Overview

Note: *This feature is only available when using AccuLoad III-X Revision 10.02 firmware or better.*

The AccuLoad III supports a new additive injector type, known as flow rate controlled injector. This new injector type is similar to a metered injector type in that a meter pulse input is received; however, rather than a solenoid, a digital valve or analog valve is used to control the flow of the additive. The AccuLoad controls the flow of the additive in an attempt to have the additive delivered by the product first trip point or the additive stop volume. The AccuLoad adjusts the valve as needed to achieve the desired flow rate if the rate is out of tolerance from the current target rate.

The flow rate controlled injector is available for straight and sequential blending load arms. Up to four of these additive types can be configured to the AccuLoad. Programming this injector type is equivalent to programming a metered injector (requires a K Factor and meter factor, and can use high and low tolerance), except that a flow rate controlled injector requires a digital or analog valve for flow control, instead of a single digital output for on/off control. Flow rate controlled injector types are limited to injectors 1 to 4.

General Criteria for Control and Delivery

- The additive can be delivered during low flow start provided the sum of the minimum flow rates of the additive meter and product meter does not exceed the programmed low flow start rate; otherwise, only the main product will deliver during low flow start.

- The additive flow rate will be maintained at a value between the minimum and maximum additive flow rates programmed, such that the AccuLoad will attempt to deliver all additive before the batch first trip point or additive stop volume, whichever is greater.

- At six-second intervals during delivery, the amount of additive remaining for delivery will be checked to determine if the flow rate of the additive should be adjusted so delivery is completed concurrent with the stop amount. If the calculated flow rate is within the tolerance of the current flow rate, no valve adjustment occurs and the current flow rate is maintained.

- If additive delivery is not complete before the first trip value is reached, it will continue to deliver through main product ramp-down. If additive delivery is not complete by the time the product's second trip is reached, the additive valve will close, resulting in a shortage of additive delivered for the batch. (If the additive is plumbed downstream, the delivery of additive will continue until the full amount has been delivered.)

- If an additive stop volume is programmed, delivery of additive will stop when the preset remaining reaches the additive stop amount, even if additive delivery is not complete.

- Even though the additive is under flow control and separate additive totals are maintained, the additive becomes part of the main product delivered once it is injected. This is true for all additive injector types.

- If the injector is located downstream, the total product flow rate would be the sum of the product flow rate plus the flow rate of the additives.

- Additive flow rates and volume calculations do not involve the additive conversion factor. Flow rate and volume calculation is identical to that used for the main product, which is as follows:

$$\text{Volume} = \frac{\text{Pulses}}{\text{K Factor}} \times \text{Meter Factor}$$

- The additive totalizes in the same units used for the main product. If the pulse input type is mass, then injector pulses are assumed to represent mass.

- Back pressure control is not supported with flow rate controlled additives, although it is still available for products delivered, even if flow rate controlled injectors are used.

Alarms

A No Additive Pulses alarm is generated when the additive is commanded to flow but the flow rate remains continuously at zero for more than eight seconds.

An Excess Additive Pulse alarm is generated when pulses are detected from an injector that has not commanded to flow.

When using flow rate controlled injectors, the tolerance set for the additive is not checked until the batch is completed or terminated. The total additive amount delivered is checked to verify that it falls within the high and low tolerance limits. The tolerances programmed represent the percentage the additive must be within from its intended delivery. If too much additive has been delivered, an Excess Additive Pulses alarm will be generated. If too little additive has been delivered, a Low Additive alarm will be generated.

For example, assume an injector has its high tolerance programmed to 5% and the low tolerance programmed to 4%. Assume that a 1,000 gallon batch is delivered with 10% additive. The intended delivery of additive is 100 gallons. As long as the additive delivered is between 96 and 105 gallons no alarm will occur.

When the batch is in progress, and the flow additive valve is requested to open, a timer is started. This internal timer is used to determine how much time it takes the valve to leave the open state. If the amount of time takes longer than the value programmed in the Injector Flow Timeout parameter, a low additive alarm will occur. This feature is available in revisions 10.06 and above.

When the batch is in progress, the flow rate controlled metered injector is monitored to predict the likelihood that the desired amount additive will be delivered. Each time a new flow rate is calculated for the additive injector, it is compared with the maximum flow rate allowed for the injector. If the calculated flow rate exceeds the maximum flow rate, the desired flow rate is set to the maximum flow rate and a counter is incremented. This counter indicates the possibility that the full amount of additive will not be delivered because the specified flow rate was not achieved. If the counter exceeds the Maximum Tolerance Error value programmed, a LOW Additive alarm will be generated.

If the AccuLoad measures a flow rate from the flow rate controlled injector that exceeds the programmed maximum flow rate plus tolerance for more than three continuous seconds, an Additive Frequency Alarm will be generated.

Program Parameters

The purpose of this section is to identify the parameters required to make a flow controlled additive operational. The following identifies the parameters.

