

CO<sub>2</sub>:

Everything You Always Wanted to  
Know

(But Were Afraid to Ask)

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Attendees will learn how to  
anticipate and recognize the  
hazard of carbon dioxide in  
various brewery operations,  
recognize that hazard and apply  
practical methods of control that  
manage that hazard that  
can be employed in breweries of  
all sizes.



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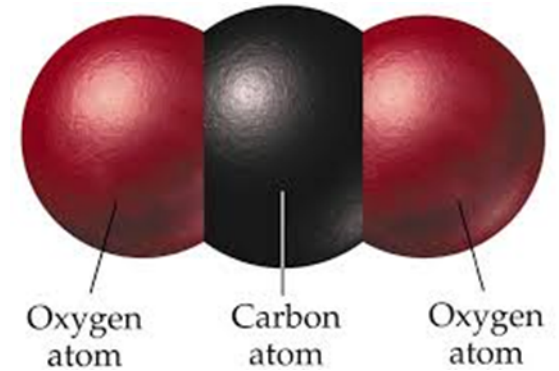
# Houston [REDACTED] brewery cited by OSHA for CO2 exposure to employees

Employment which were not recognized hazards that were causing or likely to cause death or serious physical harm to employees on January 9 2014, employees were exposed to carbon dioxide at the following concentrations:

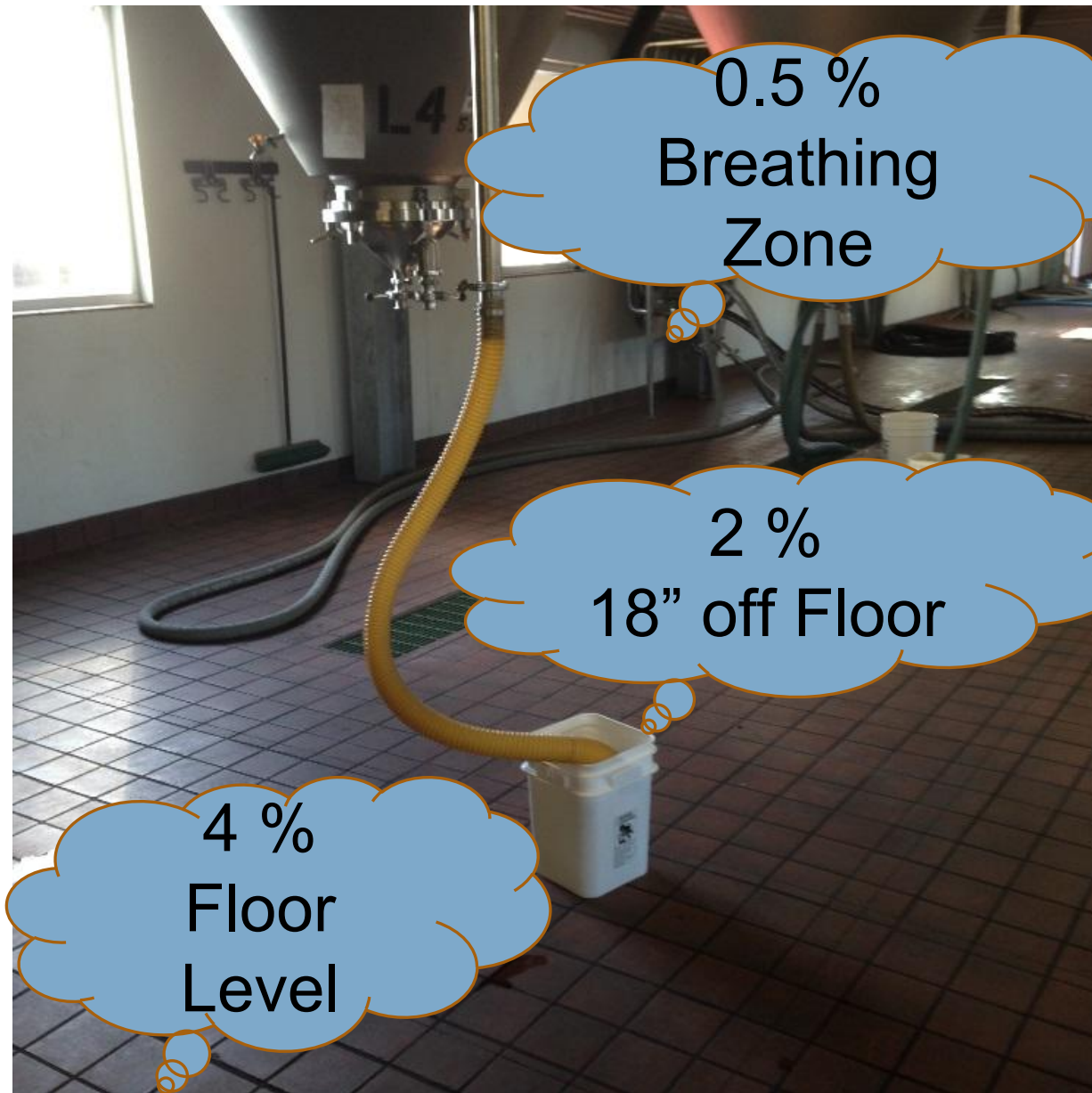
# What is CO<sub>2</sub>?

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- Colorless
- Odorless
- Tasteless
- Heavier than air







# It's Toxicity and your bodily response

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- Drowsiness/Fatigue
- Simple physiological response
  - Fresh air makes everything good again
- Increased heart rate
  - Pushes out oxygen
  - That's why we use in brewing
- Shortness of breath
- Dizziness/Headache

# Terminology and Exposure limits

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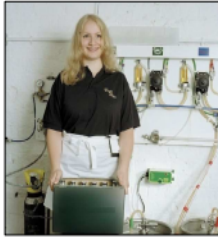
100,000 ppm = 10%

10,000 ppm = 1%

5,000 ppm = 0.5% OSHA

1,000 ppm = 0.1%

# Common levels and bodily response



- 0.04% fresh outside air
- 0.15 % average indoor air
- 0.5 % OSHA PEL for 8 hours
- 3.0 % OSHA STEL for 15 minutes
- 4.0 % IDLH (immediately dangerous)
- 8.0 % Unconsciousness
- 20.0% Death

# SAFETY DATA SHEET

**Airgas**

Carbon Dioxide

## Section 1. Identification

GHS product identifier	: Carbon Dioxide
Chemical name	: Carbon dioxide
Other means of identification	: Carbonic, Carbon Dioxide, Carbonic Anhydride
Product use	: Synthetic/Analytical chemistry.
Synonym	: Carbonic, Carbon Dioxide, Carbonic Anhydride
SDS #	: 001013
Supplier's details	: Airgas USA, LLC and its affiliates 259 North Radnor-Chester Road Suite 100 Radnor, PA 19087-5283 1-610-687-5253
Emergency telephone number (with hours of operation)	: 1-866-734-3438

