The Steam Consumption of Pot Stills in Relation to Boiler Output.

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(Mr. Owen Clarke in the Chair).

The Chairman then called upon Mr. J. G. Davies to give a synopsis of his paper on, "The Steam Consumption of Pot Stills in Relation to Boiler Output" shown hereunder.

I. Introduction.

In attempting to attain a balance between available bagasse fuel and steam demand, there has been some discussion recently concerning the steam demand of pot stills. Floro(1) has published some figures for different sizes of stills and he indicates ways in which the length of the time cycle can be reduced. He also concludes that the larger the capacity of the still, the lower the steam consumption in terms of steam used per gallon of proof spirit.

The object of the present work was to relate the demand of steam of a 1500 gallons still to the total steam production of the boiler house. The load during the various stages of the distillation cycle could then be calculated as a percentage of the total boiler output.

The observations were made at Rose Hall distillery during the 1948 crop. The rate of through-put of the factory is 17 TCH. Three boilers were in use, with a total of 6,000 sq. ft. heating surface.

It is realized that steam demands in a factory fluctuate over fairly wide limits. In order to obtain a close estimate of the proportion of the total boiler load consumed by the stills, it would be necessary to conduct a series of duplicate tests under varying conditions. The present observations are divided into two series, one of which took place on a Friday when the still coils were scaled and the other on a Monday when the coils were clean. The results, which are at least indicative, are reported herein.

II. Experimental Conditions.

The total steam output of the boiler was estimated by metering the quantity of boiler feed water used during this period. The meter was of the type recommended by Hutson and Connell. Precautions were taken to ensure that as near as possible the metered quantity of water represented the amount of steam produced.

The steam consumption of the still was obtained by measuring the volume of condensate released by the coils' traps. The condensate was collected in one of the two calibrated steel drums. A certain amount of condensate flowed direct to the drain while the drums were being changed, and an allowance of 5% has been added to the observed quantity of condensate to compensate for this loss. Furthermore, there was a loss of vapour by flash from coil pressure to atmospheric, for which a further correction has been applied(2).

On the occasion of each trial, the mill and boiling house were under full operation. Wood fuel was fired as and when necessary in accordance with the usual practice. The boiling of the still in Trial No. 1 was undertaken by one operator and in Trial No. 2 by another. There may, therefore, be small differences in technique apart from the differences in the condition of the heating surface.

The basic data are presented in Table 1 herewith:—

TABLE 1.

ROSE HALL DISTILLERY STEAM CONSUMPTION TRIALS. BASIC DATA.

			Trial No. 1.	Trial No. 2	No. Wash pre-heater
Still No.			1	1	—
Insulation			Completely lagged		
Date			18.6.48	21.6.48	—
Time Started			10:32 a.m.	1:24 p.m.	—
Time Finished			3:30 p.m.	5:59 p.m.	—
Elapsed Time		Hrs: Mins.	4:58	4:35	—
Heating Surface		sq. ft.	100	100	—
Condition of Coils.			Scaled	Clean	—
Charges. Wash		gals.	1,500	1,500	—
L.W.		gals.	180	180	—
H.W.		gals.	120	120	—
Distillates. Rum		gals.	114	90	—
H.W.		gals.	170.3	133.4	—
	Proof	gals.	120	120	—
L.W.		gals.	180	180	—
Condensate Collecting Drums.					
No. 1	Water	lbs.	109.5		
		°F.	82		
		gals.	10.98		
No. 2	Water	lbs.	110.0		
		°F.	82		
		gals.	11.03		

III. Experimental Results.

The summarized results of each series of observations are presented in Appendices 1 and 2. It will be noted that the total still cycle has been subdivided into four operations "Steam on to rum over," "Rum", "High Wine" and "Low Wine". These terms are self-explanatory. The method of calculation employed is shown in Appendix 3. Appendix 4 consists of a detailed analysis of Trial 2. The method of calculation shown in Appendix 3 has been applied to the results of each individual set of observations so that an almost continuous record of steam consumption through the cycle could be obtained. In actual fact, the results are those obtained at the end of short periods varying from three to twelve minutes. When graphed, the points on the plot fluctuate a little because the time was recorded to the nearest minute. A smoothed-out curve showing "lbs. steam consumed from and at 212°F." vs. "Elapsed time" is shown in Figure 1.

