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Cotton and Fibre Processing - Past Insights on Basic Processes

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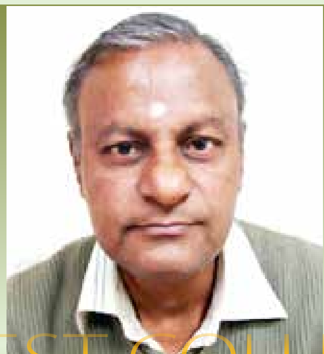

GUEST COLUMN

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Fibre Processing refers to a series of steps employed on a raw fibre to convert it into a textile fibre. This concept of conversion is in vogue since ancient times. It has been revealed in a classic book 'The Structure of Cotton Fibre' by Bowman, F.H in 1908 and more critically dwelt in 'Textile Fibre' by Mathews J.M. in 1923, in the Chapter - 'The Chemical Properties of Cotton Fibre'. The historical development about the concept of Mercerization has been analytically depicted by Mathews in his book 'Textile Fibre'. The articles in the earlier issues by the same author have highlighted the processes of spinning and weaving. In this article, the aspect of fibre processing resulting in the making of a textile fibre has been dealt with in detail with a historical perspective.

Principles and Application

The discovery of treatment of raw fibre with chemicals had potential implications in textile fibre processing. As depicted by Bowman in 1908, John Mercer, a Lancashire chemist discovered the phenomena that when cotton fibres were soaked in a solution of caustic soda, Sodium Hydroxide (NaOH), of a specific gravity of 1.2 they got converted into a useful textile fibre. This process was later patented and came to be known as Mercerisation. This process made the fibres stronger and finer and the fibres also attracted more colouring matter. It was generally perceived that chemical reagents weaken the fibres, but in this case it was the reverse.

In 1863, Walter Crum came out with a paper on this aspect. He recorded that when unripe and perfectly collapsed cotton fibre was subjected to the chemical treatment, the fibres achieved strength and got converted into a usable textile fibre.

It is different from the naturally matured and ripened cotton fibres as the former was smaller, more cylindrical and having a larger aperture or lumen in the centre. Thus, it was inferred that it was now possible to arrive at this structure by converting the unripe fibres rendering them good strength.

The cell membrane become elastic within the cell wall itself. This results in the separation of cell or concentric lamina from each other. The tube walls of a fully matured or ripe cotton fibre really consists of tissues of pure cellulose which are separated from each other by a series of intervals of more or less uniform cellular tissue forming a series of capillary surfaces. They act with utmost energy upon any liquid in which the fibres may be immersed. Thus is the fully absorbent cotton created. Crum attributed this to the fact that the thin pellucid outer sheath of cellulose acted as a dialyser. This dialysing process results in the formation of a perfect fibre.

Mercerisation

In fibre processing process lot depends on the 'Mecerising Process', the key process, its impact on the raw fibre is of immense value as a converted textile fibre. The properties attributed to the textile fibre are, better lustre, increase in strength of yarn and increase in elasticity. This is governed by time of mecerising, temperature of the process, basic chemical reactions viz., steep immersion in caustic soda solution.

Mechanism of Textile Fibre Formation

Cotton when exposed to high temperature, i.e. 169 degrees Celsius, whether moist or dry heat, results in the dehydration of cellulose accompanied by a strain stressed disintegration in the fibre. The presence of colouring matter viz., structures like endochromes irregularly distributed in the fibre, occuring mostly in the walls of the fibre immediately surrounding the inner cavity or lumen. This is observed in Egyptian cotton. The removal of these structures makes the fibre more amenable to the dyeing process resulting in a value-added textile fibre.

Notable Changes Occurring in the Mercerising Process

Cotton fibre when immersed in a concentrated solution undergoes a distinguished physical modification . The fibre absorbs the alkali swelling to a cylindrical form. This gives a hair like appearance, the fibre also untwists itself becoming more straightened, shrinking considerably in length. The internal portion of the fibre acquires a gelatinous appearance.

