CHEMICAL SAFETY IN WATER AND WASTEWATER TREATMENT FACILITIES

BCSWA/CELG ANNUAL CONFERENCE JULY 27, 2022

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SPEAKER BIO

Daniel Standish

Mr. Standish has over 37 years of experience in the operations, maintenance and management of water and wastewater systems. His responsibilities as a Senior Operations Specialist in our Water and Wastewater Engineering Department are primarily client and project management, including coordination and supervision of water treatment, distribution, sewage collection, sewage treatment, discharge, and capital improvement projects. He holds a Class A, E Water Operators license with Subclasses 1,2,3,4,5,6,7,8,9,10,11,12,13,14. His experience also involves providing technical and cost proposals for water and wastewater projects in PA, NJ, NY, MD, and VA and providing on-call Certified Operator services for numerous clients. He is adept in completing Federal and State regulatory reporting and permitting requirements.

COURSE OBJECTIVES

What we're going over today.

- Review Common Chemical Use in Treatment Facilities
- Preparation and Use of Safety Protocols
- Regulatory Requirements Review
- Safety Planning and Hazard Communication
- Operations with Chemicals
    - In the Laboratory
    - Bulk Storage Operations
    - Chemical Feed Systems

A brief quiz will follow each section.

WHY IS SAFETY IMPORTANT

Current events.

- Occurred June 27, 2022
- - 13 – Dead
- - More than 250 injured
- - Cause by improper rigging.
- Tank weight was three times more than the cable load capacity
- Investigation is pending

AP

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Toxic gas released in Jordan port kills 13, injures 250

By OMAR AKOUR June 27, 2022

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AMMAN, Jordan (AP) — A crane loading chlorine tanks onto a ship in Jordan's port of Aqaba on Monday dropped one of them, causing an explosion of toxic yellow smoke that killed at least 13 people and sickened some 250, authorities said.

Images via the Associated Press

Video content via NBC News

SECTION 1: CHEMICAL USE AND SAFETY PROTOCOLS

Chemical Safety in W/WW Treatment Facilities.

- Chemicals play an important role in many aspects of water treatment.
- Treatment operations fall under many specific regulations that apply to all site personnel.
- Developing written facility safety guidelines that are specific to the worksite is critical for compliance.
- Training and enforcing safety procedures and processes are critical to employee safety.

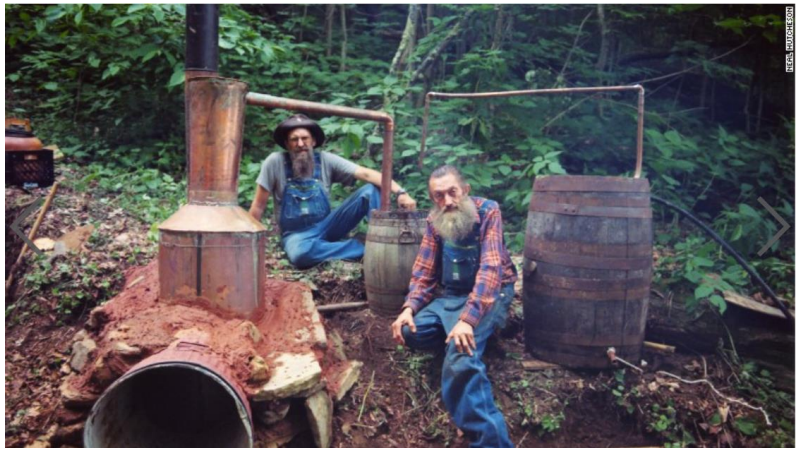
The Philosophy of Safety

- Safety is practiced at all times – there is never an excuse to work in an unsafe manner
- Everyone has a right to know information about the chemicals used in the workplace
- Knowledge is power – one cannot safely use a chemical without proper training and standard operating procedures
- Accidents with chemicals are nearly always preventable when safety policies are followed
- Everyone is entitled to a safe work environment without question
- Lapses in safety will always be reported

Quoteable…

- Safety is a full-time job – don't make it a part-time practice.
- Safety glasses: All in favor say "Eye!"
- No safety, know pain. Know safety, no pain.
- Safety does not happen by accident.
- Safety starts with "S" but begins with you.
- Safety is a state of mind. Accidents are an absence of mind.
- Safety…..Do it for life!

Chemicals Use Through History



- Fire
- Fermentation and food processing
- Bronze Age
- Iron Age
- Medieval Alchemy
- Early 16th and 17th century chemistry
- Industrial revolution
- Chlorine first used for water disinfection in Europe in the mid 1890's
- Discovery and isolation of elements though the 20th century
- Petroleum use and distillation byproducts
- Synthetic chemical production

Use of Chemicals in Water Treatment

- Disinfection
- Odor Control
- Coagulation
- Flocculation
- pH Adjustment
- Alkalinity Adjustment
- Sludge Stabilization
- Clarification

General Description of Treatment Chemicals

Treatment plant chemicals are divided into six (6) incompatibility groups:

- Acids
- Bases
- Salts and Polymers
- Adsorption Powders
- Oxidizing Powders
- Compressed Gases

Common Chemicals used in Water Treatment

- Chlorine (gas)
- Sodium Hypochlorite
- Calcium Hypochlorite
- Calcium Hydroxide
- Aluminum Sulfate
- Soda Ash
- Sodium Bicarbonate
- Ferric Chloride
- Sodium Bisulfite
- Hydrofluoric Acid
- Sodium Hydroxide
- Various polymer solutions for coagulation and flocculation

Knowing the Hazards in Chemical Situations

- Being aware of the type of chemical
  - Its physical state, whether it be liquid, solid or gas
  - Physiological effects, whether they be caused by toxins, carcinogens, asphyxiation or corrosives
  - Know how the chemical should be handled and stored
  - How to deal with unintended releases

Causes of Most Operator Injuries

- Failure to follow established safety practices
- Lack of a safety policy
- Lack of knowledge and training
- Lack of equipment maintenance
- Lack of equipment inspections
- Use of the wrong tools

Important Workplace Safety Plans

- Safety Data Sheet Notebook
- Emergency Response Plan
- Spill Prevention Plan
- Operations and Maintenance Plan
- Standard Operations Procedures (SOPs)

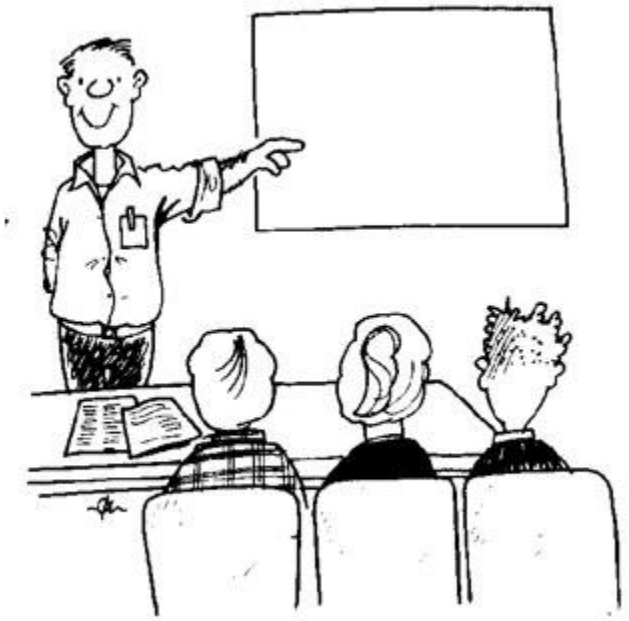
Permissible Exposure Levels (PEL)

- OSHA requires that employers provide a healthy workplace.
- Permissible Exposure Levels (PELs) are used to provide a level of exposure that is not harmful to employees.
  - Employers frequently control exposures to ½ PEL or to the “lowest achievable level.”
  - Engineering controls are the primary method for hazard control.
  - Work procedures are the secondary method for hazard control.
  - Personal protective equipment is used when other controls are not feasible or are inadequate.

Employee Training

The most important component of safe chemical management

- Training must be thorough, frequent and focused on specific work tasks.
- Management must support training by providing adequate time and funding.
- Supervisors must lead by example.



