easy molecular rotation around oxygen of the poly dimethyl siloxane (PDMS) chain together with antistatic properties of amine functional groups.

Amino modified silicones are widely used in the industry as the surface smoothening and softening properties of these are good above all other product groups. Micro and semi-micro emulsions can be made with specially selected emulsifying recipes using amino functional silicones. They offer a number of advantages, which are totally reliable for modern textile finishing. The low particle size (micro-emulsion<0.01μ) (semi-micro ulsions<0.1μ) allow the additives to penetrate in to an excellent product distribution of micro-emulsion. Silicone micro-emulsions give an excellent inner softness and a stinctive surface smoothness with out looking greasy. They improve the technological operties of the textiles (e.g. abrasion resistance, creasing angle), support the elasticity nd optimize the sewability. They are responsible for handle, flexibility and whiteness of he finish and play a major role in imparting textile finish giving soft and silky feel, to the loth, which can last multiple wash cycles. Micro-emulsions have good product stability nd decrease the hazard of roller coverings. The use of fast running machines devices with high shearing forces may cause problems when working with silicone micro-emulsion (bath stability) unless specially optimized products for the application field were selected.

The softening capacity of silicones is based on the gliding behavior on the fiber surface as well as in the fiber. Polydimethyl siloxanes attached to amino-functional groups allow a better orientation and substantivity of the silicone on the substrate. This again leads to a better soft handle and good washing permanency.

These silicones are highly absorbic in nature, due to the affinity of the amino groups to the fibers, which promotes optimum orientation of the silicone on the substrate.

.1.4 REACTIVE SILICONES

The reactive silicones as the name implies react with the fiber substance and yield a softening effect, which is extremely fast to washing. A definite covalent bond is formed between the reactive softener and the fiber under suitable conditions. Possessing the reactive groups such as sulphonic acid, isocyanate group, etc., these react with the –OH group of the substrate inorder to give the softening effect. When applied with out the curing step, it acts as a non-reactive cationic softener with some affinity for the cellulosic fibers. These may be applied as non-ionic softeners without curing, where only temporary softening effect is produced which is not fast to washing. These softeners of certain category and resin-precondensates can be applied simultaneously inorder to get permanent softening and crease resistance. Water repellency, improvement in abrasion/wear resistance, improvement of hand or feel of the goods, resistance to dry cleaning and household washing, wrinkle resistant, reduced dusting are some of the imparted properties to the finished textiles.

2.2 KNITTING

2.2.1 THE EVOLUTION OF KNITTING

The term Knitting describes the technique of constructing textile structures by forming a continuous length of yarn into columns of vertically intermeshed loops. The term knitting dates from the mid-sixteenth century, earlier words such as the Saxon 'cnyttan' and the Sanskrit 'nahyat' being less precise, indicating that knitting probably evolved from sources such as the experience gained by knotting and Coptic knitting.

In Copic knitting or Nalbindling, an upside-down looped structure is produced using a single-eyed (like a sewing needle) containing a short length of yarn. Normally, crossed loops are formed. The technique can achieve fashioning, closing, circular knitting and stitch patterning.

Weft, warp, hand knitting are various knitted technologies that are widely now a days.

2.2.2 THE POTENTIAL OF KNITTING TECHNOLOGY

The unique loop structure of knitting provides opportunities for

1. Using a minimum number of yarns
2. Easy flow of yarn from one loop to another under tension
3. Varying the size of loops
4. Loop distortion when under tension
5. Loop transfer
6. Knitting side face, double face, open work and surface interest structures
7. Increasing or decreasing the number of loops in width or depth

8. Knitting to shape fabric pieces or separate articles

9. Knitting from a selection of yarns

10. Engineering extensibility or stability

11. Introducing yarns unsuitable for knitting

Today, knitting machines can manufacture most previously hand-knitted designs and structures that are too fine, intricate or complex to be attempted with hand-held pins. Fortunately the unique properties of knitted constructions, their ability to be engineered to extracting requirements and their potential for producing shaped articles as well as fabrics, enables knitting technology to rapidly respond to the requirements.

2.2.3 GENERAL TERMS USED IN KNITTING

2.2.3.1 THE KNITTED LOOP STRUCTURE

The knitted loop structure may not always be noticeable because of the effect of structural fitness, fabric distortion, additional pattern threads or the masking effect of finishing processes. However, unless the intermeshing of the loops is securely achieved by the needles receiving new loops of yarn into their hooks before the old loops are cast-off, and the ground structure is not fractured during finishing or wear, a breakdown or separation of the structure of the structure will result.

2.2.3.2 A COURSE

A course is a predominantly horizontal row of needle loops (in an upright fabric as knitted) produced by adjacent needles during the same knitting cycle.

2.2.3.3 A COURSE LENGTH

In weft knitted fabrics (with the exception of structures such as jacquard, intarsia and warp insertion), a course of loops is composed of single length of yarn termed a course length. Weft knitted structures will unrove from the course knitted last unless it is secured.

2.2.3.4 A PATTERN ROW

A pattern row is a horizontal row of needle loops produced by adjacent needles in one needle bed. In plain weft knitted fabric this is identical to a course but in more complex fabrics a pattern row may be composed of two or more course lengths. In warp knitting, every loop in a course is usually composed of a separate yarn.

2.2.3.5 A WALE

A wale is a predominantly vertically column of intermeshed needle loops generally produced by the same needle knitting at successive knitting cycles. A wale commences as soon as an empty needle starts to knit.

2.2.3.6 STITCH DENSITY

It refers to the total number of the loops in a measured area of fabric and not to the length of the yarn in a loop. It is the total number of needle loops in a given area. The figure is obtained by counting the number of courses or pattern rows in one inch and the number of wales in one inch.

2.2.3.7 TECHINACALLY UPRIGHT

A knitted fabric is technically upright when its course run horizontally and its wales run vertically, with the heads of the needle loops facing towards the top of the fabric and course knitted first situated at the bottom of the fabric.

2.2.4 THE FOUR BASIC WEFT KNITTED STRUCTURES

2.2.4.1 SINGLE JERSY
2.2.4.2 INTERLOCK
2.2.4.3 RIB
2.2.4.4 PURL

2.2.4.1 SINGLE JERSY

The simple and the most widely used weft-knit fabric is single jersey or plain knit fabric. It consists of face loop stitches only. The loops have a V-shaped loop appearance on technical face and show semi-circular loops on the technical back side. Because of the side limbs of the loop on the face side, it feels smoother on face side than on the back side and hence it is not reversible, from the feel and appearance point of view.

Knitted loops in plain-knit fabrics tend to distort easily under tension, which helps to give a form fitting and comfort due to the property of the elastic recovery. It has a potential recovery of about 40% width after stretching. Its width shortens if the length is extended by tensions while the length shortens if width is stretched. Normally width way extensibility is approximately twice the length-way extensibility. If the unrelaxed plain knit fabric is kept flat on the surface, it curls upwards at the top and bottom and backwards at the sides.

2.2.4.2 INTERLOCK

Interlock is the interlocking of the two 1x1 rib structures in such away that the face wale of one rib fabric is directly in front of the reverse wale of the rib fabric. Then in the next wale the order is reversed. The interlocking is a result of the crossing of the sinker loops in this interchange of the sinker loops between the front and back wales. Simple interlock structure is a reversible structure. The fabric is firm due to the interlocking structures knitted in two separate planes by the sinker loops. It can be compared to a double cloth in woven structure. The structure does not curl at edges when cut and more ladder resistant than the single jersey and rib structures.

2.2.4.3 RIB

Rib is a reversible structure and its appearance shows vertical cords and thin ridges. It is heavier and thicker structure than the plain knit structure with the plain guage used for the plain-knit and rib structure. It has maximum extensibility in width way and hence rib trimmings are the most suitable for neckbands, collars, armbands, sleeves cuffs and waist bands. These are extensively used in the production of the outerwear garments. The fabric does not curl at edges. Due to this, it is particularly useful in cutting and sewing operations. The structure is more opaque than a jersey and hence this structure is used for swimwears.

2.2.4.4 PURL

Purl is the least commonly used weft-knit structure as it has very little commercial and apparel end-uses. The face and the reverse courses are knitted in alternate courses where as the earlier the face and the reverse wales are knitted alternatively in 1x1 rib structures. This structure creates more extensibility in lengthway. But, very rarely the length way extensibility is desired in the end-use of knit structure. Hence the lengthway extensibility of the purl knitted structures are more suitable to infant wears, socks, golf sweaters and sportswear. It is reversible in appearance and has soft hand with full cover. Its thickness is theoretically double than that of plain knit or jersey fabric. It does not curl at the edges and because of alternate face and reverse course. It is a balanced structure and this proper is useful in cutting and sewing.

2.3 RAW MATERIAL (COTTON)

India has an ancient history in textiles. Prof Basham of Australian National University Canberg has noted in his book 'The wonder that was India', that cotton was first used by Harappa people in Indus valley in the third millennium BC. King cotton ha always been India's staple fiber and cotton textiles has been a main export.

The Indian cotton scenario has a few specialties to its credit. No other country has the distinction of having cotton from 2s count to 120s count. Similarly India has maximum colors, patterns and designs in its cotton. Despite the prenure from other fibers, cotton has not lost its cool and culture, dressing demeanor and prosperous protocol. Cotton is the very lifetime of the textile sector in India. Indian cotton fabrics are quite popular on the international front- The Wealth of India (1996).