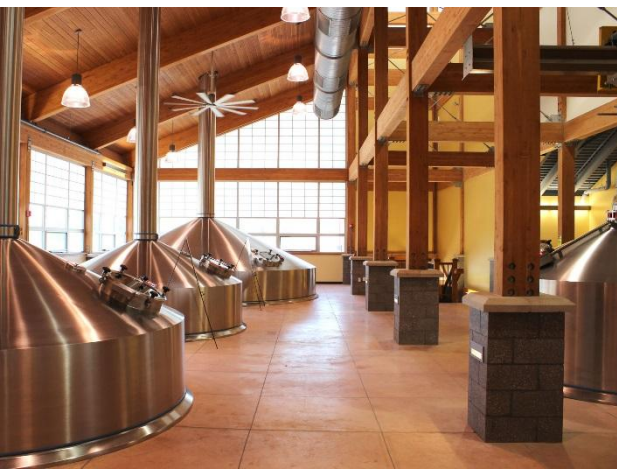
## Section 2. Hazards identification

OSHA/HCS status	: This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
Classification of the substance or mixture	: GASES UNDER PRESSURE - Liquefied gas Simple asphyxiant.
GHS label elements	
Hazard pictograms	:





# Transition into Locations



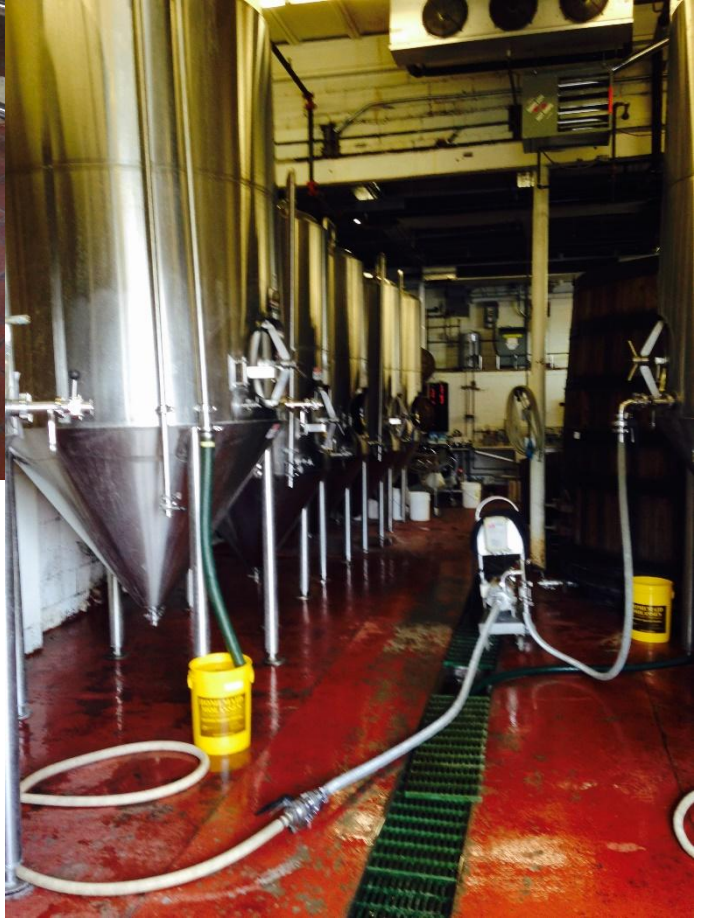
# Locations

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- Receiving and storage
- Lab
- Brew house
- Cellar
- Packaging
- Pub



# Cellar





# Packaging



# Pubs (keg cooler)

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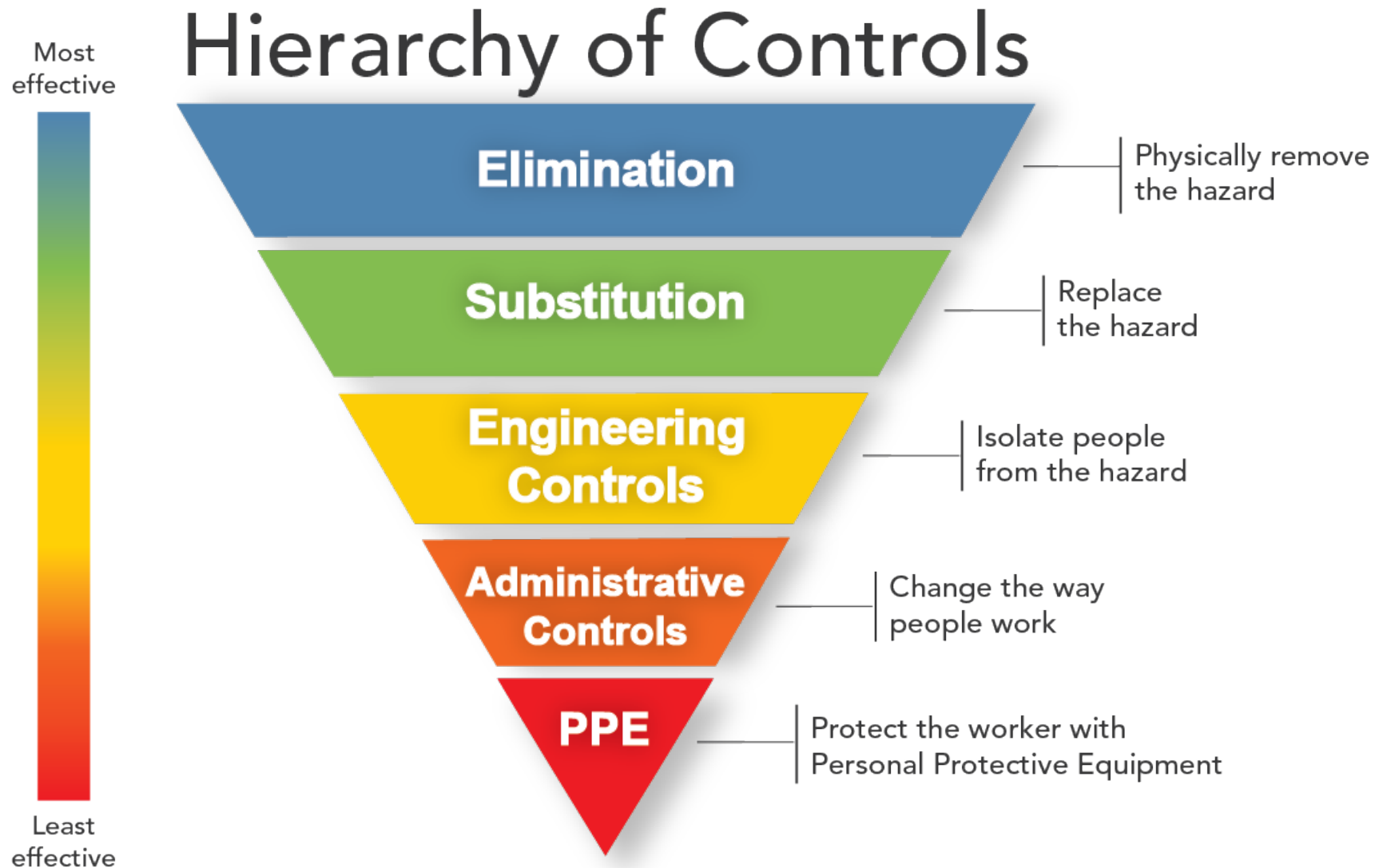
2014 MICHIGAN WORK-RELATED DEATHS #26

“A 48 year old bartender went into the basement after closing the bar where she was allegedly overcome by leaking carbon dioxide. She was found unresponsive at 7:00 a.m. EMS was called and she was taken to the hospital where she died.”

