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Confined Spaces – Where are they found?

Introduction

Confined spaces, as well as injuries and fatalities that occur within them, are not limited to one or two industries, but occur across almost all industries and workplaces – from agriculture to food and beverage, petrochemicals to construction and maintenance, water treatment and sewers to transportation and shipping.

Although you may automatically think of an oil refinery or a construction site when thinking of confined spaces, they may also exist – depending upon your national regulations – within your office building, local hospital, school, college, university, shopping centre, even within on street and in your home. If the space if partially or fully enclosed and may contain a hazard or some work within it creates a hazard to your health or safety, then the space may be classed as a confined space.

Some industrial sites typically have a high number of confined spaces, where entries cannot be avoided and need to be undertaken on regular basis. The following is not an exhaustive list of industries nor an exhaustive list of examples from within those industries highlighted.

Always ensure that whoever evaluates your site and confined spaces is competent to do so. If you need training, 3M can help you get the knowledge you need. If you are planning a confined space entry, then always ensure that you have a safe system of work in place – see our handy guides for more help

www.3m.co.uk/ConfinedSpace-Planning



Confined Spaces – Where are they found?

Pharmaceutical manufacturing

Overview

The pharmaceutical and biotech industries are diverse and complicated. The range of possible confined spaces is also extensive: from storage rooms to reactor vessels – the complexity of confined spaces also varies. Pharmaceutical manufacturing makes use of toxic and inert gases (particularly nitrogen resulting in oxygen deficient atmospheres), extremes of temperature, mechanical equipment, all often in confined spaces. The raw materials and finished pharmaceutical products can also have a range of health effects, with a need to reduce worker exposures as low as reasonably practicable - whether in production or during a period of Maintenance, Repair and Operations (MRO).

Due to the use of nitrogen in many of these areas, detection of oxygen depletion is particularly important.

Example confined spaces

- > Active Pharmaceutical Ingredient (API) production: Reactor vessels
- > Biotech:

Process systems, fermentation vessels and purification systems

> Proportioning:

Containment rooms, HVAC systems

> Mixing & Granulation:

Large sifters, granulators and blending equipment

> Liquid processes:

Storage and mixing tanks, filter presses

> Tablet and pellet coating:

Mixing and coating drums



Granulator

Who enters	Employees of the host employer
Tasks performed	 Clean down, inspection Non-routine tasks during cleaning, repair, maintenance of equipment
Frequency of entrance	Variable – weekly to annual, depends upon the task, confined space and its use
Complexity	Complex
Number of spaces	Single – many
Common vs Industry specific variation	Industry specific
Example Configuration Hazards	 Slips, trips and falls around and within the confined space Working at height to access the confined space Narrow entrances Angled entrances (particularly on the top of reactor vessels) Side entrances with then vertical access Vertical access into a vessel with no ladder Requirements to minimize possible damage to surfaces (ropes may be preferred to metal lines) Minimisation of foreign objects entering the confined space and/or being dropped within the space
Example Biological and Chemical Hazards	 Infectious agents, particularly in the biotech industries (vaccines, blood products, etc.) Active pharmaceutical ingredients Exposure particulates, gases and vapours that can cause acute/chronic systemic, respiratory, dermal or gastrointestinal health effects.
Example Atmospheric Hazards	Toxic atmospheres: Ammonia, Hydrogen chloride, Hydrogen sulfide, Ethanol, Chlorine, Freon, Nitric Oxide, Nitrogen dioxide Asphyxiant atmospheres: Oxygen deficiency, Carbon dioxide, Sulfur dioxide Flammable / explosive atmospheres: Volatile organic compounds, Oxygen enrichment, Hydrogen, Methane, Hydrogen sulfide, Ethanol, Nitric Oxide, explosive dusts
Example Physical Hazards	 Electricity Mechanical equipment Radiation Hot surfaces Being struck by objects

- Temperature Extremes
- Fluid or air pressure
- Slips, trips and falls
- Noise

References

https://gasdetection.3m.com/en/gas-detection-pharmaceutical (article accessed 22nd February 2019)

