

SOME EXPERIENCES WITH CONDUCTIVITY CONTROL OF PAN BOILING

By A. E. RABE.

As far back as 1932 some of the original articles were written by the pioneers on the subject of conductivity control of pan boiling, and it is therefore surprising that we have taken such a long time in Natal to adopt this simple and accurate instrument to control our boiling operations.

At Illovo the losses incurred in the refinery, through faulty boiling resulting in excessive conglomeration and false grain, made it imperative that some type of control be kept to ensure a higher standard of uniformity. A "Cuitometer" with re-

order was therefore installed. The instrument was an old one, having no device which compensates automatically for fluctuating voltage, such as is fitted in the latest models. This presented the first problem as the voltage from the 110-volt light mains varied considerably during occasional periods of low steam and heavy loads. This was overcome by using a voltmeter and rheostat with the "Cuitometer," which had to be adjusted to a predetermined voltage every time a reading was made—a laborious business which fortunately is no longer necessary.

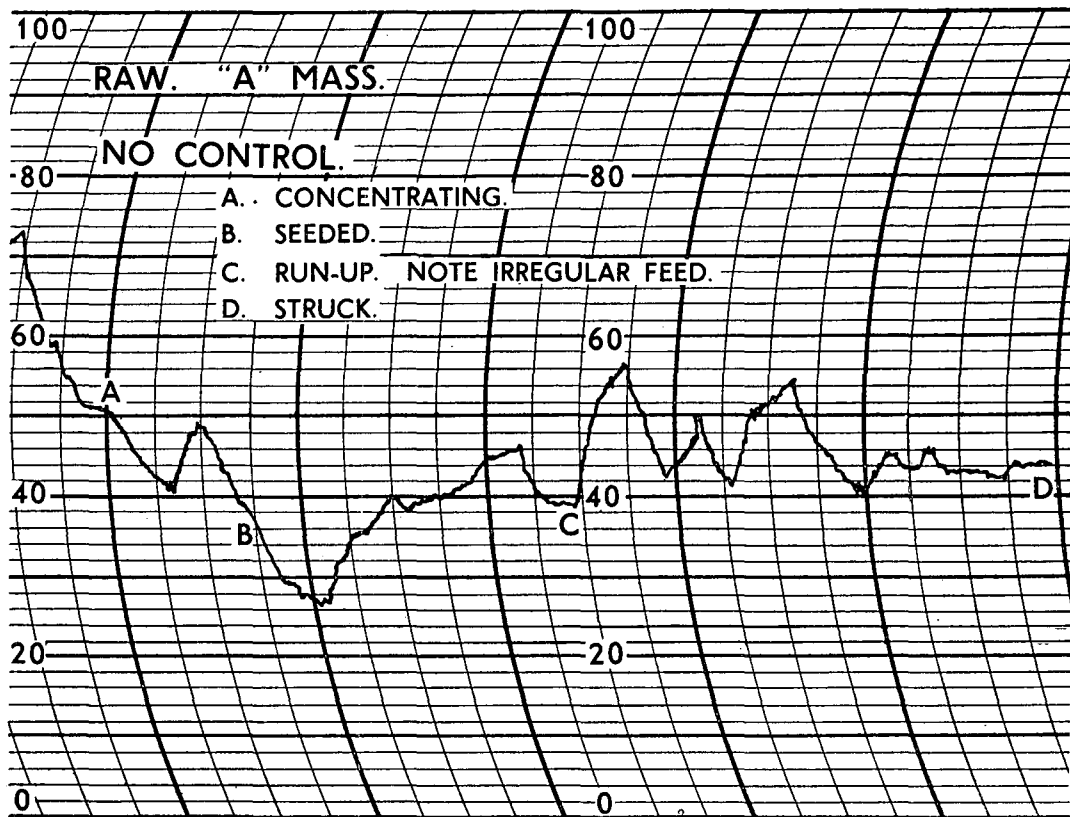


Fig. 1

The instrument is fitted with a "voltage regulator," which is simply a transformer giving eight tapings varying from 5 volts for position 1 to 80 volts for position 8. With low grade products containing a large amount of ash the lower voltages are used. With refined products, however, conductivity being very low, it was necessary to use the full available voltage in position 8, and in spite of this, the reading on the milliammeter was so low at the graining point that accuracy suffered when needed most. This was rectified by using electrodes of 2-inch length instead

of the normal 1-inch type supplied with the instrument. Graining point readings now came nearer the centre of the 0-100 m.-amp. scale, giving greater sensitivity and accuracy.

