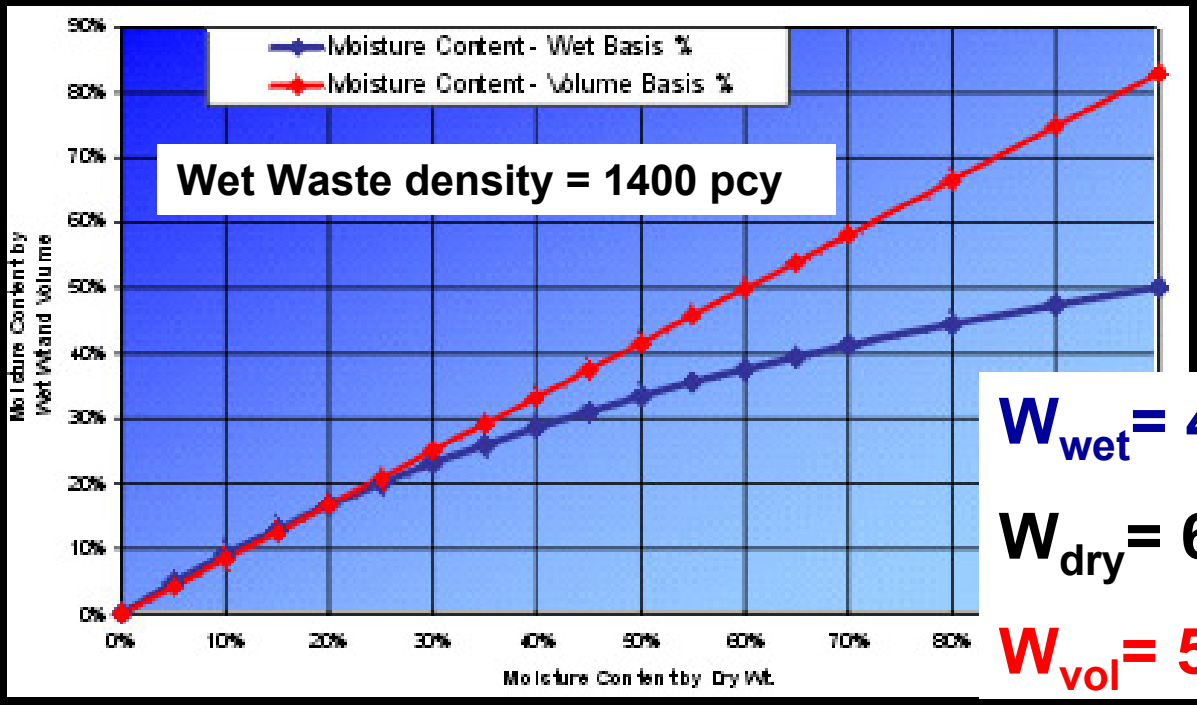
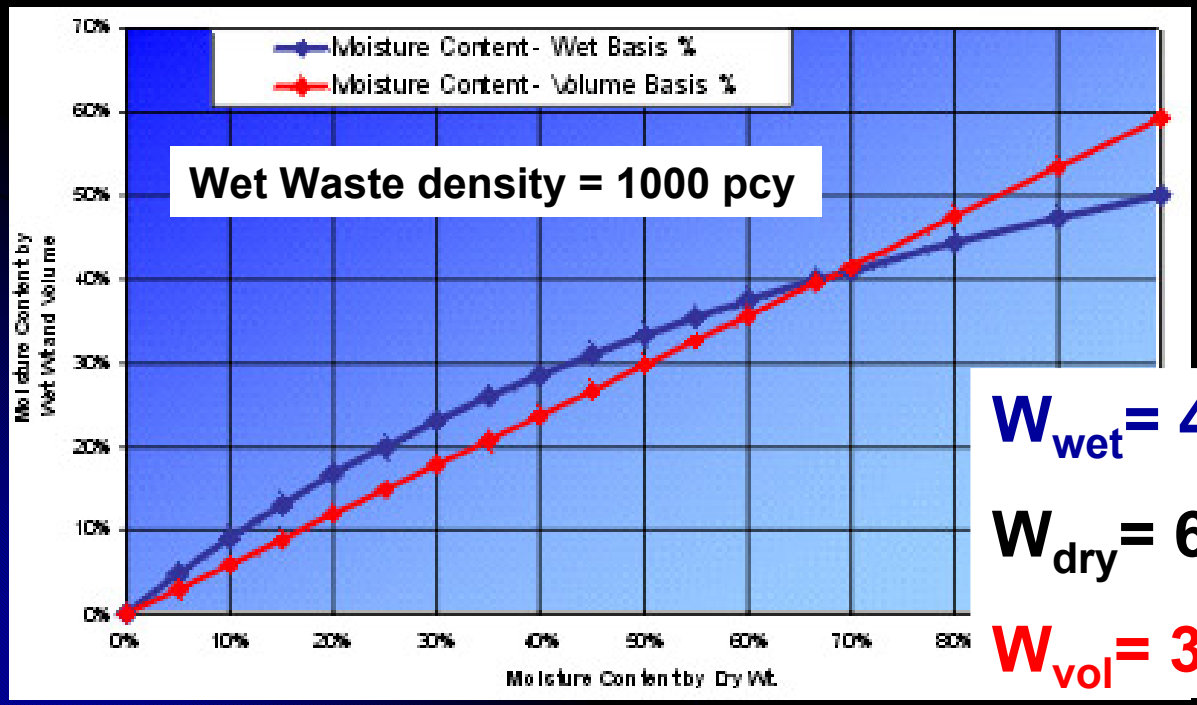
Moisture Contents Are Not Created Equal



