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SUGAR CANE TRAINING AND DEVELOPMENT CENTRE
DP/EGY/81/010
THE ARAB REPUBLIC OF EGYPT

Technical Report: Cane Sugar Industry Research and Training

Prepared for the Government of the Arab Republic of Egypt
by the United Nations Industrial Development Organization,
acting as executive agency for the United Nations Development Programme

Based on the work of H.J. Delavier, consultant
in Cane Sugar Industry Research and Training

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United Nations Industrial Development Organization
Vienna

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Explanatory note

The exchange rate of the US\$ was changed during the time of the mission:

7 May 1987	1 US\$ equivalent to 1,35 L.E.
14 June 1987	1 US\$ equivalent to 2,18 L.E.

INTRODUCTION

The activities within this project "Sugar Cane Training and Development Centre" were initiated in 1985 (see UNIDO Reports V. 85 32581 of 29 October 1985 and V. 86 60840 of 14 October 1986 as well as the unpublished Report of 14 December 1985) when the project ideas were focused on the introduction of an Experimental Plant for the Training, Research and Development Centre at Kous sugar factory grounds as one of the most important steps in the further development of this Centre. The Experimental Plant shall serve as a tool for training staff members of the Sucreries d'Egypt on specific problems in sugar technology, as raw juice purification, juice concentration by evaporation of water from it (water is a solvent for sucrose solutions in a sugar factory) and sucrose crystallization.

The present mission was related to the erection phase of the Experimental Plant, supplied by Messrs. Utzschneider in Berlin (West), on the basis of recommendations given by the UNIDO expert in 1985 and 1986 and by Sucreries' staff members, Dr. Shweil and Mr. Ali El-Amir, during their study visit in Berlin in December 1986, as well as on the basis of discussions during the expert's missions to Egypt in 1985 and 1986 with Sucreries' staff members and directors in Cairo and at the site. The erection phase was finished by May 24 in such a way that tests with cold and hot water could be carried out during May 25 to May 27, after that trials with canesugar juice were done in order to start testing the Plant with cane juice under a few operational variables. These tests were cut off due to lack of steam supplied from the sugar factory Kous which finished its cane processing season by May 31 and, therefore, stopped the steam supply to the Experimental Plant. The original idea (in 1985) to supply a little old, remaintained steam locomotive for producing steam for the functioning of the Experimental Plant, so to continue the test runs and the training of the staff, could not be realized: the Experimental Plant had to cut operation.

The expert's activity in the mission started on 6 May, travelling to Egypt, in preparation of the activities at the site during 7 to 10 May in Cairo, in assisting in finishing the erection work at Kous and to start operation of the Plant up to 5 June; from 6 June to 18 June, preparation of the report and documentation, and meetings for discussing results of works at Kous and planning further project activities.

The expert was proposed to leave Egypt on 18 June for debriefing in UNIDO Vienna on 19 June and travel back to the F.R. of Germany on 20 June in order to fulfil the contract time of the mission.

The original objectives were changed due to the short operation of the Experimental Plant so the planned intensive training of Plant staff could not be carried out. Though rather intensive informative discussions were held with the acting supervisor of the plant, Dr. Abu Fatouh, and the training programme was proposed. The last days of the

preparation of the Plant for "inauguration" on 31 May, put substantial pressure on the work, without allowing a smooth, intensive and quiet execution of the work with careful checking of the technical/technological possibilities of the Plant.

The expert indicated that a selection and nomination of personnel must be done in time so that everybody knows where and what to do.

RECOMMENDATIONS

1 Installation of a steam generating plant at the Experimental Plant

The steam supply is of greatest priority, as the Plant cannot be operated without steam.

The steam supply from the sugar factory kous, on which grounds the Experimental Plant is located, is possible only during the sugarcane crushing season, i.e. from mid-December to end-May (with slight shifting because of availability of mature sugarcane, internal work on maintenance, etc.); however during the sugarcane processing period, the trainees of the Sucreries have to participate in the sugar factory operations, which means that just the so called off-season (without cane processing but maintenance of the factory equipment and machinery) is the main season for "training" of the personnel.

The Plant should, therefore, function during this off-season, and a steam generating plant must be installed.

2 Installation of a power generating plant

The electric power is delivered from the public grid, during the sugarcane processing season from the sugar factory.