Emergency Management

- Prepare for and prevent emergencies
  - Fires
  - Spills/releases
  - Injuries
- Emergency response must be part of basic work procedures and employees must be trained.
  - Evacuation
  - Fire brigade
  - Spill response
  - Medical response

Incident Investigations

- All incidents, regardless of severity, must be investigated and *lessons learned* used for prevention
- Formal investigation of serious incidents
- Accountability at all levels, from staff to management

Safety is everyone's responsibility

- Proper and Safe Chemical Management
  - Part of the facility culture
  - Part of every employee's activity
  - Recognition of safety improvement

Four Elements of a Workplace Safety Program

1. Management, Leadership and Employee Involvement
2. Worksite Analysis
3. Hazard Prevention and Control
4. Safety and Health Training and Education

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ELEMENT #1: Involvement

Management – Leadership - Employee Involvement

- Employer and employee involvement and communication on workplace-safety and health issues are essential.
- Post the company's written safety and health policy for all to see.
- Involve all employees in policy making on safety and health issues.
- Everyone must take an active part in Safety Activities.

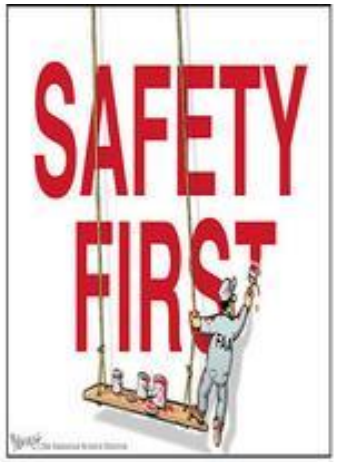
ELEMENT #1: Involvement

Basic Principles of Good Safety Management

- Management Commitment
- Documented Safety Philosophy
- Safety Goals and Objectives
- Committee Organization for Safety
- Line Responsibility for Safety
- Supportive Safety Staff
- Rules and Procedures
- Audits
- Safety Communications
- Safety Training
- Accident Investigations
- Motivation

ELEMENT #1: Involvement

Basic Safety Philosophy



- Every Incident can be avoided.
- No job is worth getting hurt for.
- Every job will be done safely.
- Incidents can be managed.
- Safety is Everyone's Responsibility.
- Safety/Best manufacturing practices
- Safety standards, procedures and practices must be developed.
- Training
- Everyone must understand AND meet the requirements.
- Working Safely is a Condition of Employment.

ELEMENT #1: Involvement

Benefits of a Zero Incident Safety Policy

- Safety standards are communicated to all employees.
- Responsibilities for implementing standards are understood and accepted.
- Records document how standards and Best Management Practices are met.
- Internal management control.
- Cost avoidance.
- Improved quality.
- Better productivity.
- Team building.
- Unsafe behavior stands out.
- Unsafe behavior is unacceptable.
- Safe Work is influenced through peer pressure.
- Consistent planning and task execution.

ELEMENT #1: Involvement

Key Safety Principles

- Working safely is a condition of employment.
- Each employee is expected to give consideration to the prevention of injury to self and co-workers.
- Involvement and thinking of all people in the safety process is valued and expected.
- Continual Improvement is the goal.
- Individuals and teams must be recognized for their adherence to and advancement of safety.

ELEMENT #2: Worksite Analysis

1. Management, Leadership and Employee Involvement
2. Worksite Analysis
3. Hazard Prevention and Control
4. Safety and Health Training and Education

ELEMENT #2: Worksite Analysis

Analyze all workplace conditions.

- Identify and eliminate existing or potential hazards.
- Outline the procedure for reporting hazards.
- Perform analysis on a regular and timely basis.
- Ensure employee understanding.
  - Current hazard analysis for all jobs and processes.
  - Emergency Response Plans and procedures.

ELEMENT #2: Worksite Analysis

Focus workplace design on all physical aspects of the work environment.

- Size and arrangement of work space.
- Physical demands of the tasks to be performed.
- Design of tools and other devices people use.
- The fundamental goal of a workplace design is to improve people's ability to be productive, without error or accident, for extended time periods.
  - Proper workplace design improves both safety and productivity.

ELEMENT #2: Worksite Analysis

Review incident causes

- Inspection results to help identify trends.
- Practice
  - Employee participation in drills

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ELEMENT #3: Hazard Prevention and Control

1. Management, Leadership and Employee Involvement
2. Worksite Analysis
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ELEMENT #3: Hazard Prevention and Control

Regularly and thoroughly maintain equipment

- Ensure that employees know how to use and maintain personal protective equipment (PPE)
- Train employees in proper procedures for handling specific situations
- Emergency Action Plans and procedures - fire, life safety and first aid issues

ELEMENT #3: Hazard Prevention and Control

Standard Operating Procedures

- Drug Free workplace
- Recognition and Awards
- Audits and Surveillances
- Incident Reporting & Investigation
- Lessons Learned
- General Safety SOP’s - Lets discuss

ELEMENT #3: Hazard Prevention and Control

Personal Protective Equipment (PPE)

- Use
- Maintain

ELEMENT #3: Hazard Prevention and Control

Protect Employees from Workplace Hazards

- Employers must protect employees from hazards that can cause injury.
  - Falling objects
  - Harmful substances
  - Noise exposures
- Employers must:
  - Use all feasible engineering and work practice controls to eliminate and reduce hazards.
  - Use personal protective equipment (PPE) if the controls don’t eliminate the hazards.
  - PPE is the last level of control.

ELEMENT #3: Hazard Prevention and Control

Select the right PPE for the job.

ELEMENT #3: Hazard Prevention and Control

Examples of PPE

Body Part	Protection
Eye	Safety Glasses, Goggles
Face	Face Shields
Head	Hard Hats
Feet	Safety Shoes
Hands and Arms	Gloves
Bodies	Vests and Aprons
Hearing	Earplugs, Earmuffs

ELEMENT #3: Hazard Prevention and Control

PPE Summary: Employers must implement a PPE program

- Assess the workplace for hazards.
- Use engineering and work practice controls to eliminate or reduce hazards before using PPE.
- Select appropriate PPE to protect employees from hazards that cannot be eliminated.
- Inform employees why the PPE is necessary, how and when it must be worn.
- Train employees how to use and care for their PPE, including how to recognize deterioration and failure.
- Require employees to wear selected PPE.

ELEMENT #3: Hazard Prevention and Control

1. Management, Leadership and Employee Involvement
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ELEMENT #4: Training and Education

Activity Hazard Analysis

- Activity hazard analysis requires everyone to be proactive in **aggressively identifying hazards** that can be anticipated and **controlling** them rather than looking back with 20/20 hindsight.

ELEMENT #4: Training and Education

Activity Hazard Analysis - Key Terms

- What's the Job or Activity?
- What are the Hazards?
- What's an Exposure?
- What is Analysis?

ELEMENT #4: Training and Education

Activity

- Workers in their first year with their employer account for more than 50% of accidents.
  - ***Why?***
    - (list three possible explanations)

ELEMENT #4: Training and Education

SECTION 1 QUIZ

SECTION 2:
HAZARD COMMUNICATION

Hazard Communication

- The following slides are credited to the PA Department of Labor and Industry for the explanation of Chemical Hazard Communication Requirements.
- The slides are excerpts from a larger presentation on the subject.

pennsylvania
DEPARTMENT OF LABOR & INDUSTRY

Hazard Communication

- OSHA
- 29 CFR 1910.1200
- (HCS-2012) & United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS, Rev 3)

Hazard Communication Standard (1910.1200)

- Intent - To provide employees with information to help them make knowledgeable decisions about chemical hazards in their workplace

Standard Requirements

- Written program for each location to cover issues of chemical safety and hazard communication (HAZCOMM)
- Labels to identify each chemical
- Material Safety Data Sheets (MSDSs) (now SDSs under the Globally Harmonized System: GHS)
- Safe work procedures/practices
- Employee training on SDS information and safe chemical procedures and practices

Training

- Upon initial employment
- When a new hazardous product/chemical is introduced into the workplace
- Change in process
- As deemed necessary by supervision/management

"Right to Know" Law

- Ensures all employees' right to know the hazards of chemicals they work with at their job
- Mandates that employees must be provided with information about chemicals they work with through:
  - Information on chemical labels
  - Safety Data Sheets (SDSs)
  - Training on hazard communication
  - Written HAZCOMM plan

Why is a Standard Necessary?

