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Expert Group Meeting on the Selection
of Equipment for the Sugar Processing Industry

Vienna, Austria 25 - 28 November 1974

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EXPLANATORY NOTES

Reference to dollars ($) is to US dollars

Reference to tons is to metric tons

UNIDO = United Nations Industrial Development Organisation

UNDP = United Nations Development Programme

FAO = Food and Agricultural Organisation of the United Nations

ILO = International Labour Organisation

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PREFACE

The UNIDO Expert Group Meeting on the Selection of Equipment for the Sugar Processing Industry, held in Vienna, Austria from 25 to 28 November 1974 discussed these problems with respect to both the cane sugar and beet sugar industries, but with particular relevance to problems experienced in developing countries. The discussions included a wide range of factors from definitions of terms to preparation of tender documents and specifications for test runs and take-over certificates. The various types of equipment and conditions of application were discussed in detail.

The present report of the Meeting, includes recommendations from the Group, a summary of discussions, and statements describing the current situation of the sugar industry with special reference to developing countries, and also the relationship of developed countries.

The Meeting was opened with a statement by A. Miklovics, the Chief of the Light Industries Section of the Industrial Technology Division, UNIDO.

F. H. C. Kelley (UNIDO) was Chairman of the Meeting. The Chairmen of the successive working sessions were:

G. Ausmüller (Federal Republic of Germany)
P. P. Colborne (United Kingdom of Great Britain and Northern Ireland)
J. T. d'Espaignet (Mauritius)
R. Hulpiau (Belgium)
I I. M. Ismail (Egypt)
F. H. C. Kelly (UNIDO)
H. Koenig (UNIDO)
G. Morvai (Yugoslavia)
Gunda Rao (India)
J. Tan Yew Beng (Malaysia)
M. M. Tantawi (Egypt)

Each session chairman was asked to act as his own Rapporteur and to prepare a summary of the deliberations of the session of which he was chairman and to present this at the concluding session of the Meeting.

INTRODUCTION

1. The format of the Meeting was generally in accord with proposals set out in the form of an "aide-mémoire" prepared in April 1974 and circulated to governments of developing countries, manufacturers and suppliers of sugar processing equipment, to participating experts and to other persons or organisations thought possibly to be interested in the discussions of the meeting.

2. The total number attending the meeting was restricted to forty persons in addition to representatives of the UNIDO Secretariat, by virtue of the size of the conference room and facilities available.

3. The meeting, to discuss the selection of equipment for the sugar processing industry, is the first of a group of such meetings projected to discuss similar problems in the vegetable oil and meat processing industries.

4. UNIDO is aware of problems resulting from unsuitable food processing systems and/or equipment purchased and installed by industrialists in developing countries. It is felt that the elaboration and publication of guidelines for the selection of food processing technologies and/or equipment might prevent the repetition of many unfortunate investment decisions and subsequent purchases of wrongly sized or obsolete equipment and industrial production schemes which have been made in the past.

5. Investors and industrialists in developing countries, because of lack of objective information, have often purchased outdated food processing equipment which proved to be unsuitable for their particular needs. Obsolescent milling equipment for example, is often sold under the guise of new technological invention for sorghum, millet and rice, crops of particular economic significance to many developing countries.

6. Rice bran extraction plants are frequently sold without any guarantee being given as to the quality of the rice bran oil produced while newly established vegetable oil plants are often equipped with unsuitable screw presses and preparation equipment that negatively effect the quality of the products made and cause high production losses.

7. In the meat processing industry, developing countries separately encounter difficulties incurred through the purchase of slaughterhouse and processing equipment, the design of which proves unsuitable under the prevailing conditions, resulting in the production of end-products which fail to meet export quality

standards. Despite the tremendous inroads made by high-temperature short-time heat transfer equipment in all sectors of the food processing industry, low-temperature evaporators, stills, concentrators, de-aerators, heat exchangers, etc., are continuously being sold to numerous developing countries. Similarly, developing countries are often supplied with refrigeration equipment, the insulation and temperature margins of which are totally inadequate for tropical conditions while the milk sterilization and pasteurization systems no longer correspond to the requirements of a modern dairy industry. In the sugar industry, for example, outdated batch diffusion and extracting systems continue to be purchased and the installation of undersized equipment often hampers a sugar factory's production efficiency and competitiveness.

8. In view of the enormous scope for development of food processing industries in developing countries, and the fact that the establishment of food processing plants is often the first step towards industrialization undertaken by developing countries, it is considered necessary that guidelines for the selection of food processing equipment be elaborated and made available to investors prior to the conclusion of relevant contracts and investment transactions.

9. From the very manifold food processing technologies applied and the equipment on sale and in use, the most important ones have to be selected for evaluation and discussion and priorities have to be set for the elaboration of the proposed guidelines. In view of the fact that the sugar industry, as a large-scale industry with a high investment potential, plays a very important role in many developing countries, and because of the increasing world market demand of sugar and sugar products, and the expanding tendency of the sugar industry, it has been decided to make it the issue of the first evaluation work and the substantive content of this Expert Group Meeting. Further evaluation work will follow within the frame-work of other branches of the food processing industry, as for example, the vegetable oil and meat processing industry and similar Expert Group Meetings might be convened in this connexion.

