



## Online e-learning courses in the field of Industrial Wastewater Treatment -International Case Examples

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## List of Abbreviations

CETP	Common Effluent Treatment Plant
CII	Confederation of Indian Industry
CPCB	Central Pollution Control Board
ETP	Effluent Treatment Plant
FGD	Focus Group Discussion
FICCI	Federation of Indian Chambers of Commerce and Industry
GIZ	Gesellschaft für internationale Zusammenarbeit GmbH
HRDP	Human Resource Development Platform
ICT	Information and Communication Technology
IT	Information Technology
LMS	Learning Management System
MIS	Management Information System
MoEF&CC	Ministry of Environment, Forest and Climate Change, Government of India
MOOC	Massive Open Online Course portal
NIT	National Informatic Centre
NMCG	National Mission for Clean Ganga
NSDC	National Skills Development Corporation
SCGJ	Skills Council for Green Jobs
SEIP	Sustainable and Environment-friendly Industrial Production
SME	Subject Matter Expert
SOP	Standard Operation Procedure



## Background

The staff employed in CETPs and ETPs play a very important role in effectively operating and managing the industrial wastewater treatment plants so as to contain the pollution levels and to ensure the protection of the receiving water bodies, including rivers and lakes. majority of these operators of ETPs/CETPs do not have essential qualifications and experience, are semi-skilled/unskilled and do not have adequate knowledge regarding the operation and maintenance of ETPs/CETPs. This often results in inefficient operation of such facilities and violation of the norms and posing negative impacts on natural resources like rivers/seas/streams/ponds etc.

To address this skills gap, in Phase 1 of SEIP project, GIZ collaborated with the Skill Council for Green Jobs (SCGJ) of the National Skill Development Corporation (NSDC) in developing a Training Handbook for skills development of technicians of ETPs/CETPs and pilot courses were conducted with German experts.

A follow-up by GIZ showed some success stories. Efforts were put in under the SEIP project to bring a training system into the Indian market for the skills development of technicians, however this was not successful. One of the main reasons was that the industries were not willing to spare their technicians to be absent from the workplace.

Under the SEIP II project, it is proposed to develop an online e-learning course to develop skills of the technicians of ETPs/CETPs.

Integration has been given the task to:

- develop an online e-learning course for skills development of the technicians of wastewater treatment plants (ETPs, CETPs)
- support the hosting of the online course technically
- trigger the change process and run workshops for the relevant stakeholders about how to deliver / run / maintain the online course.

This report is related to:

Main Task 1: Needs gathering

Sub Task 1: Compile and review good case examples and best practices of online skills development courses on wastewater treatment available internationally on their course content and their consideration of andragogical principles and identify good practices that can be used for the development of the proposed online course.

## Content of this report

This Report describes the results of the assessment of online courses.

1. Evaluation of each considered online course
  - a. General description
  - b. The following features and criteria were evaluated:
    - ❖ Target groups addressed
    - ❖ Conditions for participation
    - ❖ Clarity of objectives
    - ❖ Self-Tests, final test, entrance tests
    - ❖ Mode of learning and teaching (self-guided learning, tutored learning)
    - ❖ Feedback possibilities
    - ❖ Theoretical and practical parts
    - ❖ IT based issues (system used)
  - c. Usability
  - d. Technology used IT based issues (system used)
  - e. Media quality
  - f. Added value
  - g. General assessment
2. Qualitative Comparison
3. Recommendations



## Online Course “Water and Wastewater Treatment Engineering: Biochemical Technology

### Online course description

#### Background and purpose:

Biochemical technology in water and wastewater treatment engineering is essential in the field of water treatment. In this environmental study course, you will learn the basic principles and characteristics of biochemical technology. This knowledge is necessary for those in the environmental field. In this course we will use real world cases and vivid explanations to help you better understand the biological treatment process.

#### Course provider:

Tsinghua University via edX

#### Language:

English and Chinese

#### Characteristics:

- ❖ Massive Open Online Course format via Provider edX
- ❖ Cost Free Online Course (Audit)
- ❖ Session In progress
- ❖ Language English
- ❖ Certificate for \$49 Available
- ❖ Effort 5-6 hours a week
- ❖ Timed and flexible start date
- ❖ Duration 10 weeks
- ❖ Subscription necessary

#### Objectives:

Improved water and wastewater treatment to ensure clean water for people without access to clean water and high fatality rates due to unsafe water

Learning objectives:

- ❖ Basic principles and characteristics of biochemical technology in water and wastewater treatment
- ❖ Composition of structures and operation characteristics
- ❖ Technological advancements in water and wastewater treatment technology

### Target groups addressed:

Audience interested in:

- ❖ Civil engineering
- ❖ Water and wastewater engineering
- ❖ Environmental Engineering

### Knowledge prerequisites for participation:

- ❖ Principles of Environmental Engineering
- ❖ Environmental Engineering Monitoring
- ❖ Water Treatment Microbiology

## Water and Wastewater Treatment Engineering: Biochemical Technology | 水处理工程：生物化学方法

Learn the basic principles and characteristics of biochemical technology in water and wastewater treatment engineering. 本课程讲述水和废水处理中主要的生物处理方法的基本原理、工艺构成、运行特点、工艺计算方法以及部分工程实例。



## Course content

### Chapter 0: Introduction

- I. Development Status of Wastewater Treatment Process
- II. Typical Processes of Wastewater Biological Treatment
- III. Main Contents

### Chapter 1: Basic Principles of Wastewater Biological Treatment

- 1.1 Principles of Wastewater Aerobic Biological Treatment
- 1.2 Principles and Determination of Wastewater Biodegradability
- 1.3 Principles of Wastewater Anaerobic Biological Treatment
- 1.4 Principles of Wastewater Biological Nitrogen Removal
- 1.5 Principles of Wastewater Biological Phosphorus Removal

### Chapter 2: Aerobic Biological Wastewater Treatment Process *Activated Sludge Process*

- 2.1 The Basic Concept of Activated Sludge Process
- 2.2 Growth Rule of Activated Sludge and its Application
- 2.3 Running Mode of Activated Sludge Process Kinetics of Activated Sludge Process
- 2.4 Principles, Methods and Equipment for Aeration
- 2.5 Designing of Activated Sludge Process Operation and Management of Activated Sludge Process

### Chapter 3 Aerobic Biological Treatment Process (2) *Biofilm*

- 3.1 Basic Principle of Biofilm
- 3.2 Biofilter
- 3.3 Biodisk
- 3.4 Biological Contact Oxidation Process
- 3.5 Aerobic Biological Fluidized Bed

### Chapter 4: Wastewater Aerobic Biological Treatment Process (3) *Other Processes*



- 4.1 Oxidation Ditch Process
- 4.2 A-B (Adsorption - Biodegradation) Process
- 4.3 Sequence Batch activated sludge Process (SBR)
- 4.4 Membrane Biological Reactor (MBR) Process

### **Chapter 5: Wastewater Anaerobic Biological Treatment Process**

- 5.1 Development Status and Characteristics of Anaerobic Biological Treatment Process
- 5.2 Anaerobic Digester
- 5.3 Anaerobic Contact Process and Anaerobic Biofilter
- 5.4 UASB Process
- 5.5 Other Anaerobic Biological Treatment Processes
- 5.6 Operation and Management of Anaerobic Biological Treatment Process

### **Chapter 6: Biological Nitrogen Removal Process**

- 6.1 Overview
- 6.2 Biological Nitrogen Removal Process and Technology
- 6.3 Simultaneous Nitrogen and Phosphorus Removal Process

### **Chapter 7: Natural Biological Treatment Process**

- 7.1 Biological Stabilization Pond Process
- 7.2 Land Treatment Process

### **Chapter 8 Sludge Treatment and Disposal Process**

- 8.1 Source, Nature and Treatment of Sludge
- 8.2 Sludge Thickening and Digestive Stability
- 8.3 Sludge Conditioning, Dewatering and Drying Incineration

### **Chapter 9: Interview**

## **Technology system used and IT based issues**

The Learning Management System (LMS) edX is one of the leading platforms to-date. The platform comes with a de-facto instructional standard for online instruction (Massive Open Online Course, MOOC). It consists of short video lectures, self-tests, reading material and discussions among the audience. The instructional value is in the combination of these elements which increases participants' motivation.

edX has been serving more than 25 million participants worldwide and offers more than 2800 courses, <https://www.edx.org/schools-partners> .

