

Stainless Steel 201

Considerations about an important
ingredient of the brewery plant

Ashton Lewis

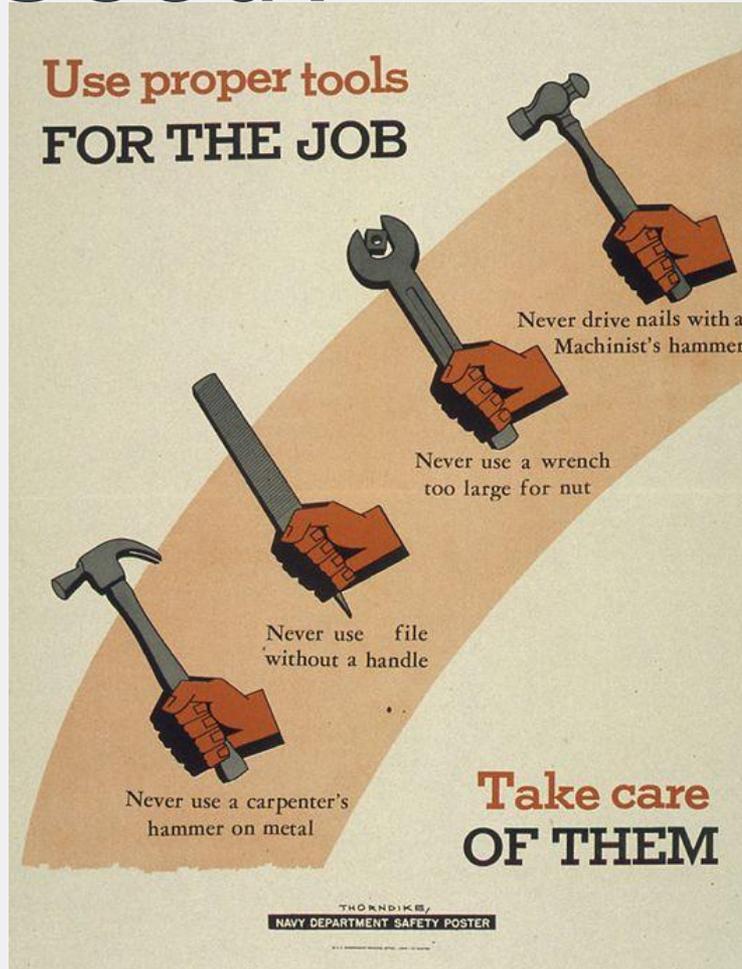
Brewery Product Manager

Paul Mueller Company

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Why is Stainless Steel

A Good Fit for the Duty
Used?



Mechanical Properties

- Malleable
- Strong
- Easily welded
- Easy to polish
- Durable

Malleability

Allows heads to be dished ...



Malleability

Allows heads to be dished ...



... and Flanged



Malleability

Allows heads to be dished ...



