ABSTRACT OF PAPERS

TWENTY-THIRD ANNUAL SUMMARY OF CHEMICAL LABORATORY REPORTS.

South African Sugar Factories, Season 1947-48.

By H. H. DODDS and J. L. DU TOIT.

Unlike the preceding three years the rainfall for 1947, 44.83 inches, was above the average. The mean annual temperature 68.9 was slightly above the normal but a fairly severe frost was experienced in July.

The 1947-48 sugarcane crop totalled 4,543,255 short tons and 512,005 tons sugar, averaging 98.83 pol, were made. The crop was still adversely affected by the 1946 drought and the prospects for the 1948-49 crop are much better. The sucrose per cent. 13.32, was rather low but the purity of mixed juice 86.24 high and the reducing sugar ratio unusually low. The lowest reducing sugar ratio and the highest purities were recorded during October whereas the peak in sucrose content was reached in September.

The older varieties, Uba (1.53 per cent.), Co.290 (1.54 per cent.), and Co.281 (58.69 per cent.) continued to form a diminishing proportion of the total crop harvested, Co.301 (33.11 per cent.) and Co.331 (1.66 per cent.) having increased and the P.O.J. varieties (3.46 per cent.) remaining about the same as in recent years.

Both extraction, 93.44 per cent., and overall recovery, 83.73 per cent., are records for this country and the boiling house recovery, 89.61 per cent. has only been bettered once when the purity of mixed juice was somewhat higher. The reduced extraction, boiling house recovery and overall recovery are all new records for Natal. The purity of final molasses, 41.10, is the lowest ever recorded here. The ratio of cane to sugar, 8.87, is somewhat higher than in recent years.

Of the 18 factories reporting, the highest crushing rate was 151.8 tons per hour to make 76,853 tons of sugar. Another factory crushed 141.8 tons per hour and there were three factories with a rate less than 30 tons per hour.

THE DEVELOPMENT OF PROCESS STEAM AND POWER.

By J. LOWNIE.

A full appreciation of the necessity for the economical use of fuel and efficient control of the heat evolved is not generally evident in South Africa. The sugar industry is one of the few exceptions where efficient control has been introduced.

Coal and oil are not much used in the sugar industry, as bagasse supplies the fuel requirements of the factories. Bagasse, however, may be used in future for the manufacture of valuable by-products, and coal or other heating agencies will then become necessary.

It may be economical to link power production at the factories with a general network utilizing surplus factory power for an electrified railway scheme. Messrs. Huletts' S.A. Refinery has been successfully linked up with a public electrical system for twenty-two years.

Fundamental Conceptions of Heat Control.

The utilization of steam for process work demands careful control, and heat and material balances should be prepared and analysed regularly. The necessary factors are surveyed, together with the fundamental laws involved.

The relationship between latent heat, sensible heat and total heat, with increasing pressure, are illustrated diagrammatically. These curves demonstrate that the production of high-pressure steam requires little more heat than does the generation of low-pressure steam, and also the advantages of low-pressure steam for process work as compared with the advantages of high pressures for power production.

It should be possible for the sugar industry to use pressures up to 400 lbs. per square inch without detracting from the safety of the plant, ease of operation or of maintenance.

Utilization of Heat.

The greatest opportunity for economy lies in the supplying of the power required electrically, and combining the generation of electricity with the use for process work of the heat in the exhaust steam from a back-pressure turbine. A comparison is made with a central power station using a condensing system. An overall thermal efficiency of 68 per cent. can be obtained by thermo-electric combinations in factories, against the 25 per cent. which represents best power station practice in South Africa.

Many heat and energy circuits can be evolved for factories, and diagrams are given to show steam circuits with and without a back-pressure turbine.

The Gas Turbine.

Rapid strides have been made with the development of the gas turbine. This has proved a useful complement to the steam turbine and the power output of a back-pressure steam plant can be practically doubled by the incorporation of a gas turbine in the system.

Diagrams are shown illustrating the construction of the gas turbine and of a typical closed-cycle application of this machine in a system using a back-pressure steam turbine.

ELECTRO-COLLOIDAL BOILER WATER TREATMENT.

