



# Use of tire-derived aggregate (TDA) for landfill leachate collection and drainage systems

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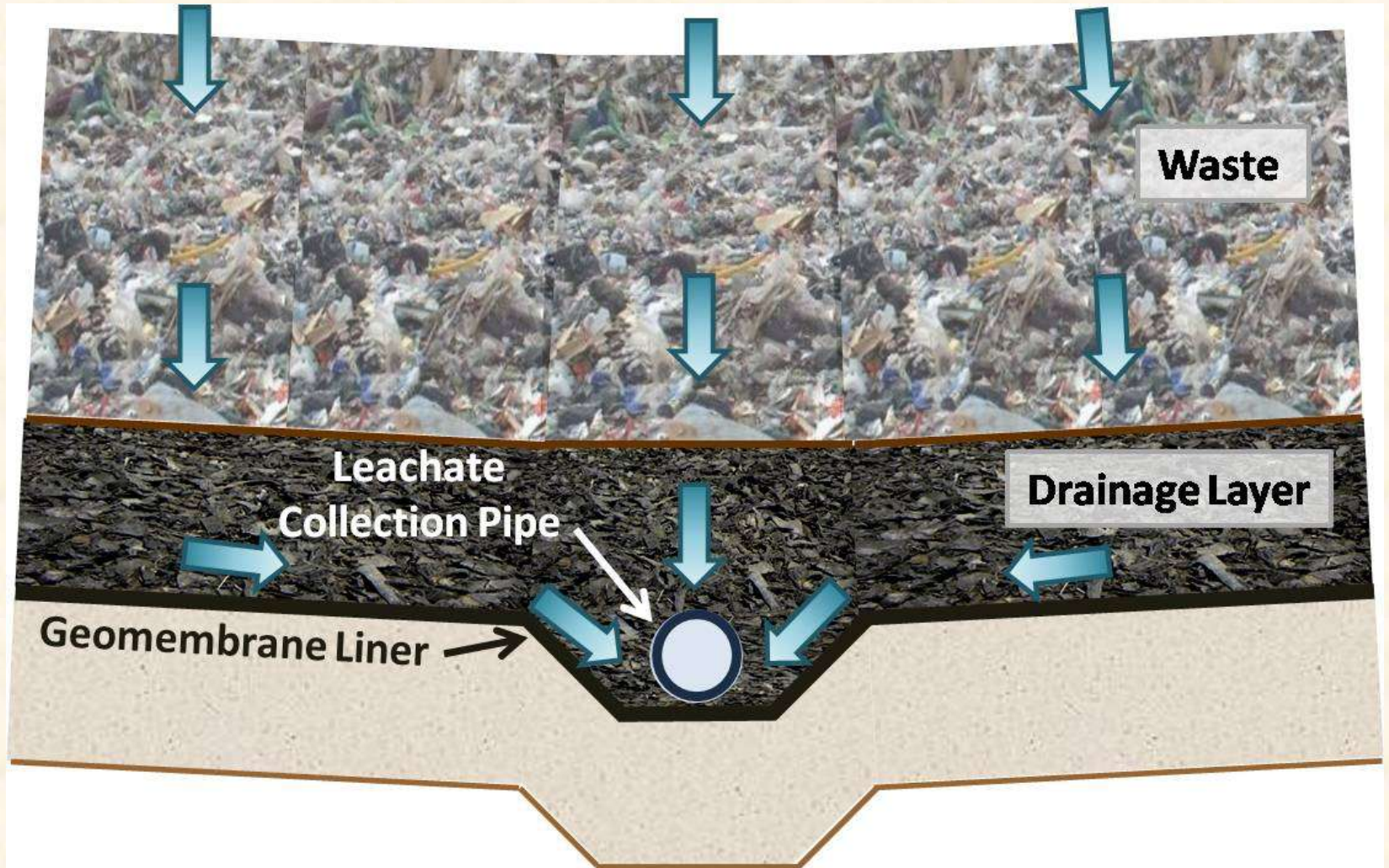
Edmonton Waste Management Centre of Excellence



# Background

- Albertans discard 5 million tires per year.
- Recycling of used tire carried out under Alberta's Tire Recycling Program.
- Products available currently produced:
  - Pour-in-place rubber surfacing for playgrounds, floor and roofing tiles, and TDA for drainage purposes.
- Other uses include blending crumb with asphalt for road construction.