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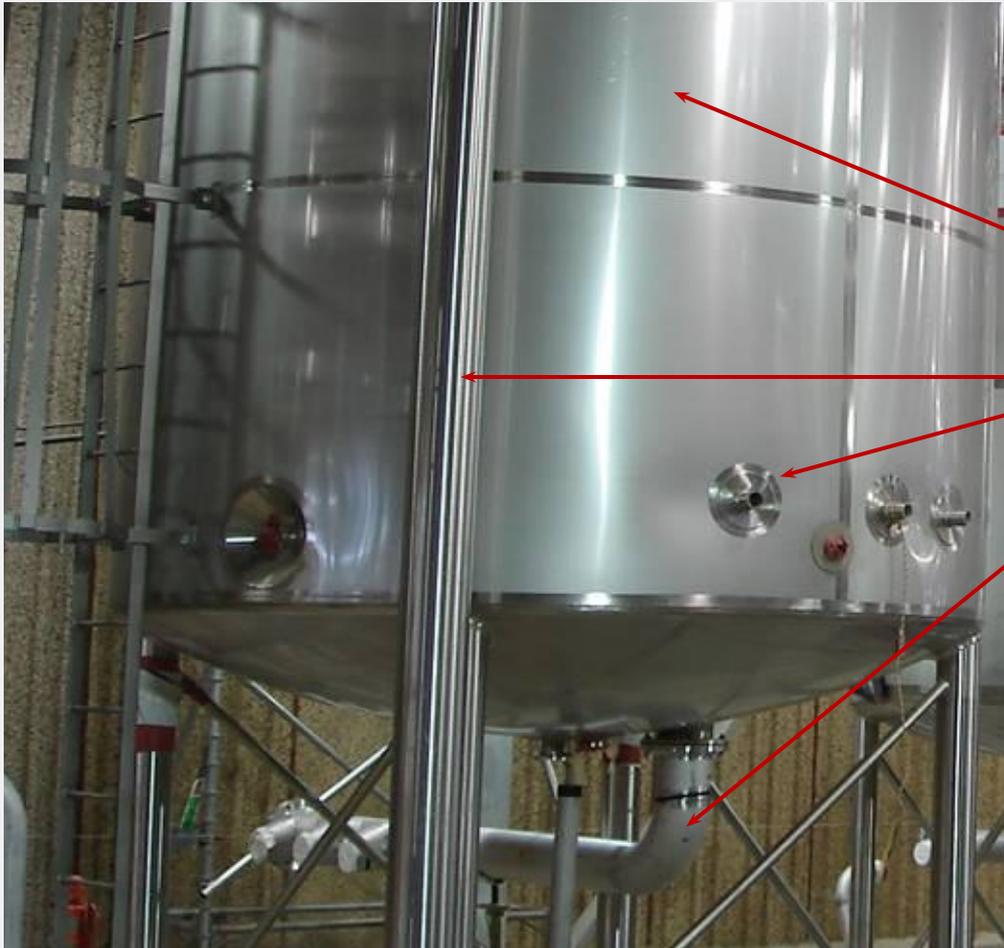


Tubing can be drawn



Surface Finishes

Requirements Duty Dependent



Finish Types

- 2B / Cold Rolled
- Mechanically Polished
- Hot Rolled, Annealed and Pickled (HRAP)

Durable ...

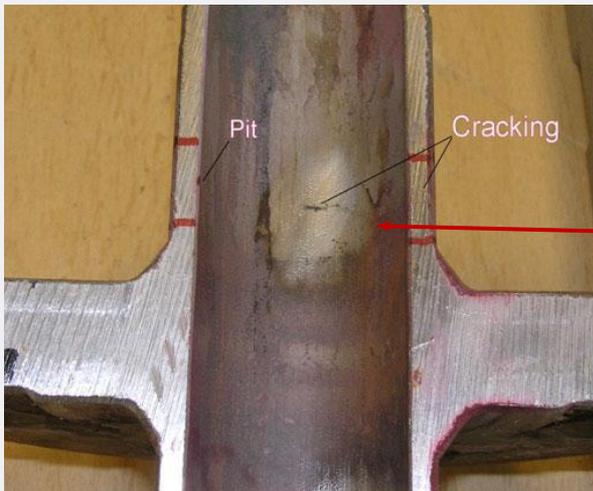
To a Point!