Though it is firm in its structure, the surface of the fibre shows a wrinkled appearance, translucent due to a somewhat unequal distension of the inner part. There is a small degree of lustre in the portions of the surface. Due to the uneven stretching and wrinkling of the external surfaces, the smooth lustrous portions are irregular in occurrence. The fibre also shows a slight increase in weight. These changes in the physical appearance of the fibre are associated with a remarkable increase in its tensile strength. This amounts in most cases increases upto 30 to 50 percent. The fibre acquires a greater power of absorption of many solutions especially dyestuff. The increase in tensile strength is probably due to the fact that mercerising causes the inner structure of the fibre to bind solidly together by filling up the interstitial spaces between the molecular components of the cell wall.

Thus, the fibre acquires a greater degree of solidity. The internal strain between the cell elements is quite high after the drying and shrinking of the ripe fibre. The shrinkage of the fibre is accompanied by the contraction of cell elements transversely on the collapse of the fibre canal. These are further distended by the action of the caustic alkali.

These cell elements become shortened longitudinally and are more tightly packed together. The increased affinity for dyestuffs exhibited by mercerised cotton does not imply the inherent property of the modified cellulose due to a change in the chemical composition. It is no doubt the result of a modified cellulose structure of the fibre itself.

The cell elements become distended like a sponge, gaining greater power of absorption and retention of liquids than when in a flattened condition.

Lustre

The high lustre of the fibre imparted to cotton does not occur by the mere action of the mecerising process, but by the conditions prevailing during that time. The swelling of the cell walls and consequent contraction of the fibre remains wrinkled and uneven due to unequal strain of expansion. The ends of the fibres when fixed, restrain them from contraction during chemical action of the alkali. The swelling of the cell wall results in a smooth structure resembling a polished surface of the reflecting light but with little scattering of the rays.

It is observed that the ribbon-like fibre resulting in a change in the twist is of great importance in the production of lustre. This is caused above 40 degrees Tw, a unit of concentration of the alkali. The untwisting follows the swelling. This 40 degrees Tw is considered the lowest concentration at which mercerisation takes place resulting in lustrous cotton.

Another reason for the lustrous appearance is the physical modification of the cell elements. The swelling due to absorption of the alkali gives a gelatinous and translucent appearance. This renders an alteration of optical properties of the fibre.

Thus, the lustre is enhanced with the reduction in the proportion of light absorption.

Tension and Elasticity

There is a considerable difference in the strength and elasticity of cotton mercerised without tension and with tension. It is the strength of the yarn which is more desired in practice. In mecerising yarn or cloth, it is to be kept in mind that the fibres shrink considerably resulting in closely knit fibres.

Thus, an increase in tensile strength adds to greater coherence of the fibres with one another, rather than an increase in the strength of the individual fibres. There is no breaking of a yarn spun from the long fibres but only pulling apart.

The chemical was reasonably defended by Mercer himself besides Gladstone, Cross and Bevan, Beltzer and many other prominent chemists. However Ristinpart was of the view that the mercerisation process is principally an osmotic action and the contraction which the cotton undergoes in mercerisation without tension is due to purely physical cause.

The cotton fibre is surrounded by a cuticle which acts as a dialysing membrane inducing osmotic action when the fibre is immersed in strong caustic soda solution, the water tends to diffuse faster from the fibre into the surrounding liquid, while the soda tends to diffuse faster into the fibre.

This osmotic condition demands an increased pressure within the fibre, causing it to swell. Thus it assumes a form which will give it the greatest internal capacity for a minimum surface. Thus the fibre reduces in length and assumes a straight cylindrical form.

Thus, mercerisation has a major impact on subsequent key processes like singeing calendering and other finishing processes.

The basic general fibre processes as depicted in 'Textile Fibres' by Katherine Hess is listed below:

1. Bleaching -whitens the cloth
2. Crabbing- sets warp filling
3. Decating- sets naps and adds lustre
4. Mercirising- increases lustre, strength, only for cotton
5. Scouring and Kier boiling - removes waxes, oils and sizing for cotton and linen
6. Shearing- clips ends of fibres for cotton and wool
7. Shrinking and filling - releases strains and shrinks somewhat
8. Singeing - removes loose yards and fibre ends
9. Sizing and weighting - Increases weight and give body for cottons, some rayons and silks
10. Tentering- Straightens and sets warps and filling at right angles

The above processes differ somewhat

depending on fibre and the effect desired. The hidden qualities of textiles rely on the processes they are subjected to and the care with which the cloth is handled. The appearance of the cloth may have been influenced by the general processes subjected to.