**Before we talk about specific controls**

**....**

**We need to talk about a concept used to  
control any hazard**



Control at the source

# Pathways and Controls

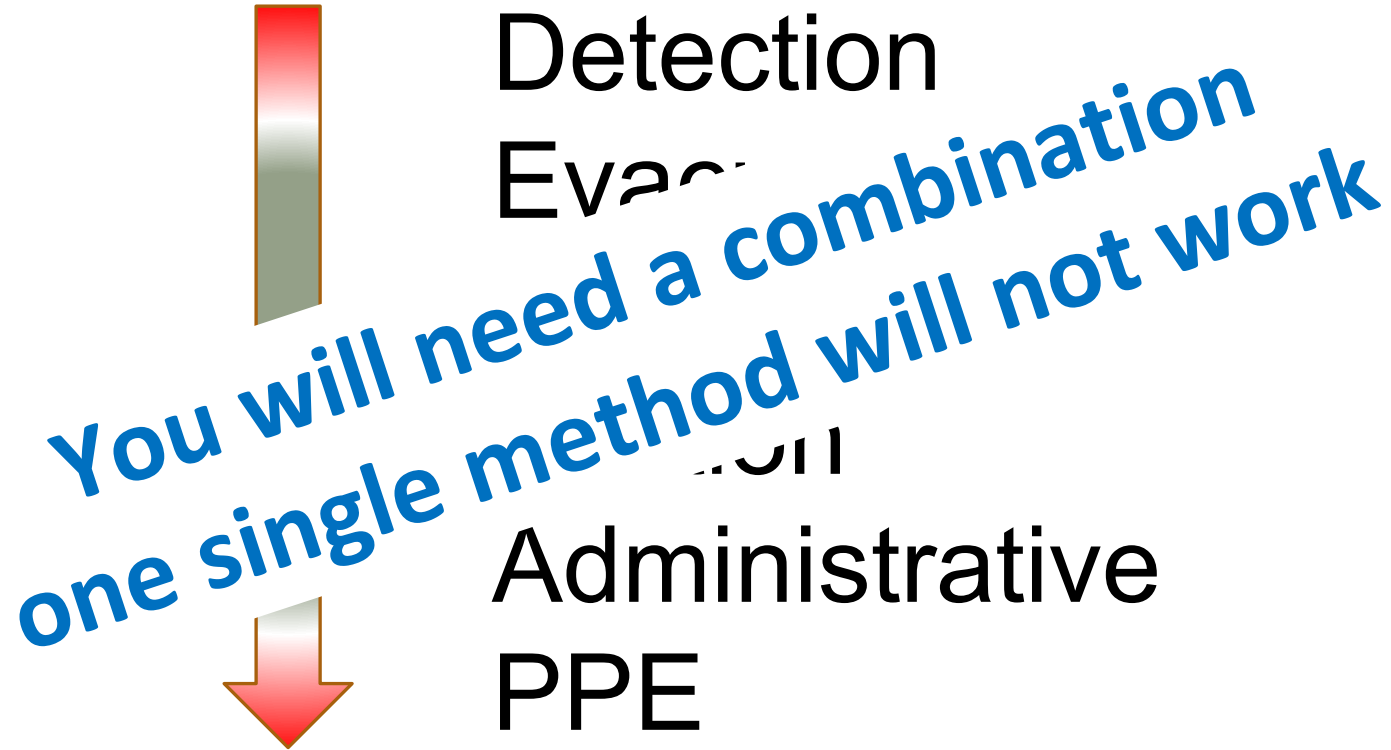
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Picture your favorite brewer here...

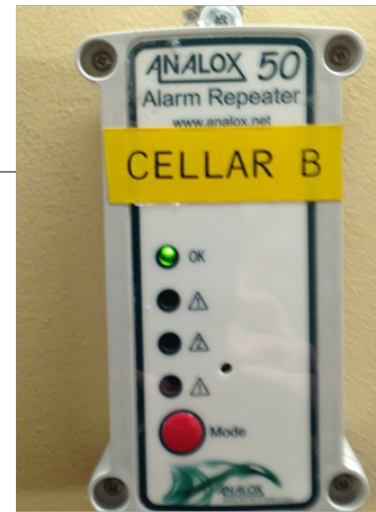
# Controls Methods for CO<sub>2</sub>

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# Detection



# Detection – Sensor Technology

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- Color Detector tubes
- Nondispersive Infrared (NDIR)



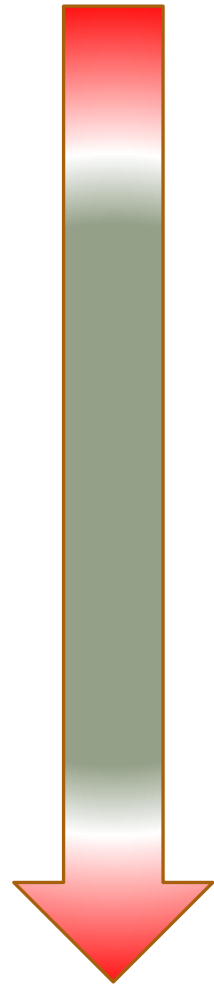
# Detection – Classification

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## ➤ Portable (Hand Held)

### ➤ Fixed location

- Job/Task specific
- Stand alone single station
- Personal monitoring
- Multi point
- Breathing zone and Floor level
- Can be connected to ventilation system, warning systems
- Preventative maintenance (calibration)



