

WASTEWATER

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Resource

# WASTEWATER:

## A Valuable Resource

# Outline

- ➔ What is Wastewater
- ➔ Municipal Sewage Treatment
  - ➔ Lagoons
  - ➔ Mechanical
- ➔ Effects on Environment
  - ➔ Terrestrial Habitat
  - ➔ Aquatic Habitat
  - ➔ Public Health
- ➔ Disposal Methods and Regulations
  - ➔ Continuous Discharge
  - ➔ Effluent Irrigation
  - ➔ Land Injection

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# What is Wastewater?

- ➔ Waste from homes, businesses and industry
  - ➔ Collected at a municipalities treatment facility
- ➔ When managed **properly** it becomes a valuable resource
- ➔ When managed **poorly** it becomes an environmental concern

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# What is Wastewater?

→ 99.9% Water

→ 0.1% Solids

→ 40% Dissolved Solids

→ 60% Total Suspended Solids

⇒ can be filtered out

→ Other parameters such as bacteria

→ range from 20 million – 200 million coliforms per 100 mL

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# What is Wastewater?

→ Communities produce:

→ 180-950 L of wastewater/person/day

⇒ highly variable due to industrial input

→ 50-90 g of organic matter/person/day

⇒ organic matter is determined by biological oxygen demand (BOD)

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# Municipal Sewage Treatment

- ➔ Primary (1<sup>0</sup>) Treatment
  - ➔ removes solids by gravity
- ➔ Secondary (2<sup>0</sup>) Treatment
  - ➔ biological process that removes organics
  - ➔ minimum level of treatment required in Saskatchewan
- ➔ Tertiary (3<sup>0</sup>) Treatment
  - ➔ furthers quality of water to meet environmental considerations
  - ➔ removes nutrients (nitrogen and phosphorus)

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# Municipal Sewage Treatment

- ➔ Treatment depends upon:
  - ➔ quality characteristics of wastewater and
  - ➔ the required effluent quality characteristics
  
- ➔ Characteristics are classified as:
  - ➔ physical
  - ➔ chemical
  - ➔ biological

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# Municipal Sewage Treatment

## ➔ Physical Characteristics:

- ➔ turbidity
- ➔ colour
- ➔ odour
- ➔ solids
- ➔ temperature

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# Municipal Sewage Treatment

- ➔ Chemical Characteristics:
  - ➔ chemical oxygen demand (COD)
  - ➔ total organic carbon (TOC)
  - ➔ nitrogen compounds
  - ➔ phosphorus compounds
  - ➔ chloride, sulfate, alkalinity and pH
  - ➔ heavy metal ions

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# Municipal Sewage Treatment

- ➔ Biological Characteristics:
  - ➔ biological oxygen demand (BOD)
  - ➔ nitrogenous oxygen demand
  - ➔ microbial population

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# Municipal Sewage Treatment

Constituent	Untreated Medium Strength Wastewater	Surface Water Quality Objectives
Dissolved Solids (mg/L)	560	
Suspended Solids (mg/L)	240	
BOD, 5day, 20°C	200	
COD (mg/L)	450	
TOC	150	
Nitrogen (mg/L)	40	
Phosphorus (mg/L)	8	
Chlorides (mg/L)	50	
Alkalinity (mg/L as CaCO <sub>3</sub> )	100	
Grease	20	

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Table 1: Typical Characteristics of Untreated Municipal Wastewater Compared with Surface Water Quality Objectives.

# Municipal Sewage Treatment

- ➔ Lagoon Treatment Systems
- ➔ Shallow ponds in which sunlight, algae, microorganisms and oxygen interact to treat wastewater
  - ➔ used by the majority of Saskatchewan communities
  - ➔ required to have at least two cells
    - ⇒ one treatment cell
    - ⇒ one storage cell with at least 180 days storage capacity

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# Municipal Sewage Treatment

→ Three types of lagoons:

→ **Aerated** – artificial addition of oxygen

→ **Anaerobic** – no dissolved oxygen (DO);

→ **Facultative** – aerobic surface and anaerobic bottom

⇒ most common type of lagoon

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# Municipal Sewage Treatment

➔ Typically discharged twice / year (spring and fall)

➔ fall discharge is of higher quality due to ideal treatment conditions during the summer months

⇒ wind

⇒ temperature

⇒ sunlight

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# Municipal Sewage Treatment

Colour	Condition
Dark sparkling green	Good; high pH and DO in treatment cell
Clear light green	Good; high pH and DO in storage cell
Dark green to black	Very bad; lagoon is septic with anaerobic conditions
Grey, tan or brown	Okay if due to a predominance of brown algae. Bad if due to bank erosion
Red or pink	Indicates purple sulphur bacteria (anaerobic), red algae (aerobic) or daphnia

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Table 2: Lagoon Colour and Probable Wastewater Conditions.

# Municipal Sewage Treatment

## ➔ Mechanical Treatment Systems

➔ treatment time = hours

⇒ deactivated sludge

⇒ RBC's

⇒ Nutrient Removal

⇒ SBR

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# Municipal Sewage Treatment

## → Preliminary Treatment

### → screens

⇒ removes larger objects

### → grit chambers

⇒ removes smaller inorganic objects

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# Municipal Sewage Treatment

## → Primary Treatment

### → primary clarifiers

⇒ heavier solids are settled out by gravity

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# Municipal Sewage Treatment

## → Secondary Treatment

- aeration tanks and bioreactors
- secondary clarifiers

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# Municipal Sewage Treatment

## → Tertiary Treatment

- chemical precipitation
- biological phosphorus and nitrogen removal process (BPNR)
- chlorination
- UV disinfection

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# Effects on Environment

## → Lagoons

### → odours

- ⇒ inadequate sized lagoon
- ⇒ spring melt

### → seepage

- ⇒ inadequate or damaged liner
- ⇒ damages land and groundwater

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# Effects on Environment

- ➔ Release of Untreated Effluent
  - ➔ bacteria deteriorate downstream water quality
  - ➔ increased minerals deteriorate water quality
  - ➔ excess phosphorus increases algae and weed growth
  - ➔ ammonia, hydrogen sulphide and decreased DO harm aquatic environments
  - ➔ colour and turbidity impair aesthetics of water

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# Effects on Environment

- When wastewater is treated properly effluent causes **NO** negative environmental impacts
  - effluent is clear, colourless, high in DO, and low in organic solids, suspended solids, phosphorus, ammonia, nitrogen and pathogenic (disease-causing) microorganisms
  - effluent can then become beneficial to the environment when disposed of

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# Disposal Methods and Regulations

- Effluent quality requirements are determined by Saskatchewan Environment (SE) based on the assessed risk and impacts associated with an effluent discharge against any downstream uses
- SE determines bacteriological limits based on the *Surface Water Quality Objectives*
- SE objectives are based on the Canadian Council of Ministers for the Environment guidelines

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# Disposal Methods and Regulations

- Most lagoon and mechanical treatment systems release effluent into a water course
- mechanical systems have continuous release
- lagoons release spring and fall
  - ⇒ spring release allows for a dilution factor

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# Disposal Methods and Regulations

- ➔ Other disposal methods include:
  - ➔ evaporation
  - ➔ snow effluent
  - ➔ effluent irrigation
    - ⇒ valuable agriculturally

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# Disposal Methods and Regulations

## → Biosolid disposal:

### → Lagoons

- ⇒ decomposed by microorganisms
- ⇒ dredging of lagoon

### → Mechanical

- ⇒ land farming
- ⇒ reused in mechanical treatment process

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# QUESTIONS?