Other processes essential for altering the surface structure of the cloth are as follows:

1. Beetling- Softens and adds lustre to linen and cotton
2. Calendering - Smooths and adds lustre to cotton linen and other some synthetic fibres
3. Embossing and Schreinering - Adds lustre and design to all fabrics
4. Moiereing - Produces a patterned effect to all fibres except wool
5. Raising (gigging and napping) - lifts fibres ends to form nap for cotton, wool and spun yarn

Thus, fibre processing undergoes many processes leading to a finished yarn of textile fibre and a refined cloth with greater tenacity, lustre and elasticity. These processes result in value-added, user-friendly textile products, reasonably amenable to dyeing and designing of fabrics. The functionality, durability and sustainability of textile fibres have been duly enhanced in recent years by the application of nanotechnology in the textile industry. Automation has enhanced these processes and shaped the emerging textile industry.

These processes have been meticulously dealt with in classic books like 'Textiles' by J. F. Parker and 'Textile Fibres' by Mathews.

In a nutshell, fibre processing plays a pivotal role in the making of a usable textile fibre.

(The views expressed in this column are of the author and not that of Cotton Association of India)

The Importance of Bale Tagging

GUEST COLUMN

Shri. Girish Nagsee
Proprietor, Hameer Cotton

With a family background of three generations in the cotton broking business, Shri. Girish Uttamchand Nagsee did the Cotton Classification and Grading Course – CIRCOT (1997) and from Ginning Trading Centre (1998).

He joined the cotton broking business in 1988 as a registered broker with the Maharashtra State Co-operative Cotton Growers Marketing Federation. Well-versed with all the growth of cotton varieties in Maharashtra, he started his own office in Jalgaon in 2006 and gradually extended the business to other regions like Amravati and Parbhani. He is majorly into canvassing cotton for spinning mills.

Cotton Association of India has a by-law, which stated that the quality dispute shall also include, 'disputes relating to false or fraudulently packed cotton.'

There was a provision for the ginning industry under the erstwhile Cotton Ginning and Pressing Act 1925, where it was mandatory for all ginning factories to report pressing figures to government authorities.

The implementation was oppressive and the act was misused. The basic purpose of traceability of goods and transparency in trade had lost its meaning.

With the ever-changing industry scenario, the restrictions laid down in the Act were no longer required and the Cotton Control Order 1986, which was issued under the Essential Commodities Act 1955, was implemented to cover the provisions which were considered essential to regulate the working of ginning and pressing factories.

All the bales were to be marked:

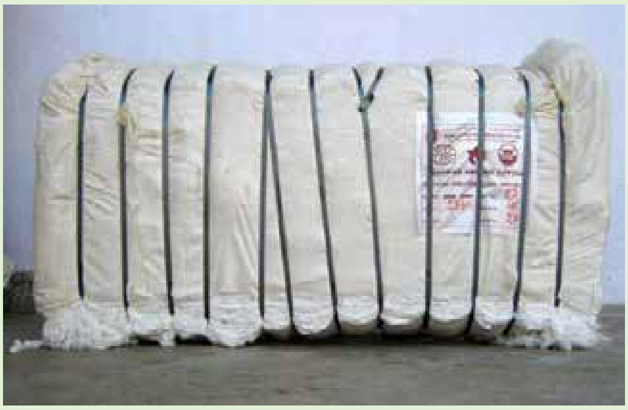
1) Station
2) Variety
3) Lot No
4) Press Running Number
5) Press Mark

Later, labelling of bales started which carried the same information. The labels were either in form of stickers or were placed between the bale straps. Eventually, this practice also vanished. As the traceability of bales became difficult, there was detoriation in quality standards and the efforts and purpose of TMC - Technology Mission on Cotton - went down the drain.

At present, the Textile Ministry along with Bureau of Indian Standards has made bale tagging mandatory for the current cotton season.

It is a system welcomed by cotton trade stake holders. If implemented in properly in a systematic and phased manner, it is likely to bring in quality, traceability and transparency.

It includes a bar-coded tag which would incorporate details like, factory / unit name, station, variety, lot no, press running numbers, press mark and basic quality standards. This will enable the buyers to trace the source of supply whenever needed.



The cotton business has now started becoming complex and voluminous. In such a scenario, the factor of time becomes extremely important. Issues arising on quality of a lot leads to loss of time as well as loss of money. This invariably leads to a loss of trust between business houses.