“Stainless” is not Absolute



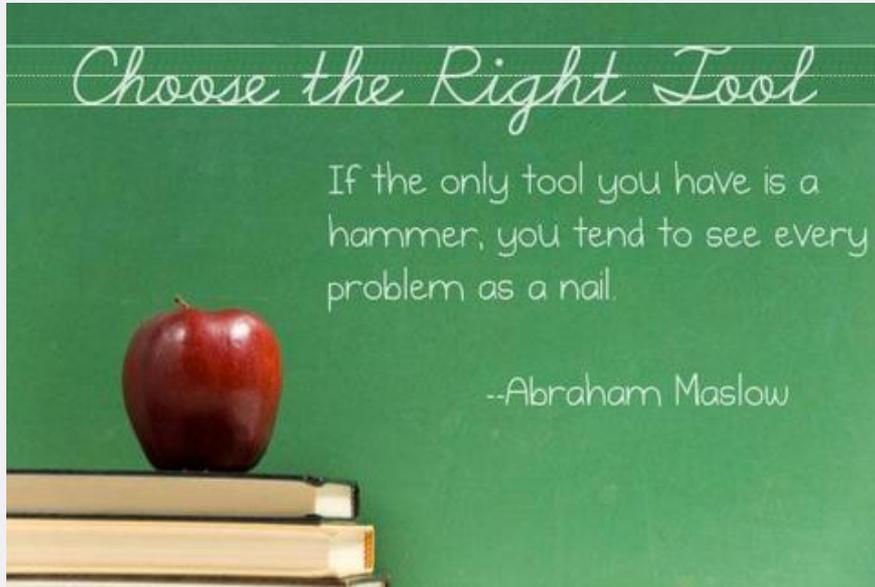
Chloride Pitting



Stress Corrosion Cracking

Steel Type

Picking the proper tool for the job



Type 304

- Most common austenitic stainless type used in food and beverage processing
- Commonly referred to as 18-8
- Most brewing equipment is fabricated from Type 304 stainless
- Relative cost = 1.00

Steel Type

Picking the proper tool for the job



Type 316

- Similar to Type 304, except for the inclusion of 2% molybdenum
- “Moly” adds improved resistance to chlorides and helps ward off pitting corrosion
- Type 316 is the most common type of stainless steel used in pharmaceutical equipment
- Also commonly used for surgical instruments
- Relative cost ~ 1.30

Big Salt Piles Contribute to Great Diving!



Steel Type

Picking the proper tool for the job



Caution
Hot water



2205

- Duplex steel
- Magnetic
- Does not readily succumb to SCC
- Readily available
- More difficult to form than Types 304 and 316
- Difficult to apply heating surfaces
- Relative cost ~ 2.00

Steel Type

Picking the proper tool for the job



Caution
Hot water



AL6XN

- Austenitic
- Does not readily succumb to SCC
- Readily available
- Has similar forming and fabrication qualities to Types 304 & 316
- Expensive
- Relative cost ~ 4.50

Steel Type

Summary of Alloy Compositions

| Alloy | Cr | Ni | Mo | Cu | N | C |
|-------|------------|-----------|-----------|--------------|--------------|--------------|
| 304L | 18-20% | 8-12% | - | - | 0.10% max | 0.03% max |
| 316L | 16-18% | 10-14% | 2-3% | - | 0.10% | 0.03% max |
| 2205 | 22% Avg | 5% Avg | 3% Avg | - | 0.14% Avg | 0.03% max |
| AL6XN | 20-22% | 23-25% | 6-7% | 0.75% max | 0.22% Avg | 0.03% max |

Steel Type

Summary of Alloy Compositions

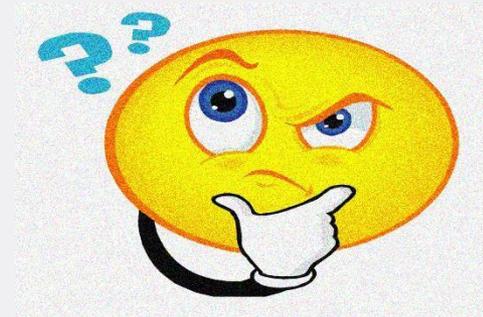
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Material selection is typically the buyer's responsibility

Different Alloy ... Visually Indistinguishable

Buyer's Protection

- Material specifications
- Material certifications
- X-Ray Fluorescence (XRF) guns are used for nondestructive testing and separate alloys by elemental composition



CHAPTER II

PROTECTING YOUR INVESTMENT

Readying New Equipment for Use

Removal of Atypical Soils ...

- Manufacturing oils

What?

Used for lubrication is polishing and machining operations

How?

- ✓ Degreasers and other solvents
- ✓ Detergents
- ✓ Elbow grease

Readying New Equipment for Use

Removal of Atypical Soils ...

- Manufacturing oils
- Adhesive residues

What?

