

A PROGRESS REPORT OF THE FILTRATION COMMITTEE ON THE WORKING OF THE OLIVER FILTER, 1941 OFF-SEASON.

The Oliver Campbell filter has now been in operation in some of our factories for several seasons, and this Committee has thought it timely to investigate the impressions of its value as a filtering unit, its value as a saver of labour, filter cloth, steam, and also its upkeep and off-seasonal overhaul.

To this end questionnaires were directed to those factories known to have installed the filter, and the Committee gratefully acknowledges the assistance received from those who responded.

Much useful information has now been collected, and it points to the fact that a detailed examination of the items above enumerated is a job of some magnitude, as the report attempts to indicate, for it must be remembered that each mill has its own problems. Even the upkeep and maintenance produce a much varied number of troubles.

It is not the purpose of this progress report to delve into financial comparisons of the Oliver filter versus the plate and frame press. It has to be borne in mind that the initial cost of the Oliver

filter is high, and to effect the capital expenditure and to compensate the discarding of capital locked up in the plate and frame presses with their accompanying tanks, etc., one must expect an immediate decrease in labour costs, in filter cloth and possibly in steam demands and chemicals. The purpose is rather to enquire into operating methods and conditions and so acquire further knowledge that should lead to increased factory recovery, apart from the saving in sucrose on the by-product, and a general betterment in factory conditions. For should not the filter be regarded in the light of a modern unit in a progressive march towards a more hygienic and more economical process of sugar manufacture?

An interchange of experience as to cost of upkeep and seasonal overhaul was necessary. This item has provided several surprises. In some factories the extent of the maintenance has "taken the gilt off the gingerbread," so to speak.

Below is tabulated an extraction of some of the questions and the replies thereto:—

Extract from Replies to Questionnaire.

	1.	2.	3.	4.	5.
Tons cane crushed per hour	63	130	52	41	48
Size of filter, sq. ft.	(8×16)=400	3(8×12)=900	(8×12)=300	(8×12)=300	(8×16)=400
Sq. ft. filter area	6.33	6.92	5.76	7.41	8.33
Tons cane crushed per hour	2.00	0.72	0.65	1.09	2.50
Screen material	Copper	Stainless steel	Stainless steel	Stainless steel	Stainless steel
Bagasse screen, sq. ft.	120	75	35	48	120
Sq. ft. of screen	2.00	0.72	0.65	1.09	2.50
Tons cane crushed per hour	40	60	25	$\frac{3}{16}$ " hole special angle screen	36
Mesh size	1,800	1,230	540	—	—
Lbs. bagacillo per hour	29	9.5	10.5	—	—
Lbs. bagacillo per ton of cane	1 in 2½	1 in 2 mins.	1 in 4 mins.	—	—
Drum speed	to 4 mins.	20 secs.			
Temperature of muds, °F.	185	200	185	205-212	175-180
Temperature of wash water, °F.	105	170	160	180	104-115
Wash water source	First effect	Boiler feed	Boiler feed	Condensed steam	Steam traps and raw cooling water
Trough is cleared	Weekly	Daily	Weekly	12-hourly	—
	also at every opportunity.				
Deterioration in trough?	Yes	No	If temp. drops	Yes	Yes
Rise in cake per cent. cane	4.28-5.7	3.15-4.15	4.2-5.2	4.0-5.5	2.95-3.04
Pol. of cake	0.27	0.70	0.40	0.35	0.30

Extract from Replies to Questionnaire.—Continued.

	1.	2.	3.	4.	5.
Disposal of first filtrate	Secondary juice	All mixed with second and returned to juice tempering tanks.			Process
Disposal of second filtrate	Primary juice				Settling tanks
Drop in purity filtrate from clarified juice	3°	2.2°	3° to 4°	—	—
Estimated increase on factory recovery due to lower pol. in cake	1.0 per cent.	0.7 per cent.	0.54 per cent.	—	0.50 per cent.

It will be seen that all filters are of standard diameter with varying lengths to suit the area. Unfortunately the size of the screen panels is not standardized, and it will be interesting to see how a new installation fitted with 9-foot panels of copper screening will stand up to the wear and tear.