The highly sophisticated laboratory equipment which should be installed in order to carry out controls of the training operations and of the investigations/researches of the Plant, need a very stable electric supply with high tension (Volts) and high frequency (cycles) stability. There are indications that needed high stability - and the permanent supply - of the electric current from the public grid cannot be guaranteed; therefore it is very necessary to install a diesel motor-generator of about 100 kVA, with special stabilizer accessories. There exist sets which allow an automatic start of the diesel motor in case of a breakdown in the public supply.

3 Installation of Laboratory Equipment

As laid down in Report V. 85 32581, the Experimental Plant needs a laboratory equipped in such a way that accurate and sophisticated chemical and technological investigations of the operations and the

operational results of the Plant can be carried out. This laboratory is different from a routine sugar factory process control laboratory, as in the sugar factory all analyses are done by standard methods, with standard equipment; in the Experimental Plant, no standard method is always applied. Any experiment may need a specific method - for comparison with standard methods, etc., and in case of research, the laboratory must be even much wider equipped with sophisticated equipment in order to follow the advanced level of such activities. Therefore, the following equipment should be installed in the Laboratory of the Experimental Plant:

- 2 automatic saccharimeters SUCROMAT
- 2 automatic digital refractometers ABBEMAT HP
- 1 immersion refractometer
- 1 normal sugar refractometer ABBE type
- 1 microscope for research work
- 1 spectrophotometer ZEISS MP III (or similar)
- 1 digital reflectance colorimeter SUCRUFLEX (or similar)
- 1 flamespectrophotometer
- 3 balances of different sensitivity, one of micro-analytic type
- 1 viscosimeter of rotational type
- 1 conductivity meter (similar raffinometer)
- 1 saturescope
- 1 laboratory centrifugal
- 1 ice machine for cooling-mixture preparation
- 2 disintegrators, heavy duty type, for sugarcane disintegration $n_{max} = 12.000/min.$
- 1 Karl-Fischer-Titrator, for water content determination, automatic
- 1 pH-meter, high precision type, with different electrodes for acidic, neutral and high alkaline media. Cl-ion selective electrode
- 5 stop watches
- 5 membrane filtration apparatuses of different sizes
- 2 sets of standard screens, with sieving machines
- 1 standard filtration velocity apparatus
- 3 electric heating plates with magnetic stirrer
- 1 muffle oven
- 1 drying chamber normal
- 1 drying chamber for vacuum with vacuum pump (electric)
- 1 water distillation unit, for simple and double distilled water
- 1 water bath, with automatic electric heating
- 1 oil bath, with automatic electric heating
- 2 thermostates
- 3 contact thermometers
- general laboratory equipment, as areometers of different scales (e.g. Beaumé, Brix, Plato), pipettes, burettes, burettes for Lane Synon method, gas burners, flasks, beakers, ventilators, etc.

- 4 For incorporating investigation/research activities on sugarcane experiments in the programme of the Training and Development Centre or to start investigations of technological character from the sugarcane, the following laboratory items are needed:
- 1 laboratory hydraulic press EMEDIBEAU, up to 350 bar
 - 1 laboratory sugarcane shredder, for sugarcane preparation for pressing, similar type WADDEL SHREDDER
 - 1 cutter-grinder for sugarcane
 - 1 bagasse digester, electric heated, automatic
 - 1 laboratory centrifugal, ultra-centrifuge type
 - 2 refrigerators
 - 1 calorimeter (bomb), automatic
 - 1 bagasse drier, electric, automatic (similar type MOISTURE TELLER)
- 5 For incorporating the research topic about "Formation of final molasses" as a block-research work, the following items are needed:
- 1 N₂ - analyser (acc. to Kjeldahl), also for micro-analyses
 - 1 amino acid analyser, fully automatic
 - 1 gas-liquid chromatographic set, complete with all accessories (WATERS)
 - 1 HPLC-set, complete with all accessories (WATERS)
 - 1 viscosimeter, capillary-type
 - 2 sets of ion-exchange columns of different sizes for various ion-exchange resins, of different matrix, for decolourization for complete ion-exchange of sucrose solutions (impure), gel chromatography (e.g. Sephadex, Sepharoses), complete with sample collector (automatic), one-way pipettes
 - 1 laboratory cooling machine for preparation of cooled liquid for cooling in circulation, with thermostat bath
 - 2 sets for thin-layer chromatography, complete, with accessories for spot-area analyser (planimeter type) with drying chamber for developing chromatograms, fume exhaust for working with dangerous chemicals, micro-pipettes
 - 1 pH-meter of high precision type, with different electrodes
 - 1 PC (computer) for data processing, complete
- 6 For incorporating microbiologic research (extremely important for modern, efficient sugar factory process control to eliminate sucrose losses by microorganisms activity), the following items are needed:
- 2 complete sets of equipment for microbiological work, as glass-ware (Petri dishes, baby bottles, etc.), special micro-pipettes, etc., cotton stoppers, etc.
 - 2 incubators
 - 2 refrigerators
 - 1 freezer
 - 1 cooling centrifuge
 - 1 sterilizer, 150 dm³, electric heated

