Editor's Note:

In May of 1986 Holly Sugar Corporation lost three key employees in a plane crash. They were Jack Corsberg, Harold Grinde, and Gordon Shemilt. In memory of their colleagues Holly established a "Lecture Series Fund" to which the U.S. sugar industry has contributed. The purpose of this fund was to allow the Beet Sugar Development Foundation to invite prominent members of the international sugar fraternity to speak to the students in attendance at the McGinnis Institute of Beet Sugar Technology.

The following transcript is presented as a non-reviewed publication representing the view of the lecturer on subjects of global importance offered in memory of professional colleagues:

Corsberg, Grinde, and Shemilt Memorial Lecture*

Tom Rodgers
Vice Chairman of the Board (Retired), British Sugar Corporation

I must start by saying that I regard it as a considerable honor to be invited by Holly Sugar Corporation to give this first lecture of a series which they have set up to commemmorate three of their senior managers who were tragically killed in 1986. No national sugar industry can afford to lose three senior executies at one stroke – not even one as large as the United States. Serious as this loss would be for any one industry, it is an even greater disaster when all come from one company. However, such tragedies do happen, and in these sad circumstances I cannot think of a better way to commemmorate their colleagues than for their friends from Holly to inaugurate a series of lectures about the industry to which the three have devoted the greater part of their lives.

I said it was an honor to give this talk, but I realize that it is also a considerable responsibility to address a group of whom some will become leaders of the U.S. beet sugar industry in the future.

When I was first told that 2 hours had been allocated for this presentation, my thoughts went back to the first technical paper which I presented in your country – at an A.S.S.B.T. meeting many years ago. I had on that occasion what I thought was a good, and interesting story to tell on some new work on crystallization. When I was making my preparations in England, one of my colleagues – senior to me – was offering some helpful

*Lecture given to students of the McGinnis Institute of Beet Sugar Technology at Colorado State University, Fort Collins, Colorado on July 13, 1987 advice. Don't forget to explain this! Remember to emphasise that! Stress this point! Show some slides of sugar crystals. I had to stop him to explain that I had been allocated exactly 10 minutes for this presentation. His response was immediate. "Look Here! If they try to stop you before you have finished, tell them you have not travelled 6,000 miles to be shut up after 10 minutes".

Well, fortunately it did not come to that, I just about managed to pack into the ten minutes all that was necessary because I was grateful for the opportunity to attend. Now you can see how circumstances have changed. On this occasion I cannot present any original work, nor have I an exciting story to tell, yet I am allowed 2 hours! All I have to offer are my thoughts and experiences of a working career in the beet sugar industry in England.

An experienced person was defined by that well known Irish playwright, and cynic, Bernard Shaw, as someone who continues to make the same mistakes as his forefathers. There can be an element of truth in that. However, if we look on the posititve side, experience can also help to avoid the mistakes of the past and that is what I want to concentrate on and offer this morning. Because I have made a few in my time.

I can start in an optimistic mood and assure you with every confidence that those of you who make your career in sugar will find it both an intriguing and satisfying job, one in which you will make many friends, both in your own country and internationally. Whether or not you also make a lot of money is up to you. But you will meet many good and helpful people. I suggest that is an important consideration. As I have said, that I intend to tell you something about my own experiences; it seems I might start by saying something briefly about my own training and career. That will have the benefit of telling you something about my background, something about the company for which I worked and also give you a clue to the sort of level at which I aim to pitch this talk.

By training I am a chemical engineer. I guess many of you will have heard that somewhat slanderous definition of a chemical engineer as a person who talks about engineering in the presence of chemists, about chemistry in the company of engineers, and about the weather in the presence of both. From the list of qualifications and experience assembled before me this morning, I did wonder if I should simply ask you if you felt that we should have fair weather today – and leave it at that.

My career in sugar started in 1945 when I joined British Sugar, which was then, and still is the only beet sugar company operating in Britain. It is also the largest beet sugar company in the world – if we leave aside the nationalised companies of the Eastern Bloc. At that time, it operated 18 factories, mostly built in the 1920's and they were in a rather dilapidated condition because we had just emerged from the Second World War when the minimum money was spent on their upkeep. The big advantage was that there was plenty of scope for improvement.

I was fortunate enough to spend my first 3 and a bit years at the technical headquarters where I was among certainly the best technologists in our company. I have to say that this was very valuable experience, and made a lasting impact on me. Since that time, I have felt strongly that any young, qualified recruits should have the opportunity to spend a year or two in a central office position in his early years in the business – the earlier the better. I agree, he may not be able to contribute too much at the beginning, but he is given the opportunity to contribute a lot more later in his career. It is too easy, and too bad, for a young engineer to get lost in a factory in the hurly burly of the campaign when the management has too much on their plates to give time to explain to him what it is all about. Of course, I appreciate it is not always easy, or convenient for the company, to make such arrangements, and it does take up some of the valuable time of senior executives. But, after all, the investment in good, well-trained staff, is one of the most expensive, and worthwhile that any company is likely to make, and it is arguably the most important duty of any executive to ensure adequate succession. That is the reason that I believe that this particular annual institute, which is sponsored by the U.S. beet sugar industry, is a very valuable one both for the students, as individuals, and for the industry also.

After my stay at head office, I spent a total of 14 years in 4 factories going through line management jobs – shift superintendent, assistant works manager and finally 5 years as factory manager. In 1963 I returned to our head office with the somewhat grandiose title of Planning and Development Engineer, which really meant that I made proposals but not decisions for new investment in our factories, and also assessed new equipment in other countries. At that time, now the mid 1960's, we were running an annual capital expenditure program of about $5 million, not really very much when spread over 18 factories, although a good deal of new plant had already been installed since the mid 1950's, and new equipment costs were, of course, very much lower than today's prices.

By the late 1960's it was becoming apparent that the U.K. would probably enter the European Economic Community which had been formed in 1957. We also knew that our probable future competitors on mainland Europe had several lengths start on us and that they were already earning enough to make much larger capital budgets per factory than we in England. We, therefore, started planning for higher annual investments. In 1970, I became production and technical director of the company – a main board appointment equivalent, I believe, to your vice president – operations. I continued with these responsibilities until my retirement in 1983, although I had added responsibilities and new titles in later years, first as deputy chief executive and finally vice chairman of the board.

You will now understand, whatever my titles, that I have been associated directly with beet sugar factory operations almost all my working life, and that the last 13 years – 1970 to 1983 – was a period of great development in British Sugar. The annual capital investment budget was running between $30 to $40 million. This was possible because earnings were very good within the E.E.C. sugar regime, which Britain had, in fact, joined in 1973. In that 13 year period we raised our company processing capacity from 60,000 tonnes beet per day, from 18 factories in 1970, to 80,000 tonnes per day from 13 factories in 1982. These are metric tonnes of 1,000 kilos, about 10% greater than the U.S. ton.

