STEAM CONSUMPTION TESTS ON VACUUM PANS

By G. N. ALLAN

A series of tests was run to obtain actual steam consumption figures for various pans boiling different massecuites.

All Umfolozi vacuum pans are connected by long condensate pipes to a central steam trap station where by-pass valves are fitted to enable sugar contaminated condensate to be rejected into a common manifold. This manifold is arranged to feed into a weir box which in its turn passes condensate either to waste or to a standby hotwell pump and thence to the boiler feed tanks.

A level recording instrument is connected by a thin wire to a float in a float chamber beside the weir box. A hook is installed behind the vee-notch with a decimal scale for measuring the height of water over the weir.

During the tests the height in inches measured by the hook was checked every two hours against the recording chart reading to establish a chart constant for calibration. An average of some forty readings settled at 1.56.

The leading dimensions of the weir box are 6 ft. x 2 ft. x 2 ft. and a 6 in. x 60° Vee notch made of $\frac{1}{16}$ths in. stainless steel was fitted. The attached sketch shows the arrangement of the tank and recorder.

A calibration graph was drawn and quantity plotted against both inch heights and recorder readings. The curve was taken from Lyle's Efficient Use of Steam and a temperature correction of -3 per cent was allowed for, as the water temperature was over 200°F. Pan floor steam pressure was 5 lbs. per sq. in.

"A" Massecuites

The three consecutive A cycles shown were boiled in a calandria pan of 1,455 sq. ft. H.S. and the quantities and types of footings and massecuites are indicated. The high initial condensation at the beginning of the first cycle remains unaccounted for despite checks on syrup brix and quantity of magma drawn in. Otherwise the cycles are similar and typical for A massecuites. Assuming a massecuite temperature of 150°F. and a steam temperature of 228°F. the Heat Transfer Rate for the beginning of the first cycle is 104 B.T.Us/sq. ft./hr./°F. dropping to 50 B.T.Us/sq. ft./hr./°F. for the final half hour. Hugot's values for A massecuites show 190 to 40.

On the long cycle from No. 2 Pan boiling A massecuite, the initial granulation period of $\frac{3}{4}$ hour gives a H.T.R. of 95 B.T.Us/sq. ft./hr./°F. (assuming a syrup inlet temperature of 130°F.). An average figure for the last five hours of this cycle is 64 B.T. Us/sq. ft./hr./°F.

"C" Massecuites

The contrast in Heat Transfer Rates between boiling high and low grade massecuite syrups and heavy massecuites is shown clearly by the steam consumption curves of two successive C cycles boiled by No. 7 Pan (1,650 sq. ft. H.S. calandria type). The former is a C footing boiled from syrup and A molasses and the latter is a C massecuite started from 350 cu. ft. of this same footing.

	H.T.R. 1st Hour	*H.T.R. Last Hour*
C footing	104	44.6
C Massecuite	63.4	11.2

There is another C cycle shown this time boiled in No. 8 Pan, a 2,032 sq. ft. H.S. coil pan. (The coils are now being replaced by a floating calandria). This also shows a very low H.T.R.

