CHEMICAL STABILIZATION LESSONS LEARNED

PROJECT DESCRIPTION

- 1,100,000 square foot warehouse and manufacturing facility for Arm and Hammer
- ¾-mile long existing municipal roadway accessing site to be constructed
- Truck parking lots, including spaces for over 500 trailers
- Over 200 tractor trailers per day
- York County, Pennsylvania

PROBLEMS SOLVED

- Drying of wet soils to allow for placement as fill during wet, cold weather season
- Stabilization of the upper one foot of the building pad subgrade to increase stability during construction and reduce base repair costs
- Full-depth reclamation of municipal roadway into business park
- Stabilization of upper one foot of pavement subgrade to reduce aggregate and asphalt costs
- Stabilization of wet, unstable areas of parking lot subgrade and aggregate base

PRESENTATION GOALS

- Present the flexibility of using chemical stabilization for numerous situations… some proactive and some reactive
- Correlate this project to situations encountered in transportation industry
- Present the lessons learned…details are important!!!!

SOIL DRYING

- Building pad required fill heights of up to 15 feet
- Native soils are sandy SILT (ML) to silty SAND (SM) derived from underlying shale and sandstone
- Low plasticity soils with PI less than 13.
- Construction started in September and proceeded into winter
- Building pad needed to be delivered on a very tight schedule

SOIL DRYING

- Soils ranged from 3 to 8 percent above the optimum moisture content; soil dried adequately during warmer weather
- Used 3 percent lime kiln dust to dry the soils and allow placement as structural fill
- Treated areas of unstable subgrade with lime kiln dust to stabilize the subgrade prior to placing fill


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SOIL DRYING LESSONS

- GC and Earthwork contractor knew the soils were moisture sensitive and that drying would likely be necessary
- Allowed a very quick mobilization to treat soils and keep project on schedule
- Manipulated the percentage of chemical to optimize drying of soils with variable moistures

BUILDING SUBGRADE STABILIZATION

- The Contractor understood that the upper soils would be susceptible to degradation
  - Construction traffic (steel, concrete, aggregate base)
  - Moisture
  - Freeze-thaw
  - Long-term saturation when building is under roof
- Degradation requires stabilizing (over-excavation and replacement prior to slab construction

BUILDING SUBGRADE STABILIZATION

- Contractor decided to use Portland cement to stabilize the upper one foot of the soil subgrade
- Preliminary testing indicated that 5% cement was needed stabilize the soils
- Proceeded with 5% cement on manufacturing side of facility
- Reduced to 3% cement warehouse side of facility

BUILDING SUBGRADE STABILIZATION LESSONS

- Stabilized soil allowed traffic for aggregate placement
- Drastically reduced the amount of subgrade stabilization, as evidenced by difference between 3% and 5% areas
- Subgrade experienced reduced degradation from long term saturation and construction traffic; reduced the associated subgrade repair costs
- Theoretically can reduce aggregate and concrete thickness.
  - Problems for buildings are exposure to weather and traffic
  - Grades will change, so need to implement early in design process

FULL DEPTH RECLAMATION

- Commerce Drive is a municipal owned roadway that services a light industrial park, with very little truck traffic
- Roadway required widening and reconstruction due to severe deterioration
- New facility expected 200+ tractor trailers per day

FULL DEPTH RECLAMATION

- FDR selected instead of full depth overexcavation and reconstruction
  - FDR more cost effective
  - FDR allowed traffic to be maintained during construction
  - FDR accelerated schedule; less roadway disturbance
  - More effective widening and profiling
  - Green solution – LEED certification points

FULL DEPTH RECLAMATION

- Existing pavement section consisted of 2.5” of asphalt and 6” of aggregate base
- Subgrade soils consisted of sandy CLAY and clayey ROCK FRAGMENTS derived from the underlying shale bedrock
- PI of 17 to 19
- CBRs of native soils were 2.8 and 3.0

FULL DEPTH RECLAMATION

- Mix design testing used Portland cement at 4 and 6% by dry weight
  - 4% cement had average UCC of 152 psi
  - 6% cement had average UCC of 223 psi
- California bearing ratio testing on 6% cement sample had CBR of 331

FDR CONSTRUCTABILITY

- Needed to maintain traffic during FDR; included heavy traffic with aggregate, concrete, and equipment deliveries
- Methods contemplated to delay traffic:
  - Close lanes – not permitted
  - Night-time work – to provide 8 hours of curing
  - Friday work – so FDR would have lower exposure to traffic
  - Pre-holiday work – so FDR would have another day of curing prior to exposure to traffic

FDR LESSONS

- Efforts to reduce traffic on FDR layer was important to allow for curing
- Separate contractors used for reclamation and compaction/fine grading caused delays in compaction
- Compaction delays caused problems for fine-grading
- Consider chemical type to generate early strength when exposed to traffic

FDR LESSONS

- Proof-rolling after FDR revealed two small areas of unstable materials requiring excavation and stabilization
- Utility installation was difficult; install utilities prior to reclamation
- Need to provide adequate construction testing
- Open section and minor utilities enhance constructability of FDR

PARKING PAVEMENT VE

- Contractor asked about using chemical stabilization to enhance the strength of the soil subgrade as a means to reduce the costs of the asphalt pavement for the parking lots

PARKING PAVEMENT VE

- Proposed asphalt pavement consisted of:
  - 6 inches of asphalt
  - 8 inches of aggregate
- Structural number = 3.28

- Value engineered asphalt pavement on FDR consisted of:
  - 4 inches of asphalt
  - 0 inches of aggregate
  - 12 inches of cement stabilized soils
- Structural number = 3.28

PARKING PAVEMENT VE

- Asphalt savings reported at about 30%
- Reduces risk of premature degradation from construction traffic and moisture prior to asphalt placement
- Reduces delays and cost of soil subgrade repair prior to pavement placement
- Green solution
  - No aggregate import
  - Less asphalt import

PARKING PAVEMENT VE LESSONS

- Need to implement early as grades will change (lost 8 inches of aggregate and 2 inches of asphalt)
- More easily implemented for "heavy" site; problematic to be implemented for "light" site
- Expect resistance when contractor owns quarry and asphalt plants

FDR SOAPBOX

- Get an experienced engineer involved
  - Pre-determined FDR thicknesses are problems
  - Asphalt thickness should be designed
  - Need subsurface information to choose proper technique
  - Inadequate samples typically provided for testing
  - Inadequate sampling information us provided
  - Have realistic expectations for design schedule

Questions and Answers