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2.2.5 Strong Ground Motion Measurements -- 2.2.6 Shear Strength Estimation Based on Stability Observations -- 2.3 Intrusive Field Measurement Techniques -- 2.3.1 General -- 2.3.2 Borehole Sampling and Testing -- 2.3.2.1 Types of Borehole Tests. A variety of different types of field measurements can be made on samples recovered from boreholes or on the waste mass surrounding a borehole. Compositional classification of bulk samples recovered from a borehole i -- 2.3.2.2 Complications Inherent to Borehole Sampling and Testing. Obstructions and large pieces of solid waste may necessitate special drilling equipment and can, in the worst case, prevent drillers from reaching target drilling depth. If a recovery -- 2.3.2.3 Health and Safety Considerations. Intrusive investigation at landfill sites (e.g., advancement of boreholes for sampling, testing, and/or instrumentation) is complicated by various health and safety concerns posed by the presence of potenti.
2.3.2.4 Disposition of Investigation Derived Waste. Another consideration associated with drilling (and trenching) in waste is the disposition of investigation-derived waste (IDW). The IDW includes drill cuttings, liquid, and drilling mud. If inves -- 2.3.2.5 Borehole and Test Pit Sampling. Bulk samples of MSW recovered from conventional and bucket-auger boreholes, and test pits are often visually classified and tested for moisture content in the field. Although standard visual classification an -- 2.3.2.6 Borehole and Test Pit Unit Weight Testing. To measure in situ unit weight at four MSW landfill sites in California, Geosyntec (1996) developed a borehole unit weight (density) test. This test was patterned after the sand cone density test -- 2.3.2.7 Borehole Hydraulic Conductivity Testing. Several in situ testing methods have been used to assess the hydraulic conductivity of waste utilizing boreholes, wells, and/or temporary piezometers. These tests are generally carried out by a monit -- 2.3.2.8 Borehole Wave Propagation Velocity Testing. Wave propagation velocity testing can be conducted in a borehole using cross-hole, down-hole, and/or in-hole methods. Cross-hole testing can be conducted if there are two or more boreholes spaced -- 2.3.2.9 Borehole Electrical and Nuclear Testing. A variety of electrical and nuclear measurements can be conducted in a borehole advanced through MSW, including "conventional" (i.e., such as those used in the oil exploration industry) down-hole ele -- 2.3.2.10 Borehole Pressuremeter Testing. The use of a pressuremeter to evaluate the mechanical properties of MSW was reported by Dixon et al. (1999 , 2006). These authors employed an 83mm diameter, 1.2m long self-boring pressuremeter in a "pre.
2.3.2.11 Borehole Standard Penetration Test and Becker Penetration Test. Both the SPT and the BPT have been conducted at MSW landfills mostly for sample recovery and visual field and/or laboratory classification. Gabr and Valero (1995) used the r -- 2.3.2.12 In Situ Direct Shear Tests. Richardson and Reynolds (1991) and Houston et al. (1995) conducted large-scale in situ direct shear tests on MSW. The general procedure for these tests consisted of isolating a "pedestal" of waste by excavat -- 2.3.2.13 Internal Deformation Measurements. Internal measurements of vertical and lateral deformation within a waste mass can provide both direct and indirect information on in situ waste characteristics. Internal deformation measurements made over -- 2.3.2.14 Internal Moisture Content and Temperature Measurements. In situ moisture content and temperature measurements are often performed together. These measurements can provide insight into moisture distribution and leachate flow within the wast -- 2.4 Hybrid Field Measurement Techniques -- 2.4.1 General -- 2.4.2 Cone Penetration Test