Refinery Massecuites

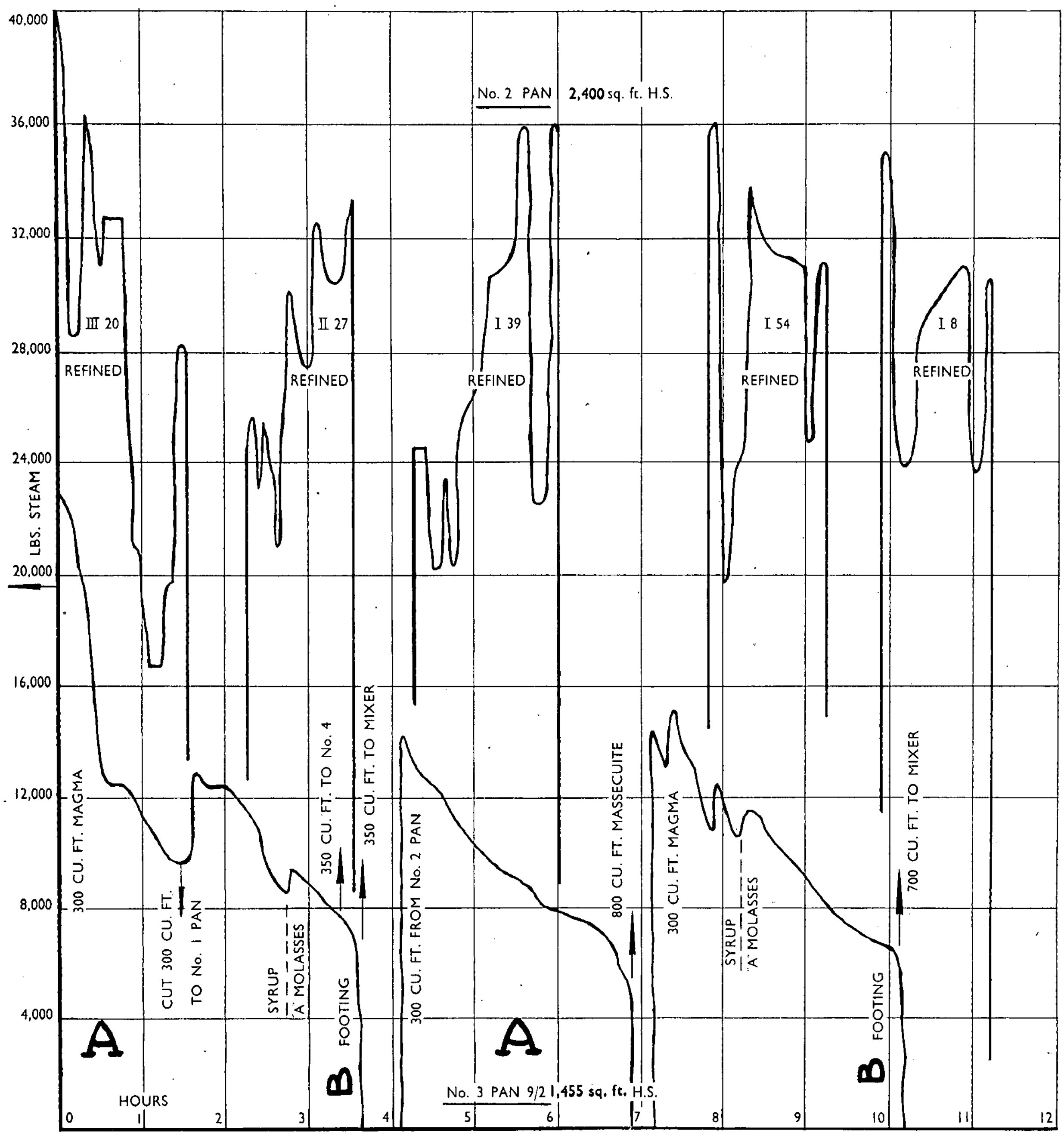
A series of 35 consecutive cycles on our No. 2 Refinery Pan (2,400 sq. ft. H.S. calandria pan) was run and the total steam used for each cycle was obtained. The hourly steam demands can be seen on the accompanying graph. An average hourly rate of 28,000 lbs./hr. would appear to be typical of the series, giving us a Heat Transfer Rate of 144 B.T.Us/sq. ft./hr./°F. Compare this with the H.T.R. during the initial granulation period on the Raw House No. 2 Pan boiling an A massecuite of 95 B.T.Us/sq. ft./hr./°F. Peaks of 36,000/40,000 lbs./hr. were not infrequent at the beginning and end of a cycle, and an average pan cycle would last $1\frac{1}{4}$ hours. This can be seen clearly on the curves showing five refinery boilings. The first is a third massecuite, the next a second and the last three are a grained first and two seeded firsts.

