Development of a Continuous Blending System

Eli Al Hadawi, IEA, 2011

***Introduction*: The market demands on the dairy, food and pharmaceutical industries to produce a wide range of products have led manufacturers to run more batches to handle this diversity of flavours and mixed products. Batch processes are often converted to continuous ones. Mixing plays a crucial role in the whole production process. A fast continuous mixer with just-in-time mixing capability can easily be integrated in a continuous production line and reduce the number of buffer storage tanks. The project's overall aim is to develop a fully automated real-time blending system starting from an existing non-continuous batch system.**

The QB MIXER is a blending machine controlled by a single Programmable Logic Controller (PLC), see Figure 1.

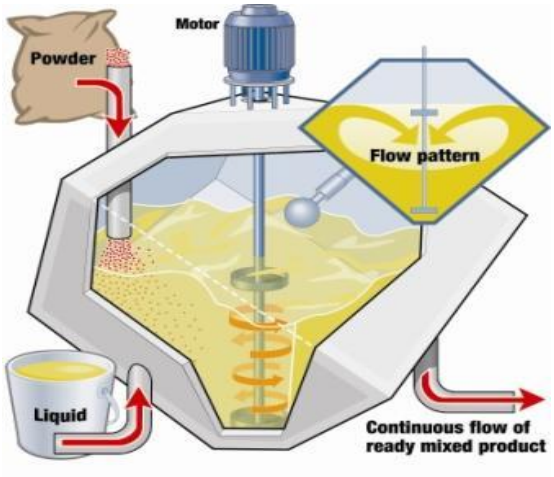

Figure 1: QB Mixer.

Powder is delivered to the mixer by a screw-conveyor. Making the mixer continuous involves measuring the current solid's concentration in the solvent at the outlet and based on that adjusting the input rate of the solid at the inlet. Therefore a concentration meter device is needed. Such a device is called a Turbidimeter. A Turbidimeter works by measuring the intensity of the scattered light and/or transmitted light. Light scatters differently depending on the particles' sizes relative to the wavelength of the lightsources as depicted in Figure 2.

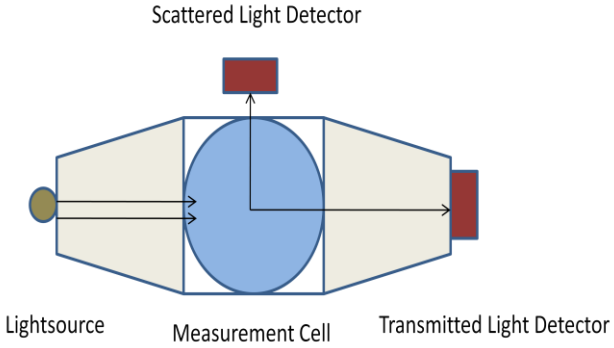

Figure 2: Working principle of Turbidimeter.

In a dairy product, for example milk, higher fat content will reflect more light back to the detector and indicate a higher output signal level than lower fat content. A screw-conveyor can imitate the functionality of a weighing system if the motor speed is controlled by a PID. The setpoint parameter to

this PID is the desired fixed concentration (SP) and the output is the manipulated frequency variable (MV) fed to the variable-speed motor. The new system (consisting of a Turbidimeter mounted on an outlet pipe and the screw-motor) was implemented in Siemen's automation software. The new solution was tested to verify the functionality. It consists of three basic modes: Pre PID, PID and Termination, see Figure 3.

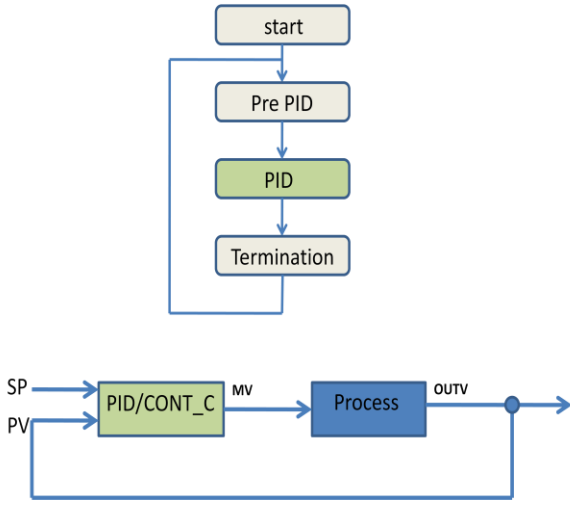

Figure 3: Three basic modes.

- Pre PID mode calculates a concentration by letting the screw conveyor run for a certain time and filling the tank with a fixed volume of the solvent.
- PID mode, the PID takes over and adjusts the manipulated variable (speed of the screw conveyor) based on the actual concentration output from the added Turbidimeter.
- Termination mode ends PID control.

Programming of the control system was done in Siemens SIMATIC software. Figure 4 shows a solid concentration maintained at 1% by the PID controller. The screw-conveyor is running on a very low frequency, less than 3% of its 50 Hz.

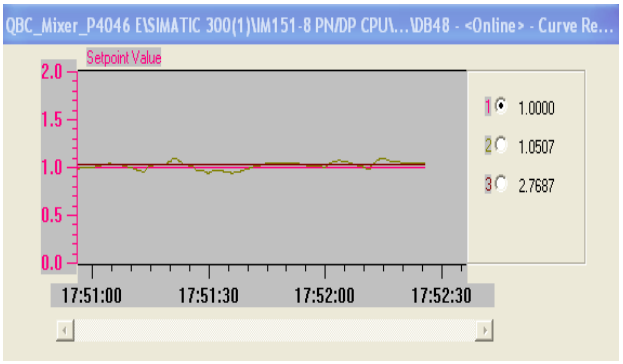

Figure 4: Concentration PID.

Conclusions: By feeding back the measured signal from the Turbidimeter to a PID controller the desired solids concentration can be maintained. The batch process is thereby turned into real-time continuous blending process.