Use of Claystone for Compacted Clay Liners

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Drumheller Regional Landfill

- Landfill location and setting
- Landfill expansion
  - Stage I Closure
  - Stage II Expansion
  - Stage III Grading
- Topography and surface water control
- Available liner materials
- Canada Alberta Municipal Rural Infrastructure Fund (CAMRIF)
- CEAA Screening
  - Paleontological assessment and inspection

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Material Evaluation

The material evaluation for the compacted clay liner and clay final cover must meet the following specifications:

- Soil must be a Unified Soil classification of CI or CH
- Soil must have a clay content of 40% (less than or equal to 0.002 mm)
- Have a liquid limit between 30 and 60
- should have a minimum plastic index of greater than15
- Soil must have saturated hydraulic conductivity less than $1x10^{-7}$cm/sec

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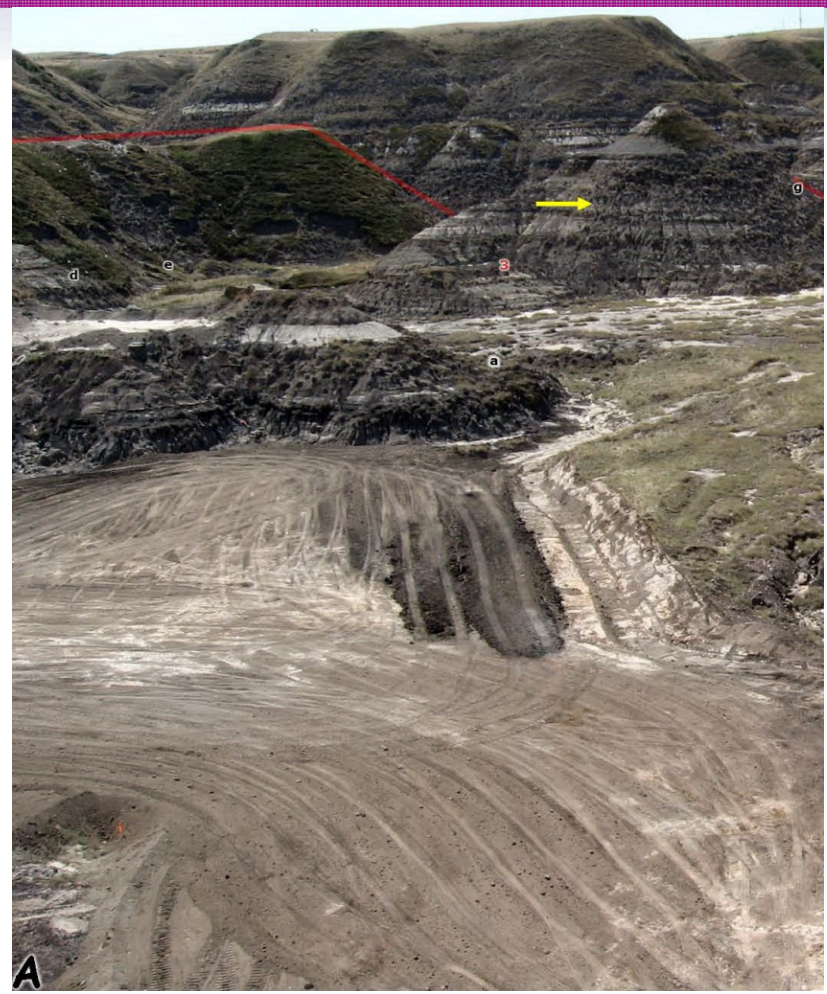
Soil test pad

The purpose of a test pad(s) is to model the construction of the full-scale liner to verify that proposed construction materials and methods will produce the desired compaction and in-situ hydraulic conductivity.



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Excavation, stockpiling, and processing

- Segregate excavated soils according to their properties
- Process excavated soils as necessary to meet required material specifications (e.g., pulverizing the soil to break down clods or screening the soil to remove large particles)
- Place excavated/processed soils into compatible stockpiles of uniform material

Subgrade preparation

- control of differential settlement
- removal of soft spots
- quality control testing (density, moisture content, soil classification, soil gradation)

Achieving low hydraulic conductivity

The most important factors in achieving hydraulic conductivity criteria are:

- using suitable soil materials
- using appropriate construction equipment
- placing the soil at the correct water content
- properly preparing the surface between lifts
- achieving density specifications
- protecting completed lifts from damage

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Clay Liner Installation

Liner Material Emplacement:

- The liner material is generally placed with a scrapers or trucks and then distributed with a dozer or grader or other equipment.
- The liner is placed in a series of lifts.
- Lift thickness is a function of the following:
  - Soil characteristics.
  - Size and type of compaction equipment.
  - Required compactive effort.
  - Generally, 15 cm to 30 cm thick, loose lift is recommended.
- Percent Proctor density - A minimum of ninety-five percent (95%) standard Proctor density

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Clod size reduction:

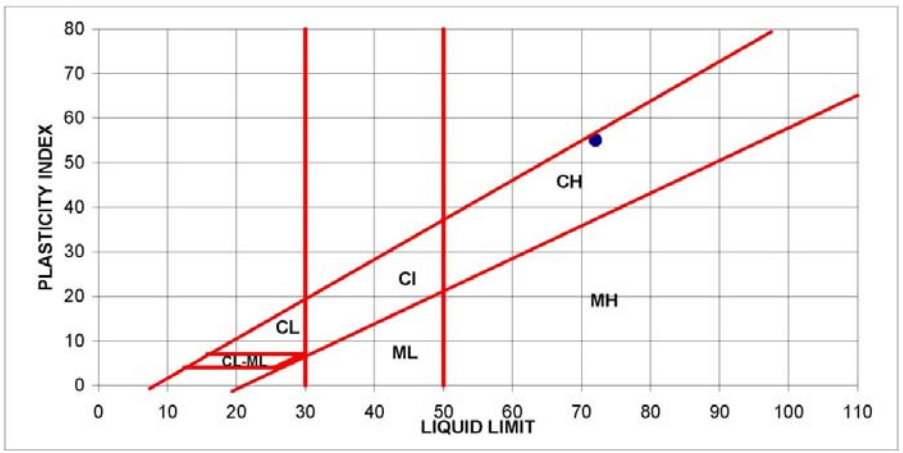
- After the placement of each lift, the liner material must be broken up for homogenization and clod size reduction.
- Clod size of 25 mm to 50 mm or smaller is recommend
- Clod size can significantly affect the hydraulic conductivity of the liner.
- Clod size reduction is usually accomplished using disk harrows or rotary tillers with various shaped tilling blades.

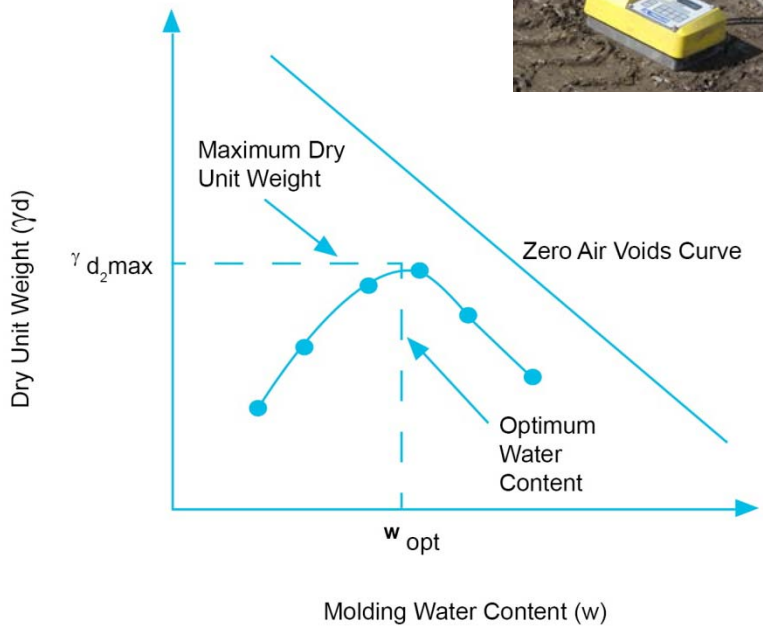
Moisture control:

- Proper and uniform moisture content is an important factor for compacting soil material to achieve the desired hydraulic conductivity.
- Minimum hydraulic conductivity can be obtained if the clay material is compacted on the "wet side of optimum" (0 to +5%). Typical values for fat clay (CH) (Wopt +5%).

Testing During Construction

- Field Density and Moisture Content
- Undisturbed Hydraulic Conductivity
- Dry Density (undisturbed sample)
- Moisture Content (undisturbed sample)
- Atterberg Limits (liquid limit and plasticity index)
- Grain Size (to the 2-micron particle size)
- Moisture-Density Curve (as per clay borrow requirements)





Protection from Desiccation and Freezing

- The liner becomes difficult to work and compact with decreasing temperature. It is difficult to achieve the desired density and hydraulic conductivity.
- Freezing of liner could cause surface cracking and desiccation of soil which could result in increased hydraulic conductivity of the liner.
- The liner must be protected from freezing.

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Potential Causes for Failure

- Inadequate clod size reduction, mixing and spreading of liner materials.
- Inadequate control of soil moisture content and density during compaction both prior to and after compaction.
- poor maintenance after construction.

Wastes encountered during construction

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Conclusion

- Compacted clay liner systems made up from claystone bedrock materials are capable of achieving hydraulic conductivity values less than the AENV's criteria of $1x10^{-7}$ cm/s
- Values in the range of 10^{-8} cm/s and even 10^{-9} cm/s can be achieved with careful construction and quality assurance
- With such low levels of hydraulic conductivity, the compacted clay liner is a viable choice as a municipal landfill liner system

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Thank You | Questions??

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