IV. Discussion.

It will be noted from Appendices 1 and 2, that the total steam consumption during the cycle, as lbs. from and at 212°F., is approximately the same in Trial No. 1 (4783.6 lbs.) as in Trial No. 2 (4885.3 lbs.) In Trial No. 1, however, when the heating surface was scaled the demand extended over a period of 4.58 hrs. and in Trial No. 2 when the heating surface was clean the demand extended over a period of 4.35 hrs. The mean evaporation rates of the boilers during the two still cycles were 4.79 lbs./sq.ft. H.S./hr. and 4.43 lbs./sq.ft. H.S./hr. respectively. Hence the average consumption of the still expressed as a percentage of the total boiler output was less in Trial No. 1 (3.34%) than in Trial No. 2 (4.01%). A calculation may be made to express the still's requirement of steam in terms of available bagasse fuel and tons of cane ground. From the above, it would appear that the total still cycle in these tests consumes about 4,800 lbs., steam from and at 212°F. On the basis of 2.5 lbs. steam per lb. bagasse, the total bagasse fuel requirement per still per cycle is 4800/2.5 = 1920 lbs. bagasse. For a cycle lasting 4.5 hrs. this is equal to 1920/4.5 or 426 lbs. bagasse per hour. With bagasse 30% on cane, the tonnage of cane to be ground per hour to supply fuel for the average steam consumption of the still is 426/0.30 = 1420 lbs. = 0.63 TCH.

Inspection of Appendices 1 and 2 shows that the highest steam demand occurs during the heating up period, that is from "steam on to rum over". Floro's data (1) indicate that this part of the cycle requires 40—45% of the total steam used for the cycle. The present results are of the same order. In Trial No. 1, 1928.3 lbs. steam were used for heating up out of a total consumption of 4783.6 lbs. or 40.3% and in Trial No. 2, 2145.5 lbs. out of 4885.3 lbs. or 44.0%. If a suitable design and materials could be obtained, it is patent that a heat exchanger between the outgoing dunder of one cycle and the incoming wash of the next would result in appreciable steam economy. Necessary precautions would have to be devised to avoid loss of alcohol. Mr. J. A. Scott, Manager of Rose Hall, is contemplating using the hot condensate from one distillation to pre-heat the incoming wash of the next, thus resulting in a real saving of steam and avoiding loss of heat since at present the condensate is ditched.

During the first part of the cycle, it will be noticed that still consumption % boiler production is 4.93% in Trial No. 1 and 7.97% in Trial No. 2. One reason for this is that in Trial No. 1, the steam was not turned on until the still was loaded and one of the traps did not function for 20 mins. or so. In Trial No. 2, steam was turned on as soon as the bottom coil was covered. Also, a higher rate of steam consumption is to be expected with clean coils (Trial No. 2) than with scaled coils (Trial No. 1). This is in fact so. The average steam consumption during the heating up period in Trial No. 2 was 18.13 lbs./sq.ft.H.S./hr. and in Trial 1, 12.58 lbs./sq.ft.H.S./hr. On the basis of a total steam requirement for heating up of 2,000 lbs. from and at 212°F., this is equivalent to the fuel supply from 1.2 TCH or about double the average requirement.

Running rum and high wine are lower steam consumers. The demand on the boilers is less than half of that for the heating up period. The actual steam consumption is about 6 lbs./sq.ft.H.S./hr., running high wine being rather more than running rum. The load increases again after the change over to low wine, and steam consumption becomes 9—10 lbs./sq.ft.H.S./hr. When the steam consumption is expressed as a percentage of the total boiler production, certain differences in these three parts of the cycle between the two trials are apparent. It will be observed that the times taken to run high wine and low wine were almost identical in each case, and that the steam consumption of the still, as lbs. from and at 212°F. per sq.ft.H.S. per hr., was less in Trial No. 2 (clean coils) than in Trial No. 1 (scaled coils). The reason for this may be the difference in technique of the two operators, or perhaps a difference in wash character.

Apart from the technical interest which these data may produce, there is a very obvious conclusion to be drawn from the operational point of view.

