WWT-007: Activated Sludge Basics: A Mechanical Approach

Time: 120 minutes

Description: If activated sludge has never made sense to you, but engines and other mechanical devices do, then this is the course for you. Inspired by the chief of maintenance at a Colorado WWTP, this course looks at activated sludge from a mechanical perspective and introduces bacteria as the little combustion engines that they are. Seeing the mechanical inputs makes the inner workings of activated sludge crystal clear.
At the end of this course, the student should be able to:

1) Explain the basic microbial metabolism.
2) Discuss microbial fuel sources specifically pertaining to activated sludge digestion.
3) Identify the dominant microbes in sludge system components and their products.
4) Calculate process control variables and balance them in a sludge system.
5) Apply the sludge volume index test process components to troubleshoot.
1) Activated Sludge Process
   a. Components
   b. Microorganisms
      i. Microbe Operations Analogies
      ii. Microbe types
         1. Facultative heterotrophs
         2. Nitrifying autotrophs
      iii. Growth Comparison
      iv. Microbe forms
      v. Activated Sludge Floc
      vi. Microbe survival parameters
   c. Process Control
      i. Waste Activated Sludge
      ii. Return Activated Sludge

2) Relational Definitions
   a. Food to Microorganism Ratio
   b. Mean Cell Residence Time
      i. Explanation
      ii. Calculation
      iii. Sludge Age
   c. Volatile Fraction of MLSS
   d. Space Loading
   e. Relationship between variables

3) Calculation Definitions
   a. Surface Overflow Rate
   b. Weir Loading Rate
   c. Solids Loading Rate
   d. Solids Detention Time

4) Sludge Volume Index
   a. Settleability Testing
   b. Calculations
   c. Test Procedures
   d. Problems in Testing
   e. Troubleshooting Process Control
Sidney has more than twenty years of experience in environmental services including contract wastewater operations, operator training, utility planning, biochemical treatment processes, comprehensive performance evaluations, wastewater process modeling, laboratory operations, environmental assessments, environmental permitting and compliance, chemistry, and toxicology.

Sidney is a certified A wastewater and A industrial treatment plant operator in Colorado. She served as the ORC for the CDOT/Jalisco groundwater treatment system at I–25 and Alameda and as a technical consultant on water treatment for CDOT. She was the ORC for the Northglenn WWTP and the Leprino Foods Company WWTP in Ft. Morgan, Colorado.

Sidney has developed numerous operations training programs for both water and wastewater and gives training classes and seminars across the United States. Her hands-on experience operating treatment plants helps to ensure operator friendly processes and final design. She is an adjunct professor at the Colorado School of Mines where she teaches Pollution Prevention.

Sidney began her career as a trace metals and wet chemistry chemist at Rocky Flats. She has over twelve years of direct laboratory experience in NELAC certified and Superfund laboratories. She conducts friendly laboratory audits and training for wastewater treatment plants throughout the United States.

Sidney has developed or audited BioWin computer models for nitrification, denitrification; and biological phosphorus removal for the $12 million Northglenn WWTP, the Boulder 75th Street WWTP, the Las Vegas Street WWTP in Colorado Springs, and several industrial facilities. Her Ph.D. research focused on biological nitrification and coursework focused on environmental regulations including water, air, landfills, and RCRA.

**Education:**
- Ph.D., Environmental Science & Engineering, Colorado School of Mines, 2001
- Master of Science, Environmental Science & Engineering, Colorado School of Mines, 1998
- Bachelor of Science, Chemistry / Bachelor of Science, Biology, Regis University, 1993

**Certifications:**
- Professional Engineer, Colorado, 38830
- Colorado Certified Class A Wastewater Treatment Plant Operator, #568, 12170
- Colorado Certified Class A Industrial Wastewater Treatment Plant Operator, #568, 12746

**Employment History:**
- August 1990 – May 1995  Rocky Flats Environmental Test Site – Chemist
- Sept 2001 – March 2002  RTW Engineering – Environmental Scientist
- March 2002 – October 2007  Integra Engineering – Environmental Scientist
- October 2007 – Present  Indigo Water Group – Principal and Founder
Offices:  Water Environment Federation Plant Operations and Maintenance Committee
Vice-Chair
Past Offices Held:
   Rocky Mountain Water Environment Association Membership Chair
   Rocky Mountain Water Environment Association Professional Wastewater Operators Chair
   Technical Program Chair for RMSAWWA / RMWEA Joint Annual Conference
       (Five years: Casper, Angel Fire, Grand Junction, Steamboat Springs, and Copper Mountain)
   WEFTEC Program Committee Chair for Plant Operations and Maintenance Symposia

