Design and Performance Considerations for Optimum Industrial Fluid Dispense Solutions

This guide provides an overview of common industrial fluid dispenser technology issues and the associated solutions.

Issue - Accurate Dispensing. Measuring Ingredients.

A scale used as a measuring device, especially with the gravimetric method, must have sufficient resolution to obtain the desired accuracy. Gravimetric machines are often advertised with 0.1 gram accuracy, however, most 55-gallon drum scales have a resolution of +/- 50 grams. A scale is never truly accurate during the dispense because the force from the pumping system is transmitted to the scale, as is the weight of the material, causing the scale to read "heavier." Often, this problem is addressed by using a software algorithm in the controller to look ahead or "guess" the weight while dispensing. In addition, multi-step dispensing processes are used with a staged valve for full, medium and fine flow, as follows:

1. Full flow for the first 80%
2. Stop and wait for the scale to "settle" (to get the true weight)
3. Medium flow for the next 15%
4. Stop and wait for the scale to "settle" (to get the true weight)
5. Fine flow for the last 5%
6. Stop and check the scale (to get the true weight) to pulse in that last amount. That's six steps!

Solution - Select equipment that uses a Weight Displacement Encoder that is not immersed in the wet material. It is beneficial for the equipment to have a single "reference" or all pumps in the system, much like a scale. Weight Displacement Encoders track the weight for each individual ingredient, even when they are all dispensed at the same time! An encoder can also be combined with optional scales for dual-reference checks for each batch. These high-accuracy, real-time devices allow for flexible methods of dispense.

Issue - Methods of Dispense: Gravimetric, Volumetric, Ratio and Priority.

Gravimetric method dispenses one ingredient at a time onto a scale until all ingredients in the formula are added.

Volumetric method dispenses all ingredients at the same time, which is much faster dispensing than a gravimetric machine.

Ratio or proportioning dispenses are common when a catalyst is involved in the formula, such as lamination adhesives and multi-component paints. With this method, formulas do not require stirring or agitation after being dispensed.

Priority Mode dispenses are useful when bases or inert portions of the formula are dispensed first and then checked for weight compliance, followed by the addition and weight-compliance check of active ingredients.

Solution - Based on the dispense requirements, select an equipment line that is capable of all methods of dispense: Gravimetric, Volumetric, Ratio, and Priority or combinations of these.

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Issue - Accurate Dispensing. Pumping the Liquid.

Fluid delivery must be smooth and repeatable, without pulsation for any system to be consistently accurate. Pneumatic-diaphragm pumps, which are typically used with gravimetric machines, produce pulsations with each pump stroke, so design and installation of equipment such as pulse dampeners and back-pressure regulators are often needed. This can be further aggravated when a wide variety of material viscosities are pumped, since each material will have unique pressure and surge characteristics.

Solution - Select machines that use electric motor-driven positive-displacement pumps that produce smooth, repeatable fluid delivery. Specifically, select a pump drive train system that uses a single motor/gearbox coupled with a Weight Displacement Encoder to drive multiple pumps. This single motor and encoder combination provides the most reliable, repeatable, and accurate fluid delivery system for all these types of applications.

Issue - Safe Dispensing in Hazardous (Explosive and Flammable) Enviroments.

Many solvent-based materials require that dispenser equipment meet National Electric Code compliance for Class 1/Division 1 (explosive) atmospheres. For many types of machines, the enclosures of water-based equipment are purged to achieve compliance, however, purged enclosures are a maintenance nightmare since all power must be off when the enclosure is opened.

Solution - Select equipment that uses explosion-proof or intrinsically-safe electronics and does not require purged enclosures.

Issue - Effective Dispensing. Feed Stock Options.

Most machines do not have options for ingredient feed methods to a dispenser, typically relying on 55-gallon drums to supply each dispense pump.

Solution – Select a line of dispensers that feature multiple feed stock options, such as:

- Feed direct from 55-gallon drum.
- Feed from remote recirculation mother tote pumping systems using a bulk tap option.
- Feed from internal, canister wings supplied with combinations of three or six gallon canisters. This allows smaller amounts to be loaded into the dispenser, typically from one or five gallon cans.
- Gravity Feed from day tank/tote combinations.

Issue - Effective Dispensing. Dispense Batch Sizes.

Dispenser equipment typically comes configured to output one batch size, for example, 55-gallon drums, and hence cannot produce smaller quantities.

Solution - Select dispensers that have the ability to output into a wide range of container sizes (i.e., pint to large chemical totes) and that can output in US gallons, US Quarts, Liters, Pounds, Grams, or Kilograms.

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Issue - Fast Dispensing. Need for Speed.

The faster one attempts to dispense a formula, the more challenging the accuracy component becomes.

Solution - Select machines that can be switched on the fly from gravimetric to volumetric dispense modes.

Issue - Effective Dispensing. Ease of Operation.

Dispenser equipment often requires setting many calibration and dispense factors in a software interface to handle various viscosities, pump rates, container sizes, valve anticipator settings, etc.

Solution – Select dispensers with "one button" fully-automatic capability, where all factors are automatically set by a controller. Gravimetric and volumetric dispenser machines address speed of dispense in different ways. Since a volumetric machine dispenses all ingredients at the same time, it is inherently much faster than the gravimetric method. This advantage becomes even larger in formulations that have many ingredients.

Issue - Effective Dispensing. Serviceability.

Dispense machines have their components crammed into small spaces and often come with electrical drawings, BOMs, and user manuals which are poorly detailed.

Solution – Look for equipment designed with easy access to components and that utilize common industrial standard fittings, tubing, and simple to understand mechanicals. Machines should come with fully detailed electrical, pneumatic, and component assembly drawings as well as thorough user manuals and troubleshooting guides.

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