ILO Encyclopaedia of Occupational Health & Safety - Pharmaceutical Industry. Tait. K., http://www.iloencyclopaedia.org/part-xii/pharmaceutical-industry/ item/385-pharmaceutical-industry#PHC_fig1 (article published 25th February 2011, article accessed 22nd February 2019)

Chemical manufacturing

Overview

Chemical manufacturing covers many disciplines and end products, along with many different raw materials and processes. The size and scale of the chemical industry is highly variable – from massive chemical parks manufacturing products by the ship-load to small batch quantities. The overall industry can be roughly split into several different sub-sects:

- Petrochemical Industry
- Polymer Industry
- Inorganic Chemical Industry
- Fertiliser Industry
- Specialty Chemical Industry
- Fine Chemical Industry
- Consumer Products
- Pharmaceutical and Life sciences

Although the industry is highly diverse, there is some commonality in terms of the likely hazards and the types of confined spaces that may be entered.

Example confined spaces

- > Storage tanks and silos
- > Columns
- > Reactor vessels
- > Furnaces, boilers, flues, towers and stacks
- > Pipework
- > Filtration units



Who enters	Employees of the host employerSpecialist contractors
Frequency of entrance Complexity	 Cleaning and removal of blockages within process plant Replacement of catalysts MRO turnarounds – annual periods of maintenance or repair during a period of plant shut-down. Other none routine tasks are also completed, for example modifications (revamp or renewal) and cleaning. MRO turnarounds are often time-limited and expensive due to plant being taken offline, resulting in significant pressure to get the tasks completed on time. External contractors specializing in MRO turnarounds, including confined space entry, are often employed. Turnarounds can present significant management challenges. Typically, annual unless an urgent repair is required Complex
Number of spaces	Single – many
Common vs Industry specific variation	Industry specific
Example Configuration Hazards	 Slips, trips and falls around and within the confined space Working at height to access the confined space, for example on a column, tank or silo Narrow entrances Angled entrances (particularly on the top of
	 Angled entrances (particularly on the top of reactor vessels) Side entrances into storage tanks, with then vertical access Vertical access into a vessel with no ladder
Example Biological and Chemical Hazards	 Exposure particulates, gases and vapours that can cause acute/chronic systemic, respiratory, dermal or gastrointestinal health effects.
Example Atmospheric Hazards	 Toxic atmospheres: Ammonia, Hydrogen chloride, Hydrogen sulfide, Ethylene oxide, Chlorine, Nitric oxide, Carbon monoxide, Nitrogen dioxide Asphyxiant atmospheres: Oxygen deficiency, Carbon dioxide, Sulfur dioxide, Inert gases (used extensively throughout the various chemical industries) Flammable / explosive atmospheres: Volatile organic compounds, Oxygen enrichment, Hydrogen, Methane, Hydrogen sulfide, explosive dusts
Example Physical Hazards References	 Electricity Mechanical equipment, e.g. agitators and stirrers Radiation Hot surfaces Being struck by objects Temperature Extremes Fluid or air pressure Slips, trips and falls Noise

(article accessed 22nd February 2019)

ILO Encyclopaedia of Occupational Health & Safety – Chemical Industry. De Boer. L., http://www.iloencyclopaedia.org/part-xii-57503/chemical-processing (article published 26th February 2011, article accessed 25th February 2019)

Confined Spaces – Where are they found?

Food and beverage manufacturing

Overview

The food and beverage industry contains many similar confined spaces, however the industry can be divided into many different sub-groups, each has its own health and safety challenges and in some cases unique confined space hazards. In many cases though, confined spaces can be found in the storage of bulk liquid or solid raw materials or finished products, within process equipment (mixers, fermentation, ovens) or in refrigerated storage rooms.

