JUTE AS A FILTER FABRIC IN SUGAR MILLS

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Filtration is intended to separate solid particles from the gaseous or liquid medium in which they are suspended, either to reclaim the solids or to obtain a clear filtrate. The success of the cloth will depend upon its ability to hold back the finest particles, which it is required to separate and in its capacity to avoid becoming "blinded" for prolonged period. The ideal cloth will also need to be sufficiently permeable to allow the liquid to pass through at a reasonable rate, and to be easily cleaned, when the arrested particles have to be removed.

An experiment was conducted with a view to reducing the cost of filter medium by replacing the usual cotton twill (Fig. 1) costing Rs. 4/7/- per yard by jute canvas (Fig. 2) of Rs. 1/12/- per yard. One thousand yards of jute canvas was purchased from Peoples Jute Mills Limited, East Pakistan, and tried out at the Charsadda Sugar Mills Limited, as filter medium for cane juice.

The recovery of dissolved sugar from cane juice includes the use of filters at two stages: first in the separation of the carbonated cane juice from the insoluble impurities and lime-sludge produced when the raw juice is heated at about 55°C. and treated with milk of lime and carbon dioxide. The filter-feed (pH 10.6) usually has about 4% cake-forming solids and the resulting lime-cake is washed to a low sucrose content. The second stage consists of the separation and washing of calcium carbonate. Here the first clear juice is further carbonated to pH 8.4, heated to 70 °C. and filtered to obtain a clear second carbonated juice. Jute canvas was tried for first carbonation only, as it is the stage involving the main consumption of filter-medium in the sugar industry.

Experiments on Life of the Filter Medium

The experiment was carried out on plate and frame type filter-presses having 46 plates with a total filtering area of 626 sq. ft. and a flow rate of 12 cu. ft./mt. Double jute canvas pieces were laid over each plate of one press and the cotton twill pieces in the similar way on the other. Comparative observations taken with these filter presses are shown in Tables 1 to 3.

These observations reveal that the number of filtrations in case of cotton and jute before repairs are the same while after repairs the consumption of jute canvas has increased, i.e., under similar conditions of temperature, pressure and abrasion etc., it deteriorates earlier. It has a high absorbency as compared to cotton. When wet, it does not retain its original strength and thus cannot withstand the operational conditions for a longer period.

It is observed that juice penetration through cotton twill, which before use is flexible, coarse-

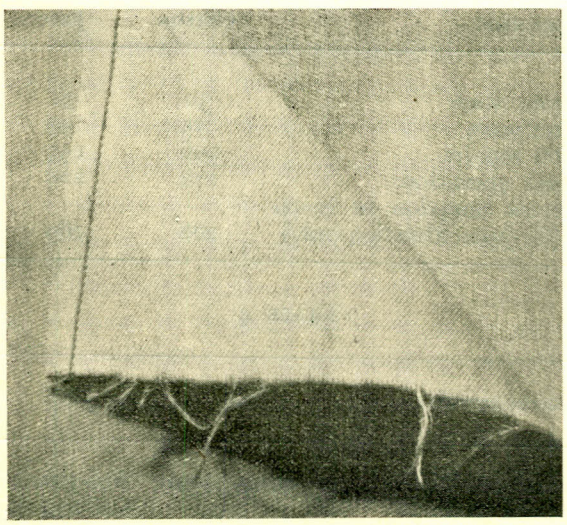

Fig. 1.—Cotton twill.

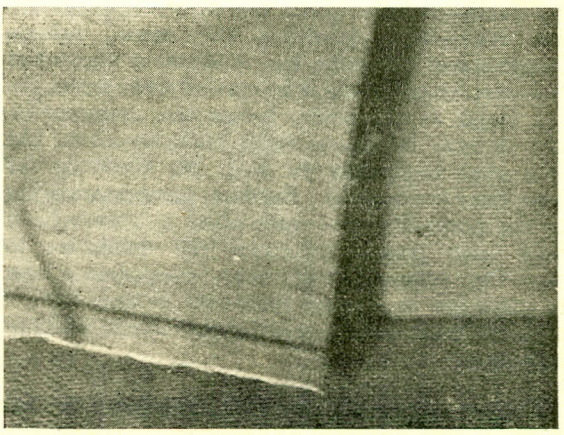

Fig. 2.—Jute canvas.

grained and porous, becomes more and more difficult after a large number of operational cycles. This is because most of silica and other fine calcium carbonate solids present in the juice are usually retained by the pores of the cotton twill. Even after washing they do not clear out but tend to blind the cloth and make it thick, stiff, hard and brittle and difficult to repair and wash. This effect of cloth plugging on filtration rate is so appreciable that it ultimately becomes the cause for the subsequent replacement of the cotton twill. Quite contrary to this, in the case of jute canvas which is thick, coarse and tough, before use, the rate of filtration ramains reasonable throughout its service. After washing, the pores do not retain silica and other particles and thus the canvas remains soft, flexible, thin, pliable and easier to repair and reuse. Both the fabrics are found to be almost equally resistant towards alkaline cane juice (pH 10.6).

Some physical characteristics of both fibres are given in Table 4.

Inspite of the higher consumption of jute canvas, yet in terms of money, the cost of cotton twill required to filter the juice obtained from 100 tons of cane is Rs. 21/12/- as compared with Rs. 10/14/- of jute canvas, i.e. jute canvas is about 50% cheaper than the cotton twill.The seasonal saving effected by use of jute fabric(on the basis of 200 days compaign at 1500 tons per day cane crushing rate, totalling 3,00,000 tons cane) comes to be as given in Table 5.

