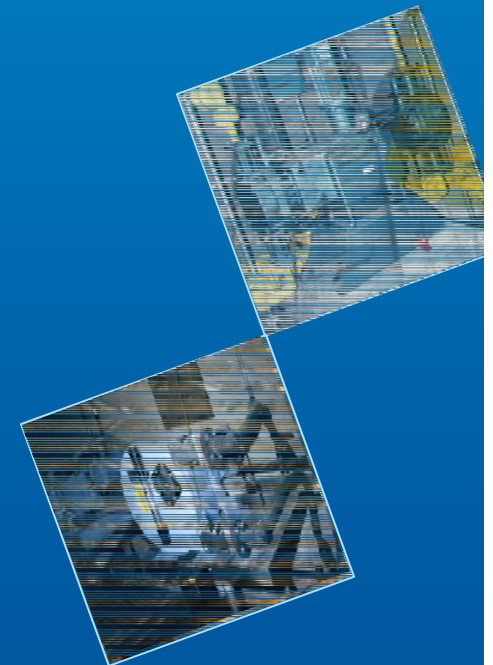


PNWS-AWWA Annual Conference Eugene, Oregon 2014 Chemical System Design 30 Years of Lessons Learned

Mark D. Ryan, P.E. BCEE
CDM Smith
Portland, Oregon
ryanmd@cdmsmith.com

May 2014



**CDM
Smith**®

CHEMICAL SYSTEM
PROBLEMS AND
HOW TO AVOID THEM

Level of Complexity Does Not Fit Users' Needs

Right level of complexity?



Start with an understanding of:

- Users' objectives
- Operating procedures
- Control approach
- Level of redundancy
- Available space

Seek simplicity whenever possible.

Failure to Appreciate Chemical's Unique Features

Chemical's unique properties?



How to gain a understanding:

- Talk with users' O&M staff
- Research AWWA material
- Evaluate others' designs
- Talk with suppliers
- Understand suppliers' differences
- Look at various forms of the chemical
- Understand safety concerns

Each chemical has unique properties and products are different.

Equipment is Difficult to Maintain

Maintenance is essential to safety and continued operation.



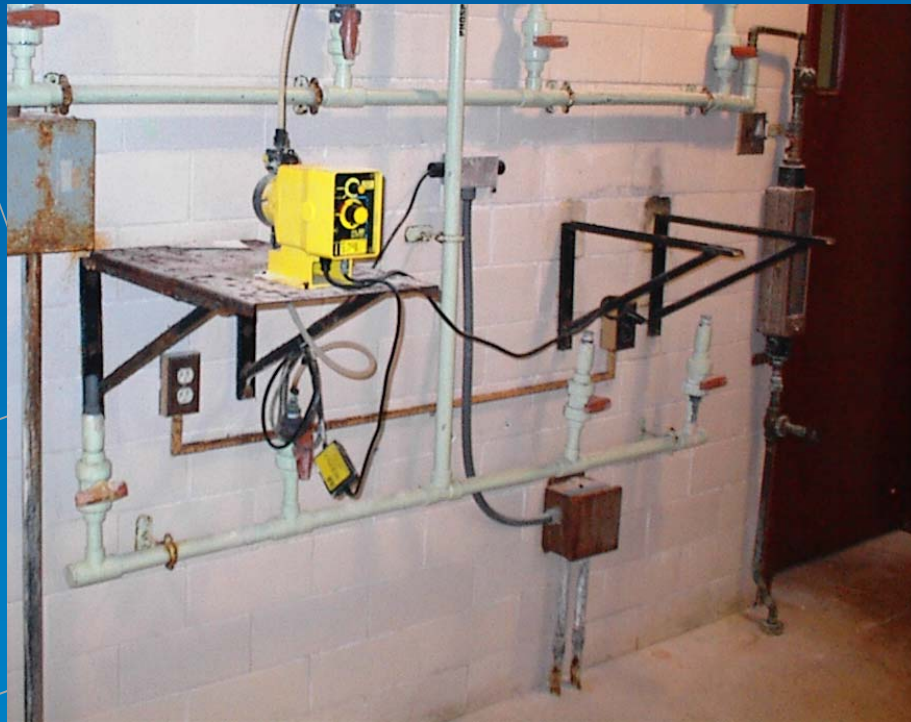
Creating good maintenance:

- Design with adequate clearances
- Set at workable height
- Ancillary systems for maintenance (lighting, power, air, etc.)
- System disassembly
- Replaceable parts and piping
- Connections for drain/testing
- Limits of skid mounting

No matter how good the system, maintenance must happen.

Single Point System Failure

Will a single failure shutdown the system and plant?



Must understand:

- Importance of chemical in process
- Need for divided power supply
- Backup control features
- Spare parts, shelf-spares
- Redundant piping or time to install new
- Are building systems a risk?

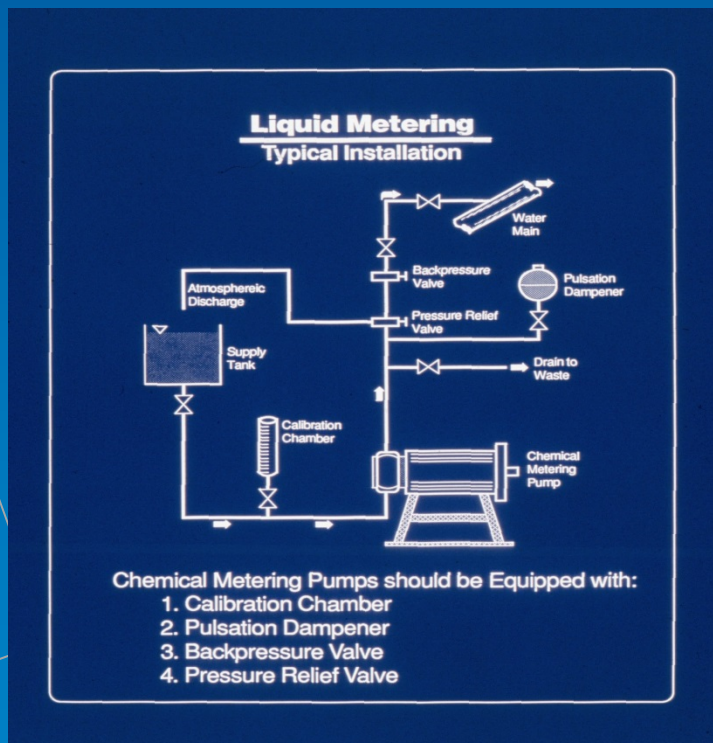
Failure happens, understand implications and plan accordingly.

Hydraulic Problems will Limit System's Effectiveness

Chemical systems have many hydraulic systems.

How to prevent problems:

- Understand the chemical
- NPSHr vs. NPSHa
- How equipment functions
- How equipment will be used
- Gas buildup?
- Potential for siphoning?



There is no replacement for hydraulic calculations and checking.

Failure to Meet Flowrate Needs

Low flow and unique situations cause capacity problems.



Features to understand:

- Dosages and plant flowrates
- Abnormal water quality events
- Startup and special operations
- Dosage vs. trim
- Equipment range limitations
- Varying chemical concentration

Understand the treatment process and operations.

Metering Equipment May Limit System's Use

All pieces of equipment in the system need to be evaluated.



What to look at:

- Research the pumping options
- Quoted range vs. actual range
- Added equipment complexity may add limitations
- Fit equipment to the chemical
- VFDs need special attention
- Flow meter range

Understand each piece of equipment's limitations.

Is the Supply of Chemical a Possible Weak Link?

Risks and possible outage time?