10. The suitability of up-to-date sugar beet and sugar cane processing equipment in connexion with an appropriate processing technology was reviewed. The problems of process and product quality control methods and their practical application were discussed and a sugar production plant's industrial production efficiency highlighted.

11. The following substantive issues, having special reference to the sugar processing industry, were dealt with within the framework of the draft guideline document prepared by UNIDO and presented at the Meeting:-

Questions of nomenclature
Process flow
Unit operations
Safety and sanitary requirements
Water, steam, gas (CO_2 and SO_2) and energy supply
Thermotechnical evaluations
Quality control requirements
Sugar production equipment characteristics and spare parts
Industrial feasibility calculations
Offers and quotations
Test runs and take-over certificates

12. The Meeting adjourned on the second morning of the programme for a field trip to the Austrian Sugar Institute and the Leopoldsdorf Beet Sugar Factory as guests of the Austrrian Sugar Company.

13. A statement was brought to the meeting by Mr. G.S. Gouri, Deputy Director of the Industrial Technology Division, UNIDO, for consideration, identifying the importance of the sugar industry in relation to food production and processing in developing countries and its effect on raising the prosperity level of these countries, particularly in rural areas. This anticipated a possible submission to the second UNIDO Conference to be held in Lima (Peru), 12 - 26 March 1975.

14. A statement was brought to the meeting by Mr. K. Sepic of the Light Industries Section of the Industrial Technology Division, UNIDO, setting out the type of assistance which UNIDO has already given to the sugar industry in developing countries and the assistance which UNIDO is able and willing to give in the future.

15. The summaries of the papers and discussions of each of the sessions were presented at the final session of the Meeting and it was agreed that these represent the official observations of the Meeting.

16. The conference programme consisted of eleven sessions, each of approximately 1 3/4 hours duration for the presentation and discussion of the substantive papers. An introductory summary of each paper was made personally by each author, taking not more than fifteen minutes. Comprehensive discussions were possible f ...

least one hour for each subject.

17. A full record of all presentations and discussions, together with a complete name list of contributors was preserved on tape and is filed with relevant documents at UNIDO, Vienna.

SUMMARY OF PAPERS AND DISCUSSIONS

The objectives of the Meeting were defined in terms of the problems associated with the selection of equipment most suited to its intended purpose. This in turn requires an understanding of the industry itself, agreement on terminology, an understanding of the local situation in terms of economic development and the cultural background and national aspirations of the country concerned.

A series of questions was generated for each session in association with the material presented to form the basis for specific discussion to help obtain organised and systematic thought to lead to useful and meaningful answers.

The papers presented and the associated discussions are recorded for each session in summarized form.

1. One paper was presented at this session: "Questions of Nomenclature in the Sugar Industry" by F.H.C. Kelly.

The language of the sugar industry, whilst generally understood within the industry, is too frequently used imprecisely. The advantages of the English language for international communication was recognised. Areas of important linguistic groups could have their own glossary and definitions based on the English equivalent.

The worth was recognised of a central compiling agency which would work in co-operation with such bodies as ISSCT, ISSBT and ICUMSA. UNIDO could well perform such a function.

The various groups of interests viz. process, mechanical, analytical, agricultural and economic were recognised.

Certain basic terminology was recognized as being factually completely meaningless, such as polarization, brix and apparent purity. Whilst this may be deplored, the manner of use and extent of usage is such that rectification would be extremely difficult.

The adoption of the International System of Units for weights and measures appeared to offer no serious problems which could not reasonably be surmounted. This has proceeded substantially in all countries as far as is known.

Communication of information through the various channels of literature services was recognised as being reasonably comprehensive. Some concern was expressed at difficulties in obtaining adequate translations from certain European languages.

The desirability of having effective communication of information on equipment and equipment supplies was expressed. A central non-involved agency could be of assistance in this respect.

Attention was drawn to the manner in which computer storages can be used for information sources. They would need to be comprehensive to be effective. To prepare such data is in itself a costly exercise and would require international industrial financing but could well be justified if a high response rate of retrieval of information could be achieved by any interested party in the industry.

Differentiation between research information and processing information was suggested as being desirable.

There are some 600 journals regularly publishing material related specifically to the sugar industry in various parts of the world. Additionally there is useful and important material in journals and technical publications in related fields of interest.

Many countries do have reasonably comprehensive libraries available to the industry in their own area. There is no international centre having a complete record of copies of publications of books and journals of concern to the industry.

Developing countries are faced with the problem of establishing their own facilities in this field, which is difficult and costly. Some guidance would be helpful.

Special language problems of developing countries were recognised. It was considered that all basic terminology should be transliterated with definitions and descriptions in the national language of the country concerned. It was observed that there are marginal words such as fibre which might already exist in the national language but having a rather broader meaning than is used in the industry itself. Appropriate care should be exercised in these cases.

Work currently underway in the Federal Republic of Germany for precise definition of sugar industry terminology was noted and the value of its later extension to the English language considered to be desirable. Such an extension would desirably be undertaken by an international body, which could well be UNIDO.

2. Two papers were presented at this session: (a) Unit Operations and Unit Processes for Beet and Cane Sugar Production by G. Ausmiller; (b) Process Flow in the Sugar Industry by F.H.C. Kelly.

The first paper set out both unit processes and unit operations, covering situations in the beet as well as the cane sugar industry. It was introduced with a glossary of terms and also included heat balances for optimal heat utilisation.

