

# BATCH PRODUCTION OPTIMIZATION BY DECREASING PRODUCT LOSS BY IN-LINE ANALYSIS & CONTROL

In-line analysis of the product constituents to determine phase change from water to product, product to product, product to water: products include cottage cheese dressings, sour cream, yogurt for the analysis of fat and total solids.

## Introduction

Various dairy ingredients for products such as cottage cheese dressings, sour cream, yogurts are mixed in a batch tank. The product from the batch tank is pumped into a balance tank that feeds a homogenizer and HTST (High Temperature Short Time) pasteurizer. When the product moves forward it displaces water in the lines and diverts it to drain. The divert valve to drain/waste is closed when the product has displaced the water and the product moves forward to a storage tank. Previously the operation of divert valve was determined by the time it takes by stopwatch, for the product to go through the process line,

based on the process pipe volume and flow rate. At the end of the batch, the product remaining in the line to the tank is pushed through by water. Once the product reaches the valve at the tank, the valve is diverted to drain to sewer.

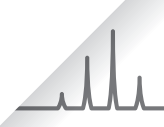
## Challenge

The time that the divert valve is switched from sewer to the product line is very critical. If delayed product will be diverted to sewer resulting in a loss of product. If the valve is switched too soon water will be mixed with the product resulting in off-spec product. Either scenario results in a loss of revenue and increase in rework to standardize the product to specification.

The Plant Production Manager and Shift Managers have the responsibility to ensure the operators are properly managing these critical valve diversions.



*ProSpect real time in-line analysis*



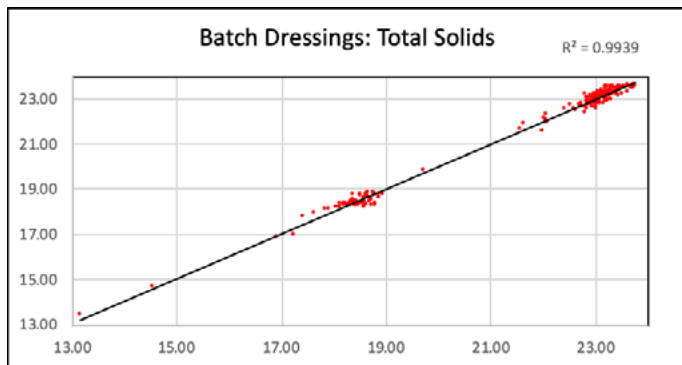
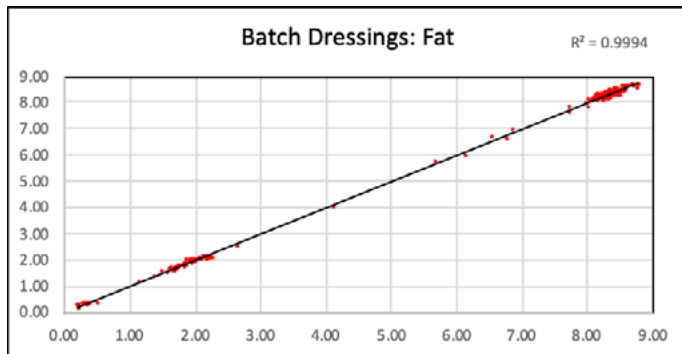
# PROSPECT BATCH PROCESS BENEFITS

## Solution

To determine the exact time the product had displaced the water, the ProSpect Process Analyzer system measurement cell was installed in the process line just upstream of the divert valve. The change from water to product was rapidly and accurately determined. Also, the actual percentage of fat and total solids was output as the ProSpect updates the results every 7 seconds. These results are output to the control systems that operate the diversion equipment.

BATCH DRESSINGS CALIBRATION STATISTICS			
	Range	SECV	R <sup>2</sup>
Fat	0.2% - 8.8%	0.08	0.9994
Total Solids	13.1 -23.8%	0.18	0.9939

- R<sup>2</sup> = The correlation between the lab reference value and the ProSpect predicted value.
- SECV = Standard Error of Cross Validation. This is the Standard Error of differences between ProSpect Predicted and Lab Reference Values, during the calibration procedure.