Used to secure protective films to stainless steel during manufacturing

How?

- ✓ Degreasers and other solvents
- ✓ Detergents
- ✓ Elbow grease

Readying New Equipment for Use

Removal of Atypical Soils ...

- Manufacturing oils
- Adhesive residues
- Road grime

What?

- Brake dust (rich in iron)
- Oils
- Salt
- Dirt

How?

- Degreasers and other solvents
- Detergents
- Salt binding compounds
- Iron chelating compounds

Readying New Equipment for Use

Removal of Atypical Soils ...

- Manufacturing oils
- Adhesive residues
- Road grime
- Free Iron

What?

- Iron that is not part of the crystalline matrix of stainless steel
- Can come from tools, carbon steel dust and contaminated grinding abrasives

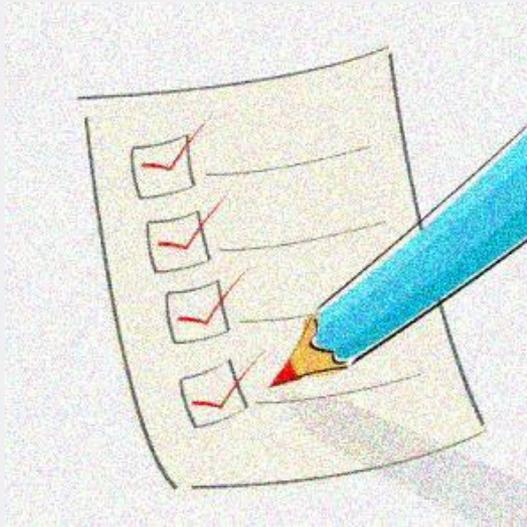
How?