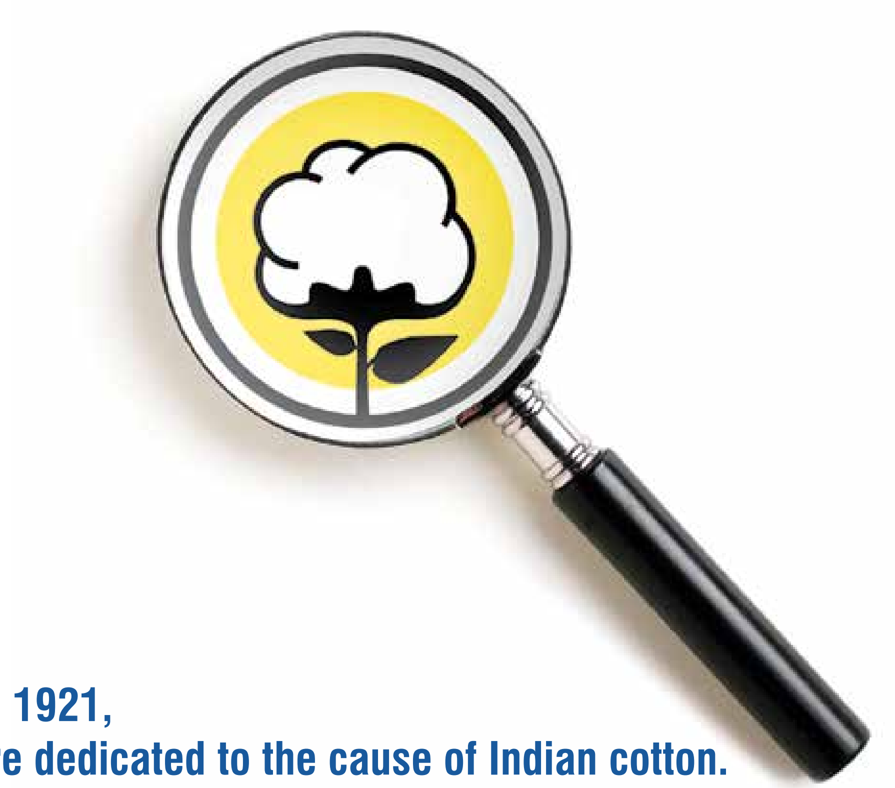
In such a situation, the need for bale tagging is not only necessary but absolutely essential. Factors like transparency and traceability must enter a regulated space as this will keep both the buyers and sellers vigilant, which will ultimately bring back the integrity we all want in this business.

India in the last few years has become one of the largest exporters of cotton bales. Due to inconsistencies in quality supply, export houses have lost huge amounts in terms of quality claims. The bale tagging will help exporters to identify and trace the bales to the source of supply.

Hence exporters would be in a good position to export good quality cotton and the risks of quality allowance on account of poor quality supply will be less or negligible. As Indian exporters have to compete in international markets with countries like Australia, Brazil, etc., this system will help to a greater extent.

To conclude, bale tagging will be helpful to all stake holders of the cotton value chain.

Courtesy: Cotton India 2018 (Aurangabad)



UPCOUNTRY SPOT RATES

(Rs./Qtl)