By MURDOCH HILL.

Considerable interest has been aroused by the appearance on the market of electrical contrivances to eliminate the depositing of scale on boiler heating surfaces.

To the writers' knowledge there are two systems, one being arranged so that an electric charge from a one-and-a-half volt cell is applied to the water outside the boiler, while in the other case the unit is installed inside the boiler where it generates its own electrical current which acts on the water in the boiler.

Apparatus of the first type was installed at Renishaw Factory during September last year. The boiler had then been steaming for three months so that a fair amount of scale had already accumulated. After four weeks there appeared to be less scale and more sludge being formed. At the end of the season, although there was still scale in evidence, it was less than in previous years.

The other system is to be installed in locomotive boilers at Renishaw and elsewhere, and it should therefore, be possible to obtain definite evidence of the value of such installations before the next Congress.

The cost of electrical treatment is very much less than external chemical treatment and is worth further trial.

REPORT OF COMMITTEE ON STANDARDIZATION OF CHEMICAL CONTROL.

New Schmitz tables for both Ventzke and the International Sugar Scale have been prepared and taken into use.

The proposed revised methods of sampling factory products such as cane, bagasse, first expressed juice, mixed juice, last expressed juice, sulphited mixed juice, clarified and filtered juice, filter cake, syrup, massecuite, molasses and sugar are given in detail.

From preliminary experiments the sampling of trash and tops from consignments of cane seems reasonably accurate, but rather time and labour consuming.

Tests carried out indicate the extent to which layers of juice differing in brix and sucrose exist in mixed juice scale tanks.

Last expressed juice was found to be about 3 degrees higher in purity than last mill juice.

There can be big differences in the sucrose per cent. filter cake in different parts of a rotary filter and examples of such variations are given. Samples of Oliver Campbell filter cake kept their pols for a surprisingly long time, but once deterioration became noticeable the fall in pol was rapid.

Routine sucrose tests on mixed juices and molasses showed no real differences at the time between the Jackson and Gillis No. 4 method of sucrose analysis and the invertase method (inversion at 55 to 60°C.). Commercial samples of invertase concentrates kept well.

Further analytical data on molasses samples are also given.

Committee for Standardisation of Chemical Control.

J. L. DU TOIT (*Convener*):
W. BUHANAN.
G. C. DYMOND.
W. G. GALBRAITH.
J. D. MILLAR.
G. S. MOBERLY.
J. RAULT.

ION EXCHANGE.

Report by Sub-Committee on Experiments Carried Out at Darnall with a Laboratory Ion Exchange Plant.

A brief outline of some theoretical aspects of the ion exchange process is given.

The laboratory ion exchange plant used was obtained from the Dorr Company and was type L-4, D-1 unit, consisting of a single pair of cells with solu-bridge and pressure indicator.

Cane juice used in the process was either clarified by the sulphitation or carbonatation factory processes in use or was clarified in the laboratory with lime, or lime, sulphur dioxide and phosphoric acid; or with either sulphuric acid or sulphur dioxide only.

Diluted molasses were also put through the ion exchange process. Good clarification gave the best results. Thus juice clarified by the carbonation process gave a high throughput, a high non-sugar removal, 83 per cent., and yielded a brilliant product. In general, about 60 to 70 per cent. non-sugars were eliminated from the original juice. The removal of ash constituents was about 90 to 95 per cent. and the juice varied from colourless and clear to yellow and cloudy. A large proportion of colloidal silica in the juice passed through the exchangers and was partly responsible for the milky appearance of most of the treated juices. Analyses of some colloidal material are given. An increase of about 20 degrees purity was observed in the treatment of diluted molasses with a non-sugar removal of 60 to 70 per cent., but the throughput was small.

Considering that a single pair of exchangers was used, the inversion losses when treating juices were high and often amounted to more than 1 per cent. of the sucrose present. No facilities, however, existed for cooling the juices and runs were done at temperatures ranging from 20 to 30°C. Where molasses were treated, however, there was apparently no increase in reducing sugars.

Regeneration of the cation resins was always done by sulphuric acid and sodium chloride, but the anion resin was regenerated with either ammonium hydroxide, sodium hydroxide or sodium carbonate. The last named regenerant was not entirely satisfactory and imperfect regeneration was suspected when using it.