The stainless steel screen is now replacing the copper screen. One factory has supplied data showing a high loss of weight of copper screen after two months immersion, as against no loss in weight for stainless steel.

The drum speed is a matter of special interest. It would appear as if in some factories the speed was governed by the amount of muds on hand. The variations recorded are wide, viz. from 1 revolution in 2 minutes 20 seconds to 1 in 4 minutes.

In a very interesting report on the working of the Oliver filter, G. H. Jenkins¹ is emphatic on the necessity for slow speeds, 1 revolution in 6 to 8 minutes being recommended. Stress is laid upon low drum speed as a factor in the separation of the so-called cloudy and clear filtrates.

Bound up with this question of drum speed and its effect on the clarity of the second filtrate juice, is the question of the ample supply and size of bagasse particles.

Only two of the replies give ideas of the quantities of bagasse available, but the size of the screen and the size of the mesh do not seem to follow any standardized rule. In this connection Jenkins, already referred to, is instructive when he advises, *inter alia*, that the use of bagasse screens of 8 holes to the inch gave a considerable increase of fine bagasse (or bagacillo) in the feed, resulting in a substantial improvement in the mud retention figure. Low drum speeds were found to assist the retention of muds in a marked degree, the effective separation of clear and cloudy filtrates being facilitated thereby.

Now, one would imagine that a dominant factor in judging the efficiency of any mechanical filter would be the amount of mud solids it can abstract in one operation. In sugar manufacture, especially

where sulphur is employed, "quick and snappy in process" should be the motto. It is therefore disappointing to find, in almost all cases, both the filtrates go back to factory process, even to the sulphur tower. The first filtrate must necessarily be muddy and therefore must be reprocessed, but is there to be no method of operation whereby the second filtrate may be separated and merged with the juices going to the settling tanks for decantation and thence to the evaporator supply.

It is obvious that this mud retention figure (that is, the ratio of fibre to mud solids in the feed and in the cake, assuming that all the fibre is retained in the cake) is an all-important matter, since it is a measuring of the efficient abstraction of muds from the juice.

From this information can be obtained a very good idea as to what recirculation of muds is going on: for naturally the aim should be to diminish this recirculation as much as possible.

As already stated, one condition for a high mud retention figure is an ample supply of bagasse of the correct size and size distribution. Large particles, whilst rendering the cake porous, pass through too great an amount of muds and lessen the efficiency of the wash water. We must remember that the actual filtering medium, as in the plate press, is the mud itself which is deposited on the layer of bagasse, which, in turn, is supported by the screen. Hence the bagasse particles should bear some size relationship to the screen holes.

At this point it is well to enquire whether a contributory factor to good filter work does not lie in the better control of our juice preparation. The obtaining of a well formed granular precipitate in the first instance would be a sensible expectation to good filter work. It can readily be imagined that, less mud recirculation, quicker filtration and less wash water required to reduce the polarization of the cake, would be the normal consequenc of a more intense control of the original precipitate in the raw juice.

With bagasse suitable in size and ample for the requirements, a low drum speed and a temperature of 190°F. minimum, it would appear that we have most of the conditions necessary for good mud retention on the filter pack.

One point requiring mention is the deterioration or decomposition that occurs in the filter trough.

From the evidence of those who have experienced this, and that is practically all operators, the presence of H_2S is believed to be the result of the drop in temperature. But may it not be assisted by the continuous circulation of reheated muds? Whilst the cleaning of the trough and all piping and tanks and the filter itself is a proposition of some effort, the decomposition evidently cannot be attributed to foul conditions. In most of the factories a twelve-hourly cleaning down is a routine job.

It is also to be noticed that there is an appreciable drop in purity between the clarified juice and the filtrates. One factory reports no increase in the reducing sugar ratio, but what about the destruction of dissolved dry substance?

The drop in the second filtrate can be more readily understood. Perhaps this drop in purity is the result of washing back of non-sugars, which may be facilitated by the presence of a large supply of over-size bagasse particles in the pack.