Standard Descriptions with Basic Grade & Staple in Millimetres based on Upper Half Mean Length [By law 66 (A) (a) (4)]								Spot Rate (Upcountry) 2018-19 Crop November 2019					
Sr. No.	Growth	Grade Standard	Grade	Staple	Micronaire	Gravimetric Trash	Strength /GPT	11th	12th	13th	14th	15th	16th
1	P/H/R	ICS-101	Fine	Below 22mm	5.0 – 7.0	4%	15	- -	- -	- -	- -	- -	- -
2	P/H/R (SG)	ICS-201	Fine	Below 22mm	5.0 – 7.0	4.5%	15	- -	- -	- -	- -	- -	- -
3	GUJ	ICS-102	Fine	22mm	4.0 – 6.0	13%	20	9111 (32400)	9026 (32100)	8998 (32000)	8970 (31900)	8970 (31900)	8970 (31900)
4	KAR	ICS-103	Fine	23mm	4.0 – 5.5	4.5%	21	10404 (37000)	10348 (36800)	10320 (36700)	10292 (36600)	10292 (36600)	10292 (36600)
5	M/M (P)	ICS-104	Fine	24mm	4.0 – 5.5	4%	23	10826 (38500)	10770 (38300)	10742 (38200)	10714 (38100)	10714 (38100)	10714 (38100)
6	P/H/R (SG)	ICS-202	Fine	27mm	3.5 – 4.9	4.5%	26	- -	- -	- -	- -	- -	- -
7	M/M(P)/ SA/TL	ICS-105	Fine	26mm	3.0 – 3.4	4%	25	10376 (36900)	10320 (36700)	10292 (36600)	10264 (36500)	10264 (36500)	10264 (36500)
8	P/H/R(U)	ICS-105	Fine	27mm	3.5 – 4.9	4%	26	- -	- -	- -	- -	- -	- -
9	M/M(P)/ SA/TL/G	ICS-105	Fine	27mm	3.0 – 3.4	4%	25	10489 (37300)	10432 (37100)	10404 (37000)	10376 (36900)	10376 (36900)	10376 (36900)
10	M/M(P)/ SA/TL	ICS-105	Fine	27mm	3.5 – 4.9	3.5%	26	10657 (37900)	10601 (37700)	10573 (37600)	10545 (37500)	10545 (37500)	10545 (37500)
11	P/H/R(U)	ICS-105	Fine	28mm	3.5 – 4.9	4%	27	- -	- -	- -	- -	- -	- -
12	M/M(P)	ICS-105	Fine	28mm	3.5 – 4.9	3.5%	27	- -	- -	- -	- -	- -	- -
13	SA/TL	ICS-105	Fine	28mm	3.8 – 4.2	3.5%	27	- -	- -	- -	- -	- -	- -
14	GUJ	ICS-105	Fine	28mm	3.8 – 4.2	3%	27	- -	- -	- -	- -	- -	- -
15	R(L)	ICS-105	Fine	29mm	3.7 – 4.9	3.5%	28	- -	- -	- -	- -	- -	- -
16	M/M(P)	ICS-105	Fine	29mm	3.8 – 4.2	3.5%	28	- -	- -	- -	- -	- -	- -
17	SA/TL/K	ICS-105	Fine	29mm	3.8 – 4.2	3%	28	- -	- -	- -	- -	- -	- -
18	GUJ	ICS-105	Fine	29mm	3.8 – 4.2	3%	28	- -	- -	- -	- -	- -	- -
19	M/M(P)	ICS-105	Fine	30mm	3.8 – 4.2	3.5%	29	- -	- -	- -	- -	- -	- -
20	SA/TL/K/O	ICS-105	Fine	30mm	3.8 – 4.2	3%	29	- -	- -	- -	- -	- -	- -
21	M/M(P)	ICS-105	Fine	31mm	3.8 – 4.2	3%	30	- -	- -	- -	- -	- -	- -
22	SA/TL/K / TN/O	ICS-105	Fine	31mm	3.8 – 4.2	3%	30	- -	- -	- -	- -	- -	- -
23	SA/TL/K/ TN/O	ICS-106	Fine	32mm	3.5 – 4.9	3%	31	- -	- -	- -	- -	- -	- -
24	M/M(P)	ICS-107	Fine	34mm	3.0 - 3.8	4%	33	- -	- -	- -	- -	- -	- -
25	K/TN	ICS-107	Fine	34mm	3.0 - 3.8	3.5%	33	- -	- -	- -	- -	- -	- -

(Note: Figures in bracket indicate prices in Rs./Candy)

