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A SIMPLE DEVICE FOR RAPID FILTRATION OF CANE JUICE IN "CREAM JAGGERY" MANUFACTURE

By G. GANAPATHY AYYAR, B. A.,

Assistant Chemist, Agricultural Research Institute, Coimbatore.

In the process of manufacture of "cream jaggery," a satisfactory rate of filtration is a *sine qua non* for the practical success of the method. The filtering apparatus as described in bulletin No. 39 of the Department of Agriculture, Madras, is, by no means, a perfect one and leaves much room for improvement.

For the benefit of those who have not had access to the above bulletin, a short description of the method as recommended therein is presented below with a few remarks as to its working.

The apparatus consists of a conical cylinder with a perforated bottom $2\frac{1}{2}'$ high with a diameter of $1\frac{1}{2}'$ at the top and 1′ at the bottom. (See Fig. 1 for laboratory model). It contains a layer of coarse washed sand at the bottom 4″—6″ deep, and above this is a 6″ to 9″ layer of activated carbon. The boiled and skimmed juice is poured carefully on to the top of the activated carbon layer.

It will be recalled that the filtration is rapid at first; but slows down considerably after 15 to 20 minutes, due to the deposition of fine particles suspended in the juice on the surface of the carbon layer forming a more or less impervious mat thereon. When this layer is scraped off, the flow of juice is resumed. With the addition of more and more juice, however, the scraping operation has to be done frequently and at each such operation, the fine particles move deeper and deeper down into the filter with the result that the latter becomes choked up after a time, rendering it unsuitable for further use without refilling with fresh activated carbon and sand.

On a consideration of the above, it will be apparent that a reduction of the colloidal and suspended impurities of the juice and prevention of the formation of the mat should result in an increased rate of filtration. With the object of reducing the colloidal content of the juice, 1% of active carbon on the weight of juice was added to the boiling juice after thorough skimming and the boiling continued for 10 to 15 minutes longer. Any scum that collected on the surface in the meanwhile was also carefully removed. This pre-treatment caused a definite, though limited, improvement in the filtration rate, probably due to the partial removal of the colloidal impurity by the activated carbon.

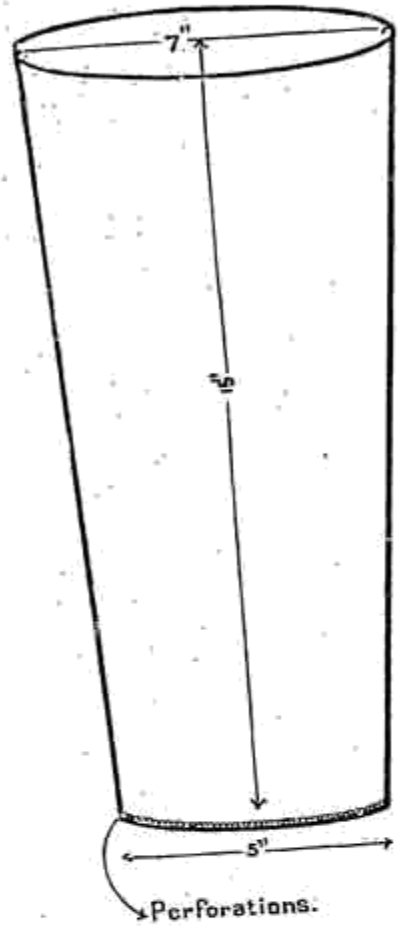
The formation of the impervious layer on the top surface of the activated carbon was sought to be prevented by superposing thereon a bed of some coarse inactive material. Among the materials tried, clean coarse sand, unactivated carbon and washed paddy husk gave a measurable improvement. Of these, paddy husk proved the speediest; it had, however, to be

rejected as the hot juice dissolved out some organic compounds from the husk, rendering the juice acid and imparting to it an undesirable flavour. Unactivated carbon was the next best. By unactivated carbon is meant the first char that has been heated strongly out of contact with air. The carbon so heated, though unable to remove colouring matter from the juice, does not discolour the juice in any way.