It is that in distilleries equipped with two or more stills, no two stills should be on the same part of the cycle at the same time. Such a procedure may require a little organization and may result in the loss of a small amount of capacity, but in terms of boiler load the result would be well worthwhile. From Appendix 2 it can be seen that if one still was turned on when the other was running high wine and the cycles then followed through, the fluctuating load on the boiler would vary between 6.05% and 9.90%. If both stills ran a synchronised cycle, the boiler load would fluctuate between 3.86% and 15.94% It may be that the bad name which distilleries have as steam consumers is due to the practice that when there are two stills, both are turned on at the same time. By so doing, a sudden demand equivalent to 15.94% of the boiler output has to be satisfied immediately. This is a load which no factory boiler house can carry without loss of pressure.

The rates of steam consumption of the still presented as lbs. from and at 212°F. per sq.ft.H.S./hr. should enable indicative calculations to be made in other distilleries of still consumption % boiler production.

The detailed calculations set out in Appendix 4 and shown graphically in Figure 1 demonstrate very clearly the high rate of steam demand and the fluctuation in that demand. During the early part of the boiling up process with clean heating surfaces, the steam consumption is slightly over 22 lbs./sq./ft.H.S./hr. This is even higher than the figure of 18 lbs. sq.ft.H.S./hr. given by Dunn & Nelson (3) for certain vacuum pan operations. As far as the length of the time cycle is concerned, material savings could be made if the boiling up period could be reduced. This would require a higher rate of heat transfer during that part of the cycle. For the present observations, the rate of heat transfer could be calculated for the first three minutes of the boiling up period if it is assumed that the average temperature of the wash for that short period was 92°F. The pressure gauge on the coils indicated 10 psi (239°F.). Steam consumption was at the rate of 22 lbs. f and a 212°F./sq.ft./hr. The temperature difference was 239—92 = 147°F. The rate of heat transfer, therefore, works out at 22.5 x 971/147 = 148 BTU/sq. ft./hr./°F. A similar calculation for the period immediately before the pot started to boil results in a figure of 416 BTU sq.ft./hr./°F. Both calculations are based upon the total installed heating surface of 100 sq.ft. But it would appear unlikely that the rate of heat transfer would be less when the temperature difference is greater. Thus the only conclusion that can be drawn is that the whole of the heating surface was not operative. It was also noted that the rate of flow of condensate to the drums did not materially lessen until the rum came over although the steam pressure in the coils had been reduced some 20 minutes before when the low wine retort first boiled. (See Appendix 4, lbs./sq. ft./hr. fa 2:23 p.m., 2:26 p.m. 2:31 p.m. and 2:43 p.m.) If a reduction in the boiling up period is to be achieved, therefore, it would appear necessary to pay more attention to the design and distribution of the heating surface of pot stills. A reduction cannot be brought about by installing more heating surface in the two coils, that is by using longer coils. This was tried in a new still installed in the island a few years ago. The answer would appear to lie with the use of a greater number of shorter coils. The standard 1500 gallon still is generally equipped with 2—4" coils and about 100 sq.ft.HS. Each coil is, therefore, about 50 feet long. Some coil pan manufacturers limit the length of their coils to 90 times its diameter. The rate of steam consumption is higher in stills than in pans and this ratio should, therefore, be set as the limit for stills. The work of Norman Smith (4) on circulation in coil pans should also be applied, particularly with reference to the angle of dish of the coil, which governs the rate of condensate drainage. Free drainage of condensate is essential in pot still coils because of the high rate of steam consumption during the boiling up period. Proper heating surface design should result in a reduction of the boiling up period to 35 to 40 minutes with a saving in time of 30 to 35 minutes.

V. Conclusions.

(a) In a factory grinding 17 TCH, the average steam consumption for a cycle of a 1500 gal. still, 100 sq.ft.H.S. is 3.34% of the boiler production when the coils are scaled.

(b) The demand may rise as high as 7.97% during the boiling up period when the coils are clean.

(c) In terms of bagasse fuel requirement, these loads would utilize the bagasse from 0.63 TCH and 1.20 TCH respectively.

(d) The heating up operation consumes 40—45% of the total steam requirement. The data confirm those of Floro.

(e) Rates of steam consumption as high as 22 lbs./sq.ft.H.S./hr. have been observed during the heating up operation.

(f) Consideration should be given to re-designing the standard heating surface of pot stills.

VI. Acknowledgments.

Acknowledgment must be made of the ready co-operation and assistance freely rendered by the Manager and Staff of Rose Hall distillery. Appreciation is also recorded of the help given by Mrs. A. Burnett, who performed all the calculations in Appendices 1, 2 and 4.