Figure 1. British Sugar Corporation 1950-1983

Year	No. Factories	Average Daily Slice T/Day	Campaign Sugar Production Raw	White	Average Factory Campaign Production
1950	18	45,000	200,000	560,000	42,000
1960	18	51,000	200,000	650,000	47,000
1970	18	60,000	220,000	680,000	50,000
1973	17	59,000	245,000	700,000	55,500
1983	13	80,000	NIL	1,400,000	104,500

From the financial aspect, the most important result was that in 1970 British Sugar was producing around 900,000 tonnes of sugar per campaign, of which just under 700,000 tonnes was white and the remainder was raw sugar which we sold to Tate and Lyle for refining. The latter was a stupid, uneconomic arrangement, but there were historical reasons. In the 1982/83 campaign, we produced over 1.4 million tonnes, all white. So the average annual sugar production per factory moved up from about 50,000 tonnes in 1970 to 100,000 tonnes per factory in 1983. That is obviously a considerable improvement in plant utilization and productivity and a major cost reducing exercise. Provided it is not necessary to transport the beets too far, the big factories obviously have a cost advantage over the smaller ones.

From my training and background, I am sure you will have a good clue about how I shall pitch this talk today. You would scarcely expect me to give you a learned discourse on the chemistry of the sugar manufacturing process, nor even a detailed discussion on the design of sugar making plant and equipment. And you would be quite correct. I intend to concentrate on that part of the job which I know best, factory operations, not only because I know it best, but because I think it will be the subject in which the majority of you will have the greatest long-term interest. I want to examine the principal production costs in our process and the technical measures we can take to minimize them, to highlight the basic understanding of the process, which every good technologist should have at his fingertips, so that quick decisions can be made. In our industry – unlike many other chemical industries – the chemical composition and processing characteristics of our raw material changes every compaign, and even within a campaign. So, to get optimum results, quick responses on the operating parameters of the factory are essential, and it is the sugar technologists job to not only react to these changes but even, hopefully, to anticipate them from his previous experiences.

Let me make it clear that I do not want in any way to underrate the importance of the specialist – chemist or engineer – to the processing of the side of the industry. Their job is to analyze problems that have occurred and advise management on the reasons so that future problems can be understood and handled correctly. However, I am sure you know that whenever a change is made in operating parameters there are often several interactions, and it is the technologists job to consider all the likely effects of any change before it is made by using his past experience. The technologist who can grasp quickly the salient problem and cast aside the trivia is the one most likely to succeed. In a nutshell, keep your eye on the key problems.

I have already told you something about myself and the company for which I worked, but before going on to more detailed discussions of the beet sugar manufacturing process and the associated costs, I think it would be interesting to give some information about the beet sugar industry in Europe and particularly its development within the EEC. One good reason for this is because it is a good example of an industry which is tightly regulated by financial controls, and where a complete knowledge of these controls is absolutely essential. This is no easy task because the rules and costs are being continually updated in order to accomodate market requirements. Figure 2 gives some general information about the current processing capacity and sugar production capability of the principal national companies operating in the EEC for the 1985/86 campaign before the entry of Spain and Portugal. Sweden is included although not a member of the EEC.

While the average beet throughput rate is fixed, more or less, in any year according to individual factory capacities, the total annual sugar production will vary depending on length of campaign.

One rather noticeable feature on Mainland Europe is the relatively short campaign, varying within the range of 70 – 90 days. Of the E.E.C. companies, only British Sugar is consistently more than 100 days. In fact, 1985/86 was a shorter campaign than normal in Europe and British Sugar normally plans to operate for an average

Figure 2. Company Comparisons, Throughput and Production – Campaign 1985/86

Company	No. Factories	Factory Capacity T/Day	Campaign Length Days	Sugar Production x 1,000 T	Av Sugar Prod. per factory per Campaign
British Sugar	13	6,016	110	1,212	93,230
Danish Sugar	5	7,346	88	456	91,200
C.S.M. Holland	4	7,490	75	299	74,750
Suiker Unie Holland	6	8,838	81	547	91,667
Rhineland (P&L) W. Germany	5	5,521	74	308	61,600
Sud Zucker W. Germany	7	10,716	85	970	138,571
Frankenzucker W. Germany	4	7,585	75	352	88,000
G.T.S. France	11	7,606	71	—	—
Tirlemont Belgium	7	8,158	69	574	82,000
Swedish Sugar	7	4,363	71	318	45,428
Italy	40	5,130	—	1,243	31,075

120 day campaign. We are convinced this is right for the British climate, but we do not press this point, as it is to British Sugar's advantage to operate longer than European companies.

FORMATION AND DEVELOPMENT OF THE EUROPEAN ECONOMIC COMMUNITY

The European Economic Community was formed by the signing of the Treaty of Rome in March 1957, although the Treaty actually came into force on 1st January 1958. The original 6 Member States were Belgium, Germany, France, Italy, Luxemburg and Netherlands. However, to examine the reasons for its formation, we must go back to the end of the War in Europe in 1945. At that time, the six countries which were to be the original signatories, had only one thing in common, namely, that their lands and manufacturing industries had suffered tremendous devastation in the previous six years of war. In fact, excluding Eastern European Countries and the U.S.S.R., – who incidentially, also combined after World War II, but maybe not for the same reasons – the six original Members had suffered the greatest damage to their economies, paradoxically, often at the hands of other Member States. Production of food on mainland Europe was well below consumption and considerable quantitites of basic food stuffs were being imported.

Post-war rationing of some foods, including sugar, was going on until the 50's. Furthermore the loss of lives in The War meant that labor was in short supply. Germany, France and Holland were importing labor from Turkey, South-East Europe, North Africa and the old Dutch East Indies, respectively. U.K. was also bringing in labor from the West Indies and Africa. Conditions were very different from today, when surplus labor is creating high unemployment.

THE IMPORTANCE OF THE AGRICULTURAL ASPECT

In the early 1950's, when the idea of a Common Market was conceived, the percentage of the working population of the six States engaged in agriculture was near to 25%. That number has dropped by about 1 – 10% a year since late 1950's, based on total working population. But in 1958, when the Treaty came into operation there were still over 17 million people in farming. When the community was enlarged by the entry of U.K., Eire and Denmark in 1973, there were still 10 million people of the original six countries, living directly from the land. It is for that reason that agriculture has been given a very important place in the Common Market. Farming was a central factor in community life and commerce, and in any design for unifying the economies of Western Europe agriculture had inevitably a central role to play. In fact, in the original Treaty of Rome in 1957 the first step in the timetable of reforms was elimination of customs tariffs between Member States, and at the same time imposing common customs tariffs with Non-Member States. The second step was, and I quote, "the adoption of a common policy in the sphere of agriculture."

It is for these reasons that the Common Agriculture Policy – CAP for short – has been described as the engine of the Common Market. Despite the problems which have arisen during its introduction and implementation, it has been a forceful instrument of European integration. Agriculture is, of course, traditionally a sector for interventionist governmental policies – as you in the beet sugar industry of the United States well know, I am sure. The fact that in Europe, during the last 30 years or so, we have seen 12 divergent farming systems being brought under a common policy, is a measure of the scale of achievement.

The basic principles of the Common Farm Policy of the Treaty of Rome were (1) to increase agricultural activity, (2) to ensure a fair standard of living for those working on the land, (3) to stabilize markets, and (4) to ensure reasonable prices to consumers. But all this is not just a matter of abandoning tariffs. For strategic, social and economic considerations – including the vagaries of the weather – virtually all governments exercise special and often complex policies to agriculture. The governments of the six Member States were no exception. Rationalizing all that was a daunting task.