Detection

Evacuation

# Best Control = Evacuation

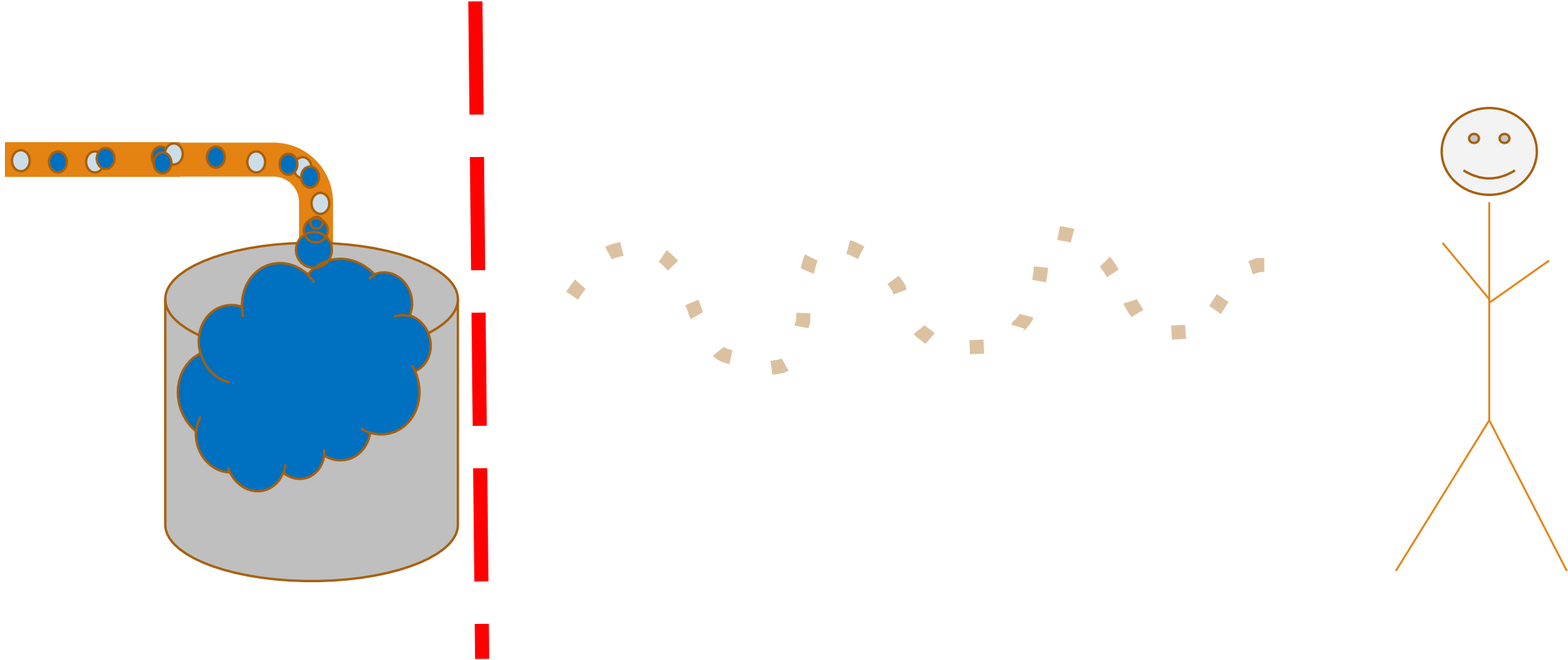
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**CAUTION**

# Evacuation

Remove the CO<sub>2</sub> before it leaves the vessel and gets into the work environment

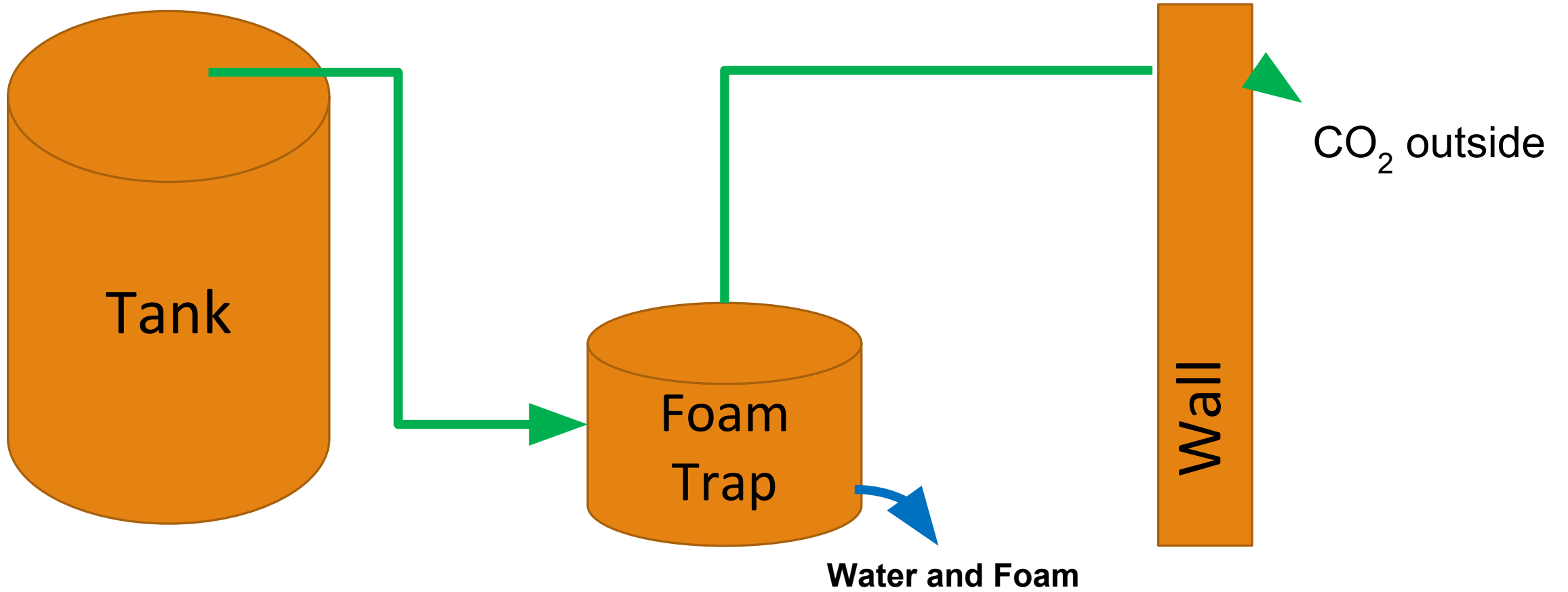


# Evacuation

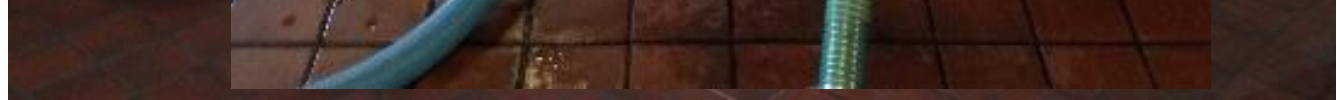
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- Most effective engineering control
- Series of pipes or hoses that take the gas from fermentation vessels directly outside
- Foam traps
- Pressure relief

