Landfills and Soil: A Love Story

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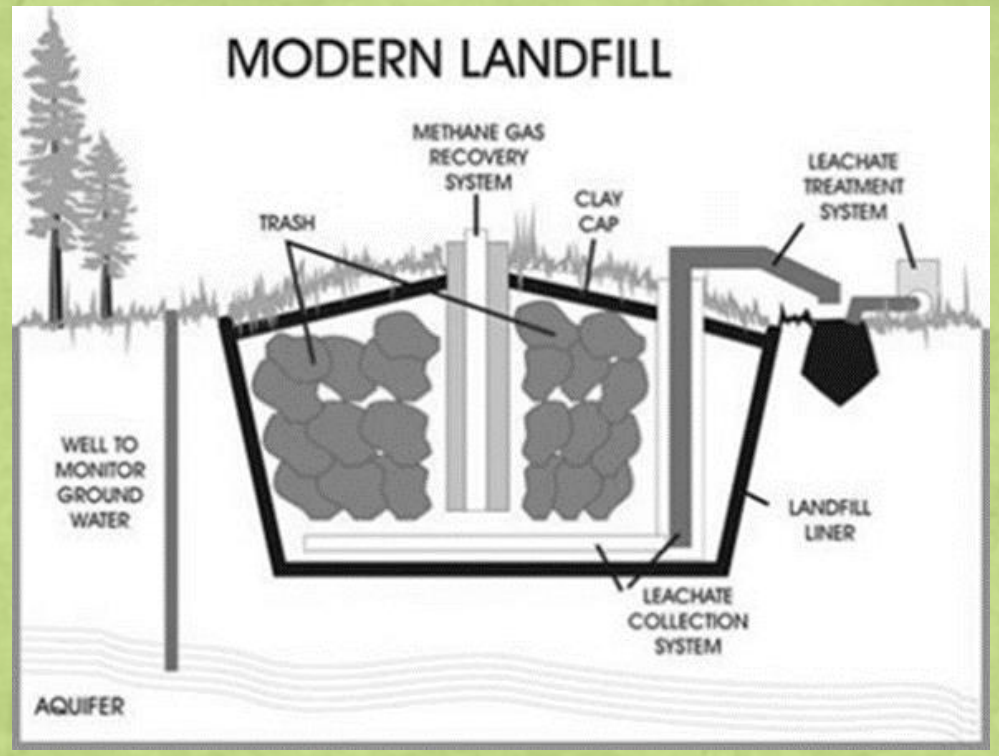
Professor Aaron Watwood's ESCI 1110

Brief Overview of Landfills

- Prevalent in all areas of world
- Can be a huge source of pollution if poorly regulated/maintained
- Most follow same basic build



Common Regulations in Developed Countries

- Cannot be built near fault lines, flood plains, wetlands
- Must have clay soil membrane at least 2 ft. thick
- Must have leachate recovery system
- A way to monitor ground water

So What's The Problem?

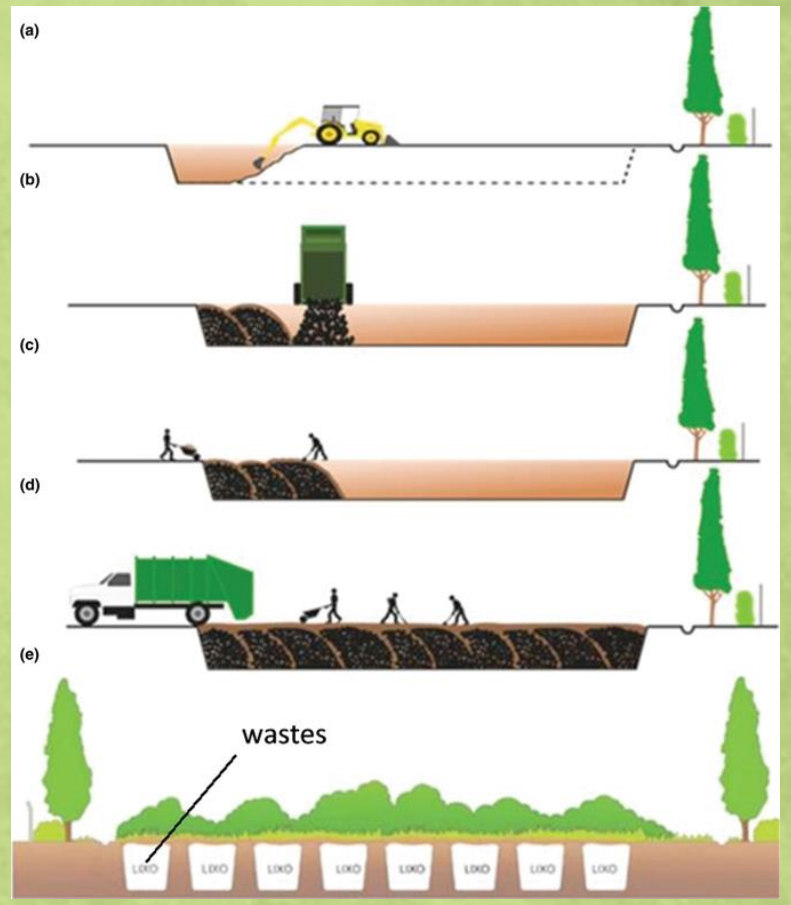
- Some places are not as lucky as US
- Weak environmental or no oversight
- Lack of infrastructure
- Lack of funding