A derivative if this platforms technology is offered as an Open-Source platform solution by an industry consortium <https://open.edx.org/the-platform/>

## **Testing and Exams**

There are 2 types of tests:

- ❖ An entrance tests
- ❖ Self-Tests as part of video lectures and afterwards

A certificate is issued upon the successful participation in the course and completion of a final exam.

## **Learning approach**

- ❖ Lecturer style like in university, college but with fast forward and rewind
- ❖ Visuals, photos, and PowerPoint presentations
- ❖ Most explanation based on graphics and pictures
- ❖ Text of the speech on the right side
- ❖ Each lesson about 5 – 16 (mostly 8-12) minutes
- ❖ By pressing the NEXT button, the program switches to the next lesson., by pressing the PREVIOUS button the previous session can be seen again. Beside that from the first page the audience can jump directly into each unit (random access).

## **Feedback possibilities**

No personal feedback available in the unpaid version

## **Reminder to keep the participants on the course**

The LMS sends reminders which can be configured by the instructor.

## **Theoretical and practical parts**

- ❖ Cognitive knowledge only
- ❖ No real-world practice or practical application

## **Media quality**

- ❖ Instructional and media quality of lectures is very adequate, cost effective and of high instructional value
- ❖ Very sophisticated simulations are used for illustration purposes partly

## **Online course usability**

- ❖ Easy to use, few minutes introduction needed only
- ❖ The course runs on mobile devices, too

## **Added value**

- ❖ The added value to vocational training is limited since only teaching lessons are provided; there is little participants involvement and no practical application

## **General assessment, advantages, and disadvantages**

- ❖ The course addresses the cognitive domain; it has no practical part in the field.
- ❖ Course participation runs fully automated
- ❖ The course is free of charge
- ❖ Certificate is available for \$49
- ❖ Reasonable amount of learning time: effort 5-6 hours a week, duration 10 weeks
- Instructional media techniques are used:
  - ❖ Graphics and pictures and PowerPoint presentations
  - ❖ Mostly verbal explanation of graphics and pictures with the possibility to fast forward and rewind

- ❖ Text of the speech on the right side
- ❖ Each lesson about 5 – 16 (mostly 8-12) minutes

**Advantages:**

- ❖ Scalable instructional format (a few dozen to a million is possible)
- ❖ Very easy to use
- ❖ Intuitively understandable
- ❖ High instructional value
- ❖ Reasonable course production effort
- ❖ Standard delivery format for all devices

**Disadvantages:**

- ❖ Classroom learning like in a university or college lecture
- ❖ No interaction between the students established
- ❖ No feedback to the facilitator possible



## Online course "Urban Sewage Treatment"

### Online course description

#### Background and purpose:

This course will focus on basic technologies for the treatment of urban sewage. Unit processes involved in the treatment chain will be described as well as the physical, chemical and biological processes involved. There will be an emphasis on water quality and the functionality of each unit process within the treatment chain. After the course one should be able to recognise the process units, describe their function and make simple design calculations on urban sewage treatment plants.

#### Course provider:

Delft University of Technology via edX

#### Language:

English

#### Characteristics:

- Cost: Free Online Course
- Session: Self-paced
- Paid certificate upon successful completion for USD 50 available
- Effort: 6-8 hours a week
- Timed and flexible start date
- Duration: 7 weeks
- Subscription necessary

#### Objectives:

Support knowledge on water and wastewater treatment for all over the world. Learn about urban water services, focusing on basic sewage treatment technologies.

- Recognize the process units in urban wastewater treatment technologies
- Describe the function of these process units
- Describe the physical, chemical, and biological processes involved
- Make simple design calculations on wastewater treatment plants

## Target groups addressed:

Audience interested in:

- Engineering

This course is based on a third year BSc course of the study Civil Engineering of TU Delft. The course is intended to be an introduction to water treatment technologies for everyone interested in sanitary engineering.

## Prerequisites for participation:

- High school level of mathematics and chemistry is recommended.
- There is an introductory questionnaire to gather information about the participants.

### Urban Sewage Treatment

Learn about urban water services, focusing on basic sewage treatment technologies.



38,845 already enrolled!



## Course content

The course consists of 6 modules:

1. Sewage treatment plant overview. In this module you will learn what major pollutants are present in the sewage and why we need to treat sewage prior to discharge to surface waters.
2. Primary treatment. In this module you learn how coarse material, sand & grit are removed from the sewage and how to design primary clarification tanks.
3. Biological treatment. In this module you learn the basics of the carbon, nitrogen and phosphorous cycle and how biological processes are used to treat the main pollutants of concern.
4. Activated sludge process. In this module you learn the design principles of conventional activated sludge processes including the secondary clarifiers and aeration demand of aeration tanks.
5. Nitrogen and phosphorus removal. In this module you learn the principles of biological nitrogen removal as well as phosphorus removal by biological and/or chemical means.
6. Sludge treatment. In this module you will the design principles of sludge thickeners, digesters and dewatering facilities for the concentration and stabilization of excess sewage sludge. Potentials for energy recovery via the produced biogas will be discussed as well as the direct anaerobic treatment of urban sewage in UASB reactors when climate conditions allow.

## Technology system used and IT based issues

The Learning Management System (LMS) is edX. The course itself consists of short video lectures, self-tests, online text pages, discussions forum among the audience. The technology platform is available as an open-source technology, too.

## Learning approach

Each module consists of a fixed instructional structure:

- ❖ An introduction with a forum discussion about the topic (not graded)
- ❖ Specific subsections with learning material and knowledge quizzes (not graded)
- ❖ A tutorial to prepare the participant for the graded module assessment (not graded)

Each module consists of various subsections which tackle an aspect of that module's learning material. A subsection has the following structure:

- ❖ It starts with a short video clip, which gives an overview of the subject
- ❖ Then there are quiz questions about the video
- ❖ Followed by reading material from the textbook
- ❖ And finally quiz questions about the reading material

The quiz questions do not contribute to the participants' grade, only the graded module assessments do. Answer-check mechanisms are provided for the quiz questions.

### Tutorials:

Tutorials are conversational step-by-step videos designed to teach how to solve design questions. Several tutorials are published in this course, helping the participant to understand the learning material.

Learning objectives are defined for each module. Then challenges are formulated which shall be discussed with fellow learners.