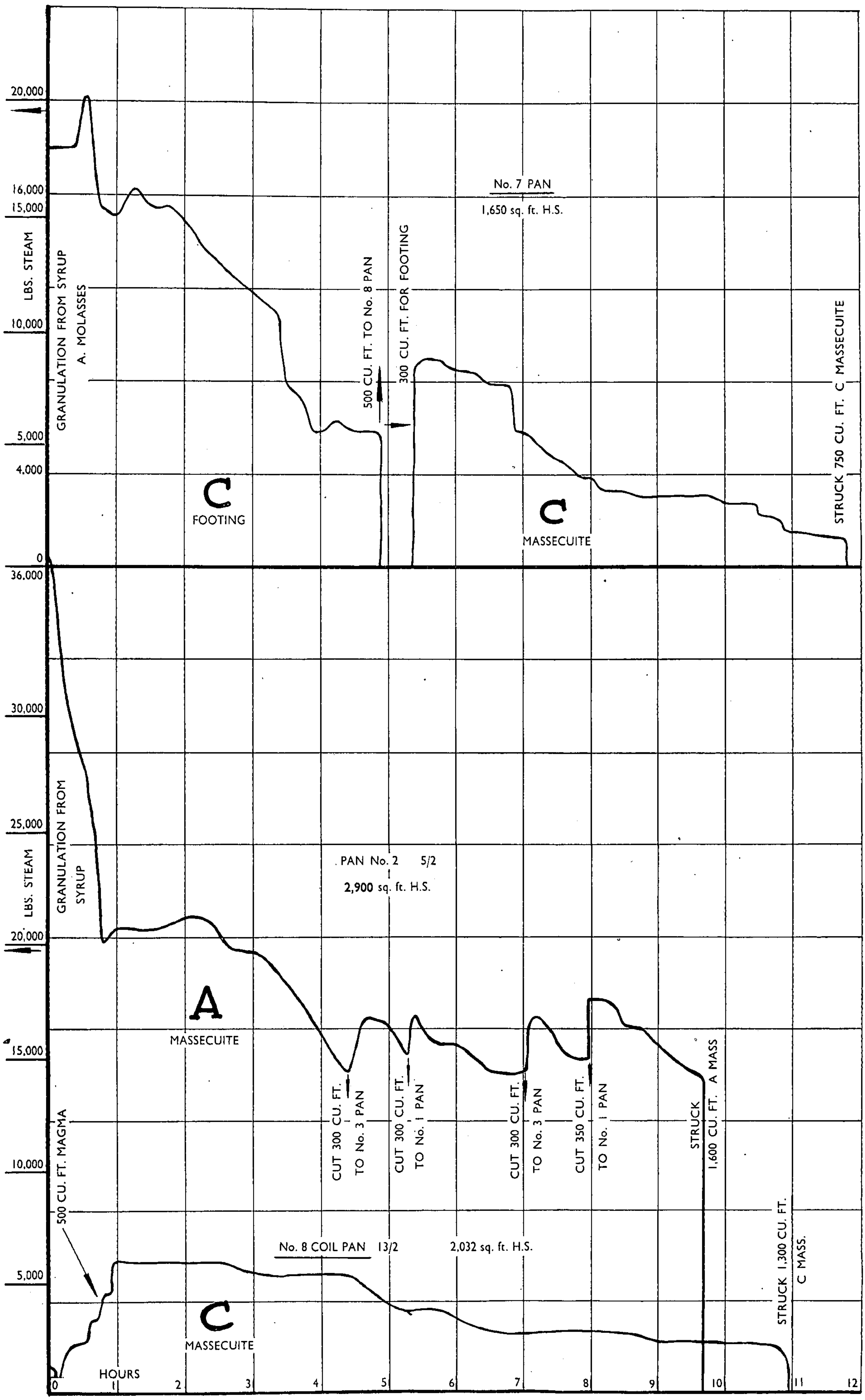
Heat Balances

Information was recorded by the process staff for these boilings, but on making out a trial balance, too many assumptions had to be made especially with regard to temperatures, dilution, water quantities and seed sugar volumes. Data on three seed cycles is given below, together with actual steam consumption figures:

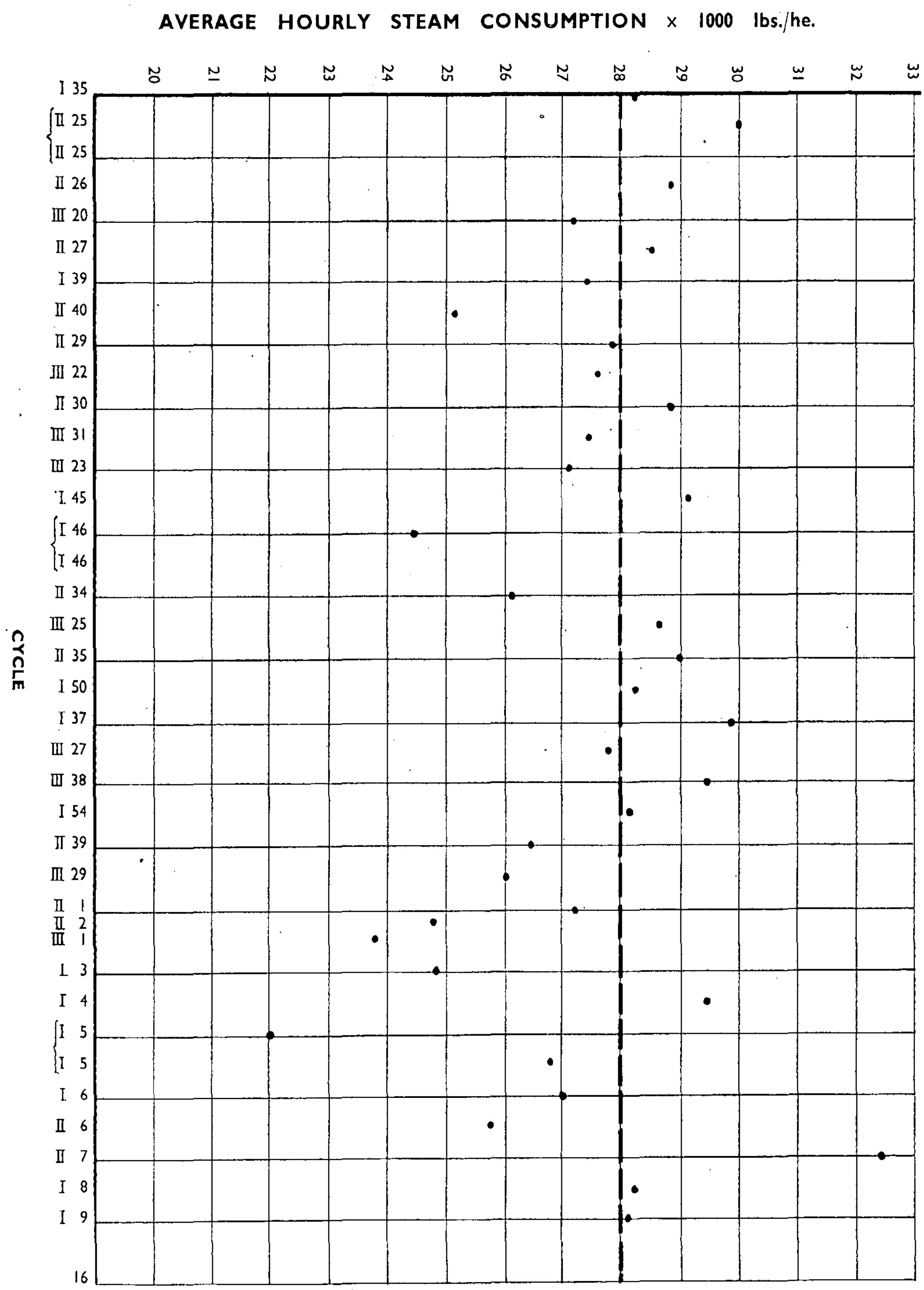
Cycle	*Strike Vol. cu. ft.*	*Massecuite Brix*	*Liquor Brix*	*Total Steam lbs.*
I 50	1,275	89.2	68.4	33,645
I 54	1,300	89.6	69	35,125
I 8	1,350	89.5	69.2	35,350