# Evacuation



# Foam Traps





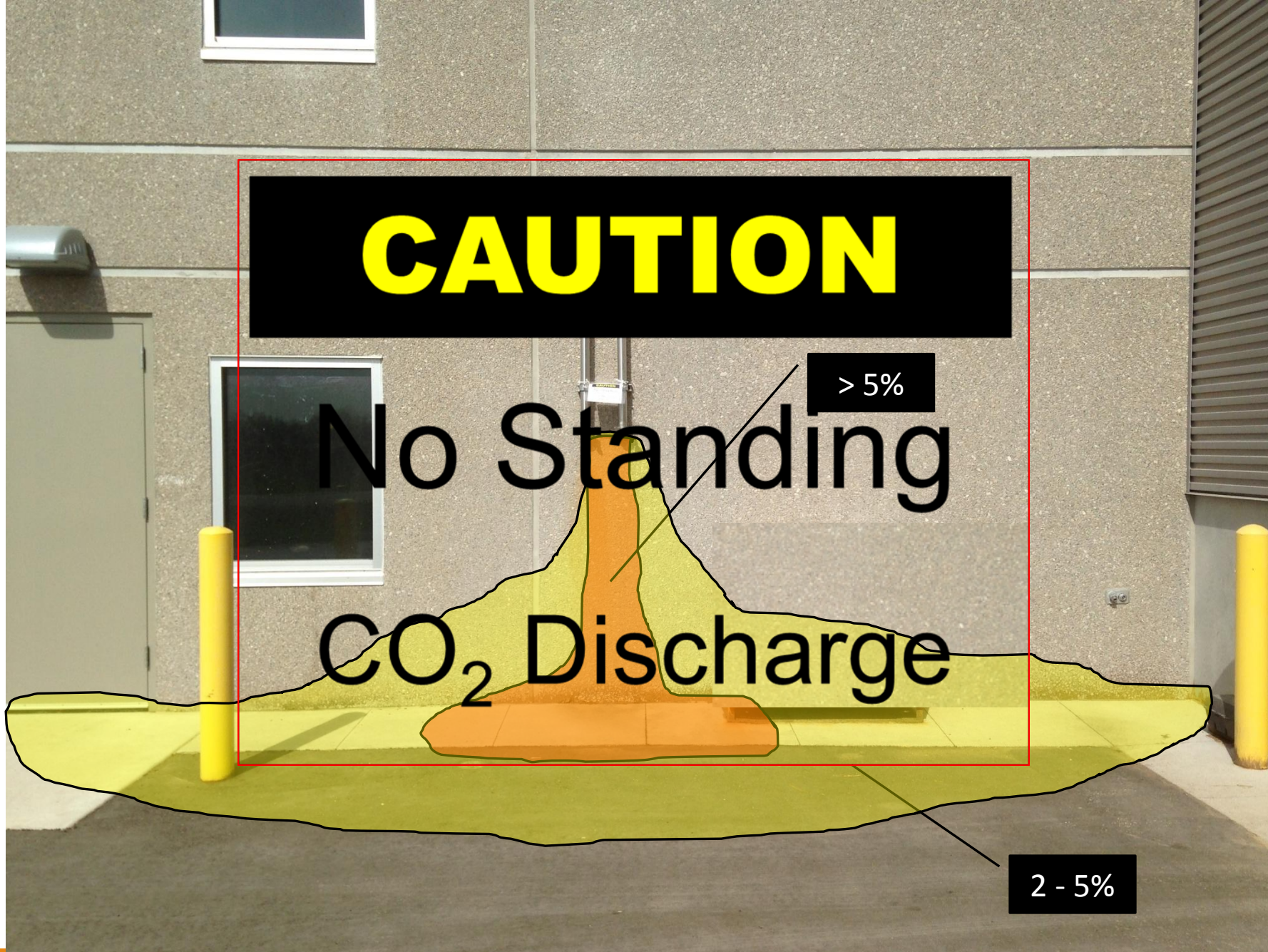
**CAUTION**

No Standing

CO<sub>2</sub> Discharge

> 5%

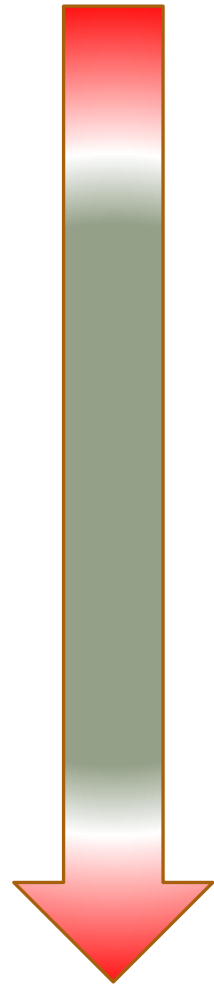
2 - 5%





# Evacuation - Pro/Con

- Cost
- Cross contamination
- Home made or highly engineered
- Foam trap
- Discharge point



