



2014 Wastewater Exam Cram Topic Descriptions

Day One

Basic Math: This two hour section covers math basics including the Order of Operations, basic algebra and rearranging equations, dimensional analysis (unit conversions), tank geometries including areas, volumes, and perimeters, hydraulic retention time, velocities in pipes and open channels, pressure head, pump horsepower, and chemical dosing. Attendees work a variety of problems with the guidance of the instructor.

Pumps: This **60-minute** section discusses the different kinds of pumps used in water and wastewater treatment including centrifugal, positive displacement, peristaltic, and more. Components of each pump and mechanism of action are discussed as well as typical uses. Other topics include: cavitation, pump curves, the pump affinity laws, and total dynamic head. This presentation is supplemented with many wonderful pump animations provided by various pump manufacturers that are linked to through youtube.

Lift Stations and Corrosion Control: This **60-minute** presentation discusses dry pit and wet pit lift stations, pump arrangement, level indicator equipment, and basic lift station operation and maintenance. It includes a brief discussion of confined space entry and the safety hazards that may be present in lift stations. Types and causes of different types of corrosion are discussed as well as mitigation techniques including coatings, wrapping, and cathodic protection.

Lagoons and Fixed Film Processes: This **90-minute** section presents the method of operation for lagoons and various fixed film processes including trickling filters, rotating biological contactors, biological aerated filters, and others. Basic design principals are discussed for lagoons as well as biological processes taking place in aerobic, facultative, and anaerobic ponds. Differences between fixed film systems and suspended growth / hybrid systems are discussed as well as typical operating ranges for each system type including hydraulic and organic loading rates. This course is supplemented with many photographs showing different technologies with descriptions of the functions of various pieces such as the plenum, underdrain, and distributors.

Chlorine Disinfection: This **two-hour** presentation walks the participant through chlorine chemistry, the different forms of chlorine available for disinfection, and chlorine safety. This class devotes time to the safe handling of gaseous and liquid chlorine and reporting requirements under SARA Title III. The

class covers recommended doses and contact times for various applications as well as the impact of water chemistry and temperature on disinfection.

Day Two

Advanced Math Topics: This two hour section covers more advanced math problems including dilutions, activated sludge (F:M, MCRT, space loading, SOR), solids handling (percent VSS reduction, land application rates), and velocities in partially full pipes given flow rate and slope. The advanced math topics course is tailored for each group of students to accentuate topics of interest such as collection systems, water chemistry, or activated sludge.

Activated Sludge Basics: This three hour section introduces participants to the basics of activated sludge. It presents fundamental concepts such as space loading, F:M ratio, MCRT, SRT, solids loading and flux to the secondary clarifier, and surface overflow rate. We focus on how each of these variables is interrelated and how changing one necessarily changes the others. Typical ranges for conventional and extended aeration activated sludge plants are compared. Different types of activated sludge systems are discussed with a focus on flow patterns (complete mix, plug flow, batch) versus operational method (pureox, conventional, extended aeration, step feed, high rate, etc.). Simple process diagrams and photographs of each process type are included.

Nitrogen Removal: This **90-minute** presentation covers ammonia removal by non-biological methods, biological nitrification, and denitrification. Topics that are covered include: the organisms responsible for nitrification and denitrification, stoichiometry, variables that impact performance, the different types of unit processes (fixed films and activated sludge) that can be used for nitrogen removal, ion exchange, and breakpoint chlorination.

Phosphorus Removal: This **60-minute** presentation covers the basics of biological and chemical phosphorus removal. Topics include: regulatory drivers, Phosphate Accumulating Organisms (PAOs), luxury uptake of phosphorus, the effect of various operational variables on phosphorus uptake, chemical phosphorus removal through precipitation, and the need for tertiary filtration.

Day Three

Aerobic and Anaerobic Digestion: A brief overview of the 503 regulations and the need for biosolids processing kicks off this informative presentation. The focus is specifically on aerobic and anaerobic digestion with an in-depth discussion of components (parts and purpose including lids, gas collection, mixing techniques, heat exchangers, and more), typical design and operating criteria, indications of souring, and process control calculations specific to anaerobic digestion. The biological mechanisms behind aerobic and anaerobic digestion are discussed with a focus on the specialized organisms responsible. Typical operating parameters for each unit process are presented along with methods for calculating them.

Dewatering (Belt Filter Presses and Centrifuges): This course is devoted to operation and maintenance of dewatering devices with a focus on belt filter presses and centrifuges. It begins with a thorough discussion of belt filter press theory followed by a close examination of the components of the press itself. Centrifugal dewatering theory followed by a close examination of the equipment components. The second half of the course is devoted to process control calculations and adjustments specific to belt filter presses and centrifuges followed by a section on troubleshooting.

Applied Biosolids Math: We'll take two different case studies for anaerobic digester upsets and use raw data to both calculate typical process control variables and troubleshoot the digester. Participants will be broken into small groups where they will be fed real operating data from two different anaerobic digester upsets. Participants will have to perform calculations and determine corrective actions. They will also be asked to theorize on the cause of each upset. Each case study consists of three rounds of process data. We'll do a similar case study for belt filter press operation.

Laboratory Testing Methods: This two and a half hour presentation goes over these essential wastewater tests and includes tons of pictures of analyses in progress. Many treatment plants have separate laboratories which makes it difficult for front-line operators to learn these valuable skills. Focus will be on correct procedure, required quality control, and potential certification test questions.