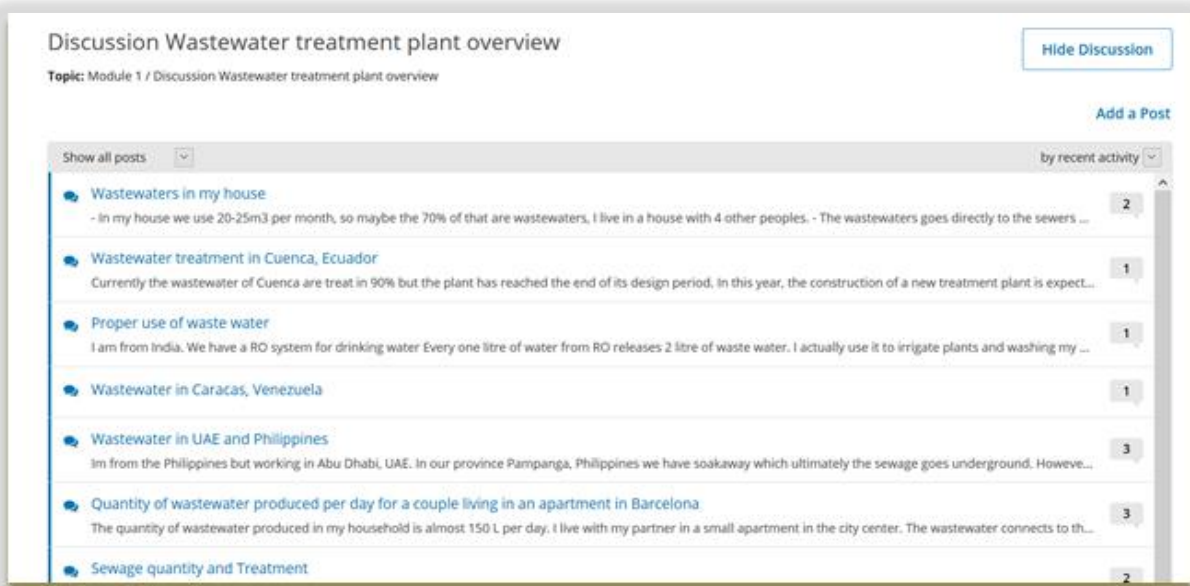
### Questions for debate

Go to the [forum](#) and discuss what the causes are for the differences in the produced amount of wastewater and about the different types of sewers among the learners in this course.

1. What is the quantity of wastewater that your household produces in a single day? And what are the number of people in your house?
2. Where is your wastewater going? Is it going to a sewer? And where is the rain water going? Does it end up at the sewage treatment plant in your area?

As soon as you find a person in the forum who has the same amount of people living in their house as you do, compare and discuss what the differences are in your context. Go to the [forum](#) to answer the questions!

**Figure 1: Example of a challenge**

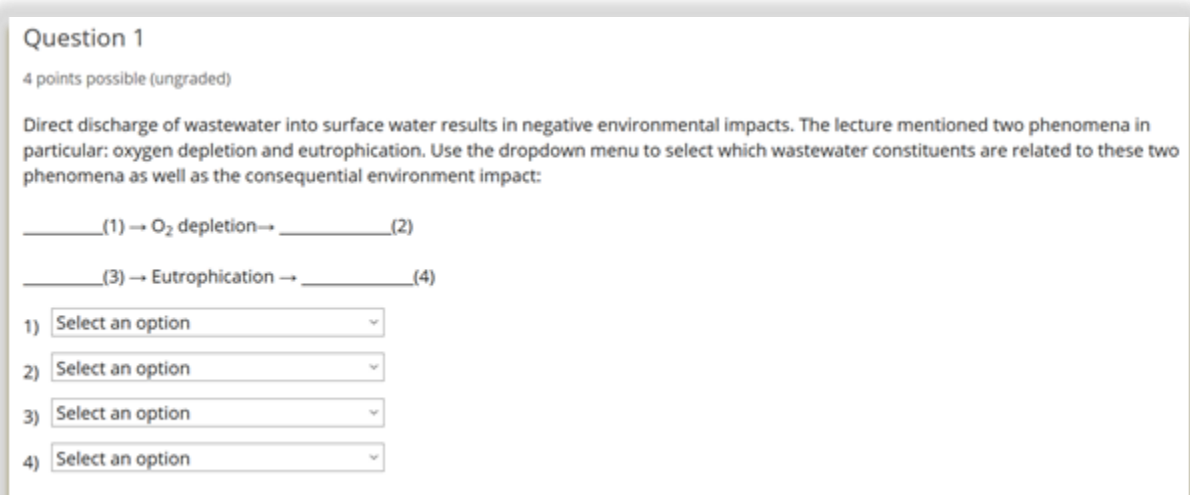


**Figure 2: Example of a discussion with fellow students**

The learning process of each module:

1. Watching video
2. Reading handbook
3. Answering questions (Quiz) regarding video and handbook

A video has a length of about 8-13 minutes. Pictures, graphics, PowerPoint slides are used. These media appear on a large screen next to the speaker.



**Figure 3: Example of a quiz question**  
**Feedback possibilities**

There is a discussion forum in the course for all students of the course. These forums may be used to discuss course concepts, problem solving approaches, interesting references, or other topics related to the course. It can be used to ask questions.

The first task of every module is a discussion assignment. This assignment provides insight into the transfer of the theory to practice. The forum is moderated frequently by course staff and community TAs, and they give feedback on the forum's most prominent discussions through a video. Posts directed to staff: If a participant wants to have a staff member look at his / her post, he must write [Staff] at the start of the message subject title. This is most relevant for any questions regarding technical aspects of the course.

The course team is moderating the discussion forum regularly, however the participants should interact with other participants first to get issues solved. Every week the course team will give feedback on the most prominent forum discussions.

### **Reminder to keep the participants on the course**

Participants are reminded by email. In addition, the edX system allows for automatic reminder configuration (e.g. in case of a higher number of participants).

### **Theoretical and practical parts**

No practical parts included

### **Testing and exams**

#### **Graded module assessment (graded)**

Every module has a graded assessment.

The graded module assessments must be completed by a certain day. Only 4 of the 6 graded module assessments count for the final grade. So, the two lowest scores of the graded module assessments are dropped. Only verified participants have access to graded assignments. Verified participants can check their score at any time under the course's Progress page.

### **Media quality**

- ❖ Instructional and media quality of lectures is very adequate, cost effective and of high instructional value
- ❖ More sophisticated video production is used for illustration purposes partly

### **Online course usability**

- ❖ Easy to use, few minutes introduction needed only; stepping forward / backwards by pressing the NEXT / BACK button
- ❖ The course runs on mobile devices, too

### **Added value**

High added value:

- ❖ Content explained in lectures, supported by graphics and pictures on a screen
- ❖ Quizzes have to be answered to involve the student.
- ❖ Communication between students enhance learning effect
- ❖ In case of exceedingly difficult issues, the facilitator can also provide help and support



## **General assessment, advantages, and disadvantages**

- ❖ The course has only a theoretical part and no practical part in the field.
- ❖ Training course free of charge
- ❖ Certificate: USD 50 Certificate available
- ❖ Reasonable amount of learning time: effort 6-8 hours a week, duration 7 weeks

Content is explained as part of lectures, supported by graphics and pictures on a screen. A video has a length of about 8-13 minutes. Pictures, graphics, PowerPoint slides are used. The media appear on a large screen next to the speaker.