VII. Bibliography.

(1) Floro. J.A.S.T. Quarterly (1944) 8. 1. 2.

(2) "Efficient Use of Fuel", page 117.

(3) Dunn & Nelson. S.A.S.T. Proc. (1948).55.

(4) Smith. Bureau of Sugar Experiment Stations, Queensland. (1937) Tech. Comm. No. 4.

APPENDIX III.

ROSE HALL DISTILLERY. STEAM CONSUMPTION TRIALS.

Method of Calculation.

For Trial No. 1, from "steam on" to "rum over", average steam pressure in upper coil 23 lbs., and in lower coil 23 lbs. During this period of 1 hour 32 mins., drum No. 1 was filled 9 times and drum No. 2 8 times.

9 x 10.98 gals. = 98.82 gals. Av. temp. 185°F. = 84°C.
8 x 11.03 gals. = 88.24 gals. Av. temp. 191°F. = 88°C.

Water at 84°C weighs 9.703 lbs. per gallon.
Water at 88°C weighs 9.677 lbs. per gallon.

Weight of water ex No. 1 drum = 98.82 gals. x 9.703	=	958.8 lbs.
Weight of water ex No. 2 drum = 88.24 gals. x 9.677	=	853.9 lbs.
		1812.7 lbs.
Add 5% for loss while changing drums 1812.7 x 0.05	=	90.6 lbs.
Add loss by flash from 23 lbs. to atmos. 5.3%	=	96.1 lbs.
Total condensate		1999.4 lbs.

$$1999.4 \text{ lbs. at } 23 \text{ lbs./sq. in.} = \frac{1999.4 \times 935.8}{970.3} = 1928.3 \text{ lbs. "f \& a 212°F."}$$

Boiler consumption during the period = 4520 gals. at 210°F.
Av. pressure 112 lbs.

Water at 210°F. weighs 9.601 lbs. per gal.
4520 x 9.601 = 43396.5 lbs. water to boiler.

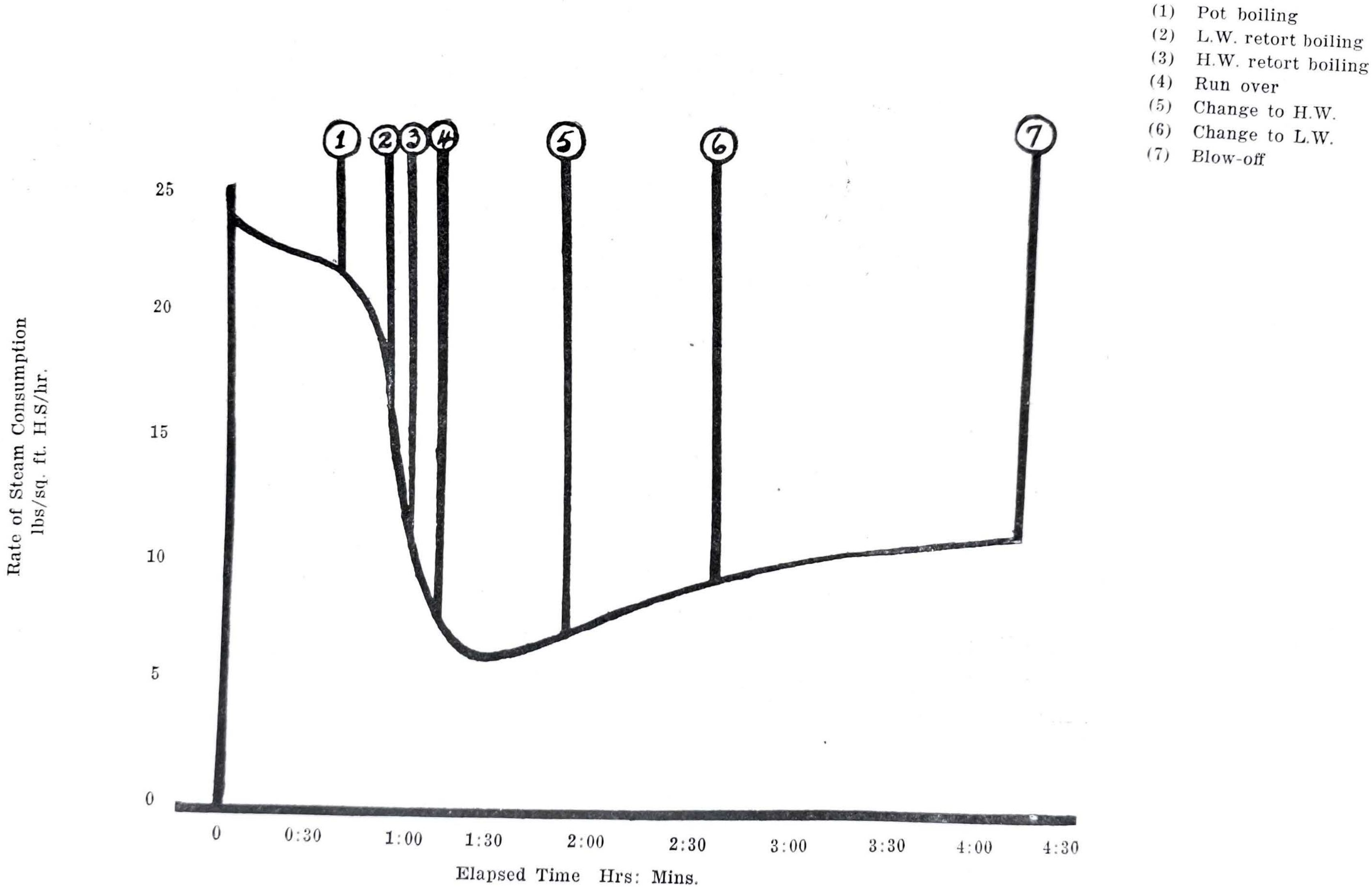
$$43396.5 \text{ lbs. at } 112 \text{ lbs./sq. in.} = \frac{43396.5 \times 874.4}{970.3} = 39107.4 \text{ lbs. f \& a 212°F.}$$