All Is Not Lost

- There are ways to make small scale landfills safe
- Brazil is a great example of room to grow:
  - 50% of cities below 50,000 dispose of their waste improperly
  - Small scale landfills have been accepted by the state of São Paulo
- Plenty of research being done
- Little infrastructure is needed

Specifics for Small Scale Landfills

- Already recommendations in place from São Paulo:
  - Minimum water table depth 3m or greater
  - Distance from bodies of water
  - Distance from urbanized area
- Backhoe needed only for initial dig
- End of day manual covering
- Two important soils
  - Surrounding soil
  - Cap soil



Surrounding Soil

- Numerous studies done on liner soils translate easily
- Ideal *in situ* type slows down leachate as it moves trough soil
- Hydraulic conductivity (k) should be $< 1 \times 10^{-9}$ m/s

Surrounding Soil (Cont.)

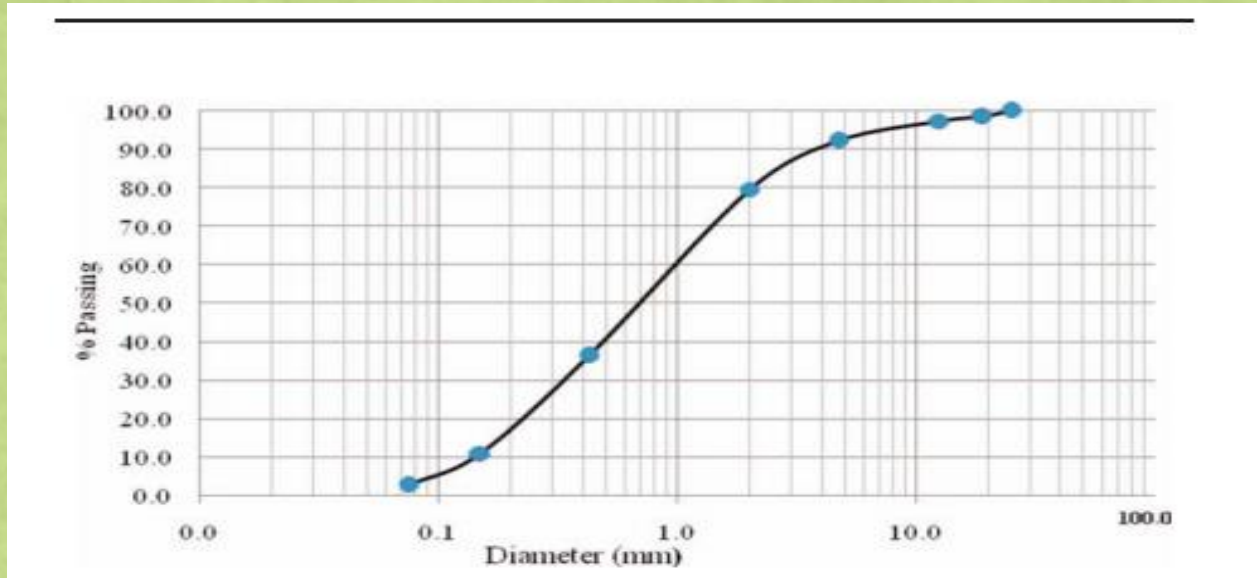
- Study from Turkey
- Particle size distributions showed clay contents of 50-65%
- Atterberg limits test showed PI of 25-35%
- All had k values of 1×10^{-10} m/s or lower