W_{wet}= 40%

W_{dry}= 66.6%

W_{vol}= 55.3%



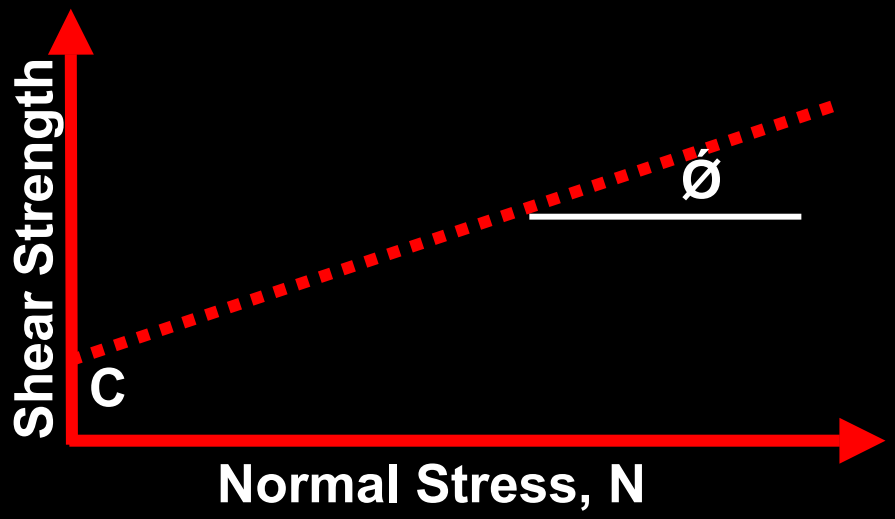
W_{wet}= 40%

W_{dry}= 66.6%

W_{vol}= 39.5%

More on Waste Shear Strength

- Assume *Mohr – Coulomb* Behavior
  - Friction equivalent, Ø
  - Cohesion equivalent, C
  - Varies with
    - ⇨ Waste type
    - ⇨ Compaction
    - ⇨ Liquids additions
    - ⇨ Daily cover
    - ⇨ Density
    - ⇨ Moisture content
    - ⇨ Age, time-dependent
- Heterogeneous, anisotropic



And more….

Bioreacted Waste: Limited testing

- Laboratory remolded samples
  - Large Triaxial cells
  - Field shear tests – none reported?
  - Direct simple shear – recent tests→→

DIRECT SIMPLE SHEARS ON DECOMPOSED WASTE*

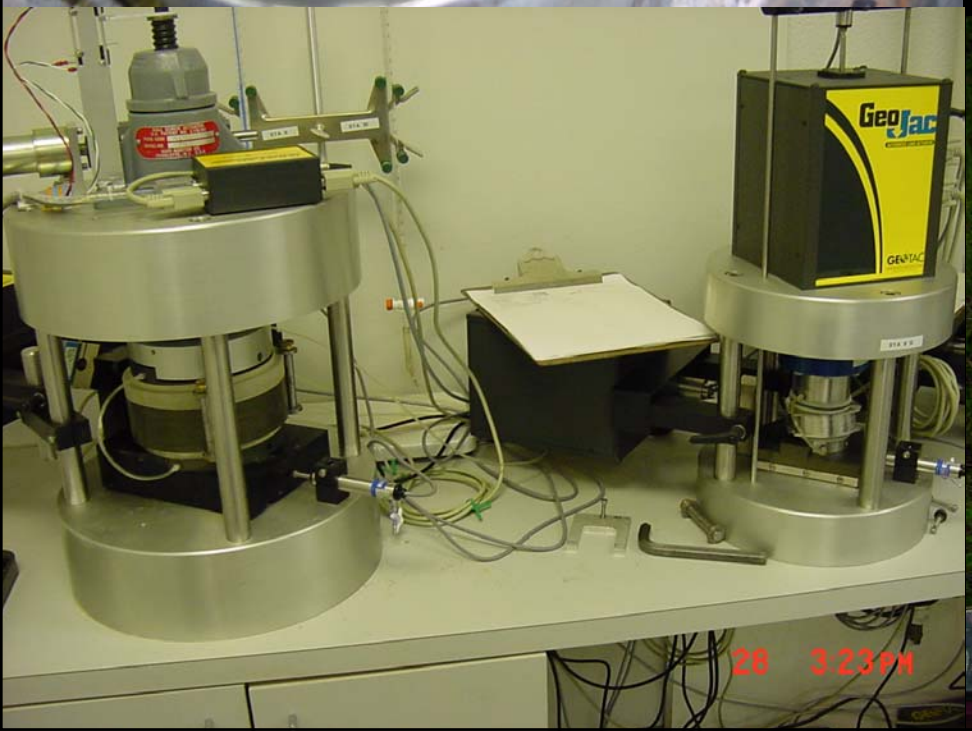
6”x6”x2” Simple Shear Box

Y=103 pcf @ w = 28% to 52% (Sat.)