2.4 THE PROCESS OF FINISHING

The fabric samples are initially scoured and bleached in order to remove the wax and other natural impurities, and the treated samples are finally finished by pad and dry method.

2.4.1 SCOURING

Scouring is the process of treating grey cotton goods in a boiling solution of weak alkali in order to move the natural impurities like wax, oil, fat foreign matters, etc.,. The changes that take place during boiling are as follows.

1. Conversion of oils, fats and waxes into soluble soaps

2. Hydrolysis of proteins into soluble products
3. Hydrolysis of simple ammonium compounds into ammonia
4. Conversion of pectin's and pectose into soluble salts
5. Dissolving of mineral matters. Emulsification of unsaponifiable oils

2.4.1.2 THE SCOURING PROCEURE

The required amount of chemicals is taken according to the recipe where it is dissolved in water and the temperature of the solution is raised to boil. The grey cotton sample is entered in scouring liquor quickly and rotated, continuously in the bath till it wets completely.

The material is kept immersed in the bath with frequent turning around. Care should be taken that the material is kept immersed when the material is not being washed on.

After a specified time, the material is taken out and squeezed. It is then washed with hot water and then with cold water in order to remove the excess solution.

2.4.2 BLEACHING (BY MEANS OF H_2O_2)

The use of hydrogen peroxide as an oxidizing bleaching agent creates greater interest, being a universal bleaching agent which can be successfully used for bleaching cotton, wool, silk.

The strength of commercial solution of hydrogen peroxide is expressed generally in terms of "Volume of Oxygen" which they are capable of yielding per unit volume of hydrogen peroxide. One volume of hydrogen peroxide means that 1cc of this peroxide will yield 1cc of oxygen. Hydrogen peroxide is usually marketed as 10,20,30,100 and 130 volume strength.

The relation between volume and percentage of hydrogen peroxide by weight is as under

S. No	Strength of commercial H_2O_2 (volume)	Percentage by weight of H_2O_2
1.	10	3.04
2.	20	6.08
3.	100	30.04
4.	130	39.52

2.4.2.1 THE BLEACHING PROCEURE

Many metals especially copper, the use of which should be avoided, rapidly decompose peroxide solution. Hence stainless steel is suitable. Iron, lead and Aluminium can also be used in the presence of sodium silicate. The fabric is treated in the bath containing required strength of hydrogen peroxide and the bleaching are as follows.

Particulars	Half Bleaching	Full Bleaching
1. Hydrogen Peroxide	0.5 - 2 volume	2-4 volume
2. Sodium Silicate	2 gms/lit	4.8 gms/lit

The temperature for bleaching 80^0 - 85^0 C and P^H is 10.5. The material to liquor ratio is 1:20. The treatment is continued for half-an-hour at 80^0 C and one hour at 95^0C. The solution is made alkali with sodium hydroxide. Sodium silicate mostly used as stabilizer and it has greater stabilizing action. In the action of sodium silicate hydrogen peroxide decompose rapidly at 85^0C. After bleaching the material is washed with cold water and dried.

$$H_2O_2 \rightarrow H_2O + [O]$$

$$H_2O_2 \rightarrow H^+ + HO_2-$$

...INISHING

...ner is a chemical that, when applied to a textile materials bring about an alteration ...dle, resulting in the goods being more pleasing to the touch than before applying it. ...ers or softening agents have been in use in textile finishing for many years ...rily for improving the softness, handle, drape, etc. An effective softener must be ...ily dispersible or miscible with water or rapidly absorbed by the materials so that the ...iform deposition can occur within a relatively short treatment time. It must impart ...ftness, fluffiness and lubricity to the treated fabrics and reduce static build up, especially in the case of the hydrophobic fibers. These effects should be obtained with out the loss of the fabric brightness. The treated fabric should retain its ability to absorb in subsequent uses like bath towels and should not adversely affect the shade and hue for the dyed printed fabrics and should not exert corrosive effect on the metal equipments used for its applications. It should not produce unpleasant odour in the fabric and should not produce skin irritation.

Fabric softeners are classified into four categories namely

1. ANIONIC SOFTENERS
2. CATIONIC SOFTENERS
3. NON IONIC SOFTENERS
4. REACTIVE SOFTENERS

2.4.3.1 THE FINISHING PROCEDURE (Application methods)

2.4.3.1.1 EXHAUSTION FROM DILUTE BATHS

A solution of .25 to 2% softener on weight of material may be used and enough time is given for adequate exhaustion.

2.4.3.1.2 PADDING FROM RELATIVELY CONCENTRATED SOLUTION

The textile material is stepped in or padded with a dilution of softening agent, followed by squeezing to remove excess liquor and finally curing with out rinsing. Application may be carried out in beck winch, jigger, padding mangle or package dyeing machine. Different silicone softeners have different concentrations to be use depending upon the end use application. And in the modern age, as the silicone chemistry is well known, there have been various developments form which we can have diverse end use applications depending upon the requirement.

2.5 TESTING

In order to carry out the tests the following testing conditions are required

1. $21 \pm 1^{o}C$ ($70 \pm 2^{o}F$)
2. 65 ± 2 % relative humidity.

2.5.1 BRIEF

The following tests has to be performed for the estimation of the fabric handle and its properties

1. FABRIC DRAPE
2. FABRIC STIFFNESS
3. AIR PERMEABILITY
4. BUSTING STRENGTH
5. ABRASION RESISTANCE (MARTINDALE)
6. CIRCULAR BENDING STIFFNESS
7. FABRIC THICKNESS
8. GSM OF A FABRIC

3. THE PROJECT

3.1. OBJECTIVE

To study the properties (between silicones & between various knitted structures) of various silicone finished knitted structures and hence the purpose is to select the best suitable silicone for a given knitted structure

3.2 METHODOLOGY

Chose the Silicones

⇩

Get the fabric samples of various knitted structures

⇩

Scouring and bleaching of fabric samples

⇩

Finish the fabric samples by pad and dry method

⇩

Testing the samples foc analyzing the properties

⇩

Analyze the test results and conclude

3.2.1 CHOSE THE SILICONES

The intricate part of it lies only when we necessitate choosing the silicones from a wide variety, for various types of fabrics available to suit those stringent end-use applications.

Of all the various silicones, amino modified and reactive silicones were taken for the investigation as amino modified silicones has unique properties of low surface tension, inert nature and the reactive silicones are selected due to its reactive nature (due to formation of cross links).

Silicone samples a) Reactive b) Amino-modified (Micro emulsion) c) Amino-modified (macro emulsion)

3.2.2 GET THE FABRIC SAMPLES

The fabric samples are taken from the same lot having the following properties in addition to the color.

Type of Fabric / Property	SINGLE JERSY	INTERLOCK	RIB
Fabric GSM	200	230	190
Courses / Inch	52	42	36
Wales / Inch	42	38	32
Loop length (cm)	0.33	0.31	0.28
Tightness factor	18.7	14.2	18.6

3.2.3 SCOURING

The scouring is done at normal standard conditions and the conditions are as follows.

Sodium Hydroxide - 4% OWM
Sodium Carbonate - 2% OWM
Wetting agent (Soap solution)- 0.5%
Material of liquor ratio - 1:10
Temperature - Boiling (100^0 C)
Time - 60 minutes

3.2.4 BLEACHING (HALF BLEACHED)

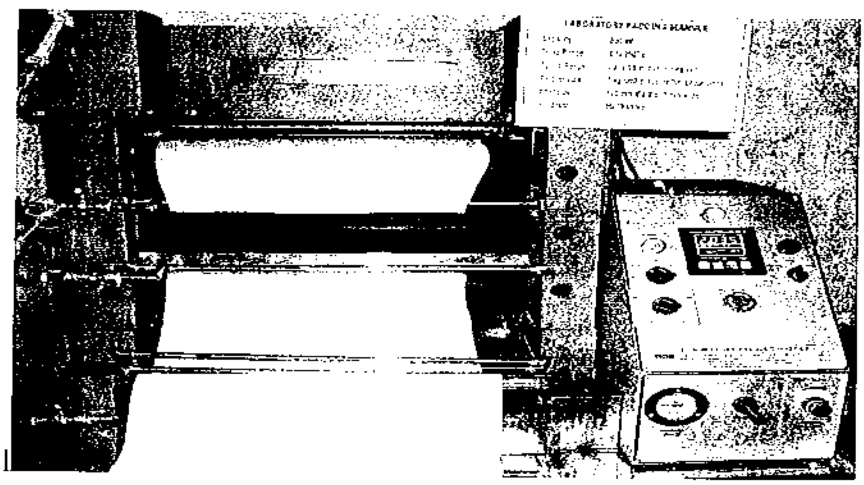
The scoured samples are half bleached using H_2O_2, which is a universal bleaching agent in the following conditions.

Concentration of H_2O_2 required for half bleach	- 2 vol
Material to liquor ratio	- 1:20
Temperature	- 800 - 85^0 C
Time	- 1 hr

3.2.5 FINISHING (RECOMMENDED)

The finishing is done as recommended by paddle mangle technique and the following process parameters are maintained strictly while finishing.

