Construction Aggregates in My Backyard

Minnesota Minerals Education Workshop 2014

Objective

To incorporate backyard geology into the classroom and discover the science behind a high-quality sand and gravel deposit.

Materials Needed

- Up to 5 different samples of "backyard aggregate".
- Tubs/bins to contain the aggregates.
- Screens or sieves of varying sizes.
- Hand spades.
- Ruler
- Subsurface Boring Log.
- Optional: County Surficial Geologic Atlas.

Background

Aggregate is a term used to describe sand, gravel, and crushed rock mixtures that are a major basic raw material used by construction, agriculture, and industry in projects of all sizes and kinds. It is hard to imagine our lives without roads, bridges, streets, bricks, concrete, roofing tiles, paint, glass, plastics, and medicine.

In order to find a high quality source of aggregate, one must first have an understanding of the geology of the region. In Minnesota, we focus on the surficial geology and Quaternary geologic history to locate deposits of sand and gravel.

Not all aggregates meet the specifications required for road and bridge construction. The suitability of sand and gravel for use as a construction aggregate depends on its geological attributes and physical properties. A sand and gravel deposit must be characterized and classified based on its properties to help determine the quality of the aggregate and thus the potential for mining.

Part 1: Characterize the aggregate in your backyard!

Advance Preparation

1. Obtain up to five different samples of materials that represent the local surficial geology that could represent varying depths in the subsurface.

   Tips: These materials could include topsoil dug up from the backyard, sand and/or gravel from a local beach or playground, unprocessed material from a local gravel mine (with permission) or landscape company.

2. Arrange the samples in separate tubs or bins and label each with the range in depth it represents, i.e. 0-5 feet, 5-10 feet. Then put the tubs in order from shallowest to increasing depth, which represents the materials as they would be encountered in the

borehole as drilling advances.

3. Place screens/sieves, hand spades and rulers next to the bins of material to assist the students understanding of grain-size distribution and sorting.
   Tips: Kitchen strainers work great as sieves, otherwise U.S. Standard Sieves are available for purchase, or you can construct sieves using wire cloth, 2x2s and heavy duty staples that can be purchased from Fleet Farm, Menards, etc.

Procedure

1. Describe the purpose of the lab; links to previous knowledge/experiences.
   Keep in mind: A high quality sand and gravel deposit should have:
   - *More than 20% gravel-sized particles*
   - *The deposit is 10 to 40 feet thick or greater*
   - *The deposit should be covered by less than 10 feet of overburden*
   - *The water table is deeper than 20 feet below the land surface (wet material)*
2. Describe or indicate on a map the source location of the "backyard aggregate".
   Students could hypothesize what materials they expect to encounter.
3. Provide students with the Subsurface Boring Log and instruct how observations of the material can be recorded in the Log with the help of the descriptive terminology included.
   a. Start by filling out the general information at the top of the Log with the students and begin to simulate the experience of heading out for a day of field work to explore for a new construction aggregate source.
   b. Next, students will begin drilling and "work their way through the borehole" by recording observations of the physical properties of the materials they encounter.
      Example: Medium to coarse-grained sand with some medium-grained gravel, brownish-yellow, poorly sorted, angular to rounded grains, and damp.
   c. Encourage students to try and identify weak materials that may not be suitable in a high quality deposit.
      i.e. materials that break apart easily, have cracks (fractures), absorb water, look "rusty" in appearance or give off pigment (which may indicate iron-oxide materials).

Part 2: Discussion of drilling results and uses of aggregate

1. What was the primary material type encountered in the borehole? Based on this borehole could the deposit be suitable for mining construction aggregates?

a. If the deposit is determined to be suitable for mining construction aggregates what challenges might be encountered next?

-Students should list things like distance to the market, competing land uses, local infrastructure (condition of the roadways for hauling), public perception on mining.

b. If the deposit is determined to be unsuitable for mining construction aggregates, why might that be?

-Students should ultimately conclude that geological processes are responsible for the distribution and quality of our aggregate resources. The deposit may be unsuitable due to weak particles or rock types, thickness of the deposit, amount of gravel, elevation of the water table, etc.

2. Brainstorm all the places you saw aggregates on your way to school today!

-Students should list things like: roads, sidewalks, basements, floors, block walls, culverts, dams, curbs, swimming pools, retaining walls, foundations, bridges, steps, drive ways, airport runways, tennis court.