< Chemical process improvement>

Introduction to Cleaning

IAMC Toolkit

Innovative approaches for the Sound Management of Chemicals and Chemical Waste

Introduction

Every manufacturer or industrial user of chemicals performs cleaning operations, whether cleaning of equipment (e.g. chemical manufacturers) or cleaning of products (e.g. industrial users). Cleaning operations are typically not value-adding processes and are a significant source of waste, downtime, pollution and costs.

This presentations provides a quick overview of the purposes of cleaning operations and the most important cleaning techniques.

Contents

1. Definition of cleaning
2. Motivation for improving cleaning operations
3. Purposes of cleaning
4. Cleaning techniques
5. Learning objectives

Definition of Cleaning

Cleaning techniques …

- …cover a wide range of activities from good housekeeping to high-quality product applications
- …are applied to chemical processing equipment (e.g. pipes and reactors) and manufactured products (e.g. metal parts)
- …can involve chemical product recovery from processing equipment
- …are an important part of operations for manufacturers and users of chemicals
- …do not typically add value to a company's operations

SMEs often waste resources (time, material, labour) on cleaning operations resulting in reduced equipment uptime and lower operational productivity.

Motivation for Improving Cleaning Operations

- Increasing costs for raw materials, manufacturing processes and waste disposal
- Customers place smaller orders more frequently and demand higher product quality
- Many products tend to produce sediments which cause malfunction

Purposes of Cleaning

Why is cleaning necessary?

- Preventing cross-contamination
- Removing degraded product and improving quality standards
- Improving heating or cooling transfer
- Achieving regulatory standards of cleanliness
- Complying with environmental regulations
- Removing unwanted biological growths
- Good housekeeping

Cleaning reactor outside

Source : Lenntech

Cleaning Techniques (1)

Techniques classified according to mechanism:

Chemical	Mechanical	Hydrodynamic
- Solvents (spray or vapour) - Chemical solutions - Scalding - Steaming - Flushing by circulation - Ultrasonic	- Brushes - Pigging - Drilling - Scraping - Abrasive blasting (standard grit or soluble sodium bicarbonate) - Ice crystals	* - Low-pressure water (2-50 bar) * - Medium-pressure water (50-250 bar) - High-pressure, cold water (250-1,200 bar)

* With or without chemical additives using hot or cold water.

Cleaning Techniques (2)

Techniques classified according to place:

CIP

Clean-in-place

For interior surfaces of tanks and pipelines of liquid process equipment

A chemical solution is circulated from a central reservoir through tanks and/or lines, then reused.

COP

Clean-out-of-place

For parts of equipment which require disassembly for proper cleaning

Parts are placed in a circulation tank and cleaned using a heated chemical solution and agitation.

Learning Objectives

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Can you explain why cleaning processes are necessary?

- Preventing cross contamination
- Removing degraded product and improving quality standards
- Improving heating or cooling transfer
- Achieving regulatory standards of cleanliness
- Complying with environmental regulations
- Removing unwanted biological growths
- Good housekeeping

Learning Objectives

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Can you explain the difference between CIP and COP?

- CIP: Clean-in-place
  - For interior surfaces of tanks and pipelines of liquid process equipment
  - A chemical solution is circulated from a central reservoir through tanks and/or lines, then reused.
- COP: Clean-out-of-place
  - For parts of equipment which require disassembly for proper cleaning
  - Parts are placed in a circulation tank and cleaned using a heated chemical solution and agitation.

Sources

Sources

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- Harrington J., Industrial Cleaning Technology, Kluwer Academic Publishers, 2001.

Images

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