This unit (which consists of a single lesson) summarizes and reviews most of the solids handling processes in common use in municipal treatment plants. The instructor's guide for the unit includes: (1) an overview of the lesson; (2) lesson plan; (3) lecture outline (keyed to a set of 72 slides); (4) student worksheet (with answers); and (5) two copies of a final quiz (with and without answers). After completing the unit students should be able to briefly describe how each solids handling process works and describe its main function within the solids handling program. In addition, students should become aware of the critical importance of solids handling to the overall operation and effectiveness of the treatment plant. (JN)
BIOLOGICAL TREATMENT PROCESS CONTROL

REVIEW OF SOLIDS HANDLING

INSTRUCTOR'S GUIDE

Text Written By:
John W. Carnegie, Ph.D.
Project Director
Linn-Benton Community College
Albany, Oregon

Instructional Design:
Priscilla Hardin, Ph.D.
Priscilla Hardin Instructional Services
Corvallis, Oregon

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REVIEW OF SOLIDS HANDLING

Overview of The Lesson

This unit is intended to summarize and review most of the solids handling processes in common use in municipal treatment plants. There is no intent to detail the theory and operation of the processes. It is hoped that the student will be able to briefly describe how each process works and what it looks like, and describe its main function within the solids handling program. It is hoped that the student will become aware of the critical importance of solids handling to the overall operation and effectiveness of the treatment plant.

The instructor is encouraged to supplement the visual material with additional slides of systems and processes if it is desirable to emphasize specific topics. Field trips to facilities using specific processes is also recommended.

Valuable demonstration items would include: samples of dried and/or dewatered sludge, samples of filter media, bench top demonstrations of gravity thickening and flotation thickening, demonstration of chemical coagulation (conditioning), demonstration of lime and chlorine stabilization showing increase and decrease of pH respectively, samples of aerobic and anaerobic digested sludge, samples of composted sludge, and samples of incinerator ash.

Lesson Plan

1. Have students read objectives and if time permits read the text material. (It may be advisable to assign the text material to be read prior to class.)

2. Lecture from outline using slides (72 slides - approximately 45 minute lecture).

3. Assign worksheet (allow about 10 min).
5. Assign final test (allow 15 - 20 min).
REVIEW OF SOLIDS HANDLING

Lecture Outline

Slide #'s

#1 & #2

Source of Sludge

Raw sludge from primary clarifiers

Biological sludge from secondary treatment

Chemical sludge from physical chemical treatment

The Importance of Sludge Management

0.125 lbs of dried sludge per person per day

The tail that wags the dog

A critical component to any treatment system

#3

Sludge Management

Goals and functions of:

Volume reduction
Solids reduction
Stabilization
Conditioning
Ultimate Disposal

A sludge management program can be a combination of these processes

#4

Volume Reduction

Gravity Thickening

Similar to sedimentation

Appearance of basins

#5
Description of cake and pressate

Gravity Concentration

Theory of process

Description of operation, equipment, and components

Description of cake and filtrate

Drying Beds

Theory of process

Characteristics of dried sludge

Solids Reduction

Aerobic Digestion

Theory of process

Description of basin and equipment

Anaerobic Digestion

Theory of process

Description of basin, equipment, components

Gas production and use

Sludge Lagoons

Theory of process

Used for storage and solids reduction

Description of operation and components

Composting

Theory of process

Description of equipment, components, and operation
#44 Description of composted material

Value of composted material

#45 Stabilization

#46 Theory of lime and chlorine stabilization

#47 & #48 Lime stabilization

Description of components and equipment

#49 & #50 Chlorine stabilization

Description of components and equipment

#51 Conditioning

#52 Conditioning used to pretreat sludge for:

Thickeners
Filters
Centrifuges
Drying beds

#53 Conditioning includes chemical conditioning, heat treatment, and elutriation

Chemical conditioning

#54 Theory of coagulation

#55 & #56 Description of components and equipment

Heat Treatment

#58 & #59 Theory of heat treatment

#60 Ultimate Disposal

Final resting place in the environment for treated sludge
Incineration

#61
Theory of process

#62 & #63
Description of equipment, components and operation
Description of gas and ash
Energy requirements

Land Application

#64
Theory of process
Fertilizer value of sludge compared to commercial fertilizer
Application methods

#65, #66, #67
Description of equipment

Landfill

#68
Theory of process

#69, #70 & #71
Description of operation and burying techniques

The Systems Approach

The sludge management system is the final piece of the puzzle required to "see" the whole picture of the total treatment program.
Answers for Worksheet

1. Which of the following is NOT one of the three major types of solids found in wastewater treatment plants?
   - [X] a. Suspended
   - ___ b. Chemical
   - ___ c. Raw
   - ___ d. Biological

2. Match the following sludge handling processes with their most important function:
   4. a. Anaerobic Digestion
   1. b. Elutriation
   5. c. Landfill
   3. d. Vacuum Filtration
   1. e. Heat Treatment
   4. f. Sludge Lagoon
   4. g. Composting
   3. h. Gravity Thickener
   5. i. Land Application
   3. j. Belt Filter
   1. k. Chemical Treatment
   2. l. Lime Addition
   3. m. Filter Press
   3. n. Flotation Thickener
   5. o. Incineration
   3. p. Centrifugation
   4. q. Aerobic Digestion
   3. r. Drying Beds
   2. s. Chlorine Addition
   3. t. Gravity Concentration
3. The "systems approach" to the design of a solids handling system means:

   a. That a "systems analyst" using computer based design will always give the best results.

   b. That the solids handling portion must be part of the overall waste treatment system.

   c. That with any wastewater plant design, the approaching collection systems are the key issue.
REVIEW OF SOLIDS HANDLING

Final Quiz

Multiple Choice: Choose the one best answer and place the corresponding letter in the blank.