# Leachate Collection and Drainage System



# Types of TDA produced in Alberta

## ➤ Four types:

- Medium truck tire shred (MTT).
- Off-the-road tire shred (OTR).
- Passenger and light truck tire shred (PLTT).
- Also mixtures of types, e.g. PLTT and OTR.

# Use of TDA in LCDS

- TDA used in LCDS since 1996.
- Useful product in offsetting need for natural aggregate, e.g. gravel, in LCDS.
- TDA has high permeability, hence the continued application in LCDS
- Over 294,000 tonnes (t) used to 2008:
  - **213,450 t - PLTT**
  - **62,510 t - MTT**
  - **18,040 t - OTR**

# TDA use in Leachate Collection & Drainage System (LCDS) of Alberta landfills

<b>Class</b>	<b>Type of landfill</b>	<b>No. Landfills</b>	<b>With TDA</b>
I	Hazardous Waste	2	0
II	Municipal Sanitary (>10,000 t/yr)	32	22
	Municipal Sanitary (<10,000 t/y)	100	7
	Industrial Waste	26	2
III	Dry Waste	6	1
<b>TOTAL</b>		<b>180</b>	<b>32</b>

# Design & Operating Standards for All Types of LCDS Materials

- Main feature of a drainage layer:
  - Ensure efficient drainage and collection of leachate.
- Design standards require less than 300 mm leachate mounding (Alberta Environment 2010).
- Need high hydraulic conductivity:
  - e.g.  $\geq 0.01$  cm per second.
- Clogging can lower hydraulic conductivity, key mechanisms are:
  - Sedimentation, biofilm formation, adsorption.

# Need for Investigation

- Investigation of long-term performance of LCDS using gravel or TDA:
  - No record of LCDS failures in Alberta.
  - Few laboratory studies of LCDS anywhere.
  - Ontario study (Rowe & McIsaac 2005):
    - Suggested the potential for long-term (30 to 50 years) clogging of both gravel and TDA.
    - Based on their work, TDA may clog faster than gravel.
    - Leachate quality and quantity, and TDA properties are different than those used in Alberta.

# Need for Investigation

- Limited investigation of long-term performance of LCDS:
  - Testing specific to Alberta situation needed.
  - It is necessary to quantify mechanisms and to identify required design specifications.
  - Specifications to cover TDA types available in AB.
  - Specifications to ensure high quality performance of TDA in LCDS.

# **Today's Objective**

Introduce you to the on-going research activities.

# Research Program & Status

1. Overview of research activities.
2. Some preliminary findings:
  - a. Alberta leachate characteristics.
  - b. TDA physical properties.
3. Future activities & expected outcome.

# 1. Overview of the research

- Main objective of research: to test long-term hydraulic conductivity of TDA and gravel.
- Main factors to consider: leachate chemistry; compressibility and type of TDA.
- Lysimeter apparatus will be used to simulate LCDS