In spite of the improvement effected as a result of the modification introduced, the need was still felt for a further advance in the filtration rate. Our object being the development of a simple and cheap process for securing rapid filtration, the application of the principles of vacuum and pressure filters so commonly employed in factories and laboratories is precluded from the investigation in question. On further consideration, the idea suggested itself that the principle underlying the construction of the Soxhlet oil-extraction apparatus may be made applicable to the problem on hand. Those who have worked this apparatus will have noticed that, once the liquid reaches the bend of the syphon, it is drawn down the longer tube of the syphon with some force. It was thought that fixing of a syphon to the filter which will now have no perforations in the bottom, would secure the desired result. Trials with an apparatus provided with a syphon did not, however, prove satisfactory in the first instance. Further trials indicated that to get the apparatus into working condition, the relative position of the bend of the syphon with reference to the level of the carbon within the cylinder had to be adjusted. Again, the arrangement of the filtering media within the cylinder was found to have a great bearing on the rate of filtration. As a result of a series of trials carried out in this connection, the laboratory apparatus shown in Fig. 2, has been found to give a satisfactory rate of filtration when used in the manner described below

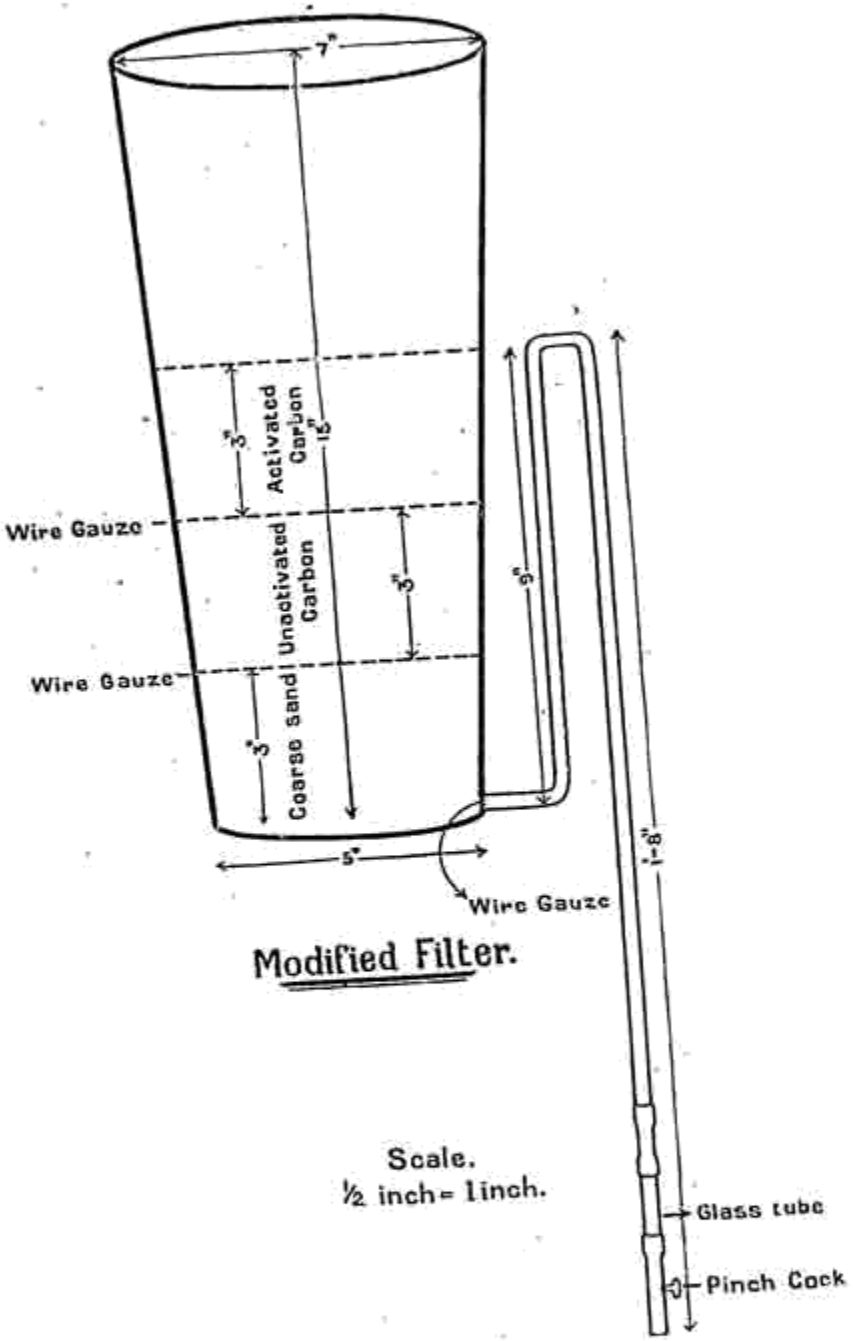
The apparatus consists of a conical cylinder provided with a syphon on one side, of the type and dimensions shown in the sketch. A circular piece of wire gauze of a diameter slightly larger than that of the exit hole in the cylinder is placed against the latter, flush with the side of the cylinder. This is kept in position by coarse sand placed in the cylinder up to a height of about 3 inches from the bottom and a wire gauze is placed above the sand layer. Over the wire gauze are placed in succession a 3 inch layer of unactivated carbon, another wire gauze and a 4 inch layer of activated carbon in the order mentioned. For preparing the filter for use, the following procedure may be adopted. Water is poured into the filter up to the top till a continuous flow of water, uninterrupted by air bubbles, is obtained through the syphon. As soon as the water level in the filter reaches that of the carbon layer, the flow from the syphon tube may be stopped by means of a cork or a rubber tube and pinch cock. The filter is now ready to receive the treated juice. The cork may be removed or the pinch cock may be opened after pouring the juice into the filter. In case the filtration slows down, the surface of the carbon layer may be scraped with the broad blade of the scraper.

