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Next Generation

This title applies to both the next generation of technologies that the sugar industry may apply to its operations and to the next generation of scientist and engineers that will be responsible for its application. We can expect to deal with generational issues related to what may be called the "philosophy of processes." The traditional approach, especially in the cane industry, is to make or force the equipment do the job, even if it was poorly designed – make it bigger and stronger, put more power to it and you will get the desired result. Sheer will-power becomes important and I fondly remember a mill manager in Louisiana who seemed to be able to induce fear in the machinery itself (Randy Roane of Jeanerette). The new generation of technology and technologists are much more involved with the finesse of design and especially of the control of process. Factories are becoming more complex and it is now more difficult, if not impossible, to operate by the seat of the pants. It is very different to operate a small factory using 100,000 lb steam per hour produced at 300 psi by four boilers compared with one using >1,000,000 lb per hour at >1,000 psi and having boilers with ~400,000 lb per hour capacity.

The following comments (paraphrased) were recently made in a trade magazine for instrument engineers – "No other engineering profession can offer to greatly increase the gross domestic product without building a single new plant, and to do that while increasing safety and reducing pollution. We can achieve that goal through the optimization of existing industries without additional raw material and without additional energy." This has happened in the cane industry – increased throughput and lower operating costs without major investment in primary technology – mills, evaporator, vacuum pans, etc. Secondary (control) technology has been applied to optimize equipment performance.

As technology and automation improve in factory operation we cannot ignore the fact that the sugar industry, especially the raw cane and beet operations, is an agriculture based industry subject to all the inherent vagaries of processing variable and perishable raw materials at short notice. Oil refineries may have to handle variable quality crude oil but not without warning since the raw material is stored and in transit for some time and operational changes can be planned ahead. Adverse weather conditions can impact a sugar factory within hours and the professional experience and judgment of the operating staff become invaluable.

Judgment is based on having seen and had to deal with such changes, often without the resources now available. A different type of judgement requires the ability to think abstractly, to put on paper the essential information and calculations and to think through "what if" questions. The latter are often thought of in terms of computer modeling and are may be regarded as the province of the novices or new guys, but the ability to perform "thought experiments" using no more than pencil and paper is the real test of understanding. A problem is that the novice probably has much greater formal education and computational experience than most seasoned technologists. There are few things more professionally daunting than to enter a company with much more experienced people, knowing that they are looking over your shoulder, not in a negative way, but doing so nevertheless. It is simply part of life. This relates to the problems or recruiting and retaining young and able engineers and technologists. The expectation of the old hands that the novices will put up with the same conditions, long hours, limited resources, etc, that they went through and learned from, is probably unreasonable. It is important to have seasoned operating and management staff who can mentor the novices and develop confidence in their judgment, especially as it pertains to change. Unfortunately, there are always some who feel that any transition to new technology is not possible or even undesirable. They have invested too much time in established, maybe even out-dated technologies, procedures and systems. Change is inevitable, but is it timely?

It is not good enough to say "I don't know why it works, all that I know is that it does work". This may be a good first step but not the final step, especially for optimization of the process. Modern systems should be grounded in theory and mathematical modeling, but proven with experience on the factory floor. The question becomes how far can the existing process be controlled or what are the practical limits to "controllability". For improved performance would it make more sense to control a modified process? It may be necessary to redesign the process and not the control system. For example, sugar crystallization is in batch or continuous systems, both involving evaporative crystallization, with the latter being intrinsically more controllable since the process is continuous. Could continuous cooling crystallization be even more controllable and produce better product at lower cost, including energy consumption?

I recently read about a bicycle with the chain drive to the front wheel and steering with the rear wheel. This is very difficult to ride and therefore a very flawed design. Sometimes the process is so difficult to control that it becomes necessary to begin again with the design of a better and more controllable process. The overall function of the process may be unchanged but the equipment and operating details may need to be changed.

Some raw sugar processes or unit operations are inherently difficult to control. For example, rotary vacuum filters where the goal is to recover as much sucrose as possible; metal screens rather than cloths result in dark filtrate with significant levels of fine suspended and colloidal solids; the only reasonable measurement that could be made is for brix in the final filtrate using a differential pressure sensor system (near-infra-red systems for sucrose are possible but quite expensive) and adjustment of the wash water flow; this would require being able to capture the last filtrate from the wash section of the filter; not at all easy and perhaps more readily achieved with a belt press?

The overall goal remains the same, to convert raw agricultural material into a finished food (or other) product. The question is whether the processes involved be reassessed, combined and simplified using a different set of parameters that optimize control and therefore costs and profitability.

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