

Ethanol Production

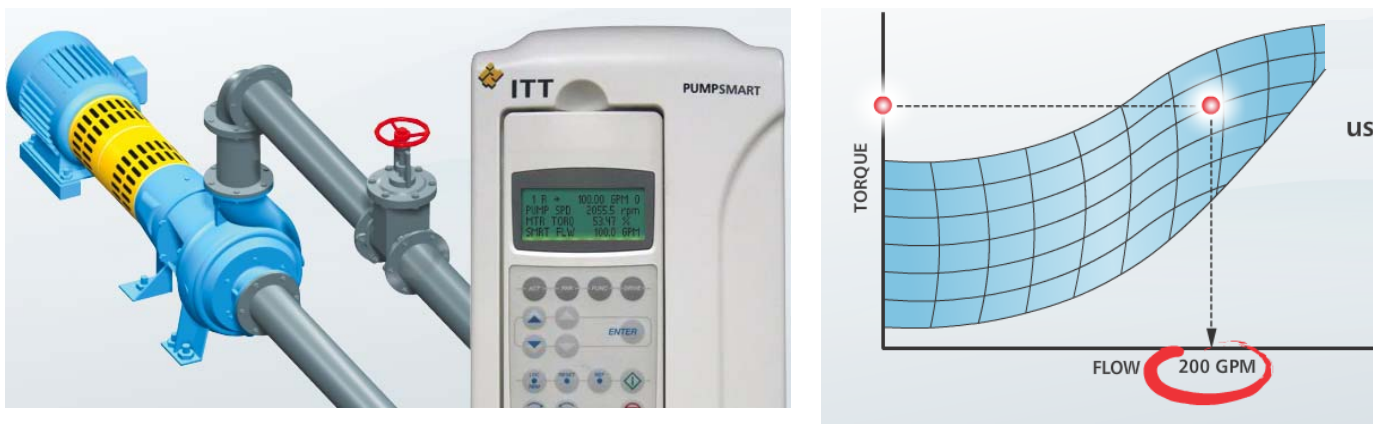
Ethanol production is increasing to meet the demands of alternate energy fuels. Gasoline in most states now contains 10% ethanol. In an effort to decrease plant production costs engineering design companies have made control schemes fairly simple. Operators are expected to control pump operation including shutting down pumps when a tank transfer is complete. PumpSmart can be used to provide automated and more reliable processes.

Urea Mixing and Transfer Case Study

Application Overview: Bags of urea are manually poured into 500 gallon tanks full of water. A pump located adjacent to the tank is used to mix the urea and water mixture by drawing from the bottom of the tank and then pumping into the top of the tank. After the mixing is complete, the water and urea mixture is pumped to various storage tanks located at highly variable distances from the urea mixing tank. This application creates three distinct challenges; mixing, tank transfer, and dry-running of the pump.

Mixing Challenge: In the original design, the pump would run at a fixed, maximum, speed with the discharge diverted back into the batch tank. To prevent over agitation of the mixture, operators would throttle the isolation valve in an attempt to manually control the flow back into the tank. This practice resulted in reduced bearing and seal life due to higher radial loads on the shaft, consumption of excess energy, and accelerated wear on the isolation valve.

PumpSmart Mixing Solution: PumpSmart was able to provide the benefits of variable speed and the ability to estimate pump flow without any process transmitters. This capability, referred to as SmartFlow, allow the operators to determine the optimal mixing rate of the application to be 100 GPM. They then set PumpSmart to automatically regulate to the 100 GPM setpoint during the mixing phase without having to make any valve adjustments.



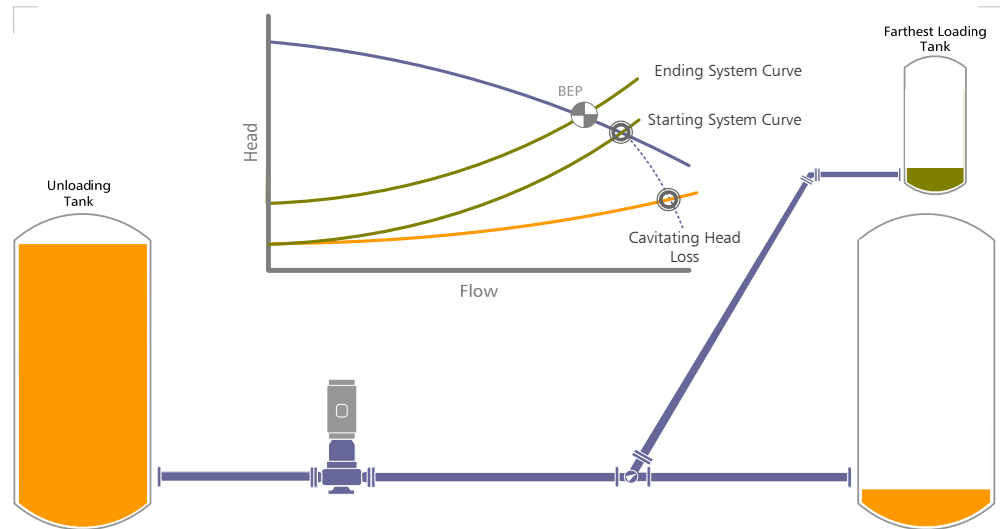
PumpSmart will utilize sensorless SmartFlow to provide a constant flow rate

Tank Transfer Challenge: After mixing, the recirculation valve is closed and the water/urea mixture is transferred to various tanks that are located at various distances from the pump. Line losses vary proportionally to the distance and impact where the pump operates on its curve and affects the transfer flow rate. Operators would attempt to use the discharge control valves to control the approximate flow rate, with limited success. This method resulted in reduced

mechanical seal life as a result of cavitation during run-out. It also resulted in varying batch times and required greater operator oversight and intervention.