What do you need to look at:

- Are there various forms of the chemical? Which is most available?
- How many local suppliers?
- Supplier's vulnerability
- Supply volume vs. delivery time
- Plant backup?
- Process importance?

Natural disasters and freak storms happen, likely with increasing frequency.

Truck Unloading Area is Primary Point of Possible Exposure to Personnel and Environment

What are the risks?



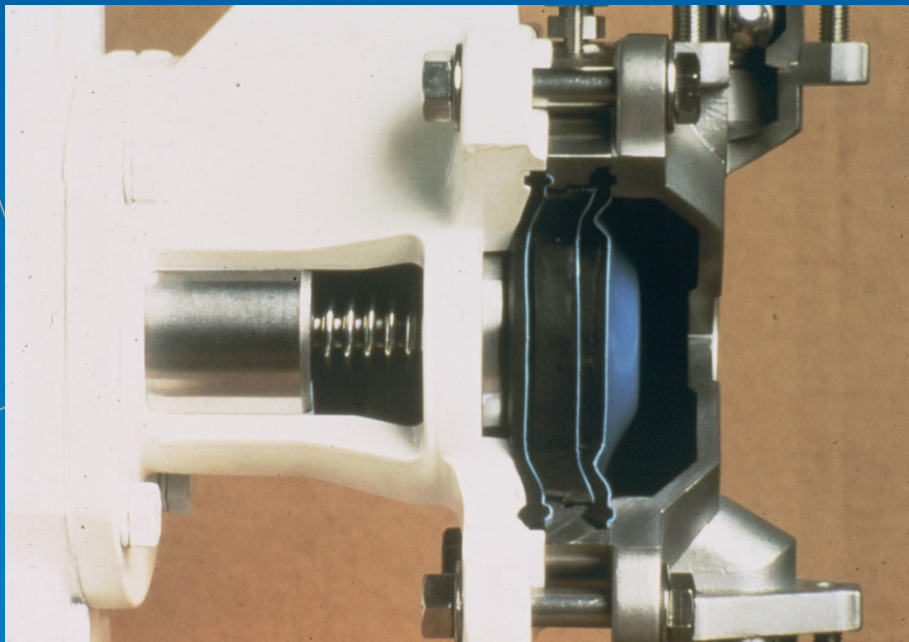
What do you need to know:

- Chemical properties and hazards
- Operating policies and regulations
- Supplier's policies and equipment
- Containment of possible spills
- Creation of fumes and odors
- How transfer completed

Chemical transfer poses the greatest risk of exposure.

Failure of Materials within the System

Material failure is a high risk!



How to mitigate material failure:

- Understand chemical properties
- Understand various forms of the chemical that will be present
- Research each material's limitations
- Look at all materials in the system and related facility systems
- Not all chemical comparison charts are created equal

Understand chemical properties and materials' track record.

Lack of Maintenance Creates Risks

Preventative maintenance critical.



What is needed:

- Design for maintenance
- Be proactive with CMMS
- Asset Management creates adequate budget
- Good eO&M makes information available
- Safety features can be maintained and checked

Procedures, policies and programs provide the safest system.

Failure of the System May Involve the Building Systems

Building Systems are important.



Where are the problems:

- Single source of power and emergency power source
- I&C complexities
- Structure and secondary containment
- HVAC – air flow, heating and cooling
- Match supports and anchors amongst all the disciplines

Failure of the building systems can shutdown a chemical system.

Poor Mixing or Distribution of Chemical in Process

Without proper mixing – it may not work!



Where are the problems:

- Inadequate dispersion and mixing
- Injection too close to analytical element
- Back mixing creates inefficient chemical use
- Need for carriage and mixing water
- Process water hydraulics

Proper injection and mixing critical.

Questions?

Mark D. Ryan, P.E., BCEE
CDM Smith
Portland, Oregon
(503) 205-7405 (Office)
(503) 347-3940 (Cell)
ryanmd@cdmsmith.com