1. Which of the following is NOT one of the three major types of solids found in wastewater treatment plants.
   ___ a. Biological
   ___ b. Raw
   ___ c. Chemical
   ___ d. Suspended

2. The pre-treatment of sludge to enhance the effectiveness of volume reduction processes is called
   ___ a. ultimate disposal
   ___ b. stabilization
   ___ c. solids reduction
   ___ d. conditioning
   ___ e. centrifugation

3. Treatment of sludge with lime or chlorine to decrease odor problems and reduce the pathogenic bacteria content is called
   ___ a. conditioning
   ___ b. volume reduction
   ___ c. stabilization
   ___ d. solids reduction
   ___ e. ultimate disposal

4. Solids handling processes that concentrate the solids into dewatered sludge cakes and result in a smaller quantity of sludge is called
   ___ a. solids reduction
   ___ b. volume reduction
   ___ c. conditioning
   ___ d. stabilization
   ___ e. ultimate disposal
5. A volume reduction process in which solids are concentrated by sedimentation in a clarifier-like basin is called
   ___ a. flotation thickening
   ___ b. belt filtration
   ___ c. gravity concentration
   ___ d. gravity thickening
   ___ e. elutriation

6. The solids handling process that concentrated solids by spinning them like a washing machine is called
   ___ a. belt filtration
   ___ b. filter press
   ___ c. centrifugation
   ___ d. vacuum filtration
   ___ e. aerobic digestion

7. A volume reduction process in which filter media covers a large drum and in which liquid is pulled into the drum and away from the sludge is called
   ___ a. belt filter
   ___ b. filter press
   ___ c. vacuum filter
   ___ d. gravity concentration
   ___ e. composting

8. A solids reduction process in which sludge is dewatered by being squeezed between two continuous, porous filters mats is called
   ___ a. filter press
   ___ b. belt filter
   ___ c. vacuum filter
   ___ d. centrifugation
   ___ e. gravity concentration

9. The process of volume reduction in which water drains away from sludge as well as evaporates is called
   ___ a. drying beds
   ___ b. incineration
   ___ c. gravity concentration
   ___ d. aerobic digestion
   ___ e. landfill
10. The sludge conditioning process in which sludge is treated with coagulants is called
   ___ a. heat treatment
   ___ b. lime addition
   ___ c. chemical treatment
   ___ d. chlorine addition
   ___ e. composting

11. The solids reduction process which takes place in large covered tanks, some of which may have covers designed to collect the gas produced during the process, is called
   ___ a. anaerobic digestion
   ___ b. aerobic digestion
   ___ c. composting
   ___ d. sludge lagoons
   ___ e. elutriation

12. The solids reduction process that is almost the same as the activated sludge process is called
   ___ a. anaerobic digestion
   ___ b. aerobic digestion
   ___ c. composting
   ___ d. sludge lagoons
   ___ e. flotation thickening

13. The solids reduction process in which sludge is mixed with a bulking agent, spread out in rows and then turned and mixed periodically is called
   ___ a. anaerobic digestion
   ___ b. aerobic digestion
   ___ c. composting
   ___ d. sludge lagoons
   ___ e. land application

14. The stabilization process whereby the pH of the sludge is raised to about pH 11 is
   ___ a. composting
   ___ b. sludge lagoons
   ___ c. chlorine addition
   ___ d. elutriation
   ___ e. lime addition
15. The stabilization process in which pathogenic organisms and obnoxious odor are controlled by chemical oxidation is
   ____ a. elutriation
   ____ b. lime addition
   ____ c. chlorine addition
   ____ d. incineration
   ____ e. heat treatment

16. The conditioning process that is essentially a washing process to remove very fine particles of sludge is called
   ____ a. centrifugation
   ____ b. belt filtration
   ____ c. elutriation
   ____ d. heat treatment
   ____ e. composting

17. The ultimate disposal method that reduces sludge to inert ash, carbon dioxide, and water vapor is
   ____ a. landfill
   ____ b. land application
   ____ c. vacuum conditioning
   ____ d. gravity decomposition
   ____ e. incineration

18. The ultimate disposal method in which sludge is sprayed on agriculture land or injected into the soil is called
   ____ a. landfill
   ____ b. land application
   ____ c. incineration
   ____ d. sludge lagoons
   ____ e. drying beds
Answers to Final Quiz

Multiple Choice: Choose the one best answer and place the corresponding letter in the blank.

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   **X** a. anaerobic digestion
   ___ b. aerobic digestion
   ___ c. composting
   ___ d. sludge lagoons
   ___ e. elutriation

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