TRAINING OF TECHNICAL PERSONNEL FOR THE SUGAR INDUSTRY

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SUMMARY

This paper aims to discuss the training required for technical personnel in the sugar industry with relation to the type of training and the standard of qualification required. It aims to deal mainly with the requirements at the top level for positions such as Factory Superintendent or Factory Manager, but also adds some comments on the standard of training required for personnel at the lower level of shift supervision.

The need for efficiency in operation of the process under modern conditions is obvious, and should need no emphasis. Modern scientific knowledge and technology have given the know-how for operation of the manufacturing process at a high efficiency; to maintain operation at that high level of efficiency, scientific control and management are essential, and a high standard of training is necessary for the personnel charged with supervision of the plant and process. A high efficiency of operation is essential, not only for the sake of the financial benefit of the organization operating the plant in competition with other factories or other countries, but for the efficient utilization of the world's natural resources in the production of an essential commodity.

GRADES OF STAFF

Control of the process takes place at two levels, the persons responsible being:
(1) The Factory Superintendent, sometimes designated as Chief Chemist or Mill Manager, who is responsible to the management for the process as a whole.
(2) The Shift Superintendent or Shift Chemist, who is responsible for routine supervision.

The factory superintendent will normally have one or more senior assistants, one of them perhaps being a technical officer concerned mainly with trouble-shooting and investigation of operating problems. Research, using the term in its correct sense, will generally be the function of a central research organisation serving a large section of the industry rather than an individual factory. Three shift supervisors will of course be required for round-the-clock supervision, or four where rostered for continuous operation over weekends.

TRAINING FOR HIGHER POSTS

We shall consider first the training required for those at the higher level, the factory superintendent and his colleagues. He is responsible for operating the plant at its
maximum economic efficiency, and must be able to cope not merely with normal conditions, but with the abnormalities which occur from time to time. Such departures from normal are perhaps more frequent in a sugar mill than in most process industries, on account of the great variations in the raw material. His training must be therefore at a high level, and must cover a sound basic knowledge of the various operations making up the overall process, be it manufacture or refining.

Suitability of Chemical Engineering Qualifications

These operations are in fact the unit operations of Chemical Engineering, many of them, such as multiple effect evaporation, filtration, vacuum boiling and centrifugal separation, having originated in the sugar industry before chemical engineering developed as a separate discipline. Thus the senior man in charge of the process should preferably be a chemical engineer by training. Davis discusses the development of these unit operations in the sugar industry, and comments that the chemical engineer in any industry is particularly interested in economic aspects, being concerned with the preservation and extraction of the valuable product—in this case sugar—at minimum total cost. His training and his interests consequently often lead him to a position in management and administration in a process industry such as sugar. Prince in discussing the place of chemical engineering in the sugar industry, emphasises the widely based education of the chemical engineer*. A chemical engineering course has as its core the systematic study of unit operations, while it also includes much other material such as study of basic sciences, mathematics, thermodynamics and industrial administration. These subjects are all taught from basic principles so that they are useful to a wide range of industries, rather than being aimed at the study of a particular industry.

A degree in chemical engineering therefore gives a widely based training in the principles of operation of process industries; these are the basic methods used in the sugar industry, and give a sound theoretical basis, as far as possible, for the operations concerned. It may be argued that a training more specifically directed towards the sugar industry would be more valuable. This contention is discussed by Prince, who quotes the claim that graduates from a widely based course are not as immediately useful when entering industry, since they are not familiar with the specialised problems of a particular industry or with its special language. He concludes however that any disadvantage of this kind is outweighed by the more thorough coverage of first principles and the more extensive treatment of contemporary techniques which are common to all process industries. The widely based course also includes knowledge gained from the experience of other industries, e.g. process control methods from the petroleum and chemical industries. In order to include within a reasonable period of four years the large amount of material required in a modern University course, unnecessary material such as detailed consideration of specific industries must be rigorously curtailed.