Inconsistencies of graining point reading still occurred and were traced to scaling of the electrodes, which necessitated cleaning them with fine emery paper once every eight hours. It was now possible to determine accurately the saturation point and the point where false grain would occur. Saturation point was fixed firstly by observation of the liquor,

and when nearing saturation, a few grains of sugar were placed in the proof stick and left in the liquor in the pan for about thirty seconds, taken out, and examined under a microscope for signs of solution, at the same time noting the reading on the milliammeter. This procedure was continued while the liquor was concentrating for every 2 m.-amps. indicated, until the point was reached where the sugar no longer dissolved. A measured quantity of powdered sugar was drawn into the pan, and the concentration allowed to continue for about "8 m.-amps" and held there until the grain had grown to a size which could be felt between the fingers.

The point where false grain occurs was easily established thereafter by concentrating until it actually came in. With this danger point known, the pan was run up, keeping about "6-8 m.-amps" above it, ensuring a safe but concentrated run-up. In "tightening" the strike, before discharging, this point was also used as the limit of concentration. Repeated boilings were now made using the readings

obtained, with excellent results. The quality of the sugar improved immediately. The number of remelts due to large conglomerates was reduced considerably, and less dust from the driers was noticeable. Although there still was a tendency to form conglomerates, this was only slight by comparison with the old method, and the cause has been traced to very poor circulation of the pans—a defect which is shortly to be rectified.

Pan yields were rather surprising. In the year before the "Cuitometer" was used, i.e. 1947, 1,375 strikes yielded an average of 13.097 tons of sugar, which is approximately 36.18 lbs. per cubic foot.

In 1948, 1,390 strikes yielded an average of 14.608 tons of sugar (40.35 lbs. per cubic foot).

In 1949, 1,583 strikes yielded an average of 15.203 tons of sugar (42.00 lbs. per cubic foot).

In 1950, 1,510 strikes yielded an average of 14.976 tons of sugar (41.37 lbs. per cubic foot).

These figures speak for themselves.