- Meat, poultry and fish
- Milling, animal feeds
- Bakery products
- Dairy products
- Fruit and vegetables
- Confectionery
- Chilled and frozen foods
- Sugar processing and refining
- Corn milling and ethanol
- Oil and fat processing
- Supply chain
- Fruit juices
- Bottling and canning
- · Coffee and tea
- Brewing, fermentation and distilling

Example confined spaces

- > Mixing tanks
- > Fermentation vats in brewing and wine making
- > Fermenters and stills in the distilled drinks industry
- > Ovens
- > Boilers
- > Storage tanks
- > Grain bins and silos
- > Sewer pits
- > Machine pits / spaces around machinery
- > Water treatment vessels

Who enters	 Employees of the host employer Specialist contractors / maintenance engineers
Tasks performed Frequency of	 Cleaning Clearing blockages Maintenance and repair Weekly or monthly
entrance	weekly of monthly
Complexity	Simple
Number of spaces	Single
Common vs Industry specific variation	Industry specific
Example Configuration Hazards	 Slips, trips and falls around and within the confined space Working at height to access the confined space, for example on a column, tank or silo Narrow entrances Angled entrances (particularly on the top of reactor vessels) Side entrances into storage tanks, with then vertical access Vertical access into a vessel with no ladder
Example	Exposure particulates, gases and vapours

Biological and Chemical Hazards

- Exposure particulates, gases and vapours that can cause acute/chronic systemic, respiratory, dermal or gastrointestinal health effects, particularly cleaning and disinfection chemicals
- Exposure to moulds and bacteria on grain and other crops
- Exposure to animals, urine, feaces, mites/ ticks, blood products, animal carcasses, decomposing materials, infectious microorganisms, vermin

Example Atmospheric Hazards

- Toxic atmospheres: Ammonia, Hydrogen chloride, Hydrogen sulfide, Chlorine, Ethanol, Carbon monoxide, Nitrogen dioxide, Phosphoric acid, Hydrogen peroxide
- Asphyxiant atmospheres: Oxygen deficiency, Carbon dioxide, Sulfur dioxide, Inert gases (used extensively throughout the various chemical industries)
- Flammable / explosive atmospheres:
 Volatile organic compounds, Oxygen enrichment, Hydrogen, Methane, Hydrogen sulfide, explosive dusts

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Example Physical Hazards

- Engulfment in flowing solids such as grain
- Drowning in liquids
- Electricity
- Mechanical equipment
- Radiation
- Hot surfaces
- Being struck by objects
- Temperature Extremes
- Fluid or air pressure
- Slips, trips and falls
- Noise

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Confined Spaces – Where are they found?

Oil and gas

Overview

The oil and gas (petroleum) industry can be divided roughly into two or three sections:

- **Upstream** exploration, extraction and production of crude oil and natural gas
- Midstream (sometimes included in downstream category) transportation of crude oil and natural gas, storage
- Downstream refining of petroleum crude oil, processing and purification of natural gas, sales and marketing of finished products.

Confined spaces hazards within this industry typically are orientated around the production (cracking, distillation, refinement), transportation and storage of petroleum products, by-products and waste.

Example confined spaces

- > Pipelines
- > Storage and transportation tanks
- > Coke (by-product) storage silos
- > Distillation towers
- > Reactor vessels
- > Alkylation units
- > Furnaces, boilers, flues, towers and stacks
- > Filtration units
- > Water treatment vessels



References

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ILO Encyclopaedia of Occupational Health & Safety – Oil and Natural Gas. Kraus. R.S., http://www.iloencyclopaedia.org/part-xii-57503/oil-and-natural-gas (article published 26th February 2011, article accessed 25th February 2019)