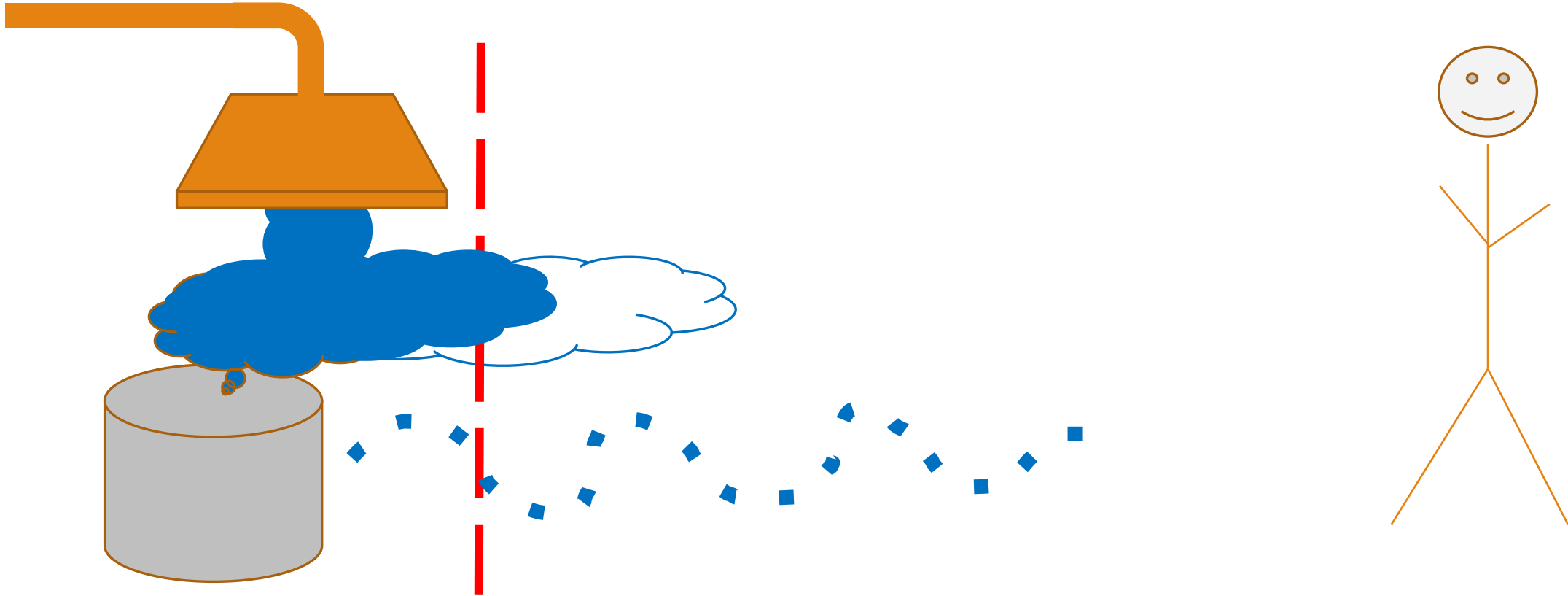
Detection

Evacuation

**Exhaust**

# Exhaust Ventilation

Removing the CO<sub>2</sub> after it enters the work environment

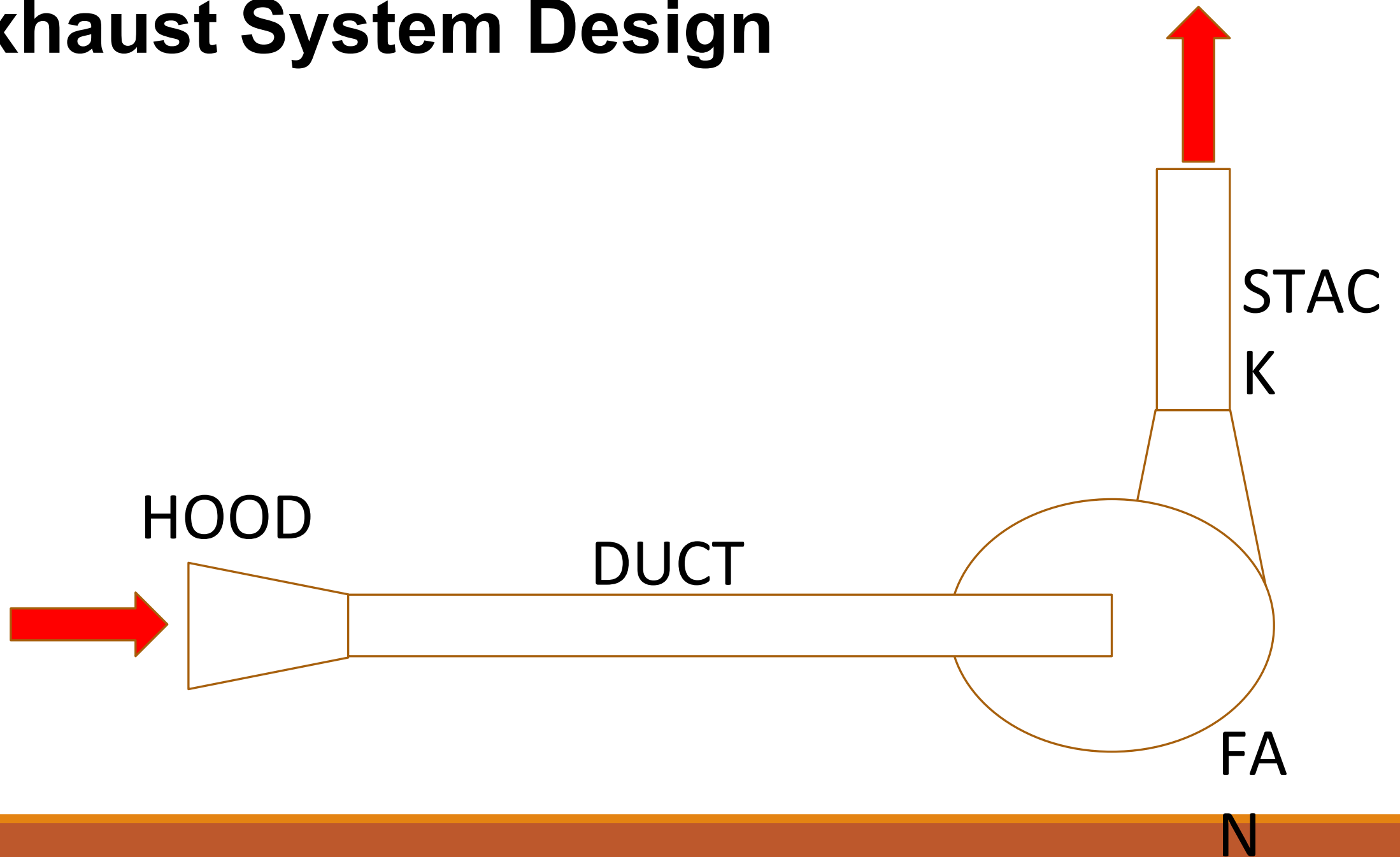


# Exhaust - Ventilation

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- Drawing air out of a space
- Less effective engineering control
- Sustainable
- General or Localized
- Must be designed for the operation

# Exhaust System Design



# Local Exhaust - Ventilation

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- Limited application
- Most effective exhaust
- Cost
- Engineered system
- Tied with detection/automatic









# General Exhaust - Ventilation

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- Wider application
- Must draw air from floor level
- Large volumes of air
- Lower Cost vs. local exhaust
- Engineered system – Balanced system
- Tied with detection

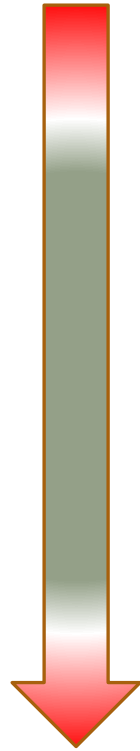




# Exhaust - Ventilation

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- Effective engineering control
- Drawing air out of a space
- Sustainable – local better
- Must be designed for the operation
- Required for open top fermentation