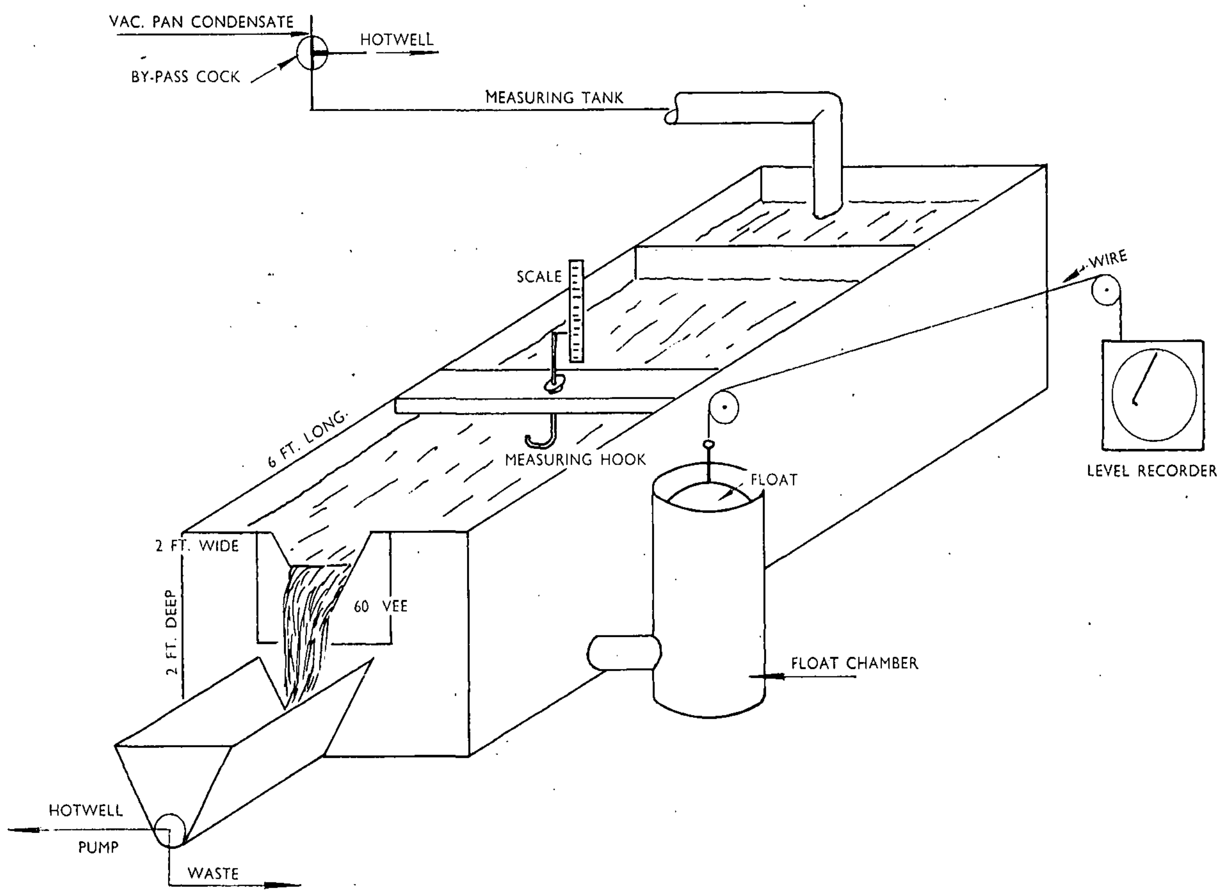
During the coming season it is hoped that these missing figures will be filled in and a complete picture obtained of some typical cycles.


No. 2 PAN 2,400 sq. ft. H.S.
No. 3 PAN 9/2 1,455 sq. ft. H.S.
LBS. STEAM
HOURS
40,000
36,000
32,000
28,000
24,000
20,000
16,000
12,000
8,000
4,000
0 1 2 3 4 5 6 7 8 9 10 11 12
III 20 REFINED
II 27 REFINED
I 39 REFINED
I 54 REFINED
I 8 REFINED
300 CU. FT. MAGMA
CUT 300 CU. FT. TO No. 1 PAN
SYRUP 'A MOLASSES
350 CU. FT. TO No. 4
350 CU. FT. TO MIXER
FOOTING
300 CU. FT. FROM No. 2 PAN
800 CU. FT. MASSECUITE
300 CU. FT. MAGMA
SYRUP 'A MOLASSES
FOOTING
700 CU. FT. TO MIXER
A
B
A
B