Learning process of each module:

1. Watching video
2. Reading handbook
3. Answering questions (Quiz) regarding video and handbook

### **Advantages:**

- ❖ Very easy to use, intuitively understandable
- ❖ Communication forum for all students: communication between students enhance learning effect
- ❖ Discussion assignment (with other students) at the beginning of each module
- ❖ Quizzes have to be answered to involve the student.
- ❖ In case of exceedingly difficult issues, the facilitator can also provide help and support

### **Disadvantages:**

- ❖ The human support system makes scalability more challenging (e.g. higher cost)



## Water and Wastewater Treatment Engineering: Physicochemical Technology

### Online course description

#### Background and purpose:

This introductory environmental science, environmental engineering and municipal engineering course will explore how physicochemical technology and techniques are applied to water and wastewater treatment. We will explore the basic calculation method, composition of structures and operation characteristics, and the latest advancements in water and wastewater treatment technology. Main physicochemical units, including coagulation and flocculation, sedimentation, flotation, filtration, disinfection, oxidation and reduction, membrane separation and ionic exchange, will be covered.

#### Course provider:

Tsinghua University via edX

#### Language:

English and Chinese

#### Characteristics:

- ❖ Massive Open Online Course format via Provider edX
- ❖ Cost Free Online Course (Audit)
- ❖ Session In progress
- ❖ Language English
- ❖ Certificate for \$49 Available
- ❖ Effort 5-6 hours a week
- ❖ Timed and flexible start date
- ❖ Duration 10 weeks
- ❖ Subscription necessary

**Learning objectives:**

- ❖ Basic principles and characteristics of physicochemical technology in water and wastewater treatment
- ❖ Composition of structures and operation characteristics
- ❖ Technological advancements in water and wastewater treatment technology

**Target groups addressed:**

Audience interested in:

- ❖ Civil engineering
- ❖ Water and wastewater engineering
- ❖ Environmental Engineering

**Knowledge prerequisites for participation:**

- ❖ Principles of Environmental Engineering
- ❖ Environmental Engineering Monitoring
- ❖ Water Treatment Microbiology

**Covered content**

- > Chapter 0 Introduction
- > Chapter 1 Coagulation and flocculation
- > Chapter 2 Sedimentation and Clarification
- > Chapter 3 Air floatation
- > Chapter 4 Filtration
- > Chapter 5 Disinfection
- > Chapter 6 Ion exchange
- > Chapter 7 Membrane separation
- > Chapter 8 Redox method
- > Chapter 9 Adsorption
- > Final Exam

## **Technology system used and IT based issues**

The Learning Management System (LMS) is edX. The course itself consists of short video lectures, self-tests, online text pages, discussions forum among the audience. The technology platform is available as an open-source technology, too.

## **Testing and exams**

There are 2 types of tests:

- ❖ An entrance tests
- ❖ Self-Tests as part of video lectures and afterwards

A certificate is issued upon the successful participation in the course and completion of a final exam.

## **Learning approach**

(only self-learning, mentored learning, activities by participants)

- ❖ Lecturer style like in university, college but with fast forward and rewind
- ❖ Visuals, photos, and PowerPoint presentations
- ❖ Most explanation based on graphics and pictures
- ❖ Text of the speech on the right side
- ❖ Each lesson about 5 – 17 (mostly 8-12) minutes
- ❖ By pressing the NEXT button, the program switches to the next lesson., by pressing the PREVIOUS button the previous session can be seen again. Beside that from the first page the audience can jump directly into each unit (random access).

## **Feedback possibilities**

No personal feedback available in the unpaid version

## **Reminder to keep the participants on the course**

The LMS sends reminders which can be configured by the instructor.

## **Theoretical and practical parts**

- ❖ Cognitive knowledge only
- ❖ No real-world practice or practical application

## **Media quality**

- ❖ Instructional and media quality of lectures is very adequate, cost effective and of high instructional value
- ❖ Very sophisticated simulations are used for illustration purposes partly

## **Online course usability**

- ❖ Easy to use, few minutes introduction needed only
- ❖ The course runs on mobile devices, too

## **Added value**

- ❖ The added value to vocational training is limited since only teaching lessons are provided; there is little participants involvement and no practical application

## **General assessment, advantages, and disadvantages**

- ❖ The course addresses the cognitive domain; it has no practical part in the field.
- ❖ Course participation runs fully automated
- ❖ The course is free of charge
- ❖ Certificate is available for \$49

- ❖ Reasonable amount of learning time: effort 5-6 hours a week, duration 10 weeks

Instructional media techniques:

- ❖ A screen with graphics and pictures and PowerPoint presentation
- ❖ Most explanation based on graphics and pictures
- ❖ Text of the speech on the right side
- ❖ Each lesson about 5 – 16 (mostly 8-12) minutes

**Advantages:**

- ❖ Scalable instructional format (a few dozen to a million is possible)
- ❖ Very easy to use, intuitively understandable
- ❖ High instructional value
- ❖ Reasonable course production effort
- ❖ Standard delivery format for all devices

**Disadvantages:**

- ❖ Classroom learning like in a university or college lecture
- ❖ Monotonous (boring) voice in the English version
- ❖ No interaction between students established
- ❖ No reminder (e.g. by email) to keep the student in the course
- ❖ No feedback to facilitator possible

# Introduction to Faecal Sludge Management

★★★★★ 4.8 559 ratings



Dr. Linda Strande

**Enroll for Free**  
Starts Jan 25

Financial aid available

11,544 already enrolled

## Introduction to Faecal Sludge Management

<https://www.coursera.org/learn/faecalsludge>

### Online course description

#### Background and purpose:

Do you want to learn how to apply concepts of sustainable faecal sludge management (FSM) on a city-wide scale? This course starts with an overview of what faecal sludge is and an introduces you to the engineering fundamentals and required information for the design and selection of technologies. Sanitation solutions are prone to failure if an integrated planning approach that includes stakeholder involvement and the development of appropriate institutional, management and financial arrangements is not implemented. The course therefore dedicates a complete week to presenting the full picture, in addition to technology, that needs to be considered for sustainable solutions. It concludes with a focus on current research and innovations in technologies, to provide an understanding of the most up-to-date options.

This course is one of four in the series "Sanitation, Water and Solid Waste for Development".

#### Course provider :

École Polytechnique Fédérale de Lausanne via Coursera

#### Language:

English and French, Portuguese, Spanish

#### Characteristics:

- ❖ Cost: free online course, textbook also free for download
- ❖ Session: self-paced
- ❖ Certificate: available, has to be paid for
- ❖ Effort: 4-6 hours per week
- ❖ Duration: 5 weeks
- ❖ Timed and flexible start date
- ❖ Subscription: yes

**Learning objectives:**

Course on how to apply concepts of sustainable faecal sludge management

**Target groups addressed:**

Audience interested in:

- ❖ Engineering, intermediate level

**Knowledge prerequisites for participation:**

- ❖ Not mentioned

**Covered content****An introduction to faecal sludge management:**

This first week of this course includes an overview of what faecal sludge is, and the importance of an integrated approach to faecal sludge management. It introduces what is currently lacking, weak links in the service chain, and also presents positive examples of what is working.

**Overview of fundamentals for design and selection of treatment technologies:**

The second week of this course is based on an integrated engineering design approach, and will introduce fundamentals and required information for the design and selection of technologies, including objectives, mechanisms, quantification and characterization. It also includes the collection and transport of faecal sludge to treatment.