# Complete apparatus

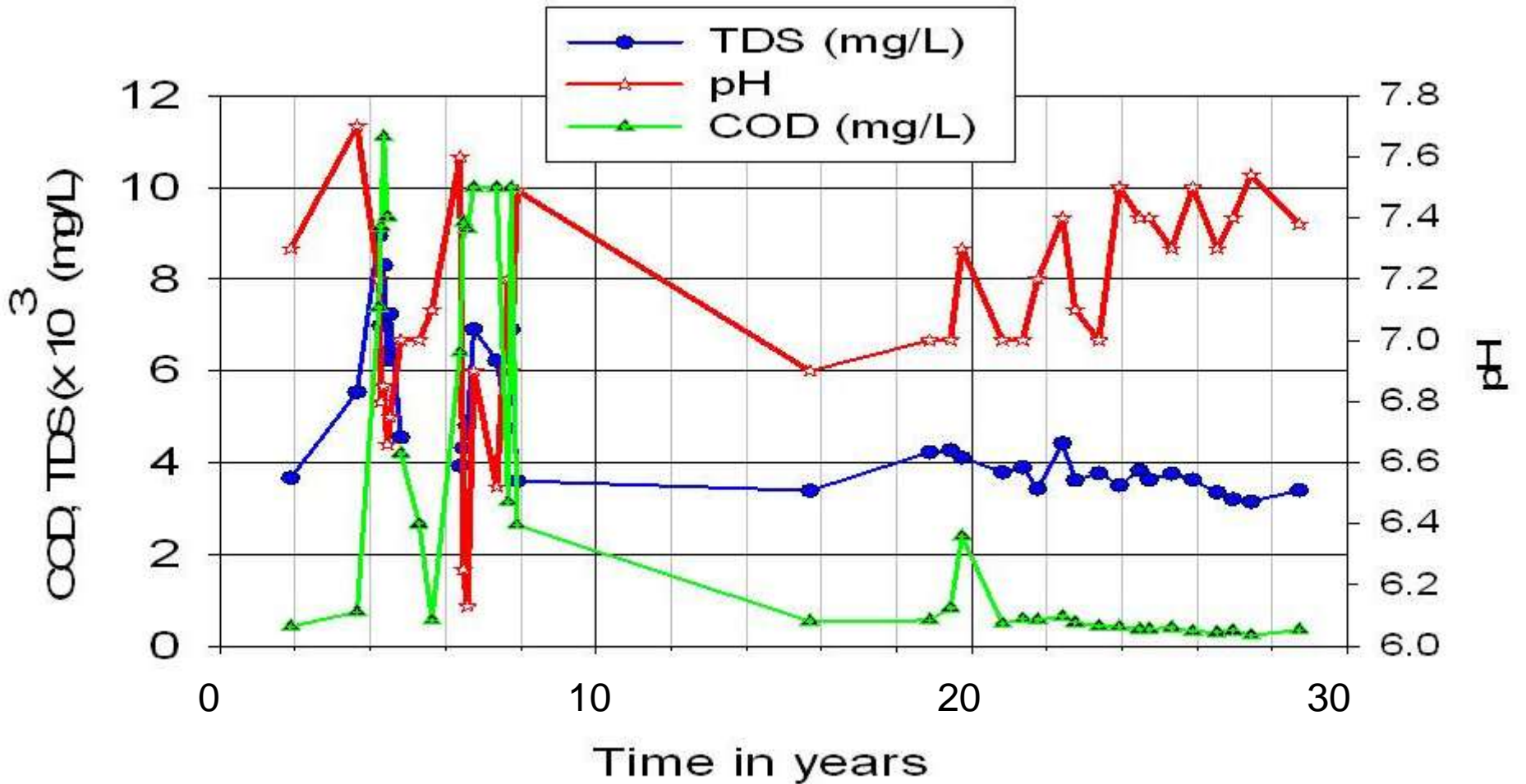


## 2a. Alberta Leachate characteristics

- Leachate chemistry very variable between and within landfills.
- Chemistry depends on age of landfill, waste composition, seasons.
- Results consistent with information available in the literature.