So the community's policy was gradually developed with the aims of:

- Allowing free competition between Farmers in Member Companies
- Eliminating unequal treatment in different areas
- Providing help for the modernization of European Agriculture.

In 1973 the six original Members were increased to nine when Denmark, Eire and Britain joined. Greece was admitted to membership in the early 1980's, and last year Spain and Portugal joined. Now Turkey is making noises about entry. At present five Member Countries are located on the Mediterranean, which of course, has a climate which allows production of fruit and vegetables which cannot be grown in Northern Europe. This is significant for self sufficiency within Europe.

In addition, agricultural yields have forged ahead in the past 15 years, so that the E.E.C. is now a net exporter of most agricultural products, instead of a net importer as in the 1950's and 60's. However, this change is not entirely due to the formation of E.E.C. but largely the result of significantly increased yields for agriculture worldwide. Nevertheless, as self sufficiency was one of the main objectives of the common agricultural policy, one can only say that on this basis, the policy has been a great success for Europe. However, there is another side to the coin, and an important one. For such a large market as is compounded by the present 12 Member States, a switch from large importer to large exporter has had important trade effects around the world. Certainly, in the commodity markets in which the E.E.C. can climatically compete it has come in for a great deal of criticism. And let me make it quite clear that there is also concern about this in Europe, and steps have been, and continue to be taken to constrain production of certain crops – for example, sugar beet.

However, it is difficult to make sudden changes in agricultural production, and it will take time to be implemented.

Gentlemen, that paints a very brief picture of the background, formation and progress of agriculture in Europe since the 1950's. It has changed farming from almost a peasant industry of small holdings into a large scale business. It has shown the greatest level of integration ever, between the present Member States. It has been fortunate that in its lifetime, agriculture, world wide, has probably made more scientific advances – I mean in seed breeding, herbicides, pesticides, mechanisation, livestock breeding, etc., than ever before. It is understandable that agriculture has been called the engine of the European Economic Community.

Of course, sugar is our particular interest today, and it is administered and controlled by the sugar regime. I intend now to give you more details of this regime, particularly the production and financial controls on sugarbeet growers and beet sugar manufacturers.

BRIEF DESCRIPTION OF E.E.C. SUGAR REGIME

The basic function of the sugar regime is to control the price and production of sugarbeet and the manufacturing and marketing of all sugar within the community. Indeed, it has now spread to encompass the marketing of all sweeteners. The principal non-sucrose sweeteners in Europe are corn syrup and high fructose corn syrup at present.

The sugar regime is designed to be even-handed between the farmer on the one hand and the sugar producer, or manufacturer, on the other. It fixes minimum farm prices for sugarbeet, which in effect influence the price of sugar within the E.E.C. As already explained, an important first objective of the C.A.P. in Europe was to encourage self sufficiency among member states. This policy has been so successful that from being a net importer the E.E.C. is now an exporter of sugar, as well as cereals, dairy products, meat, etc. Nevertheless, the E.E.C. has accepted its obligations to member states, in so far as any long term importing contracts entered into before a member state joined the community, are now fulfilled by the E.E.C. For example, the Lome Convention still guarantees a market for sugar within Europe of over one million tonnes per year, which Britain had contracted with its old commonwealth countries under the commonwealth sugar agreement. (Figure 3) France also has a right to import about 460,000 tonnes per year, at E.E.C. prices, from islands such as Reunion, Guadeloupe and Martinque. Although France regards these overseas departments of France.

Figure 3. EEC Regulations Protocol on A.C.P Sugars

Country	Tonnes	Country	Tonnes
Barbados	50,049	P.R. Congo	10,000
Belize	40,105	St. Christoph	15,394
Fiji	164,862	Surinam	0
Guyana	158,935	Swaziland	117,450
Ivory Coast	10,000	Tanzania	10,000
Jamaica	118,300	Trinidad	43,500
Kenya	5,000	Uganda	0
Madagascar	10,573	Zimbabwe	30,000
Malawi	20,618		
Mauritius	489,914	Total	1,294,700
D.O.M.	460,000		
TOTAL	1,755,000		

The sugar regime is complicated in detail, but as these finer details are not necessary for this meeting, I intend to concentrate on the basic controls, because they have an important impact on the world sugar market. Largely because of the importance of sugar production to the so-called underdeveloped countries of the world, combined with the attractions of sugarbeet to arable farmers, the community rules on sugar impose more discipline on the sugar sector than those for most other commodities. The system combines production quotas, support buying and penalities for over production. The original requirements to achieve self-sufficiency, together with the overall community aims for agriculture, meant that prices were set initially on the high side, and indeed still remain above most world prices. Of course, that is also true of commodity prices in many world countries.

Nevertheless, within the E.E.C., these price levels have given a good return to growers and processors alike, and encouraged large investments in the industry over the years. The result is that the E.E.C. has now probably the most efficient beet sugar industry in the world-in terms of land, fuel and manufacturing supplies.

Of the present 12 member countries in the E.E.C., 10 have beet sugar industries, the exceptions being Luxemburg and Portugal. Each country with an industry is allocated a basic quantity, or quota, for white sugar production. (See Figure 4) These national quotas were originially based on annual consumption in the countries concerned and are sometimes referred to as a quota. It is clear, therefore, that there was no original plan to produce sugar in excess of community requirements. It is then the responsibility of national governments to divide these quotas between the sugar factories or companies in its territory, and it was up to the individual factories, or companies, to ensure that they get the supplies of sugarbeet to meet their quota. Similarly, basic prices are fixed annually for sugarbeet and also for white sugar, and in the case of sugar they are fixed for the area of greatest surplus – which is Northern France – and the derived prices increase towards the deficit areas. The sugarbeet minimum price is a minimum that must be paid, but normally a higher price is paid following negotiations between each company and its growers. (Figure 5)

Figure 4. E.E.C. Regulations Sugar Marketing Year – 1985/86

Member State	Basic Quantities – 1985/86 A-Quota Tonnes	B-Quota Tonnes	Total Quota Tonnes	Actual Production Tonnes	B/A %
Germany	1,990,000	612,313	2,602,313	2,895,324	30.8
France + D.O.M.	3,432,000	852,483	4,284,433	4,513,089	24.8
Italy	1,320,000	248,250	1,568,250	1,274,282	18.8
Netherlands	690,000	182,000	872,000	935,058	26.4
Bleu	680,000	146,000	826,000	836,868	21.5
U.K.	1,040,000	104,000	1,144,000	1,325,000	10.0
Denmark	328,000	96,629	424,629	547,287	29.5
Ireland	182,000	19,200	200,200	221,631	10.0
Greece	290,000	29,000	319,000	217,856	10.0
E.E.C.(10)	9,516,000	2,242,225	12,746,006	12,507,395	—
		1986-87			
Spain	960,000	40,000	1,000,000	901,000	4.2
Portugal	72,726	7,273	80,000	5,000	10.0
E.E.C.(12)	10,539,636	2,288,589	13,652,006	13,413,395	—

The basic price of sugar is designated the target price and is the price which the manufacturer is expected to achieve in the market place corresponding to the basic price for sugarbeet. Community policy is really geared to keep market prices as close as possible to target prices – in French the "Prix Indicatif". However, the price in the market place may fall below the targe price, and if it falls to the intervention price which is also fixed annually and is about 5% less than the target price, then at that level the producer has the right to ask his own national intervention agency to buy the sugar from him at the intervention price and the agency must do so. The future disposal of this sugar – usually on to the world market – is done by the intervention authorities, who have to bear any financial loss. Thus the grower and producer are guaranteed, in effect, a minimum price for all quota sugar, viz. the intervention price.

