

# USE OF A MICROCOMPUTER AT S.A. SUGAR TERMINALS LABORATORY

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## Abstract

Much time spent in checking the analytical and other calculations in a laboratory may be saved by using a programmable calculator. At a slightly higher cost, a microcomputer will not only give a more efficient service, but also permits the computerisation of many activities within a framework of a small to medium industrial organisation.

The results of any laboratory analytical procedures invariably require a mathematical interpretation to produce a usable result in terms of percentages, concentrations, etc. Thus the calculation step is an important one and it is sometimes unfortunate that an involved and time consuming analytical procedure which has been accurately carried out, is made worthless by a calculation error.

A possibility of a calculation error exists if the operator carries out his calculations without any aids, and its probability increases considerably if many repetitive calculations are carried out, as for instance with routine analytical control, where the number of samples examined is fairly large. It thus becomes incumbent on the operator to recheck his calculations with a consequent loss of time. The calculation time and also the arithmetical reliability may be improved by using mechanical or electrical calculators and a further improvement will be obtained by using calculators which produce a printed record of various procedures. None the less, there are frequently a number of errors due to mistakes in calculation entries and incorrect calculator operation.

With the use of a programmable calculator, a large number of these difficulties fall away as the calculations are programmed in a set sequence and are mechanically repeated for as many occasions as required. The calculations may now be carried out without any mistakes and the only possible source of error is an incorrect entry into the machine. The latter is readily detected by the operator on the print-out of entries and results.

When the S.A. Sugar Terminals Laboratory came into operation, it became necessary to purchase a calculator and with the above reasons in mind, a programmable calculator was selected.

Initially, the calculation programs were prepared for the calculation of analytical determination results. As an example, a moisture determination in a sample of VHP (Very High Pol) sugar may be considered; the machine is instructed to accept entries of weights of (a) empty container, (b) container with sugar and (c) container with sugar after a period of oven drying. The machine will then calculate the percentage moisture content of VHP sugar sample examined and print it out under the three entries, rounding off to the required decimal place. This operation will be repeated (without further programming) for as many samples as required. The various arithmetical procedures such as subtraction, multiplication and division will be carried out without an error and in a correct sequence and the operator will only have to check that the input data was correctly entered.

More involved calculations such as the determination of percentage fines, specific grain size of VHP sugar and others were being readily handled and processed.

The machine was handled by the laboratory personnel who include a number of semi-skilled staff and no operator difficulties were experienced. Each analyst calculated his own results, using prepared programs.

The programming may be done by various specialist firms or after some training, within the firm. In-house programming has been implemented at S.A. Sugar Terminals from the time of purchase of calculator.

The programming technique requires that the mathematical manipulation is divided into a number of simple steps. It is convenient to illustrate this with a simple calculation to determine the percentage moisture content of a sugar sample.

- (i) Programming sequence is initiated.
- (ii) Accept weight of empty basin.
- (iii) Transfer the above to a selected register, say 1.
- (iv) Accept weight of basin plus sugar.
- (v) Transfer to selected register, say 2.
- (vi) Accept weight of basin plus sugar after drying.
- (vii) Transfer to selected register, say 3.
- (viii) Take 2 and from it subtract 1 (weight of sugar).
- (ix) Transfer result to a selected register, say 4.
- (x) Take 2 and from it subtract 3 (loss in weight).
- (xi) Transfer to selected register, say 5.
- (xii) Divide 5 by 4.
- (xiii) Multiply the result by 100.
- (xiv) Print the result.
- (xv) Return to the beginning of programme.

These series of instructions are recorded on a plastic card impregnated with ferric oxide and thus provide a recallable calculation facility. It has been found by S.A. Sugar Terminals laboratory staff that it is very advantageous to have in-house programmers. The cost of training is repaid many times over and great flexibility and efficiency of calculator use is obtained.

From the routine analytical calculations, the use of the calculator was soon extended to other computations such as the conversion of VHP sugar received by S.A. Sugar Terminals from various mills into:— tons of sucrose, moisture and averaged temperature. Weighted-average analytical results could now be easily calculated and this combined with the weight-components could now be used for the Material and Weight Balance calculations round the Terminal.

Amongst further uses of calculator described, it may be mentioned that various calculations are necessary at the completion of shiploading of export sugar. These have to be completed before the ship leaves the Terminal Wharf and at some times it is necessary to expedite the procedure to enable the ship to sail before the low tide.

No problems have been experienced in this respect since the calculator has been brought into use.

It soon became apparent that the programmable calculator became an integral part of the laboratory work and was routinely used for about 4-5 hours, per working day.

A few disadvantages were noted and amongst these were:—

- (1) Limited input of some 120 instructions which restricted the full utilisation.
- (2) Inability to encode numerical data on magnetic cards.
- (3) Relatively slow operation.

After some six years of fairly hard use, the programmable calculator began to suffer frequent breakdowns and could not be easily repaired, due to obsolescence and lack of spare parts.

It then became necessary to purchase a new machine, but at the same time it was known that S.A. Sugar Association was considering the use of a large in-house computer which would be available to other users in the sugar industry. Several options became available to S.A. Sugar Terminals and these were considered in terms of the necessary financial outlay:—

- (1) *Non-intelligent Slave Terminal to a very large commercial computer*

This would handle any routine and non routine technical calculations.

It could also store a very large amount of information and handle other envisaged calculations such as sugar stocks, pay, accounts, etc.

