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TYPES OF INDUSTRIAL WASTE AND HOW THEY CAN IMPACT A TREATMENT PLANT
Types of Industrial Waste

- Airport Deicing
- Breweries
- Electroplating
- Fruits and Vegetable Processing
- Semiconductor
- Metal Finishing
- Transportation Equipment
- Dairy Products Processing
Effects on Collection System

Hydraulic Loading
pH
Blockages
Odors
Flammables
Inhalation Hazards /
Toxic Fumes
Corrosion
Reactive
Hydraulic Capacity

Large slug wastewater or continuous flow
- sewer backup or pump station overflow
- process disruptions at treatment plant

Flow equalization
Flow monitoring
Slug discharge or flow control plan

<table>
<thead>
<tr>
<th>Industries of Concern</th>
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<tbody>
<tr>
<td>Dairy Products Processing</td>
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<tr>
<td>Meat &amp; Poultry Products</td>
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<tr>
<td>Transportation Equipment Cleaning</td>
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<tr>
<td>Fruits &amp; Vegetable Processing</td>
</tr>
</tbody>
</table>

Source: Industrial Waste Treatment Volume I, Office of Water Programs CSU Sacramento
**pH**

Acidic or alkaline wastewater - corrosion of sewer pipes and facilities

Typical limits 5.5 - 10 on standard units scale (0 - 14)

- pH neutralization equipment
- Equalization
- Slug discharge control plans

### Industries of Concern

<table>
<thead>
<tr>
<th>Industries of Concern</th>
<th>Most Common Chemicals Used</th>
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<tr>
<td>Dairy Products Processing</td>
<td>Sodium Hydroxide</td>
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<td>Meat &amp; Poultry Products</td>
<td>Hydrochloric Acid</td>
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<td>Transportation Equipment Cleaning</td>
<td>Sulfuric Acid</td>
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<td>Soap &amp; Detergent Manufacturing</td>
<td>Potassium Hydroxide</td>
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<td>Fruits &amp; Vegetable Processing</td>
<td>Sodium Hypochlorite</td>
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<td>Centralized Waste Treatment</td>
<td>Citric Acid</td>
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</tbody>
</table>

Source: Industrial Waste Treatment Volume I, Office of Water Programs CSU Sacramento
Blockages

Fibrous or stringy materials
Heavy solids
Floatable solids
FOG

Drain traps
Grease traps & interceptors
Dissolved Air Flotation
Precipitation / Clarifiers /
Filter Presses

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<td>Detention Centers (Jails)</td>
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<td>Breweries</td>
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<td>Meat Poultry Products</td>
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<td>Restaurants</td>
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<td>Dairy Products Processing</td>
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<td>Fruits &amp; Vegetable Processing</td>
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</tbody>
</table>
Flammables

Petroleum fuels
Plant based fuels / alcohols
Organic solvents
H2S

Storage / containment
Solvent Mgmt Plans
LEL gas sensors
Toxic Fumes

Toxic organic solvents
H2S
Cyanide
Chlorine
Phosgene
Arsine / Phospine

Solvent Mgmt Plans
Lab Mgmt Plans
Toxic Fumes

Phosgene
  COCl₂
  Produced UV, O₂, chloromethanes
  Disrupts blood-oxygen barrier in lungs
    - Suffocation
  Odor threshold 0.4 ppm, 4X TLV

Hydrogen Cyanide
  Colorless
  Flammable
  Extremely poisonous - binds to Fe in blood and
  Inhibits cellular respiration
Reactive

Sodium azide
Hydrogen-producing reactions
H2S-producing reactions
Phosgene-productions reactions
Solvent mgmt plans
Lab mgmt plans
Effects on Treatment Plant Processes

- Hydraulic Loading
- pH
- Blockages
- Odors
- Flammables
- Inhalation Hazards / Toxic Fumes
- Corrosion
- Reactive Metals
- Dyes / Photoresist
- Dissolved solids
- Metals
Hydraulic Loading

Large slug wastewater or continuous flow
Decrease efficiency of treatment processes
Increase solids carryover
Unit processes such as neutralization, sedimentation, and biological treatment operate best at a constant flow rate
  Flow equalization
  Flow monitoring
Slug discharge or flow control plan

Source: Industrial Waste Treatment Volume I, Office of Water Programs CSU Sacramento
pH

Acidic wastewater
  Increased H2S production and odor
  Increased suspended solids from secondary clarifier such
  Decreased COD removal

Typical limits 5.5 - 10 on standard units scale (0 - 14)
  pH neutralization equipment
  Equalization
  Slug discharge control plans