1928.3 x 100/39107.4 = 4.93% of total consumption.
Table 35 p. 117 "Efficient Use of Fuel".

FIGURE I.

ROSE HALL DISTILLERY. STILL No. 1. TRIAL NO. 2. 21.6.48

CLEAN COILS.



The Chairman declared the paper open for discussion.

DISCUSSION.

Mr. Floro enquired what method was used for estimating the quantities of high and low wines produced, and also remarked on the fact that the cycle time seemed to be the same whether the heating surface was in a scaled condition or clean.

Mr. J. G. Davies replied that the volume was estimated by dipping in the can pit. The similarity in time between the two cycles might have been due to the fact that there were two different distillers operating the stills, or difference in the character of the washes.

Mr. Henzell thought that in connection with reducing the cycle time a lot depended on the design of the heating surface. He demonstrated on the black-board a design of easily removable coil the main feature of which was a very steep slope which resulted in efficient condensate removal, and by thus increasing the efficiency of the coil it was possible to lower the cycle time.

Mr. Dron said he had had the opportunity of observing two stills, one of which had a cycle time of half an hour less than the other, and the only difference between them was in the size of the condensate drain. He agreed with Mr. Henzell that efficient condensate to drainage was a most important factor.

Mr. Nurse quoted figures for boiler loads at Barnett Estate which demonstrated that at a small factory like Barnett the fluctuation was considerable, ranging between 4.42 and 8.25 p.s.i. pounds of water evaporated per square ft. of boiler heating surface from and at 212°F. as shown by tests taken over a period of 8 hours.

Mr. Owen Clarke felt that the temperature to which the wash was pre-heated was an important factor. At Worthy Park he had raised this temperature from 50° to 70°C, and this had the effect of enabling him to get in an extra still in the 24 hour period.

Mr. Dalley said that by heating to 135°F in an open heater he had saved in time but had lost alcohol to the extent of 10%. When he switched to a closed juice heater he could raise his temperature to 180°F and no loss in recovery resulted. His contention was that the important point about wash heating was to have the heating and loading performed in a closed system.

Mr. H. A. Suberan said that they had installed a live steam injector to the stills at Caymanas, and this had reduced their cycle time considerably, but they lost 15 gallons of rum per still on a complete cycle, through dilution with condensate and taking the original 10% high wine and 12½% low wine when running low wine. By this method they had been able to reduce the original cycle and alcohol loss.

Mr. Floro pointed out that with this method of using steam injection, they were merely supplying steam to the retort via the still and he thought that greater efficiency could be obtained by supplying the retort itself with sufficient heating surface.