FIG I



Old Filter.

FIG II



Modified Filter.

Scale.
½ inch = 1 inch.

It is important that no air be allowed to enter the apparatus during the course of filtration and it may also be emphasised that pre-treatment of the juice, viz., boiling with activated carbon and efficient skimming contributes a good deal towards rapidity of filtration. Below are presented some of the results obtained in the laboratory with the modified filter compared with the ordinary filter of the same dimensions.

Particulars of filtering arrangement.		Amount of juice handled.	Time required for filtration.
Old filter—containing gravel, activated carbon and unactivated carbon.		62 lbs.	22 minutes.
Old filter containing gravel, wire gauze—unactivated carbon—wire gauze—activated carbon.		62 ,,	30 ,,
Old filter containing gravel—wire gauze—activated carbon—wire gauze—unactivated carbon.		62 ,,	30 ,,
Modified filter containing gravel—wire gauze—unactivated carbon—wire gauze—activated carbon.	(1)	65 ,,	13 ,,
	(2)	27 ,,	7 ,,
	(3)	55 ,,	11 ,,
	(4)	55 ,,	11 ,,
Modified filter containing gravel—wire gauze—paddy husk—wire gauze—activated carbon.	(1)	88 ,,	13 ,,
	(2)	68 ,,	15 ,,

It must be admitted that the above results were obtained with an apparatus of a size suitable for laboratory studies. A bigger filter of the modified type has been got ready for large scale trials and will be tested in the coming season. There is, however, no reason to doubt that the modified filter will not work equally well in large scale trials.

It may be pertinent in this connection to record certain observations made regarding the effect of addition of egg-white on the clarification of cane juice. When well-beaten egg-white is added to cold juice and mixed well, subsequent boiling of the juice produces a copious scum. After removal of the scum, addition of carbon to the juice and further boiling and skimming bring about very efficient clarification. On stopping the heating, the impurities settle down to the bottom very readily, leaving a clear, supernatent solution. Filtration of the juice prepared as above even with the old filter has been found to be markedly rapid. The egg-white being alkaline in reaction, there is the further advantage of a reduction in the acidity of the juice by its use for clarification.

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