## 2a. Alberta Leachate Characteristics

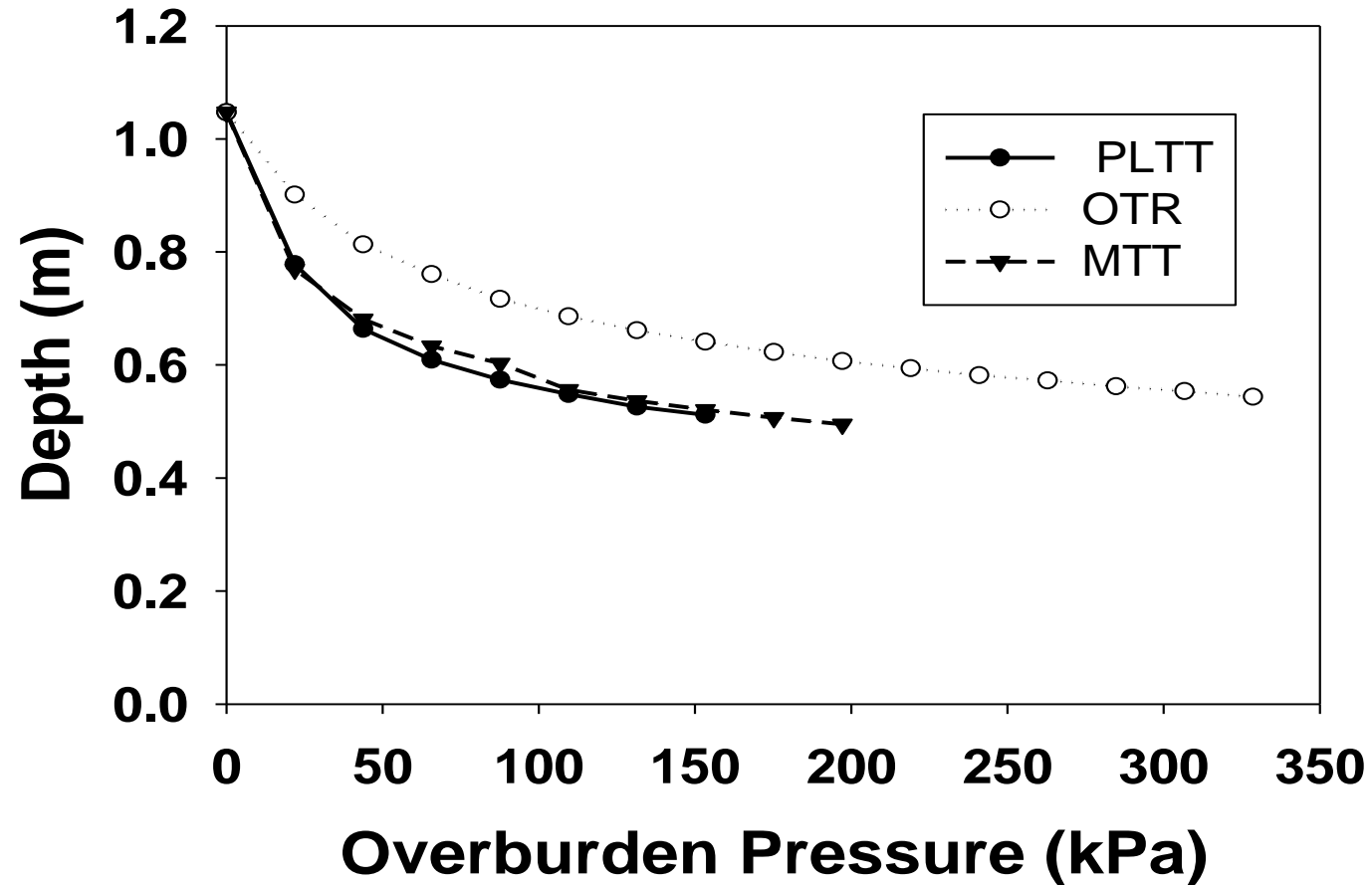
# Leachate Quality Trends



## 2b. Tire shred properties

<b>Property</b>	<b>TDA</b>	<b>Gravel (as reported in literature)</b>
Specific gravity (ratio)	1.18-1.38	2.67-2.72
Dry density loose (kg/m <sup>3</sup> )	385-469	1370
Initial porosity (%)	62-72	46
Water absorption (%)	2-4	1-3
Compressibility (%)	40-50	Not compressible
Hydraulic conductivity (cm/sec), uncompacted	4.9-59.3	0.78
Particle size distribution (mm)	25-300	50-80

# Compressibility of tire shreds



# 3. Future activities

- To complete TDA physical testing.
- To investigate short and long-term permeability of LCDS.
- To provide data that facilitates the use of TDA in LCDS.

# 3. Expected Outcome

- Research expected to provide information/ data that facilitates the use of TDA in LCDS.

# Summary

- There is a need to investigate factors affecting LCDS
- Leachate chemistry variable over space and time:
  - Within and between landfills.
- Physical properties of TDA to be determined.
- Long-term tests being conducted to compare hydraulic conductivity of TDA and gravel

# Acknowledgements

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Thank you