The amounts of regenerants required per unit of non-sugar elimination were calculated. For a one-stage regeneration about 0.6 lbs. 25 per cent. ammonia and 1 lb. 98 per cent. sulphuric acid are necessary to eliminate 1 lb. non-sugars. Analyses of the effluents after regeneration are given and the possibility of recovering ammonium sulphate, where sulphuric acid and ammonia are used as regenerants, is discussed.

The report was prepared by J. L. du Toit for the ion exchange committee consisting of :—

G. Booth (*Convener*).
J. L. du Toit.
G. C. Dymond.
J. Rault.

PRE-CLARIFICATION AND THE ION-EXCHANGE.

By G. C. Dymond.

The best results from the ion exchange process were those in which good pre-clarification methods were used. Colloidal matter and in particular silica must be eliminated. A new method of clarifying the mixed juice *in the cold* is described. Sufficient phosphoric acid is added to give a minimum of 0.03 per cent. in the juice. SO_2 gas is then passed until a pH of 3.2 is reached. A quantity of puddled clay is added and the black slimy precipitate of waxes, gums, pentosans, nitrogen compounds and silica allowed to settle. This precipitate contains from 10 to 30 per cent. of cane wax.

The supernatant liquid may either be limed, heated and settled and the clear juice used for ordinary processing; or it can be filtered with hyflo-supercel and the resulting juice passed through the ion exchange process. By these methods the reversible colloids are eliminated from the cold mixed juice. A flow sheet indicating by-product possibilities is also given, together with a record of various clarification tests carried out with lime, sulphur, phosphoric acid and carbon dioxide.

THE EARLY DAYS OF THE NATAL SUGAR INDUSTRY, WITH SPECIAL REFERENCE TO THE INTRODUCTION OF VARIETIES.

By A. McMartin.

The first attempt to cultivate sugarcane in Natal appears to have been made towards the end of 1847 by E. Morewood of Compensation, when he planted some varieties introduced from Mauritius and Reunion (then Bourbon). Records of cane growing by natives prior to this date leave some doubt as to whether true sugarcane was referred to. About the time of the commencement of Morewood's plantation, and for some years thereafter, many economic plants were introduced and experimented with, mainly by the newly-formed Agricultural Society, but sugarcane in the end proved to be the only crop which succeeded in becoming firmly established. In 1852 sugarcane cultivation began to spread, and planting began in that year on the South Coast. A further importation of cuttings from Mauritius was made about that time. The favourite variety was one known as Green Natal (subsequently identified as Light Preanger), which was the main variety till 1870.

The earliest cane fields were on the flat lands, but when it was realised that this crop would also grow on the hill sides, a rapid extension of cultivation took place.

Another variety of unknown origin became favourite after 1864, called China cane. This, however, became badly infected with smut disease and was eventually discarded. Numerous variety introductions occurred again from Mauritius, but later, mainly as a result of the ravages of smut, canes were imported from other countries also, among which was Uba, a variety destined to become the main variety for a long period.

In 1914 the Natal Sugar Association acted co-operatively with the Department of Agriculture in introducing canes under supervision, and distributed them to growers, a procedure which was eventually tightened up with the discovery of moasic disease. At present no grower can introduce any cane on his own. All varieties are introduced by the South African Sugar Association under stringent quarantine regulations and issued to growers after a prolonged test.

SOME FACTORS INFLUENCING THE SPREAD OF SUGARCANE MOSAIC IN NATAL.

By A. McMartin and N. C. King.

A survey of the Natal sugarcane area has shown that mosaic disease is distributed throughout the North and South Coast, but has only been found in a few cases in Zululand. Near the sea it is usually absent, and the most severe outbreaks have been found in areas where large quantities of *Setaria sulcata* exist. This grass is an important alternative host for the disease.

No evidence of strains of different degrees of severity has been found, and the varieties mainly affected, Co.301 and Co.281 appear to be tolerant, i.e., show no diminution in vigour when infected.