- Iron chelating compounds
- Passivating acids, such as nitric and citric acid

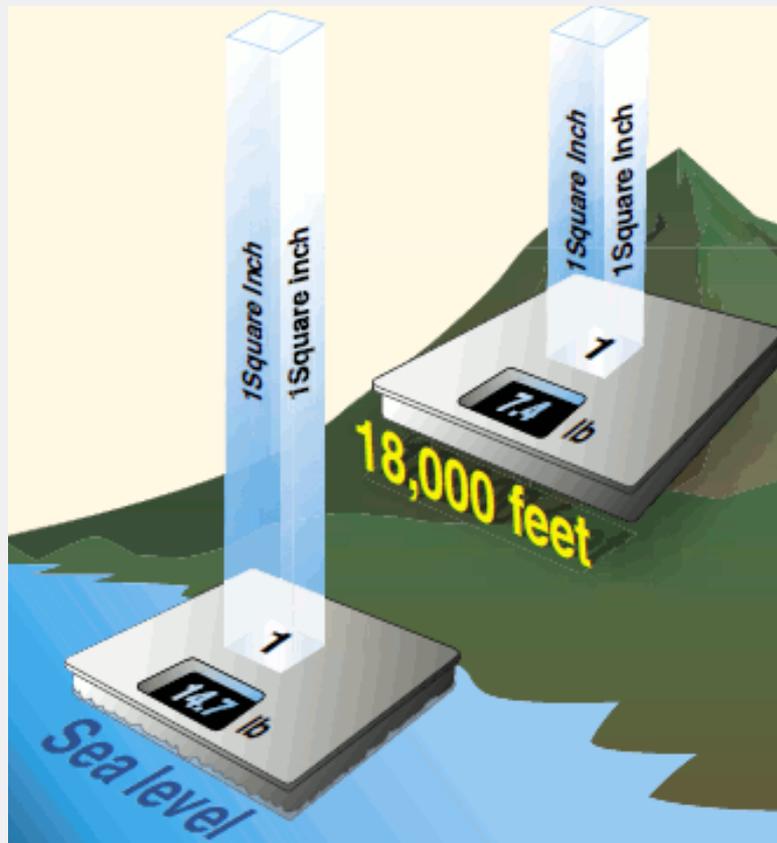
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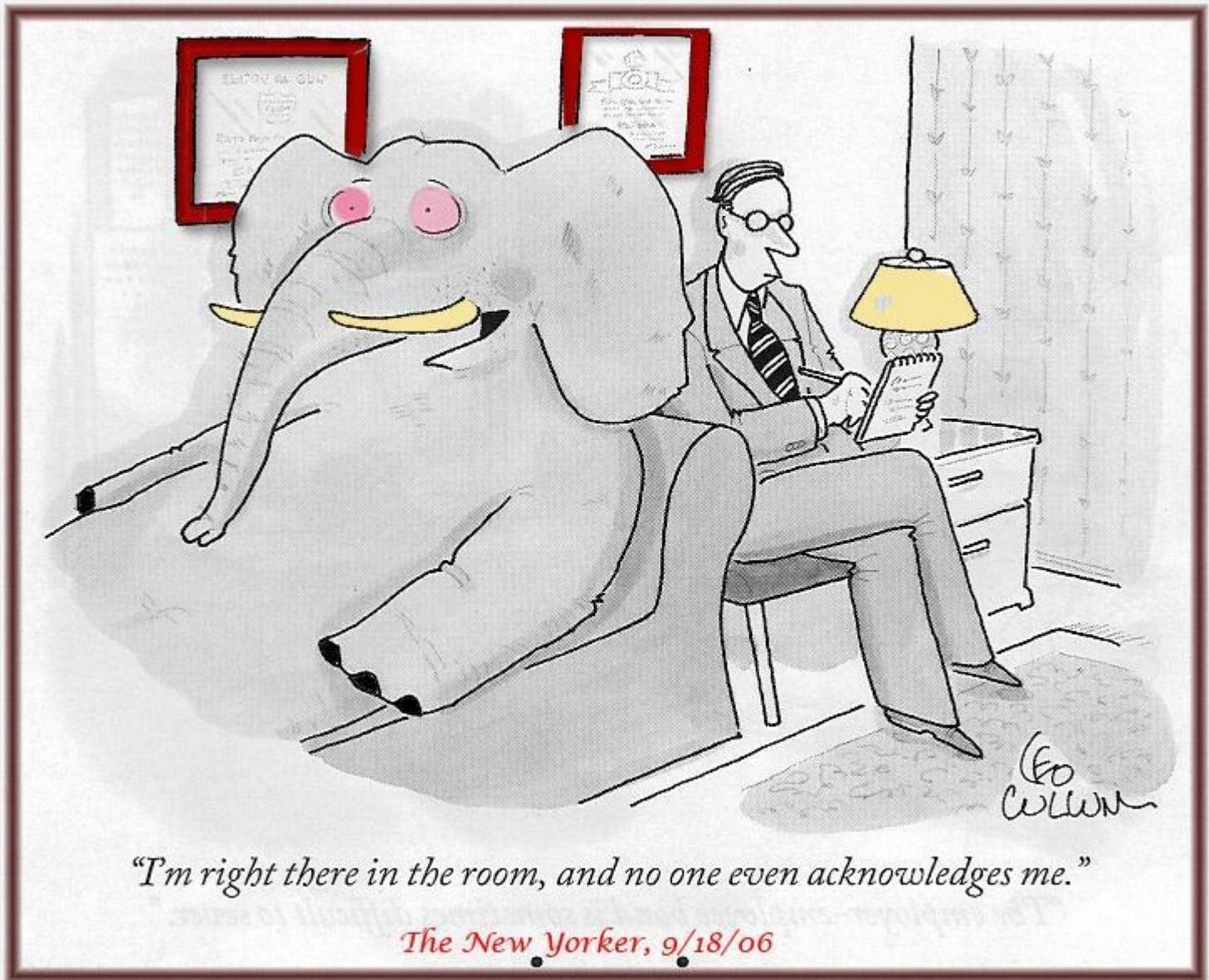
Removal of Atypical Soils ...

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- Free Iron



The Invisible Force





The Invisible Force is Real!



April 16, 2015

2015 Craft Brewers Conference

The Invisible Force is Real!



