SERVAacm®-III Automatic Density Control System

The Automatic Density Control System is designed for the Serva High Energy Recirculating Mixing system and uses the latest Computer Control Technology.

The ACM® -III interacts with the cement-metering valve that controls the dry bulk cement. The mixing process is controlled by an industrial grade programmable controller that is equipped with an operator interface control panel. This programmable controller controls the cement metering valve position. The control software analyzes the measured mix water rate, slurry density and the desired slurry design. The “go-to” control algorithm calculates the required cement to match the measured water to meet the required slurry density. The mix water flow meter measures the water rate that is flowing into the mixer, and the control algorithm calculates the required percent opening for the cement-metering valve to meet desired density.

A PID loop dials-in the fine setting of the metering valve as it reads the signal from the densitometer. The control algorithm will respond to three possible changes during the job. Changes in the throughput rate, which is reflected in changes in the mix water rate; changes in set point density (operators can thicken the slurry at the tail end of the slurry mix or reduce the set point due to measured air entrainment); and changes in cement delivery due to irregular and/or declining cement delivery from the bulk supply.

The system also has a training simulator mode that lets the operator run cementing jobs without having bulk cement supplied to the unit. The operator can improve his skills for controlling density in manual or automatic mode with no material cost or cleanup. The programmable controller, while in simulation mode, provides system function verifications to test all lines, cables, flow meter, hydraulic system, feed back system and the programmable controller itself.

The cement flow rate is controlled and adjusted via a proportional solenoid valve, which is automatically controlled by the computer. The slurry densitometer located on the circulating piping system detects the actual density and feeds the measured value back to the computer. The 3” water flow meter mounted on the mix water piping system measures the water flow rate and sends the measured value to the computer. With the water rate and the desired density, slurry design and measured density, the computer calculates the required cement valve position. A command signal is sent to the hydraulic actuating system to adjust the opening of the bulk cement-metering valve and thus controls the slurry density to the set range. The auto mixing system has interfaces for triplex discharge pressure and rate, bulk delivery ability and discharge rate. It displays and records the slurry density, discharge rate, and pressure bulk deliverability.

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KEY FEATURES

1. GO-TO and PID Program

The “Go-To” program and the “PID” program together precisely control the slurry density. The “Go-To” feature adjusts the cement metering value before a density error occurs. When the job requires a change to the water flow rate, the computer will automatically adjust the opening of the cement-metering valve. The “Go-To” feature will normally adjust the cement metering to the correct position. If the density is still off a little, the PID control algorithm takes over to make final adjustments. The PID algorithm uses density error (set desired value less measured value) to correct density errors that the “Go-To” system did not take care of. Thus, the PID system is a secondary control system that makes the final trim in the control values.

2. Simulator Module

The ACM® System is configured with a simulator program. In the simulating mode the operator can implement the system self-check without bulk cement before starting the cement job. The program is also very helpful for training operators.

3. Non-radioactive Source Densitometer

The non-radioactive source densitometer responses very quickly and works reliably. It requires no calibration.

4. Manual/Auto Mode Switch

The system shifted back and forth between manual and automatic mode whenever the operator wishes.The job can be started and stopped in either manual and auto mode.

5. American Standard Industrial Computer

The American standard industrial computer is of top shock resistance. It is applicable to all different kinds of oilfield job services. Its operation temperature ranges from -29ºC to +49ºC (-20ºF ~120ºF). The computer is equipped with 6” color screen. Only one screen is used for running the job but other screens are used for prejob setup and calibration.

Note: The system also has features to ensure proper operation in cold weather. The ACM® System is also configured to receive triplex pump discharge rate and pressure measurements for recording. The triplex discharge pressure and rate sensors are available.

COMPONENTS & FUNDAMENTAL OPERATING PRINCIPLES

Operator interface panel
Computer with I/O interface
Electro-hydraulic control valve (drives the cement metering valve)
Cement metering valve feedback transducer
Mix water flow meter
Densitometer
Triplex pump rate sensor (optional)
Triplex pump pressure sensor (optional)