

Reverse Osmosis Water Treatment (ROWT)

INWT 145: (3) Math, Chemistry, Biology

1. Whole Numbers, Fractions, Decimals
2. Scientific Notation & Significant Figures
3. Addition & Subtraction
4. Multiplication & Division
5. Solving Equations

Sectional Exam

6. Atoms & Molecules
7. Atomic & Molecular Bonds
8. Properties of Water
9. Dissolved Substances: Ions
10. Dissolved Substances: Other
11. Dissolved Substances: Measurement

Sectional Exam

12. Suspended Substances: Nonliving Particles
13. Suspended Substances: Microorganisms
14. Suspended Substances: Measurement

INWT 146: (3) Reverse Osmosis

15. Pretreatment: Overview
16. Particulate Control: Overview
17. Microbial Control: Overview
18. Scale Control: Overview

Sectional Exam

19. Reverse Osmosis: Theory Of Osmosis
20. Reverse Osmosis: Theory Of Osmosis
21. Reverse Osmosis: Reversing Osmosis
22. Semipermeable Membranes: What Are They?
23. Cellulose Acetate & Thin Film Membranes

Sectional Exam

24. Membrane Performance: Water & Salt Flux
25. Membrane Performance: What Gets Rejected
26. Membrane Elements: Construction
27. Membrane Elements: Characteristics
28. Reverse Osmosis Unit: Equipment
29. Reverse Osmosis Unit: Design Criteria
30. Reverse Osmosis Unit: Unit Operation

Sectional Exam





INWT 147: (3) RO Troubleshooting

- 31. Problems: Overview
- 32. Problems: Biofouling I
- 33. Problems: Biofouling II
- 34. Monitoring: Pressures, Flows, Conductivities
- 35. Monitoring: Instrumentation Calibration & Pressure Drops
- 36. % Salt Rejection & Normalized Permeate Flow
- 37. Silt Density Index

Sectional Exam

- 38. Troubleshooting: Profiling & Probing
- 39. Troubleshooting: Normalized Permeate Flow
- 40. Troubleshooting: Salt Rejection & Pressures
- 41. Chemical Cleaning: Overview
- 42. Chemical Cleaning: Process
- 43. Troubleshooting: Chemical Cleaning

Sectional Exam

Final Exam



Advanced Reverse Osmosis Water Treatment (AROWT)

INWT 255: (3) Pretreatment Troubleshooting

1. Introduction to Advanced Pretreatment Troubleshooting
2. Multimedia Filtration I
3. Multimedia Filtration II
4. Multimedia Filtration III
5. Activated Carbon I
6. Activated Carbon II
7. Activated Carbon III
8. pH
9. Temperature
10. Scale Inhibitors & Silt Dispersants
11. Fouling Potential: I
12. Fouling Potential: II
13. Dechlorination With Sulfite Compounds

Sectional Exam



INWT 256: (3) Scaling & Fouling Troubleshooting

14. Introduction to Advanced RO Troubleshooting
15. Water Analysis: Analytical Methods I
16. Water Analysis: Analytical Methods II
17. Water Analysis: Equivalents
18. Water Analysis: Hardness
19. Water Analysis: Alkalinity
20. Water Analysis: Ionic Strength

Sectional Exam

21. Calcium Carbonate Scale: Saturation Index
22. Sulfate Scales: Solubility Products
23. Iron & Sulfur Fouling
24. Silica Scaling & Fouling
25. Scale Inhibitor & Dispersant Dosages
26. Acid Dosage
27. Recovery Limitation
28. Scale Control Software I
29. Scale Control Software II

Sectional Exam

INWT 257: (3) Advanced RO Monitoring/Cleaning

30. RO Design Parameters I
31. RO Design Parameters II
32. RO Monitoring Software I
33. RO Monitoring Software II
34. Replacing Elements I

35. Replacing Elements II

Sectional Exam

36. Chemical Cleaning: Scalants

37. Chemical Cleaning: Foulants

38. Chemical Cleaning: Problems

39. Chemical Cleaning: Procedures

40. Chemical Cleaning: Analysis

41. Chemical Cleaning: Disinfectants

42. Membrane Damage

43. Element Autopsy I

44. Element Autopsy II

Sectional Exam

Final Exam



High Purity Water Treatment (HPWT)

INWT 160: (3) High Purity Water From Ion Exchange

1. Characteristics
2. Processes
3. Total Oxidizable Carbon (TOC)
4. Particles
5. Conductivity/Resistivity
6. Microbiology
7. Silica