The second paper dealt essentially with basic questions related to unit processes in the sugar industry in general. Six fundamental steps were recognised as being necessary for the processing of any type of raw material for sugar production. Reference was made to other possible sources of sucrose than beet or cane, such as palms or sorghum.

It was also recognized that the product could appear in a variety of forms either for consumption after processing in the juice extraction factory or as raw sugar for subsequent processing in a refinery commonly located in some other country. The possibility of transporting unrefined sugar in the form of syrup or thick juice was discussed, it being recognised that this is now being successfully stored at beet sugar factories for the purpose of obtaining more extended usage of crystallizing equipment and machinery.

The basic purification techniques, their effectiveness and applicability were considered.

Discussion elicited a range of views on the economics and technical aspects of raw syrup or thick juice storage and transport as applied to either the beet or cane sugar industry. Each individual situation would require its own careful evaluation.

Situations in which direct consumption sugar are advantageously produced in the juice extraction factory were identified.

Processes for extracting sugar from molasses were considered. Such are already operating for beet molasses but cane molasses is more recalcitrant and processes have not yet gone beyond the pilot plant stage.

Attention was drawn to the importance of employing techniques - already well known - for the maximum recovery of sugar from molasses by crystallisation.

The production of liquid sugars for certain special market requirements was discussed, with special reference to the variety of specifications associated with this term.

The possibility was discussed of extending the processing season for a factory located in an area suitable for the cultivation of both beet and cane. The extent to which common equipment could be used required careful study, but an understanding of the real mechanism of each process could go a long way toward extending the range of commonly usable facilities.

Referring to present world conditions of sugar supply which do not meet the demand, the question was raised as to whether the standard of refined product could be reduced and enable output to be increased with existing equipment. Both advantages and disadvantages were recognised.

3. Two papers were presented at this session: (a) Technical and Technological Processing Considerations for Beet and Cane Sugar Production by G. Morvai; (b) Unit Operations in the Sugar Industry by F.H.C. Kelly.

The first paper drew attention to the important influence of quality of cane or beets on the factory performance. The author considered that white consumption sugar, rather than refined sugar, had many advantages for developing countries. In feasibility studies he observed that whilst bagasse from cane should be considered mainly as fuel, beet pulp and both cane and beet molasses had value as cattle fodder.

For developing countries the author considered that machinery and equipment should be of limited automation and that capacity values should be generously designed.

The second paper more specifically defined the meaning of the term unit operation and its incidence in the sugar industry - seventeen specific unit operations were identified, without the list necessarily being exhaustive.

Attention was drawn to the need to define objectives clearly when selecting a unit operation and for having an understanding of its behaviour for correct design and operation. As an example, factors controlling the cane milling operation were identified and the question raised - that with a thorough understanding of these factors, would it not be feasible to design a milling procedure for extracting the juice from beets? Obviously the same set of units would not be interchangeable.

Factors influencing the control of sugar boiling operations were also discussed as another specific example. The need for knowing true purity rather than apparent purity values for effective control was emphasised. A simple technique for effecting this was outlined.

General discussion gave extensive consideration to the relative merits of "diffusion" or lixiviation and milling in the cane sugar industry. Each operation was recognized as having both advantages and disadvantages and great care needed to be exercised in relative costing. It was observed that there was great difficulty in obtaining figures of the desired degree of precision for either method. These involved not only capital and maintenance costs of equipment but also a full assessment of power consumption, particularly in the effective preparation of cane. Furthermore, the losses of sugar by hydrolysis during either milling or diffusion were very difficult to determine with the desired degree of precision and were largely an unknown quantity.

It was generally conceded that developing countries should prefer simplicity of operations as far as possible but that these should be consistent with a satisfactory degree of effectiveness, although possibly not the very best which could be obtained from a higher degree of sophistication with which they might be unable to cope.

4. Two papers were presented at this session:- (a) Review of Sanitary Measures to be taken in a Sugar Factory by L. Nesvadba; (b) Safety and Sanitary Requirements in the Sugar Industry by F.H.C. Kelly.

Both authors stressed the importance of safety and sanitary measures in sugar factories. The industry is an important employer of labour, having personal contact with both heavy and light machinery as well as with a range of materials in process.

From the point of view of sanitation, it is necessary to remember that sugar is a food and very often goes direct from the factory to consumption situations.

Safety measures also extend to the design and construction of buildings with appropriate care to foundations and soil loading conditions; as well as the possibility of earthquake, heavy rainfall or atmospheric pressure hazards.

The certification of pressure vessels and correct specification of operating conditions for all vessels are necessary precautions.

The careful lay-out of machinery and equipment, providing adequate working space with sufficient ventilation and lighting, can go a long way towards preventing accidents.

Plant for generating gases such as SO_2 or CO_2 are better located outside a factory with appropriate care to pipeline reticulation.

Exposed live wires such as for overhead cranes should be clearly marked.

Explosive mixtures, resulting from high concentration of sugar dust or cane pith, could be avoided through properly designed dust collectors and sufficient ventilation.

Fire hazards need to be recognised in both bagasse and beet pulp storage areas as well as in bulk sugar stores.

Molasses stores can pose explosion possibilities and concentration of bulk molasses should not exceed 90°Bx. for storage.

Sanitary measures within a sugar factory should also give attention to canteen facilities and to potable water supplies for associated communities as well as within the factory.

