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IMPROVING A BLENDING PROCESS BY CONTINUOUSLY DISPLAYING AND/OR CONTROLLING INGREDIENTS BY WEIGHT AND FLOW RATIOS

SUMMARY

Demand for rigidly specified products has led to a new system for controlling the blending process. A personal computer based product, provides the operator with a continually updated display for adjusting the blending process.

1. NEED FOR IMPROVING INGREDIENT BLENDING

Increasingly rigid specifications impose greater difficulties in the blending process. Manufacturing of blended sand products demand the greatest accuracy of all aggregate blending processes because the finished product, high strength concrete for commercial construction, requires precise ratios among the sand ingredients.

1.1 Belt Scales

Belt scales can be placed at strategic locations throughout the blending facility to monitor flow rates from gates or feeders. The belt scales consist of either a dual or single-idler weighframe. The Combined Systems Technology Inc., Weighflow Monitor signal processors are microcomputer based and have remote communications capability, a basic data transmission requirement for a sand blending and processing network.

A particular feature of the C.S.T., Inc. Weighflow Monitor belt scale is the ability to interface with IBM compatible personal computers.

1.2 Feeder/Gate Control - Two Types Of Control Are Available

- Closed loop control with a digital computer in the loop without an operator in attention
- Visual indication of all flow rates with the operator adjusting each feeder or gate manually.

2. SYSTEM CONFIGURATION

2.1 Physical Layout

The blending system consists of two seperate horizontal conveyor belts with a number of feeder/gates along each belt as shown in fig. 1. Three of the four sand ingredients which make up the series of blended products, flow onto one belt and the fourth ingredient is fed onto a second belt. The two belts discharge into a bin at the loadout facility.

Just downstream of each of the four feed points, a belt scale measures the flow rates and totalizes the combined material at that point.

2.2 1700 Flow Ratio Monitor

The 1700 Flow Ratio Monitor is a hardware measurement and software computational system for providing the necessary real-time blending process information to an operator. Three seperate elements make up the system:

- four Weighflow Monitor conveyor belt weighing and totalizing systems, which serve as the necessary flow rate sensors and provide accumulated total weight information

- PC 1700 software program, resident in an IBM-compatible computer, which communicates with the Weighflow Monitor digital signal processors and gathers information about setup parameters and operating data. This program can also send control commands to the Weighflow Monitor signal processors, such as run zero calibration tests.

- Flow Ratio Monitor software program, resident in the system's computer, which also communicates with the Weighflow Monitor signal processors, but only to gather information about flow rates and totalized tons. It cannot send control commands or download parameters as can the PC 1700 program.

Fig. 2 shows a block diagram of the 1700 Flow Ratio Monitor. This system may be run in auto or manual.

- For this discussion the operator makes the actual control adjustments. The system calculates the flow rate and totalized tonnage of each individual ingredient from the cascaded flows and tonnages provided by the three belt scales on one belt. Ratios of the four ingredient flow rates and tonnages against the total flow rate and tonnage become the basis for comparison with the target values of the product in process. The remote display terminal displays deviations in ingredient flow rates from corresponding target values in the form of vertical bar graphs; target weight percentages and actual weight percentages are presented in a side-by-side comparison. If a given ingredient lags behind the other ingredients in a blending run, the operator may increase the actuation signal to the feeder which meters that particular ingredient until all ingredient weights are within tolerance.

2.3 Weighflow Monitor Belt Scales

The C.S.T., Inc. Weighflow Monitor consists of three components or subsystems: a. the weighframe, which supports one or two idlers and senses any load changes on the belt, b. a belt motion sensor for detecting belt travel, c. the totalizing and display hardware, firmware and sofrware.

The weight sensing is performed by two strain gage modules called MicrocellsTM. Each sensor consists of two semiconductor strain gages arranged in half bridge configuration such that they detect the bending strain of the weighbeam. Because the microcell sensors develop a relatively large signal with a very high signal to noise ratio, the weight signal can be transmitted to a signal processor up to 2000 feet without any active signal processing or amplification.

