Treatment Technologies in Hazardous Waste Management (Chapter 44)

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Federal Environmental Regulatory Overview

TREATMENT TECHNOLOGIES

- Introduction
- Review Types of Wastes
- Overview of Treatment Technologies
  - Filtration
  - Neutralization
  - Chemical Precipitation
  - Reduction and Oxidation
  - Biological Treatment
  - Thermal Treatment Processes
  - Chemical Fixation and Solidification
  - Other Physical/Chemical

INTRODUCTION

- Generators and Treatment, Storage & Disposal Facilities (TSDF)
  - Licensing - RCRA, TSCA
  - Permitting - CWA Categorical Industry
  - Local Limits - MMSD Chapter 11
  - Remediation - CERCLA or Similar Cleanup
  - Improve Process/Reduce/Recycle
- Physical Treatment
- Chemical Treatment

INTRODUCTION

- Factors
  - Nature of Waste Stream(s)
  - Process Effectiveness
  - Dependability
  - Health and Safety
  - Economics
  - Flexibility
  - Public Exposure - Air, Water, Land Disposal
  - Future Regulation

REVIEW OF TYPES OF WASTES

- Characteristic
  - Ignitability (D001) - f.p. <140^{o}F
  - Corrosivity (D002) - pH <2 or >12.5
  - Reactivity (D003) Reacts Violently w/H_2O
  - Toxicity (D004 - D043) TCLP Concentrations

REVIEW OF TYPES OF WASTES (cont.)

- Listed
  - Non-Specific Source (F)
  - Specific Source (K)
  - Acute (P)
  - Toxic (U)
- Mixtures - Listed w/Non-Haz
- Declared by Generator

FILTRATION

- Process Description - Porous medium subjected to pressure gradient such as gravity or pumping
- Applications
  - Remove Particulates
  - Polishing Step
  - Molecular Separation - UF, RO
  - Limitations

FILTRATION (cont.)

- Example Treatment
  - Cartridge
  - Sand / Dual with Carbon
  - Advancing Media
  - Vacuum Filter
  - Membrane Technology

NEUTRALIZATION (pH ADJUSTMENT)

- Process Description - Reaction Between Acid and Base
  - Acids dissociates in solution to produce a proton (H+)
  - Bases accept a proton

    $HNO_3 + Na\ OH \rightarrow NaNO_3 + H_2O + heat$
  - Titration Curve
- Applications
  - Discharge Limits - pH 6-9
  - Metals Precipitation/Solubility
  - Chrome Reduction

NEUTRALIZATION (pH ADJUSTMENT) (cont.)

- Example Treatment
  - Reaction tanks with mixing of reagent
  - Sulfuric acid - raise pH
  - Sodium hydroxide - lower pH

CHEMICAL PRECIPITATION

- Process Description - Chemical reaction to change soluble to insoluble form. Solids separated by settling and/or filtration
- Applications
  - Hydroxide Precipitation for Metals

    $M^{+2} + 2(OH^-) \rightarrow M(OH_2)\downarrow$
  - Chelated Wastes
  - Other

CHEMICAL PRECIPITATION (cont.)

- Example Treatment
  - Batch System
  - Continuous System

REDUCTION AND OXIDATION (REDOX)

- Process Description
  - LEO the Lion Goes GER
  - Pretreatment step followed by precipitation or fixation
  - ORP Control
- Applications
  - Cyanide Destruction w/Alkaline Chlorination
  - Chrome Reduction - Hexavalent (+6) to Trivalent (+3)
  - Phenols

REDUCTION AND OXIDATION (REDOX) (cont.)

- Example Treatment
  - Redox Reaction Systems
  - Hydrogen Peroxide
  - Ozone/UV

BIOLOGICAL TREATMENT

- Process Description - Bacteria breakdown and detoxification of organic materials, measured as Biological Oxygen Demand (BOD)
  - Aerobic (use of oxygen)
  - Anaerobic (absence of oxygen)
- Applications
  - POTWs - Domestic, storm water, industrial
  - Pulp and Paper
  - Food Processing - Dairy, Brewing, Candy
  - Hydrocarbon and other organic compounds

BIOLOGICAL TREATMENT (cont.)

- Example Treatment
  - Activated Sludge
  - Lagoons
  - Trickling Filters
  - Anaerobic Digestion

THERMAL TREATMENT PROCESSES

- Process Description - Thermal decomposition by oxidation to primarily reduce carbonaceous matter
  - Products are CO_2, H_2O, ash, heat
  - Waste delivery, combustion, gas scrubbing, ash, energy recovery
- Applications
  - VOCs
  - Hydrocarbons
  - PCBs
  - Pesticides, Herbicides

THERMAL TREATMENT PROCESSES (cont.)

- Example Treatment
  - Multiple Hearth
  - Fluidized Bed
  - Liquid Incinerators
  - Kilns
  - Industrial Boilers

OTHER PHYSICAL / CHEMICAL

- Air Stripping (BAB)
- Oil/Water Separation
- Settling
- Dissolved Air Flotation
- Multiple Unit Processes