April 16, 2015

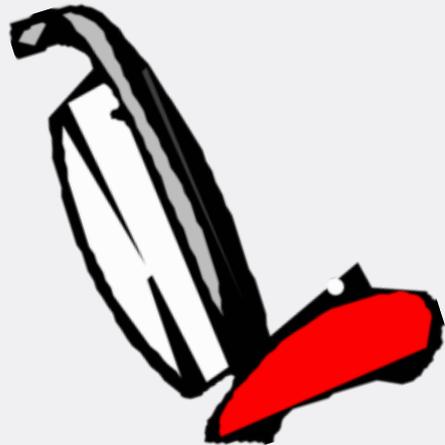
2015 Craft Brewers Conference

Vacuum Defined

External pressure $>$ Internal Pressure

Vacuum Defined

External pressure > Internal Pressure



This Sucks!

Common Causes of Vacuum

Pumping out of an unvented vessel or accidentally draining an unvented vessel

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Common Causes of Vacuum

Pumping out of an unvented vessel or accidentally draining an unvented vessel

Overfilling a vessel without a siphon breaker ... really?

Tank Overfilling

Question:

While filling a tank, beer begins overflowing from the vent line.

What do you do?



Tank Overfilling

Possible Actions:

- Shut the inlet valve

Tank Overfilling

Possible Actions:

- Shut the inlet valve
- Turn off the supply pump

Tank Overfilling

Possible Actions:

- Shut the inlet valve
- Turn off the supply pump
- Shut the overflow/vent line valve

Tank Overfilling

Possible Actions:

- Shut the inlet valve
- Turn off the supply pump
- Shut the overflow/vent line valve
- Close all valves and turn off supply pump

Tank Overfilling

Possible Actions:

- Shut the inlet valve
- Turn off the supply pump
- Shut the overflow/vent line valve
- Close all valves and turn off supply pump
- Grab a pitcher to prevent beer loss



Tank Overfilling

Possible Actions:

- Shut the inlet valve
- Turn off the supply pump
- Shut the overflow/vent line valve
- Close all valves and turn off supply pump

These actions can all lead to a siphon if not performed properly

Tank Overfilling

This is what happens if you simply stop liquid supply...



Tank Overfilling

This is what happens if you simply stop liquid supply...



Tank Overfilling

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Tank Overfilling

This is what happens if you simply stop liquid supply...