It is suggested that the recent years of severe drought may have contributed towards the extent of mosaic by possibly greater numbers of the insect vector feeding on cane than normally, as the crop remained green and attractive longer than the natural grass flora. Also, the practice of planting maize in the cane fields was suspected of increasing the amount of infection, a suspicion which has been verified by experiment. It has been shown that a much greater spread of the disease occurs in a plot of cane interplanted with maize than in one without, where foci of infection were provided by means of already infected cane.

Interplanting maize with cane is now being used as a means of testing in the field the reaction of new varieities towards mosaic.

Cases of recovery from mosaic have been noted with both Co.281 and Co.301, the latter showing some recovery on germination. Hot water treatment and manuring with compost have had no effect on germination recovery.

SOME INSECTICIDE TESTS AGAINST THE ELEGANT GRASSHOPPER.

By J. Dick.

A series of laboratory experiments is described in which a number of insecticides were tested for control of *Zonocerus elegans*.

1. DDT as a 2½ per cent. agricultural dusting powder was ineffective when applied against young hoppers at a rate equivalent to about 10 lbs. per acre, but gave mortalities of 24 and 71 per cent. at rates of 20 and 100 lbs. per acre respectively.

2. A dusting powder containing 2 per cent. gamma benzene hexachloride was consistently the best material tried, giving an average mortality of 98 per cent. in four tests in which it was applied at about 10 lbs. per acre.

3. A dusting powder dontaining 0.5 per cent. gamma benzene hexachloride was practically as effective as the more concentrated dust when applied at the same rate.

4. A proprietary insecticide of the carbolic dip type did not kill the hoppers when used as a 4 per cent. emulsion at 10 gallons per acre. Used at 80 gallons per acre it gave a mortality of 55 per cent. As a 10 per cent. emulsion used at about 30 gallons per acre it killed 92 per cent. but burned the foliage of plants.

5. Lead arsenate powder as a suspension of 1 ounce per gallon of water, sprayed at a rate equivalent to 30 gallons per acre on to foliage on which the hoppers fed, gave a mortality of 31 per cent.

6. Sodium fluosilicate used at the same concentration and rate as the lead arsenate killed about 43 per cent.

7. A pyrethrum powder consisting of the flowers dried and ground, applied at about 20 lbs. per acre, killed about 37 per cent.

8. A pyrethrum spray made up in kerosene as recommended by the makers, the mixture being used at 20 gallons per acre, gave a kill of 29 per cent. in one test. In another test, however, it only killed 16 per cent. and was not significantly better than kerosene alone.

9. A 5 per cent. solution of DDT in kerosene, used at 20 gallons per acre, gave mortalities of 80 and 75 per cent. in two tests.

10. The addition of pyrethrum extract to the DDT spray did not significantly increase the kill obtained.

11. A proprietary brand of hexaethyl tetraphosphate and a proprietary insecticide containing pyridine were ineffective against this insect at the concentrations recommended by the suppliers.

The rates of application quoted are those which would be required if the whole surface of an acre were to be treated. In practice much smaller amounts would be required especially if the insects were treated while still in the cluster stage.

The insecticides made up in kerosene produced a certain amount of burning of plant foliage.

In rough field tests, Gammexane was successful in controlling clusters of hoppers, whereas DDT was markedly less effective.

PRESENT DEVELOPMENTS IN THE SEARCH FOR NEW SUGARCANE VARIETIES IN NATAL.

By A. McMartin.

Since the almost entire elimination of the one variety Uba from Natal, and the cultivation of several varieties, mainly Co. canes and P.O.J. canes, it has become obvious that different localities have different varietal requirements, and that a high yield over the whole sugar area is contingent upon the cultivation of different varieties suited to the specialised requirements of these different localities.

Adaptability to different areas is related to reaction towards diseases and pests, which vary in different districts, but also to plant characters such as rooting habits, drought resistance, reaction to low temperature, etc.; and to interaction between environmental factors, e.g., that between root pruning fungi and low temperature.

As specialisation in varieties becomes greater, however, there may be a tendency towards the cultivation of types in which diseases of a minor nature become more acute, leading to an earlier abandonment of the variety. Thus the succession of varieties might become increased, but yet with continuous higher yields.