Ø (drained) = 27.8º to 32.4º

Ø (undrained) = 29.6º to 36.2º

*Testing for Waste Management, Inc. by Applied Land Sciences, JQH Engineering, and Fugro South



Sensitivity Analysis
Bioreactor "Types"

TYPE 0: Baseline; non-bioreactor Subtitle D without recirculation
-"normal" waste density

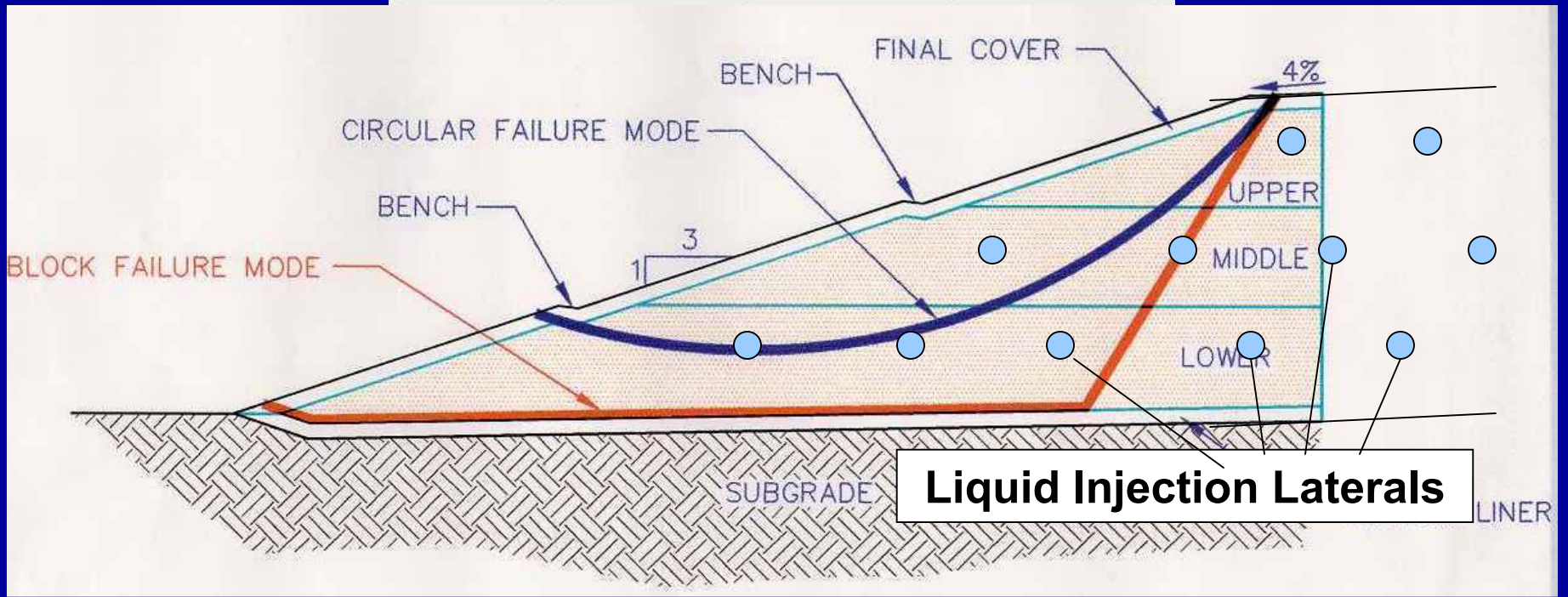
TYPE I: Limited or intermittent recirculation
>25% waste density increase

TYPE II: Moderate, controlled recirculation (below field capacity)
>50% waste density increase

TYPE III: Heavy recirculation; at field capacity
~75% waste density increase

Sensitivity Modeling Parameters

LAYER BioType:	DENSITY (pcf) O→III	FRICTION (degrees) O→III	COHESION (psf) O→III
Upper	45 →78.8	26 → 18	200 → 40
Middle	55 →96.3	30 → 22	250 → 50
Lower	65 →113.8	34 → 26	300 → 60



Geotechnical Design Considerations

- What is the goal?
  - Capacity, leachate control and treatment, gas
  - What type of bioreactor?
- Shear strength and density will change
- Prevent excess pore pressures
- Revise filling sequences
- Set risk based FS values

What Geotechs Need To Do

- Testing and standards for waste shear strength and compressibility
- Database
- Improved monitoring methods

What Operations Should Consider

- Monitor liquids additions continuously
- Maintain moisture below waste field capacity
- Keep liquids away from slopes
- Develop an operations plan
- Monitor performance and resolve


FINAL COMMENTS . . .
Pipe
SCS ENGINEERS