- To evaluate the hazards of all chemicals imported into, produced, or used in workplaces in the United States
- To prevent or minimize employee exposure to chemicals
- Because chemical exposure can contribute to serious health effects:
  - Heart ailments
  - Burns/rashes
  - Kidney/lung damage
  - Sterility
  - Cancer
  - Central nervous system damage

Globally Harmonized System

GHS

- Created by United Nations
- A system for standardizing chemical classification and labeling for world-wide implementation

Labels

- Signal words
  - Danger/Warning
- Hazard statements
- Precautionary statements
- Pictograms (9)
  - SDS-16 categories
  - Training

GHS

- Provides a single, harmonized system to classify chemicals, labels and SDS to increase the quality and consistency of information provided to workers, employers and chemical users

- GHS is updated every two years

OSHA HazComm Modifications due to GHS

- Hazard classification of chemical hazards
  - Revised labeling provisions that include requirements for:
    - Standardized signal words
    - Pictograms
    - Hazard statements
    - Precautionary statements
  - Specified format for safety data sheets in 16 section format and Revisions to definitions of terms used in the standard and requirements for employee training on labels and Safety Data Sheets (SDS)

Other OSHA Label Elements for:

- Pyrophoric Gases:
  - Signal Word: Danger
  - Hazard Statement: “Catches fire spontaneously if exposed to air”
- Simple Asphyxiates:
  - Signal Word: Warning
  - Hazard Statement: "May displace oxygen and cause rapid suffocation”
- Combustible Dusts:
  - Signal Word: Warning
  - Hazard Statement: “May form combustible dust concentrations in the air”

Hazard Communication & Chemical Safety

- Chemicals are all around us every day
- Chemicals can be:
  - Corrosive
  - Reactive
  - Flammable
  - Explosive
  - Oxidizing
  - Inert

Chemical Safety

- In many cases, the chemicals you may deal with at work are no more dangerous than those you use at home.
- But in the workplace exposure may be greater, concentrations higher, exposure time longer: potential danger could be greater on the job.

Routes of Occupational Exposure

- Inhalation
  - Nearly all materials that are airborne can be inhaled
- Skin Absorption
  - Skin contact with a substance can result in a possible reaction
- Ingestion
  - Most workers do not deliberately swallow materials they handle
- Injection
  - Normally associated with bloodborne pathogens
- Ocular
  - Absorbed through the eyes

Hazards

- A chemical can pose a “physical hazard” or a “health hazard”
- The hazard communication standard applies to both types of hazards
- GHS looks at:
  - Class-nature of hazard
  - Category-degree of severity

Physical Hazards

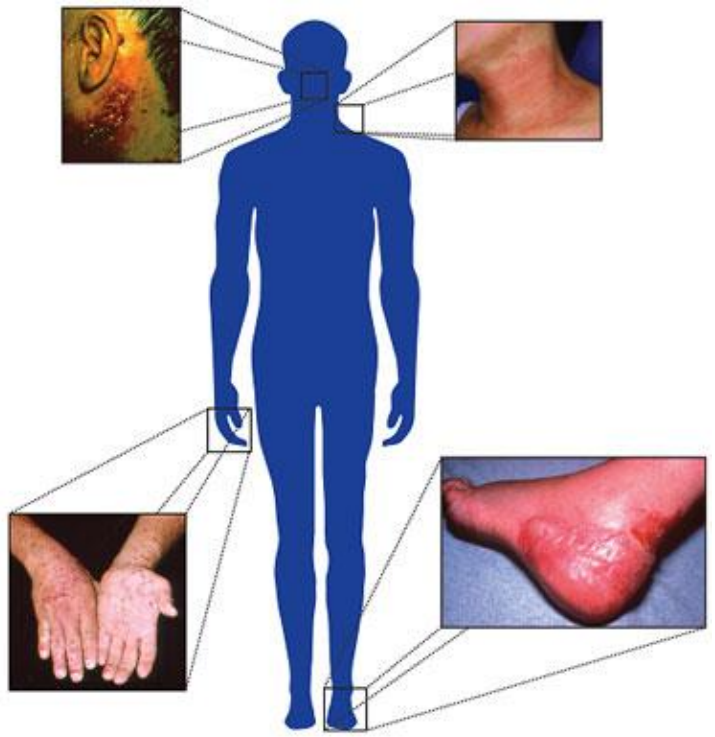
- Physical hazards are exhibited by certain chemicals because of their physical properties (e.g. flammability, reactivity, etc.)
- These chemicals fall into the following classes
  - Flammable liquids or solids
  - Combustible liquids
  - Compressed gases
  - Explosives

Physical Hazards

- Organic peroxide
  - May react explosively to temperature/pressure changes.
- Oxidizers
  - Chemicals that initiate or promote combustion in other materials.
- Pyrophoric materials
  - May ignite spontaneously in air temperatures of 130°F or below
- Unstable materials
- Water reactive materials

Health Hazards

- Occurs when a chemical produces an acute or chronic health effect on exposed employees



Acute Health Effects

- Happen quickly
- High, brief exposure
- Examples:
  - Carbon monoxide poisoning
  - Cyanide inhalation
  - Hydrogen sulfide inhalation

Chronic Health Effects

- May be caused by chemical exposures that do not cause immediate, obvious harm or make you feel sick right away
- May not see, feel, or smell the danger
- Effects are long, continuous and follow repeated long-term exposure
  - Lung cancer from cigarette smoking
  - Black lung from coal mine dust

Keeping It Safe

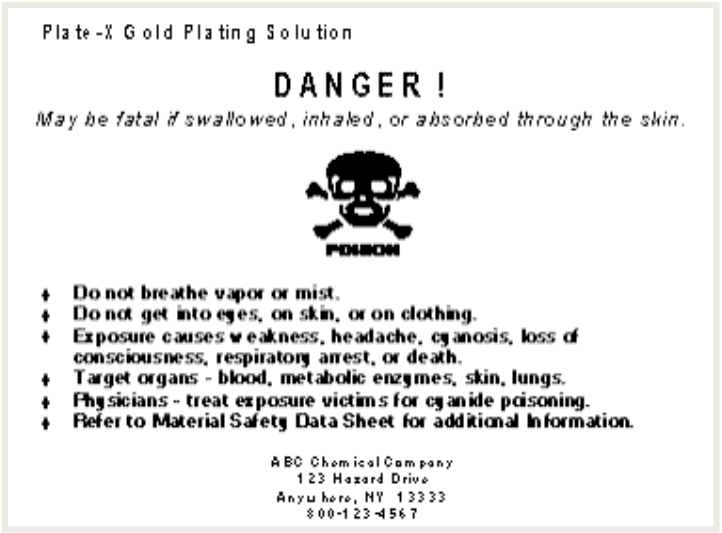
- Corrosives, solvents and other chemical substances can be potentially dangerous
- Safe handling procedures
  - Read container labels
  - Check SDS(s)
- Never sniff a chemical for identification
- Use appropriate personal protective equipment

Labeling

- Example of one type of labeling system used

Chemical Labels

- Each container must be labeled, tagged or marked.
- Warning can be a message, words, pictures or symbols.
- Labels must be written in English and prominently displayed.

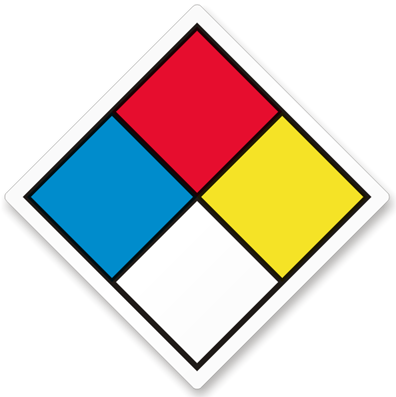


Reading Chemical Labels

- Warning labels provide important information about the chemical:
  - DANGER
  - WARNING
- Always read the label before you begin a job using a potentially hazardous chemical

GHS Consumption

- GHS classification ratings order of severity differ from NFPA and HMIS:
  - HMIS/NFPA
    - 0 = Least Hazardous
    - 4 = Most Hazardous
  - GHS
    - 5 = Least Hazardous
    - 1 = Most Hazardous



Health Hazard

- Used to describe:
  - Carcinogen
  - Mutagenicity
  - Reproductive toxicity
  - Respiratory sensitizer
  - Target organ toxicity
  - Aspiration toxicity
  - Germ cell mutagens

Flame

- Describes:
  - Flammables
  - Pyrophorics
  - Self-heating
  - Emits flammable gas
  - Self-reactives
  - Organic peroxides

Exclamation Mark

- Describes:
  - Irritant (skin and eye)
  - Skin sensitizer
  - Acute toxicity (harmful)
  - Narcotic effects
  - Respiratory tract irritant
  - Hazardous to ozone layer (non-mandatory)

Gas Cylinder

- Describes:
  - Gases under pressure

Corrosion

- Describes:
  - Skin corrosion/burns
  - Eye damage
  - Corrosive to metals

Exploding Bomb

- Describes:
  - Explosives
  - Self-reactives
  - Organic peroxide

Flame Over Circle

- Describes:
  - Oxidizers

Flame Over Circle

- Describes:
  - Oxidizers

Anything wrong with this picture?