He then inquired of Mr. Davies whether they had attempted to use the alcohol % wash as a basis for the operation of the stills.

Mr. J. G. Davies replied that some experiments had been conducted which showed that as distillation progressed Alcohol % Wash followed a straight line graph falling steadily with time as distillation progressed.

Mr. Sharpe said that he had noticed that the new stills which had vertical sides were not only slower than the old shallow designs but if an attempt were made to speed them up, "creeping" of wash resulted. He wondered whether this could be due to the arrangement of the heating surface as regards point of inlet of steam and outlet of condensation.

Mr. Floro replied that he thought that Mr. Sharpe's observations were probably the result of the increased hydrostatic head under which the new design was forced to operate by virtue of its shape.

Hon. F. M. Kerr-Jarrett agreed that design was a most important factor. In the old pot still days the continental flavoured rum stills on which he was initiated, the crowns were flat and the goose necks came over without a swell as in the present goblet piece; and the present crowns had more head. He told Blair's representative on a recent visit, he was surprised at the lack of technical advice they got from them as designers and makers of stills, and the reply was that most estates objected to any alterations in their existing design.

Mr. Nurse mentioned the case of collapsed coils as a factor which reduced efficiency, and he recommended that small safety valves to break vacuum be installed between the steam inlet and the coil in order to protect the coil against the vacuum when wash at a lower temperature was loaded into a pot still.

Mr. Dalley said that he had trouble with collapsed coils at New Yarmouth and although he had now installed safety valves he did not quite see how the maximum probable vacuum of 14.5 p.s.i. could cause collapse of new coils constructed of such tough material.

The Chairman then thanked Mr. Davies for his very interesting paper, also those who took part in the discussions.

APPENDIX 1.

ROSE HALL DISTILLERY STEAM CONSUMPTION TRIALS.

Summarised Results of Trial No. 1. Scaled Heating Surface.

Time.	Operation	Drums Fld. No. 1	No. 2	Gallons No. 1	No. 2	Av. Temp. No. 1	No. 2	Wat. lbs./gal. No. 1	No. 2	Wt. water lbs. No. 1	No. 2	Uncrtd. Total	Add Loss 5%	Flash loss %	wt.	Cortd. Total
1 hr. 32 mns.	Steam on to Rum over	9	8	98.82	88.24	84°C	88°C	9.703	9.677	958.8	853.9	1812.7	90.6	5.3	96.1	1999.4
1 hr. 0 mns.	Rum	2	2	21.96	22.06	85°C	86°C	9.697	9.690	212.9	213.8	426.7	21.3	3.6	15.4	463.4
46 mns.	H.W.	3	3	32.94	33.09	87°C	87°C	9.684	9.684	318.9	320.4	639.3	31.9	4.3	27.5	698.7
1 hr. 40 mns.	L.W.	7.2	8	79.06	88.24	89°C	89°C	9.671	9.671	764.6	853.4	1618.0	80.9	5.0	80.9	1779.8

Av. Coil Press	Latent Heat	Still lbs. f & a 212°F	Boiler Gals.	Boiler Press	Wt. water to boiler	Latent Heat	Boiler f & a 212°F	Still % Boiler	Still cons. lbs/sq. ft./hr.	Boiler evap. lbs/sq. ft./hr.
23	935.8	1928.3	4520	112 lbs./sq. in.	43396.5	874.4	39107.4	4.93	12.58	4.26
13	947.9	452.7	3310	95 do	31779.3	883.2	28926.6	1.56	4.53	4.82
16	944.0	879.8	3810	95 do	36579.8	883.2	33296.2	2.04	8.87	7.21
20	939.2	1722.8	4800	110 do	46084.8	875.8	41596.5	4.14	10.34	4.17

Total steam consumption of still for cycle f & a 212°F .... 4783.6 lbs.

Total steam production of boilers during cycle f & a 212°F. .... 142926.7 lbs.

Still cons. % boiler prod. 3.34%

Yield of proof spirit .... 170.3 gals.

lbs. steam f & a 212/gal. proof spirit.... 28.09

Average evaporation of boilers during cycle .... 4.79 lbs./sq. ft./hr.

APPENDIX 2.

ROSE HALL DISTILLERY STEAM CONSUMPTION TRIALS.

Summarised Results of Trial No2. Clean Heating Surface.

