544. **Amelioration of physical strength in waste foundry green sands for reuse as a soil amendment.**
de Koff, J. P.; Lee, B. D.; and Dungan, R. S.
Journal of Environmental Quality 37(6): 2332-2338. (Nov. 2008-Dec. 2008)
NAL Call #: QH540.J6; ISSN: 0047-2425 .
18948487
Descriptors: green sands/ foudry waste/ soil amendment
Abstract: To avoid increasing costs of landfill disposal, it has become increasingly important for U.S. foundries to identify beneficial reuses for the 8 to 12 million tons of waste foundry sand (WFS) generated annually. A major drawback to the reuse of some WFSs as a soil amendment is their high soil strength, under dry conditions, where root growth may be limited. Fifteen WFSs were analyzed for strength to rupture using lab-formed clods, exchangeable cations (Na, Mg, Ca), metal oxide concentration (Fe, Mn, Al, Si), cation exchange capacity (CEC), and % clay. Several WFS samples from gray iron foundries demonstrated high strength to rupture values (> 1.5 MPa), and could potentially restrict root growth in amended soils. The percentage of Na-bentonite exhibited a positive correlation (R(2) = 0.84) with strength to rupture values. When WFSs containing more Na-bentonite were saturated with 1 mol L(-1) Ca ions, strength values decreased by approximately 70%. Waste foundry sands containing less Na-bentonite were saturated with 1 mol L(-1) Na ions and exhibited a threefold increase in strength. Additions of gypsum (up to 9.6 g kg(-1) sand) to high strength waste foundry sands also caused decreases in strength. These results indicate that high strength WFSs have properties similar to hardsetting soils which are caused by high Na(+) clay content and can be ameliorated by the addition of Ca(2+).
This citation is from PubMed.

545. **Blending foundry sands with soil: Effect on dehydrogenase activity.**
Dungan, R. S.; Kukier, U.; and Lee, B.
Science of the Total Environment 357(1/3): 221-230. (2006)
NAL Call #: RA565.S365; ISSN: 0048-9697
Descriptors: binding agents/ biological activity in soil/ copper/ enzyme activity/ landfills/ lead/ microbial activities/ oxidoreductases/ sand/ soil amendments/ zinc/ redox enzymes
Abstract: Each year U.S. foundries landfill several million tons of sand that can no longer be used to make metalcasting molds and cores. A possible use for these materials is as an ingredient in manufactured soils; however, potentially harmful metals and resin binders (used to make cores) may adversely impact the soil microbial community. In this study, the dehydrogenase activity (DHA) of soil amended with molding sand (clay-coated sand known as "green sand") or core sands at 10%, 30%, and 50% (dry wt.) was determined. The green sands were obtained from iron, aluminum, and brass foundries; the core sands were made with phenol-formaldehyde or furfuryl alcohol based resins. Overall, incremental additions of these sands resulted in a decrease in the DHA which lasted throughout the 12-week experimental period. A brass green sand, which contained high concentrations of Cu, Pb, and Zn, severely impacted the DHA. By week 12 no DHA was detected in the 30% and 50% treatments. In contrast, the DHA in soil amended with an aluminum green sand was 2.1 times higher (all blending ratios), on average, at week 4 and 1.4 times greater (30% and 50% treatments only) than the controls by week 12. In core sand-amended soil, the DHA results were similar to soils amended with aluminum and iron green sands. Increased activity in some treatments may be a result of the soil microorganisms utilizing the core resins as a carbon source. The DHA assay is a sensitive indicator of environmental stress caused by foundry sand constituents and may be useful to assess which foundry sands are suitable for beneficial use in the environment. Reproduced with permission from the CAB Abstracts database.