Configuration 103, 107, 111, 115, 119, 123, 127, 131, 135, 139 – Pulse Input Function

Like a metered injector, a flow rate controlled additive requires a pulse input to be configured with it. The following indicates the pulse input functions for each flow controlled additive.

- Flow Rate Controlled Injector #1
- Flow Rate Controlled Injector #2
- Flow Rate Controlled Injector #3
- Flow Rate Controlled Injector #4

Configuration 501, 5005, 509, 513, 517, 521, 525, 529, 533, 537, 541, 545, 549, 553, 557, 561, 565, 569, 573, 577, 581, 585, 589, 593, 597, 601, 605, 609, 613, 617, 621, 625, 629, 633, 637, 641, 645, 649, 653, 657, 661, 665, 669, 673, 677, 681, 685, 689, 693, 697, 701, 705, 709, 713, 717, 721, 725, 729, 733, 737, 741, 745, 749, 753, 757, 761, 765, 769, 773, 777, 781, 785, 789, 793, 797, 801, 805, 809 – Digital Output Function

If the flow controlled additive is to be controlled with a digital valve an upstream and downstream solenoid must be configured. The following indicated the digital outputs functions for digital valve control additive that can be configured.

- Flow Controlled Injector #1 Upstream Solenoid
- Flow Controlled Injector #2 Upstream Solenoid
- Flow Controlled Injector #3 Upstream Solenoid
- Flow Controlled Injector #4 Upstream Solenoid
- Flow Controlled Injector #1 Downstream Solenoid
- Flow Controlled Injector #2 Downstream Solenoid
- Flow Controlled Injector #3 Downstream Solenoid
- Flow Controlled Injector #4 Downstream Solenoid

Configuration 901, 911, 921, 931, 941, 951 – Analog Output Function

If the flow controlled additive is to be controlled with an analog valve an analog output must be configured for each flow controlled additive configured. The following indicates the analog outputs function for analog valve control for each of the four flow controlled additives can be configured:

- Inj #1 Analog Value
- Inj #2 Analog Value
- Inj #3 Analog Value
- Inj #4 Analog Value

System 810 - 821 – Additive Types, Additive Arm, Additive Plumbing

To define as additive as being flow controlled the additive type must be configured as Flow Controlled. In addition the arm location and plumbing must be assigned as well. Programming arm location and plumbing is similar to other additive types.

System 043, 048, 053, 058 – Additive Valve

This parameter defines what valve type will control the flow controlled additive. Defining a valve type is required for each flow controlled additive. The selections are:

- Digital
- Analog

System 044, 049, 054, 059 – Additive Valve Proportional Gain Factor (Kp)

This three-digit entry is the proportional gain factor if an analog value is used for flow controlled additives.

System 045, 050, 055, 060 – Additive Valve Integral Factor (Ki)

This three-digit entry is the integral gain factor if an analog value is used for flow controlled additives.

System 046, 051, 056, 061 – Additive Valve Derivative Factor (Ki)

This three-digit entry is the derivative gain factor if an analog value is used for flow controlled additives.

System 047, 052, 057, 062 – Additive Valve PID Interval

This two-digit entry is the time interval in seconds between PID calculations. This entry is used with analog values only.

System 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925 – K-Factor, Meter Factor, High Tol, Low Tol, Max Tol Err

K-Factor and Meter factor are required for each flow-controlled additive. High Tolerance, Low Tolerance, and Max Tolerance Error are optional. The functionality of these optional parameters is described above. Zero disables the functionality of these parameters.

System 027, 031, 035, 039 – Min Flow

Defines the minimum flow rate that the AccuLoad will allow the additive to deliver.

System 028, 032, 036, 040 – Max Flow

Defines the maximum flow rate that the AccuLoad will allow the additive to deliver.

System 029, 033, 037, 041 – Flow Tol

Defines the percentage above and below the target flow rate that the additive will deliver without value correction.

System 030, 034, 038, 042 – 2nd Trip

Defines the amount of additive remaining in the delivery before final valve closure occurs.

System 089, 090, 091, 092 – Flow Timeout

Defines the amount of time in seconds the valve is allowed to be in the open state in order to reach the desired flow rate before a low additive alarm occurs. This feature is available in revisions 10.06 and above.

Recipe – Inj %

Defines the percentage of additive required for the products pacing the flow controlled additive. Example: if the percentage is set to 10% and the additive is required to deliver for a straight product load arm then 10% of the batch will be additive and 90% will be product.

Recipe – Inj Products

This defines which products the additive will deliver with in blending applications. Example: if the additive is configured with a two product sequential blending arm and this parameter is set to Product 2 only, when Product 2 is scheduled to flow the flow controlled additive will deliver with it. If the “Inj %” is 10% then Product 2 delivery will consist of 10% flow controlled additive and 90% product. Since “Inj Prods” does not include Product 1 in this example, then flow additive will not deliver with Product 1.

The specifications contained herein are subject to change without notice and any user of said specifications should verify from the manufacturer that the specifications are currently in ef-fect. Otherwise, the manufacturer assumes no responsibility for the use of specifications which may have been changed and are no longer in effect.

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