There is a third price, the threshold price, which is the minimum import price at which non-community sugar, (or other commodities), may be delivered at community ports. This price is about 10% above target price, and if commodities are delivered at a lower price, then a levy is applied to bring it up to threshold price.

These are the fundamental rules controlling the quotas and prices.

Now, we all know that agricultural yields cannot be forecast precisely in advance – like building motor cars – so some elasticity had to be built into the system, but with appropriate safeguards. This was achieved by introducing a second quota, usually referred to as a B quota, (See Figure 4) which really represented over-production of A quota. Originally B quota was equivalent in tonnage to 35% of the A quota, for all member countries. This has now been considerably reduced to control over-production, and current B quotas now vary from country to country with maxima in Germany, France and Denmark of 30% of A, down to 10% of A in U.K., Ireland and Greece. The safeguard against over-production is in the form of a fine, or levy, which the manufactuer must pay back into community funds, and he is entitled to pass on a proportion (58%) of the fine to the grower. The levy is currently 37.5% of the A quota price. This means that B quota sugar price is 62.5% of A sugar price. However, it is permitted to market B quota sugar within the community, and the same disposal arrangements apply with the intervention authorities as do with A quota.

Any sugar produced in excess of maximum (A + B) quotas – is sometimes called C quota, although no such quota exists. All C quota sugar must be marketed outside the community. That normally means at world prices. It is not permitted to sell C sugar within the community, nor do the national intervention agencies have any responsibility.

Sugarbeet growers also operate under the same three tier system. Each factory's white sugar quota is translated into the required quantity of sugarbeet, and this is paid at least at the minimum top beet price, or slightly above as agreed by contract between grower and manufacturer. Between basic and maximum quota, i.e., B quota, the grower pays his part of the penalty. Above the maximum quota (C quota) no price is guaranteed. Production quotas are normally fixed over 5 year periods and then revised. However, adjustments to prices are made annually.

Within the rules of quotas and prices, the contracting system between factories and growers carries on as normal. Minimum beet prices are set, and the growers try to negotiate a higher price. One of the terms laid down by the community is that sugarbeet is purchased at the farm gate, and indeed, some factories actually collect the beet at the farms. The more common method however is to arrange with the grower to deliver sugarbeet and pay him a mileage allowance. A peculiarity about the beet price in Europe is that, for historical reasons, the pulp element of the sugarbeet is not included within the beet price, i.e., the pulp belongs to the grower after the factory extracts the sugar. This refers to pulp in the wet form only, or lightly pressed to, say 8 to 9% dry substance. This is normal in mainland Europe, but not in the U.K. Consequently, if the manufacturer wishes to dry the pulp, or sell it elsewhere, he must first make arrangements with the grower to acquire the right to the pulp. Normally this is done by adding a negotiated pulp allowance on to the beet price. Nevertheless, many growers – especially the small ones – in Europe prefer to collect their wet pulp (in trucks which have delivered the beet) and ensilage the pulp on the farm. Molasses on the other hand is purchased with the beet and sold to the advantage of the factory.

It will be clear that the final payment to growers for sugarbeet is complicated. It will depend on the total sugar production in any year and that is something that will not be known until the campaign is completed, or even later if it is a juice storage factory. It is obviously impossible to know how much sugar each grower produced, therefore averaging has to be used. Total production may be all within the A quota, but more likely it is within the maximum quota, say all A quota plus a part of B. Or it may go over the maximum and produce some C quota. Whatever it is, it should be possible to make a relatively large estimated payment soon after the end of the campaign and then a balancing one later in the year. That would apply to all growers, some of whom may have finished their deliveries by the first few weeks of the compaign.

You may be interested to know the production strategy adopted by the majority of the companies operating in the E.E.C. history has shown that most companies try to achieve certainly all the A quota and as much as possible in the B, i.e., close to their maximum (A + B) quota, even at the risk of going over the top into C. In view of the fairly large financial penalties on B production and probably greater ones with C, you may wonder why they aim so high. The answer is as an insurance against future quota cuts.

First, it is apparent that no company would wish to fall below their A quota because that is the most profitable production. All the overheads can normally be covered in the A quota, so that B sugar becomes a marginal costing exercise. That is one reason. Secondly, I suppose most would agree that we could expect annual variations of 10% in yield due to climate, disease etc., that means that we should aim at 110% of a quota to avoid undershooting in the bad year. Thirdly, companies have learned that when the commission comes to review quotas every 5 years, they take a rather pragmatic approach. I mean that those companies that have had the greatest overproduction appear to be treated more favorably with the new quotas than those who have kept clsoe to their A quota. There is some logic in that approach, because it may be that the lower producers are unable to contract enough beet, or yields are low. Therefore to over produce is something of an insurance policy against A quota reduction in the future.

Finally, before leaving this section, I want to illustrate how the pricing system is constructed, by quoting some numbers for the sugar marketing year 1985/86 i.e. 1st July '85 to 1st July '86. (Figure 5)

Figure 5. E.E.C. Regulation, Sugar Marketing Years 1985/86 & 1986/87

Basic Price for Sugar Beet 16.0% Sugar	1985/86	1986/87
Minimum Price for A Sugar Beet	E.C.U.	E.C.U.
Germany, France, Benelux, Denmark, Greece	40.07	40.07
Gt. Britain, Ireland	41.64	41.64
Italy	42.59	42.59
Spain	——	47.16
Portugal	——	42.90

We start with the beet price and it was decided for that year that 40.89 E.C.U. per tonne at 16.0% sugar would be an equitable basic price with other agricultural prices on mainland Europe. The normal unit of sugar on which calculations are based is the quintal, which is 100 kilos, or 1/10 of a tonne, or 220 lbs.

A standard extraction of 13% sugar is assumed from beet of 16.0% sugar. This is, of course, rather a modest extraction rate of 81.25%, which is normally beaten comfortably. That is to the benefit of the manufacturer! If we then translate the price of beet for year 1985/86 into E.C.U. per quintal of sugar, we get the cost of 31.45 E.C.U. for sugarbeet. To this price must be added transport and reception costs for beet of 3.73 E.C.U. and a processing margin for the factory of 20.89 E.C.U. (See Figure 5) when added, the total expenses are 56.07 E.C.U. Then we must deduct the income from molasses which accrues to the factory, and which amounts to 1.89 E.C.U., total 54.18. Add storage cost charge of 4.25 E.C.U. which gives an intervention price of 58.43 E.C.U.