Quality of the Filtrate

Analytical data showing comparative operational efficiency of both the fabrics is given in Table 6. From this data it is found that both the filter-mediums have given the same "appreciable cake thickness". Applying the same volume of wash-water the cake has retained a somewhat lower percentage of sugar in case of jute canvas,i.e. more sugar is recovered, hence less evaporation cost. It may be due to right bridging across the pores after beginning to feed. No bleeding for longer time is observed. Further, particle-wedging into the pores does not take place as otherwise it would have greatly increased the resistance to flow. The press-efficiency w.r.t. evaporation cost and sugar left in washed lime-cake is thus high if canvas is used which retains the solids without plugging.

Taking account of the above factors, the net saving effected by use of jute canvas, assuming that 3,00,000 tons cane is crushed in a season, has been shown in Table 7.

TABLE 1.—PHYSICAL NATURE OF THE FILTER MEDIUM BEFORE AND AFTER FILTRATION.

Particulars	Type of Medium	
	Cotton	Jute
Weave	Twill	Plain
Weight per sq. yd.	17 oz.	16 oz.
Dimension before use	78″ × 38″	80″ × 37″
Dimension after use	76″ × 38″	75″ × 37″
Shrinkage after use	2.56 %	6.25 %

TABLE 2.—TIME REQUIRED PER OPERATION (AT ABOUT 50 LBS. P.S.I. PRESSURE).

Operation	Cotton cloth	Jute canvas
Press filling time (from 1st cock to last cock)	6 min.	5 min.
Running time (juice filtration)	46 ,,	46 ,,
Washing time	10 ,,	8 ,,
Steaming time	5 ,,	5 ,,
Total time	67 ,,	64 ,,

TABLE 3.—NUMBER OF OPERATIONS PERFORMED PER SET OF FILTER FABRIC (94 PIECES) PER PRESS.

Operation	Cotton	Jute
Before wash	30	31
After wash	35	34
After repairs	206	155
Total operations	271	220
Service duration in hours (for juice filtration only)	208	169

TABLE 4

Characteristics	Cotton	Jute
Sectional shape	Bean-shape	Polygonal
Specific gravity	1.52	1.48 to 1.50
Moisture regain %	8.5	12 to 13

TABLE 5

Particulars	Cotton twill	Jute canvas
Filter-medium consumed / 100 tons cane	4.9 yd.	6.2 yd.
Filter-medium required for 3,00,000 tons	14,700 yd.	18,600 yd.
Total cost of medium required	Rs. 65,231	Rs. 32,550
Tailoring charges	Rs. 1,029	Rs. 1,581
Total cost incurred	Rs. 66,260	Rs. 34,131
Saving	Rs. 32,129	

TABLE 6.—COMPARATIVE OPERATIONAL EFFICIENCY.

Particulars	Cotton twill	Jute canvas
Thickness of cake ..	1.25″	1.25″
Moisture % cake ..	49.16	48.60
Pol % cake ..	0.80	0.60
Wash-water used ..	54 cu.ft.	54 cu. ft.
Brix of sweet water ..	2.75	2.67
Pol % sweet water ..	2.00	1.99

TABLE 7

Particulars	Cotton twill	Jute
Press-cake % cane	8	8
Total cake for 3,00,000 tons cane	24000 tons	24000 tons
Total sugar lost for 24,000 tons cake	192 tons	144 tons
Price of sugar @ Rs. 816/10/6 per ton	Rs. 1,56,798	Rs. 1,17,599
Saving per season in sugar	Rs. 39,199	
Saving per season in filter-medium cost	Rs. 32,129	
Total saving in a season	Rs. 71,328	

The clarity of the filtered juice remains somewhat low at the outset of filtration with a new jute canvas but afterwards, i.e. throughout the use of canvas, the clarity remains almost as high as that obtained with cotton twill.

Discussion

The experiments described above have shown that the use of jute canvas to replace cotton twill: as a filter medium is advantageous in two ways (a) by directly reducing the overall expenditure on the filter medium by 50%, and (b) by giving a higher sugar concentration in the filtrate.

On the other hand, the main drawback in using the jute canvas as filter-fabric is that the press-cake sticks to the outer surface of the canvas due to hairy fibres and thus cake removal process is rendered difficult, taking more time and affecting the press-capacity. Further, the holes through which juice and water is made to pass widens and loosens due to separation of fibres, and earlier failure at the edges where it serves as a gasket between plate and frame affects durability to a greater extent. This requires improvement in its manufacture. Because of these difficulties, jute canvas in its present form can be best used as a "backing" for the cotton twill.

To popularise jute canvas as a filter fabric, the jute manufacturers must produce special type of less absorbing and more heat-resistant canvas of requisite specifications for filtration in sugar industry. A balance must be struck between as open a weave as possible in order to reduce plugging, and as tight a weave as is necessary to prevent excessive "bleeding" of fine particles. The surface must be smooth for easy discharge of cake. Jute canvas in its improved form may then be successfully used for a wide range of filtration processes in several other industries and may achieve considerable economies in respect of time and money as compared with cotton and other synthetic fabrics.

If the manufacturers prepare a fabric specifically designed to suit the type of process involved, it will enable them to create a new market for this economical industrial fabric.

Acknowledgement

The authors are indebted to Lieut-Colonel Nawabzada Abdul Ghafoor Khan of Hoti, Managing Director of the Charsadda Sugar Mills Limited, for his encouragement and for providing necessary facilities.