bulk solids handling Volume 1, Number 2, May 1981

Microprocessor Control of Blending and Weighing Systems

F. Gripton, England

Die Steuerung von Meß- und Wiegeprozessen mittels Mikroprozessoren
Commande des procédés de mélange et de pesage à l'aide de microprocesseurs
El control de procesos de mezcla y de pesaje por medio de microprocesores

ブレンド・秤量システムのマイクロ・プロセッサー・コントロール
混合与称重系统的微信息处理机控制
التحكم بالميكروبروسيسور في أنظمة الخلط والوزن

Summary

Whenever the costs of raw materials escalates, the justification for more sophisticated control is re-examined. Microprocessors can improve cost control by reducing giveaway, improving quality and reducing operational costs.

Microcomputer control refinements are almost without limitation, but practical application experience is still developing. This paper highlights the successful application of microprocessor control technology to solids weighing and blending.

1. Introduction

What was heralded as the expected new *industrial revolution* two years ago is now with us.

Although the *space race* led physicists to develop their molecular engineering on the Western side of the Atlantic to provide the micro chip, the innovative nature of British engineers has enabled the UK to take advantage of the new technology extremely quickly. Even in the present industrial recession microprocessor based systems are being pressed into service to cut costs and improve control.

The new software specifications for plant control have been detailed, developed, installed and proven. Virtually as fast as practical ideas are generated the *micro men* come up with the answers. In the field of weighing and blending control, particularly in the animal feedstuff and rubber industries, microprocessor applications have gradually expanded after providing initially improved accuracy and stored formulations.

Emphasis then transferred from weighing to the provision of management data. Running totals of ingredients used were quickly supplemented by stock levels, totals of formulations produced and production scheduling.

More recently a formulation explosion facility, coupled with the production schedule, enables a manager to enter the production requirement for the day and instantly check the raw material quantities to meet that schedule. Comparing this data with the stock figures held in the blending bins immediately pinpoints shortages, minimising any problem area before it arises by enabling transfer of raw material from bulk or remote store to meet the day's demand.

The UK transport strike of 1979 highlighted the benefits of the *bin matrix*! This feature enables plant management to refer ingredients to specific blending bins through the microprocessor. When formulae are entered, the ingredients and their quantities are detailed. The microprocessor store may hold 200 different formulae. If raw material deliveries are not available as required, or if mechanical problems are experienced on a blending bin charging or discharging system, it would be necessary to reformulate. Without a *bin matrix* every formulation would require modification. The *bin matrix* is a facility that allows supervision to change the cross-reference of a material to a particular bin discharger. To alter, for example, all formulations using a certain ingredient, it is only necessary to address the *bin matrix* via the processor terminal, and change the reference to a different blending bin. When any formula using that ingredient is called, the batch control will automatically refer to the new raw material location.

When an ingredient is held in more than one blending bin the matrix can also be used to automatically search for the same ingredient in the alternative location. A control flag, generated when the stock in the bin in use reaches a preset low level figure, effects this action. These control levels can also be developed to provide automatic transfer from bulk store to the blending bins.

2. Processor Terminals

The most practical location for the main terminal access equipment, i.e. the visual display unit (VDU), keyboard (Fig. 1) and printer in a feed mill, is remote from the control room in the laboratory or least cost formulation office; in a rubber mill room it should be located in the chief chemist's office. The access required by the plant operator is then minimised. Even if a production schedule is not used the operator has only to select a formula and the number of batches required.

Fig. 1: VDU and printout facilities are located remote from the production line

F. Gripton, Senior Engineer, Precision Handling and Control Systems Ltd., Prospect House, 55 Lawton St., Congleton, Cheshire, CW12 1BH, England

However, it is essential for him to be provided with full monitoring facilities on the batch process. The author's company has developed an industrial monitor for their DATASTOR range of control. This terminal can be customised to the application specification and an integral 10 inch sixteen line monitor provides the plant operator with an informative display on the state of the blending sequence. The identification of the formulation, the number of batches required, target and actual weights are displayed as the batch progresses. As most installations involve multiple weighers the operator is advised which weighers are in use, i.e. Weigher 1 started, Weigher 3 started etc. This terminal and P.H.C.'s VIDEOTRAK make the system ideal for updating existing conventional batch plant control to provide microprocessor facilities, incurring minimal interference with production. A solid state triac or conventional relay interface ties the microprocessor in with existing power control.

3. Batch Tracking

Formulation batch tracking through the various stages of the process is another valuable facet of microprocessor capability (Fig. 2).