Water PH	- 5.5-6 %
Temperature	- room temp
Pick up	- 102 %
Water hardness	- <50 ppm
Amount of Reactive silicones	- 10-15 gp
Amount of Amino Modified (Ma)	- 50 gpl
Amount of Amino Modified (Mi)	- 40gpl



Finishing of knitted fabric in paddle mangle

3.3 TESTING

Various tests have been done for the calculation of the properties of the silicone finished knitted fabrics. The brief of them are as follows.

3.3.1 FABRIC DRAPE

Testing Method : ISO 9073

Testing procedure:

1. Make all the tests in the standard atmosphere.
2. The sample can be prepared by cutting the specimen fabric to desired size of 30 cm diameter and providing a center hole 6mm diameter to facilitate the fixing in the supporting disc by using a template designed as an accessory for the drape tester.
3. The transparent lid of drape tester is opened and the supporting disc is pressed down to the platform and locked at the position is taken out by unscrewing the knurled net.
4. The conditioned specimen is then carefully transferred and placed over the bottom-supporting disc.
5. The top-supporting disc is then placed over the fabric and it made tight by screwing on the knurled nut over the threaded stem of the supporting disc.
6. Carefully press the supported disc by untwisting anti – clockwise.
7. The supporting disc unit is released and allowed to raise by means of a compressed spring.
8. This allows the edge of the fabric to drape freely under its own weight.
9. The top lid is now closed and sheet of paper of size 35 cm x 35 cm is placed over it.
10. The light is switched on. Draw the outline of projected area of specimen.

3.3.2 FABRIC STIFFNESS

Testing method : D 1388-96

Testing procedure:

1. Make all the tests in the standard atmosphere.
2. A sample size 6" x 1" is cutted using scissors for warp and weft way.
3. The tester is set on a table, so that the horizontal platform and the index lines are at eye level.
4. The specimen is placed in between the platform and the templated so that the fabric and the zero mark of the template coincides with the datum line.
5. Both the template and fabric are slowly pushed forward.
6. The fabric will tend to drop over the edge on its own weight.
7. Both are moved forward until the tip of the fabric cuts the index lines when viewed in the fabric.
8. The bending length is measured from the scale.
9. Take 10 readings.

3.3.3 AIR PERMEABILITY

Testing Method: BS 3424

Testing procedure:

1. Make all the tests in the standard atmosphere.
2. The sample is placed in the sample holder and the template of 4 sq.cm.
3. The valve is adjusted to zero.
4. The rate of flow of the air in the fabric is adjusted by the valve A,B,C.
5. The flow rate of air is noted
6. Take 10 readings.

3.3.4 FABRIC BUSTING STRENGTH

Test method: ASTM D 3787-89

Testing procedure:

1. The fabric sample is kept on the clamping base and is tightly holded by a movable clamp.
2. There are two pressure gauges (150 lbs/sq inch & 400 lbs/sq inch), the pressure gauge is selected according to the type of the fabric.
3. The pressure of the glycerine in the cylinder underneath of the fabric and the rubber diaphragm is developed by forward switch.
4. After the fabric bursts the switch is turned off and the reading in the pressure gauge gives the bursting strength of the fabric.
5. Then the reverse switch mode is set on and the motor switches off automatically.

3.3.5 ABRASION RESISTANCE

Testing Method: ASTM 4966: 1998 (Martindale method)

Testing procedure:

1. Make all tests in the standard atmosphere.
2. A sample size of 1.5" inches is cut using template, weighed amd mounted on a mushroom shaped holder.
3. The abradant material may be in the form of emery paper, sand paper, and canvas etc, cut the abradant to the size of 5" x 5" using the template provided.
4. Place the abradant on the abrading table.
5. Now mount the mushroom holder in its position.
6. Set the counter with required number of cycle.
7. Start the machine and after the required number of cycle is completed the machine will stop.
8. Remove the sample from the holder and weight it.

13.8 CIRCULAR BENDING STIFFNESS TEST

Testing Method: D 4032 – 94

Testing procedure:

1. Make all the tests to be carried out in the standard atmosphere as directed in practice D 1776.
2. Set the tester on a flat surface with dial at eye level.
3. Select a gage with a capacity in which results will fall within 15 to 100% of dial gage force or 1.5 to 100% of digital gage force.
4. Check the tester plunger speed control for full stroke length.
5. Pneumatic Plunger – Set the air pressure control to the actuator at 324 Kpa (47 psi). Using a stopwatch, adjust the pneumatics to provide plunger speed of 1.7 ± 0.15 secs under the no load conditions.
6. Manual Actuator – Using stop watch, establish and confirm a plunger speed of 1.7 ± 0.3 secs.
7. Center a double-ply specimen on the orifice platform below the plunger.
8. Check the gage zero and adjust, if necessary.
9. Set the maximum force reading switch.
10. Actuate the plunger for the full stroke length. Avoid touching the specimen during testing.
11. Record maximum force reading to nearest gage graduation.
12. Continue as directed until all specimens have been tested.
13. The circular bending specific handle value is given as follows

$$\frac{\text{Force required to pull the fabric through the orifice (mN)}}{\text{GSM of the fabric}}$$

3.3.6 FABRIC THICKNESS

Testing method: IS 7702: 1975

Testing procedure:

1. Conduct the test in a standard atmosphere.
2. Clean the presser-foot and the reference plate. Check that the pressure foot shaft moves freely. With the presser-foot so loaded as to exert the appropriate specified pressure on the reference plate, set the thickness gauge to read zero.
3. Raise the presser-foot and position the sample, with out tension, on the reference plate so that no part of the area to be measured lies nearer to a selvedge than 150 mm. Ensure that the area chosen for the test is free from creases. Do not attempt to flatten out any creases; this is likely to affect the result.
4. Lower the presser-foot gently on to the sample and not the gauge reading after 30 seconds.
5. Similarly determine the thickness at 10 places on the sample so chosen that each such place contains different warp and weft threads as relevant.

3.3.7 GSM OF A FABRIC

Testing Method: D 3776 – 96

Testing procedure:

1. Make all the tests in the standard Atmosphere.
2. The cloth sample of 10 x 10 cm is cut by using scissors.
3. Then the fabric is hanged in the hook of the quadrant scale.
4. So that according to the weight of fabric the pointer moves and shows the value on the marked scale in which fabric weight (metre^2 and weight per sq.yard) are marked.
5. Take 10 readings.

SULTS AND DISCUSSIONS

ABRIC DRAPE

following graphs show the trend, how the drape coefficient varies with the different cone finishes.