SELECTED PROJECT EXPERIENCE

Utility Planning
- Clifton Sanitation District Wastewater Utility Plan Update, Clifton, Colorado – Principal
- Town of Erie Wastewater Utility Plan Update, Erie, Colorado – Principal
- Water and Wastewater Utility Planning, Victor, Colorado – Principal
- Wastewater Utility Plan, Meeker, Colorado – Principal
- Wastewater Feasibility Study, Brush, Colorado – Project Manager
- Environmental Report for Wastewater Treatment Plant Upgrade, Brush, Colorado – Project Manager
- Wind Cave National Park Environmental Site Assessment, Wind Cave, South Dakota – Project Manager
- Wild Basin Lodge Utility Plan, Allenspark, Colorado – Principal / Project Manager
- Northglenn Wastewater Treatment Plant Utility Plan, Northglenn, CO – Environmental Scientist
- Wastewater Process Optimization and Facility Plan; Carbondale, CO – Project Manager
- Water and Wastewater Infrastructure Plan, Thornton, CO – Environmental Scientist
- Wastewater Treatment Plant Siting Study; Carbondale, CO – Project Manager
- Wind River Ranch Facility Evaluation and Regulatory Assistance; Estes Park, CO – Project Manager
- Nitrification Upgrades; Mountain Water and Sanitation District – Environmental Scientist
- Fairways Wastewater Treatment Plant, Boulder, CO – Project Manager
- City of Elko, Nevada Wastewater Treatment Plant Master Plan, Elko, Nevada – Senior Consultant

Comprehensive Performance Evaluations
- Fremont Sanitation District, Florence, Colorado – Principal
- Comprehensive Performance Evaluation, Town of Carbondale, Colorado – Project Manager
- Wastewater Feasibility Study, Brush, Colorado – Project Manager
- City of Victor, Colorado Wastewater Treatment Plant Comprehensive Performance Evaluation – Principal / Project Manager
- Town of Erie, Colorado South Wastewater Reclamation Facility Comprehensive Performance Evaluation
- Town of Meeker, Colorado Wastewater Treatment Plant Comprehensive Performance Evaluation
SIDNEY INNEREBNER, PH.D., P.E., C.W.P.

- Coors Brewing Company Comprehensive Performance Evaluation, Golden, CO – Environmental Scientist
- Elko Wastewater Treatment Plant, Elko, Nevada – Environmental Scientist
- City of Dinuba, California Wastewater Treatment Plant Comprehensive Performance Evaluation – Environmental Scientist
- Wild Basin Lodge, Allenspark, CO – Principal
- Wind River Ranch, Allenspark, CO – Principal

**Biological Process Modeling and Collection System Modeling**
- Hydrogen Sulfide Investigation, Clifton Sanitation District, Clifton, CO – Principal
- Biowin Modeling, Clifton Sanitation District, Clifton, Colorado – Principal
- Collection System Modeling, Brush, Colorado – Principal
- Collection System Modeling, Meeker Sanitation District, Meeker, Colorado – Principal
- Sewer Model Development and Evaluation; Northglenn, CO – Project Manager
- Sewer Model Development and Evaluation; Thornton, CO – Environmental Scientist
- BioWin Modeling and Basis of Design Review, Leprino Foods Company; Lemoore, CA
- Biowin Model Verification for Boulder 75th Street WWTP; Boulder, CO – Environmental Scientist
- Trickling Filter and Nitrifying Trickling Filter Optimization, Boulder, CO – Project Manager
- Biowin Modeling and Basis of Design, Northglenn WWTP; Northglenn, CO – Environmental Scientist

**Pilot Projects, Plant Start-Ups, Contract Operations, and O&M Manuals**
- Pilot Plant for Denitrification of RO Brine Reject, City of Brighton WTP, Brighton, CO – Subconsultant to JVA Engineering
- Wastewater Treatment Plant Startup Assistance, City of Buffalo, WY
- Chief Plant Operator – Leprino Foods at Fort Morgan, CO
- Backup Chief Plant Operator – City of Northglenn WWTP, Northglenn, CO
- Operator in Responsible Charge – Pump and Treat Groundwater System for Jalisco, International – Denver, CO
- Operations and Maintenance Manual – Town of Oak Creek WWTP, CO
- Operations and Maintenance Manual – Wolf Creek Ski Area WWTP, Pagosa Springs, CO
- Operations and Maintenance Manual – Three Lakes WWTP, Granby, CO
- Operations and Maintenance Manual – St. Vrain Sanitation District WWTP, Firestone, CO

