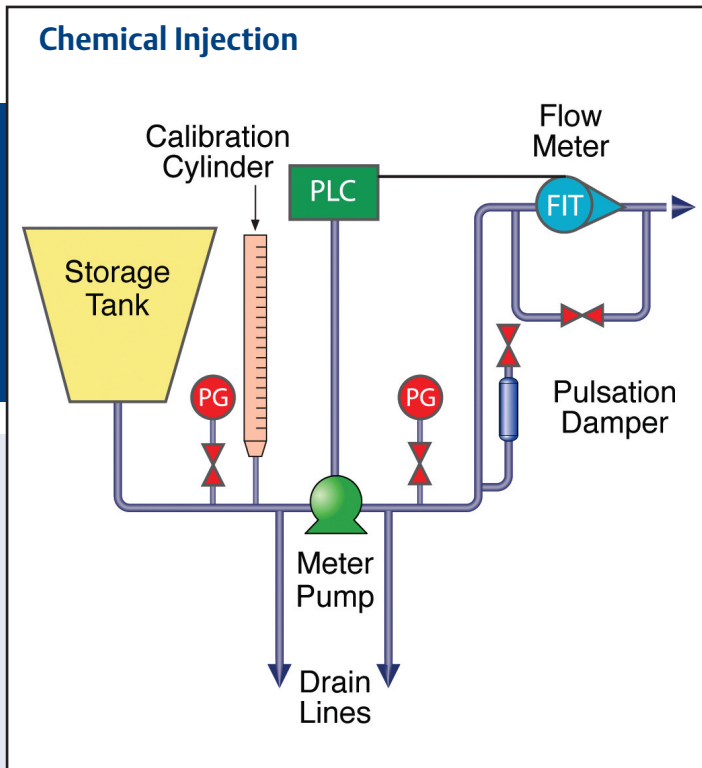


Chemical Injection



Micro Motion Measurement Benefits

- Improve flow assurance
- Reduce lost time accidents
- Reduce potential for environmental excursions
- Improve availability of wells and facilities
- Lower lift costs

Coriolis Applications

- Inhibiting scale and corrosion
- Hydrate control
- Minimizing paraffin coating and asphaltene deposits
- Breaking foamy oil or oil-water emulsions
- Preventing the growth of bacteria and algae
- Drag reducers in pipelines

Chemical Injection in Upstream Facilities

The variety of fluids, their composition and the varying fluid properties associated with an upstream production facility make continuous chemical injection programs quite common in oil and gas production facilities.

The chemicals used for treatment programs can consist of a single compound through to a blend of different chemicals. These compounds are typically hazardous to the health (inhalation and/or skin contact) and are not suitable for discharge into the environment.

The fluids typically treated include natural gas, natural gas liquids (condensates), oil, produced water (brine), fresh water or a combination of these fluids (oil, water & gas). The primary objective is to inject the appropriate volume of treatment chemical in proportion to the volume of process fluid being treated. Injection rates vary with the type of treatment program (hydrate control versus corrosion inhibitor), the properties of the fluid being treated and the type of chemical being used. As such, typical injection rates can range from 0.4 LPH through to 28 LPH.

Chemical treatment systems or skids include a storage or solution preparation tank. In some cases, level indicators are employed to provide an indication of when the stock of chemical needs to be replenished. Injection pumps are combined with some means of metering the volume of chemical to ensure the correct rates are being set and maintained. Pump suction and discharge pressure are sometimes monitored to assess pump performance, particularly in high pressure injection applications. Fluid temperatures may also be monitored if volume corrections due to temperature fluctuations are required.

In applications that require high volumes of chemical to be injected (hydrate control) a chemical recovery process may be used to recover and re-inject the chemicals being used. This is common for glycol or methanol injection programs associated with offshore production facilities.

Customer Benefits

Responsible operations to meet regulatory compliance, avoid lost time accidents, exposure to produced fluids and environmental excursions



Challenges:

- Regular inspection, maintenance and calibration to ensure optimal operations
- Systems distributed over a wide geographical area and/or remote locations.
- Hazardous chemicals and produced fluids that are not environmentally friendly.

Chemical treatment sites require regular inspection, maintenance and calibration to ensure optimal operations. The number and location of chemical treatment sites often leads to a high frequency of site visits (field interventions) by operations and maintenance personnel. The higher the number of field interventions, the higher the potential risk for accidents, of being exposed to hazardous chemicals or of handling chemicals in a fashion that results in an environmental problem.

Solutions:

- Regular inspection, maintenance and calibration to ensure optimal operations
- Avoiding abnormal situations requiring operator intervention and maintenance events.