Few factories have exercised much control over the quantities of wash water employed—the quantity of water applied should be governed by the economical limit capable of being handled at the evaporator, although it is difficult to say at what point the water actually displaces the juice in the mud pack and where it redissolves some of the non-sugars direct into the filtrate.

Records available show that one factory applying as much as 100 per cent. water on cake obtained 0.3 per cent. polarization, whilst a second applying half that amount of water obtained 0.4 per cent. polarization in cake.

It is a debatable point whether the efficiency of the filter may be reckoned by the lowness of the polarization of the cake and to regard, say, 0.2 per cent. polarization of cake as a fine achievement, whilst neglecting the purity of the filtrate and the amount of muds returned for recirculation into the juice.

Some diversity of opinion exists as to the recoverability of the sucrose thus saved in the cake, and with this question is bracketed the greater question as to whether the Oliver filter, because of the elimination of the quondam excess alkalinity required for successful operation of filter presses, is in itself an agent for higher factory recovery—that is, productive of better boiling house conditions.

Comparison with past records are, of course, not sound, since the greater proportion of new canes crushed may have influenced operating conditions.

Incidentally, it is interesting and instructive to note that our Experiment Station's notes for December tell us that the season's figures in respect to sucrose, fibre, purity and reducing sugars, i.e. the quality of the cane, are the worst for some years.

Many interesting points have come to light that may have some bearing on the successful operation of the filter. One factory reports a variation in the quality of the bagacillo. On occasions it is found that the bagacillo simply floats and will not mix with the mud in the feeding tank. This behaviour has been attributed to certain cane varieties. It is not, however, an experience common to the mills.

Again, the storage of bagacillo against mill stoppages, chokes, etc., has its problems. Stored bagacillo has a tendency to ferment, especially under conditions favourable to fermentation, so here at least we have one trouble not inherent in the filter and the juice.

It can, of course, be readily understood that the bagacillo and the muds from stale and/or fermented cane are not good material for filter work.

The Committee was unable to secure much data on the saving of chemicals directly due to the installation of the Oliver filter. There is, however, a definite drop in consumption.

As the amount of dilution of muds is less, resulting in a diminished volume of juices returned for retreatment with chemicals, the saving must be significant in normal times.

The elimination of aforesaid heavy dilution of filter press muds must also show a diminished draw on the process steam, even allowing for the continuous reheating of the muddy juices to be filtered. Only one factory ventured to cost out the savings in terms of coal and the figure was encouraging.

This report has already made brief reference to the upkeep and maintenance aspect of the Oliver filter.

The overhaul of the plant has in some instances provided big problems. Corrosion of essential parts, excessive wear and tear on fittings, heavy depreciation on piping, etc., are the common experience.

Abrasion in the bagacillo supply pipe, in the fan itself and in the cyclone, necessitating the fitting of rubber padding, the difficulties of getting rid of the sand in the trough and generally a more rapid and efficient method of cleaning, to mention but a few, are matters of vital importance and all make up quite a respectable contra account to the gains associated with the installation of the Oliver filter.

The Committee having taken this preliminary step in reviewing the knowledge and experience now available on this expensive and useful unit in our factories, feels that the further investigation and study is a matter well worth while. To this end the members would strongly recommend that our Association follow the good example of Australia and ask that our Council take steps to have a skilled technician seconded for studying this problem during the coming season.

It is felt that there is much to learn in the more efficient operation and many pitfalls can be avoided. The interchange of ideas on layout and in maintenance alone will be profitable. The question of a whole-time technologist has been urged on previous occasions, and the suggestion is submitted that no phase of our production is more deserving of attention than the filtration of juices.

G. BOOTH, *Convenor.*

Reference.

¹ Jenkins, G. H. (1940): Bur. Sug. Exp. Stns., Queensland, Technical Communications, No. 2.

The PRESIDENT, in opening the paper for discussion, remarked on the great deal of work that had been done by the Committee. It was time that the industry realised that it had got a body of men who were sufficiently interested to give up their spare time to improve new plant and for adapting it to the requirements of the industry. He pointed out that when the Oliver filters were first installed at Maidstone, he carried out certain experiments with stainless steel and it was as a result of these experiments that the Oliver filters now had stainless steel screens. There were other problems in connection with these filters which had not been fully answered, but with the goodwill and interest of everybody concerned, a fuller understanding of these questions would lead to further improvements.