- 1 laboratory bioreactor, type BIOSTATE, automatic
- 1 laboratory mixer for cultures
- 1 colony counter
- 1 microscope of research type, for microbiological work

In order to consolidate, develop and utilize the results of the activities of the Centre, the objectives of the Centre's activities should be intensively discussed with the management of the Sucreries, and respective staff (general managers or directors, chief engineers, chief chemists, etc.) in order to induce "thinking" about the Centre as such, and in order to create active co-operation of the respective staff members within the sugar industry.

The expert had already recommended to form a Research Board within the Sucreries' top management level in order to induce contribution to the Centre's activities from all sides concerned. The expert also had already recommended to organize annual technical meetings, for 2 or 3 days for the personnel concerned, among others to create a mutual exchange of information within the Sucreries, to clarify problems which occurred during the processing season(s), etc., and to induce these problems for handling in the Centre. The Centre itself, together with other respective organizations within the Sucreries, should have a leading function for the Egyptian Sugar Industry.

ACTIVITIES AND OUTPUT

The main activities of the expert during his mission from 6 May to 20 June 1987 were:

1. Assisting in the final erection phase of the Experiment Plant at Kous sugar factory, to correct piping, to fix points for instruments (due to too late ordering of instruments) which have not been fixed correctly before shipping of the equipment from Germany to Egypt (shipping date of the equipment mid December 1986, order of instruments end December 1986/January/February 1987) etc.
2. Providing information to the supervisor of the Plant on the outlay of the equipment, its function, the technique to operate the Plant, details on instrumentation, adjusting of pH-meter and conductivity meter, technique of batchwise and continuous operation, control of the operation, etc.
3. Starting of the Plant by testing of piping, equipment, etc. on tightness, tests with water, steam, etc., elimination of faults, testing of single groups of equipment of the Plant, like filter presses, evaporation station, evapo-crystallizers, etc.

4. Running tests with sugarcane juice for three days, mainly to train the operators of the Plant equipment, how to operate reactors, filters, evaporators, evapo-crystalliser centrifuge.

Due to the end of the sugarcane processing season of Kous which was to supply steam to the Experimental Plant, the steady supply was cut off, therefore the operation of the Plant stopped.

The too short time for training of operators has shown that it is not possible to operate such an Experimental Plant effectively; much more time is needed for training such staff, especially to induce the understanding of the responsibility for operating such plant: operating errors should be eliminated, e.i. that predetermined temperature values, or pH-values, or retention times must be kept in each batch of material (in batchwise operation), that the supply of e.g. steam or chemicals must be kept constant - that the composition of the product from trials or test runs is kept constant (within normal ranges of errors, whereas these errors must be determined) and allows quantitative evaluations of the various experiments. As long as the simple technique of operation is not completely known and executed, no serious investigation/research can be carried out.

UTILIZATION OF THE RESULTS

The results of the activities are shown in technical reports, notes, Protocol, memorandum, etc.

The detected misfunctions of equipment must be corrected so that the Experimental Plant at the next operation period will function smoothly.

The additional equipment needed, e.g. steam generation plant, power generation plant, laboratory equipment, should be at site also at the next operation period, e.i. from January 1988 on.

The staff of the Experimental Plant shall be nominated and trained in advance: it was demonstrated that the plant needs a full-time staff, which concentrates of the Experimental Plants operation only: during the next operation period, the sugar factory Kous will be also in operation so that the staff during the trial runs, mainly staff from the process laboratory of Kous factory and from the factory itself, will not be available: those employees will be fully occupied with their work in the sugar factory.