## Benefits

The use of the ProSpect Analyzer in this process to output real-time analytical data to the plant system to automate the divert valve switch reduces waste and maintains product target specifications. It eliminates the dependence on using a stopwatch required to manually operate the process.

The other feature is the continuous analysis of the product for Fat and Total Solids content. When the divert valve is switched from drain to product tank, the running average of the results is initiated. This running average is used to determine when to divert the product tank valve to sewer while this average for Fat and Total Solids are within specification of the product. The final running average values are the average of the Fat and Total Solids in the tank. This is validated by collecting a sample and testing in the lab.

The main benefits are:

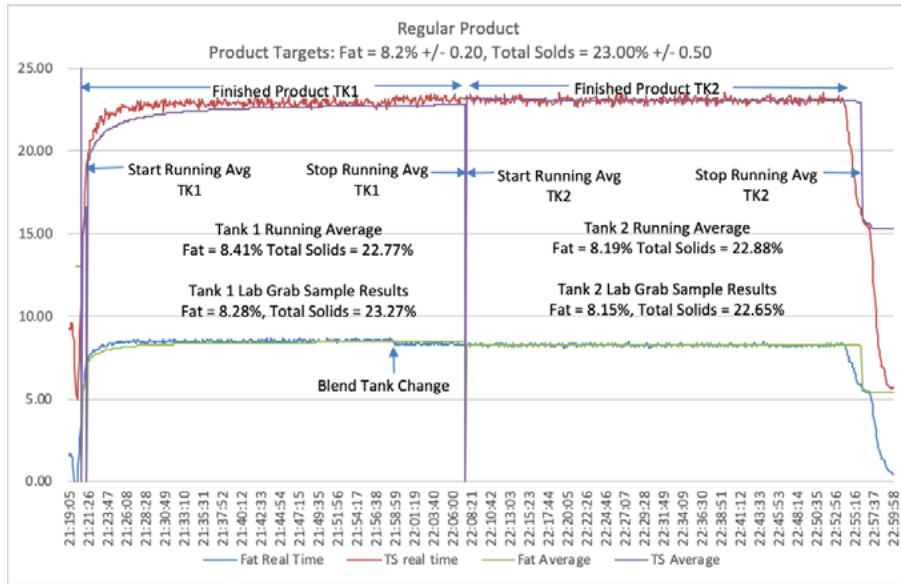
- Automatically determine when to switch the divert valves to keep the product within specification
- Output the overall average of the finished product in the storage tank

This configuration is used for water-to-product, product-to-water and produce-to-product analysis.

# PROSPECT BATCH PROCESS ANALYSIS AND CONTROL

## Single Product Production Run

Below is an example of the production of a large batch of a single product. It was run into 2 finished product tanks. The start of the running average was determined by preset product qualification level (Mahalanobis Distance) and the stop point of averaging was determined when the tank valves switched from Tank 1 to Tank 2. These setpoints were set up in the plant PLC. Output to the ProSpect PLC started and stopped the running average. The running average can also be determined in the plant PLC.



## Multiple Product Production Run

Below is an example of a multiple product run. In a case like this the products are run in order of fat content, i.e. low to high. In some cases, the production line requires a water flush in which the water would go to drain until the product came into qualification set point.



# PROSPECT FULLY INTEGRATED SYSTEM

### The ProSpect is a fully integrated system with:

- Built-in process computer with touch screen interface
- Built-in PLC which includes bi-lateral communication to the plant PLC.
  - Output of analytical results to the plant PLC via ethernet or analogue
  - Input of production signal from the plant PLC to automatically select the product that is in production
- Built-in power conditioning
- Built-in air-conditioned temperature control
- Insensitive to vibration
- Ethernet ready
- Self-diagnostics
- All housed in a NEMA 4X environmental enclosure
  - Wash down ready
- 3A compliant CIP measurement flow cell with NIR energy transmitted through fiber-optic bundles.

*ProSpect In-line Process  
NIR for measurement  
of fat and protein in  
cheese milk.*