Bearing in mind the E.C.U. is approximately equivalent to a U.S. dollar, we see that sugarbeet of 16% are approximately 40 U.S. $ per tonne, that is about 36 U.S. $ per U.S. ton, (plus the value of wet pulp in both cases) and the intervention price for sugar was about 584 dollars per metric tonne, or 525 dollars per U.S. ton, or 26.25 cents/lb, "nude ex factory". However, the equivalent target price was fixed at 61.28 E.C.U. per quintal in mainland Europe, and the derived target prices about 1 E.C.U. higher in Italy and nearly 2.0 E.C.U. higher in U.K. and Ireland. Similarly, the beet prices are higher in U.K., Ireland and Italy. A standard method for measuring sugar quality is laid down and the recommended prices may be discounted for lower quality. Of course, at the end of the day, the seller achieves the best price he can in the market place and there are numerous long and short term contracts made between buyers and sellers. But there is no doubt that prices are contained within rather narrow bands of the recommended prices, mainly because these prices are realistic ones based on actual manufacturing margins.

Obviously, in an industry where 75% of production will have to be stored for anything up to 9 months, both storage and financing costs are significant. This is handled by adding a realistic cost on to the basic cost of sugar (intervention price and other prices) and this is passed on to the authorities as sugar is sold in the off-season, pro rata to the date of sale.

AGRARIAN OR "GREEN" CURRENCY

We now come to the complications of agrarian, or green currency. We talk of money in terms of E.C.U.'s, but of course there is no such currency. It is only a unit which has to be translated into the various currencies of the member countries. However, for the financial system to work, it is necessary to relate precisely the E.C.U. to each member's currency. (Figure 6) The real individual exchange rates will change relatively, so the fixed exchange rate relative to the E.C.U is known as green currency. For each year, the E.C.U. has a fixed exchange rate equivalent to, say, the green pound, or the green d.m, or the green franc, etc. Difficulties then arise when the actual rate of the pound, d.m. or franc, etc., drift away from the agrarian or green rate, and this is compensated for by what we know as M.C.A's, meaning monetory compensatory amounts. The M.C.A.'s are meant to compensate for relative differences between actual and green exchange rates and thus eliminate any advantages or disadvantages caused within the community by currency fluctuations. It is a good principle, but it makes life complicated.

Finally, I explained that several overseas countries, largely members of the British Commonwealth had been granted a right to quotas within the E.E.C., and I have already shown the quantities permitted, by country. The prices c.i.f. European ports of the community, for sugar of standard quality are:

White – 55.39 E.C.U.

Raw – 44.85 E.C.U. (92% yield)

Figure 6. E.E.C. Regulations, Sugar Marketing year 1985/86

Sugar Beet 16% Sugar
Minimum Price for A – Sugar Beet = 40.07 E.C.U./Tonne
Minimum Price for B – Sugar Beet = 24.74 E.C.U./Tonne
Premium & Discounts per 0.1% Sugar
More Than 16.0 – 18.0 % Min. Premium 0.9 %
More Than 18.0 – 19.0 % Min. Premium 0.7 %
More Than 19.0 – 20.0 % Min. Premium 0.5 %
More Than 20% As for 20%
Less than 16.0 – 15.5 % Max. Discount 0.9 %
15.5 – 14.5 % Max. Discount 1.0 %

I have tried to cover briefly the pricing policy of the E.E.C sugar regime. I do not expect you to remember the numbers, nor is there any need to do so; in fact, there is no point in your knowing the system, other than in very general terms and as a matter of interest. I have tried to illustrate, however, that the whole financial mechanism is set up on purely practical lines. Basically to ensure self sufficiency in sugar within the community on the one hand, and a satisfactory financial return to growers and producers on the other. It can be criticized for being too successful in the latter, resulting in a bad effect on world markets, and particularly prices, on the one hand, and for being too expensive within the community on the other. These criticisms are acknowledged and steps have been taken in the past 10 years to redress the balance, both by reducing physical quotas and also the relative price support levels. However, there is no doubt that the system has achieved its initial goals of self sufficiency and an efficient beet sugar industry in western Europe.

CONTROL OF FACTORY OPERATIONS AND MANUFACTURING COSTS

Following the brief description of the beet sugar industry in England and Europe, and the important influence of the formation of the European Economic Community, I shall continue on more specific matters of factory operations with particular emphasis on the control of manufacturing costs. It cannot be emphasised too strongly that the most important responsibility of the technologist in any sugar industry is to produce the quality of products required by the customer, from whatever quality of beet he receives, and at the lowest cost. Manufacturing costs have always been of prime importance but have now become even more critical because of the current attitude of the public to sucrose sweeteners. The industry has to look, not only to improving its present techniques and costs, but also for new techniques which reduce costs.

You may think that all this is so obvious that it is hardly worth repeating. I do so because it is usual when technologists meet – and I have said earlier that there is a great amount of information exchanged nationally and internationally, in our industry – they tend to discuss their results and performance in technical numbers only. This is understandable, because factory operating reports are generally produced in that form – % sugar in pulp, lime % beet, fuel % beet, thick juice purity, molasses purity etc., etc. This concentration on technical numbers is the jargon of the sugar man, and I do not object to it, provided he always remembers that these numbers are not an end by themselves but only guides for the performance of the factory, and their real importance is the control of manufacturing costs.

I recently attended an international meeting in Italy, the C.I.T.S. The participants were largely sugar technologists, with many research and development people from most European countries, east and west, but only a few from U.S.A., unfortunately. The discussions were centred almost entirely on technical numbers, which again is understandable on this forum. However, I gradually began to feel a little concerned because I got the impression that some of the participants – too many in my view – were being carried away in a confusion of highly technical processes and equipment, which although very clever, may, or may not, pay their way, either in terms of hardware invested, or because of over complication to the process which can lead, too often, to errors in operation. The best ideas, best processes and even the best equipment are generally not complicated.

We heard much about new ideas and improvements in technical results, but scarcely anyone converted those into financial terms. That was a little worrying. We must never forget that manufacturing costs, and their affect on our profitability, is the key to our success, or failure.

In order to examine and compare current manufacturing costs, we need first to establish a cost structure for our process. In other words, we need to know the split of the manufacturing costs – sugarbeet, labor, energy etc. I must accept, however, that the pattern of costs will differ somewhat in different areas and different countries depending on local conditions (e.g. climate, prices, availability, local taxes, wages, etc.) and in fact even in different areas of one country, if it is large – such as U.S.A. Despite that reservation, such cost comparisons are very useful and do not invalidate the exercise. Indeed, possibly the most useful comparisons can be made by combining both costs and technical results, and we can often spot where prices, etc. are influencing cost comparisons.

As a basis for my example, I shall use the annually published manufacturing margin of the E.E.C. This will of course be based on Western European conditions, but I know it will give a similar pattern of costs as in your country. It represents average costs in E.E.C. countries which I believe is preferable to using those of any one company. Futhermore, we know the costs are accurate because they have to be supplied annually to the E.E.C. commission from the national governments, who in turn get them from their own manufacturers, who in turn are using these same figures in their published annual company reports. (See Figures 7 & 8).

We can see that our raw material cost is, by far, our highest single manufacturing cost, representing 56% of the total. In fact, it could be over 60% if we included beet transport and reception costs which would be regarded as normal in some accounting systems. That means that total costs for beet represent nearly 2/3 of total manufacturing costs. The next highest cost is salaries and wages, plus associated costs for personnel. These, at 15% of total, represent only 1/4 of beet costs. The third significant cost is energy but this will be influenced by prices, which I suspect are probably higher in Europe than in U.S.A. However, usage in Europe is below U.S.A. So we can now see that our first line of attack should be beet costs and to do that means improving sugar extraction – or bludgeon the farmers, which would probably produced only a very short term gain.