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* The following sections dealing with chemical engineering training are largely a summary of portion of Professor Prince's paper.
Queensland courses

The development of the chemical engineering course at the University of Queensland may be briefly outlined as illustrating what is perhaps a general trend. The course was originally founded about 1920, and was designated as Applied Science in Industrial Chemistry. While a parallel course giving a degree in chemical engineering was instituted a few years later, the main course was that in industrial chemistry, and in 1957 a fifth year was offered which, following on the four year course in industrial chemistry, gave a degree in chemical engineering. In 1951, a one year course in Sugar Technology was instituted. This was a postgraduate course following on the degree in industrial chemistry; thus the recommended training for a career in the sugar industry was the four-year course in industrial chemistry, plus a year on sugar technology. The postgraduate course was subsidized by the Queensland sugar industry through the Bureau of Sugar Experiment Stations, which covered the full operating cost of the course as well as offering scholarships to interested students. At the end of 1963 the industry withdrew its subsidy on account of the small number of students offering, and the course was accordingly discontinued, the scholarships provided by the Bureau being now available to students undertaking the chemical engineering degree course. An important factor contributing to the shortage of students for the Sugar Technology course was no doubt the alternative of an extra year for the degree in Chemical Engineering; this, being useful in any industry, often proved more attractive to students than the sugar technology course which was useful only in the sugar industry.

In 1965 a full department of chemical engineering was founded, and the course was reorganised to give a B.E. degree in chemical engineering after four years of study. The postgraduate course in sugar technology, if it had been still in existence, would have followed more logically on this degree, without the competition of a second degree obtainable with a further year's study.

Specialised training in sugar technology

While accepting that the chemical engineering degree, with its wide coverage of the principles applied in various industries, offers the most suitable training, the writer considers that some specialised training in Sugar Technology would be valuable to supplement that degree. One Queensland graduate remarked that the postgraduate diploma course in sugar technology had given him a knowledge of the industry which otherwise would have required four years' experience. Referring again to Queensland practice, the present chemical engineering curriculum offers a short course in sugar technology as an optional subject in its final year. While this gives some brief introduction to the practice and special problems of the sugar industry, some further specialised post-graduate study would appear desirable. Prince comments that the University looks quite deliberately to industry to do any further training of this sort, and this would indeed seem quite reasonable. The writer would suggest that such a course would best be conducted by the appropriate Sugar Institute as indeed is done in some cases, e.g. in Hawaii and India. The nature and duration of such specialised courses would depend on the particular needs and practice of the industry concerned, and on the training already covered by the graduate. It is
suggested that, following on a chemical engineering degree, a short course of a few months at an industry-operated institute in a sugar district would be quite appropriate and sufficient. Generally, such a course could be fitted in quite well with the research and technical programme of the institute, and could be covered between the completion of the University course and the commencement of the next crushing season.

Training in sugar institutes

The post-graduate diploma course in Queensland, during its rather short life, attracted a number of students from South Africa, India and Pakistan, demonstrating a considerable interest in a course of that nature. It is suggested however that such countries could well conduct the specialised sugar courses in their own institutes, as has long been done in one of those countries. Such sugar institutes can in fact be considered as serving their local industries in three distinct fields: technical advice, research and the training of technologists.

Qualifications of staff for institutes

The training and recruitment of staff for such Institutes is of course an important matter. For the research staff, specialists in various fields will be required—Chemists, Mechanical and Electrical Engineers, as well as Chemical Engineers: for the technical advisory work, chemical engineers will probably perform the most useful role. These officers should have higher degrees and some training in research methods. The numerical strength of the staff in such an institute will of course depend on its stage of development and that of the industry which it serves. In a less developed industry, attention will naturally be concentrated on the technical advisory or "extension" functions, rather than real research; otherwise, the not unfamiliar situation can well develop where a select number of staff are doing worthwhile research, but where a serious gap exists between the standard of their work and that of an industry working at a low standard of efficiency. Close liaison between the institute and the industry is essential.

Training for routine supervision

While the prime object of this Symposium has been stated as promoting interest for high and specialised training, a request has been made that some comments should be included on the training of staff for work at the lower level of routine process supervision.

Efficient day and night supervision of the process at every step is important to maintain operation at its optimum, and to see that the methods and standards of the factory superintendent are fully carried out. As such shift supervisors are mainly carrying out instructions rather than making decisions, they do not require such a high standard of training as the man in charge of the whole process. They must however have a sound understanding of the process and the underlying prin-
ciples determining its control, so as to be able to make correct decisions on the minor matters which fall within their province in the round-the-clock supervision of the process.

