Gas Feed Control Techniques

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General

There are three methods of control for gas feed: manual, semi-automatic, and automatic. The control method recommended depends upon the process water flow rate and demand as follows

Control Method	Flow Rate	Gas Demand
Manual	Constant	Constant
Step feed	Intermittent	Constant
Shock feed	Variable	Constant/ Variable
Flow proportioning	Variable	Constant
Residual	Constant	Variable
Compound loop	Variable	Variable

Manual Control

Manual feed control is accomplished by manually setting gas flow rates and manually opening the gas container valve and the ejector water supply. This is effective when the process receiving the gas being fed is manually started and stopped or when occasional feed is desired.

Semi-Automatic Control

Semi-automatic control is essentially a manual, fixed feed rate with automatic start-stop capabilities. That means the feed rate is manually set at the desired level and the system is activated automatically. There are two examples, step feed and shock feed as follows:

Step-feed Control

A step feed gas control system is an economical means of metering at several feed rates into a single point of injection.

A typical step-feed control system feeds gas at one point of application. A vacuum line from the vacuum regulator connects to a set of flowmeters. The manual rate control valve in each flowmeter is set to feed gas at a desired level. The vacuum line from each gas flowmeter, and the vacuum lines from each valve is manifolded to the ejector.

The actuating signal for the shut-off valves may come from several different sources depending upon the individual application. For example, in a multiple pump system, the pump starter can be used to actuate the shut-off valves and allow operation of an individual gas feed rate. There are occasions when other signals may be used (chlorine residual, level, flow, ORP, etc.).

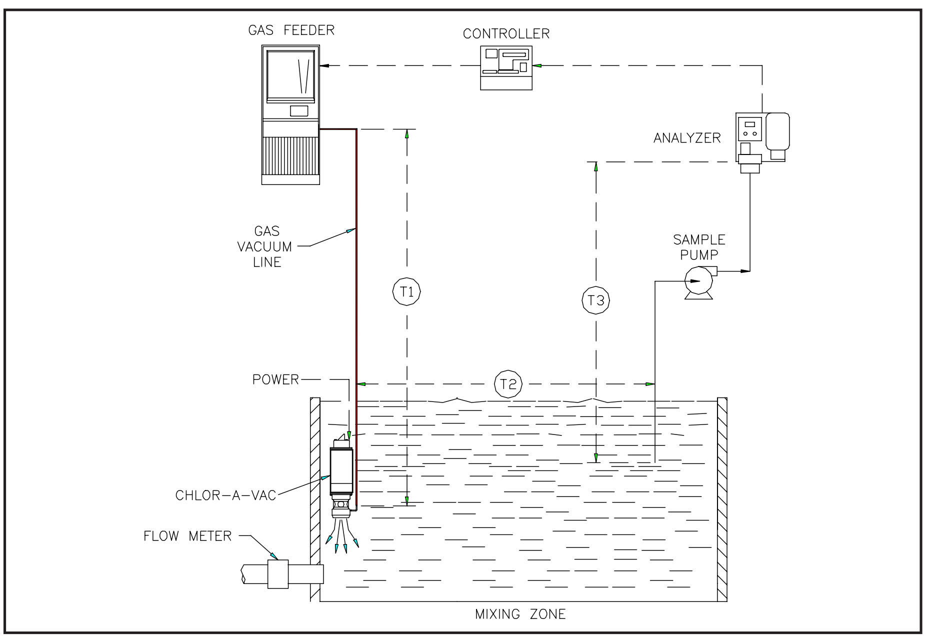

Figure 1 - Residual Control Lag Time - Open Channel

Shock Feed

Shock feed control is used for dosing for a specific time period. A duration timer is used to control the shock time period which is usually set for one cycle of the process. Timers can also control the frequency of dosing and the flushing of the solution line, if required. Dosages vary, but are sized on a design dosage of five parts per million. Processes in which a residual analyzer can be used, can override the duration timer period.

One application of shock feed is industrial cooling water systems. Measured residual in the return line to a cooling tower should not exceed 0.5 ppm (mg/l) of free chlorine (HOCl). This low residual prevents damage to materials, such as wood used in the construction of the tower, and eliminates the waste of chlorine.