546. **The characterization of total and leachable metals in foundry molding sands.**
Dungan, R. S. and Dees, N. H.
Journal of environmental management 90(1): 539-548. (2009)
NAL Call #: HC75.E5J6; ISSN: 03014797 [JEVMA].
Notes: doi: 10.1016/j.jenvman.2007.12.004.
Descriptors: beneficial use/ foundry/ leaching/ metals/ molding sand/ SPLP/ TCLP/ aluminum/ antimony/ arsenic/ barium/ beryllium/ boron/ cadmium/ chromium/ cobalt/ copper/ iron/ lead/ magnesium/ manganese/ metal/ molybdenum/ nickel/ silver/ vanadium/ zinc/ chemical analysis/ concentration (composition)/ leaching/ toxicity/ trace metal/ agricultural land/ chemical analysis/ chemical binding/ foundry/ leaching/ precipitation/ sand/ soil pollution/ solid waste/ toxicity testing/ water contamination
Abstract: Waste molding sands from the foundry industry have been successfully used as a component in manufactured soils, but concern over metal contamination must be addressed before many states will consider this beneficial use. Since there is little data available on this topic, the purpose of this study was to characterize total and leachable metals from waste molding sands. A total elemental analysis for Ag, Al, As, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, Sb, V, and Zn was conducted on 36 clay-bonded and seven chemically bonded molding sands. Total metal concentrations in the molding sands were similar to those found in agricultural soils. The leaching of metals (i.e. Ag, As, Ba, Be, Cd, Cr, Cu, Ni, Pb, Sb, and Zn) was assessed via the toxicity characteristic leaching procedure (TCLP), synthetic precipitation leaching procedure (SPLP), and ASTM water leach test. Based on the TCLP data, none of the 43 molding sands would meet the Resource Conservation and Recovery Act (RCRA) characteristic for toxicity due to high Ag, As, Ba, Cd, Cr, and Pb. Compared to the TCLP results, the metal concentrations were generally lower in the SPLP and ASTM extracts, which is likely related to the buffering capacity of the extraction fluids.

547. **The characterization of trace metals and organics in spent foundry sands over a one-year period.**
Dungan, R. S.
Journal of Residuals Science and Technology 5(3): 111-125. (2008); ISSN: 15448053
Descriptors: trace metals/ organic materials/ spent foundry sands/ beneficial use

Abstract: Millions of tons of spent sand, used to create metalcasting molds, are generated by the foundry industry each year In the United States. Not surprisingly, spent foundry sands (SFSs) are an excellent substitute for virgin sands that are currently used in manufactured soils and geotechnical applications. The purpose of this study was to characterize trace metals and EPA-priority polycyclic aromatic hydrocarbons (PAHs) and phenolics in ferrous and non-ferrous SFSs over a one-year period. Overall, the total metal concentrations in the SFSs were similar to those found in native soils, while the PAHs and phenolic concentrations were relatively low. Metal leaching tests were also performed, which revealed that the SFSs have a low metal leaching potential under the specific test conditions. The data from this study suggests that the majority of SFSs are not hazardous in nature, except those that use olivine sands or are from brass foundries, due to the presence of elevated concentrations of Ni or Cu, Pb, and Zn, respectively. This information will be useful to environmental regulators who are considering including SFSs in their beneficial use regulations. © 2008 DESTech Publications, Inc.

548. **Sand and organic amendment influences on soil physical properties related to turf establishment.**
McCoy, E. L.
Agronomy Journal 90(3): 411-419. (May 1998-June 1998)
NAL Call #: 4 AM34P; ISSN: 0002-1962 [AGJOAT]
Descriptors: Lolium perenne/ soil amendments/ peat/ sand/ soil physical properties/ topsoil/ guidelines / cation exchange capacity/ bulk density/ hydraulic conductivity/ soil organic matter/ porosity/ biomass production/ compression/ water availability/ humus/ cation exchange/ establishment/ bubbling pressure/ soil compression index
Abstract: Topsoil blending is a common practice in many metropolitan areas, yet few scientific guidelines are available for design of general-use, lawn-area soils. The objective of this study was to provide blending guidelines with focus on establishing a vigorous turfgrass ground cover. A Mahoning silt loam (fine, illitic, mesic Aerie Epiaqualf) and a Tioga loam (coarse-loamy, mixed, mesic Dystric Fluventic Eutrochrept) were each blended with a spent foundry sand and a peat humus to form 28 individual soil mixes for each native soil. Soil properties and perennial ryegrass (Lolium perenne L.) growth were measured for each soil mix. Cation exchange capacity (CEC), bulk density, and plant available water exhibited changes due to soil mix that largely resulted from differences in mix organic matter (OM) content. Compression index, bubbling pressure (Hb), air-filled porosity, and saturated hydraulic conductivity (Ksat) responded to both sand and OM contents of the soil mixes. The pore distribution parameter, gamma, exhibited a response to sand and OM contents, but only at high levels of either component. Principal component analysis (PCA) of soil properties revealed that the first two principal components contained 85 to 88% of the total data variation with correlations between compression index, Hb, air-filled porosity, Ksat, and gamma contained in the first component and correlation between CEC, bulk density, and available water contained in the second component. Regression of turf clipping yield vs. PCA factor scores and regression of factor scores vs. total sand and OM contents suggested that a high-quality, general-use soil for lawn establishment would contain about 65% sand and have an OM content of 8% by weight. The multivariate process of relating turf yield to soil physical properties, as applied in this study, should provide more generalized mix formulation guidelines than do recommendations based on relating turf yield to mix composition.
This citation is from AGRICOLA.