Within the operations of a cane factory the milling tandem demands continuous careful attention to minimise microbiological activity. Both hot steam and chemical cleaning techniques should be used.

Effluent disposal imposes social obligations upon sugar factory management toward the region in which the factory is located. Attention needs to be given to both air and water pollution, with appropriate measures for avoidance and for treatment. Effective disposal of effluent probably increases the investment costs of a sugar factory by about 12%.

5. Two papers were presented at this session:- (a) Water, steam, gas and energy supply and consumption problems experienced in the sugar industry by M.H. Tantawi; (b) Water, steam, gas and energy supply for a sugar factory by P.H.C. Kelly.

A sugar cane factory is distinguished as an industry for its high degree of self-sufficiency with respect to water and energy supply and for the sophisticated inter-relationship of mechanical and electrical energy requirements on the one hand and the process thermal needs on the other.

The sugar beet factory does, however, require an external source of fuel since the fibre content of beets is inadequate to provide the thermal needs of the factory. Furthermore, it has found greater value as animal fodder than as fuel. Mechanical energy is only a minor concern in a beet factory, although electrical energy for the centrifugals, condenser water pumps and steam generator fans is significant.

Hence power generation has an important place in the steam cycle. Because of the high cost of fuel, much emphasis is placed on the economical usage of steam, employing the best known techniques of multiple effect evaporation and vapour heating combined with a high standard of thermal insulation.

Sugar refineries which are independent of juice extraction factories have power and heat problems comparable to those of a sugar beet factory and comparable techniques are employed for their control.

Sugar cane fibre as a source of replenishable energy was discussed at some length, especially in relation to its most efficient use associated with the most efficient use of steam, whereby a useful surplus of electrical energy can be provided. Special problems associated with its generation and use were recognised, especially the unwillingness of central electric authorities in many countries to take advantage of this or to co-operate with the cane sugar factory in any way. An effective solution to these problems was seen to take on greater urgency in the context of the world wide problems of energy supply.

In each section of the sugar industry, cooling water for the condensers is required in large volumes. Recycling requires attention to water treatment as well as to the cooling operation. Contamination of condenser water by traces of sugar entrained from evaporators should firstly be minimised by entrainment control devices and suitable treatment selected for residual quantities.

Feed water for steam generators requires close attention, especially with high operating pressures. Most can be recycled from process but special problems arise at the commencement of a season, or during long-term interruption in the supply of beet or cane.

Storage tanks and simple cation exchange treatment plants were considered as suitable means for meeting these needs.

Factories employing gas purification treatments, i.e. sulphitation and carbonatation, need to give special attention to their generation and reticulation. Sulphur dioxide is not only obnoxious and toxic but also highly corrosive, involving significant maintenance costs for equipment.

In sugar cane factories where fibre values are high the remelt system of sugar boiling could have advantages over the sulphitation system for producing direct consumption sugars in spite of higher steam requirements, for which fibre would be available.

6. One paper was presented at this session:- Thermo-technical evaluations of the sugar production process by F.H.C. Kelly.

This session provided opportunity for more detailed discussion of the specific problems related to power and energy requirements on the one hand and process steam needs on the other, as was introduced in the previous session.

Particular study was given to the cane sugar factories where a continuously regenerated source of fuel is employed.

It was recognised that the energy balance of a sugar factory is of vital importance to its economic survival. The two aspects of economy in steam consumption and efficiency of steam generation were recognized as being interdependent in the case of a cane sugar factory with basic reference to the fibre content of the cane. On the other hand, a high standard of both consumption and generation are of vital importance to a beet sugar factory or to an independently operating refinery, each of which is dependent on an external source of fuel.

One major problem in employing surplus power potentially available from a cane sugar factory, is its seasonal character and to a lesser extent intermittency resulting from factory stoppages. The development of multiple fuel usages in a steam generator has now reached a high degree of sophistication and its exploitation would minimise intermittency problems.

An extension of this concept to cover all or portion of inter-seasonal periods could be considered in terms of transfer of central power generating stations to cane sugar factory sites.

The possibilities of extending the use of regenerated fuel by associating wood as a secondary source of fuel appeared to have merit in areas where forest farming could also be practiced.

Problems of administrative control and acceptability by national power generating authorities were recognised and would need to be overcome.

Mauritius was cited as an advanced example of development in this field, where one third of the total electrical power needs of the country are supplied from surplus generation at sugar cane factories.

Electrically powered drives for sugar cane mills have not developed significantly, one reason being the low range of speed regulation.

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Shortages of bagasse, resulting from sub-optimal operation of equipment or from break-down stoppages related to poor maintenance standards were considered generally to be evidence of ineffective management.

Prime movers featuring mechanical simplicity even at the expense of some loss in efficiency were considered to have advantages, especially as the steam required for power production was generally less than that required for process.

Attention was drawn to the need for a high standard of power factor control in either a cane or beet sugar factory or an independent refinery. High-powered batch-type centrifugals are a major source of problems of this character, and suitable correction procedures should be applied.

7. One paper was presented at this session:- Quality control requirements of the sugar industry by F.H.C. Kelly.

The quality of raw material, product and in-process materials were identified as separate areas of specialization.

The purchase of raw material introduces direct financial factors and in-built incentive systems have substantial merit. This has been developed to a high degree in the cane sugar industry in Australia and this was used as a specific example for consideration - both advantages and disadvantages.