Dosages vary, but are usually within one to three parts per million. Residuals, measured in the return line to a cooling tower, should not normally exceed one ppm chlorine. Low residuals prevent damage to towers and eliminates the waste of chlorine. The length and frequency of the treatment are adjusted to meet each application by use of a timer. The timer uses contacts to activate the chlorine feed, and an chlorine residual analyzer is used to override the timer.

Flow Proportioning Control

Flow proportioning reflects process conditions of variable flow and constant demand. These conditions are most normally encountered in potable water treatment. Flow proportioning control is found in two configurations and is applicable to different rates of process water flow.

For water flow rates over 300 GPM (1135.5 lpm), conventional gas flow proportioning systems are used. For flow rates under 300 GPM (11 lps), the system is described in Bulletin 010.4001.

Important considerations in the design and application of flow proportioning control include:

Flow Meter Sizing

In all flow proportioning systems, flow meter sizing is critical. If the process water flow meter is over-sized to accommodate future flow requirements, the current output signal from the flow meter will be low, and will consistently operate the gas feeder in the low and less accurate scale range through start-up and the first several years of plant operation. Automatic systems should be sized to normally operate in the 50-70% of full scale range.

Solution Splitting

Solution splitting is to be avoided in the design of a flow proportioning system. The amount of gas is precisely metered for the application point whose flow is being sensed by the flow meter.

If the solution is then split to a second application point, the metered application point will not receive the required quantity of chlorine. The second application point may receive excess chemical. If multiple application points are required, individual gas metering, rather than solution splitting should be considered.

Residual Control

For residual control, process conditions of constant flow and variable demand exists.

Residual control is usually specified when the demand change is greater than 10% per minute.

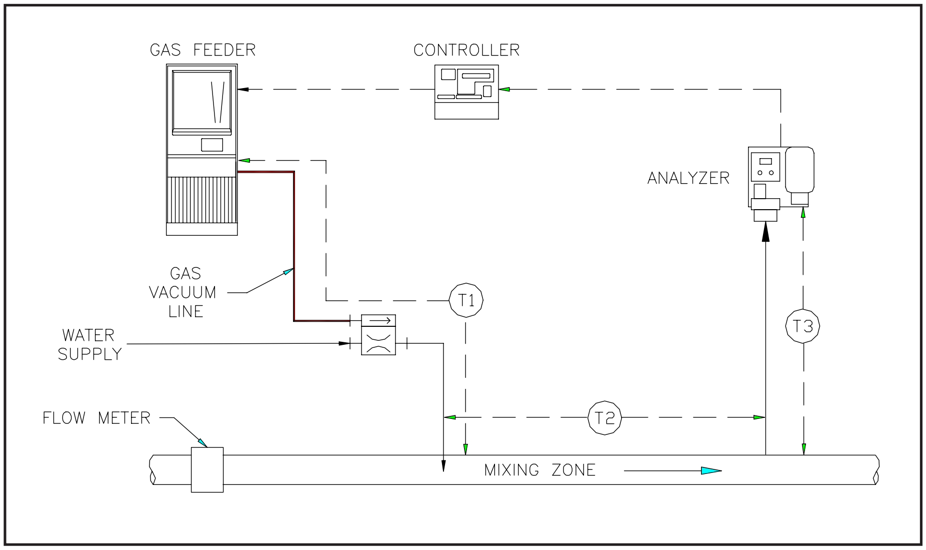

Figure 2 - Residual Control Lag Time - Closed Pipeline

Conventional residual control uses a modulating valve, a set point controller, and a residual analyzer in a feedback control loop to maintain gas feed to a desired set point.

Lag time is defined as the time in minutes required for a change in a gas feed rate to be measured by the residual analyzer. Lag time is the most critical design parameter in a residual control system. Total lag time is divided into three components: T1; T2; T3.

T1 is transportation time in the solution line, from solution generation to the point of solution injection, or the gas movement from the automatic valve to a CHLOR-A-VAC vacuum induction mixer.

Sample pipe length should be minimized. T3 can be reduced if the analyzer is placed directly at the sampling point.

Figures 1 and 2 illustrate the lag time in closed pipeline and open channel applications.

Compound Loop Control

Compound loop control is required when the process flow rate varies and the demand of the process also varies. This condition is prevalent in many municipal and industrial water and wastewater applications.

A more precise control of chemical residual is obtained when process has two variables: flow and demand.

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