549. **Saturated hydraulic conductivity of soils blended with waste foundry sands.**
Dungan, R. S.; Lee, B. D.; Shouse, P.; and Koff, J. P. de
Soil Science 172(10): 751-758. (2007)
NAL Call #: 56.8 So3; ISSN: 0038-075X
Descriptors: bentonite/ clay soils/ Inceptisols/ industrial wastes/ loam soils/ Mollisols/ sand/ sandy loam soils/ saturated hydraulic conductivity/ soil amendments/ waste utilization/ pedotransfer function
Abstract: Beneficial uses are being sought after for the large quantities of waste foundry sand (WFS) that are landfilled. Potential applications include their use in synthetic soils and incorporation into agricultural soils. In this laboratory study, we investigated the saturated hydraulic conductivity (K_s) of sandy loam, loam, silty clay, and clay soils that were blended with WFS. Each soil was blended with 0% to 50% green sand (bentonite-coated sand) from an iron and aluminium foundry and a phenolic urethane no-bake sand from a steel foundry. The soils and foundry blends were packed into fixed-wall columns, and K_s was assessed using the constant and falling head methods. The results showed that K_s generally increased in a linear manner as the WFS blending ratio was increased in the soils. Compared with soil only, K_s increases were the greatest in the loam and silty clay soils; at 50% WFS, K_s was as much as 235- and 600-fold higher, respectively. However, K_s was lower over the blending range in soils containing green sands that were predominantly coated with sodium bentonite as compared with calcium bentonite. We attribute this to the high swelling properties of sodium bentonite.

550. **Use of spinach, radish, and perennial ryegrass to assess the availability of metals in waste foundry sands.**
Dungan, Robert S. and Dees, Nikki H.
Water, Air and Soil Pollution 183(1-4): 213-223. (July 2007)
NAL Call #: TD172 .W36; ISSN: 0049-6979
Descriptors: soil pollution/ polluted soils/ heavy metals/ waste disposal/ sand/ soil amendments/ Spinacia oleracea/ spinach/ Raphanus sativus/ radishes/ Lolium perenne/ grasses/ bioavailability/ uptake mechanisms/ bioaccumulation/ chemical constituents of plants
Abstract: Plant uptake is a major pathway by which toxic metals can enter the food chain. In this laboratory study we grew spinach, radish, and perennial ryegrass on sand blends containing 50% waste foundry sand (WFS) to assess the availability of Al, B, Ba, Be, Cd, Co, Cr, Cu, Fe, Mg, Mn, Mo, Ni, Pb, V, and Zn. The WFSs utilized in this study were from aluminum, iron, and steel foundries. Although there were differences in the amounts of metals accumulated by the various plant species, excessive amounts of heavy metals were not taken up, regardless of WFS treatment. In spinach and radish, B, Cu, Fe, Mn and

Zn were found to be within or close to the sufficiency range for agronomic crops. In ryegrass cuttings at 27, 57, and 87 days, Cu and Zn were within sufficiency ranges, but plants were Fe deficient and contained elevated concentrations of B, Mn, and Mo. Data from this study will be useful for state regulatory agencies interested in developing beneficial use regulations for WFSs.
This citation is from AGRICOLA.