**Treatment technologies for faecal sludge**

The third week of this course focuses on engineering aspects of how to size and properly operate treatment technologies.

**Integrated approach to faecal sludge management**

Sanitation solutions do not rely on technology alone and are prone to failure if an integrated planning approach that includes stakeholder involvement and the development of appropriate institutional, management and financial arrangements is not implemented. Presented in week 4 is the full picture, in addition to technology, that needs to be considered for sustainable solutions.

**Innovations in faecal sludge management**

Faecal sludge management is a relatively new and rapidly growing field. As a result, many solutions are not yet fully developed, which has to be carefully considered in technology implementation. Week 5 will focus on current research and innovations in technologies, to provide an understanding of the most up-to-date options, and what needs to be considered for further development and implementation.

**Technology system used and IT based issues**

The Learning Management System (LMS) Coursera is one of the leading platforms to-date. The platform comes with a de-facto instructional standard for online instruction (Massive Open Online Course, MOOC). It consists of short video lectures, self-tests, reading material and discussions among the audience. The instructional value is in the combination of these elements which increases participants' motivation.

Coursera has been serving millions of participants worldwide and offers thousands of courses, <https://www.coursera.org/about/partners>.

In contrast to edX the online platform and Apps are available for Coursera partners exclusively.

### Learning process

- ❖ Videos and readings
- ❖ The time allocated for readings is about twice the time for videos
- ❖ The course starts with an initial survey. The survey is related how the students wants to participate, with how much effort, and which parts of the training he/she wants to perform (e.g. videos, readings, group discussion, quizzes)
- ❖ Textbook available for free
- ❖ Time for videos: 8-12 minutes
- ❖ Expert explains and stands in front of PowerPoint sheet. On the sheet are shown pictures and/or text
- ❖ Each unit has a short conclusion and outlook on the next unit.
- ❖ At the end of each chapter videos and readings are recommended.

### Feedback possibilities

There is a discussion forum provided (meet and greet) to get in contact with fellow learners. For technical issues, the student can go to a trouble shooting page.

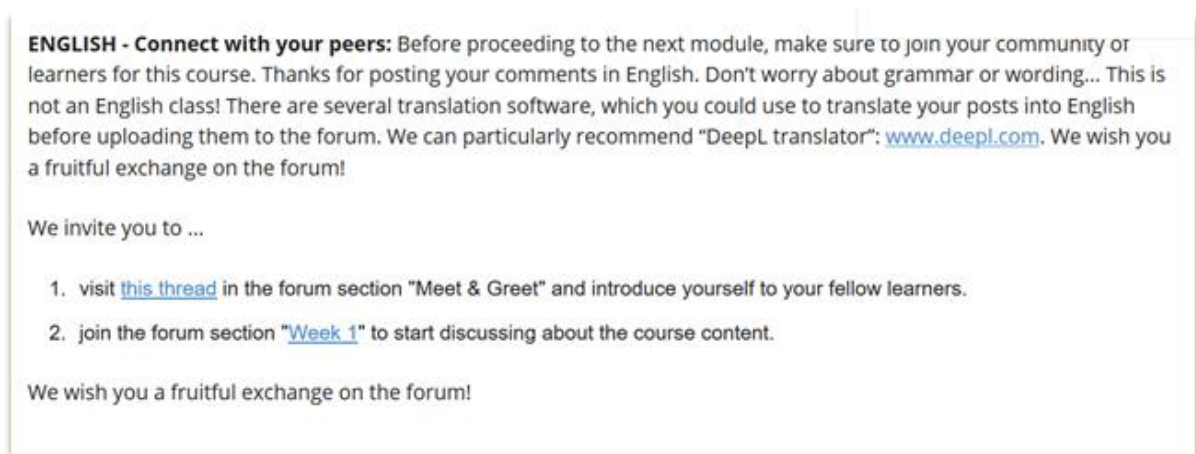
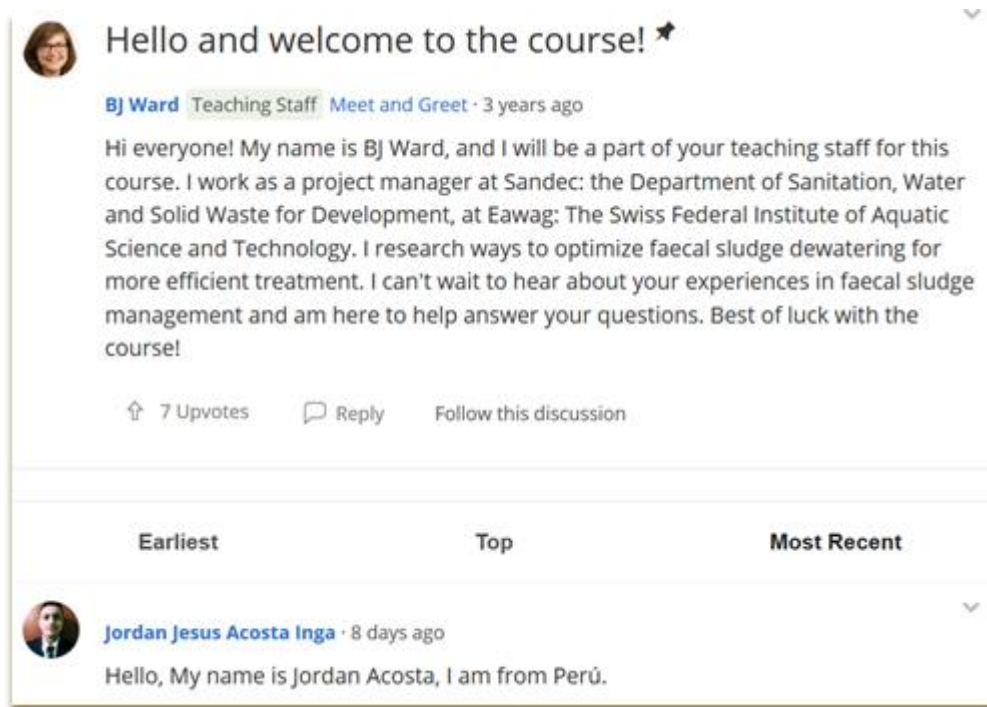


Figure 4: Screenshot of a discussion forum which can be joined





**Figure 5: Discussion forum: introductory thread**

**45. Reminder to keep the participants on the course**

- ❖ No reminders

**46. Theoretical and practical parts**

- ❖ No practical part included

**47. Testing and Exams**

- ❖ Exams are available at a fee

**48. Media quality**

- ❖ Instructional and media quality of lectures is very adequate, cost effective and of high instructional value
- ❖ Visuals (graphics and photos) are explained by voice

**49. Online course usability**

- ❖ Easy use
- ❖ Each side it has to be marked as “completed”. Then the participants can click a button “next”

**Added value**

High added value:

- ❖ clear explanations,
- ❖ good pictures,
- ❖ professional slides,
- ❖ clear graphics
- ❖ possibility to interact with other students

**General assessment, advantages, and disadvantages**

- ❖ The course has a theoretical part and no practical part in the field.
- ❖ Cost: free online course, textbook also free for download
- ❖ Session: self-paced
- ❖ Certificate: available, has to be paid for
- ❖ Effort: 4-6 hours per week
- ❖ Duration: 5 weeks
- ❖ Participants can start the course any time, however a timed course sequence is offered, too

**Instructional techniques used:**

- ❖ Lecture format, supported by graphics and pictures on a screen
- ❖ Videos and readings
- ❖ Each unit has a short conclusion and outlook on the next unit.
- ❖ The time allocated for readings is about two times the time for videos
- ❖ The course starts with an initial survey. The survey is related how the students wants to participate, with how much effort, and which parts of the training he/she wants to perform (e.g. videos, readings, group discussion, quizzes)
- ❖ Textbook available for free
- ❖ Time for videos: 8-12 minutes
- ❖ Expert explains and stands in front of PowerPoint sheet. On the sheet are shown pictures and/or text
- ❖ At the end of each chapter videos and readings are recommended.