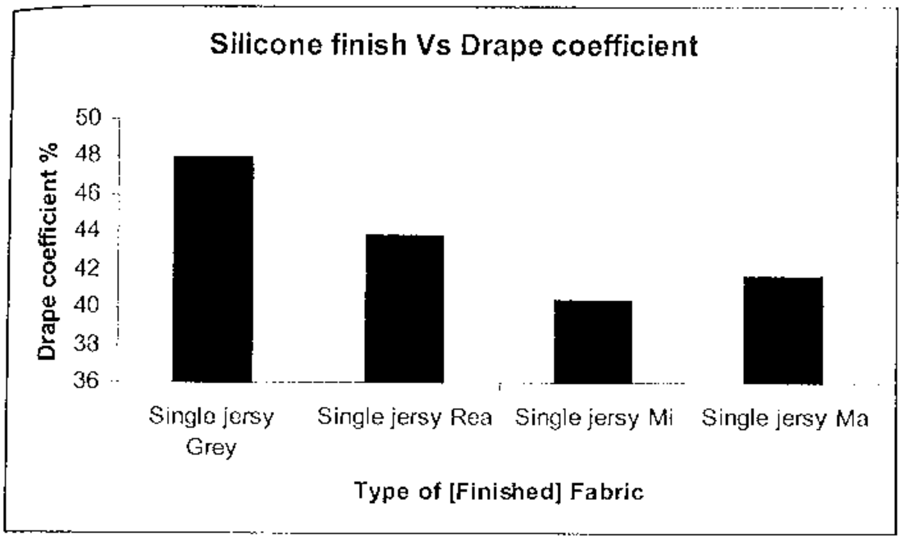


fig-1

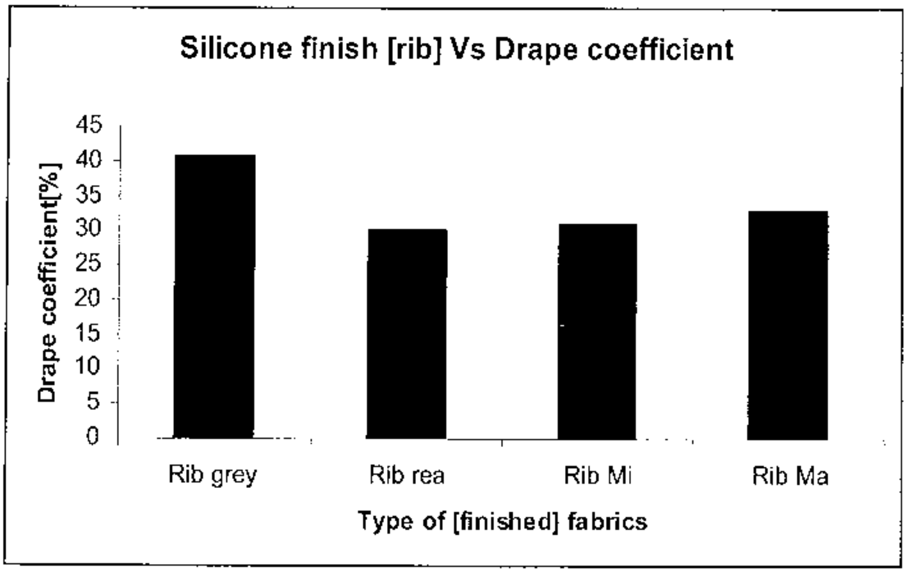


fig-2

P- 1630

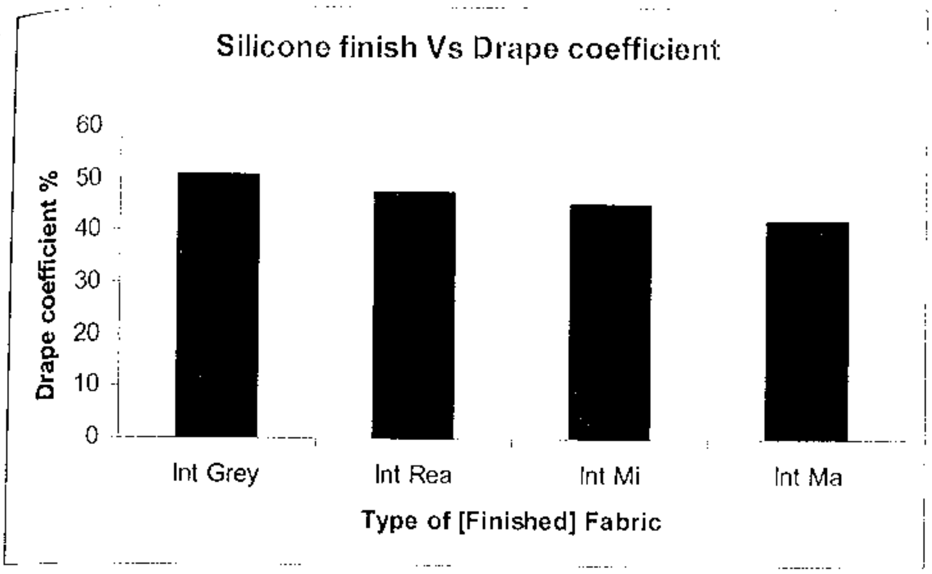


fig -3

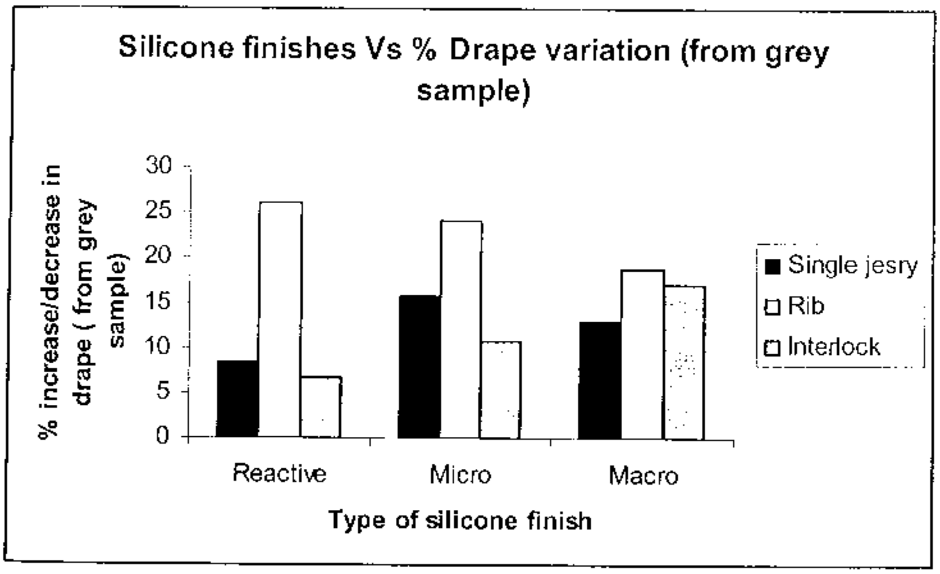


fig -4

By the above graphs, it can be clearly seen that single jersey and Interlock structures have shown better drape when treated with reactive silicones, but the amino-modified (macro emulsion) treated fabrics shows a better drape in rib structure (which shows no significant effect). And it can be finally said that reactive silicones gives a better drape, and the amino-modified (micro emulsion) silicones give an optimum drape for all the structures.

STIFFNESS

following graphs show the drift, how the stiffness (bending length) varies with the [different] silicone finishes.