Figure 7. E.E.C. Regulations, Structure of Price for 100 kg White Sugar

	1985/86	1986/87
Raw Material Costs At 13% Yield	31.45 E.C.U.	
Transport Costs for Sugar Beet	3.13 E.C.U.	
Reception Costs for Sugar Beet	0.60 E.C.U.	
Processing Margin for Facotry	20.89 E.C.U.	
Total Expenses	**56.07 E.C.U.**	
Less Income From Molasses	1.89 E.C.U.	
Intervention Price Net	54.18 E.C.U.	
Add Storage Costs Charge	4.25 E.C.U.	4.00 E.C.U.
Intervention Price Gross	58.43 E.C.U.	58.18 E.C.U.
(Germany, France, Benelux, Denmark, Greece)		
(U.K., Ireland)	60.37 E.C.U.	59.39 E.C.U.
(Italy)	59.64 E.C.U.	60.12 E.C.U.
(Spain)	—	66.78 E.C.U.
(Portugal)	—	54.12 E.C.U.
Target Price	61.28 E.C.U.	61.03 E.C.U.
Threshold Price	66.86 E.C.U.	67.03 E.C.U.

Figure 8. E.E.C. Regulations, Price Structure 1985/86

E.C.U./Quintal White Sugar	**E.C.U.**	**%**	**%**
Sugar Beet Costs – 13% Yield	31.45	56.1	56.1
Beet Transport & Reception Costs	3.73	6.6	6.6
Processing Margin	20.89	37.3	
Total Expenses	**56.07**	**100.0**	
Processing Margin			
Expenses for Personnell	8.41	40.4	15.0
Energy Expenses	5.25	25.1	9.4
Supplies – Limestone & Coke	0.76	8.3	3.1
– Others	0.98		
Maintenance	3.05	14.6	5.5
Taxes & Levies	0.63	3.0	1.1
Other Expenses	1.81	8.6	3.2
	20.89	**100.0**	**100.00**

Later in my talk I shall discuss the technical factors affecting both sugar extraction and energy. There are several conventional ways we could improve extraction, but to take a large step forward we may have to go to ion exchange, or ion exclusion, a system recommended by Amalgamated Sugar for many years. With improved techniques and equipment, perhaps the time is now ripe.

In energy reduction I believe Europe has a lead on U.S.A. but that may be partly explained by higher fuel costs in Europe, thus providing a greater incentive to reduce.

In the case of personnel, the modern beet sugar factory is reasonably well automated, particularly now that continuous plant has replaced many of the old batch type operations. However, there is more scope for reducing costs during the season, and in this respect more systematic maintenance work is necessary. We have also made some good progress in my old company by installing better corrosion and erosion resistant materials. There is a higher initial cost, but we recoup the money in two or three seasons.

I end this subject with one word of warning. It is often possible to reduce costs, albeit marginally: by compromising on product quality. Don't do it, unless, you can be certain you will not harm your reputation or even lose income. The sweetener market is very competitive. There are plentiful supplies and buyers take every opportunity to force prices down. Customers will very soon notice and complain if quality fails. If you try to cut costs and lose income, you have gained nothing and possibly lost your good name.

Finally, before we leave the subject of manufacturing costs and technical performances, there are two important pieces of information which I believe every aspiring sugar technologist should acquire as early as possible in his career, and certainly before he reaches a senior position.

The first is financial. Anyone in a position to take decisions on factory operations must get himself fully acquainted with the financial rules and regulations within which his factory, or company, must operate. Now this may seem straight forward, but actually it can be very complicated. I do not mean only the broad rules, but down to every detail. It is surprising how much money can be gained – or lost – by knowledge, or ignorance, of some apparently unimportant detail. I speak from my heart on the subject, and also with a little expertise, having wrestled with the convoluted financial details of the sugar regime of the E.E.C. And it is not only confined to the E.E.C. Of course, no doubt someone in your factory and certainly in your company will know these details. But it is safer, and actually quite interesting, if the factory operators are "au fait" with the effect of all the regulations because they have the expertise to know best what can, or cannot, be safely altered in their process to achieve the optimum financial results. Remember that is your responsibility.

My second recommendation is much more straight forward and also of interest to the technologists. It is that each one of you should be able to construct a materials balance and an energy balance for your factories. I can assure you it is a very interesting and sometimes revealing exercise, if you have not done it before. The energy balance requires a bit of trial and error, so in order to save time, I suggest you write a computer program. I do not know of a better way to get a complete picture and feel for the process and an understanding of the energy distribution in the factory. If constructed from your own laboratory results, (and these are correct) you may come upon some very unforseen occurences, and be able to make improvements.

SUGAR EXTRACTION

We have said that as sugar is our main source of income, we should relate all manufacturing costs to saleable sugar produced, or in unit terms, per tonne or pound of white sugar. In the E.E.C. prices and costs are normally expressed as E.C.U/Quintal, but I believe in U.S.A. you prefer cents/pound. As I am more accustomed to the former, I shall use E.E.C. units, but if it helps I can say that 1 E.E.C. is still equivalent to about 1 dollar, while 1 quintal is 100 kg, or 0.1 of a metric tonne, or 0.11 of a U.S. ton, 220 lbs.

It is obvious that the greater the quanity of sugar extracted, expressed as a percentage of intake sugar, the lower will be the cost of beet relative to income. However, as most other manufacturing costs are more proportional, or relative, to beet than sugar, it also means that other manufacturing costs will also be lower – except of course for those that are strictly related to sugar output, such as sugar packaging, etc. All this shows that sugar extraction has an extremely important influence on factory costs, and thus profitability and deserves the highest priority.

Extraction is usually defined as sugar produced as a percentage of sugar intake. There is no problem with production, but what intake figure should we use? Because we are discussing financial figures, the obvious one is sugar paid for in the tare house according to the beet purchasing contract. Whatever happens between tare house and factory has all got to be the responsibility of the processor. In turn, this emphasises the importance of having an equitable and carefully defined beet contract, and what is equally important, that the work in the tare house is carried out precisely to its terms.

While this is the first, and the most important step in the sugar extraction process, there are also a number of actual and potential sources of loss in the manufacturing process. We shall examine them to see how we can control, and minimize, losses of sugar.

Sugar losses are generally recorded in factory operating reports as known and unknown. Whichever they are they both cost money and are equally important – although it may be argued that in known loss you may get a little money back in terms of increased pulp and molasses production. Known losses normally refer to sugar lost in pulp, in the filter cake, and in the molasses tank. Known losses can be measured, more or less, while the unknown loss is the balancing number.

Unknown losses can be subdivided into four potential sources as follows:

1. TARE HOUSE. By this I mean that any discrepancies in tare house work which pays for sugar not received, or to put it another way, any over estimation of sugar delivered to the factory.
2. PHYSICAL LOSS IN YARD OR FACTORY
3. CHEMICAL LOSS IN PROCESS
4. BIOLOGICAL LOSS IN FACTORY KNOWN LOSSES

There is ample information in text books and technical papers detailing these losses and means of reducing them.