**Advantages:**

- ❖ Scalable instructional format since the learner community is used as a support group
- ❖ Very easy to use and intuitively understandable
- ❖ There is a discussion forum provided (meet and greet) to get in contact with fellow learners.
- ❖ For technical issues, the student can go to a trouble shooting page.

**Disadvantages:**

- ❖ none



## Online Course on Nile Basin Decision Support System (river water management in the Nile region)

### Online course description

#### Background and purpose:

The Decision Support System eLearning course seeks to introduce to the Nile Basin Decision Support System (NB DSS). The NB DSS is an analytical tool a common computer-based platform for communication, information management and analysis of water resources. It provides a framework for sharing knowledge, understanding river system behaviour, evaluating alternative development and management strategies, and supporting informed decision making.

The Nile Basin eLearning academy and the course portfolio has been built by GIZ in 2016 and the team of consultants. The eLearning academy has been operating successfully and independently by local staff in Entebbe since then.

#### Course provider:

The Nile Basin Initiative, an inter-governmental partnership for cooperative management of the Nile Basin, established in 1999

#### Language:

English

#### Characteristics:

- ❖ Participation upon invitation only
- ❖ Free of charge
- ❖ Cross country online training
- ❖ Action oriented eLearning using the widely recognized WebQuest methodology

### Learning objectives:

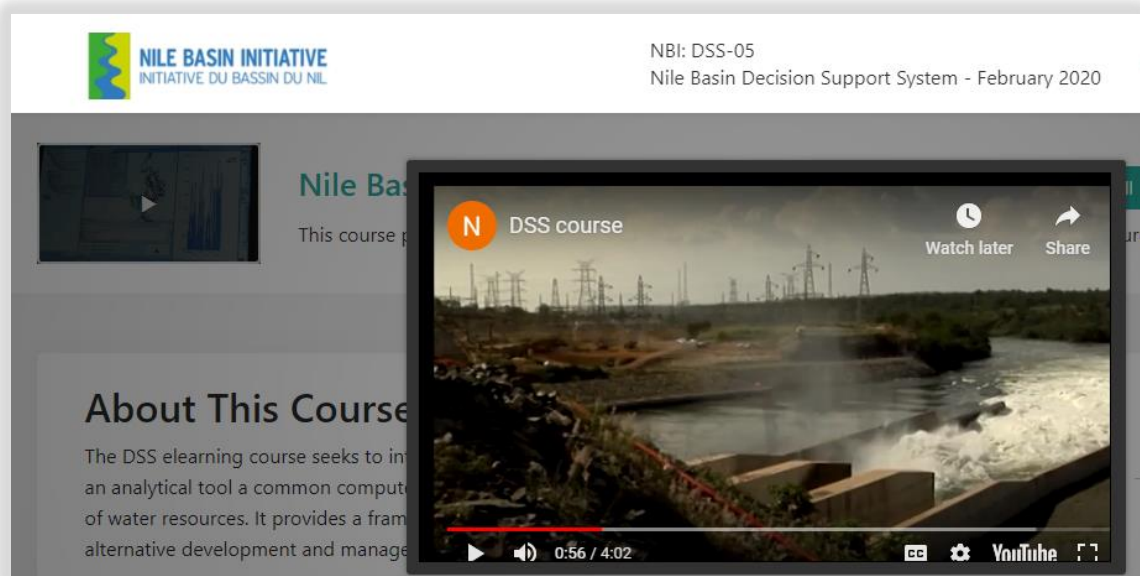
Understand and appreciate the benefit of using the Nile Basin Decision Support System in water resources management and development.

### Target groups addressed:

- ❖ Water policy decision makers and official in nine Nile Basin states: Burundi, D.R. Congo, Egypt, Ethiopia, Kenya, Rwanda, Sudan, Tanzania, Uganda, Eritrea
- ❖ Admission is open to anybody interested in the course, but priority will be given to citizens of the Nile riparian countries with DSS licenses.

### Prerequisites for participation

Applicants must preferably be citizens of the Nile riparian countries or involved in promoting water resources management and development. Applicants must also have attained a basin level of education (secondary school level) and have basic knowledge of geography, natural resources management, water management, energy, water resources modelling and agriculture. Trainees also need to have basic computer skills to be able to launch and view multi-media instruction materials, download, and read course notes, and participate in a discussion platform.



Level	Certification / Incentives	Criteria
Basic	Certificate of participation	After completion of modules: <ul style="list-style-type: none"><li>• Module 1: DSS Installation</li><li>• Module 2: DSS User Interface</li><li>• Module 3: Database Manager Utility and System Manager</li><li>• Module 4: Time Series Manager</li></ul>
Intermediate	Certificate of successful completion	In addition to basic level after completion of modules: <ul style="list-style-type: none"><li>• Module 5: GIS Manager</li><li>• Module 11: Model tutorial</li><li>• Module 6: Scenario Manager</li><li>• Module 7: Script Manager</li><li>• Module 8: Spreadsheet Manager</li></ul>

Professional	Professional certificate	In addition to basic and intermediate levels after completion of modules: <ul style="list-style-type: none"> <li>• Module 9: Indicator Manager</li> <li>• Module 10: Analysis Manager</li> </ul>
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### **Technology system used and IT based issues**

The Learning Management System (LMS) is Open edX hosted by an independent provider. The course itself consists of short video lectures, self-tests, online text pages, discussions forum for the audience. Open edX is a course delivery as well as courseware production platform.

### **Testing and exams**

There are 2 types of tests:

- ❖ An entrance tests
- ❖ Self-Tests as part of video lectures and afterwards

3 types of certificates are issued dependent on prior knowledge, upon the successful participation in the course and completion of a final exam.

### **Learning process**

- ❖ Lecturer style, with fast forward and rewind
- ❖ An action-oriented course template was applied which puts the participant's task in the centre of a module; participants get familiar with a task first and study in order to accomplish the task. The outcome is shared for peer learning.
- ❖ Visuals, photos, and PowerPoint presentations
- ❖ Most explanation based on graphics, pictures, videos, screen recordings
- ❖ Each lesson about 5 – 15 minutes

### **Feedback possibilities**

- ❖ The course is moderated by subject matter experts

### **Reminder to keep the participants on the course**

- ❖ No reminder

### **Theoretical and practical parts**

- ❖ Theory and practical exercises using the DSS software

### **Media quality**

- ❖ Rich media content and the content can be downloaded by a participant

### **Online course usability**

- ❖ Easy to use since only NEXT button has to be operated

### **Added value**

- ❖ Highly relevant content and practical exposure for operators of the regional Nile Water Decision Support System

### **General assessment, advantages, and disadvantages**

- ❖ The course addresses the cognitive domain as well as the DSS software practice
- ❖ Course participation runs fully automated
- ❖ The course is free of charge
- ❖ Flexible start is possible, moderation is offered for a times start
- ❖ Duration approx. 6 hours throughout 5 weeks

Instructional techniques are used:

- ❖ Instructional videos with graphics and pictures and text
- ❖ Most explanation based on moving pictures and through interviews

### **Advantages:**

- ❖ Scalable instructional format if unmoderated
- ❖ Very easy to use and intuitively understandable
- ❖ Rich media content

**Disadvantages:**

- ❖ Because of logistical obstacles and geographical dimension side visits are not possible; thus, software training without real world exposure



## Online Maintenance Course for Facility Maintenance Technicians: Wastewater Treatment Processes

### Online course description

#### Background and purpose:

TPC's recommended maintenance technician training curriculum for Facilities Maintenance Technicians includes online 90 technical skills courses. Each maintenance course contains 5-12 detailed, job-specific lessons for a total of 616 lessons. The buildings maintenance training's subject matter ranges from courses like "Troubleshooting Skills" to more advanced maintenance competencies like "Introduction to Water Technology".