Flame Over Circle

- Describes:
  - Oxidizers

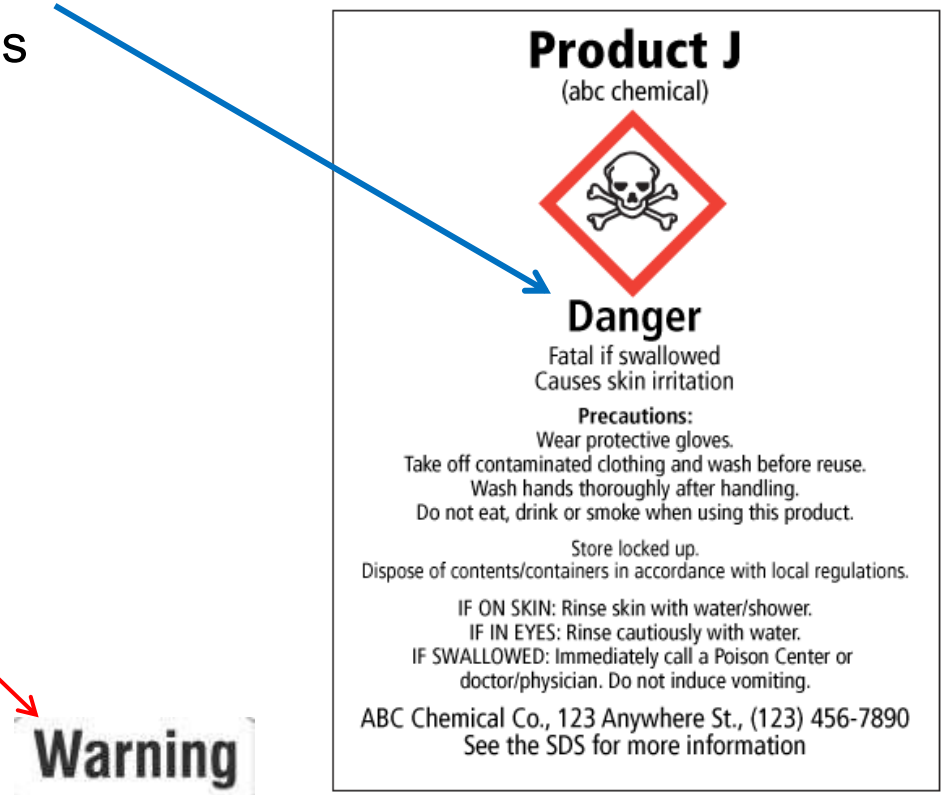
Anything wrong with this picture?
YES!
Unsafe storage. Cylinders falling over.

Skull and Crossbones

- Describes:
  - Acute toxicity (fatal or toxic)

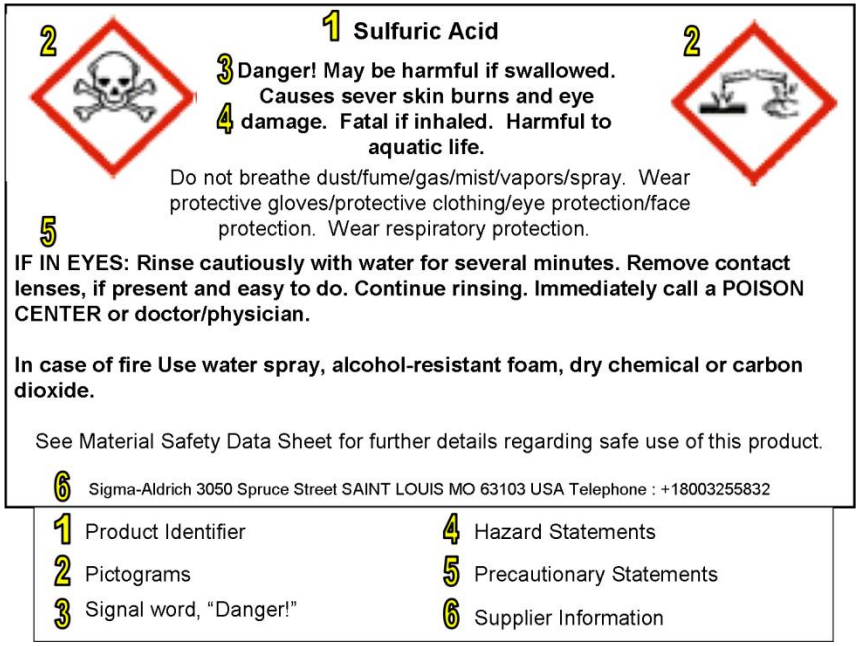
Signal Word

- A single word indicating relative hazard severity
- “Danger” for more severe hazards
- “Warning” for less severe hazards



Labels

- Information required on a GHS label:
  1. Product identifier
  2. Pictograms
  3. Signal word
  4. Hazard statement
  5. Precautionary statement
  6. Supplier information

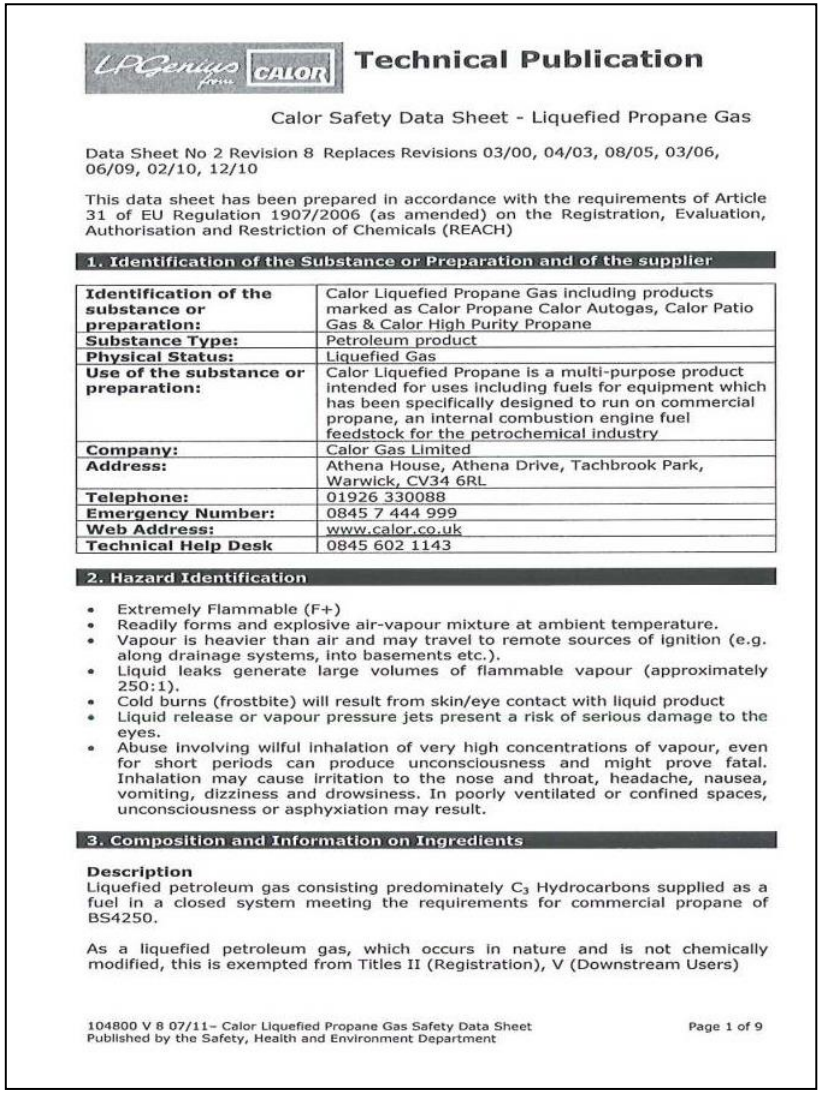


SDS

- Under the GHS, MSDSs (material safety data sheets) become SDS (safety data sheets)
- Categories (16) to be listed in a specific order
- Adheres to ANSI standard Z400.1
- GHS requires new SDSs be in uniform format by June 1, 2015
- Information for mixtures not individual chemicals in a mixture

SDS

- Safety Data Sheet
- Developed by chemical manufacturers and importers
- An SDS must be on hand for each hazardous chemical used
- SDS for mixtures not individual chemicals in the mixtures



LPGenius from CALOR **Technical Publication**

Calor Safety Data Sheet - Liquefied Propane Gas

Data Sheet No 2 Revision 8 Replaces Revisions 03/00, 04/03, 08/05, 03/06, 06/09, 02/10, 12/10

This data sheet has been prepared in accordance with the requirements of Article 31 of EU Regulation 1907/2006 (as amended) on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