Deliverables:

- Reduced field trips and materials handling.

The Coriolis meter long-term stability, immunity to changing process / fluid conditions and non-mechanical design significantly reduces the need for operator interventions and maintenance events. The reduction in field trips contributes to safety while fewer meter maintenance events reduces the potential for exposure to hazardous chemicals and environmental spills.

Maintain reliable and consistent production by ensuring the availability of wells and surface facilities



Challenges:

- Flow and production assurance management
- Changing chemical programs over the life of the facility

The under injection of treatment chemicals can result in coatings (scale or paraffin) in well production strings or pipelines which in turn cause a reduction in the production rate. If the coating is allowed to occur over an extended period of time, the well may have to be shut-in to undergo a batch treatment process resulting in the interruption of well production. In the case of corrosion inhibitor treatment programs, wells and surface facilities can be rendered unavailable for production until failed or unsafe components are replaced.

The optimal chemical dosage rate can vary over the life of the facility and is impacted by changes in the type of chemicals used, the quality of the chemical and on-going changes in process fluid characteristics and production rates.

Solutions:

- Maintain optimal and reliable chemical injection programs

Deliverables:

- Reduce lost production

Sustained flow accuracy under field conditions and the ability to measure chemical quality as a function of density with a Coriolis meter ensures the correct chemical dosage is continually being applied. Product losses due to reductions in production rate or interruptions in production due to plugging and damaged equipment are avoided.

Coriolis meters provide the flexibility to modify or change chemical treatment programs as they are not impacted by changes in fluid composition or properties and maintain flow measurement performance over a wide range of flow rates (100:1 turndown).

SAVING	EVENT/REMEDIATION ACTION
\$1,500/day	5% flow reduction
\$90,000	Pipeline interruption • 3 days to remove plug
\$60,000 \$120/100 gallon	Well production interruption • 2 days to remove plug • Methanol injected to melt hydrates
\$719/year	Overdosing using a $\pm 2\%$ of rate meter

- 5MMcfd, 10 bpd condensate, 2 bpd water
- \$6 per Mscf of natural gas
- \$1.20 per gallon methanol
- 3.6 gallon per hour methanol injection program



Control lift costs associated with maintenance, operations and equipment reliability.

Challenges:

- Increasing operations lift costs
- Increasing maintenance requirements

Solutions:

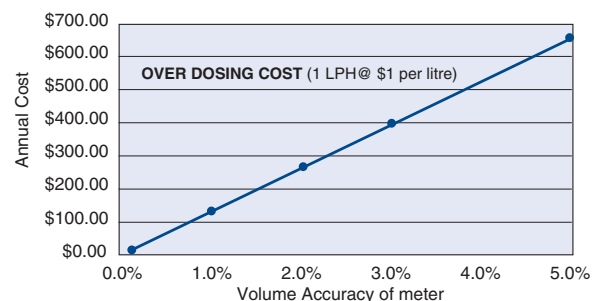
- Reduce operations cost
- Improve utilization of field resources

Deliverables:

- Lower lift cost

Maximizing the profitability of oil and gas production facilities is challenged by changes in the price of oil and the natural decline in hydrocarbon production that occurs over the life of the field. The over injection of chemical additives increases operation cost due to the cost of the chemicals and in some cases can impact the effectiveness of downstream processes or chemical treatment programs. Under injection for extended periods of time increases the need for costly well maintenance programs or the replacement of mechanical surface facilities.

Coriolis meter volume and mass accuracy reduces the level of overdosing required resulting in a lower chemical usage and cost. The breadth of Micro Motion Coriolis product line provides the optimum combination of best flow meter performance in relation to total cost of ownership.



The frequent maintenance, calibration and repair of a large number of chemical injection sites can significantly add to the cost of maintenance particularly when located in remote locations. As production facilities age, utilizing available resources in higher value maintenance activities become critical.

The “no mechanical parts” design of Coriolis meters provides a high level of meter reliability and lowers costs associated with meter replacement or repair. The flow measurement stability over time and device diagnostics capability reduces costs associated with field trips, time to identify problematic devices, routine maintenance and regular calibration. By reducing maintenance requirements associated with chemical injection points, personnel can focus more time on higher value maintenance and asset optimization activities.

With meter verification diagnostics, additional maintenance cost reductions are realized through improved preventative maintenance programs and a quick (4 minutes) in-line verification of meter and electronics integrity.

Recommended Product Solution

Micro Motion ELITE Series, F-Series, LF Series

Applications

- Anti-foam
- Biocides
- Corrosion inhibitor
- Hydrate control
- De-emulsifier
- Paraffin / Asphaltene
- Drag reducer
- Scale inhibitor