In diffusion plant, we must pay attention to slice quality, temperature and time of diffusion, pH and pulp pressing. All influence the sugar lost in the pulp. In filtration, sugar loss will depend on the washability of the cake, which usually means a good filterability of juice also. Sugar loss to molasses is the largest single loss of sugar in the manufacturing process. Both water and soluble non-sugars in molasses have an affinity for sucrose and they will both carry some sucrose to the molasses tank. There are, or course, ways and means of removing some of the non-sugars, which will also lower the water content and thus further reduce molasses sugar. However, these removal costs are quite large, and up to now have been largely ignored by the sugar industry. A partial ion exchange system has found some favor in Europe. This exchanges the less melassigenic magnesium with sodium and potassium. However, once one starts on the ion exchange route, it is arguably worthwhile going the whole way with the ion exclusion process.

With the new competition from non-sucrose sweeteners – especially in your country – I am not sure that these ion exchange processes can continue to be ignored in the future. However, without new techniques, the sugar man can only follow the normal rules of allowing sufficient time and the right conditions for the massecuite to reach equilibrium and thus maximize crystal sugar yield by conventional, well established methods.

UNKNOWN LOSSES

TARE HOUSE WORK. The accurate estimate of sugar delivered in each of many individual loads of sugarbeet is quite impossible in practical terms. It is impossible because we can neither get a truly representative sample, nor is our analysis precise. However, these difficulties must not deter us from trying to reach an equitable result between the grower and the manufacturer, and in fact this is achieved in most cases. As far as the manufacturer is concerned, swings and roundabouts should apply, and the final intake of sugar should be reasonably accurate according to the contract. Nevertheless, it is as well to remember the failings of the system as far as individual loads are concerned. But too many adjustments should not be made because they will all be in one direction.

In some years, deviations can occur even with average results, due to peculiarities with climate, seed or disease. It is better that either side accept these – unless they become intolerable, when some sort of adjustment may be made. But this sets a dangerous precedent.

It is most important that the terms of the contract are strictly adhered to at all times. It is also essential to remember that the contract is an overall package agreed by seller and purchaser and there is no point in one side, or the other, picking out individual parts which they allege (perhaps quite rightly) are working against them on occasions, while conveniently ignoring others which may be to their advantage. With these qualifications, the sugarbeet contract works satisfactorily in many countries, with lots of minor variations, and as far as the buyer is concerned, it is his responsibility to adhere to the terms of the contract while ensuring that he does not err in paying for more sugar than the contract terms specify.

PHYSICAL LOSS. This is a fairly obvious source. Any leaks or spillages which are not returned to the process – and even then, there may be a chemical or biological loss – are obvious causes. However, perhaps two of the most dangerous and large physical losses are:

(1) Loss of any beet material containing sugar and the most common of these are losses of tails – or small pieces of beet material – in the beet flumes and beet washers before they even reach the slicing machines. Such losses are doubly dangerous, because they not only lose sugar, but the chemical or biological destruction of sugar can cause embarrassing environmental problems. The preference for discarding beet tails is due largely to the fact that they are a nuisance to handle in the slicing machines. However, this is no valid reason for tolerating – or even encouraging – such a loss. You cannot afford to give away anything you have paid for.

(2) A second large physical loss can take place in the condensers, particularly those on the vacuum pans. A large amount of sugar – as a concentrated syrup – can be lost in a very short time and one of the better safeguards in detecting such losses is to have a closed water system using cooling towers for condenser water. This gives a much better opportunity to detect a loss, because sugar lingers for some time. It is also the preferable method for heat economy and for environmental reasons, if this is important.

(3) There are, of course, many other ways by which sugar can be lost physically in the process. One of the most common

being across heating surfaces, particularly juice heaters where the juice pressure is often much higher than the vapor pressure. When these losses are significant they are generally rather easily detected, but when small they may occur for longer periods without detection. Regular sampling and testing of all discarded waters is essential. Obviously, solid particles of sugar can be lost at the sugar end when discharges from granulators, or driers, and dust collection plant are not monitored frequently.

CHEMICAL LOSS. We refer here to the destruction of sucrose by some chemical reaction. Fortunately there are not many chemicals used in the process which react vigourously with sugar and the greatest threat is in having sucrose solutions at a too low pH when inversion can occur. This has a doubly bad effect, because not only is crystallisable sucrose destroyed, but the glucose and fructose, and even further breakdown products, can eventually trap even more sucrose in the molasses. This effect is most likely – in fact nearly always does – occur in the diffuser, often contributed to by bacteriological action. The solution, therefore, is to inhibit low pH by controlling bacteriological action by the addition of formalin, or some such bactericide and maintaining adequate temperatures. Inversion of sucrose can also take place at the sugar end – mainly in final boilings and crystallisers. Again too low pH must be avoided.

BIOLOGICAL LOSS IN PROCESS. Biological destruction of sucrose can, of course, take place directly, but also as in physical loss above. The result of biological action on sucrose is to create organic acids, thus lowering pH and causing inversion as previously described. Another source of biological desctruction can be the production of *leuconostoc mesenteroides* in dilute sugar juices, usually arising from leaks from tanks, pipelines or pump glands. Infections can occur at high temperatures due to thermophiles, but the more common infections are in cool dilute juices caused by leaks and bad housekeeping.

Finally, but certainly not least in importance, a major influence on sugar extraction is the quality of sugarbeet. This is outside the direct control of the factory but the latter can, and should, guide the growers, or even exercise pressure on them – with or without penalties or incentives – to produce a raw material more favorable for the industry. It is the particular responsibility of all agricultural staffs. For example, a higher sugar content should be rewarded more than pro-rata, because not only more, but a greater proportion of the total sugar can be crystallized from beet of higher sugar content.

Another important influence is to minimize the use of nitrogenous fertilizers. In fact, it can be shown that the use of nitrogen on the crop is not only bad for the processor, but also for the grower. Leaving aside factory extraction, the cost of nitrogen to the grower is generally (certainly in the U.K.) greater than the benefits in yield of roots. Certainly, if a grower wishes to impress his neighbors by having luscious green tops, nitrogen will provide that, but it will certainly not produce roots that put more money in his pocket, or in the manufacturer's pocket. So, high sugar content, low nitorgen, and not too large roots (i.e. high plant population) will provide the best beet for the industry as a whole.

ENERGY REQUIREMENTS

In the beet sugar manufacturing process the cost of energy in the form of fuel (solid, liquid or gas) is normally the second largest manufacturing supply cost (after sugarbeet). Consequently, the minimizing of fuel cost has received a great deal of attention.

We are fortunate that the requirements of our process permit us to choose a pressure and temperature for steam generation which allows us to integrate both our mechanical and heat energy requirements. However, it must be said that with increasing mechanical power requirements, coupled to decreasing heat requirements, the initial steam generating pressures have risen to rather high levels. In Europe, the latest boilers are not up to 60 atmospheres, which makes rather special demands on feed water treatment. However, it is normal to assume that mechanical and heat energy are integrated in the modern factory.