1. Identification of the Substance or Preparation and of the supplier

Identification of the substance or preparation:	Calor Liquefied Propane Gas including products marked as Calor Propane Calor Autogas, Calor Patio Gas & Calor High Purity Propane
Substance Type:	Petroleum product
Physical Status:	Liquefied Gas
Use of the substance or preparation:	Calor Liquefied Propane is a multi-purpose product intended for uses including fuels for equipment which has been specifically designed to run on commercial propane, an internal combustion engine fuel feedstock for the petrochemical industry
Company:	Calor Gas Limited
Address:	Athena House, Athena Drive, Tachbrook Park, Warwick, CV34 6RL
Telephone:	01926 330088
Emergency Number:	0845 7 444 999
Web Address:	www.calor.co.uk
Technical Help Desk	0845 602 1143

2. Hazard Identification

- Extremely Flammable (F+)
- Readily forms and explosive air-vapour mixture at ambient temperature.
- Vapour is heavier than air and may travel to remote sources of ignition (e.g. along drainage systems, into basements etc.).
- Liquid leaks generate large volumes of flammable vapour (approximately 250:1).
- Cold burns (frostbite) will result from skin/eye contact with liquid product
- Liquid release or vapour pressure jets present a risk of serious damage to the eyes.
- Abuse involving wilful inhalation of very high concentrations of vapour, even for short periods can produce unconsciousness and might prove fatal. Inhalation may cause irritation to the nose and throat, headache, nausea, vomiting, dizziness and drowsiness. In poorly ventilated or confined spaces, unconsciousness or asphyxiation may result.

3. Composition and Information on Ingredients

Description
Liquefied petroleum gas consisting predominately C_3 Hydrocarbons supplied as a fuel in a closed system meeting the requirements for commercial propane of BS4250.

As a liquefied petroleum gas, which occurs in nature and is not chemically modified, this is exempted from Titles II (Registration), V (Downstream Users)

104800 V 8 07/11– Calor Liquefied Propane Gas Safety Data Sheet
Published by the Safety, Health and Environment Department

Page 1 of 9

SDS – Can You Identify This Prodcut?

7) Handling and storage

General	Avoid eye and skin contact. Protect against physical damage to containers. Store in closed containers away from heat, caustics and oxidizing materials or any sources of ignition.
	As with all semi-finished materials, prudent industrial practices should be employed to minimize contact with eyes, skin and mucous membranes.
- UN No.	Not applicable (Consumer Commodity)

8) Exposure controls/personal protection

TLV (mg/m3)	Not established
PEL (mg/m3)	Not established
- Respiratory protection	No special respiratory protection equipment is recommended under normal conditions of anticipated use with adequate ventilation.
- Skin protection	Skin protection appropriate to the conditions of use.
- Eye protection	Safety glasses with side guards should be worn to prevent injury from flying particles and/or other eye contact with this product.
- Hand protection	Wear suitable gloves resistant to chemical penetration.
- Other	Adequate ventilation is recommended.

9) Physical and chemical properties

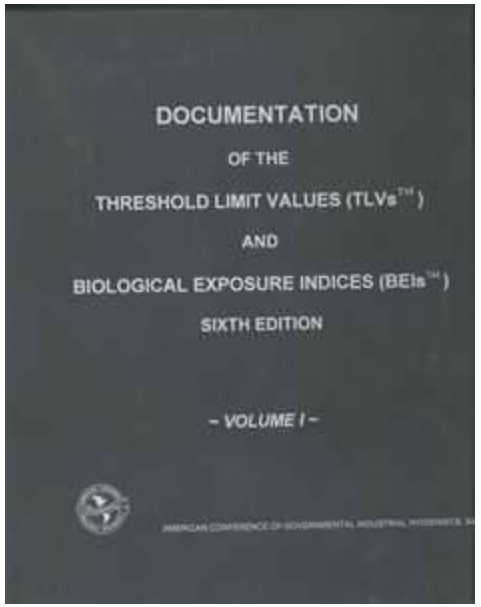
Physical state	Opaque liquid
Color	Dark brown
Odor	Caramel
	Citrus
Apparent Density at 20° C (kg/L)	1.1
pH value	2
Flash point	>200 °F ASTM D 93 Pensky-Martens Closed Cup
	Non-Combustible Liquid (OSHA)

Information on a SDS

- Chemical names
- Manufacturer info (name, address and telephone numbers)
- List of chemical ingredients
- Permissible exposure limits (PELs) and threshold limit values (TLVs)

Information on a SDS

Any other exposure limit used or recommended by chemical manufacturer, importer or employer preparing the SDSs now are required on the SDS



Information on a SDS

- Reactions with other chemicals
- Physical appearance
- Date of preparation
- Plus:
  - How to put out a fire caused by a chemical
  - How to handle spills
  - How to prevent dangerous exposures

Where are your SDSs?

- SDSs:
  - Must be readily accessible to employees during their work shift
  - Are typically kept in a centralized location
  - Must be updated as new information becomes available

SDS Categories

- Section 1: Identification
- Section 2: Hazard identification
- Section 3: Ingredients
- Section 4: First-aid measures
- Section 5: Fire fighting measure
- Section 6: Accidental release measures
- Section 7: Handling and storage

SDS Categories

- Section 8: Exposure controls and personal protection
- Section 9: Physical and chemical properties
- Section 10: Stability and reactivity
- Section 11: Toxicological information
- Section 12: Ecological information*
- Section 13: Disposal considerations*
- Section 14: Transport information*
- Section 15: Regulatory information*
- Section 16: Other information

*OSHA indicated that since other agencies regulate sections 12-15, OSHA will not be enforcing them

Written Hazard Communication Plan

- The standard requires industry:
  - To develop and implement a written hazard communication program
  - To provide hazard communication training for employees:
    - Initially (to newly hired personnel)
    - Whenever a new hazard is introduced into the workplace

Special Hazards

- Management of process spills or leaks:
  - Implement the facility's emergency control program
  - Secure the area

Summary

- All facilities should have a hazard communication plan in a location that is accessible to all employees.
- All hazardous products should be labeled and all employees should be aware of what and where they are.
- SDSs should be available and accessible for all hazardous products.

Do you see any problems here?

Do you see any problems here?

Large containers balanced on edge of shelf- not safe

If chemical, coffee can is not proper type of storage container

Maybe improperly labeled container- what's in the coffee can? Coffee not allowed with chemicals; if chemical, not labeled properly.

HAZARD COMMUNCIATION

LABORATORY SAFETY

Acquisition Recommendations

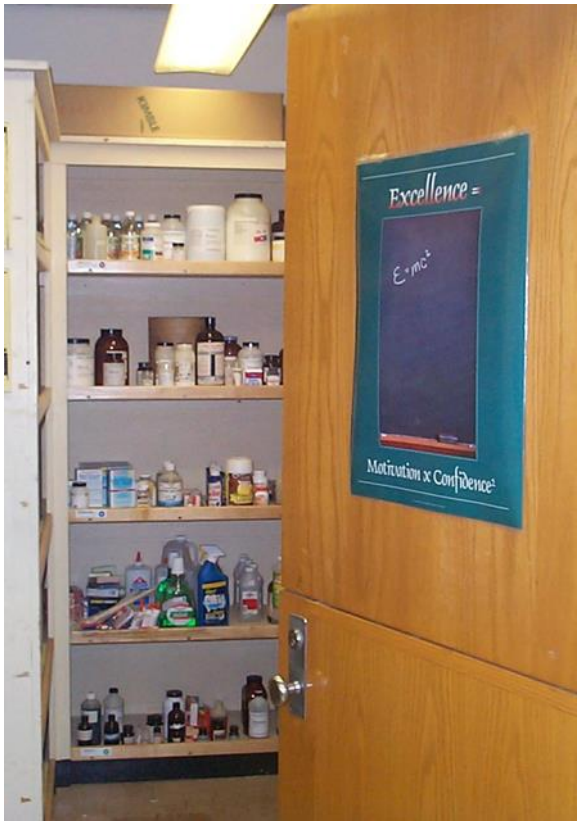
- Order the smallest quantity possible for each chemical
  - No discounts, but final cost is less
- Never accept “left-over” or “donated” chemicals
  - There’s no guarantee of its purity
  - If you don’t normally use it, you probably don’t need it

