



ICM APC+: The Synergy of Optimization

Today's ethanol producers operate under intense market pressures. The changing costs of corn and energy versus the price of ethanol and ethanol co-products are always pushing the margin between revenue and profit.

To stay competitive, ethanol producers need to meet the following challenges.

- Increased yields
- Reduced energy usage
- Co-products quality consistency
- Emissions compliance

Why Optimize?

Maximize the return from your plant's assets

The standard control system furnished with the plant is not capable of optimizing operations and getting the maximum return from plant assets. These PID controls utilize a One-Input-One-Output design with each loop working independently. A PID controller cannot react to a disturbance until its process deviates from setpoint. Thus, PID loops are reactive, getting behind and playing catch-up, which results in high variability. Our Ethanol APC Solution is Multivariable, Model-Based Predictive Control (MPC). The whole unit operation is seen at once, and the model predicts and begins making changes to mitigate a disturbance as soon as it occurs. This is proactive control which does not get behind, so variability is reduced. The graph below illustrates how reduced variability relates to improved operations and profits.

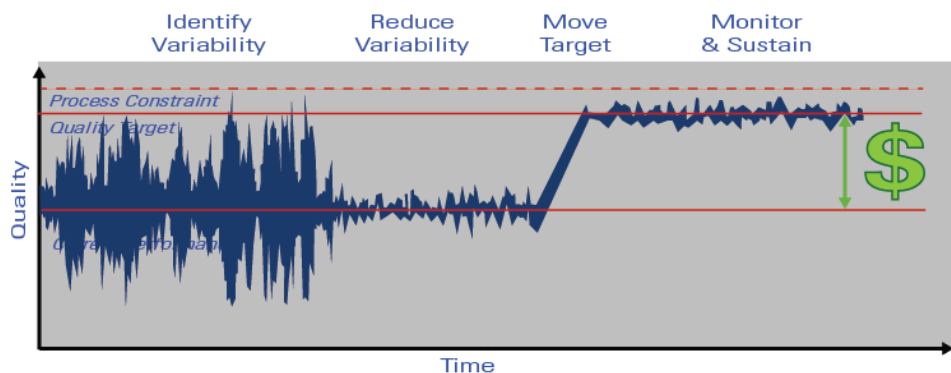


Fig 1: Reducing variability enables moving closer to spec limit

Increased profitability

Reduced Variability

The trends shown on the back page are before-and-after illustrations of how MPC improved beer column temperature control. All loops in a distillation column interact. If one variable moves, all other variables move as a result of that disturbance. These multiple moving variables are difficult for a human operator to visualize and even harder to handle well. Every deviation from steady state operation costs money. In this example, the constant acceleration and deceleration of the boil up rate (and thus column temperature) in the operator-controlled column causes extra steam usage. The much more stable operation with MPC control shows less steam usage as can be seen by the lower position of the gray trace. In this 44 MM g/y plant, the steam reduction due to better control amounted to \$120,000/yr. with the natural gas price at \$4.00. This value would be \$150,000 in a 55 MM plant and \$300,000 in a 110 MM plant.



the energy of innovation™



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Our Ethanol APC solution leverages the synergy of ICM's unique combination of Ethanol APC, Ethanol Operations Expertise, Ethanol Process Engineering Experience, and Ethanol Bio-Scientists. Removing bottlenecks and improving operating and lab procedures enables our ICM Ethanol APC solution to realize the maximum possible return.

The ICM APC solution includes:

- **MPC controllers for all major unit operations**
- **Evaluation and optimization** of biological operating and lab procedures
- **Detailed evaluation** CIP operations and plant equipment to detect limitations, design flaws, or equipment malfunctions
- **Life Cycle Maintenance support** for both PID and MPC controls

Contact us

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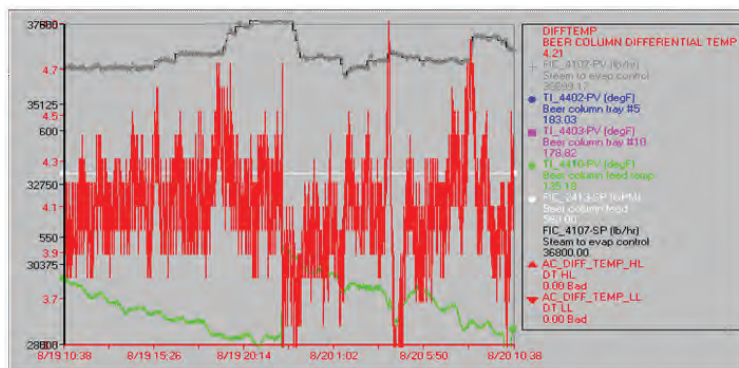


Fig. 1 - Beer Column trends with operator in control

Red is temperature. Gray is steam to evaporators.

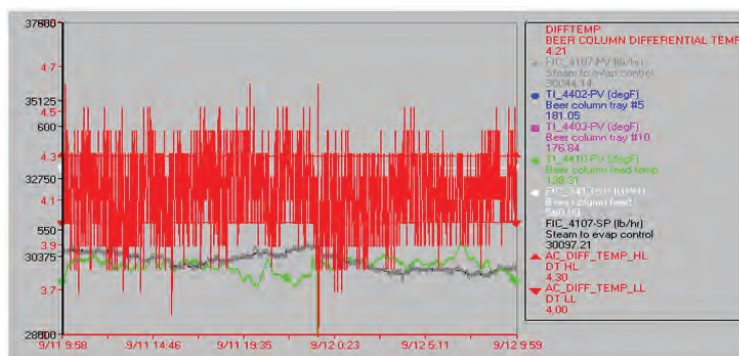


Fig. 2 - Beer Column trends with MPC in control

Red is temperature. Gray is steam to evaporators.

Results from a recent application of APC in a 110 MGY plant

- **Increased run rate** from 114.3MGY to 120.4MGY (5.3% increase)
- **Increased yield** 1.1%
- **Reduced Btu/gal** by 3.4%

- **Additional ethanol profit:** 6.078mm g/y x [\$2.14/gal - \$1.82131/gal] = \$1,936,998/y
- **Additional DDG sales and profit =** \$796,460/y
- **Nat. gas saving =** 811/Btu/g x 120,400,000 = 97,644mm Btu x \$4.74 = \$462,834/y
- **Water sale as DDGS =** 0.137% 0.00137 x 388,892t/y = 532 t/y x \$130/t = \$69,160/y
- **Enzyme (Alpha Amylase) usage reduction =** 57.8 ml/min = 7802 g/y x \$24.89/g = \$194,199/y

Total additional profit = \$3,459,651/y

If the same results were achieved in a smaller plant, additional revenue could be:

60MGY plant = \$1,729,500/yr.

48MGY plant = \$1,383,860/yr.