Detection

Evacuation

Exhaust

**Dilution**

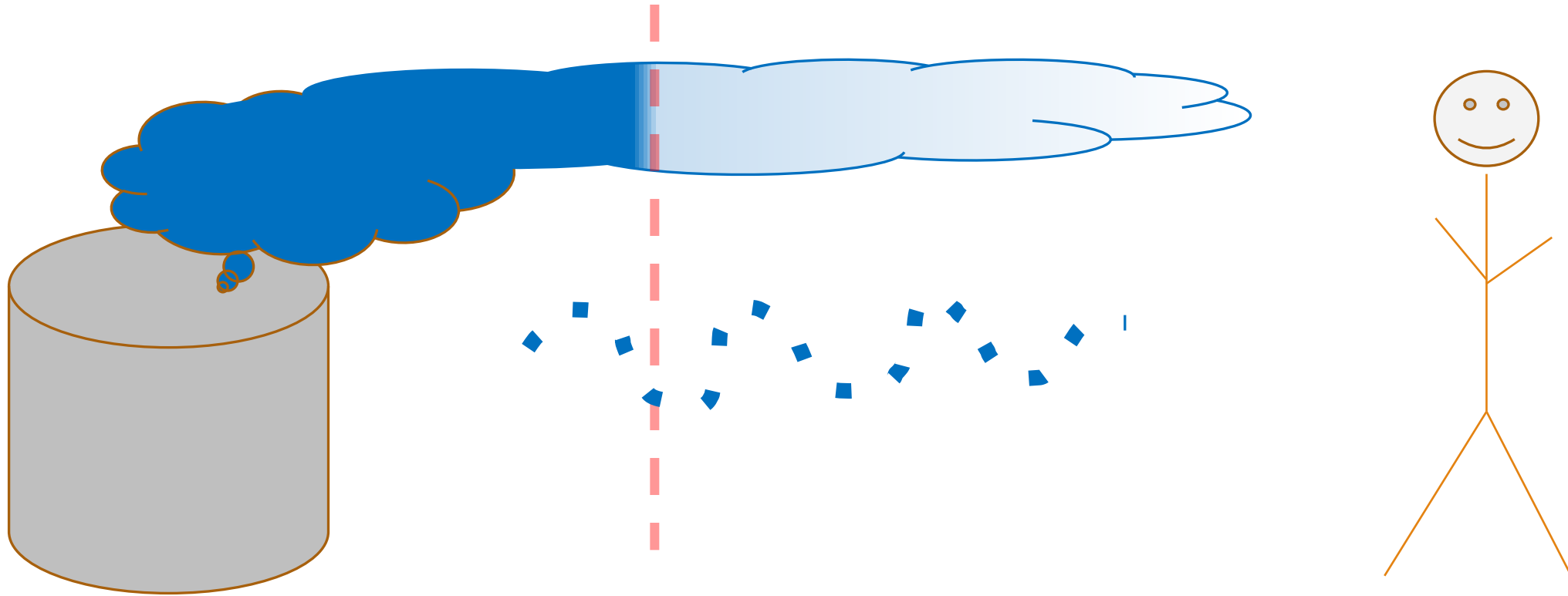
Administrative

PPE



# Dilution

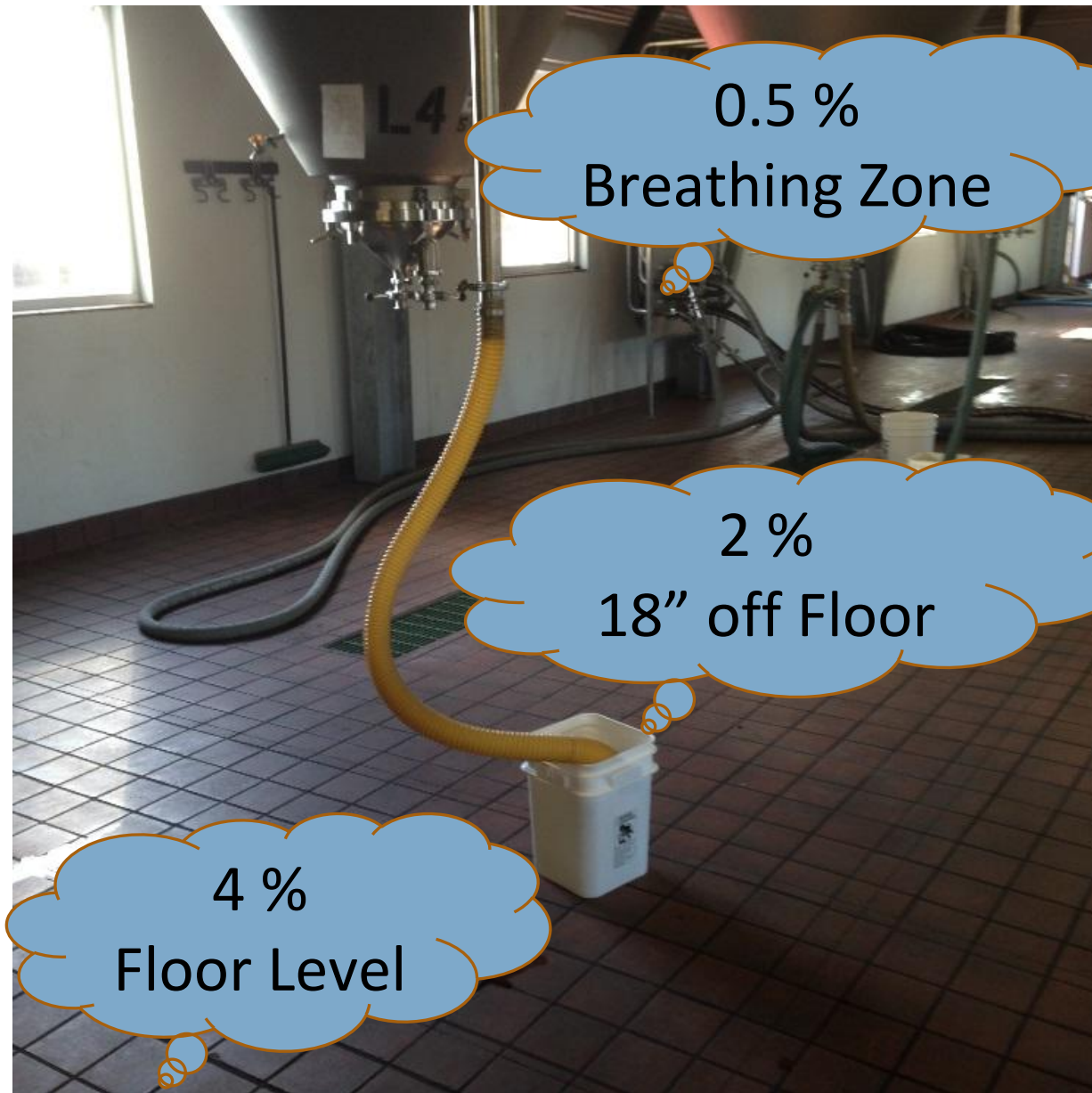
“Dilution is the solution to pollution”



# Dilution

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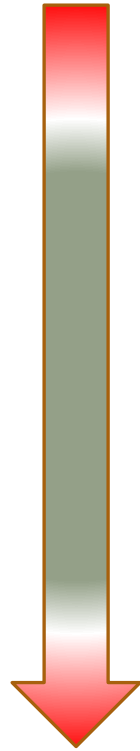
- Least effective engineering control
- Adding air (or space) to lower exposure
- Detection is critical



# Dilution

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- In small operations within large spaces and detection system it can functional
- Fans just blow it around
- Standard HVAC systems/units are not designed to control CO<sub>2</sub> from brewing