Safe Storage & Handling

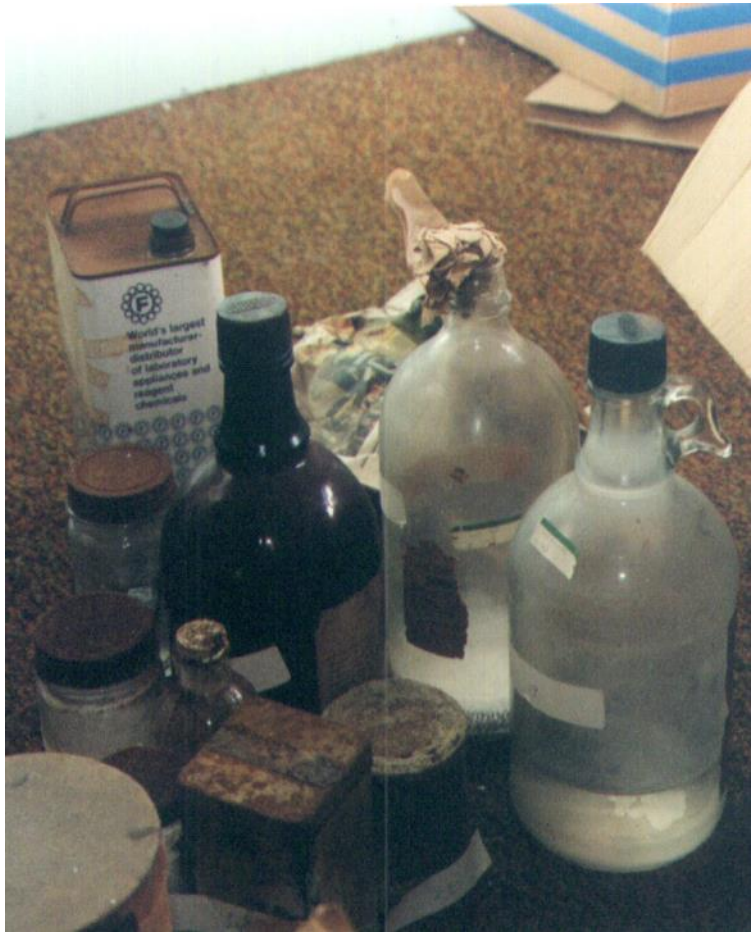
VS.

RECOMMENDED PRACTICES

Examine your currently available storage space



Avoid floor clutter



Avoid shelf clutter

Avoid desk clutter

Use storage containers for small or loose items

Arrange containers based on compatibility

Keep your containers in good conditions

Sturdy shelving units

- Use edging to prevent containers from falling off.

Store acids in Acid Cabinet

Store flammables in a Flammables Cabinet

Avoid overhead storage

Additional Safety Measures

- An eye wash unit and/or emergency shower nearby (but not in the storage room)

Additional Safety Measures

- Ensure Adequate Ventilation for:
  - Chemical storage areas
  - Chemical preparation areas
  - For volatile compounds use a fume hood!
  - Chemical use areas

Additional Safety Measures

- Emergency gas shut-off valve

Additional Safety Measures

- Retractable electrical outlets

Remember these costly phrases:

- “Frequently used chemicals should be ordered in bulk.”
- “Ordering in bulk is the best deal for the money.”
- “Accept any donated chemicals…”
- “I’ll remember what I put in that jar.”

Lab Safety

Label everything clearly

Appropriate containers in good condition

Be neat and orderly

Store only what you will use

Always wear protective clothing

Food allowed in eating areas only

Everything in its place on a shelf

Time to inventory & organize

Your safety is important

SECTION 2 QUIZ

SECTION 3: CHEMICAL FEED SYSTEMS AND STORAGE

Examples of chemical feed systems

- The liquid form of chlorine
- Clear and has a slight yellow color
- Ordinary household bleach (~5% chlorine by solution) is the most common form
- Industrial strength: 12% and 15% solutions
- Can lose up to 4% of its available chlorine content per month; should not be stored for more than 60 to 90 days
- Very corrosive; should be stored and mixed away from equipment that can be damaged by corrosion

Diaphragm Pump/Tank for Chlorine

On-site generated sodium hypochlorite

- 0.8% sodium hypochlorite is produced on demand by combining salt, water & electricity
- Electrolysis of brine solution produces sodium hydroxide and chlorine gas, which then mix to form sodium hypochlorite
- Hydrogen gas byproduct; vented to atmosphere
- Alleviates safety concerns associated w/ hauling and storing bulk chlorine
- Higher initial cost, high power cost
- Mixed oxidants (proprietary)

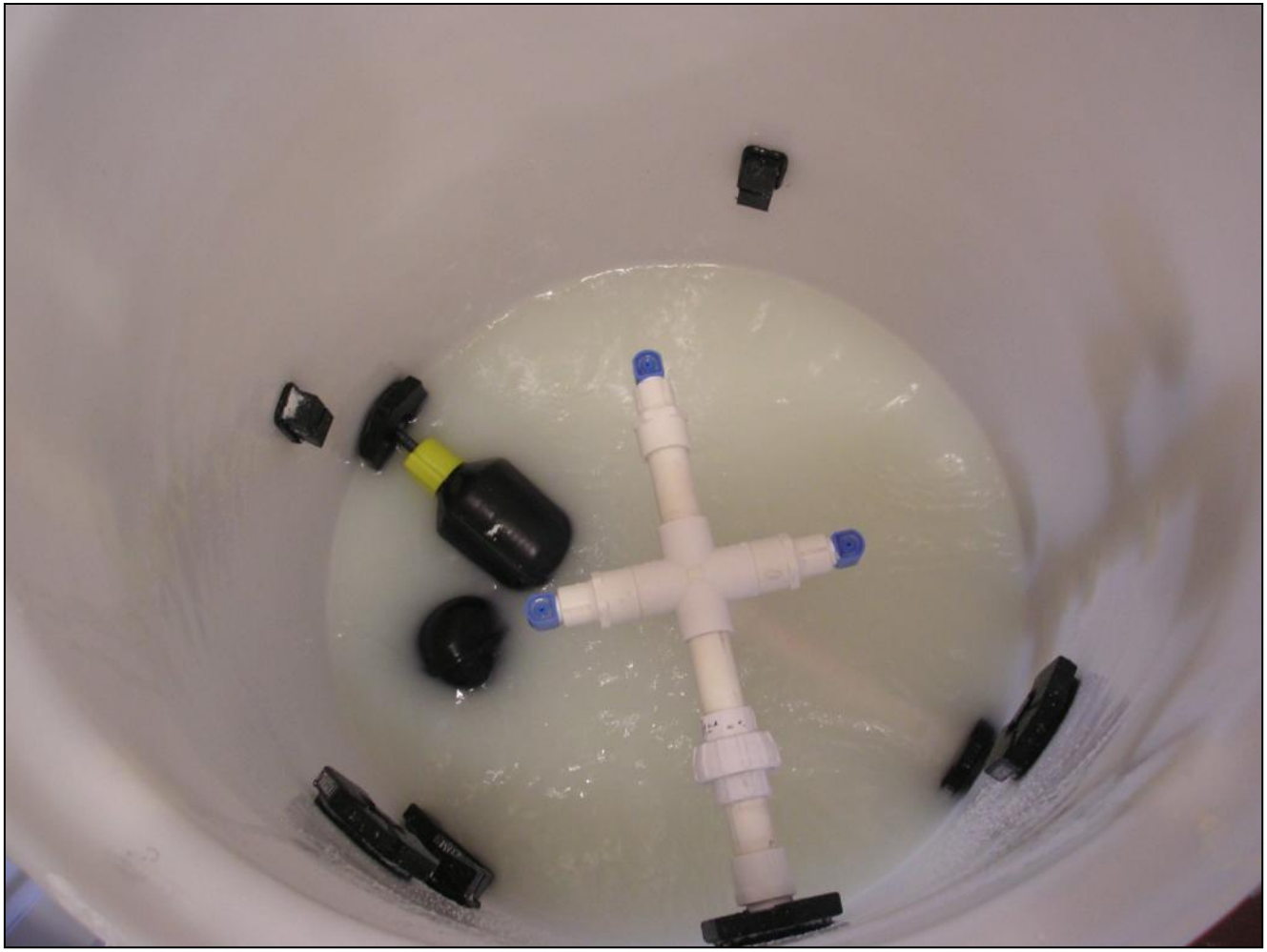
Electrodes for onsite chlorine generation

Calcium Hypochlorite

- The solid form of chlorine
- Usually tablet or powder form
- Contains ~65% chlorine by weight
- White or yellowish-white granular material and is fairly soluble in water
- Important to keep in a dry, cool place
- More stable than liquid
- Used by small systems w/ low flows or no power