**Training Courses**
- Over 22 years of experience as a trainer and tutor.
- Adjunct Professor at Colorado School of Mines.
- Invited guest lecturer at Red Rocks Community College, Boulder Operators School, Leadville Operators School, Boulder Fundamentals School, and University of Tennessee at Knoxville.
- Customized on-site training in a variety of topics for the following entities:
Training Course Development

- Small Water Systems Webinar Series – These webinar series was developed as part of a drinking water training grant from the State of Colorado Capacity Building Unit. The webinar series was based on ACRP’s course book – Introduction to Small Water Systems – and included 16 individual webinars that varied in length between 1 and 2 hours. In 2012, over 144 operators took part in the webinar series with 78 unique PWSIDs reached. Attendees completed an average of 11 webinars and more than 60 attendees completed all 17 webinars. Pre- and post–test score results for each webinar had an average improvement (average post–test scores minus average pre–test scores) between 11.7 and 33.9 percent. Improvements in the minimum scores were much more exaggerated with average minimum scores jumping by as much as 60 percent.

- Small Water Systems Workshops – Curriculum for these workshops were developed as part of a drinking water training grant from the State of Colorado Capacity Building Unit. Eleven on–site training workshops were conducted throughout the State. They focused on disinfection, averaged 16 attendees per class, and had a total of 176 attendees. For each workshop, the average post–test scores were between 17.6 and 40.3 percent higher than the pre–test scores. Even more impressive is the difference between the lowest test scores recorded at each venue at pre– versus post–testing. The lowest test scores jumped from as low as zero (none correct) to as high as 82.4 percent.

- One–Day Advanced Nutrient Removal Course – This one day training course covers Colorado nutrient criteria regulations, nitrification, denitrification, biological phosphorus removal, and chemical phosphorus removal. This advanced course discusses operational controls and troubleshooting. Participants use plant specific data to create mass balances, explore the impact of recycle streams, and troubleshoot case histories.

- Three Day Wastewater Exam Cram – Sidney developed all of the course materials for a three–day intensive wastewater training course meant as a review and preparation for operator certification exams. The three day course includes relevant topics for each level of certification and is organized so topics increase with difficulty as the course builds. Day one topics include basic math, pumps, lift stations, lagoons, fixed film
processes, disinfection, and completing the discharge monitoring report. Day two topics include advanced math, activated sludge basics, nitrogen removal, and chemical and biological phosphorus removal. Day three topics include solids handling, activated sludge troubleshooting, representative sampling, and various laboratory procedures. The course has been given between four and eight times a year for the past four years and has earned rave reviews from attendees.

- **On–Line Wastewater Training** – Sidney has developed ten on–line training course for water and wastewater operators that are hosted through the Indigo Water Group website. Topics include geometry, hydraulics basics, hydraulics and pumped systems, chlorine disinfection, lagoons and fixed film processes, lift stations, pumps, pretreatment and pollution prevention, nitrogen removal, and phosphorus removal. Since their introduction in August 2011, more than 100 operators have attended on–line courses.

- **Laboratory Training and Setup** – Sidney worked as a chemist at Rocky Flats and the Littleton/Englewood Wastewater Treatment Plant for the first twelve years of her career. Her laboratory skills are used to help small municipalities set up their on–site testing laboratories and to provide friendly audits to help ensure compliance with requirements under Standard Methods and EPA protocols. Some of the many municipalities that have received laboratory training include: Leprino Foods Company, Cargill Meat Solutions, Granby W&SD, the City of Victor, Tabernash Meadows, City of Dinuba, California, the Town of Silverthorne, Frisco Sanitation District, Town of Silverthorne, Widefield W&SD, Clifton SD, and the Meeker SD.

- **Water Environment Federation Laboratory Manual** – Sidney served as the Task Force Chair and as a primary author of a new laboratory manual for water and wastewater operators. The manual includes simplified step–by–step directions for laboratory tests commonly used in water and wastewater such as fecal coliforms, residual chlorine, total suspended solids, and others. The manual is unique in that it ties laboratory results back to process control by recommending sampling locations and giving typical ranges for various parameters. The book was published in February 2012.