Sectional Exam

8. Ion Exchange Principles
9. Decarbonation & Degasification: Principles
10. Decarbonation & Degasification: Equipment
11. Reverse Osmosis Impacts on Ion Exchange
12. Resins: Structure & Manufacture
13. Resins: Functional Groups
14. Resins: Selectivity

Sectional Exam

INWT 161: (3) Ion Exchange Operation

15. Weak Acid Cations: Normal Service
16. Weak Base Anions: Normal Service
17. Strong Acid Cations: Normal Service
18. Strong Base Anions: Normal Service
19. Strong Base Anions: Organics & Silica Removal
20. Dual Beds (C & A): Normal Service

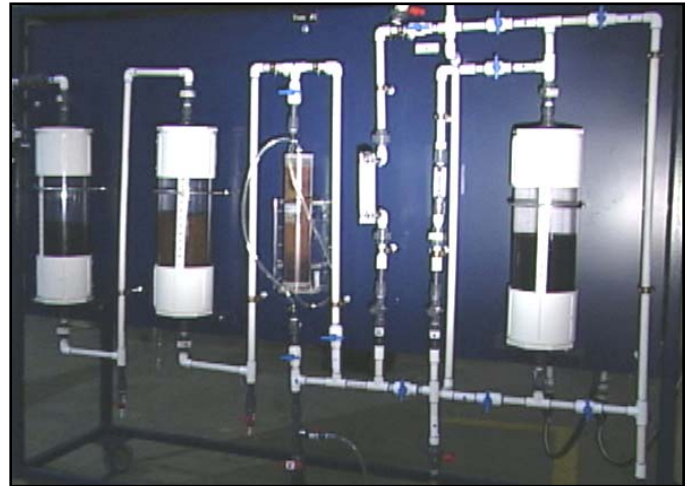
Sectional Exam

21. Weak/Strong Combinations: Normal Service
22. Sodium-Cycle Softening
23. Chloride-Cycle Dealkalizing
24. Mixed Beds: Principles
25. Mixed Beds: Normal Service
26. Full-Train Deionization: Cation/Anion Mixed Bed

Sectional Exam

27. Cation Regeneration: Principles
28. Cation Regeneration: Procedures
29. Anion Regeneration: Principles
30. Anion Regeneration: Procedures
31. C & A Concurrent Regeneration: Principles
32. Mixed-Bed Regeneration: Principles
33. Mixed-Bed Regeneration: Procedures

Sectional Exam



INWT 162: (3) Maintaining High Purity

- 34. Overview
- 35. Piping: Dead Legs, Flow Rates & Materials
- 36. Ultraviolet Irradiation: Principles
- 37. Ultraviolet Irradiation: 254 nm
- 38. Ultraviolet Irradiation: 185 nm
- 39. Other Disinfectants: Ozone, Hydrogen Peroxide, Heat

Sectional Exam

- 40. Principles
- 41. Equipment: Microfiltration, Ultrafiltration & Hyperfiltration
- 42. Piping & Storage
- 43. Polishing Disinfection & Final Filtration

Sectional Exam

Final Exam

Advanced High Purity Water Treatment (AHPWT)

INWT 270: (3) Feedwater & Pretreatment

1. Overview of Laboratory Analysis I
2. Overview of Laboratory Analysis II
3. Silica
4. Organics
5. Particles
6. Microbiology
7. Ions

Sectional Exam

8. Raw Water
9. Backflow Prevention I
10. Backflow Prevention II
11. Backflow Prevention III
12. Pumps I
13. Pumps II
14. Pumps III

Sectional Exam



INWT 271: (3) Ion Exchange Troubleshooting

15. Feedwater Analysis
16. Ion Exchange Capacity: Feedwater Calculations
17. Ion Exchange Capacity: Resin Calculations
18. Ion Exchange Capacity: Feedwater Changes
19. Resin Problems
20. Resin Analysis
21. Resin Replacement

Sectional Exam

22. Overview of Regeneration Problems
23. Cation Regeneration Troubleshooting
24. Anion Regeneration Troubleshooting
25. Mixed-Bed Regeneration Troubleshooting I
26. Mixed-Bed Regeneration Troubleshooting II

Sectional Exam

INWT 272: (3) Post Ion Exchange

27. Ultraviolet Irradiation I
28. Ultraviolet Irradiation II
29. Final Filtration I
30. Final Filtration II
31. Periodic Sanitization I
32. Periodic Sanitization II
33. Waste Neutralization I
34. Waste Neutralization II
35. Waste Neutralization III
36. Waste Solvents I
37. Waste Solvents II
38. Heavy Metals I
39. Heavy Metals II

Sectional Exam

40. Gases I
41. Gases II
42. Bulk Chemicals I

43. Bulk Chemicals II
Sectional Exam
Final Exam