The essential prerequisites of effective quality-control are the reliability of information collected, representativeness of the samples, precision of the methods of analysis and the proper application of techniques of statistical analysis.

The control of raw material quality - whether beet or cane has been based on the estimation of extraneous matter and the sugar content of the raw material free from such extraneous matter. With the increasing adoption of mechanical harvesting of cane, the determination of extraneous matter such as trash, leaves, dirt, roots and rocks has become necessary for evaluating cane quality. The main approach to the control of the quality of cane has been to evaluate it for its sugar content or the recoverable sugar content and to make payments on the basis of such evaluation, with adequate built-in incentives for improving quality.

The Australian system of estimating the commercial cane sugar value of sugar cane, based on the analysis of first expressed juice for pol and brix, and the fibre estimation on direct samples, as first introduced by Kotman as far back as 1890, has proved to be a reasonably satisfactory system, in spite of some drawbacks.

The direct sampling of cane, using a core sampler and analysis using a disintegrator, involve costly equipment and sophisticated techniques.

The system of evaluation using the relationship between the first expressed juice and the total sugar in cane (Java ratio) is empirical and does not sufficiently consider the fibre content.

The evaluation of sugar cane for commercial cane sugar and the system of payment based on it have been largely responsible for the high quality of cane in Australia. The average quantity of cane required per ton of 94 polarization (WT) sugar in the 1972 crop was 6.06 tons with 5.95 tons as the best for a single factory.

The economic factor of what the farmer gets for his cane is very important in the context of increasing fertilizer and other input costs. The price has to be realistic and provide for a built-in incentive for quality.

For comparing field productivity the figure of "available sugar per hectare per month of standing crop" was considered the best.

The application of productivity studies and charts to guide the operators in maintaining optimum operation conditions in relation to throughput and losses was emphasised.

The quality of white sugar - direct consumption white sugar, or refined sugar to be produced, depends on the need and preference of the consumer and has to be controlled accordingly.

While 13 parameters were listed to specify the quality of raw sugar, the actual quality will also have to be related to the needs of the refiners, as their quality stipulations depend on the end use of the produots of the refining, as well as on the quality of raw sugar the refinery is equipped to handle.

The importance of disciplining the needs of product quality in the interest of economy and increased production was highlighted.

The control of the quality of in-process materials has as its objectives, the preparation of material balance sheets and maintenance of process variables at optimum levels, keeping an eye on the nature of the raw material being handled, as well as the efficiency level and product quality desired. Depending on the system of control adopted, the estimations of brix, pol or sucrose, fibre, moisture, pH and colour, provide specifications of the materials in process and an accurate determination of the quantities at different stages of production.

Process quality control involves numerous decisions relating to the precision required and the cost of obtaining the higher precision in relation to the value of the information.

Sampling errors need specific evaluation.

Undetermined loss if real, is costly, but may be the net result of imprecision in individual loss assessment, quality of raw material and quality of product. The law of propagation of errors needs to be applied and its implications understood.

8. Two papers were presented at this session:- (a) Repair and maintenance problems experienced in the sugar industry by S.M. Gundu Rao; (b) Sugar production equipment characteristics and spare parts by F.H.C. Kelly.

This subject was reviewed within the context of quickly increasing the production of sugar and also the means of production. Attention was focused on existing capacity - the reduction of idle time caused by avoidable machinery stoppages, and the optimisation of efficiency parameters by improved control.

Means for expansion of existing capacities and the installation of new production facilities were discussed under the following headings:-

Plant and machinery specifications should be functional, taking into basic consideration the technological level of each user since the effective capacity and efficiency of a factory as a production unit is determined by the men who operate the mill. It is therefore both wasteful and bad practice to apply sophisticated plant and machinery specifications for a factory to be operated by less sophisticated and experienced operational personnel.

Standardisation of plant and machinery specifications will simplify, accelerate and reduce the cost of machinery and plant manufacture and construction. Practices in India and Thailand were noted as examples.

This will also facilitiate other machinery manufacturing industries to switch to sugar machinery manufacture, e.g. ship-building facilities could switch to sugar (food) machinery manufacture.

Machinery manufacturing licensing arrangements should be reviewed with an aim to facilitate the transfer of lower and medium level technology to developing countries so that local manufacture in the user country can be maximised.

Countries, particularly developing ones, should review and up-date their

machinery regulations (if any) so that the regulations will not inhibit the desired rapid rate and low cost of technological development.

Suggestion

That UNIDO develop the above guidelines and effectively diffuse them to the appropriate parties involved, particularly developing countries and international financing institutions.

Repair and maintenance

Loss in production capacity due to avoidable downtime brought about by machinery and plant breakdowns is substantial and varies between 1.8% and 30% from country to country.

Causes

(a) Incorrect operation due to inexperienced and poor operatives leads to serious machinery damage and downtime.

(b) Poor inherent machinery design features in both workmanship and materials, e.g. defective roller metal resulting in premature polished rollers and slippages; rapid wear of pumps, due to absence of efficient sand catchers.

(c) Poor maintenance and repair supervision and workmanship. Proper logging of breakdowns can help scheduling and reduce the occurrence of breakdowns. Preventive maintenance can also be facilitated.

Lack of spare parts and consequent waiting for them can seriously prolong breakdowns.