### Selected Publications


**Dennis Crock, David Anderson, Sidney Innerebner, Angela Kana–Spitz, and Mark Van Nostrand** (2013) Meeting Permit Limits for Discharge of Brine Wastewater (Denitrification), presented at the Joint Annual RMWEA / RMSAWWA Conference in Keystone, Colorado

Chair and Principal Author

Contributing Author

**Sidney Biesterfeld, Mark Dane, Richard Dingeman, Dan Freeman, Paul Heppler, Kurt Keilbach, Ernie Oram, David Paterniti, Dan Waddas, and Mike Lutz,** (October 2004) Impact of Water Treatment Plant Residuals on Fixed Film Wastewater Treatment, presented at the 77th Annual Water Environment Federation Conference, New Orleans, Louisiana.


Course Contact

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Course website is http://indigowatergroup.com/On-Line%20Training.htm

Course Logistics

On-line training courses are sold through Indigo Water Group’s website and are hosted on iSpring which is SCORM compliant. Someone wanting to attend an on-line training course may do so on demand. These are not live webinars. A visitor to the website will select the desired course, place it in their virtual shopping cart, and then pay for the course with a credit card. (We can also set up on-demand accounts or invoice in place of credit cards. Please see our FAQs.) Courses are priced at $20 per contact hour so a one hour course is $20 while a 2.5 hour long course is $50. Receipts for payment are issued automatically by e-mail along with a link to the training login location. Each attendee receives a unique login ID and password. Only they can access their training account.

There are currently 50 unique on-line training courses. Classes last between 30 minutes and 2.5 hours, depending on the topic.

There is no time limit for course completion provided courses are completed before the end of the calendar year. Most of the courses are broken into smaller pieces so an operator can complete each piece when it is convenient for them. Each piece is followed by an interactive quiz to reinforce concepts learned and to demonstrate attendance. If an attendee starts a training course and has to leave for some reason, the next time they log into the system, they will be asked if they want to start over or continue on from where they left off.

Documentation of Course Attendance:

On-line courses use a combination of narrated PowerPoint presentations and movie clips. The file format is either shockwave media (PC based) or html5 (iPhone, iPad, and other mobile devices).

Attendees must watch each slide or animated clip in its entirety to receive credit and may not “skip” forward on a particular slide or within the presentation. Attendees can use the back button to review a missed slide, but cannot move forward. Lastly, we want to be sure that folks don't login to a class and then walk away from their computer or start doing other work while the class plays. To prevent this, we force the attendee to press the “next” button to move from one slide to the next and we incorporate quizzes throughout the presentations.

Throughout the courses, mini-quizzes of three to five questions each are embedded. At the end of each course, there is a larger final quiz of up to 15 questions. The course attendee must enter their name and
e-mail address before they can take each quiz. Quiz results are e-mailed to Sidney Innerebner and are tracked on the iSpring site.

The training accounts within iSpring track total time spent on each training course as well as quiz scores. An attendee can log in and see a list of courses paid for as well as those already completed.

Attendance is verified by 1) tracking total time spent on a course within iSpring, 2) ensuring that all of the quizzes for a particular training course have been completed, 3) the date/time stamps for the individual classes are spaced a reasonable distance apart, and 4) checking to see if questions are answered correctly. Attendees are not required to obtain a minimum passing score to earn their training unit certificate or credits. Once a course has been completed, training unit certificates may be printed directly from the iSpring site by the attendee. In the event of a technical glitch, Indigo Water Group will manually issue a training unit certificate and/or reports attendance to State agencies once course completion has been verified.

Requested time does NOT include time required for attendees to answer quiz questions.

**Biographical Information for Instructor**

The primary instructor will be Sidney Innerebner, the Principal Engineer and Owner of Indigo Water Group. Her resume is attached as part of this training unit application. Sidney is a licensed professional engineer in the State of Colorado and has a PhD in Environmental Science and Engineering from the Colorado School of Mines where she now serves as an adjunct professor. Sidney holds an A level Wastewater and an A level Industrial Wastewater in Colorado and has been the Operator in Responsible Charge for several activated sludge wastewater treatment plants over the last ten years. She is the Chair of the Water Environment Federation Plant Operations and Maintenance Committee and has been the primary or contributing author to numerous publications and books on wastewater process control and has served as a reviewer for many others.

Other instructors include: Stacy Passaro, Joshua Baile, Dale Colerick, Dave Flowers, Toni Glymph-Martin, Eric Wahlberg, Ken Schaars, Michael Lutz, and Gary Parham. Their resumes are included with specific training unit applications as appropriate.

**Agreement to Provide Training Documentation**

Training records are maintained for a minimum of three years.