Calcium hypochlorite erosion feeder

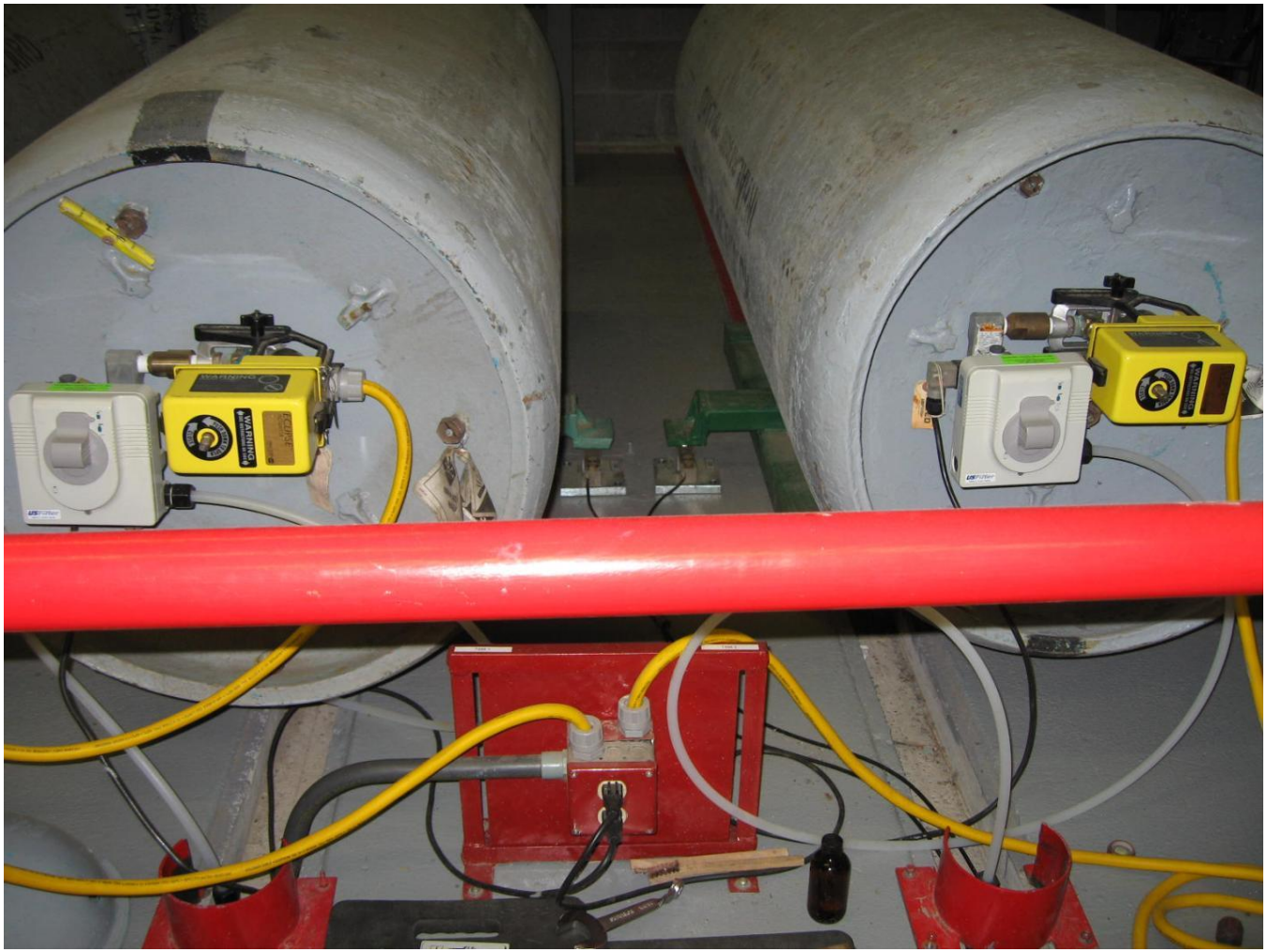
Calcium hypochlorite hopper interior



Chlorine Gas (Cl2)

- 99.5% pure chlorine
- Yellow-green color 2.5x heavier than air
- 1 part liquid = 457 parts gas vapor
- Liquefied at room temperature at ~107 psi – hence the pressurized cylinders actually contain liquefied chlorine gas
- Liquefied Cl2 is released from tanks as chlorine gas, which is then injected into the water stream
- Usually used only by large water systems
- Smaller systems may find initial cost of operation prohibitive

1-ton chlorine gas cylinders



1-ton chlorine gas cylinders

- Note: scales used to weigh cylinders (to tell when they are empty)

150-lbs chlorine gas cylinders

- Chain to secure tank in place
- Spare tank on hand
- Tanks clearly marked

Chloramines

- Chlorine + ammonia = chloramination
- Two advantages to regular chlorination:
  - Produces a longer lasting chlorine residual (helpful to systems with extensive distribution systems)
  - May produce fewer by-products depending on the application
- Disadvantage:
  - Needs a lot of contact time to achieve CTs compared to free chlorine (300 times more) which is why not used for primary disinfection
  - Requires specific ratio of chlorine to ammonia or else potential water quality problems

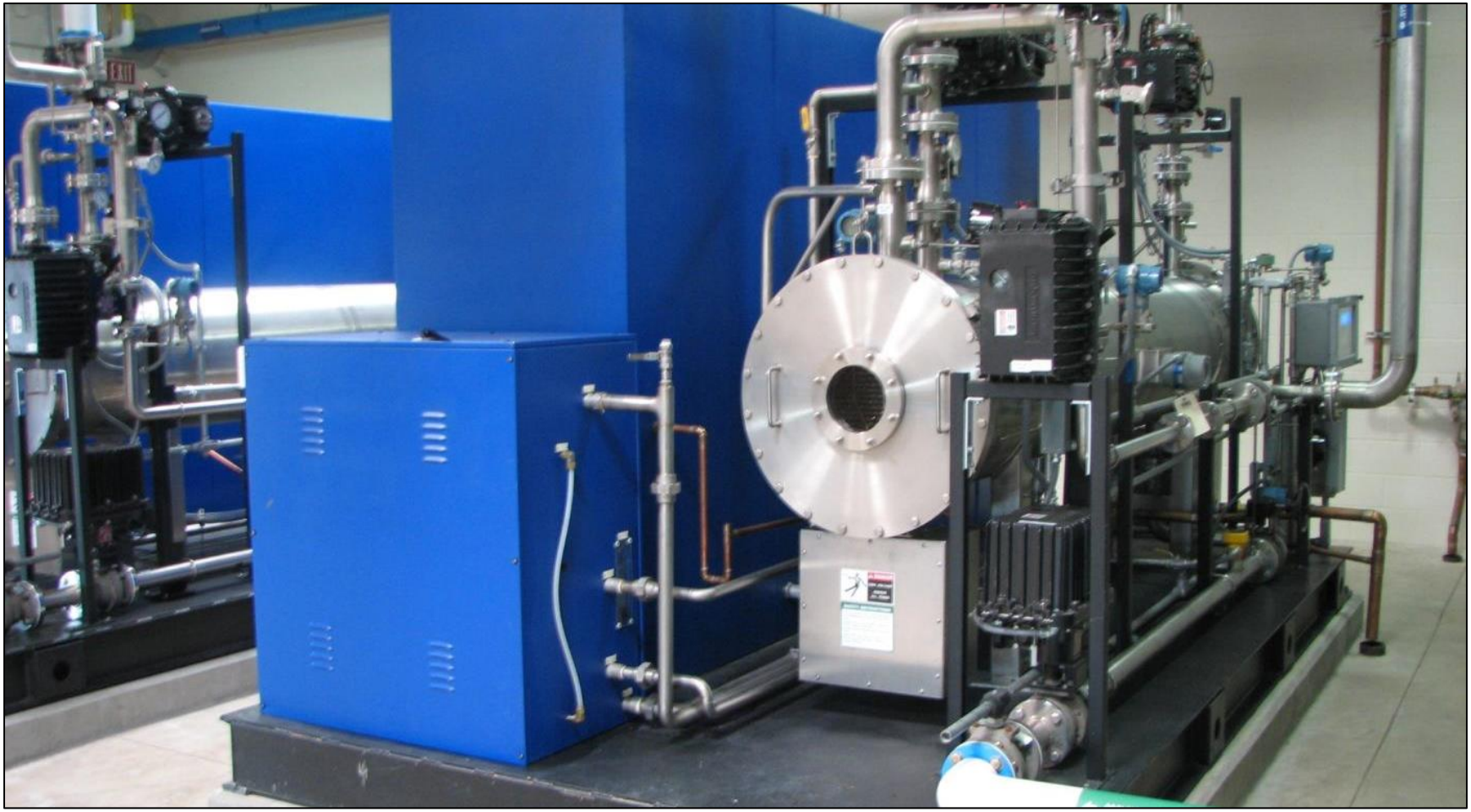
Ammonia for making chloramines

Ozone

- Colorless gas (O_3)
- Strongest of the common disinfecting agents
- Also used for control of taste and odor
- Extremely Unstable; Must be generated on-site
- Manufactured by passing air or oxygen through two electrodes with high, alternating potential difference
- Is an irritant when inhaled