Detection

Evacuation

Exhaust

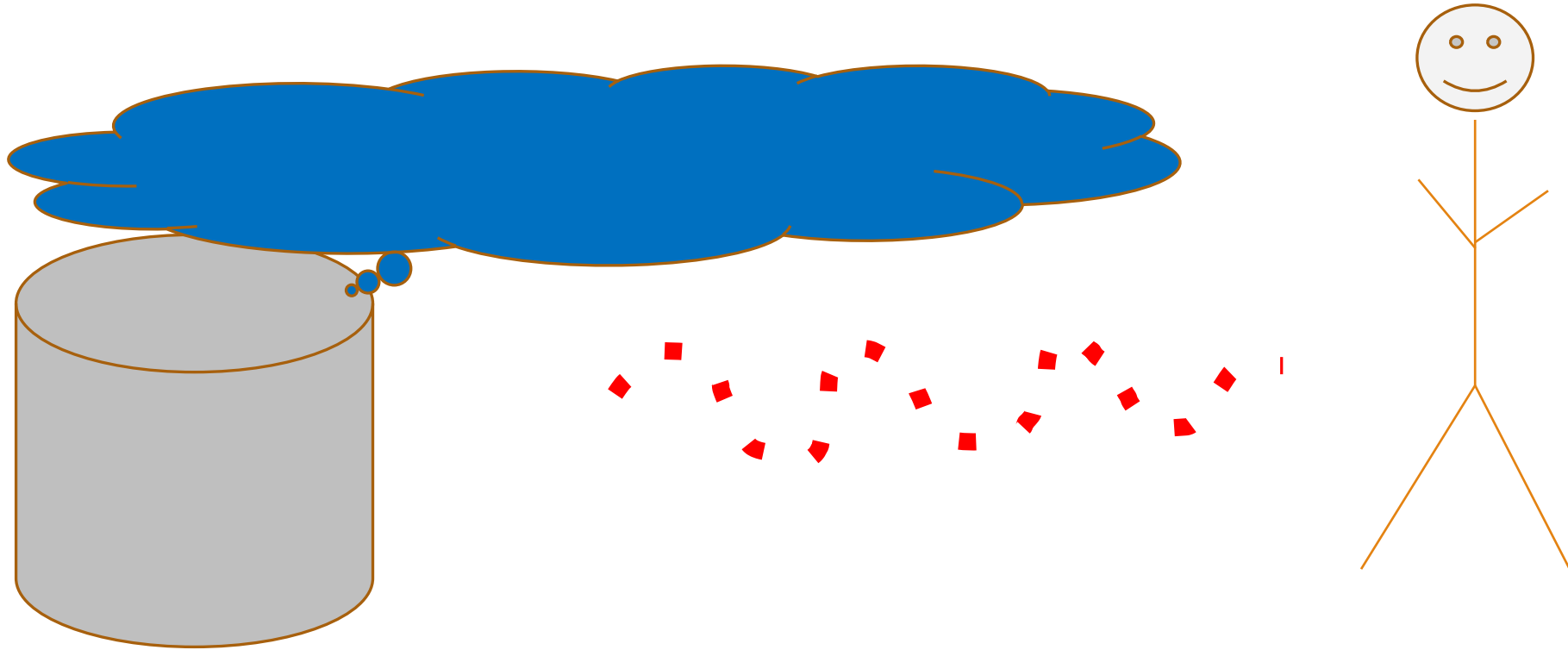
Dilution

**Administrative**



# Administrative

Must be part of any other control method

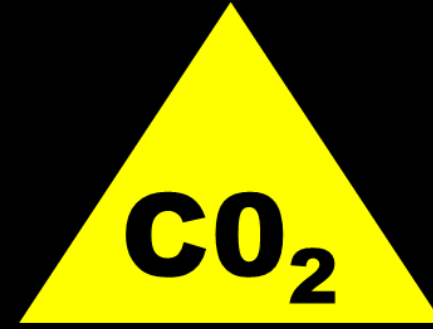


# Administrative

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- Policy, SOP
- Manual ventilation
- Job rotation or Work / Rest Cycles
- EAP – Emergency Action Plan
- Education
- PM needed for equipment, detection, ventilation, evacuation systems

# WARNING



green

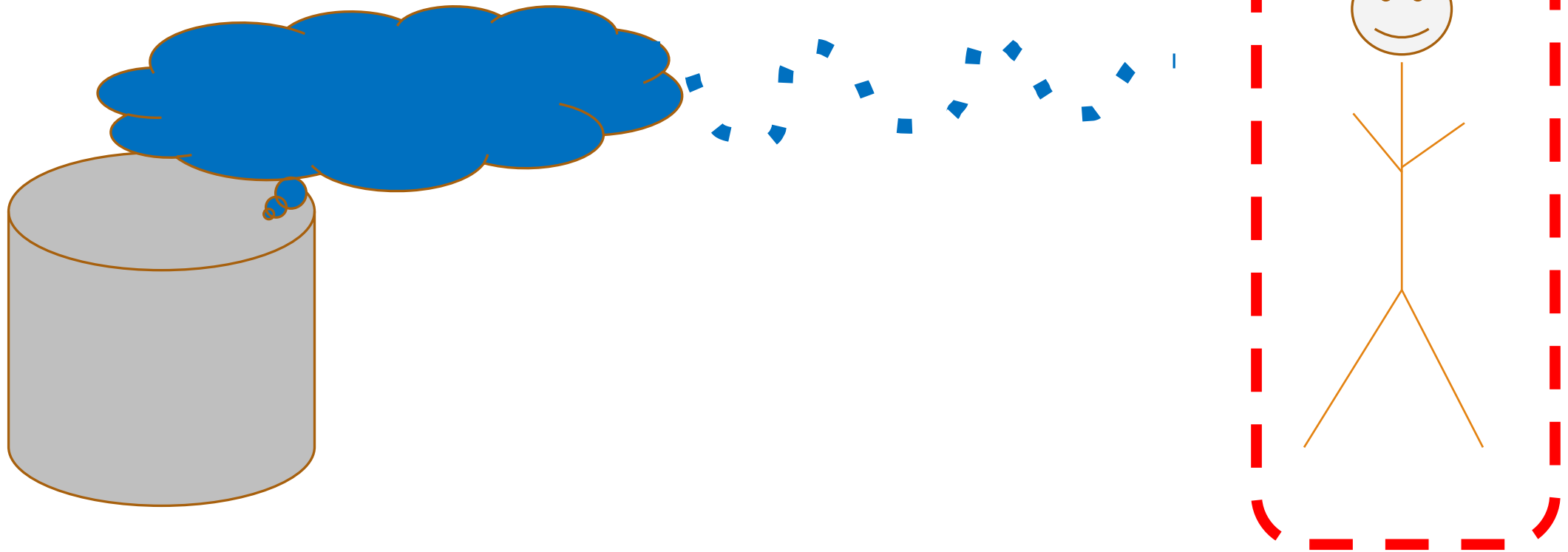
light

light

Do not enter

# PPE – Personal Protective Equipment

Least effective of any Control



# PPE



- No “real” PPE for CO<sub>2</sub>
- Least effective of any Control

“WARNING! A half-mask or full-face air-purifying (or cartridge) respirator can not be used in an oxygen deficient environment nor can they protect against carbon dioxide asphyxiation.” *NIOSH*





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anticipate and recognize the  
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various brewery operations,  
recognize that hazard and apply  
practical methods of control that  
manage that hazard that  
can be employed in breweries of  
all sizes.

# Questions



? ? ? ? ? ?  
Q & Ale  
? ? ? ? ?  
? ? ? ? ?

# What should I do when I get back to the brewery?

## What should I do when I leave here?"

- Talk about it
- CO<sub>2</sub> Management
- “Yet” it is a journey



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