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1	P/H/R	ICS-101	Fine	Below 22mm	5.0 – 7.0	4%	15	10798 (38400)	10798 (38400)	10798 (38400)	10686 (38000)	10686 (38000)	10686 (38000)
2	P/H/R (SG)	ICS-201	Fine	Below 22mm	5.0 – 7.0	4.5%	15	10911 (38800)	10911 (38800)	10911 (38800)	10826 (38500)	10826 (38500)	10826 (38500)
3	GUJ	ICS-102	Fine	22mm	4.0 – 6.0	13%	20	- -	- -	- -	- -	- -	- -
4	KAR	ICS-103	Fine	23mm	4.0 – 5.5	4.5%	21	- -	- -	- -	- -	- -	- -
5	M/M (P)	ICS-104	Fine	24mm	4.0 – 5.5	4%	23	- -	- -	- -	- -	- -	- -
6	P/H/R (SG)	ICS-202	Fine	27mm	3.5 – 4.9	4.5%	26	10236 (36400)	10236 (36400)	10264 (36500)	10320 (36700)	10292 (36600)	10320 (36700)
7	M/M(P)/ SA/TL	ICS-105	Fine	26mm	3.0 – 3.4	4%	25	- -	- -	- -	- -	- -	- -
8	P/H/R(U)	ICS-105	Fine	27mm	3.5 – 4.9	4%	26	10320 (36700)	10320 (36700)	10348 (36800)	10432 (37100)	10404 (37000)	10461 (37200)
9	M/M(P)/ SA/TL/G	ICS-105	Fine	27mm	3.0 – 3.4	4%	25	- -	- -	- -	- -	- -	- -
10	M/M(P)/ SA/TL	ICS-105	Fine	27mm	3.5 – 4.9	3.5%	26	- -	- -	- -	- -	- -	- -
11	P/H/R(U)	ICS-105	Fine	28mm	3.5 – 4.9	4%	27	10432 (37100)	10432 (37100)	10461 (37200)	10489 (37300)	10461 (37200)	10517 (37400)
12	M/M(P)	ICS-105	Fine	28mm	3.5 – 4.9	3.5%	27	11107 (39500)	11051 (39300)	11079 (39400)	11079 (39400)	11079 (39400)	11079 (39400)
13	SA/TL	ICS-105	Fine	28mm	3.8 – 4.2	3.5%	27	11107 (39500)	11051 (39300)	11079 (39400)	11079 (39400)	11079 (39400)	11079 (39400)
14	GUJ	ICS-105	Fine	28mm	3.8 – 4.2	3%	27	11051 (39300)	10995 (39100)	11023 (39200)	11023 (39200)	11023 (39200)	11079 (39400)
15	R(L)	ICS-105	Fine	29mm	3.7 – 4.9	3.5%	28	10967 (39000)	10967 (39000)	10995 (39100)	11051 (39300)	11023 (39200)	11023 (39200)
16	M/M(P)	ICS-105	Fine	29mm	3.8 – 4.2	3.5%	28	11445 (40700)	11389 (40500)	11417 (40600)	11417 (40600)	11417 (40600)	11417 (40600)
17	SA/TL/K	ICS-105	Fine	29mm	3.8 – 4.2	3%	28	11389 (40500)	11332 (40300)	11360 (40400)	11360 (40400)	11360 (40400)	11360 (40400)
18	GUJ	ICS-105	Fine	29mm	3.8 – 4.2	3%	28	11360 (40400)	11304 (40200)	11332 (40300)	11332 (40300)	11332 (40300)	11332 (40300)
19	M/M(P)	ICS-105	Fine	30mm	3.8 – 4.2	3.5%	29	11557 (41100)	11501 (40900)	11529 (41000)	11529 (41000)	11529 (41000)	11529 (41000)
20	SA/TL/K/O	ICS-105	Fine	30mm	3.8 – 4.2	3%	29	11501 (40900)	11445 (40700)	11473 (40800)	11473 (40800)	11473 (40800)	11473 (40800)
21	M/M(P)	ICS-105	Fine	31mm	3.8 – 4.2	3%	30	11726 (41700)	11670 (41500)	11698 (41600)	11698 (41600)	11698 (41600)	11698 (41600)
22	SA/TL/K / TN/O	ICS-105	Fine	31mm	3.8 – 4.2	3%	30	11670 (41500)	11614 (41300)	11642 (41400)	11642 (41400)	11642 (41400)	11642 (41400)
23	SA/TL/K/ TN/O	ICS-106	Fine	32mm	3.5 – 4.9	3%	31	12007 (42700)	12007 (42700)	12035 (42800)	12035 (42800)	12035 (42800)	12035 (42800)
24	M/M(P)	ICS-107	Fine	34mm	3.0 - 3.8	4%	33	14847 (52800)	14847 (52800)	14875 (52900)	14875 (52900)	14875 (52900)	14875 (52900)
25	K/TN	ICS-107	Fine	34mm	3.0 - 3.8	3.5%	33	15129 (53800)	15129 (53800)	15157 (53900)	15157 (53900)	15157 (53900)	15157 (53900)

(Note: Figures in bracket indicate prices in Rs./Candy)