Wastewater Treatment Fundamentals II – Solids Handling and Support Systems

Chapter Summary and Time Allotments

Chapter Title	Learning Objectives	Completion CE Credits
Chapter 1 Introduction to Solids Handling	• Identify the different types of residuals generated during wastewater treatment and give general characteristics for each. • List five objectives for solids handling. • Estimate primary sludge production in both mass and volume. • Calculate sludge volume reduction following thickening and/or dewatering. • List and describe the four types of water present in sludge. • Explain why dewatered sludge concentrations are limited. • Determine which types of sludge are easiest and most difficult to thicken and dewater. • Select an appropriate conditioning chemical. • Conduct jar testing and apply results to full-scale operation. • Interpret results from jar testing and time to filter tests. • Summarize U.S. EPA Standards for the Use or Disposal of Sewer Sludge (40 CFR Part 503).	**0.6 CEUs**
Chapter 2 Thickening	• List the main objectives of thickening. • List the common types of thickening equipment used in a WRRF. • Calculate process control variables including hydraulic loading rate and solids loading rate. • Start up, operate, and shut down various thickening devices. • Explain how thickening reduces electrical and operating costs at a WRRF. • Understand how to troubleshoot and maintain various thickening devices. • Review of what polymers are and why they are used in thickening and dewatering • Explain the O&M basics for dry polymer and emulsion polymer systems. • Understand how to determine polymer feed rates to optimize thickener performance. • List safety risks to be aware of when working around thickening and polymer equipment.	**0.6 CEUs**
Chapter 3 Aerobic Digestion	• List five objectives of aerobic digestion. • List the different groups of bacteria likely to be present in aerobic digesters. • Describe the different biological reactions that can take place in aerobic digesters.	**0.6 CEUs**

	• Explain the concept of endogenous respiration. • Compare and contrast the fate of ammonia in aerobic digesters and ATAD. • Calculate process control variables including hydraulic detention time (HDT), solids retention time (SRT), volatile solids (VS) loading rate, and percent volatile solids reduction (%VSR). • Collect process control samples, conduct testing, and evaluate results. • Start up a new aerobic digester, place a digester into service, and remove a digester from service. • Implement corrective actions to maintain pH and alkalinity within accepted limits. • Troubleshoot common aerobic digestion process control and mechanical problems.	
Chapter 4 Anaerobic Digestion	• List five possible objectives of anaerobic digestion. • List the different groups of bacteria likely to be present in anaerobic digesters. • Explain the concept of fermentation. • Describe the different biological reactions that can take place in anaerobic digesters. • Explain why a constant feed rate is important in anaerobic digestion. • Explain how temperature affects the performance of an anaerobic digester. • Calculate process control variables including hydraulic detention time, solids retention time, volatile solids loading rate, volatile acid to alkalinity ratio, and percent volatile solids reduction. • Collect process control samples, conduct testing, and evaluate results. • Start up a new anaerobic digester, place a digester into service, and remove a digester from service. • Implement corrective actions to maintain pH, alkalinity, and digester gas composition within accepted limits. • Explain why digester supernatant recycle that goes back to the liquid treatment process must be monitored and managed. • Determine when to stop feeding a secondary anaerobic digester. • Troubleshoot common anaerobic digestion process control and mechanical problems.	**0.6 CEUs**
Chapter 5 Dewatering	• Explain the purpose of dewatering. • Explain the advantages/disadvantages of mechanical dewatering versus air drying. • List the common types of mechanical dewatering equipment used at water resource • recovery facilities (WRRFs). • Calculate process control variables including hydraulic loading and solids loading rates. • Start up, operate, and shut down different types of dewatering systems.	**0.6 CEUs**