Suggestions

(a) The UNIDO Secretariat assist to collate industry data pertaining to production capacity losses.

(b) That UNIDO assist in an exchange programme for maintenance personnel and operators amongst countries, e.g. cane versus palm oil operators, cane vs. beet etc.

(c) UNIDO assist to step-up the training of technical staff of key sugar operations within the industry.

(d) That factories in developing countries should not be used for prototype testing other than that on a mutually acceptable basis.

9. Two papers were presented at this session: (a) Tender documents to be prepared on the results of a feasibility study and technical data for plant specifications in the sugar industry by P. Hulpiau; (b) Industrial feasibility calculations in the sugar industry by P.H.G. Kelly.

In the first paper concrete examples were given of tender documents for a beet sugar factory of 2,000 tons/day with specifications for suitable plant and also plant for the recovery of sugar from molasses and a baker's yeast plant. The tender comprised a turn-key job and required specified technical guarantees from the suppliers.

In the second paper details were outlined of steps necessary for a feasibility study and the elaboration was suitable for either beet or cane sugar or for refinery projects. It could also be applied to the extension of existing plants.

Techniques for checking of estimates and the calculation of new locality costs were explained with the aid of appropriate formulae. The relative cost of preparing each step in a feasibility study was set out in such a way that the effectiveness of the proceeding could readily be recognised at any appropriate stage.

Difficulties of not knowing exact figures for inflation rate or of the influence of disasters which could happen (e.g. floods) were explained.

It was observed that the evaluation of profits (or other benefits) to be obtained, would depend to a large extent on the political outlook of the country concerned.

The following points were emphasized during the discussion:-

(1) The profitability of any project needs to be proved to any financing body who will become involved in the project. A cash flow diagram would show this clearly;

(2) The financial difference between sugar produced for export to world markets and sugar produced for local consumption was emphasised, especially in relation to current price conditions;

(3) A feasibility study or tender document for a turn-key job should show and elaborate all costs and cost factors;

(4) For special processes and machinery a special reference list of supplies should be submitted so that the economic value can be clearly calculated and the risk as far as possible reduced;

(5) In order to achieve the target for higher sugar production related to the increasing demand for sugar, greater emphasis should be placed on increasing the proportion of equipment fabricated in the developing countries themselves.

Whilst discussion largely centred on financial implications of any new development of a sugar factory, attention was drawn to the fact that this may not always be the chief motivating factor for the new development. Three main possible reasons were identified:-

(a) As a financial investment;

(b) As a service to the community;

(c) To develop a new area of country.

In fact, there may often be motivation towards two or even all three of these reasons. It is wise, however, first of all to itemise the reasons for the proposal and to define, as far as possible, the objectives, with some kind of time scale for stages of achievement.

10. One paper was presented at this session:- Offers and quotations for sugar production equipment and complete plants by F.H.C. Kelly.

The author drew attention to the following points:-

(a) The customer-vendor relationship often starts at the offer stage and it is at this point that misunderstandings must be detected and avoided;

(b) Costs, although escalating, must be observed against a background of rising salaries and improved living standards;

(c) The contract should be framed to cover payment conditions, arbitration opportunities, accommodation of wage escalation and, if called for, bonus/penalty clauses.

Discussion revealed strong interest in the following points:-

(1) <u>Escalating costs</u>

It was considered still to be the responsibility of the supplier to take account of escalating costs when preparing his tender. Differentiation of the local component was needed as an overseas supplier could not be held responsible for escalations in this component.

(2) <u>Supplier services</u>

The relative merits of a turn-key contract as compared with a contract controlled by a manager with a stake in the business were discussed. The need

to avoid the supply of obsolete or unsatisfactory equipment was emphasised. A reputable supplier could be expected also to provide technical management for a fixed term (e.g. two years) after installation, and also training services for a customer's staff if and when agreed, following the commissioning of a turn-key factory.

(3) Bonus/penalty clauses

The level of any bonus/penalty figure was considered to be primarily a matter of judgement on the part of the customer, bearing in mind the effect on his profits should completion be early or late. It should also be a matter for negotiations. Carefully prepared time scheduling was considered important.

(4) Advisory services on contract formulation

It was suggested that a standard form of contract would greatly simplify the task of the customer's engineers but doubts were expressed as to its practicability.

UNIDO could provide advisory services for evaluating bids, and could offer guidelines for such evaluations. A list of UNIDO publications relevant to this subject was quoted.

The responsibilities of consultancy engineers with respect to contracts need to be clearly defined.

(5) Guarantee considerations

Most suppliers will incorporate safety margins before they quote performance guarantees. To avoid disputes the methods of analysis to be employed in the determination of performances should be agreed and the details annexed to the contract.

The inspection of goods at the customer's premises may not necessarily absolve the supplier from his responsibilities with respect to performance guarantee

(6) Contracts between parties of different nationalities

The choice of language used for documents and the choice of an arbitration court, in the event of a dispute, were subjects which depended heavily on the government policy of the country concerned. The banks may name the official language, with respect to financial matters.

The translation of documents should be by an officially recognised, non-involved translator.

General preference was expressed for ultimate arbitration by the High Court in Rome, but in many developing countries this principle is not acceptable, the view being held that their own country should become the ultimate arbiter with respect to work done in their country.