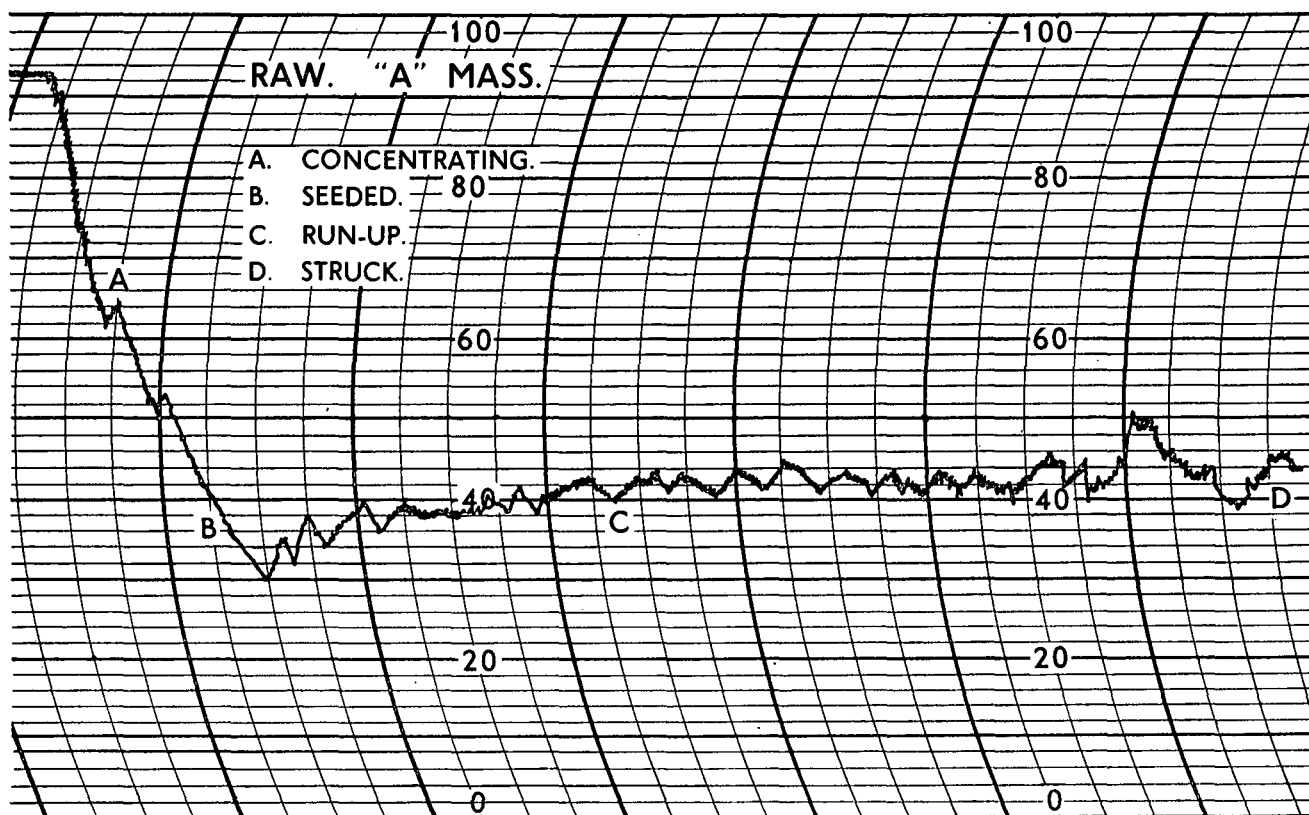


Fig. 2

A "Cuitometer" was then fitted to the raw sugar pans using the same technique as for refined pans, and although we have no record of yields the quality of the raw sugar has improved greatly. The marked improvement in the regularity of the boiling which is obtained with the aid of the instrument is demonstrated in Figs. 1 and 2. Fig. 1 shows the variation which can occur during the boiling of a raw sugar

massecuite when the usual method, without conductivity control, is followed. By comparison, Fig. 2 shows the great improvement observed when the pan-boiler is assisted by the instrument.

A typical chart of the boiling of a first refined massecuite is shown in Fig. 3, where the regularity of operation throughout the boiling operations, obtained by using the "Cuitometer," is again observed.

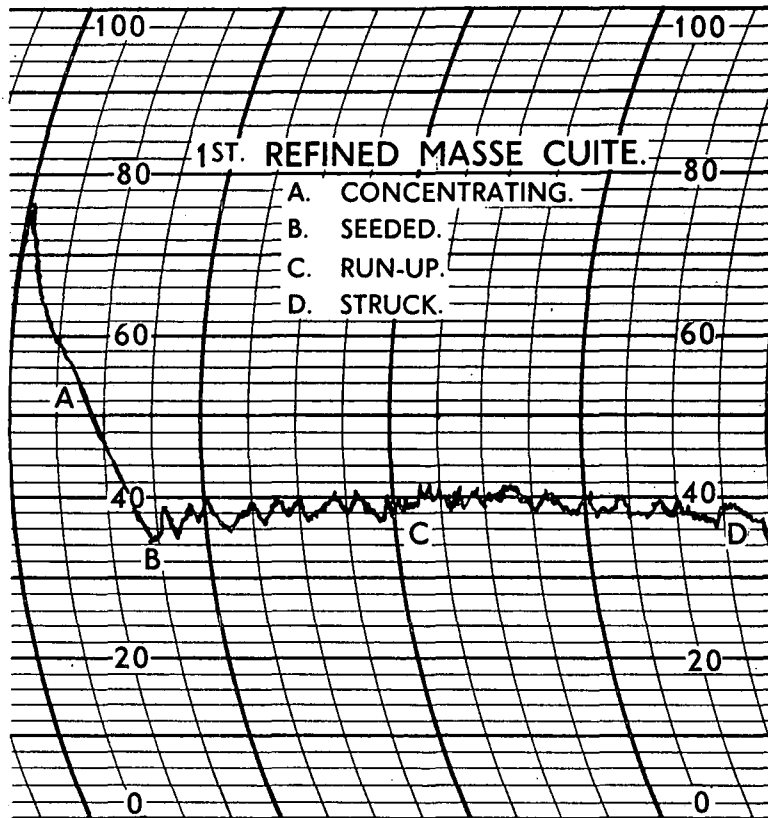


Fig. 3

Pan boilers who in the beginning were prejudiced, soon recognised the value of the instrument, which enabled one who had no previous experience, to boil a pan of sugar as easily as they could. They now protest strongly whenever the instrument is out of commission through power failure, and they have to revert to the old method.

Summary.

A brief account is given of the reasons for installation of "Cuitometers," the difficulties encountered through fluctuating voltage, electrode sizes and scaling, and also circulation. The method of determining the saturation and "false grain" points, is laid out. Comparative figures are given of yields prior to, and after, installation of "Cuitometers."