The total energy requirements of any factory will be dependent on the conditions under which it has to operate. For example, considering mechanical energy, the basic requirement will depend on whether or not pulp is being dried, or whether environmental demands are significant (recirculation of beet transport water, or recirculation and cooling of condenser water, etc.) or whether it is a juice storage factory, or operates a packeting plant, etc. Similarly, climatic conditions can affect heat energy demand. A factory processing low temperature, or even frozen, beet will require more heat to raise the beet to its processing temperature of 70 C, than a factory which may receive beet at a temperature of say 10 C.

With these varying conditions, it is quite obvious that there is no one standard demand for heat, energy, mechanical energy, and therefore total energy. Therefore, when evaluating the performance of individual factories, it is important to calculate theoretically a "bogey", or target, or budget – call it what you will – figure, to eliminate factors outside the control of operators. However, within these reservations, we can lay down certain rules which must be satisfied to minimize energy requirements.

These may be stated briefly as follow:

1. Ensure that generating steam pressure is sufficiently high to produce all electric power demand within process steam requirements, with a safety margin.

2. Minimize the amount of water to be evaporated in the process. In other words, do not add water to process at any point unless it is necessary. (No water permitted into vacuum pans).

3. Minimize the loss of heat energy from all sources. Waste materials, waters, even finished products to be as cool as possible.

4. Have closed circuits for condenser waters, and if posible, for beet transport water. These requirements cover many details of factory work which we can now enumerate.

The greatest mass of low temperature material entering a factory should be sugarbeet. For the best heat economy, that should be true. Both beet transport water (except that used to transport the mud to the ponds) and condenser water should be recirculated. They can thus be used for pre-heating the beet. Bear in mind that 75/80% of sugarbeet is water, there is no need to bring any additional water into a factory, after campaign start-up. Nor should it be done because it costs money both to import water and then dispose of it.

To heat beet to its processing temperature, say 70 C, requires a great amount of heat, but fortunately much is low temperature heat. This can be provided most efficiently in stages, for example, in the flumes with recirculated transport water which contains superfluous condenser water, then in the beet washer with excess condenser water – which is also preferable for cleaning the beet and on the slicing machines, possibly, by the use of steam for knife cleaning – although this is a luxury which can less well be afforded. Finally, a counter-current prescalder is essential as a first stage in heating the cossettes. Why a prescalder? Because we must cool the raw juice from its diffuser temperature of 70 C, in order to use low potential heat from condensate and vacuum pan vapors to heat it up again. Thus we obey the requirement of discharging the least amount of heat from the process.

The final cossette heating will be by circulation juice prior to their entering the diffuser at 70 C. The diffuser must be operated at optimum conditions for extraction, so that the draft can be kept to a minimum to achieve the desired sugar loss in pulp. By optimum conditions, I mean close to 72 C, pH in range 5.8 to 6.0; diffusion water temperature 72 C and, of course, cossettes of good quality in relation to beet quality. It is important that good pulp pressing is obtained, say 28-30% dry substance, because that is an integral part of the extraction process, high pressed pulp dry substance energy saving on pulp driers and also allows a slightly lower draft.

The remaining heating in the beet end, i.e., pre-second carbonation, pre-sulphitation (if used) and pre-evaporation, should be done with the lowest temperature vapor available. This ensures the maximum evaporation from the evaporator juice which is essential if the amount of steam used is minimal.

Meanwhile, beet end operations should ensure minimum water dilution on filtration, from milk of lime, and from pumping sugar contaminated water back into process from floor drains, etc.; all leakage of sugar juices, whether from spills, gland leaks, etc., must be avoided. Apart from possible bacteriological destruction of sugar, there can be expensive dilution of the juice from floor washings which is then pumped back into process. So water dilution occurs without having achieved any benefit to extraction.

The exhausted pulp should be discharged from the diffuser at the correct pH, and it is most important for the benefit of pulp drying fuel that the pressed pulp dry substance is as high as possible – this also helps sugar extraction and thus minimizes draft. At a recent conference they were talking about pressed pulp dry substances in the 33-43% range, but averages are more in the 28-30% range at present.

Any form of ion exchange is a source for water dilution, and also a potential loss of sugar. Thus the addition of anti-scalants prior to evaporation is preferable for control of calcium scale in evaporators.

Thin juice will be heated in stages to achieve the best evaporation in evaporators, thus ensuring a thick juice brix of more than 60. This brix depends on the amount of remelt, but it is important to achieve at least 70 brix of standard liquor to white pans.

All water additions to pans must be carefully measured with the object of eliminating this entirely during normal operations. It is not necessary, provided adequate attention is paid by sugar boilers. Automatic control of boiling can eliminate water, but this should also be achieved with manual boiling.

Adequate treatment of 3rd product massecuite in crystallizers is necessary and vertical crystallizers generally give better yields, easier control, and consequently better sugar extraction than horizontal designs.

It is important to get most effective use of wash water on centrifugals – thus minimizing dilution – and so such details as application being at correct speed, covering full length of basket and water at highest temperature must be given attention.

Stepwise flashing of condensate in evaporators is necessary, but the employment of vapor compressors is not essential provided the heat scheme is well designed. Juice storage factories may have to resort to vapor compression because of the imbalance of vapor demand at the sugar end.

Pulp drying is a major user of energy, and so we must consider pulp treatment, from diffuser to storage of dried pulp. The most efficient arrangement is not to dry pulp, but use it direct, either molassed or not, or ensilaged or not, as a cattle food. If farming arrangements do not permit this, then it must be dried in which case the following guide lines are important.

A pulp drier drum acts not only as a transferer of heat for drying, but also as a transporter of the pulp. Therefore, not only are hot gases required, but also a definitive quantity of gas to provide the correct velocity. For drying efficiency one requires the hottest practical inlet temperature, approx. 1000 C, together with the lowest possible outlet temperature, say 100 C, or lower if possible. Additional gas volume is often required, and it is thermally more efficient to get this from excess boiler flue gases than from excess air to the combustion chamber. This arrangement can be regarded as partial preheating of combustion air. Similarly, steam generating plants should also be fitted with air preheaters as well as economizers.

THERMAL INSULATION

It is important that all hot vessels, boilers, evaporators and pans, heaters, storage tanks, pipelines, etc., are adequately insulated from the surroundings. This not only reduces heat loss by radiation, but it retains the working areas of the factory at a more comfortable temperature. Working spaces which are too hot lead only to the occupants opening windows, doors etc. to reduce the temperature to more tolerable conditions, thus wasting heat.

Finally, having outlined the requirements, it is imperative that accurate, and in particular, well maintained instruments, gauges, thermometers etc. are installed so that working conditions can be seen, and seen accurately, at a glance. Any instrument, or gauge which indicates that wrong result, is worse than having no gauge. at all. Management should always demand, and ensure, that all measuring devices in a factory are kept in good order, and trustworthy. It is a major error if this is not so.

Finally, by way of conclusion I want to remind you that my remarks have covered a broad range of subjects from my own long experience. I did not intend to offer the final word on any of these subjects, but I clearly intended to leave you with the impression that you must cultivate your own experience by working hard to gather as much knowledge as possible to increase your understanding of all aspects of the business.

The best way to memorialize our colleagues is to move forward with our effort to enhance the application of technology in order to compete more efficiently in this exciting business.