Foundry Sand

Geotechnical Projects
Characteristics and Examples

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Public Service Announcement

What is a Foundry?

- A place where molten metal is poured into an engineered shape.
- “Castings” are used in all manufactured products.
- You are never more than six feet away from a casting.
- Demonstration

Are Castings Important?

Significant Importance

Casting Industry Historically Important

Why Elaborate on History?

- Survival of this industry is important to all of us, both from an economic standpoint and national security standpoint
- Recycling provides an opportunity to conserve natural resources, reduce all of our costs, preserve our environment, and make us all more cost competitive
- We should be the leaders in the world when it comes to innovation
- Our success as a country long-term depends upon finding sustainable solutions in manufacturing, rebuilding and expanding our infrastructure, and providing good paying jobs to build our economy

Foundry Sand

- What is it?
  - "Foundry Sand" is a specialty silica sand used to make a mold that comes in contact with the molten metal during the casting process.

Foundry Sand

Foundry Sand
Up Close and Personal

Typical Foundry Sands

- Uniform specific gradations and chemistries are desired in the casting process
- A number of different types of sands
  - Round Grain Silica and Lake Sands most common
- Mined in many parts of the United States
- Some regions of the US are more actively producing these sands

Before Using Sand in Casting Process

- Right Gradations and Chemistries Located
- Sand is Screened
- Impurities are Removed
- Fines are Removed
- Sand is Dried

Once Sand Arrives at Foundry

- Sand is prepared for casting process
  - Stabilized relative to temperature
  - Coated or mixed with other materials depending on casting process
  - Distributed to various machines to create molds or cores in preparation for introduction to molten metal

How Sands Are Used

Automated Molding Line

General Appearance

Can This Material Be Recylcled?

- Casting Process
- Asphalt
- Concrete
- Cement
- Horticultural Soils
- Potting Mixes
- Polymer Composites
- Remediation Product
- Embankment Material
- Sub-Base
- Leachate Collection
- ADC

What About Volumes?

- Casting Industry Generates Roughly 6 to 8 Million Tons of Sand in the US Annually
- Much of Material Generated Regionally
  - Upper Midwest
  - Alabama
  - Texas

What About Environmental?

- Many Factors
- Some General Observations
- Some Specific Considerations

Environmental Data Sets

- The Following Slides Show Comparative Analysis of Sands and Soils
  - Total Metals – Units MG/KG
  - Based on 17 No-Bake Samples, 11 Mold Sand Samples, 3 Mixed Sand Samples

Environmental Comparison Soils versus Sand (MG/KG)

Parameter	Store-Bought Soil	No-Bake Sand (Core)	Green Sand (Mold Sand)	Mixed Sand
Arsenic	15.3	<0.05	<1.9	<0.2
Barium	137	<0.04	11	1.93
Cadmium	1	<0.1	<0.42	<0.34
Chromium	33.3	<0.004	<19.6	<2.0
Lead	16.3	0.28	<2.6	<3.41
Mercury	0.16	<0.02	<0.1	<0.1
Selenium	3.3	<0.05	<0.3	<0.35
Iron	22,400	0.4	1,467	

Midwest Farm Soils vs. Foundry Sand

Parameter	Soils Bkgrd.	No Bake	Green Sand	Mixed Sand
Cadmium	0.2	<0.1	<0.42	<0.34
Chromium	12	<0.004	<14.6	<2.0
Copper	119	1	16.9	------
Lead	19	0.28	<2.6	<3.1
Mercury	------	<0.02	<0.1	<0.1
Zinc	75	1.6	<12.7	------

Environmental Considerations

- Almost all foundry sands are suitable for recycling in wide variety of applications
  - Exceptions – Sands from brass and bronze foundries pouring leaded alloys
- State Laws Dictate Allowable Applications
  - Wide Variety of What States Allow
  - Good Source of Information www.afsinc.org
    - Look at AFS FIRST Section

Engineering Information

- Granular Material
- Avg. Sieve Size Roughly 55 Mesh
- Dark Brown/Dark Gray in Color
- 85% Silica, Balance Primarily Clays
- Virgin Sands have less than 0.5% passing 200 Mesh – see a little more in recycled sands (1 to 4%)

Typical Physical Properties

Property	Results	Test Method
Specific Gravity	2.39 – 2.55	ASTM D854
Bulk Relative Density kg/m3 (lb/ft3)	2590 (160)	ASTM C48/ AASHTO T84
Absorption, %	0.45	ASTM C128
Moisture Content, %	0.1-10.1	ASTM D2216
Clay Lumps/Friable Particles	1-44	AASHTO C142/AASHTO T 112
Coefficient of Permeability (cm/sec)	10 minus 3 – 10 minus 5	AASHTO T215/ASTM D2434
Plastic Limit/Plastic Index	Nonplastic	AASHTO T90/ASTM D4318

Physical Properties

- Tell Us
  - Size and Distribution of sand is uniform
  - Particle Shape Sub angular to rounded
  - Low absorption and nonplastic (variations in absorption can be attributed to different binder systems)

Typical Mechanical Properties

Property	Result	Method
Micro-Deval Abrasion Loss, %	< 2	----------
Magnesium Sulfate Soundness Loss	5-15 6-47	ASTM C88
Friction Angle (deg)	33-40	---------
California Bearing Ratio, %	4-20	ASTM D 1883

Mechanical Properties

- Tell us:
  - FS has good durability characteristics as measured by the MD abrasion and magnesium sulfate soundness loss
  - If you have a higher soundness loss, usually attributed to samples of bound sand not a breakdown of individual sand grains
  - Friction angle in the range of conventional sands

Geotechnical Expertise

- Tomorrow's Presentation – John Dingeldein, PE
- Very Good Source of Information
- Long History of Project Work – Variety of Applications
- Highly Advise Discussing His Experience Working with Foundry Sands

Geotechnical Characteristics

- Sand Classification AASHTO = A3, USCS =SP
- Typical Proctor B/W 109 and 122 pcf at optimum moisture content of 15%
- Friction Angle = 35 Degrees
- Resistivity > 5,600 ohm-cm

Geotechnical Characteristics

- pH for molding sands usually aroun 9.0 with others closer to neutral and a few can be slightly acidic (depending on binder)
- Typical Sulfates Molding Sand < 100 ppm
- Typical Chloride Levels Molding sand < 40 ppm

Some Project Examples

- Road Projects
- Sub-Base Projects

Road Projects

Pictures From Road Project

Another Road Project

Ohio Turnpike - KBI

Ohio Turnpike - KBI

CLSM Project

CLSM Project

Bottom Line

- Foundry Sands Can Be Utilized in Myriad of Applications
- Really Talking About Sand
- Uniform Material
- Cost Advantages
- Environmental Advantages
- Help is Available

The End – Thank You (Go Irish!)

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