(7) General

Emphasis was placed on the importance of clearly defining responsibilities in the first place, the need for careful study of the fine print in any document, terminology should be well understood by both parties. The specific requirements for work to be done by sub-contractors should be clearly defined.

11. One paper was presented at this session:- Test runs and take-over certifiicates of sugar production plants by F.H.C. Kelly.

It was recognised as of paramount importance that test runs for new equipment should be specified both for whole plant turn-key installations as well as for unit but nevertheless important items.

The necessity for writing test requirements into contractual agreements in the first place, was emphasized. This requires very careful preparation and substantial forethought. Such points as possible need for arbitration must be anticipated.

It is important to understand the policies of the country concerned, to be conversant with safety regulations and registration requirements. The effects of taxation, methods of financial transactions, internal pattern of wages and social benefits, currency stability and insurance cover available, are necessary information.

Discussion emphasised the need for careful preliminary specification of test run requirements. The nature of such specifications were discussed and conditions under which certificates of satisfaction are issued. Attention was also drawn to the place of warranties related to the expected life of equipment.

The quality of material is the responsibility of the supplier. The standard of competence of the operator is the responsibility of the sugar factory management but training may, by arrangement, be provided by the supplier of the equipment.

A definition of fair wear and tear must be agreed upon. This specification is difficult to put into quantitative terms.

The place of a commitment in a developing country was discussed intensively.

Comments from contributors to the discussion covered the following items:-

- What is a reasonable duration for a test run for take-over of a whole factory?

Opinions varied:-

(1) A continuous run for 7 days at the specified rate of tons of cane per day;

(2) Modification necessary for extreme climatic conditions;

(3) Provisional certificate for the first campaign;

(4) Turn-key projects can be given a test run for three days followed by load tests. Adjustments are made at this time and followed by a three day test under full load conditions;

(5) Provisional and final certificates should be issued and should be put together by a commission made up of representatives of both vendor and customer.

(6) The length of the final test run should be from 5 to 7 days.

(7) A take-over certificate involves three areas of concern:
   (a) specifications;
   (b) guaranties - technical requirements. Within two months of starting a factory, guaranties should be fulfilled;
   (c) waranties - this relates to guaranties of material and machinery for normal wear and tear. A reasonable test period would be for two campaigns.

(8) A two-week period is needed for testing capacity;

(9) In the beet industry a test run of six to seven days is usual or two five-day periods.

(10) Sometimes it is not possible to get the full period required for a test run in the first campaign due to cultivation or other cane supply problems. A two-day test period might have to suffice in the first campaign, followed by a three-day period in the second campaign.

Safety regulations are necessary for the preservation of life. Certificates for pressure vessels are under government supervision. Questions elicited the fact that the minimum pressure limit for certification varied from one country to another.

It was stated that vendors sometimes avoid their obligations, throwing undue blame on the quality of raw material input, or to a sub-standard situation of

operator qualifications.

The question was phrased "what is the role of consultants?"

Difficulties of obtaining adequate guarantees from suppliers were indicated, especially in relation to the effect of wear and tear.

Attention was drawn to the necessity for a good understanding between vendor and customer.

The view was expressed that there should be a distinct primary or partial take-over.

Attention was drawn to the importance of an effective infrastructure.

It was observed that consultants play an important role in the feasibility study and financing institutions require the employment of consultant firms with good credentials. Changing a consultant during erection can be a source of real trouble.

It was pointed out that UNIDO can do a lot to help but that the request must come through the government of the country concerned.

A decision about a contract is a legal matter but UNIDO experts are also available to help to reach the right decision.

There is a lot of government involvement in a sugar industry, but government involvement makes the sugar industry of special interest to UNIDO.

The work of a consulting engineer in a sugar factory is to help a client to solve problems. He is not the supplier and should not set time schedules but can be used to check schedules. He should help the supplier in overcoming local difficulties such as transport and sub-contracting, but not control of equipment.

A decision-maker relies heavily on a consultant but consultants are not decision makers.

In western countries test certificates are issued by government institutions to meet safety standards of the western country. Certificates may be difficult to get in a developing country because of the absence of sophisticated testing equipment. On the other hand, developing countries are progressively improving in this respect.

Developing countries should progressively build up their own consultants.

A take-over certificate is a very important stage, representing the transfer of responsibility from an experienced to a non-experienced party.

A consulting technologist can sub-let to specialists as a sub-consultant.

Are consultants aware of the real problems in a developing country? How are consultants picked by such international organisations as the World Bank?

UNIDO recruits experts of international experience and reputation. They should have no personal interests in the developing country. It is very difficult to find the right person and it is preferred to take a little longer to ensure selecting the right personnel.