Varietal introduction in Natal has consisted till recently of testing varieties produced in other countries; lately fertile seed has been introduced and from that our own selections made. More recently, however, the demonstration that fertile seed may be produced here by artificial means opens the possibility of carrying out some, at least, of our own breeding work.

ADVANCES IN AGRICULTURAL PLANT BREEDING IN THE SOUTH AFRICAN SUB-TROPICS.

By W. L. FIELDING.

The author describes the success of plant breeding methods in developing the agricultural potential of South Africa's sub-tropical areas, where sugar, cotton and maize are concerned. The country described lies east of the Drakensberg Mountains between latitudes 23°S and 32°S and a map depicts how the areas suitable for cotton cultivation overlap those where sugar is successfully cultivated, in Northern Natal. The writer was engaged in cotton and maize breeding in these areas for many years before becoming associated with sugarcane breeding.

In the course of 23 years breeding at the Cotton Experiment Station, Barberton, Transvaal (1924-47), varieties of cotton were produced which gave a yield five times greater than that of the type grown when work commenced; 500 lbs. lint per acre compared with 100 lbs. This high yielding cotton is designated A2106 and is a hybrid, U.4./5143 × Cambodia. Of Upland (*Gossypium hirsutum*) origin it produces lint of good 1⅛ inch staple, and is highly resistant to Jassid (*Empoasca spp.*).

The maize breeding programme described aimed at the production of a high yielding, white-grained maize, suitable for consumption as rations for native labour, and resistant to *streak* virus. This virus, which militated against successful maize cultivation at Barberton and in the surrounding lowveld, is the same as that responsible for the demise of Uba cane in Natal. A hybrid, "P × H" (Peruvian × Hickory King) was eventually produced. Capable of yielding about 2,000 lbs. grain per acre in years of heavy infection, this hybrid maize has met with wide commercial success.

A contrast between sugarcane and cotton breeding is that material of new strains available for planting is multiplied 400 times annually for cotton and only 10 times for sugarcane. The results of successful breeding are therefore more rapidly effective in cotton (and all crop plants cultivated as annuals from seed) than in sugarcane cultivation.

The intimate nature of the relation between genotype and environment involved in local adaptation is likely to be of as great importance in sugarcane breeding as it has been proved to be with cotton. The importance of out-station trials, to test adaptation to numerous environments is being proved in cane breeding in Natal.

The Sugar Experiment Station, Mount Edgecombe, commended work in 1924; a diagram shows that improvement in yield due to introduction of new varieties was about 50 per cent. by 1943. Data presented show the possibility of a further 20 to 30 per cent. increase in yield with the new seedlings raised at Mount Edgecombe.

The method of local seedling selection gives greater scope for improvement in cane varieties than the importation of varieties which perform well in distant environments. This conclusion emphasises the importance of achieving a successful technique for the local production of hybrids.

A SUMMARY OF RESULTS OF MANURIAL TRIALS IN THE SUGAR BELT.

By C. D. SHERRARD.

After extracting all data possible from some 72 fertilizer trials conducted on many different soil types and in different localities over a period of about 20 years, the following are some of the most important facts which have been established:—

1. The response to phosphate is widespread throughout the industry and phosphate is most necessary on sandy soils and those not previously under cane and therefore having had little or no phosphatic manures.

2. Furrow dressing at time of planting is the best method of application of phosphates and top dressings are not recommended.

3. Of phosphatic fertilizers superphosphate has given the best results on sugar cane.

4. Nitrogen is best applied in the form of ammonium sulphate as a top dressing only and not as a furrow dressing, and the need for nitrogen is most apparent on sandy soil.

5. High altitude areas do not respond so readily to nitrogenous fertilizer as do the coastal areas.

6. So few positive responses have been recorded from the application of potash that it would seem wise to leave this out of the fertilizer scheme on the cane farm.

7. The use of mixed fertilizers is not recommended.

It has been found after conducting field experiments in this belt for some years, that very careful selection of the site of the experiment is essential. A large number of replications of treatments, and if possible repetition of experiments, on varying soil types is desirable. The previous treatment of a field is also important.

The split-plot design is proving a useful one for experiments on this crop.