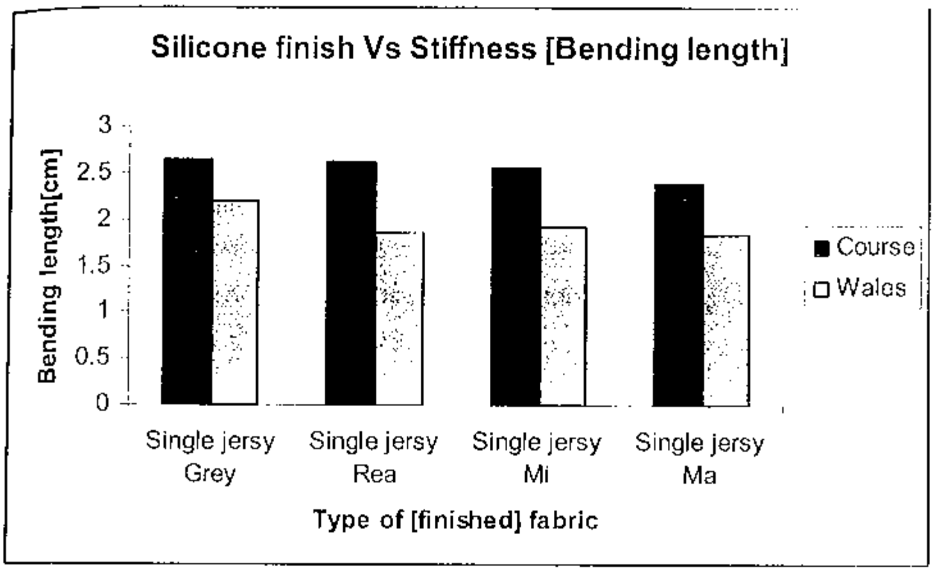


fig -5

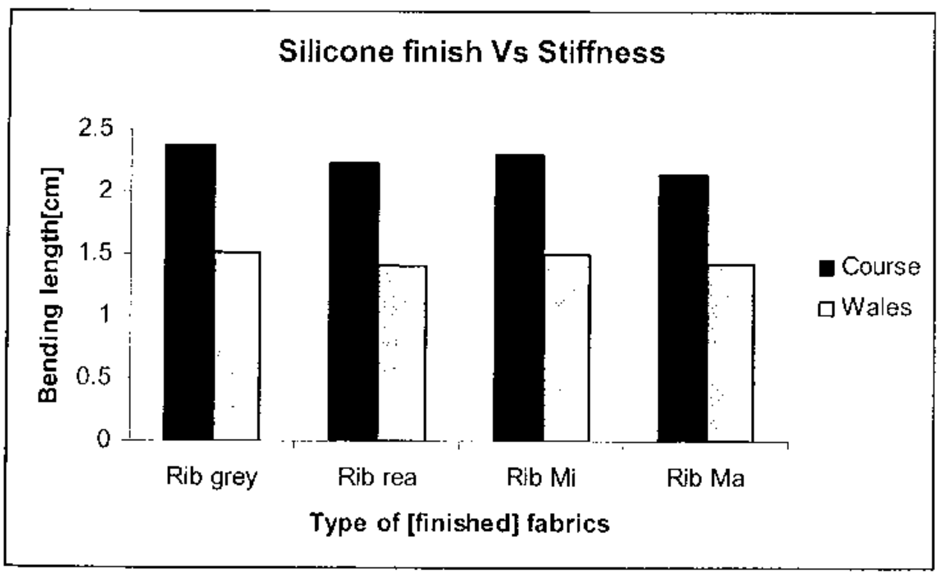


Fig-6

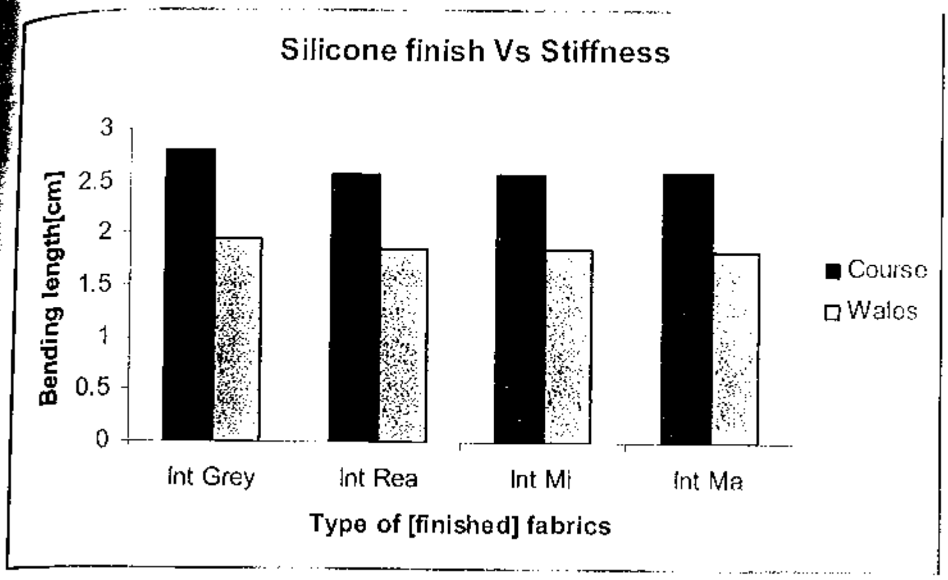


Fig-7

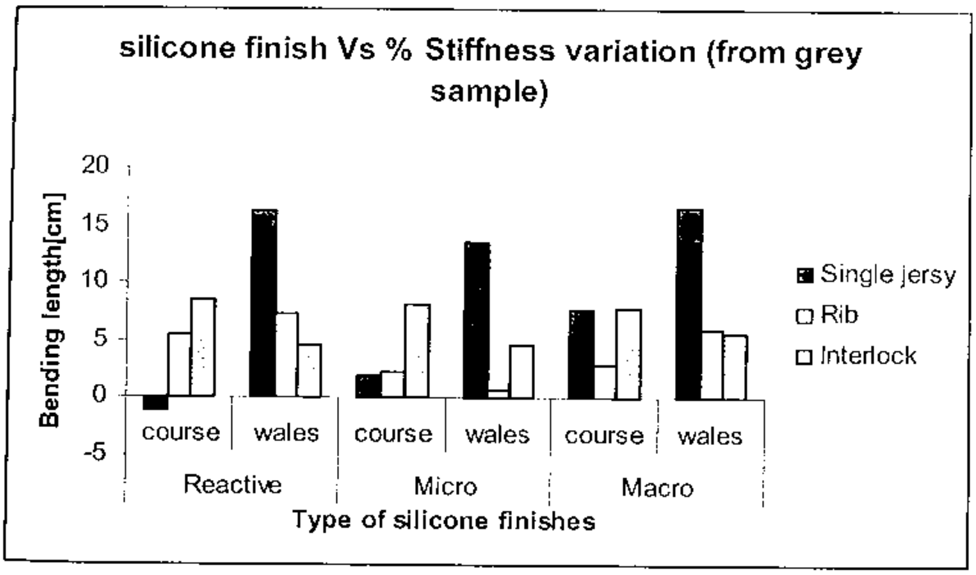


Fig-8

Above graphs clearly shows that all the silicone finished knitted structures had shown a better stiffness when treated with amino-modified (micro emulsion) silicones. And it can be concluded that amino-modified (micro emulsion) silicones gives a better (lesser) stiffness compared to that of other silicones.

AIR PERMEABILITY

Following graphs show the fashion how the air permeability varies with the different ...e finishes.