No. 7 PAN
1,650 sq. ft. H.S.
LBS. STEAM
20,000
16,000
15,000
10,000
5,000
4,000
0
GRANULATION FROM SYRUP
A. MOLASSES
500 CU. FT. TO No. 8 PAN
300 CU. FT. FOR FOOTING
STRUCK 750 CU. FT. C MASSECUITE
C
FOOTING
C
MASSECUITE
36,000
30,000
25,000
20,000
15,000
10,000
5,000
PAN No. 2 5/2
2,900 sq. ft. H.S.
GRANULATION FROM SYRUP
A
MASSECUITE
CUT 300 CU. FT. TO No. 3 PAN
CUT 300 CU. FT. TO No. 1 PAN
CUT 300 CU. FT. TO No. 3 PAN
CUT 350 CU. FT. TO No. 1 PAN
STRUCK 1,600 CU. FT. A MASS
500 CU. FT. MAGMA
No. 8 COIL PAN 13/2
2,032 sq. ft. H.S.
C
MASSECUITE
STRUCK 1,300 CU. FT. C MASS.
HOURS
0 1 2 3 4 5 6 7 8 9 10 11 12


AVERAGE HOURLY STEAM CONSUMPTION × 1000 lbs./he.
20
21
22
23
24
25
26
27
28
29
30
31
32
33
CYCLE
I 35
II 25
II 25
II 26
III 20
II 27
I 39
II 40
II 29
III 22
II 30
III 31
III 23
I 45
I 46
I 46
II 34
III 25
II 35
I 50
I 37
III 27
III 38
I 54
II 39
III 29
II 1
II 2
III 1
I 3
I 4
I 5
I 5
I 6
II 6
II 7
I 8
I 9
16



Dr. Douwes Dekker (in the Chair) said the paper gave practical data of interest to all who were connected with production of steam in the factories.

Mr. D. Hulett suggested that shortage of steam was more likely to be due to the boilers rather than to consumption on the pan floor. When the boilers were automatically controlled and there was a plentitude of fuel they could quickly absorb all pan fluctuations. There was about a half-hour's reserve in the accumulators so that if the boilers did not respond, there was probably something wrong with the boilers or their operation.

Mr. Allan said it had been found that with boilers operating sufficiently well and without a drop in high pressure steam the conditions mentioned did arise.

Mr. Grant said that many years ago tests done by weighing the condensed steam from various pans and various cycles revealed conditions of heavy demand similar to those mentioned by Mr. Allan. He could not agree that the boiler plant could be at fault, as if there were ample boiler capacity sudden demands should be met by the accumulator unless they were excessive.

Dr. Douwes Dekker stated that the operational schedule of the vacuum pans should be such, that two or three pans should never start simultaneously.

Mr. Walsh thought the conditions were made worse by the fact that the refining pans operated on a much shorter cycle than did the rawhouse pans, and more steam was demanded in the initial stages of boiling.

Mr. Thumann said that with ten pans in use it was impossible to arrange that more than one were not started together. One could not stop a pan for a hour or so if one wanted to get the maximum through-put in the boiling house.

Mr. Davies said a problem at Felixton was that a carbon deposit formed on the outside of the vacuum pan tubes which could not be removed by propriety chemicals or paraffin followed by caustic soda. Although it appeared that such treatment did remove some carbon a tube removed from the centre portion of the calandria still had this carbon coating.

Mr. Perk hoped that Mr. Allan would continue his tests. With regard to Mr. Davies's problem, the only solution was to draw the tubes, fit them in a lathe and remove all dirt by holding a brick to the rotating tubes.

Mr. Bentley considered that this deposit must come either from the chemicals used in the boiler-feed water or from oil in the exhaust steam. The oil could be removed more easily than the tubes could be taken out and cleaned.

Mr. Davies said that a vapour cell at Felixton, which was commissioned two years ago, was supplied with steam from a turbine. He had expected that the tubes in this pan would collect no deposit, but actually they were in worse condition than those in the pans which drew their steam from reciprocating engines.