The President said that, speaking as a layman, he had always been under the impression that pan boiling was an art for which there would never be a substitute and that pan boilers were bred, not made, but that was apparently not the case.

Mr. Bechard said he was astonished to see that there were still people not using cuitometers. He had used one twelve years ago and pan boilers became interested in the instrument. When the electrodes got burned the pan boilers soon cleaned them because they preferred to use the instrument.

Mr. Bouch congratulated Mr. Rabe on his excellent paper and agreed with all that he had said. Some years ago his company had installed a cuitometer on the low grade pan and at first the pan boilers thought that it was useless. Nevertheless they soon got used to it and to-day if a fault developed an SOS was sent for someone to repair it. One had since been installed on the large white sugar pan and it was hoped eventually to instal them on all pans. He expressed surprise that other mills had not gone in for cuitometers as they were extremely simple and he felt sure that pan boilers would find them of great assistance in eliminating the formation of false grain.

Mr. Rabe said that as far as pan boiler prejudice was concerned, this had been overcome, which was an achievement as pan boiling had always been considered a secret process and interference was resented. Even if the cuitometer were not used for graining its value for "running up" was considerable. This was shown in the charts. In Fig. 1 the variations of concentration could be noticed, caused by the bad practice of giving the strike a large "drink" and then allowing it to concentrate. The new method, as in Figs. 2 and 3, showed that the pan had been run up at the same concentration throughout.

Mr. Rault said that such control instruments gave a workman more confidence in the reproducibility of his technique, but should not be expected to show immediate gains in sugar recovery as other important factors from year to year had a great bearing on factory performance. Mr. Rabe must be congratulated in that he had been able to interpret the readings of his instrument in terms of pan boiling language without using too much of the jargon of "supersaturation terminologies" and at the same

time succeeded in raising the yield of each strike by approximately two tons of sugar from a 700 cubic foot pan.

At Natal Estates factory they had found the cuitometer very useful on the last massecuites but not so much for the refined sugar pans, where the yield per cubic foot had been raised from a level of 40/42 lbs. to 44/47 lbs. by means other than control instruments. It had been his privilege to visit one of the most modern U.S.A. refineries fitted with supersaturation control instruments, and also a large number of beet factories and refineries, some of which did not have these instruments. Nevertheless, none of them equalled the exceptional yields of crystals regularly obtained at the Plaistow Wharf Refinery of Tate & Lyle—other factors than control instruments were responsible for the latter results. He believed in the help given by the conductivity and other instruments, whose records had to be interpreted but were not meant to do away with the skill of the sugar boiler and have him replaced by a robot.

Mr. Rabe said the idea was not, as far as this paper was concerned, to give the impression that the cuitometer in the hands of a complete novice would give perfect results. An operator with a fairly good theoretical knowledge was certainly required to boil sugar with the instrument. He contended that anyone with theoretical knowledge of pan boiling only, using a cuitometer, would learn the operation much sooner than would an apprentice having to learn by practice only.

In Figure 2 the saturation point was fixed at approximately 52 by the cuitometer and the point where the false grain came in was 32-34. Slight variation of these points occurred but they were close enough.

Dr. Douwes Dekker congratulated Mr. Rabe on his excellent paper. The work done by Mr. Rabe proved that, parallel to the work done by the S.M.R.I., important contributions to the knowledge of sugar technology could be rendered by mill staffs. He was particularly interested in Mr. Rabe's statement that the pan boilers recognised the value of the instrument. It was well known that some resistance from

that side has always to be overcome and it was gratifying to find that in Natal, as in other countries, surmounting this difficulty had proved to be possible and propitious. Of course, some knowledge and intelligence was required to read the indications of the instrument and the graphs, but by now the boiling process should have risen from the stage wherein it was in the hands of men guided by experience without understanding. Extensive experience with the cuitometer was required before it was possible to proceed to the next step—automatic control of the boiling process based on conductivity measurement. In Australia this application was now being studied.

Mr. Walsh said that the late Mr. George Booth had proved conclusively that pan boiling efficiency was improved tremendously by the use of the instrument. Pan boilers could be trained to carry out definite instructions and the recording charts could readily be checked. Mr. Rabe was to be commended on the original work he had carried out on increasing the length of the electrodes. Another important fact was the comparison between the work of individual pans and data of this type would assist manufacturers to improve designs. Mr. Rabe had shown that the circulation of one of the pans required improvement and this was valuable information.