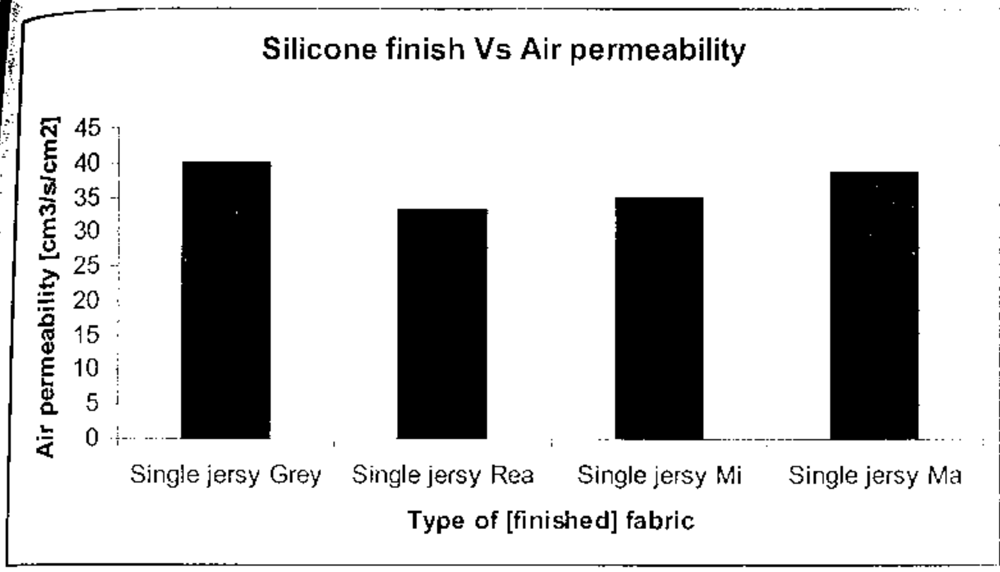


Fig-9

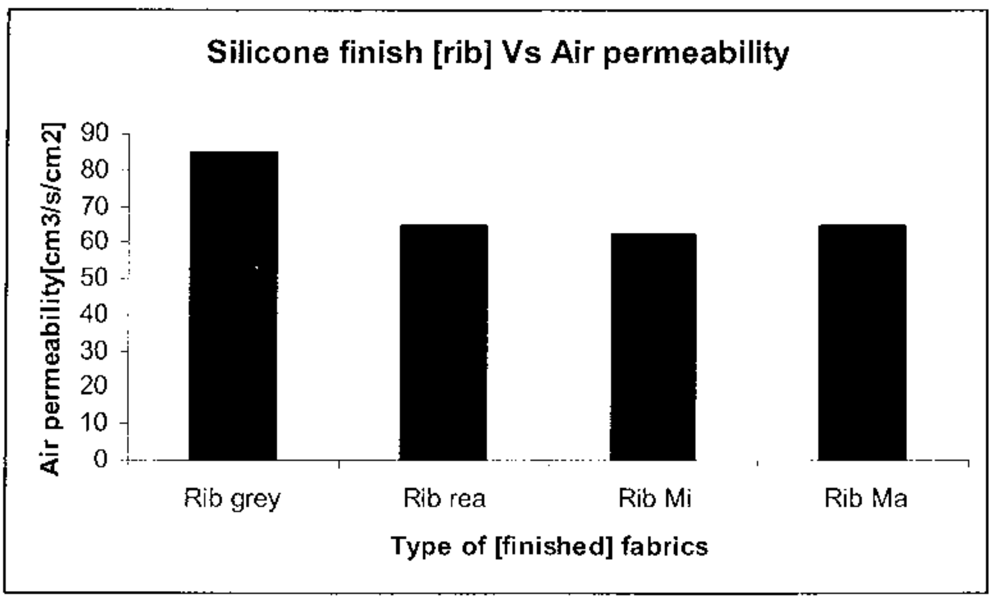


Fig-10

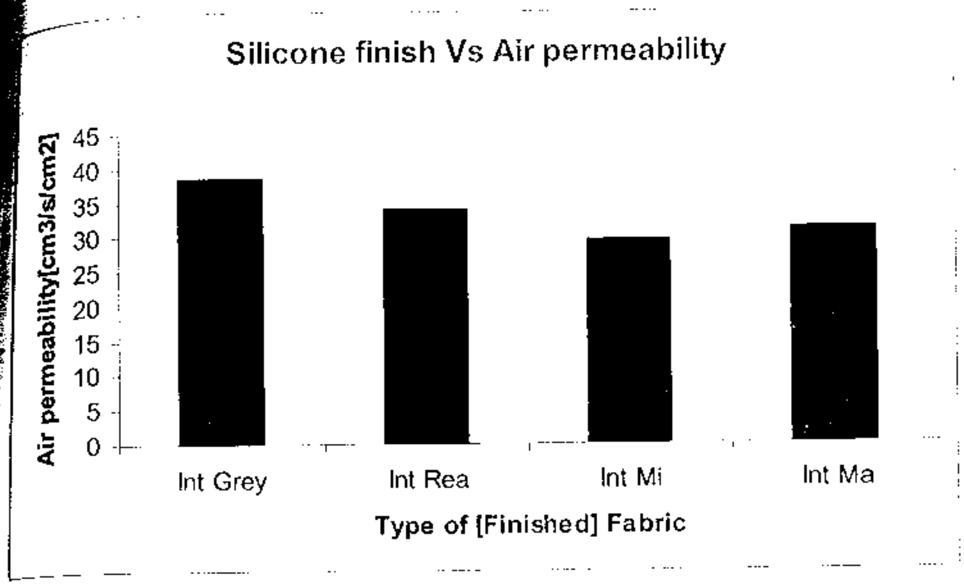


Fig-11

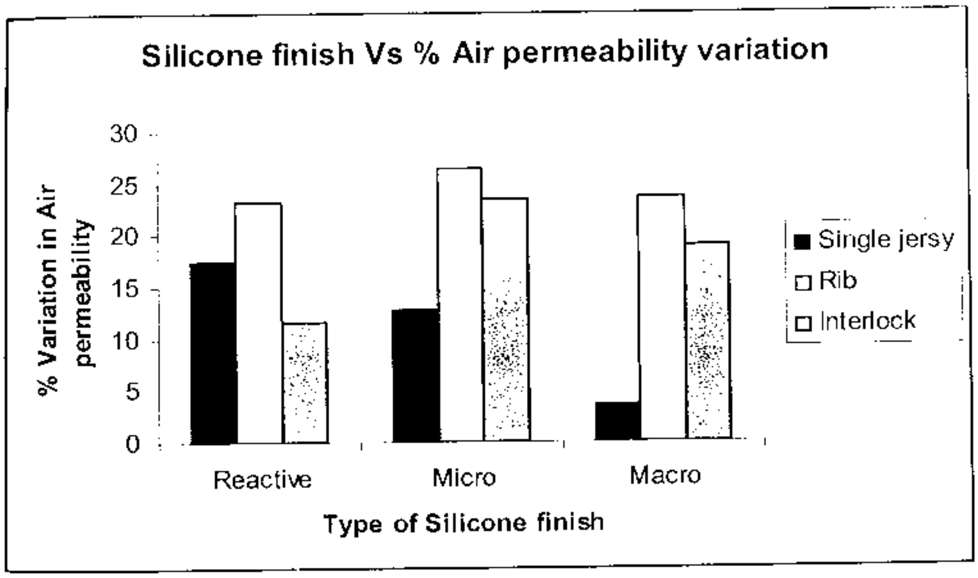


Fig-12

Above graphs shows that all the silicone finished knitted structures had shown a better (less decrease) in air permeability when treated with Amino-modified [Macro emulsion] silicones. And it can be concluded that Amino-modified [macro emulsion] silicones gives a better air permeability compared to that of other silicones.

USTING STRENGTH

llowing graphs show the trend how the bursting strength varies with the different e finishes.

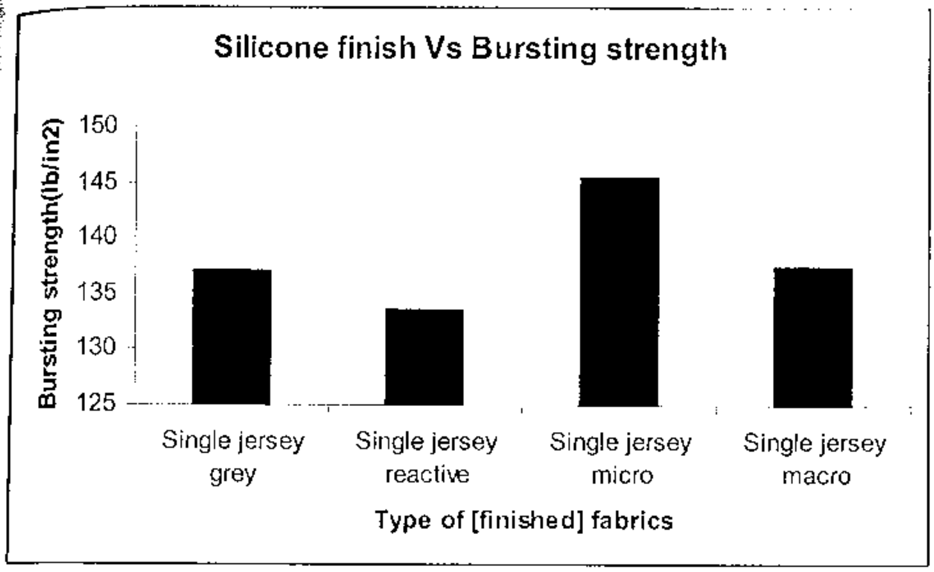


Fig-13

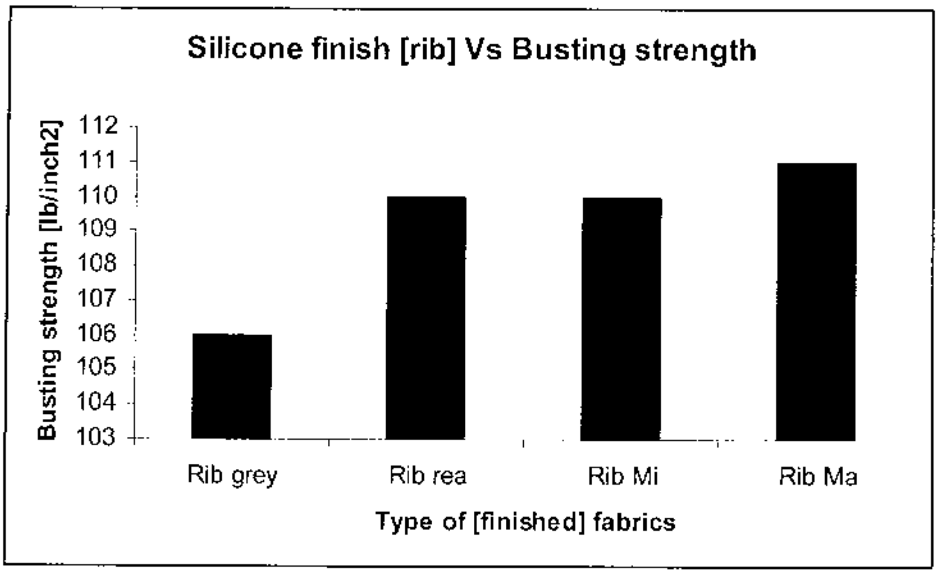


Fig-14

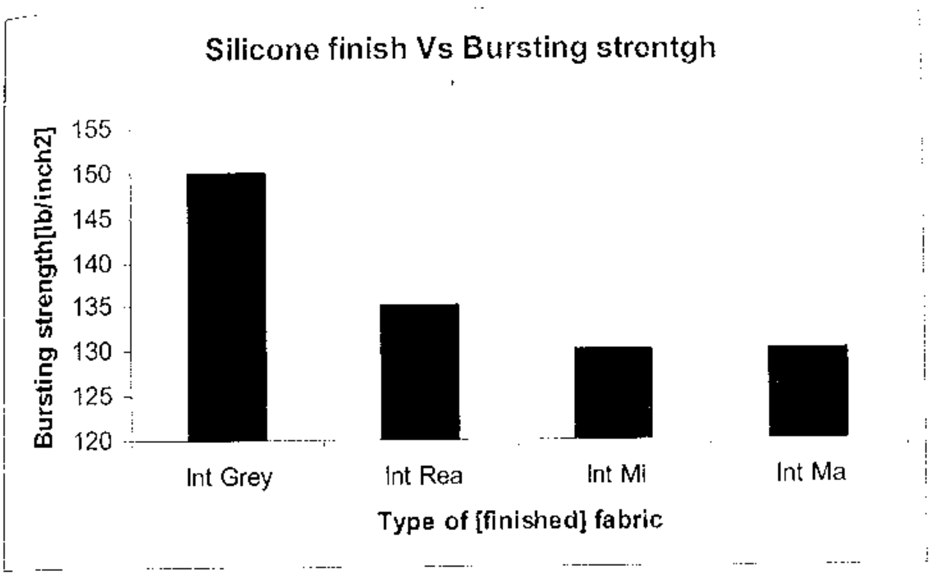


Fig-15

From the above graphs it can be noticed that all the single jersey and rib silicone finished knitted structures had shown a improved busting strength where the interlock structure had shown reverse trend when compared to the grey samples. And it can be said that amino-modified (micro emulsion) silicones gives a better (better than that of other compared silicones) bursting strength.

ABRASION RESISTANCE

following graphs show the trend, how the abrasion resistance varies with the ent silicone finishes.