Traditionally, representation of the formula has been by digital numeric displays mounted in the plant mimic on the control panel. P.H.C. Ltd. have

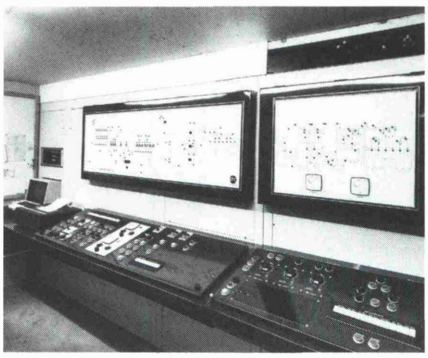

Fig. 2: Control panel for animal feed mill at Lopen Feeds, England: Access terminals, VDU and printer are built into the panel

recently introduced their VIDEOTRAK batch tracking monitor. VIDEOTRAK allows up to 20 plant locations to be identified with 12 digit full alphanumeric formula codes as the batch is processed through the plant. An advantage of this system is that an existing conventional mimic does not have to be renewed or modified when a plant update is carried out. This revolutionary concept was developed due to many of the large national companies having complex computer referenced formulation identification for their products.

4. Hierarchial Control on Larger Installations

This type of control is often utilized when a central main frame computer is used to store the process control data. Separate microprocessors are dedicated to sections of plant. All instructions and formula data are received from the computer via a serial link. The microprocessors carry out their directed duty, report back to the computer on completion and await further tasks. This system utilizes the computer to its best advantage, its tremendous storage and mathematical capability, without tying it up with lesser duties.

5. Provender Mills

In provender mill design, to include a microcomputer into the specification provides the system designer with the facility to extend control downstream from the main batch plant.

The following items can be included in the basic formulation in addition to the main batching control:

— Pre-destination routing of the batch through to either press bin, bulk outloading or bagging-off plant.
— Data concerning drugs and critical ingredients, added manually at the additive tip station can be relayed with other formulation data and displayed on a monitor. The display would include identification of the ingredients and the quantities required.
— Where automatic screen changers are fitted to a grinder the relevant screen requirement can be included in the formulation, and controlled from the processor.
— The quantity of fat to be added at the mixer can be included and controlled by either weighing, digital pulse count or time period volumetric parameters.
— The quantity of mollasses can also be metered into the batch.

Including these in the formulation held in the microcomputer assures a consistently manufactured product whilst also relieving the plant operator of the involvement with downstream additions.

6. Mixer Control in Rubber Compounding

For improved quality control in the rubber industry, as well as fully automating the raw material feed (this covers the bulk powders, polymers, oils and small powders) it is essential to remove as many of the human factor and power variables in the operation of the mixer as possible. A dedicated microprocessor package is now available to control all aspects of the mixer on either an absorbed power, time or temperature basis. The formulations of the raw materials can be selected in conjunction with any of 30 mixer sequences. On absorbed power operation, as the mixer progresses through its cycle, the amount of energy needed to ensure a homogeneous dispersion of additives is automatically controlled.

The mixer ram, hopper doors, oil injection, batch component transfer and discharge doors are controlled via the microprocessor software to values set in the program. Each action of the mixer is given a reference number in the software, a *macro* number. For example, a 3 second ram sweep can be called into the program, oil, and powders can be injected after up to six specified time or energy levels. The mixer sequence is programmed in, via the VDU, by requesting these subroutines, and by setting the energy or time periods the mixer cycle can be controlled. The mixer then acts as the mill room master control with the production schedule referred through it to the raw materials weighing.

7. Diagnostic Facilities

One of the prime requisites of a well designed microprocessor system is that it should provide good diagnostic facilities for fault location. These should be built into the standard package. The microprocessor itself has inherent stability and long term reliability, however interlocks are provided by items which are exposed to the harshest industrial environments (microswitches etc). Primarily, therefore, the processor should provide visual monitor facilities on all inputs from, and outputs to the plant. In the event of a process control hold-up the reason should be identifiable without resort to test instruments or even a knowledge of electronics.

The processor should also have keypad and display facilities which enable supervisory staff to look into the processor at any step in the software sequence and check the status. This is particularly useful for fault diagnosis over the telephone. With basic information on a problem an engineer can then instruct a non-technical person on site to set the processor on certain steps in the sequence and obtain relevant data to enable the engineer to localize a problem area.

8. Final Comments

Whenever cost of raw materials have escalated the justification of more sophisticated control should be re-examined. Microprocessors can improve cost control by reducing giveaway, improving quality and reducing operational costs.

Microcomputer control refinements are almost without limitation but the practical application experience of a good number of successful installations is the criteria which divides those who have done, and those who claim they can.

Finally, no matter how superior a microprocessor is, a blending system is still only as good as the *front end* design, its load cells, amplifiers and their installation. It is essential that the supplier can provide this capability.