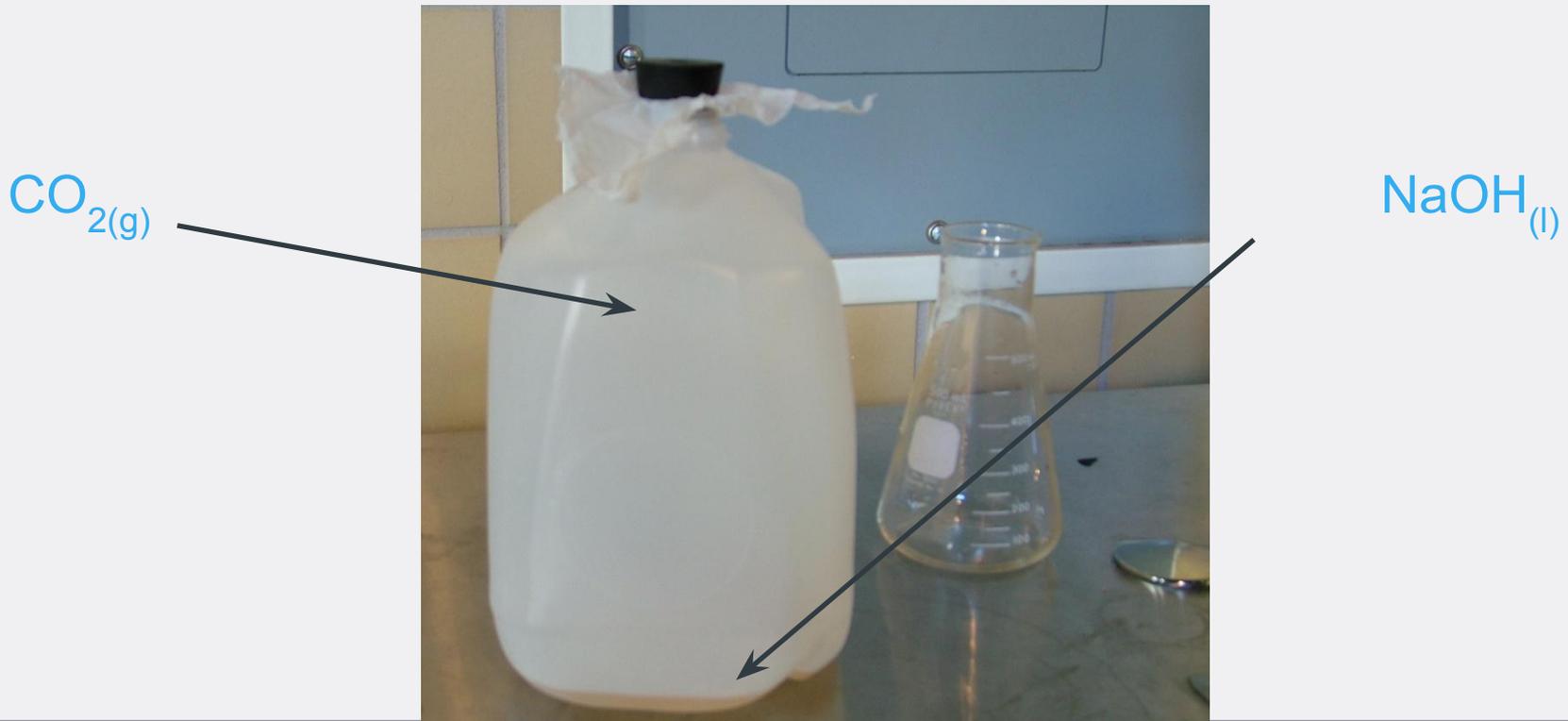
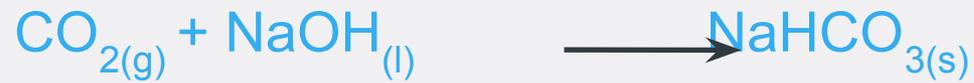
Common Causes of Vacuum

Pumping out of an unvented vessel or accidentally draining an unvented vessel

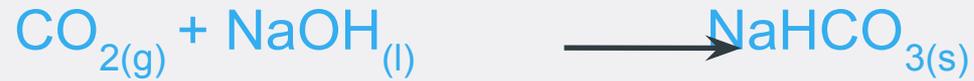
Overfilling a vessel without a siphon breaker ... really?

Spraying caustic into a CO₂ atmosphere

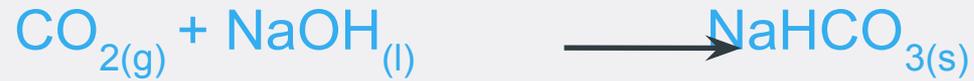
Caustic & Carbon Dioxide



Caustic & Carbon Dioxide



Caustic & Carbon Dioxide



Common Causes of Vacuum

Pumping out of an unvented vessel or accidentally draining an unvented vessel

Overfilling a vessel without a siphon breaker ... really?

Spraying caustic into a CO₂ atmosphere

Hot CIP followed by cold rinse

When Hot Meets Cold



When Hot Meets Cold



Real-World Examples



Real-World Examples



Real-World Examples



Preventing Vacuum-Related Failure

1. Installation of properly sized vacuum relief valves. Attention must be paid to the worst-case scenario when selecting relief valves and all possibilities need to be considered.

Vacuum Relief Valve Types



What?

- Spring type valve
- Combination pressure and vacuum relief or vacuum-only designs

Notes

- May have relatively high vacuum relief pressure with respect to tank design, especially for larger tanks
- Limited gas flow due to size, and most useful for smaller vessels
- Cleaning actuators not available



Vacuum Relief Valve Types



What?