PumpSmart Tanks Transfer Solution: With SmartFlow still enabled from the mixing stage, the operators were able to simply close the recirculation valve and open the isolation valves to the desired tank. PumpSmart automatically adjusts speed to maintain the 100 GPM setpoint, regardless of the head loss, or back-pressures, associated with each different tank.

Lowest Demand Condition that can lead to cavitation: Highest level in unloading tank, lowest level in loading tank and pumping to closest tank



Tank emptying and shutdown Challenge: Once the mixing tank is emptied operators must be in close proximity to shut down the pump to avoid dry running. Frequently operators were pre-occupied with other activities which resulted in detrimental dry running pump operation.

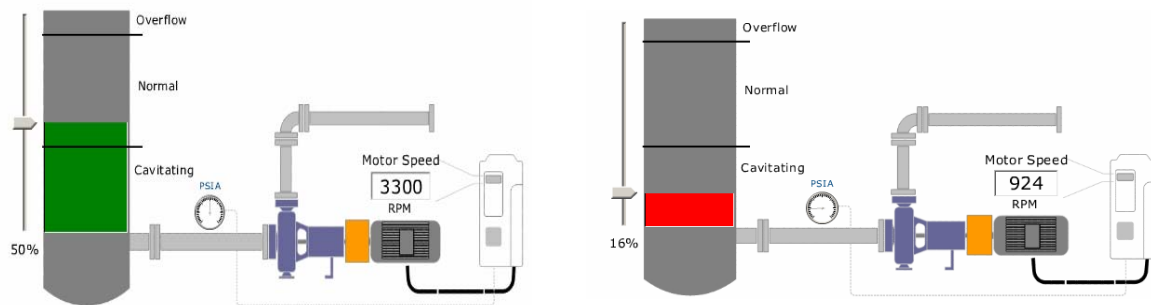
PumpSmart tank emptying and shutdown Solution: PumpSmart is programmed to detect a dry running or empty tank condition by constantly checking the pump load. When it detects a starved condition, such as when the tank is near empty or drawing a vortex, it automatically shuts down the pump.

Customer Testimonial: The units have been operating without incident for close to 2 years without any need for adjustment. Our customer is very pleased with the operation and is looking for additional opportunities to apply PumpSmart.

Corn Starches and Mash Slurry Transfer:

Application Overview: Ethanol production involves a multi-step cooking process. The starch in the corn flour is physically and chemically prepared for fermentation. Fermentation of this starch slurry or mash produces the ethanol and a separate distillation process extracts the high purity ethanol. There are numerous steps in the cooking, fermentation and distillation processes and pumps are used to transfer the slurries and mash to each tank/process step.

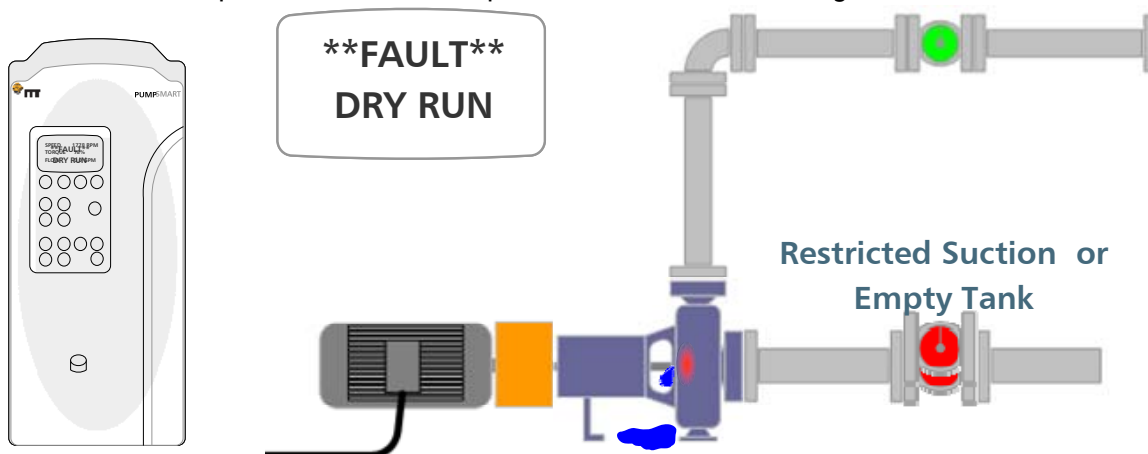
- **Cavitation Challenge:** Due to the high temperatures, cavitation is fairly common as the tank level drops.
- **Pump Smart Cavitation Solution:** PumpSmart is programmed to use SmartFlow as the primary variable and suction pressure as the secondary variable. PumpSmart operates at maximum flow when the tanks are full and linearly steps down as the tanks are emptied.



If cavitation is a concern for lower tank levels, pump speed and pump flow can be automatically reduced as the tank empties. In this example tank level is correlated to the suction gauge pressure.

Dry Running Challenge: Dry running occurs when the tank is completely evacuated until the operator realizes a tank is emptied and can shut down the pump. Seal selections that can accommodate some dry running were made by the engineering contractors given the expectation that dry running will occur for extended periods of time. In addition the need for operators to be attentive to the tank unloading keeps them from performing other higher value activities.

- **Pump Smart Dry Running Solution:** PumpSmart is also programmed to detect an empty tank condition and automatically shuts down the pump. This automation of the pump tank transfer processes allows the operators to focus on other high value added activities.



PumpSmart will detect a dry run condition and can be configured to automatically shut down the pump to avoid a catastrophic mechanical seal failure.