#### Course provider:

TPC Training

#### Language:

English

#### Characteristics:

- ❖ Fee for Online Course
- ❖ CEU, Continuing Education Unit: A CEU is a unit of credit equal to 10 hours of participation in an accredited program designed for professionals with certificates or licenses to practice various professions certificate by a leading training provider
- ❖ Flexible Start Date
- ❖ Duration: 90 technical skill courses (basic and applied knowledge) have been compiled to a *Facilities Maintenance Technician Training* whereas each course covers a learning amount between 0,5 and 1 CEU (Total of approx. 500 – 1000 learning hours, approx. 62,5 – 125 training days); the dedicated wastewater treatment module covers 1 CEU (10 learning hours; Effort: 2 full days
- ❖ Subscription necessary

**Learning objectives:**

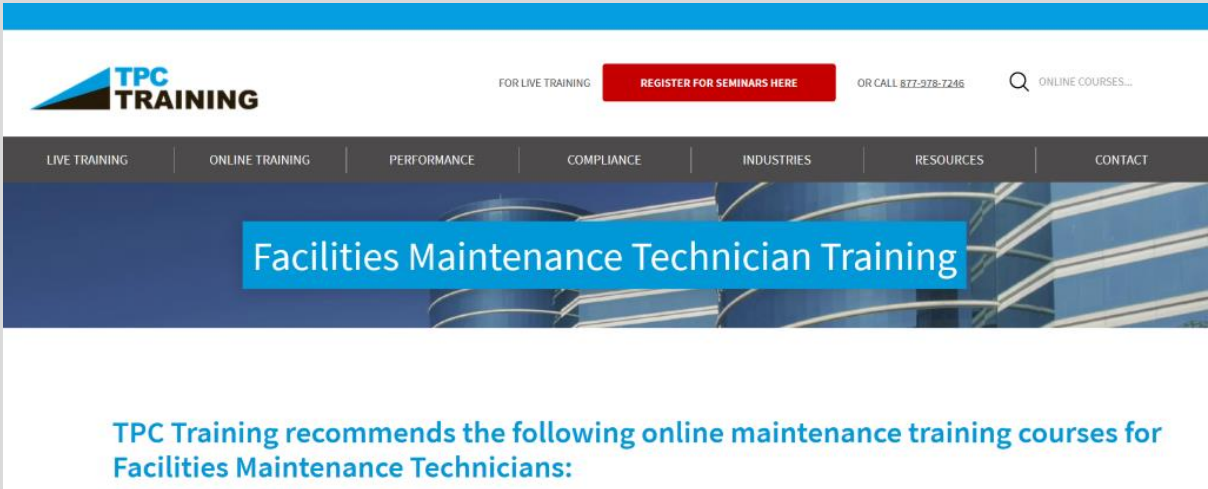
Covers the various stages of wastewater treatment. Goes into detail on the removal of solids, then explains the use of chemical and biological processes for water purification. Covers the treatment and disposal of the extracted solids.

**Target groups addressed:**

- ❖ Technicians on wastewater treatment plants

**Prerequisites for participation**

- ❖ No prerequisites



The screenshot shows the TPC Training website. The header includes the TPC TRAINING logo, a search bar, and a red button labeled 'REGISTER FOR SEMINARS HERE'. The navigation menu includes 'LIVE TRAINING', 'ONLINE TRAINING', 'PERFORMANCE', 'COMPLIANCE', 'INDUSTRIES', 'RESOURCES', and 'CONTACT'. The main banner features the text 'Facilities Maintenance Technician Training' over a background image of industrial pipes. Below the banner, a blue box contains the text: 'TPC Training recommends the following online maintenance training courses for Facilities Maintenance Technicians:'.

**Content****Lesson 1 - Overview of Wastewater Treatment**

Collection systems; Treatment facilities; Influent; Preliminary, primary, secondary, and tertiary treatment; Disinfection; Solids handling

*Learning Objectives:*

- List the purposes of wastewater treatment.
- Describe the way organic wastes pollute water.
- Identify elements of wastewater collection systems.
- Outline the stages of wastewater treatment at the typical treatment facility.
- Explain what happens to wastewater during preliminary, primary, secondary, and tertiary treatment.
- Describe methods of solids handling.

**Lesson 2 - Physical Separation of Solids**

Screening; Grinding; Grit removal; Sedimentation; Clarifiers; Air flotation; Filtration; Effluent disposal

*Learning Objectives:*

- Identify and describe the different types of bar and woven screens used for screening.
- Identify and describe common types of grit-removal equipment.
- List factors affecting settling rates.
- Figure the length of detention time needed to settle out settleable particles.
- Describe the three principal methods of land disposal.



### **Lesson 3 - Chemical Treatment Processes**

Solids in wastewater; Chemical coagulants; Phosphate removal; Chemical clarification; Disinfection; Equipment used in chlorine feeding

*Learning Objectives:*

- Describe what colloidal particles are and outline the problems associated with removing them from wastewater.
- List chemicals used as coagulants.
- Explain how the flocculation process works.
- Explain the function of a precipitant.
- List chemical agents commonly used as disinfectants.
- Identify factors affecting disinfection.
- Describe methods for applying chlorine to wastewater.

### **Lesson 4 - Biological Processes**

Lagoons; Activated sludge; Aeration; Trickling filters; Activated biofilter process; Rotating biological contactors; Secondary clarifiers

*Learning Objectives:*

- Differentiate between the way unaerated and aerated lagoons function.
- Distinguish between suspended growth and fixed-growth systems.
- List and describe different methods of utilizing activated sludge to stabilize wastewater.
- Tell how trickling filters, ABFs, and RBCs operate.
- Explain how secondary clarifiers are used in conjunction with fixed- and suspended-growth systems.

### **Lesson 5 - Solids Treatment and Disposal**

Sludge conditioning; Thickening; Dewatering; Drying beds; Lagoons; Vacuum filtration; Filter presses; Composting; Ultimate disposal

*Learning Objectives:*

- Distinguish between conditioning, thickening, and dewatering.
- List the factors that affect which conditioning, thickening, and dewatering methods are used.
- Describe four methods of sludge conditioning.
- Describe three methods of thickening.
- List factors that affect drying-bed operation.
- Describe methods for disposing of digested or dewatered sludge.