Who enters Employees of the host employer Specialist contractors Tasks performed Cleaning and removal of blockages within process plant Replacement of catalysts in catalytic cracking or alkylation units MRO turnarounds - annual periods of maintenance or repair during a period of plant shut-down. Other none routine tasks are also completed, for example modifications (revamp or renewal) and cleaning. MRO turnarounds are often time-limited and expensive due to plant being taken offline, resulting in significant pressure to get the tasks completed on time. External contractors specializing in MRO turnarounds, including confined space entry, are often employed. Turnarounds can present significant management challenges. Frequency of Typically, annual unless an urgent repair is entrance required Complexity Complex **Number of spaces** Single - many Industry specific Common vs **Industry specific** variation Example Slips, trips and falls around and within the Configuration confined space Hazards Working at height to access the confined space, for example on a column, tank or silo Narrow entrances Angled entrances (particularly on the top of reactor vessels) Side entrances into storage tanks, with then vertical access Vertical access into a vessel with no ladder Example Exposure particulates, gases and vapours Biological and that can cause acute/chronic systemic, **Chemical Hazards** respiratory, dermal or gastrointestinal health effects. Acid catalysts used in some petrochemical processes Welding fume Mercury Example Toxic atmospheres: Ammonia, Hydrogen Atmospheric chloride, Hydrogen sulfide, Ethylene oxide, Hazards Chlorine, Nitric Oxide, Carbon monoxide, Nitrogen dioxide Asphyxiant atmospheres: Oxygen deficiency, Carbon dioxide, Sulfur dioxide, Inert gases (used extensively throughout the various petrrochemical processes) Flammable / explosive atmospheres: Volatile organic compounds, Oxygen enrichment, Hydrogen, Natural gas and other combustible gases, Hydrogen sulfide, explosive dusts **Example Physical Flectricity** Hazards Mechanical equipment, e.g. agitators and stirrers Radiation Hot surfaces Being struck by objects **Temperature Extremes** Fluid or air pressure Slips, trips and falls Noise

Water and Waste water treatment

Overview

Water treatment plants use a range of processes to remove solid, liquid and gaseous contaminants from water, including sedimentation, coagulation, flocculation, aeration, disinfection, filtration and sludge treatment.

There are a range of hazards within these process steps, including physical, microbial and chemical.

Within a water treatment facility there will be a diverse range of confined spaces that are underground, below grade vaults, manholes and sedimentation tanks. Within these spaces there are risks of oxygen deficiency, toxic atmospheres, engulfment/drowning risks and mechanical hazards from pumping / stirring equipment. Oxygen is consumed by some processes or may be displaced by toxic/asphyxiant/explosive gases such as methane and hydrogen sulphide which are created by organic decomposition.

Microbiological hazards exist throughout the waste water treatment processes, as well as chemical hazards from the various process steps.

Example confined spaces

- > Manholes
- > Sedimentation tanks
- > Aerators
- > Chlorinators
- > Enclosed filtration units
- > Pite
- > Sumps
- > Separator units
- > Incinerators



References

https://gasdetection.3m.com/en/gas-detection-petrochemical (article accessed 22nd February 2019)

Repair and maintenance workers Who enters Tasks performed Cleaning and removal of blockages within process plant Replacement of catalysts in catalytic cracking or alkylation units MRO turnarounds - annual periods of maintenance or repair during a period of plant shut-down. Other none routine tasks are also completed, for example modifications (revamp or renewal) and cleaning. MRO turnarounds are often time-limited and expensive due to plant being taken offline, resulting in significant pressure to get the tasks completed on time. External contractors specializing in MRO turnarounds, including confined space entry, are often employed. Turnarounds can present significant management challenges. Frequency of Daily entrance Moderate Complexity **Number of spaces** Few Common vs **Industry Specific Industry specific** variation Example Slips, trips and falls around and within the Configuration confined space Hazards Working at height to access the confined space, for example on a column, tank or silo Access into tanks from walkways, catwalks and over concrete walls Narrow entrances Angled entrances Side entrances into storage tanks, with then vertical access Vertical access into a vessel with no ladder Example Exposure particulates, gases and vapours Biological and that can cause acute/chronic systemic, **Chemical Hazards** respiratory, dermal or gastrointestinal health effects. Exposure to decomposing organic materials, human and animal waste Vermin Example Toxic atmospheres: Ammonia, Hydrogen Atmospheric sulfide, Chlorine, Hydrogen cyanide, Hazards Carbon monoxide, Nitrogen dioxide, Ozone Asphyxiant atmospheres: Oxygen deficiency, Carbon dioxide, Sulfur dioxide, Flammable / explosive atmospheres: Volatile organic compounds, Oxygen enrichment, Hydrogen, Natural gas and other combustible gases, Hydrogen sulfide, explosive dusts **Example Physical** Drowning in water and other liquid effluents Hazards Electricity Mechanical equipment, e.g. agitators and stirrers Radiation Hot surfaces Being struck by objects **Temperature Extremes** Fluid or air pressure Slips, trips and falls

Noise



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