Source: Industrial Waste Treatment Volume I, Office of Water Programs CSU Sacramento
Odors

H2S - sulfur bearing compounds
Amines - nitrogen bearing compounds
Putrescibles
Flammables

Petroleum fuels
Plant based fuels / alcohols
Organic solvents
H2S

LEL gas sensors
Toxic Fumes

Toxic organic solvents
H2S
Cyanide
Chlorine
Phosgene
Arsine / Phospine
A Word About Phosphine . . .
Metals - Zinc

Essential for life of organisms
Excess - toxicity *anti-microbial*
Balance of binding with proteins & essential for numerous cellular functions - viability
Intoxication - disrupts balance of functions especially oxidative stress and ability to take up carbon
Metals - Copper

Essential for life of organisms
Excess - toxicity *anti-microbial*
   *Oligodynamic effect*
Balance of binding with proteins & essential for numerous cellular functions - viability
Intoxication - disrupts balance of functions - promotes development of oxygen reactive compounds
Drinking water - 1.3 mg/L EPA Standard
Organic ligand vs. metallic
Metals - Copper

Essential for life of aquatic life

Excess . . .
Acute - mortality
Chronic - survival, growth and reproduction
(Brain function, metabolism, enzyme activity, blood chemistry)
Metals - Cadmium

Catalyst in forming reactive oxygen compounds

Exposure:
- Uptake in plants from soils
- Cigarette smoke
- Workplace inhalation

Low limits for Biosolids application

Batteries, pigments, plastic stabilizers, platings, photovoltaics

Buildup in kidneys - renal failures
Metals - Chromium

Inhibits respiratory activity and cellular growth - activated sludge
Inhibition of nitrification process Cr+6
Higher concentrations
Cr+6 crosses membrane into cell & forms Cr+3
Lead

7-day toxicity much greater than 24-hour
Particularly degrading to nitrification
OUR responds quickly to addition of Pb

Developing nervous systems - children
Wide range neurological effects
Renal effects and gout
Interferes and inhibits enzymatic and hormonal conversions e.g. Vitamin D
Mercury

May inhibit cellular growth
Accumulates in aquatic food chain - methylated form
Treatment plants removed 90% of Hg

Ingestion of metallic mercury - typically 0.01% absorbed into body. For organic mercury, 95%
Inhalation of vapors - 80%
Nickel

Inhibits respiratory activity and cellular growth – activated sludge
Inhibition of nitrification process

Carcinogen (Ni compounds)
Dermatitis
Effects on Plant Effluent / Receiving Waters

Bioaccumulation in aquatic life & food chain
Hormonal disruptions
Fish behavioral disruptions
Anaerobic Digestion

Anaerobic systems have a narrower spectrum of life forms and are more sensitive to heavy metals.
Microbeads

Tiny bits of plastic - soaps, cosmetics
Can adsorb toxic compounds
Ingested by fish

Microbead-Free Waters Act Of 2015

2017!
Total Dissolved Solids

Minerals, salts, anions, cations, metals dissolved in water
Typ. Magnesium, sodium, potassium, borates, chlorides, calcium, carbonates, sulfate

Affects to Whole Effluent Toxicity tests

General ROT: 1,500 mg/L or higher

Varies - hardness, composite of TDS, species tested
Dyes / Photoresist

Affects transmittance of UV light in water for disinfection
A Word on Perfluorinated Compounds

PFAS – perfluoroalkyl substances
PFOA – perfluorooctanoic acid
PFOS – perfluorooctane sulfonate
Bioaccumulative, persistent
Possible growth inhibition, mortality

Water and stain resistant materials
Keep food from sticking to packaging
A Word on Nonylphenols . . .

Highly toxic to fish, aquatic invertebrates, plants
As low as 0.12 mg/L
Industrial laundries
Textile & paper coatings
Adhesives
Degreasers
Deicers

Encourage uses of other alkylphenols
A Word on Sodium Azide . . .

NaN$_3$

Biocide in hospitals

Similar to CO – attaching to hemoglobin

Reactive – acids
Dry & Wet Strength

Tensile strength (N/m)

- LQ TP: 248, 4
- HQ TP: 371, 6
- HT: 503, 73
- MTP: 265, 149
- TW: 494, 212
- BW: 266, 257
Slosh Box – Reynold’s # Correlation

\[ \text{Re} = \frac{R_h V \rho}{\mu} \]

Ratio of inertia force, and viscous (friction) force
# 20,000

8” sewer lines
2 fps
0.0022 slope
South Interceptor 1.5 fps 32 min (2,816 ft)