Time	Operation	Drums Fld. No. 1	Drums Fld. No. 2	Gallons No. 1	Gallons No. 2	Av. Temp. No. 1	Av. Temp. No. 2	Wat. lbs./gal. No. 1	Wat. lbs./gal. No. 2	Wt. water lbs. No. 1	Wt. water lbs. No. 2	Uncrtd. Total	Add loss 5%	Flash loss %	Flash loss wt.	Cortd. Total
1 hr. 11 mns.	Steam on to Rum over	10	9	109.80	99.27	89°C	88°C	9.671	9.677	1061.88	960.64	2022.32	101.12	3.6	72.80	2196.24
44 mns.	Rum	2	2	21.96	22.06	84°C	85°C	9.703	9.697	213.08	213.92	427.00	21.35	2.0	8.54	456.89
51 mns.	H.W.	2	3	21.96	33.09	87°C	85°C	9.684	9.697	212.66	320.87	533.53	26.68	2.4	12.80	573.01
1 hr. 49 mns.	L.W.	8	7.3	87.84	80.52	89°C	88°C	9.671	9.677	849.50	779.19	1628.69	81.43	2.9	47.23	1757.35

Av. Coil Press	Latent Heat	Still lbs. f & a 212	Boiler Gals.	Boiler Press	Wt. water to boiler	Latent Heat	Boiler lbs. f & a 212	Still % Boiler	Still cons. lbs./sq. ft./hr.	Boiler evap. lbs./sq. ft./hr.
13	947.9	2145.5	3150	135	30243.2	863.6	26917.5	7.97	18.13	3.80
6	958.4	451.3	2300	135	22082.3	863.6	19653.9	2.30	6.15	4.49
8	955.2	564.1	3400	125	32643.4	868.2	29208.5	1.93	6.64	5.73
10	952.1	1724.4	5350	125	51265.4	868.2	45960.5	3.75	9.49	4.21

Total steam consumption of still for cycle f & a 212°F. .... 4885.3 lbs.

Total steam production of boilers during cycle f & a 212°F. .... 121740.4 lbs.

Average Still cons, % boiler prod. 4.01%

Yield of proof spirit .... 133.4 gals.

lbs. steam f & a 212/gal. proof spirit.... 36.62

Average evaporation of boilers during cycle .... 4.43 lbs./sq. ft./hr.

APPENDIX IV.

ROSE HALL DISTILLERY STEAM CONSUMPTION TRIALS. Detailed Results of Trial No. 2.