Mr. CAMDEN SMITH congratulated Mr. Booth and his Committee on the production of the excellent report. The Oliver filter was comparatively new to this country, and not much data regarding its performance were available, but taking that into consideration, the report was really very detailed.

He regarded the Oliver filter as a most efficient labour-saver and clean in its operation, but he did not think it timely yet to state anything definite as regards improvement in recovery. It should also be stated that it was expensive and its upkeep was considerable.

He stated that the problems of corrosion were to a great extent foreseen by the makers, and as far as possible provided for, and he had no doubt that

further improvements in this connection could be expected shortly.

He had great faith in the filter and welcomed the suggestion of a whole-time technologist, who should also have the necessary assistance, to investigate its problems. Such an investigation was the more necessary now when the mill staffs were restricted and could not find the time to make all the necessary observations.

Mr. Camden Smith further said that some factories have tried to reduce the polarization of the filter cake too far. By applying too much wash water in an attempt to lower the sucrose content of the cake, the mud was simply washed through the blanket of the bagasse and by doing that one would defeat one's own object. Strictly speaking, they were dealing with mud eliminators and mud washers rather than filters. He had never seen a clear filtrate from an Oliver filter. He advocated a reduction in wash water to reasonable proportions, and to reject filter muds at about one per cent. sucrose.

Mr. DODDS also congratulated the Committee on their work. The sucrose in filter cake per cent. sucrose in cane had fallen from 1.37 to 0.60 from 1935 to this season, and the boiling house recovery had gone up from 84 to 87. He thought the rotary filter did not only give smaller losses in filter cake, but also gave an improved quality of filter juice which would lead to better boiling house recovery. He was firmly in agreement with the proposal to have a whole-time technologist studying this and other problems. It was, to his mind, essentially one of the functions of the Experiment Station to provide from its staff men who were capable of making these studies in co-operation with the Committee. The result of such an investigation ought to be very valuable.

Mr. J. PUGNET, relating his own experience of the Oliver filter, said it was a cleaner process than the old filter presses. All the scums sent to the filters were absorbed, whereas in the best filter presses there were leaks, splashes and the continuous handling of the cloths all caused inevitable losses.

He considered the Oliver filter a labour-saver. In the case of his own factory, they used to have 16 presses and 15 boys were employed to load the presses, remove cloths and scums, clean the frames and work two washing machines, etc. In 1940, with two Oliver filters, 8ft. by 16ft., they required only 2 boys. It was therefore clear that a considerable amount was saved in a single crushing season lasting 8 months and working 3 shifts a day.

The Oliver filter did not require filter cloths, and this item was expensive, amounting to £820 per year at his factory.

The losses in sucrose in the filter cake was 6.5 times less in the Oliver filters than was the case with the filter presses. This did not include losses due to leaks, bursts, splashes, sucrose left in the cloth and sucrose lost by over-liming in certain

cases. If these were taken into account the losses would probably only be one tenth of what they used to be.

Mr. Pougnet quoted the following figures from his particular factory :—

Year.	Mixed Juice.		Filter Press Juice.		Difference		Sucrose % Filter Cake.	Filter.
	Brix.	Purity.	Brix.	Purity.	In Brix.	In Purity.		
1936	14.36	84.89	11.74	76.32	2.62	8.57	3.25	Filter press.
1937	14.98	84.42	12.09	80.88	2.89	3.54	3.27	„ „
1938	14.82	86.26	7.91	82.69	6.91	3.53	3.12	„ „
1939	14.20	85.63	8.32	82.29	5.88	3.34	3.46	„ „
1940	14.36	85.60	10.83	81.71	3.53	3.89	0.54	Oliver filter.

There was therefore a big saving in sucrose and improved recovery here, but whether this was maintained in subsequent stages was not possible to tell owing to local conditions.

The fine bagasse used in the process contained a certain amount of sucrose and it did not keep. The danger of deterioration was greater if the bagasse was derived from bad cane.