Soundings -- 2.4.3 Dilatometer and Seismic Dilatometer Testing -- 2.4.4 In Situ Measurement of Shear Modulus Reduction -- 2.5 Recommendations -- Acknowledgments -- References -- Chapter 3 : Laboratory Testing for Chemical Characterization of Solids, Liquids, and Gases -- 3.1 Introduction -- 3.2 Solid Analysis Methods -- 3.2.1 Bulk Chemical Analysis -- 3.2.2 Mineralogical Analysis -- 3.3 Liquid Analysis Methods -- 3.3.1 General Parameters -- 3.3.2 Analysis of Metals and Metalloids -- 3.3.3 Analysis of Organics -- 3.3.4 Analysis of Other Compounds and Parameters -- 3.4 Gas Analysis -- 3.4.1 Questionnaire -- References -- Part 3: Waste Material Properties -- Chapter 4: Hazardous Waste -- 4.1 INTRODUCTION. 4.2 DEFINITION AND IDENTIFICATION PROCESS FOR HAZARDOUS WASTE -- 4.2.1 Listed Hazardous Waste -- 4.2.2 Characteristic Hazardous Waste -- 4.2.3 Hazardous Wastes, Constituents, Chemicals, and Substances -- 4.3 CRADLE-TO-GRAVE REGULATORY FRAMEWORK -- 4.3.1 Hazardous Waste Generation and Transportation -- 4.3.2 Hazardous Waste Recycling, Treatment, Storage, and Disposal -- 4.4 REQUIREMENTS FOR HAZARDOUS WASTE LANDFILLS -- 4.4.1 Double-Liner System -- 4.4.2 Action Leakage Rate and Response Action Plan -- 4.4.3 Closure and Postclosure Care -- 4.5 RESOURCE CONSERVATION AND RECOVERY ACT LAND DISPOSAL RESTRICTIONS -- 4.5.1 Basic Requirements and Treatment Standards -- 4.5.2 Alternative Land Disposal Restrictions for Contaminated Soils -- 4.6 REMEDIATION OF CONTAMINATION AT RESOURCE CONSERVATION AND RECOVERY ACT HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES -- 4.7 REMEDIATION OF CONTAMINATION AT NON-RESOURCE CONSERVATION AND RECOVERY ACT SITES UNDER COMPREHENSIVE ENVIRONMENTAL RESPONSE COMPENSATION AND LIABILITY ACT -- 4.7.1 Comprehensive Environmental Response Compensation and Liability Act Basics -- 4.7.2 Comprehensive Environmental Response Compensation and Liability Act Removal Actions and Remedial Actions -- 4.7.3 Comprehensive Environmental Response Compensation and Liability Act Applicable or Relevant and Appropriate Requirements -- 4.7.4 Redevelopment of Remediated Comprehensive Environmental Response Compensation and Liability Act Sites -- 4.8 SPECIAL REQUIREMENTS FOR MANAGING AND DISPOSING POLYCHLORINATED BIPHENYL WASTES -- 4.9 SPECIAL REQUIREMENTS FOR MIXED WASTES -- REFERENCES -- Chapter 5 : Municipal Solid Waste: Characterization and Engineering Properties -- 5.1 Introduction -- 5.2 Municipal Solid Waste Composition -- 5.3 Solid Waste Structure -- 5.4 Biogas Generation -- 5.5 Unit Weight -- 5.6 Moisture Content. 5.7 Field Capacity -- 5.8 Hydraulic Conductivity -- 5.9 Shear Strength -- 5.10 Compressibility and Settlement -- 5.11 Dynamic Properties -- References -- Chapter 6 : Coal Combustion Residuals -- 6.1 Background -- 6.2 Environmental Regulation -- 6.3 Characteristics and Properties of Coal Combustion Residuals -- 6.3.1 Size and Shape -- 6.3.2 Chemical Composition -- 6.3.3 Classification of Fly Ashes -- 6.3.4 Particle Size Distribution -- 6.3.5 Specific Gravity -- 6.3.6 Loss on Ignition -- 6.3.7 Compaction -- 6.3.8 Shear Strength -- 6.4 Beneficial Use of Coal Combustion Residuals -- 6.4.1 Reuse of Coal Combustion Residual (Particularly Fly Ash) -- 6.4.1.1 Encapsulated Beneficial Uses. The two largest encapsulated uses reported by ACAA in 2014 are fly ash used in "concrete/concrete products/grout" (13.12 million tons) and flue gas desulfurization (FGD) material (i.e., gypsum) used in gypsum pa -- 6.4.1.2 Unencapsulated Beneficial Use. Unencapsulated uses of coal ash are those where the coal ash is used in a loose particulate, sludge, or other unbound form. In 2019, ACAA reported about 9% of

generated CCRs (1.5 million tons) are beneficially -- 6.4.2 Environmental Concerns -- References -- Chapter 7 : Woody Biomass Fly Ash: Properties and Engineering Applications -- 7.1 Introduction -- 7.2 Biomass Ash -- 7.3 Characterization of Physical and Chemical Properties -- 7.3.1 Particle Morphology and Particle Size -- 7.3.2 Specific Gravity -- 7.3.3 Chemical Composition and Classification of Biomass Fly Ash -- 7.3.4 Organic Content: Loss on Ignition versus Residual Organic Carbon -- 7.4 Engineering Properties and Applications -- 7.4.1 Biomass Fly Ash in Concrete -- 7.4.2 Biomass Fly Ash for Soil Improvement -- 7.4.3 Biomass Fly Ash as Mine Backfill.
7.4.4 Biomass Fly Ash for Waste Solidification/Stabilization.

Sommario/riassunto

MOP 159 provides an overview of a variety of aspects of geoenvironmental engineering, outlining design procedures and recommendations in engineering practice when appropriate.