Time	Acc. Elapsed Time	Drum No.	Conden-sate Temp. °C	Lbs. gal.	Uncrtd. Lbs.	Loss 5%	Flash %	Flash Wt.	Coretd. Lbs.	Coil Press	Latent Heat	Lbs. f & a 212	Elapsed Time—Hrs.	Lbs. per sq. ft. per hr.
1:32 p.m.	:0		Both coils on and No. 2 drum emptied											
1:35	:03	1	88	9.677	106.3	5.3	2.9	3.1	114.7	10	952.1	112.5	0.05	22.5
1:38	:06	2	90	9.664	106.6	5.3	2.9	3.1	115.0	10	952.1	112.8	0.05	22.6
1:41	:09	1	89	9.671	106.2	5.3	3.3	3.3	114.8	12	949.3	112.3	0.05	22.5
1:44	:12	2	91	9.657	106.5	5.3	3.3	3.5	115.3	12	949.3	112.8	0.05	22.6
1:48	:16	1	91	9.657	106.0	5.3	3.3	3.4	114.7	12	949.3	112.2	0.066	17.0
1:51	:19	2	90	9.664	106.6	5.3	3.3	3.5	115.4	12	949.3	112.9	0.05	22.6
1:55	:23	1	90	9.664	106.1	5.3	4.1	4.4	115.8	16	944.0	112.7	0.066	17.08
1:58	:26	2	91	9.657	106.5	5.3	4.1	4.4	116.2	16	944.0	113.1	0.05	22.6
2.01	:29	1	89	9.671	106.2	5.3	4.3	4.6	116.1	17	942.8	112.8	0.05	22.6
2:05	:33	2	90	9.664	106.6	5.3	4.3	4.6	116.5	17	942.8	113.2	0.066	17.15
2:08	:36	1	90	9.664	106.1	5.3	4.5	4.8	116.2	18	941.6	112.7	0.05	22.5
2:11	:39	2	90	9.664	106.6	5.3	4.5	4.8	116.7	18	941.6	113.2	0.05	22.6
2:15	:43	1	90	9.664	106.1	5.3	4.5	4.8	116.2	18	941.6	112.7	0.066	17.08
2:18	:46	2	91	9.657	106.5	5.3	4.5	4.8	116.6	18	941.6	113.1	0.05	22.6
2:23	:51	1	90	9.664	106.1	5.3	2.9	3.1	114.5	10	952.1	112.3	0.083	13.53
2:26	:54	2	91	9.657	106.5	5.3	2.9	3.1	114.9	10	952.1	112.7	0.05	22.5
2:31	:59	1	90	9.664	106.1	5.3	2.6	2.8	114.2	9	953.7	112.3	0.083	13.53
2:43	1.11	2	86	9.690	106.9	5.4	1.7	1.8	114.1	6	958.4	112.7	0.20	5.64
2:54	1:22	1	84	9.703	106.5	5.3	1.7	1.8	113.6	6	958.4	112.2	0.183	6.13
3.06	1:34	2	85	9.697	107.0	5.4	1.7	1.8	114.2	6	958.4	112.8	0.20	5.64
3:18	1:46	1	84	9.703	106.5	5.3	1.7	1.8	113.6	6	958.4	112.2	0.20	5.61
3:27	1:55	2	88	9.677	106.7	5.3	2.4	2.6	114.6	8	955.2	112.8	0.15	7.52
3:36	2:04	1	85	9.697	106.5	5.3	2.4	2.6	114.4	8	955.2	112.6	0.15	7.51
3:46	2:14	2	86	9.690	106.9	5.4	2.4	2.6	114.9	8	955.2	113.1	0.166	6.81
3:55	2:23	1	86	9.690	106.4	5.3	2.4	2.6	114.3	8	955.2	112.5	0.15	7.50
4:03	2:31	2	87	9.684	106.8	5.3	2.4	2.6	114.7	8	955.2	112.9	0.133	8.49
4:12	2:40	1	87	9.684	106.3	5.3	2.4	2.6	114.2	8	955.2	112.4	0.15	7.49
4:20	2:48	2	87	9.684	106.8	5.3	2.4	2.6	114.7	8	955.2	112.9	0.133	8.49
4:28	2:56	1	88	9.677	106.3	5.3	2.9	3.1	114.7	10	952.1	112.5	0.133	8.46
4:35	3:03	2	87	9.684	106.8	5.3	2.9	3.1	115.2	10	952.1	113.0	0.116	9.74
4:42	3:10	1	89	9.671	106.2	5.3	2.9	3.1	114.6	10	952.1	112.4	0.116	9.69
4:50	3:18	2	89	9.671	106.7	5.3	2.9	3.1	115.1	10	952.1	112.9	0.133	8.49
4:57	3:25	1	87	9.684	106.3	5.3	2.9	3.1	114.7	10	952.1	112.5	0.116	9.70
5:05	3:33	2	88	9.677	106.7	5.3	2.9	3.1	115.1	10	952.1	112.9	0.133	8.49
5:12	3:40	1	89	9.671	106.2	5.3	2.9	3.1	114.6	10	952.1	112.4	0.116	9.69
5:19	3:47	2	89	9.671	106.7	5.3	2.9	3.1	115.1	10	952.1	112.9	0.116	9.73
5:25	3:53	1	89	9.671	106.2	5.3	2.9	3.1	114.6	10	952.1	112.4	0.100	11.24
5:32	4:00	2	88	9.677	106.7	5.3	2.9	3.1	115.1	10	952.1	112.9	0.116	9.73
5:39	4:07	1	89	9.671	106.2	5.3	2.9	3.1	114.6	10	952.1	112.4	0.116	9.69
5:46	4:14	2	89	9.671	106.7	5.3	2.9	3.1	115.1	10	952.1	112.9	0.116	9.73
5:52	4:20	1	89	9.671	106.2	5.3	2.9	3.1	114.6	10	952.1	112.4	0.100	11.24
5:58	4:26	2	89	9.671	106.7	5.3	2.9	2.1	115.1	10	952.1	112.9	0.100	11.29
5:59	4:27	1/3 of 1	89	9.671	35.4	1.8	2.9	1.0	38.2	10	952.1	37.5	0.017	2.21