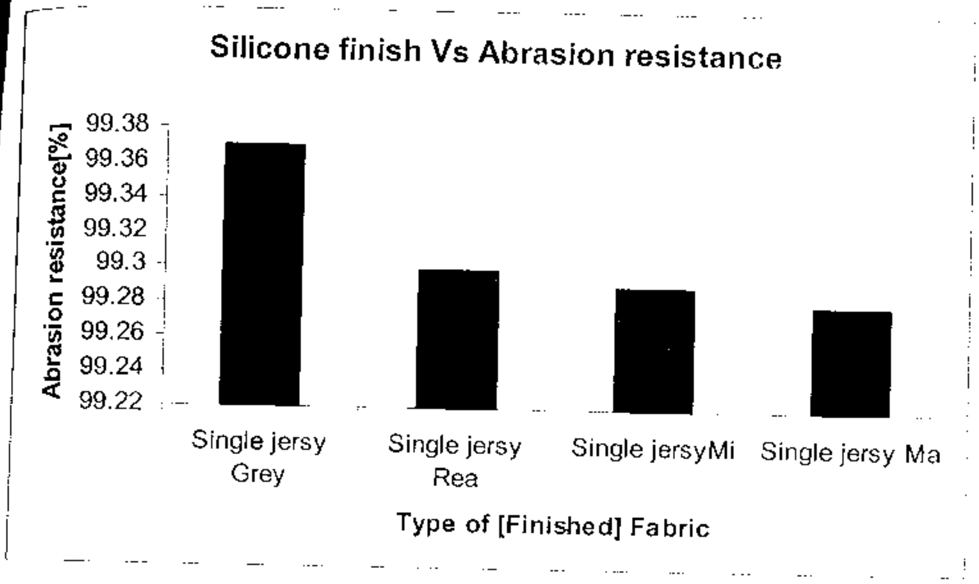


Fig-16

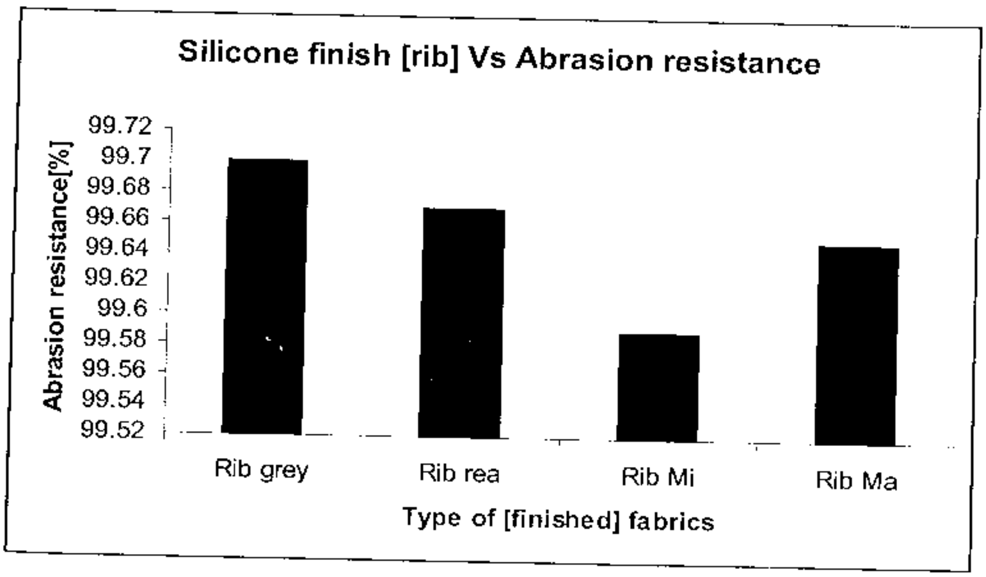


Fig-17

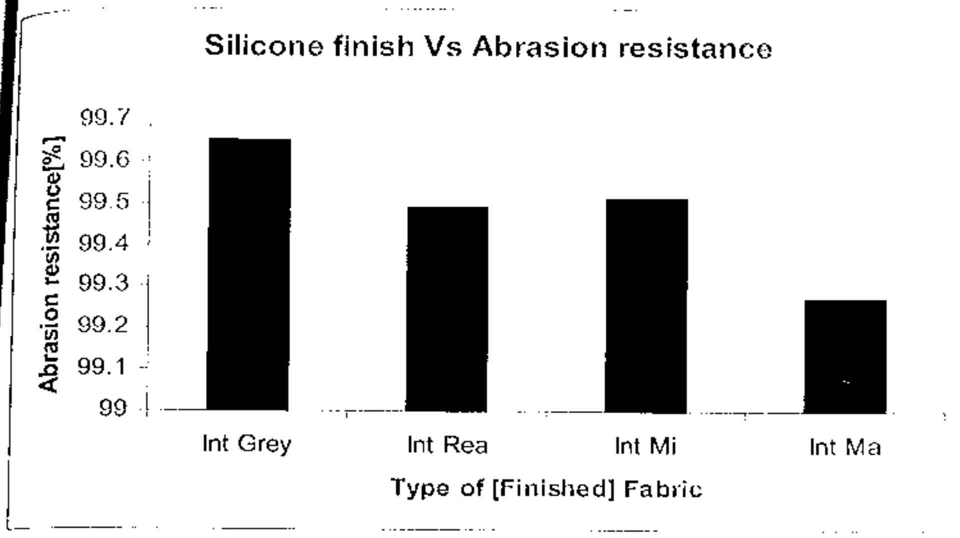


Fig-18

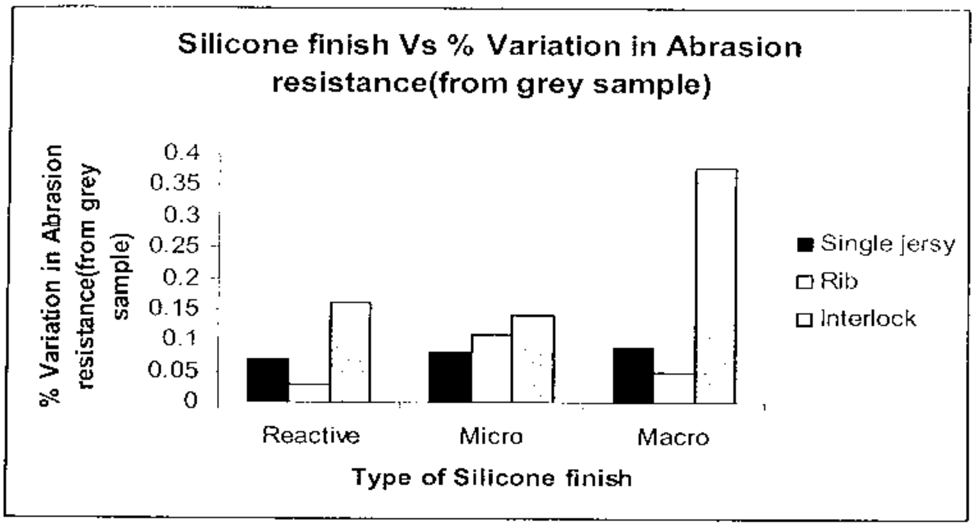


Fig-19

From the above graphs it can be noticed that all the silicone finished knitted structures had shown a drastically improved performance in abrasion resistance when finished with amino-modified (macro emulsion) but a reverse trend in rib structure when compared to the grey samples. But the amino-modified silicones (micro-emulsion) give a consistent trend for all the three structures which had shown a better drift. And it can be said that amino-modified (micro emulsion) silicones gives a better (better than that of other compared silicones) abrasion resistance.

IRCULAR BENDING SPECIFIC HANDLE VALUE [mN m^2/g]

ollowing graphs show the trend, how the specific handle value varies with the nt silicone finishes.