- Rupture Disk
- Combination pressure and vacuum relief (dual acting) or vacuum-only designs

Notes

- When these devices act they vent the vessel to atmosphere and do not re-seat
- Burst disk indicators flag alarms about the condition

Vacuum Relief Valve Types



What?

- Weight-loaded vacuum relief valve

Notes

- Available with varying and quite low vacuum pressures (easy to open)
- Available in a range of sizes up to 400 mm (~16")
- Cleaning actuators available
- Heating inserts available
- Can equip with proximity sensors to flag alarms

Preventing Vacuum-Related Failure

1. Installation of properly sized vacuum relief valves. Attention must be paid to the worst-case scenario when selecting relief valves and all possibilities need to be considered.
2. Maintaining and inspecting vacuum relief valves, vents and overflows.

Vent line with heat tracing on milk silo



Preventing Vacuum-Related Failure

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Vent line with heat tracing on milk silo



Caution
Convenient location
can cause problems
when rapid vacuum
occurs!

Preventing Vacuum-Related Failure

1. Installation of properly sized vacuum relief valves. Attention must be paid to the worst-case scenario when selecting relief valves and all possibilities need to be considered.
2. Maintaining and inspecting vacuum relief valves, vents and overflows.
3. Proper training to correctly respond to atypical events, such as tank over-filling.

Preventing Vacuum-Related Failure

1. Installation of properly sized vacuum relief valves. Attention must be paid to the worst-case scenario when selecting relief valves and all possibilities need to be considered.
2. Maintaining and inspecting vacuum relief valves, vents and overflows.
3. Proper training to correctly respond to atypical events, such as tank over-filling.
4. **Implementation of procedures consistent with process.**

Take Home Messages

1. Select stainless steel material type with the same care used when choosing your brewing materials.



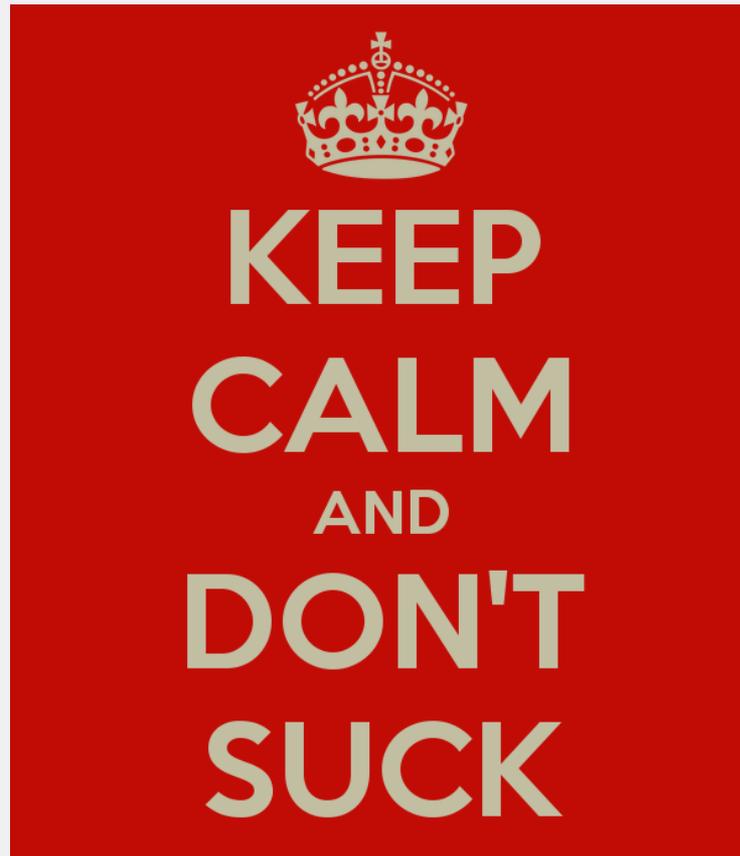
Take Home Messages

2. Prepare new equipment for use by removing atypical soils.



Take Home Messages

3. Recognize and respect the invisible force!



Thank You for the Opportunity!



Contact Information

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