Some critics compared the Oliver filter with the Petree process in that muds or cloudy juices were returned; but if there were any ill effects the clarification figures would soon show them. He had noticed, however, that whenever the fine bagasse supply was insufficient owing to mill stoppages or "choked sieves" or some other cause, the vacuum filters were covered with a waxy slime which interfered with the filtration, and when the juice was returned it increased the muds in the clarifiers. This can readily be seen in a test tube. This, however, was not caused by the Oliver filter.

Corrosion took place in most factories. It was found in parts where the fine bagasse travelled, such as the bagasse suction pipes, fans, etc. This corrosion was probably due to friction and to the acids from fermented bagasse. Then, of course, corrosion was found where the scums came in contact with the metal. The intensity varied a lot with local conditions.

Mr. Pougnet said that he was actually using less water on the filters now than he used to. He believed in reducing the sucrose content of the cake as far as possible, and thought that he could get still better figures by using more water. In the Oliver filter the washing of the cake was direct, whereas in the old system intense dilution had to be done. Even then the results were inferior and it increased the work of the evaporators.

Further investigation on the working of the Oliver filters was necessary and should be undertaken.

Mr. VIGER referred to a paper, "Survey of Oliver Filter Performance," by S. N. Wickey of the Hawaiian Sugar Technologists. It was found in Hawaii that the tentative standard Oliver filter area was eight square feet per ton cane per hour. The average speed of the filter drum was 14.1 revs. per hour and the mud elimination 0.585 tons per 100 square feet per hour.

Mr. Viger recommended slow filter drum speed for good mud retention. Considerably less water was used in washing the cake on an Oliver filter than was the case with the plate and frame process. This resulted in a saving of steam. The amount of water used in the Oliver filter was about 6 per cent. on cane as against 10 to 15 per cent. on cane with the plate and frame process. There was therefore about 61 tons less water to evaporate per 1,000 tons of cane. There were also huge amounts of water used in washing the filter cloths where filter presses were used, and that had to be pumped away and disposed of as dunder. The Oliver filter completely eliminated this, which is a great advantage.

The filtrate from the Oliver filter prior to the closing of the screen perforations with bagasse, was always dirty, and this turbid juice amounted to 37 to 40 per cent. of the total flow. It has been found that when operating on settlings containing 5 per cent. suspended solids, approximately half of the dirty filtrate might be added to the settlings, and with 6 or more per cent. all might be added and still maintain a cake sufficiently thick to ensure a fair clarity of the final filtrate. Mr. Viger recommended this method of disposing the dirty filtrate from the Oliver filter. It decreased the load of the clarifiers

and also avoided to a great extent the recirculation of dirty juice through the mixed juice to the clarifiers.

Mr. RAULT said that he had definite proof that if washing went too far, impurities were washed out which might form molasses. Colouring matter was also washed out and that had an effect on the sugar when making white sugar.

Mr. GALBRAITH did not agree with Mr. Camden Smith. At Esperanza they diluted very heavily and supplied as much water as possible on the cake, reducing it to 0.3 per cent. sucrose, yet he could see no ill effects in the boiling house. The massecuite boiled well and there were no adverse effects on the colour of the white sugar they were making.

Mr. BOOTH, in reply, said that he agreed with Mr. Camden Smith and thought there was too much mud circulation. He also agreed with Mr. Viger that the Oliver filter largely eliminated the problem

of wash water. He still thought that the recovery of sucrose as a result of the installation of the Oliver filter was a debatable point. In his opinion Co.281 was responsible for some improvements in our factory figures.

Mr. Booth expressed his appreciation for the enthusiasm and good work of the Committee, and was delighted that the paper provoked such useful discussion.

Mr. CAMDEN SMITH proposed, and Mr. WILSON seconded that the Congress make a recommendation to the Council that they push forward with the suggestion contained in the report that a full-time technologist should be appointed to investigate the problems connected with the Oliver filter.

The PRESIDENT concluded by asking for a hearty vote of thanks to be accorded to Mr. Booth and his Committee for their interesting report.