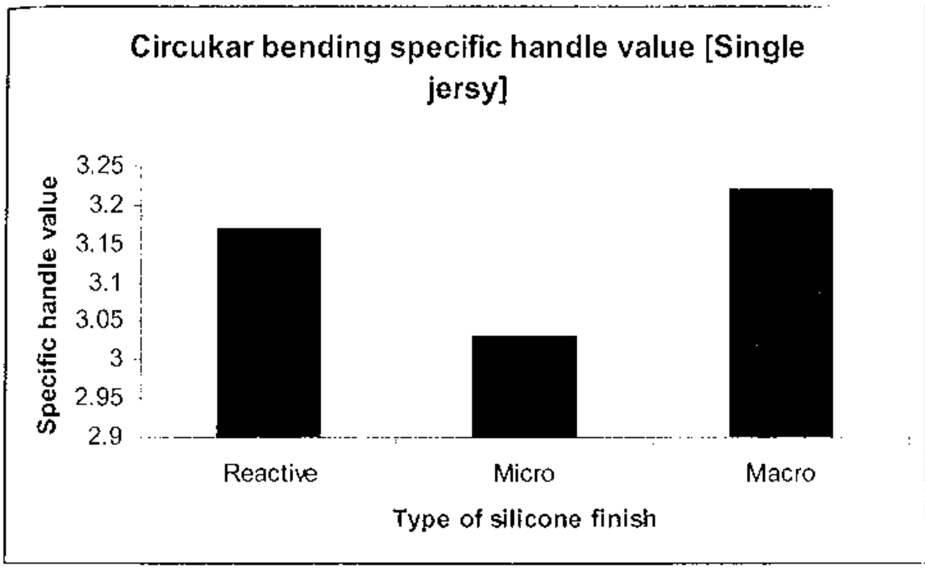


Fig-20

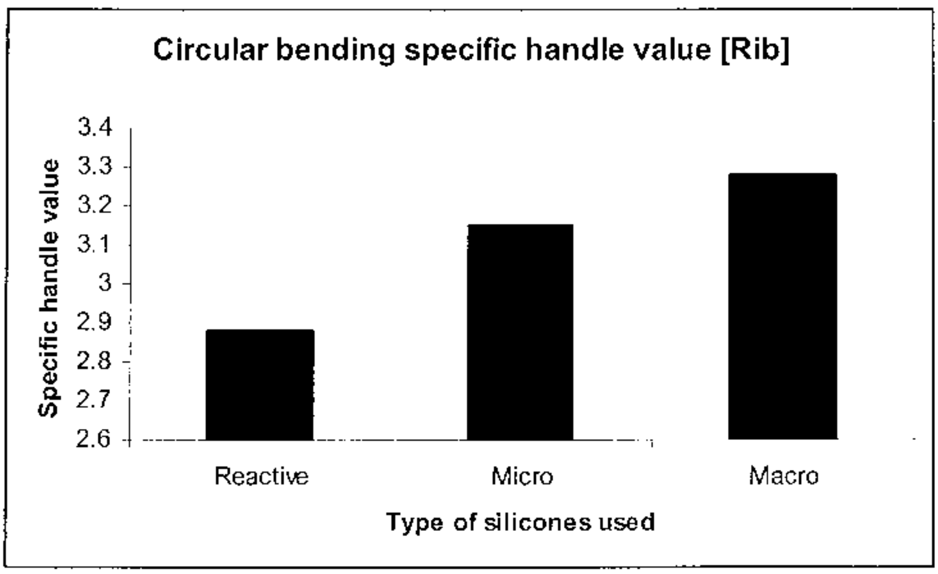


Fig-21

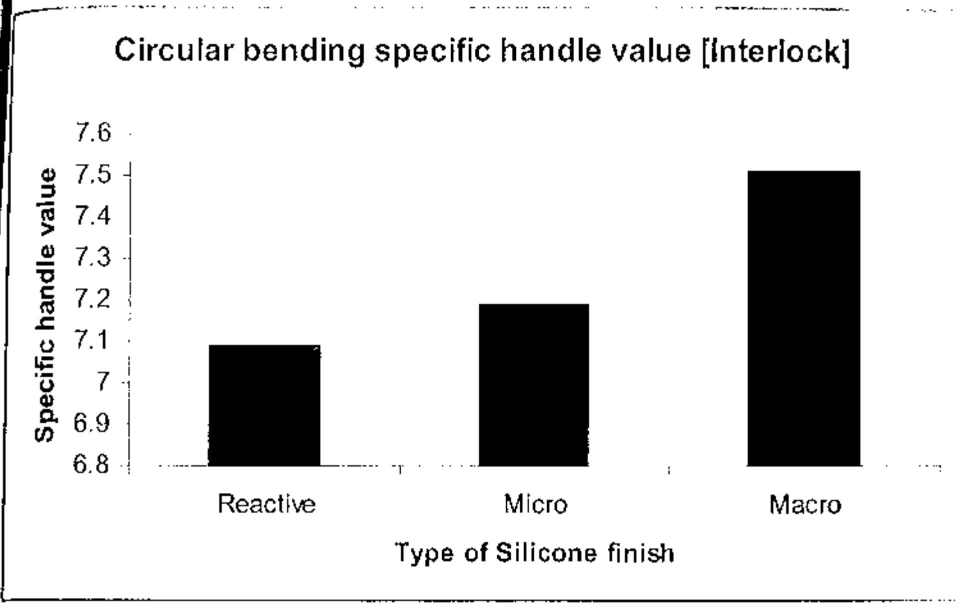


Fig-22

m the above graphs it can be noticed that all the silicone finished knitted structures d improved the handle property, but the reactive silicone had shown the best. As handle perty is mainly dependent on the GSM of the fabric it can be seen that interlock uctures had shown a reverse trend. And it can be concluded that reactive silicones had own better handle property followed by amino-modified (micro emulsion) silicones d amino-modified (macro emulsion) respectively.

HOSING THE BEST SILICONE

ollowing graphs show the overall trend, how the fabric properties vary with the ent silicone finishes.

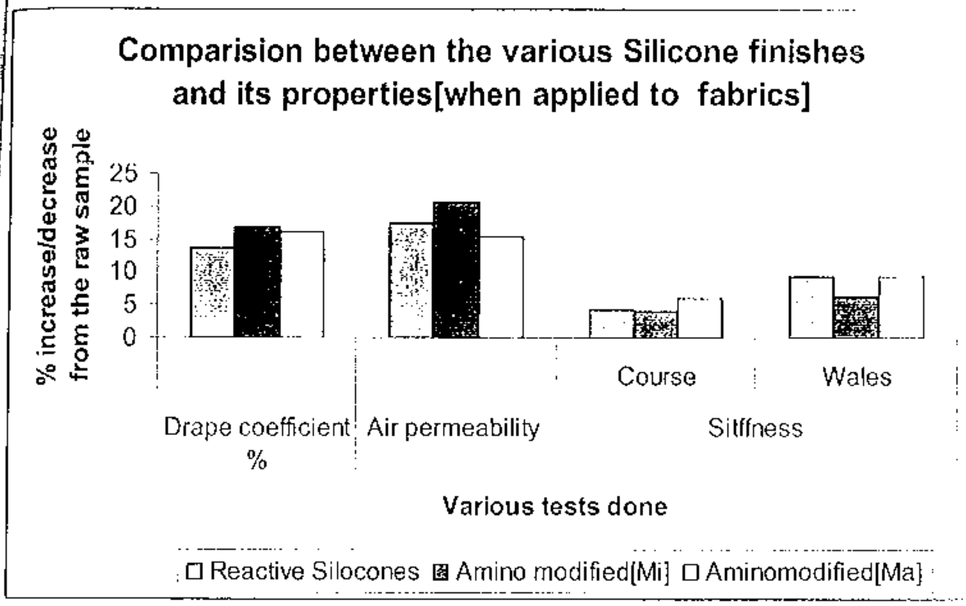


Fig-23

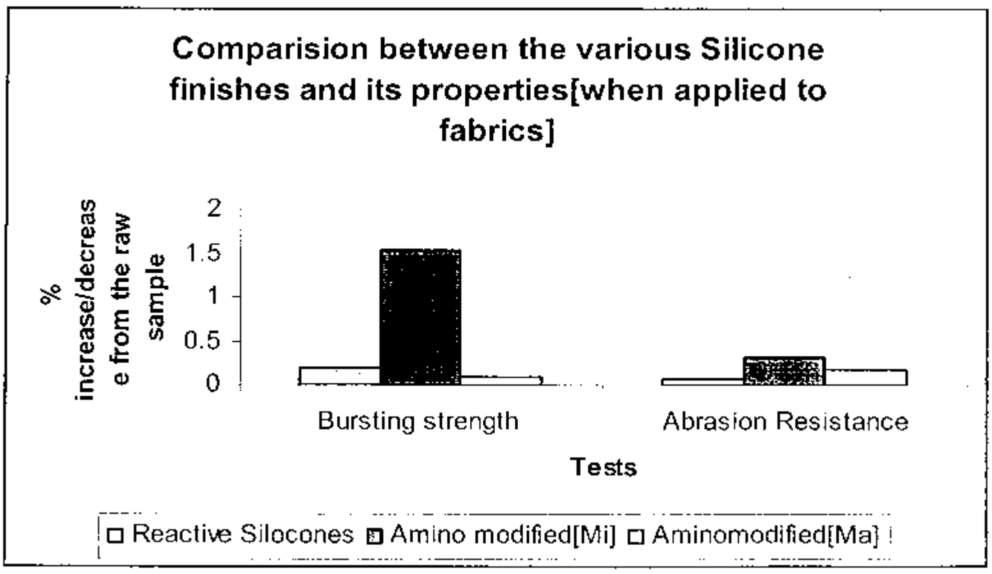


Fig-24

the above results, we found that though the reactive silicones had given a good ar bend specific handle value and reactive silicones finished samples had shown air permeability; other properties such as busting strength, drape, abrasion ance, etc had shown a better trend in the Amino-modified (Micro emulsion) nes.

UTURE SCOPE

1. The effect of GSM on silicone finished fabrics
2. Effect of knitted / woven structure on silicone finishing
3. Comparative study between various possible silicones and its properties

CONCLUSION

ɔllowing are the conclusions drawn from the foregone results and discussions.

The drape coefficient has been decreased 16.83 % in Amino-modified [Micro emulsion] silicone finished fabric samples, where the other reactive and amino-modified [Macro emulsion] silicone finished samples had shown comparatively poor result.

. The Air permeability has been decreased 15.383 % in Amino-modified [Macro emulsion] silicone finished fabric samples, where as reactive silicones and amino-modified [Micro silicones] silicone finished samples had shown comparatively poor result.

}. There is a decreasing trend in the busting strength of the reactive silicone and Amino-modified [Macro emulsion], where as the Amino-modified [micro emulsion] finished fabrics have given a good result.

4. The abrasion resistance of the amino-modified [micro emulsion] silicones had given a good result compared to other silicones.

5. The reactive silicones had given good circular bending specific handle value, followed by Amino-modified [micro emulsion] and Amino-modified [macro emulsion] silicone treated knitted fabrics.

6. The stiffness of the Amino-modified [Micro emulsion] is less (4.13 and 6.25 % course wise and wales wise respectively) compared to other silicones.

'm the above results, we found that even though the reactive silicones had given a ɔd circular bend specific handle value and reactive silicones finished samples had ɔwn better air permeability; other properties such as busting strength, drape, abrasion istance, etc had shown a better trend in the Amino-modified (Micro emulsion) icones. And hence Amino-modified [Micro emulsion] silicones had found to be the st among the other reactive and Amino-modified [Macro emulsion] silicones espective of cost factor.

.IOGRAPHY

1. Lalit Mohan Singh negi, "*A study on the effect of bath PH on exhaustion and softness during the textile finishing of textiles*" Colourage – oct 2000
2. "*A brief history of silicones*" Colourage – june 2004
3. Fernando et al, "*Silicone softners for stain repellent and strain release fabric testing*", Dow corning corporation
4. Arun N, "*Use of Silicones in Textile finishing*", Man made textiles in India – Sept 1999
5. Mehra R H et al, "*Modified silicone fluids*" Colourage
6. Konrad Nostadt et al, "*Softners in the textile finishing industry*"
7. Colourage – June 2000
8. "*Silicones -The versatile wonder*", www.expresstextile.com/20050315/processworld01.shtml
9. Teli M D et al, "*Softeners in Textile Industry: Chemistry, Classification and Applications*", Colourage – June 2000
10. Gokulnathan S & Dr Thomas P T, "*Organo-Modification of silicones for textile applications*", Colourage – February 2005