Sediment: Fluff vs. Liquid Mud 3-9-16

Properties of sediment:

Kim Hargett

Pleistocene – 2 million years ago

Beaumont sediment harder

Willis formation – Harris county and surrounding – sandy/gravel

Lissie Formation – red/gray

Beaumont Formation – river sediments and marine and lagoonal water in bays

Clay – poorly grated marly clay

Dry, not much water content, very compacted

Beaumont Sands (less common)

Berth

Unconsolidated silt at top of core, but quickly consolidates

Almost even content between fine grain silt and clay

**Geotechnical measurements of dredge material**

In a boring 10-15 or up to 30 feet of soft material before hitting harder Beaumont clay

**Dredgeability of Recent Sediments – Importance of Geotechnical Data for Dredging**

Such as compactibility, plasticity, shear strength, etc.

International Association of Dredging Contractors – soil classification – look up

Cutter-Suction dredge production estimating

Soil strength, until weight, layer thickness, rock quality

Upland placement of dredge material: column settling tests, etc.

**Measurement of water depth**

Equipment

1. Poles
2. Lead lines
3. Acoustics – digital depth sounders – single/dual frequency
   1. Measure the thickness of the water from a given surface elevation measured to the bottom of the water column as defined by a return acoustic echo – the bottom of water
   2. Not the same answer as you’ll get from a lead line

Army Corps handbook - Theoretical calculations provide large swing in accuracy - .66+ ft. Updated 2013 recommendation based on repeated data provides between error - .3 ft

Lead line – almost always will measure a little deeper, weight penetrates mud layer + won’t drop exactly vertical (measures hypotenuse)

Nominal precision of an echo sounding is +/- 0.1ft to .3 precision in a 50ft channel.

Due to effects of temperature and salinity of the water can change sound velocity between 4600 to 5000 ft/s. Usually get about 15 ft/s max for the Houston Ship Channel for each temp and salinity

For single beam, average temp is ok. Not ok for multibeam – can be impacted by water columns

Use a velocimeter to get a sound profile

Soft layer causes issues for digitizer. The amplitude of the received signal is low so the confidence level is lower. The return is sharper for hard material, so the return is stronger and more definitive

Sediment testing – can develop siltation rate cycle

Need more sediment testing to know the cycle better so planning can take place.

Can also identify high spots in dock

Note – if there is topography to the silt, it’s not liquid mud. It’s not flowing.

Often, it’s not so simple.

Liquid mud is different that other sediment types.

Has no cohesion, no internal shear strength

Fluff – even if it’s mobile, it still has shear strength and topography. Is consolidating material. Very sticky. Will cause suction on hull that can prevent movement.

Liquid mud is usually put into suspension by dredging

Dual frequency – using a low frequency provides lower resolution, but penetrates through loose material before it reflects off hard bottom. Almost only used if survey occurs directly after dredge episode.

Nautical bottom – aka navigation depth. Current definition relies on density.

Acoustic reflection: at some point changes in density between successive layers therefore changes the specific acoustic impedance and produces a reflection. But if the material is smoothly graduated and very unconsolidated, may not be able to identify the surface causing the reflection. May have to physically test with lead line.

In a sounding – can see major flood events with congested debris. Air has higher impedance than water, so the gas emitting from decaying plants will cause a firm impedance layer.

Liquid mud – acoustically transparent. Houston’s current quickly eliminates liquid mud, flushes out of dock into channel.

Density less than 1.2 g/cm^3 (fluff) is navigable. In Houston – 6-12 inches deep max into top of sediment layer.

**In-situ measurement of sediment density**

STEMA system – composed of tuning fork and SILAS software that identifies the density of sediment by measuring the changes in the acoustic frequency as the device is lowered into the sediment.