# HISTORY OF WASTEWATER TREATMENT IN THE US

1800's

US population grew from 5 million to 75 million

**PRIMARY DEVELOPMENT**: COLLECTION SYSTEMS

**PRIMARY PURPOSE**: DISEASE PREVENTION

Pit privies and open ditches replaced by buried sewers: sewered population increased from 1 million in 1860 to 25 million by 1900.

"Treatment" was mostly dilution into receiving waters

EARLY MANAGEMENT PRACTICES

**TRENDS**: awareness and control of impacts of sewage discharge on receiving waters through standards, regulation, and simple treatment (probably now called "primary")

1887, first biological treatment, an intermittent sand filter, was installed in Medford, Mass.

1886, Standards for discharge loading and treatment developed at Lawrence, Mass experiment station and for Chicago, IL (Rudolph Hering)

1899, first federal regulation of sewage, Rivers and Harbors Appropriations ("Refuse Act") prohibited discharge of solids to navigational waters without permit from US Army Corps of Engineers

1900's

Early 1900s, 1 million people served by 60 sewage treatment plants for removal of settling and floating solids.

**TREND:** population growth and sewer construction

1900-1930s, sewered population increased at ~ same rate as total population

**TREND**: development of secondary (biological treatment)

1901: first trickling filter operated in Madison, WI

1909, first Imhoff tank (solids settling)

1914, first liquid chlorination process for effluent disinfection

1916, first activated sludge plant, San Marcos, TX

**TREND**: PROTECTION OF RECEIVING WATER QUALITY

1920 – 1940's:

Wastewater treatment linked with importance of dissolved oxygen to aquatic life, aesthetic properties of surface waters (odor, color, solids), measurement of organic matter in sewage as biological oxygen demand (BOD)

- 1944 Steeter Phelps DO sag curve model for streams to predict BOD assimilation capacity
- Secondary treatment processes to remove BOD

Increased wastewater treatment meant increased residuals (sludge). Heated sludge digesters and use of gas. 1921: mechanical dewatering of sludge in vacuum filters and centrifuges, Milwaukee, WI. Early 1930's: sludge drying and incineration in Chicago.

**TREND:** NEW REGULATION AND GOVERNMENT GRANTS

1948: Federal Water Pollution Control Act. Primarily for provision of federal funds for water quality surveys and construction of collection and treatment plants.

1952: extension of FWPCA funding. 1966 (Clean Water Restoration Act) extended federal grants for plant construction.

**1960 MILESTONE:** 50% of US population had access to some form of wastewater treatment.

1960 - present:

**TREND:** TREATMENT PROCESS ADVANCES to improve receiving water quality

Nutrient (nitrogen and phosphorus) removal (eutrophication control)

Use of chemical conditioners (polymers, polyelectrolytes), dissolved air flotation for enhanced solids separation and thickening

New process configurations: high rate activated sludge processes, high purity oxygen, sequencing batch reactors, high rate trickling filters and hybrid trickling filter-activated sludge processes, membrane bioreactors

Improved sludge digesters: high temperature processes

Effluent disinfection

**TREND: REGULATION**

1972 Federal Water Pollution Control Act Amendments (PL 92-500) amended 1977 (Clean Water Act) and subsequent until 2002. (to be discussed in detail)

CWA summary

- Water Quality Standards for receiving waters (based on designated uses and related human health and aquatic life criteria)
- Antidegradation policy with ambient monitoring
- If WQS not met: plan (strategies and controls) to improve impaired waters using Total Maximum Daily Load (TMDL) approach.
- Implementation:
- POINT SOURCES. National Pollutant Discharge Elimination System (NPDES) PERMIT PROGRAM
    - Control of toxics, Industrial pretreatment
    - Sludge (Biosolids)disposal
- Non-point sources (section 319)
- Section 404 (Wetlands protection)
- State Revolving Funds

## EMERGING TRENDS:

WASTEWATER REUSE

- Non-potable, separate distribution
- Indirect potable
- Direct potable
- Local regulation

ENERGY

- Recovery of energy (biofuels, co-generation, fertilizer)
- Conservation of energy (aeration, pumping, mechanical solids processing, heating, embedded materials)
- $CO_2$ caps?

TRACE CONTAMINANTS

- Receiving water
- Biosolids
- Recycled water