Large water system ozone

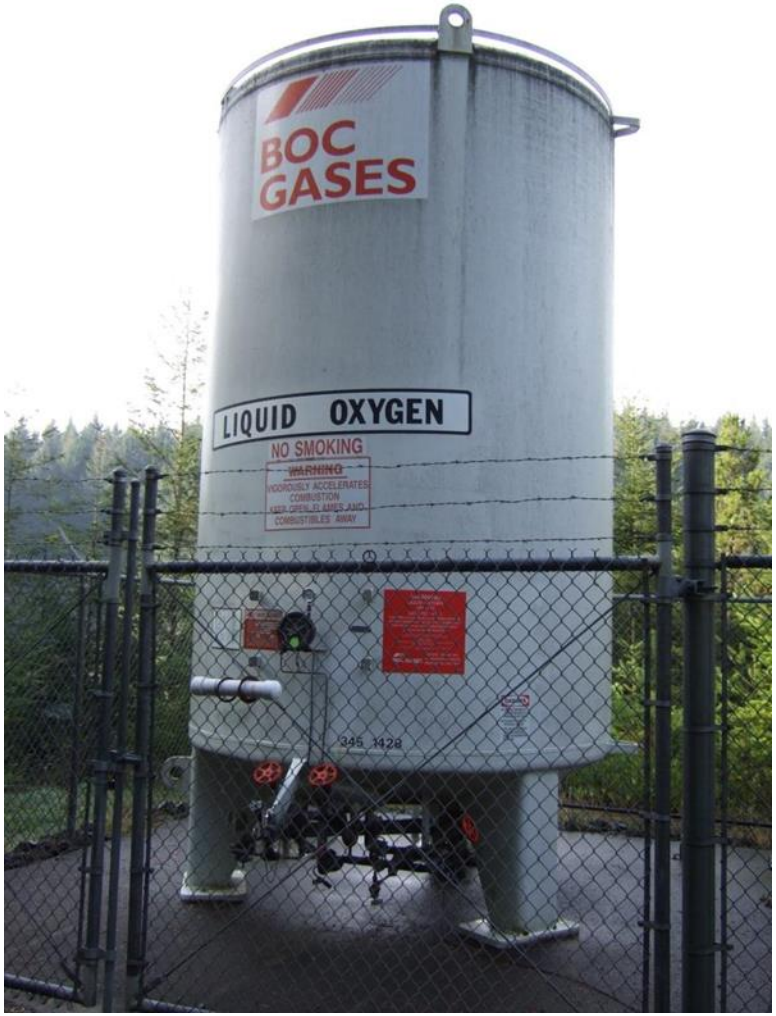
Large water system ozone



Ozone Contactors

Ozone & Liquid Oxygen

- Ozone is too reactive to store, so liquid oxygen is used for making ozone



Storage Tanks and Containment

Example Storage Tanks (Containers)

- Single-wall Aboveground Storage Tank (AST)
  - Has one wall to contain the contents of the tank, typically older fuel and oil tanks were single-wall construction. Some form of containment is required when storing oil.
  - Typically admixture tanks are single-wall polyethylene tanks.
  - Industrial Bulk Containers (IBC) totes and drums are typically single-wall.
- Double-wall AST
  - The primary tank is wrapped by an exterior tank that may be in contact with the primary tank (a tank within a tank). The outer tank has the capacity to capture the inner tank contents should a leak develop. This interstitial space between the tanks can be checked for signs of leakage during regular inspections.

Storage Tanks and Containment

Example Storage Tanks (Containers)

- Industrial Bulk Containers (IBC) Totes
  - Typically these totes are single-wall and range in size from 275 to 330 gallons. Many chemicals such as admixtures and form oils are shipped in totes. Containment would also be required if storing oil.
- Drums
  - 55 gallon Drums are an industry favorite for a variety of chemicals. They come in a multitude of materials and sizes ranging from 10 gallons all the way to 95 gallons. Some form of containment is required when storing oil.

Storage Tanks Examples

Single-Wall Steel AST in Plastic Containment

Steel Oil ASTs not in Containment

10,000 Gallon Diesel Double-Wall Steel AST

55 Gallon “Oil” or Larger Drums

Plastic Admix Tanks in Containment

Industrial Bulk Containers (IBC Totes)

What is a Storage Tank?

- Variety of shapes and sizes
- EPA uses the term "bulk storage container".
  - 55 gallons or larger
  - Everything from a drum to the 10,000 gallon or larger diesel Aboveground Storage Tank (AST) at your facility is a Bulk Storage Container.

Storage Tanks

Chemical Storage Do’s and Don’ts

- Never store liquid and dry chemicals together, regardless of the compatibility group

- Do not store chemicals from different compatibility groups together

Storage Tanks

- Chemicals stored in bulk should be provided with secondary containment.

- With multiple tanks, the secondary containment should cover the tank with the largest volume.

Storage Tanks

- Select materials for containers, pipe, pumps, and ancillary equipment to be compatible with the chemical being stored
- Incompatible chemicals should not use common secondary containment structures
- Storage areas must be code compliant for ventilation, alarms, and type of containment used
- Ensure storage area environmental conditions are suitable for the chemical being stored – temperature, humidity, and sunlight exposure

Storage Compatibility

Compatibility Groups: Common Water Treatment Chemicals

Group I: Acids

Name	Common Name	Available Forms
Acetic Acid	Ethanoic Acid	Liquid
Hydrofluosilicic Acid	Fluosilic Acid	Liquid
Hydrogen Fluoride Acid	Hydrofluoric Acid	Liquid
Hydrochloric Acid	Muriatic Acid	Liquid
Nitric Acid	Sulfuric Acid	Liquid

Group II: Bases

Name	Common Name	Available Forms[1]
Calcium Hydroxide	Hydrated Lime	Dry
Calcium Oxide	Quicklime	Dry
Calcium Hypochlorite	HTH	Dry
Sodium Bicarbonate	Sodium Bicarbonate	Dry
Sodium Carbonate	Soda Ash	Dry
Sodium Hydroxide	Caustic Soda, Lye	Liquid, Dry
Sodium Hypochlorite	Bleach	Liquid
Sodium Silicate	Water Glass	Liquid

[1] Certain concentrated dry chemicals, like calcium hypochlorite and calcium oxide (quicklime) will produce an exothermic reaction when exposed to liquid or even small amounts of moisture.

Storage Compatibility

Group III: Salts & Polymers

Name	Common Name	Available Forms
Aluminum Sulfate	Alum	Liquid, Dry
Copper Sulfate	Blue Stone	Liquid, Dry
Ferric Chloride	Ferrichlor	Liquid, Dry
Ferric Sulfate	Ferri-Floc	Dry
Ferrous Sulfate	Copperas	Liquid Dry
Polyaluminum Chloride	PACL	Liquid
Polyelectrolytes (Cationic, Anionic, Non-ionic)	Polymer	Liquid, Dry
Sodium Aluminate	Soda Alum	Liquid, Dry
Sodium Fluoride	Sodium Fluoride	Liquid, Dry
Sodium Hexametaphosphate	Glassy Phosphate	Dry
Sodium Phosphate	Sodium Phosphate	Liquid, Dry
Zinc Orthophosphate	Zinc Ortho	Liquid

Group IV: Adsorption Powders

Name	Common Name	Available Forms
Powdered Activated Carbon	PAC	Dry
Granular Activated Carbon	GAC	Dry

Storage Compatibility

Group V: Oxidizing Powders

Name	Common Name	Available Forms
Potassium Permanganate	Permanganate	Dry

Group VI: Compressed Gases[2]

Name	Common Name	Available Forms	Incompatible Chemicals Within This Category[3]
Ammonia	Ammonia	Liquid, Gas	Chlorine
Chlorine	Gas Chlorine	Liquid, Gas	Ammonia
Carbon Dioxide	Dry Ice	Liquid, Gas	-
Sulfur Dioxide	SO_2	Liquid, Gas	-

[2]Each compressed gas should have its own separate storage/feed area.

[3] Chlorine and ammonia should be stored separately from each other, as well as from all other chemical groups.

SECTION 3 QUIZ

Thanks for joining us!
Download the slides at ssmgroup.com

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