Cap/Cover Soil

- Failures include cracking, root infiltration, erosion, rainwater infiltration
- Must avoid bathtub effect by matching k of liner soil

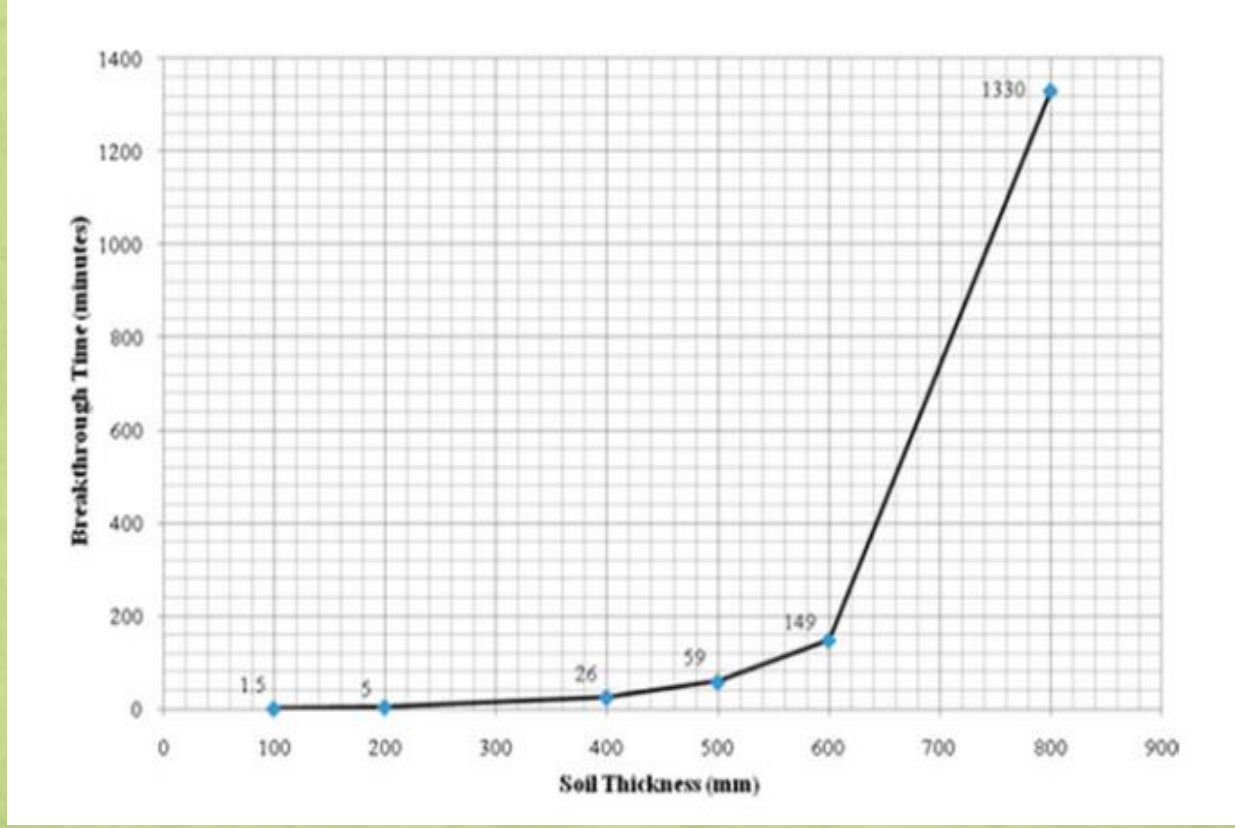
Cap/Cover Soil (Cont.)

- Study done in Saudi Arabia with well graded sandy soil
- Simulated rainfall on soil columns
- Time of breakthrough recorded



Cap/Cover Soil (Cont. 2)

- Time until breakthrough showed an exponential increase
- Indicates critical thickness
- Confirmed *in situ*



Cap/Cover Soil (Cont. 3)

- Another more technical study on clay coverings and their tendency to crack
- Clayey soil coverings even 1m plus can crack
- Overburden pressure needed
- Can be soil covering, plants, or other structure

Is This Really Safe?

- Brazilian study looked at small landfill, i.e. <10 ton/day
- Electro-resistivity tests were conducted:
  - 8 yr old ditch
  - 4 yr old ditch
  - 2 yr old ditch
- Low resistivity = heavy metal leachate or moisture

Is This Really Safe? Conclusion