Seawater Effects on Clay Plasticity

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Freshwater, Seawater, and Construction

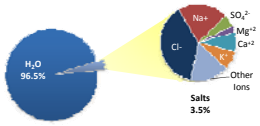
Freshwater Used in Construction

- Less than 3% of all water on earth is fresh water and even less is actually potable
- Thousands of gallons of freshwater are used in construction
- Seawater is not used in construction because its effects on soil are unknown and because of possible ground water contamination
- Construction Uses:
  - Soil compaction
  - Dust control

Seawater Properties

- 96.5% water and 3.5% salt
- 6 ions constitute 99% of dissolved salts
- Proportions of salts consistent throughout the world
- Only amount of H_2O varied based on location

Seawater Composition



Clays and Plasticity

Clay

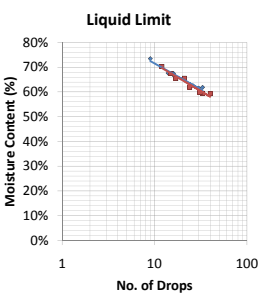
- Individual particles too small to be seen with naked eye
- Formed through extensive weathering
- Clay types differ based on chemical composition and type of weathering producing different behaviors
- Particles have a net negative charge
- Must absorbed water to achieve electrical neutrality from ions
- Samples:
  - Kaolinite: larger particles, non expansive, and stable
  - Bentonite: very small particles, expansive, and unstable
  - Unknown: collected from field

Plasticity

- Used to describe a workability similar to toothpaste or putty when hydrated
- A result of the negatively charged particles
- Only clays and silts exhibit plasticity, sands and gravels cannot
- Typically an undesirable soil property
- Plasticity is measured using Atterberg Limits testing (ASTM D431)
  - Liquid Limit: moisture content at which clay begins to act as a liquid
  - Plastic Limit: moisture content at which clay begins to exhibit plastic characteristics and will break apart if dehydrated
  - Plasticity Index = Liquid Limit – Plastic Limit

Results

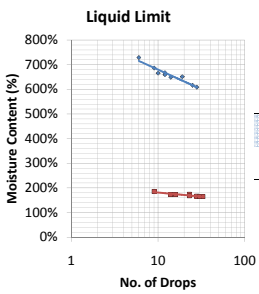
Kaolinite



	Liquid Limit	Plastic Limit	Plasticity Index
DI Water	62	36	26
Seawater	61	35	26

- Lower plastic and liquid limits
- No plasticity index reduction

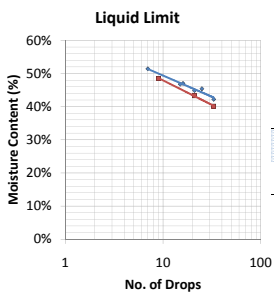
Bentonite



	Liquid Limit	Plastic Limit	Plasticity Index
DI Water	617	47	570
Seawater	175	51	124

- Significant reduction in plasticity
- Visibly different

Unknown Clay



	Liquid Limit	Plastic Limit	Plasticity Index
DI Water	45	20	25
Seawater	42	19	23

- Slight reduction in plasticity

Conclusion

- Seawater reduced the plasticity of some clays
- Highly expansive clays showed a greater response to seawater hydration
- Seawater may be suitable for some construction uses
- Using seawater for construction could help conserve fresh water for other beneficial uses