The disadvantages of this arrangement were:—

- (a) Non availability outside the normal working hours.
  - (b) Inconvenience of delays due to connection via P.O. telephone line.
  - (c) High cost.
- (2) *Non-intelligent Slave Terminal to a somewhat smaller computer at S.A. Sugar Association.*

Here the connection would be via a direct telephone line, the costs would be lower, but this service would be still unavailable outside the normal working hours. The latter disadvantage was a major stumbling block as the S.A. Sugar Terminals had to have these facilities at all times.

- (3) *Intelligent Terminal connected to S.A. Sugar Association Computer.*

This would provide instantaneous computation facilities coupled with data storage facilities of a large computer.

- (4) *In-House Microcomputer at S.A. Sugar Terminals*

This would of necessity have lesser data storage facilities but could be adapted for all the desired purposes, using computer peripheral devices such as electronic printer, data storage banks, etc.

The consideration of the 4 options in terms of practicability and costs, revealed that the acquisition of a microcomputer would be the best choice.

In accordance with this decision, the available machines were investigated and a desk-top microcomputer was selected. This is available in two options 2 000 and 4 000 input character capacity. Initially the smaller machine was selected. The computer could now be used to encode information on magnetic cards, and also to prepare encoded calculation instructions (programs) which would use the data stored on magnetic cards.

The machine has a further advantage in that it forms the centrepiece of a computer system which can be built up by connecting various peripheral devices into a highly sophisticated computing device.

The microcomputer was put into service directly after purchase and relatively little difficulty was experienced in adapting the programs previously used in the programmable calculator. It soon became apparent that because of its much greater capacity and operating speed, the use of the new machine could be extended for other purposes.

S.A. Sugar Terminals receives VHP sugar from up to 17 mills and these are despatched by both rail and road consignments. On arrival, these consignments are weighed and offloaded into the three storage silos where they are stored until shipped overseas.

The sugar-stock bookkeeping had previously been done manually and since this item is one of the laboratory's responsibilities, it was decided to use the microcomputer to mechanise the procedure. As the computer could now be used to encode numerical data on magnetic cards, it was possible to allot a magnetic card to each mill where the daily deliveries could be added up and totalled into season's production.

By means of a subsequent programmed calculation, the computer was requested to read the mill cards, total up the daily weights of VHP sugar received from all the consigning mills, update all season's receipts and subsequently to allocate the sugar into storage silos, taking into consideration any sugar shipped overseas.

At this stage a minor difficulty was encountered whereby the cost of these procedures was likely to be considerable since a number of magnetic cards (at R3,00 each) would have to be used for this exercise and any others of similar nature.

Since the writing and reading process used by the computer are similar to that found in tape recording, experiments were commenced to try and produce home-made magnetic cards. After a number of trials, satisfactory cards were made by affixing lengths of video-recording tape to cardboard cards cut to the required size.

It was further found that the computer could be programmed to clear and scrutinise the newly made cards, so that any faulty cards could be rejected. It was found that most of the reject cards had dirty tape surfaces and that after cleaning, the majority of reject cards could be used.

When exposed to daily processing, the substitute magnetic cards were found to be reliable and hard wearing.

The computerised sugar stock keeping has been found to be less time-consuming than the previously used procedure and has until the present time worked satisfactorily.

It had previously been planned to purchase an electronic alphacharacter printer as a computer peripheral, so that the stock sheets could be completely prepared by the computer. It was found however that the computer numerical tape print out could be attached to a previously prepared stencil and a fairly presentable document could be produced at far lower cost.

With the computerisation of sugar stockkeeping, it was decided to investigate the possibility of similar approach to the payment of wages at S.A. Sugar Terminals. By now the laboratory had sufficient programming experience and magnetic cards to be in position to tackle this project.

The S.A. Sugar Terminals staff consists of approximately 180 Africans, 40 Indians and Coloureds and 30 Europeans. The weekly paid employees work a 46-hour week and three different rates of overtime are in operation. The computerisation of wage payment involved encoding a magnetic card for

each employee with his daily and hourly rate of normal and overtime pay and other items such as the Pension and UIF deductions.

The computer calculation was programmed to commence with the entry of number of days attendance and hours of overtime worked. The Man Card was then read by the machine and pay calculated. When the Taxable Pay was arrived at, the machine stopped and PAYE deduction was obtained from tables and entered manually. Pay calculation ended with a manual entry of extra deductions such as Medical Aid, Garnishee Orders, etc.

At this stage the computer updated each employee's card with itemised and totalled records of all the above calculations and when each group of employees was completed a sub total of updated pay details was printed out. At the end of pay computation the computer was instructed to print the total pay reconciliation and cash breakdown for pay preparation.

It was found that the computer paper tape may be obtained in 2 ply sensitised paper form and this allows for the printed calculation for the individuals to be cut from the main tape, stamped with the necessary details, labelled with the employee's name and used as a pay sheet, the bottom copy being kept for reference purposes.

With the inclusion of computerisation of wage payment the working time of the machine increased to the point where the computer operation had to be planned and rationalised and

its general use limited. It thus became necessary to appoint a computer operator who would operate the machine in the most effective way and utilise the available time to the best advantage. This too has given good results with the individual analysts handing in the data for computing and obtaining their calculated results so that a mere check that correct entries were made, was necessary.

The present working time of the microcomputer is of the order of 3-6 hours per day and further extension of computer usage is planned to include stores control, account payment control and vote allocation control.

#### Summary and conclusion

From a very modest beginning it has been possible to gradually increase the use of the programmable calculator and later a desk-top microcomputer (at a very slight cost increase) not only for the laboratory purposes but also within the rest of S.A. Sugar Terminals framework. It may be that other users in the Sugar Industry and particularly the sugar mills would find it similarly useful for such procedures as stocks, production checks and efficiency calculations, etc.

#### REFERENCES

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