ANNEX I

Working Programme of the mission

- May 6: 8:30 h Dept. Braunschweig-Stöckheim
12:20 h Dept. Hanover LH 5825 to Munich
15:00 h Dept. Munich LH 682 to Cairo, Arr. 19:15 h
- May 7: 9:00 h Briefing at UNDP Office Cairo, Mr. Tharwat Sabry
10:30 h Meeting at Sucreries' Office Cairo
Mr. Abdel Azim Bedewy, Acting Director General of
Production
Mr. Salama F. Shweil, General Director of Projects
Introduction into the situation at Kous Site
Fixation of further programme of expert
11:45 h Continuation of briefing at UNDP Office, with
administration, etc.
Preparatin of mission at Hotel
- May 8:
May 9:
May 10: 9:00 h Meeting at UNDP Office, Mr. Sabry
Reporting about Meeting at Sucreries'
Fixation of programme
11:00 h Airport Cairo for flight to Luxor, travel to Kous
14:00 h Meeting at Kous Site
Kous Sugar Factory Mr. Yehya Selem El-Shereif
General Director (G.D.)
Mr. Ishak Shafik
Erection Supervisor
Dr. Abu El Fatouh
Chief Chemist
and other staff members
Sucreries' Cairo Dr. Salama F. Shweil
Messrs. Utzschneider Mr. Dieter Walwei
UNIDO/UNDP Prof. Dr. H.J. Delavier
- Information about the state of erection of the
Experimental Plant. Discussion of technical matter,
elaboration of working programme for fixation of the
date of the end of the erection and for fixation of
the date of the inauguration of the Plant.
- May 11: Meeting with the erection personnel at site, further
clarification of technical matter, listing of
material which was damaged during transport for
insurance claim, checking of working programme
progress and actualization, reporting to UNDP Cairo,
Mr. Sabry and to Messrs. Utzschneider Berlin (West).
- May 12: Continuation of checking of plant, discussing
technical matters with Kous staff, reporting to G.D.

- May 13: Continuation of checking, information-discussions with Kous staff especially with Dr. Fatouh as acting supervisor of the Experimental Plant___when in operation.
- May 14 -23: every day: 7 to 9 h in Experimental Plant for discussing technical matter, for corrections, etc.
9 to 13 h information-discussions with Dr. Fatouh
14 to 17 h elaboration of papers, etc.
17 to 19 h Experimental Plant for checking work progress
- May 24 - 27: start of tests in the Experimental plant with water and steam, corrections of piping, tightening of connections, etc.
- May 28 - 30: start of processing of sugarcane juice: operational trials, preparation for inauguration
- May 31: Cleaning of Experimental Plant, corrections on equipment, piping, etc.
- June 1 - 3: Preparation of documents about trial runs with Experimental Plant, technical-technological discussions with Dr. Fatouh and Kous staff members
- June 4: Meeting with Dr. Shweil, Cairo Headquarter, for finalizing reports and formulation of PROTOCOL
- June 5: Flight to Cairo
- June 6: Meeting at Sucreries' office Cairo
- June 7: Meeting at UNDP Office with Mr. Sabry
Fixation of further programme of expert
- June 8: Meeting at UNDP office: Mr. Sabry, Dr. Shweil from Sucreries and Prof. Dr. Belavler from UNIDO
- June 9: Meeting at Sucreries' Office with Mr. Bedewy, Dr. Shweil and UNDP Expert for discussing the Memorandum of the Meeting of June 8, discussion about further steps in the project, fixation of meeting of June 10
- June 10: Meeting at UNDP Office: Mr. Sabry, UNDP, Mr. Bedewy and Dr. Shweil Sucreries, Prof. Dr. Belavler UNIDO

- June 11/12: Elaboration of reports and drafting of project Document "Cane Sugar Training and Development Centre, Phase II"
- June 13: Meeting at Sucrieries' Office with Mr. Bedewy and Dr. Shweil and expert for discussing Project Document proposal
- June 14: Meeting at UNDP Office: Mr. Sabry, Sucrieries and UNIDO expert
- June 15: Reporting and discussions of reports with Mr. Sabry UNDP
- June 16: ditto
- June 17: ditto
- June 18: Flight to Vienna
- June 19: Debriefing at UNIDO: Mr. Kresimir Sepic, Head, Agro-based Industries Branch
- June 20: Travel to Braunschweig