**Technical college courses**

Suitable training for such supervisory staff can be well provided at the Technical College level; in Queensland such training has been provided for some 30 years by a Technical College course of four years' duration occupying about five months per year, and conducted during the slack season. Thus the student can obtain employment in a sugar factory during the crushing season, and gain some useful experience as well as earning some income. Entrance qualification is a pass in the Junior examination (two years short of matriculation standard) and four years' work leads to the award of a certificate in Sugar Chemistry. The course has been modified considerably over the years, but has maintained these characteristics, aiming to give the student the necessary knowledge for an intelligent supervision of the process, with a moderate general education standard.

While the general scheme of such a course would appear quite satisfactory, a somewhat higher standard would be desirable. The writer would prefer to see matriculation required as entrance qualification, with a correspondingly improved standard from the four seasons' course. This would also facilitate subsequent admission to a University course where warranted. A broader chemical engineering basis would also be desirable, consistent with the emphasis in earlier paragraphs on the value of chemical engineering training at the degree level.

**Training within industry**

On the other hand, it is common experience to find men with lower qualifications who still have the potential ability to make good shift supervisors. Such men are often found among process operators and, with some carefully planned training, can to a great extent, make up for their deficiencies in basic training by their experience and familiarity with the process as a whole. Training of such people within the industry is something which can be effectively done with the right attitude on the part of management.

Training of process workers for the various jobs in the factory is again a responsibility of the management. Such training will give them an intelligent interest in the work and improve their satisfaction in doing the job, as well as enhancing their usefulness to the organisation. This however is rather beyond the scope of the present paper.

**Routine analytical work**

Routine analytical work constitutes a third level of technical staff. This is an important task, as it involves careful and conscientious skilled work, and forms the basis of all chemical control and generally of payment for cane and specification of the finished product. This is often done by junior chemists who are in the course...
of qualifying for a certificate, such as that mentioned in a previous paragraph, which will qualify them as shift supervisors. Given the opportunity, such persons will generally qualify and step up to the more responsible position of process supervision. As the analyst progresses in his bench job, he should be given the opportunity to gain experience on the plant; and some degree of interchangeability between laboratory and process supervision staff is highly desirable.

The author would submit that the most suitable qualification for the factory superintendent is a chemical engineering degree, preferably supplemented by a short specialised course in sugar technology; while the shift supervisor will be well equipped by a course at Technical College standard. The latter course can well be of the "sandwich" type, conducted during the slack season, so that the trainee chemist can gain experience during the crushing seasons (generally on the basic job of routine analysis) which will help him to progress to the supervisory job. Depending on availability of trained personnel, some persons with less formal qualification, but with the right qualities in other directions, may well fill the routine supervisory positions quite creditably.

Some prominence has been given to Queensland courses, not because such courses are considered the best, but because they follow a pattern which appears generally suitable.

AUTHOR’S COMMENT (Written Contribution to Discussion)

No mention has been made of training personnel for the cane growing side of the industry, since the author’s qualifications and experience have been on the factory side only. It is suggested however that a rather similar scheme could be recommended for the field side, e.g. a University course leading to a degree in Agricultural Science or a kindred discipline, supplemented by a short period of specialised training in the sugar industry; the latter could effectively done at one of the agricultural institutes conducted by the industry.

REFERENCES

1 Davis C.W., (1967). Raw Cane Sugar, Manufacture and the Chemical Engineer. University of Queensland Press.

Discussion

M. A. Mascaro: There is a need for further special post-graduate courses for both scientists and chemists in the sugar industry. This has been overlooked in the past.

R. Grant: Courses should also be instituted at universities to update the information and knowledge of professionals working in the agricultural side of the industry.

H. J. Delavier: The Berlin Sugar Institute offers a higher course for sugar technologists. Sugar technologists should be trained in chemistry, chemical engineering and economics to understand all basic problems in the industry.

J. D. De Saint Antoine: Training facilities are offered in Mauritius in a three year course including sugar manufacturing and engineering or agronomy at the College of Agriculture.

A. G. Ramos: We must also bear in mind that the sugar industry also includes art as well as science. This short training course looks to me one aim to preserve the art part of it, if we con-
sider that we start with sucrose and end up with it we may apply instrumentation to the process to make it more.

M. Matic: Do you feel that there is no chemistry in the sugar industry? I consider that there is a large area which needs a great deal more science, especially in physical chemistry.

J. W. Wilson: We have a Sugarcane Agronomists Association which aims, with the help of the Experiment Station, to keep pace with new techniques and advances.