Belt Motion Sensor: The belt motion sensor is a proximity switch that senses the passage of an electrically conducting target, such as one of more metal objects attached to a driven belt pulley. This sensor, when calibrated, tells the signal processor when the belt has travelled a known distance.

1700 Totalizer: The 1700 Totalizer is a microcomputer-based signal processor which accepts and stores setup parameters, carries out calibration procedures automatically upon command, calculates and displays belt speed, material flow rate, belt loading per unit length, and totalized production. It can transmit flow rate via a 4-20 mA current loop and material totalization via a 5-Volt logic pulse. Any of the above variables may also be transmitted to a remote location through an RS232 or RS422 serial link.

Three setpoints may be programmed for either flow rate or belt speed in order to turn on other devices above or below a desired speed or flow rate. Finally, the 1700 Totalizer can communicate with a personal computer at a remote location as described below.

2.4 PC1700 Software Program

The PC1700 software program is intended to operate on IBM-compatible computers with a serial communications port and 256k of RAM memory. The program requires only a monochrome monitor. It can communicate with a maximum of 16 Totalizers on a single network at distances up to 4000 ft.

Communications is via an RS422 communications bus consisting of a 4-wire cable.

The operator can display the setup parameters on the computer screen, download new parameters values, and store them on a disk. The operator may also call up and display operating variables such as totalized production, belt speed, belt loading, and flow rate. These values can then be stored on a disk file for audit purposes, along with time/date and identification code information. These audit files can be subsequently viewed with a simple editor or with programs such as LOTUS 123.

2.5 Ratio Monitor Software Program and Remote Display

The Ratio Monitor software program creates, modifies, lists, and stores blend formulas required to carry out the blending processes. This program sets flow rate limits for alarm conditions, calculates individual ingredient flow rates and totalized weight from the belt scale measured values, computes flow rate deviations, and enables or disables a remote terminal to display the unfolding flow and blending process. At the end of a run it stores the results together with appropriate identification information.

This software program communicates with the 1700 Totalizer connected to the network, but only to gather flow rate and totalized production data. It can neither read nor return new parmeter data as can the PC1700 program. It requires two asynchronous serial ports on the host computer; one to communicate with the belt scale signal processors and one to communicate with the remote terminal.

An operator at the remote terminal can read the list of stored blend formulas, select a formula, enter an identification for the upcoming run, input a target tonnage, and command the system to store the run results. Once the run is started, the host commuter performs as a slave to the blending process on display at the remote location.

3. RESULTS

a. Blend products to much tighter specifications.
b. Establish control settings for the ingredient feeder flowrate which are consistently more accurate and repeatable.
c. Readily adapt to this type of computerized tool and enjoy operating the system.

Other benefits of the system include traceable record keeping of each run and improved inventory control of in plant materials.