ANNEX I

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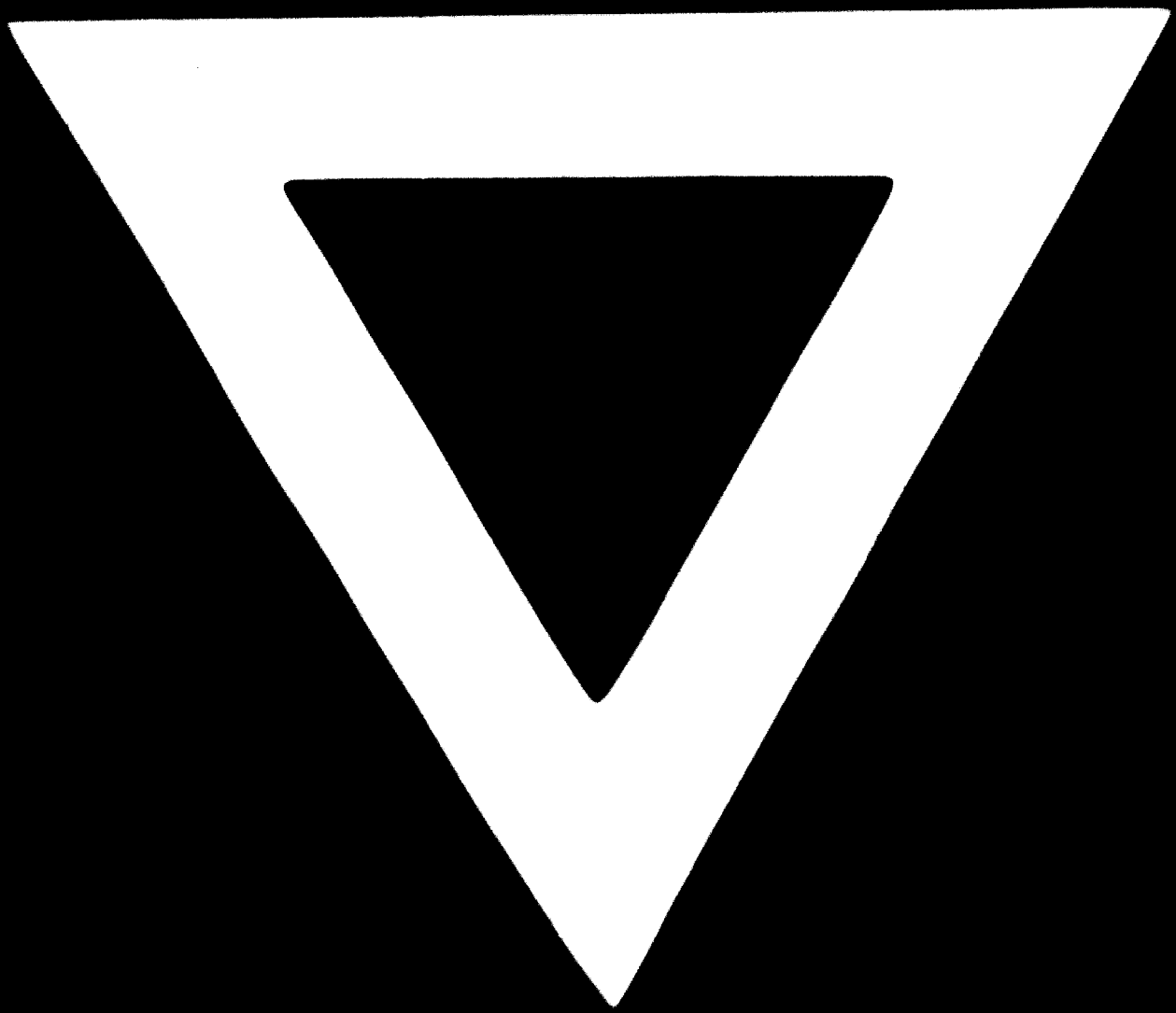
ANNEX II

LIST OF PAPERS PRESENTED TO THE MEETING 1/

ID/WG.191/1	-	Tender documents to be prepared on the results of a feasibility study and technical data for plant specifications in the sugar industry by R. Halpiem.
ID/WG.191/2	-	Unit operations and unit processes for beet and cane sugar production by G. Ausmiller.
ID/WG.191/3	-	Technical and technological processing considerations for beet and cane sugar production by G. Horvai.
ID/WG.191/Inf. 1	-	Information and remarks on eleven documents reviewing and analysing industrial sugar production activities by Frank H.C. Kelly.
ID/WG.191/4	-	Questions of nomenclature in the sugar industry by Frank H.C. Kelly.
ID/WG.191/5	-	Process flow in the sugar industry by Frank H.C. Kelly.
ID/WG.191/6	-	Unit operations in the sugar industry by Frank H.C. Kelly.
ID/WG.191/7	-	Safety and sanitary requirements in the sugar industry by Frank H.C. Kelly.
ID/WG.191/8	-	Water, steam, gas and energy supply for a sugar factory by Frank H.C. Kelly.
ID/WG.191/9	-	Thermo-technical evaluations of the sugar production process by Frank H.C. Kelly.
ID/WG.191/10	-	Quality control requirements of the sugar industry by Frank H.C. Kelly.
ID/WG.191/11	-	Sugar production equipment characteristics and spare parts by Frank H.C. Kelly.
ID/WG.191/12	-	Industrial feasibility calculations in the sugar industry by Frank H.C. Kelly.
ID/WG.191/13	-	Offers and quotations for sugar production equipment and complete plants by Frank H.C. Kelly.
ID/WG.191/14	-	Test runs and take-over certificates of sugar production plants by Frank H.C. Kelly.
ID/WG.191/15	-	Review of security and sanitary measures to be taken in a sugar factory by L. Noevedhe.
ID/WG.191/16	-	Water, steam, gas and energy supply and consumption problems experienced in the sugar industry by M.M. Tantawi.
ID/WG.191/17	-	[illegible] maintenance problems experienced in the sugar industry by [illegible]

1/ A limited number of copies are available upon request



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