

DOCUMENT RESUME

ED 252 415

SE 045 337

AUTHOR Carnegie, John W.  
 TITLE Review of Solids Handling. Instructor's Guide. Biological Treatment Process Control.  
 INSTITUTION Linn-Benton Community Coll., Albany, Oreg.  
 SPONS AGENCY Environmental Protection Agency, Washington, D. C.  
 PUB DATE 84  
 GRANT EPA-T901238  
 NOTE 21p.; For related documents, see SE 045 333-354.  
 AVAILABLE FROM Linn-Benton Community College, 6500 S.W. Pacific Blvd., Albany, OR 93721 (Instructor's Guide and accompanying slides).  
 PUB TYPE Guides - Classroom Use - Guides (For Teachers) (052)  
 EDRS PRICE MF01 Plus Postage. PC Not Available from EDRS.  
 DESCRIPTORS \*Biology; Laboratory Procedures; Post Secondary Education; \*Sludge; Solid Wastes; \*Training Methods; \*Waste Disposal; \*Waste Water; \*Water Treatment  
 IDENTIFIERS Unit Processes

ABSTRACT

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)

\*\*\*\*\*  
 \* Reproductions supplied by EDRS are the best that can be made \*  
 \* from the original document. \*  
 \*\*\*\*\*

# Biological Treatment Process Control

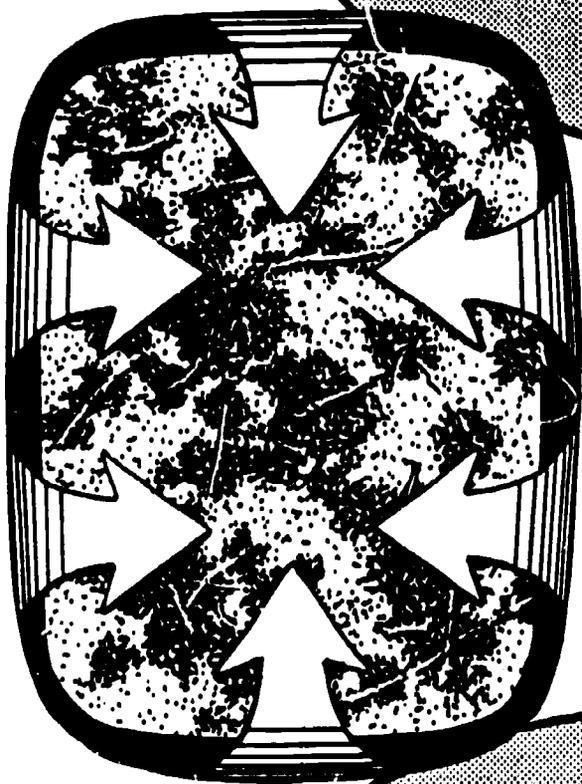
U.S. DEPARTMENT OF EDUCATION  
NATIONAL INSTITUTE OF EDUCATION  
EDUCATIONAL RESOURCES INFORMATION  
CENTER (ERIC)

✓ This document has been reproduced as received by the person or organization originating it.

Minor changes have been made to improve reproduction quality.

- Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

## Review of Solids Handling



### Instructor's Guide

"PERMISSION TO REPRODUCE THIS  
MATERIAL IN MICROFICHE ONLY  
HAS BEEN GRANTED BY

*John W. Carnegie*

TO THE EDUCATIONAL RESOURCES  
INFORMATION CENTER (ERIC)."

**Linn-Benton Community College**  
**Albany, Oregon** **1984**

ED252415

SE 045 337

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

Developed Under:  
EPA Grant #T901238  
1984

## REVIEW OF SOLIDS HANDLING

<u>Table of Contents</u>	<u>Page #</u>
Overview of Lesson	I-SH-1
Lesson Plan	I-SH-1
Lecture Outline	I-SH-3
Answers to Worksheet	I-SH-8
Final Quiz	I-SH-10
Answers to Final Quiz	I-SH-14

## 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).

4. Correct and review worksheet (allow 10 - 15 min).
5. Assign final test (allow 15 - 20 min).

# REVIEW OF SOLIDS HANDLING

## Lecture Outline

### Slide #'s

#1 & #2

Title and Credits

Sources 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

#5

Similar to sedimentation

Appearance of basins

#6	Theory of operation
#7	Process components
#8	Description of settled sludge and supernatant
#9 & #10	Flotation Thickening
	Appearance of basins
	Process components
#11	Theory of operation
#12	Description of float and subnatant
	Centrifugation
#13	Theory of operation
#14	Description of equipment and components
#15	Description of cake and supernatant
	Belt Filtration
#16	Theory of process
#17	Description of equipment and components
#18	Description of cake and filtrate
	Vacuum Filtration
#19	Theory of process
#20 & #21	Description of operation, equipment and components
#22	Description of cake and filtrate
	Filter Presses
#23	Theory of Process
#24	Description of operation, equipment, and components

#25	Description of cake and pressate
	Gravity Concentration
#26	Theory of process
#27	Description of operation, equipment, and components
	Description of cake and filtrate
	Drying Beds
#28	Theory of process
#29 & #30	Characteristics of dried sludge
#31	Solids Reduction
	Aerobic Digestion
#32	Theory of process
#33 & #34	Description of basin and equipment
	Anaerobic Digestion
#35	Theory of process
#36, #37, & #38	Description of basin, equipment, components
	Gas production and use
	Sludge Lagoons
#39	Theory of process
	Used for storage and solids reduction
#40	Description of operation and components
	Composting
#41	Theory of process
#42 & #43	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
	Theory of heat treatment
#58 & #59	Description of components and equipment
#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

#72

## 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.

## REVIEW OF SOLIDS HANDLING

### 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:

- |              |                          |                      |
|--------------|--------------------------|----------------------|
| <u>  4  </u> | a. Anaerobic Digestion   | 1. Conditioning      |
| <u>  1  </u> | b. Elutriation           | 2. Stabilization     |
| <u>  5  </u> | c. Landfill              | 3. Volume Reduction  |
| <u>  3  </u> | d. Vacuum Filtration     | 4. Solids Reduction  |
| <u>  1  </u> | e. Heat Treatment        | 5. Ultimate Disposal |
| <u>  4  </u> | f. Sludge Lagoon         |                      |
| <u>  4  </u> | g. Composting            |                      |
| <u>  3  </u> | h. Gravity Thickener     |                      |
| <u>  5  </u> | i. Land Application      |                      |
| <u>  3  </u> | j. Belt Filter           |                      |
| <u>  1  </u> | k. Chemical Treatment    |                      |
| <u>  2  </u> | l. Lime Addition         |                      |
| <u>  3  </u> | m. Filter Press          |                      |
| <u>  3  </u> | n. Flotation Thickener   |                      |
| <u>  5  </u> | o. Incineration          |                      |
| <u>  3  </u> | p. Centrifugation        |                      |
| <u>  4  </u> | q. Aerobic Digestion     |                      |
| <u>  3  </u> | r. Drying Beds           |                      |
| <u>  2  </u> | s. Chlorine Addition     |                      |
| <u>  3  </u> | 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

## REVIEW OF SOLIDS HANDLING

### Answers to 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