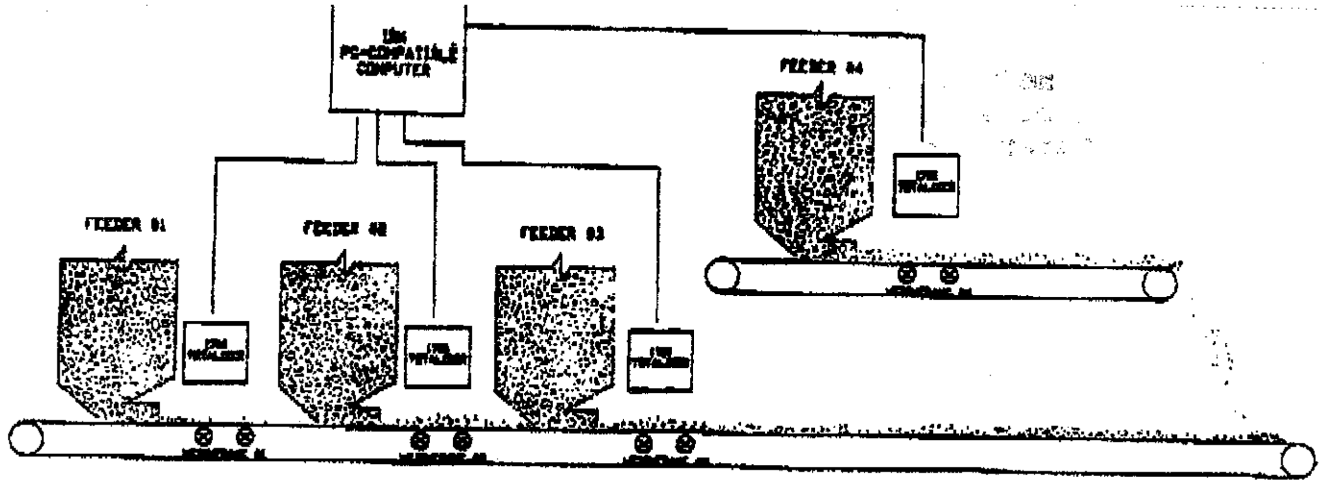

Fig. 1: Conveyor, feeder and weighframe layout

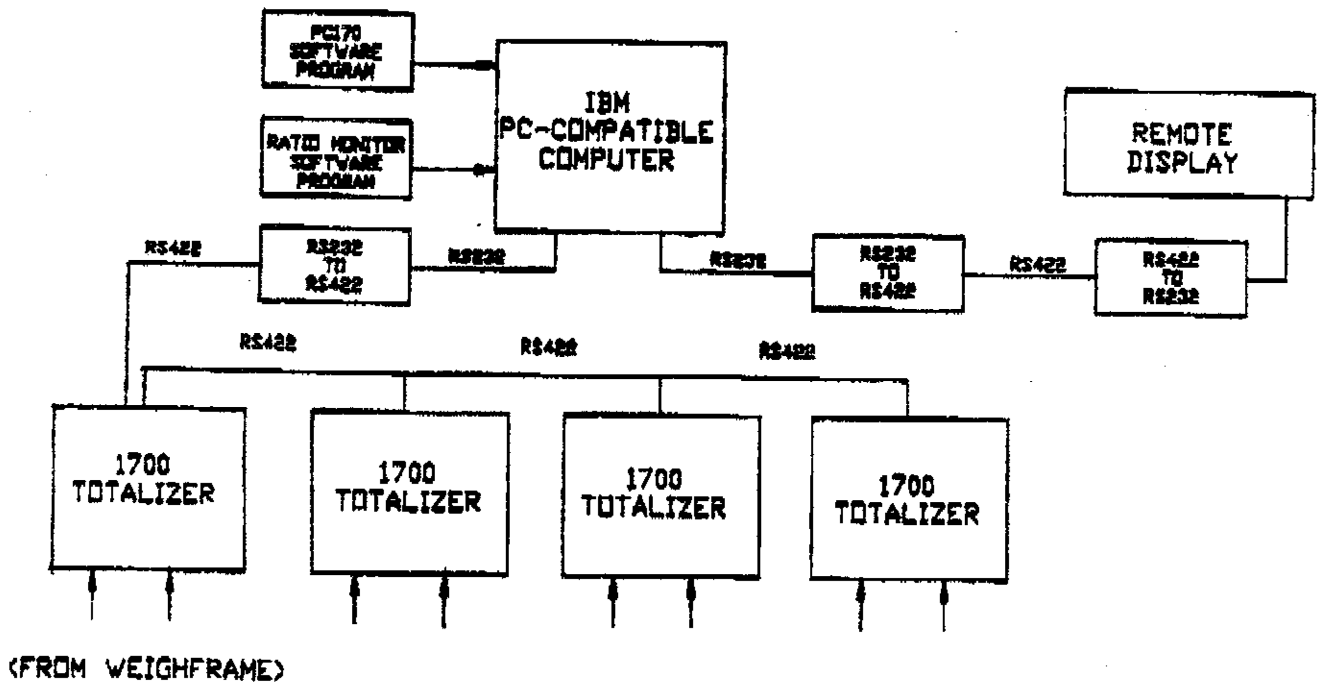

Fig. 2: System block diagram