	• Explain how dewatering is required to meet regulatory requirements and how it increases disposal options, reduces hauling costs, and often reduces other disposal costs. • Understand how to adjust polymer feed rates to optimize dewatering performance. • Describe how to troubleshoot and maintain various types of mechanical dewatering systems and drying beds. • Understand various common types of sludge conveyance equipment. • Understand basics of sludge storage and hauling practices.	
Chapter 6 Electrical Fundamentals and Motors	• Define electricity and list at least two conducting and two insulating materials. • Describe the relationship between electricity and magnetism. • Compare and contrast electrical and hydraulic system operating variables. • Use Ohm's Law and the Power Wheel to calculate voltage, resistance, current, and power for an electrical circuit. • Calculate the cost to operate a piece of electrical equipment. • Compare and contrast series and parallel electrical circuits. • Compare and contrast direct versus alternating current. • Explain how various types of electrical equipment work, including solenoids, transformers, and disconnects. • Explain how different types of electric motors operate and list their components. • Interpret information listed on an electrical motor name plate. • Interpret electrical drawings and trace the path of power from the source to a piece of equipment. • Describe the hazards of working with electricity and methods for mitigating those hazards.	**0.6 CEUs**
Chapter 7 Pumps and Lift Stations	• List the main purposes for using pumps and lift stations. • Define hydraulic terms and explain how they relate to pump operation. • List the defining characteristics of different types of pumps. • Select a pump type given information about the fluid or solids to be pumped and the • application. • Identify the components of different types of pumps and explain their function. • Explain the fundamental principles (theory) behind the operation of different types of pumps. • Calculate water, brake, and motor horsepower. • Determine why a pump may be cavitating and plan a course of action to eliminate cavitation when it occurs.	**0.6 CEUs**

	• Identify the best efficiency point and the preferred operating region of a pump. • Use the pump affinity laws to calculate the new flow output, discharge head, amp draw, and brake horsepower for a centrifugal pump after changing either the impeller diameter or motor speed. • Safely start up and operate different types of pumps. • Perform basic maintenance and troubleshooting on different types of pumps. • Identify lift station components. • Start up and shut down a lift station. • Perform basic maintenance and troubleshooting of lift stations.	
Chapter 8 Aeration Systems	• Describe the purpose of aeration systems. • Compare and contrast different types of aeration systems. • Explain the various components in a diffused aeration system. • Describe the maintenance tasks required for different types of blowers and diffusers. • Explain the basic types of control strategies used on aeration systems. • Identify the basic components and operating principles of mechanical aerators. • Describe the maintenance of common mechanical aerators.Describe how hydraulic and solids loading parameters are calculated for secondary clarifiers and the relative importance of each. • Explain how the maximum solids loading rate to a secondary clarifier depends on sludge settling characteristics. • Collect process control samples, conduct testing, and evaluate results. • Start up a new activated sludge process, place a basin into service, or take one out of service. • Troubleshoot common activated sludge and secondary clarifier process control and mechanical problems. • Discuss differences between different types of activated sludge processes (complete mix, step feed, oxidation ditch, pureox, etc.). Understand that they are all based on the same underlying biological principles	**0.6 CEUs**
Chapter 9 Laboratory Procedures	• Compare and contrast various types of flow measurement devices. • Select the most appropriate type of flow measurement device for a particular application. • Explain the purpose behind each type of quality control sample, including blanks, duplicates, replicates, standards, calibration standards, calibration verification samples, spikes, and spike duplicates. • Select appropriate quality control samples based on analyte, how the data will be used, and regulatory requirements.	**0.6 CEUs**

	• Evaluate results from quality control samples to determine the most likely source of error in an analytical measurement. • Explain Beer's Law and how it applies to testing with colorimeters and • spectrophotometers. • Apply fundamental principles of colorimeters and spectrophotometers to analyze samples • for a wide variety of parameters including chemical oxygen demand and nutrients. • Conduct the following analyses: ♦ pH ♦ alkalinity ♦ total solids and total volatile solids ♦ total suspended solids (TSS) and total volatile suspended solids ♦ biochemical oxygen demand (BOD) ♦ carbonaceous biochemical oxygen demand (CBOD) ♦ soluble BOD and CBOD • Assess raw analytical data to determine whether to accept or reject results. • Perform all necessary calculations to transform raw analytical data into reportable results.	
Chapter 10 Chemical Storage, Handling, and Feeding	• Identify the most common chemicals used in wastewater treatment and their purpose. • Understand the steps in the chemical supply chain. • Know how to safely off-load bulk chemicals. • Understand why and what personal protective equipment (PPE) is required when working • with chemicals. • Discuss the dependence of reaction order on reactant concentration. • Calculate a feed rate for a desired dose. • Calculate a dose given a feed rate. • Calculate the stoichiometric dose required given a balanced chemical equation. • Explain the difference between neat, dry, and active chemicals. • Calculate the mass of active chemical in neat chemical. • Understand the equipment and operations and maintenance of chemical feed systems.	**0.6 CEUs**
Final Exam	• Randomized 100 question final exam cover questions from each chapter. Must achieve a passing score of 70%.	**Total Credits – 6.0 CEUs or 60 Hours**