### **Technology system used and IT based issues**

TPC training is using a proprietary LMS and courseware production environment which has been common approx. 10 – 15 years ago. The technology has been widely used for the development of Computer Based Trainings / Web Based Trainings where learners interact with rich content but do not exchange information with fellow learners or instructors.

#### **Testing and exams**

- ❖ Self-Tests, final test, entrance tests
- ❖ After each lesson one testing is performed with one question. Test in multiple choice mode with three answers. Right answer is provided after ticking a box.

#### **Learning process**

- ❖ Self-learning without interaction
- ❖ A voice explains what is seen on the screen
- ❖ The screen shows text like in PowerPoint format and equipment.
- ❖ The equipment is moved around, dismantled, put together.
- ❖ Most explanation based on graphics and pictures
- ❖ Each lesson about 5 – 10 minutes

- ❖ Each lesson is divided into scenes. Each scene is like one PowerPoint slide and last for about a minute
- ❖ By pressing the NEXT button, the program switches to the next scene, by pressing the PREVIOUS button the previous session can be seen again.

#### **Feedback possibilities**

- ❖ Not available because a course is a classical computer-based training (CBT) stored on a webserver

#### **Reminder to keep the participants on the course**

- ❖ No reminder

#### **Theoretical and practical parts**

- ❖ Only theory
- ❖ No practical exercises

#### **Media quality**

- ❖ Rich media content
- ❖ The content can neither be copied nor saved / downloaded by a participant

#### **Online course usability**

- ❖ Easy to use since only NEXT button has to be operated

#### **Added value**

- ❖ Limited added value since only teaching lessons are provided and no participants involvement
- ❖ Moving pictures of equipment provided good understanding of these equipment

#### **General assessment, advantages, and disadvantages**

- ❖ The course has only a theoretical part and no practical part in the field.
- ❖ High cost for the training course
- ❖ Flexible start
- ❖ Duration 2 days full time

#### **Instructional techniques are used:**

- ❖ Screen with graphics and pictures and text
- ❖ Most explanation based on moving pictures
- ❖ Text of the speech on slides
- ❖ Each lesson about 5 – 10 minutes

#### **Advantages:**

- ❖ Very easy to use and intuitively understandable
- ❖ Rich media content

#### **Disadvantages:**

- ❖ The courses are difficult to use on mobile devices because the pages lack responsiveness.
- ❖ The course has been produced with a proprietary courseware production environment which is not available to the public
- ❖ The courses have not been designed for portability (e.g. download) nor interaction among the participants and / or with instructors

## Qualitative comparison of best practices and conclusion

This chapter describes the wide spectrum of qualitative criteria applied in the best practices compiled from chapter 3.

As a conclusion of this comparison the criteria marked in bold have been assessed as **highly recommended**.

### Characteristics

- ❖ **Moderated** versus unmoderated
- ❖ Free versus paid; payment for the course versus **payment for the certification**
- ❖ **Graded exam** versus no exam
- ❖ **Self-control tests after each small unit** versus self-control test at the end of a module
- ❖ **Certified** versus not certified; if certified, **various levels of certification**
- ❖ Flexible course starting versus fixed start date or **both**
- ❖ Open end or **fixed finishing date**

### Prerequisites for participation

- ❖ No prerequisites versus **admission process based on requirements**
- ❖ **Admission test** versus free access to the course

### Technology

- ❖ **Open Source delivery and development platform** versus proprietary course development and delivery platform
- ❖ **Rich media with instructional videos** versus reading material mainly
- ❖ **An instructor visible** versus no instructor visible
- ❖ **Interactive web-based training** (e.g. interaction among participants) versus computer-based training in the web (interaction with the software only)
- ❖ Device dependency versus **device independency** (responsiveness of the pages)

### Learning process

- ❖ **Self-paced** versus daily schedule
- ❖ No interaction among participants versus **discussion assignment** at the beginning of each module (e.g. discussion with other students or an instructor)
- ❖ No defined module structure versus **a defined structure of a course module for learner guidance** (e.g. course Nile Basin) consisting of e.g.:
  - ❖ Start of each module with an overview about the context, the task, and the learning process
  - ❖ Short video units of about 10minutes with knowledge input
  - ❖ Self-test quizzes at the end of each video / lesson
  - ❖ Closure of each module with a conclusion and outlook into the next module
  - ❖ At the end of each module a reference to related instructional material in order to deepen learning

### Communication with fellow students and moderator

- ❖ No communication versus **communication**
  - ❖ Communication with other students is important to improve learning effect. Many content related issues can be solved during such conversation and without contacting the facilitator;
  - ❖ The learner community is a source of learner support
  - ❖ Serious problems can be solved
  - ❖ Technical problems can be solved

### Reminder

- ❖ Fully self-paced courses without reminders versus **reminder** e.g. sent by the system or a moderator

❖ Since higher drop-out rate in eLearning is challenge reminders are much needed in order to bring participants back on track

### **Usability**

- ❖ Sophisticated interface versus **ease of use**
- ❖ Course introduction versus **self-explanatory**
- ❖ Mandatory course units versus **random access**
- ❖ No user tracking versus **user tracking** (e.g. show which unit has been completed)
- ❖ **Readability on small screens** also (e.g. mobile devices) versus readability on larger screens only

# Recommendations

## 1. General remarks and recommendations

This chapter provides recommendation for the concept of an online training for wastewater plant technicians. The online training courses evaluated were conducted only without practical part.

### Characteristics

- ❖ Moderated
- ❖ payment for the certification
- ❖ Graded exam
- ❖ Self-control tests after each small unit
- ❖ Certified and various levels of certification
- ❖ Flexible course starting and a fixed start date
- ❖ A fixed finishing date

### Prerequisites for participation

- ❖ Admission process based on requirements
- ❖ Admission test

### Technology

- ❖ Open Source delivery and development platform Open edX (this is the only Massive Open Online Course platform available freely); course maintenance is relatively easy to perform, and low-tech devices can be served
- ❖ Rich media with instructional videos and an instructor visible
- ❖ Interaction among participants
- ❖ Responsiveness of the pages

### Learning process

- ❖ Self-paced
- ❖ discussion assignment when needed
- ❖ A defined structure of a course module for learner guidance using the WebQuest methodology

### Communication with fellow students and moderator

- ❖ Communication is facilitated and supported
- ❖ Communication with other students is important to improve learning effect. Many content related issues can be solved during such conversation and without contacting the facilitator
- ❖ Facilitator is necessary for serious problems

### Reminder

- ❖ The LMS and/or the moderator sends out reminders in order to keep participants in track

### Usability

- ❖ Ease of use; the course usability must be self-explanatory
- ❖ Course units must be accessible at random
- ❖ User interaction is tracked in order to show completion status
- ❖ The course must be readable on small screens e.g. mobile devices)

## 2. Micro didactic module concept to be considered

- ❖ A module consists of units (e.g. 1 hour) and a unit consists of sessions (e.g. 10 min video session)
- ❖ Each module has a short introduction;
- ❖ Start of each module with an overview about the module and the units
- ❖ Short videos session of about 10minutes with knowledge input
- ❖ Videos session with speaker, pictures, drawings, text, short videos, PowerPoints as an instructional wrapper for each session
- ❖ Quizzes at the end of each video session

- ❖ Reference to the related reading material in the handbook and reading time
- ❖ Closure of each unit with a conclusion and outlook into the next unit
- ❖ At the end of each module a reference to all videos and instructional material of the module is given (a module library)

