



Wisconsin Department of Natural Resources
Municipal Waterworks Operator Certification

Zeolite Softening Study Guide

January 1994 Edition

Subclass Z

Wisconsin Department of Natural Resources
Bureau of Science Services
Operation Certification Program
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Preface

This operator's study guide represents the results of an ambitious program. Operators of water supply facilities, regulators, educators and local officials, jointly prepared the objectives and exam questions for this subclass.

How to Use This Study Guide with References

In preparation for the exam you should:

1. Read all the objectives and write down the answers to the objectives that readily come to mind.
2. Use the resources at the end of the study guide to look up those answers you are not sure of.
3. Write down the answers found in the resources to those objectives you could not answer from memory.
4. Review all answered objectives until you can answer each from memory.

It is advisable that the operator take classroom or online training in this process before attempting the certification exam.

Choosing a Test Date

Before you choose a test date, consider the training opportunities available in your area. A listing of training opportunities and exam dates is available on the internet at <http://dnr.wi.gov/> and by searching keywords "Operator Certification". It can also be found in the annual DNR "Certified Operator" or by contacting your DNR regional operator certification coordinator.

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Chapter 1 - Principle, Structure, and Function

Section 1.1 - Principle of Zeolite Softening

- 1.1.1 Define the term water hardness.

- 1.1.2 Explain why water becomes hard.

- 1.1.3 Describe the characteristics of an atom, an element, and chemical bonding.

- 1.1.4 Discuss the elements that cause hard water.

- 1.1.5 Discuss the various compounds that carry the hardness elements.

- 1.1.6 Explain the difference between carbonate and non-carbonate hardness.

- 1.1.7 Explain the difference between cations and anions.

- 1.1.8 Describe the basic concept involved with cation exchange softening.

- 1.1.9 Explain which cations are, or may be, exchanged through the ion exchange process.

Section 1.2 - Structure and Function

- 1.2.1 Sketch a diagram of a typical zeolite softening unit and identify the components.
- 1.2.2 Describe the function of the media, the gravel support bed, the underdrain system, the air relief valve, and the brine distribution system.
- 1.2.3 Identify different types of media, citing advantages and disadvantages to each.

Chapter 2 - Operation and Maintenance

Section 2.1 - Operation

- 2.1.1 Outline the problems associated with hard water, and list the advantages and disadvantages of using zeolite softening to control hardness.
- 2.1.2 Explain stable water.
- 2.1.3 Discuss various methods used to determine water stability.

- 2.1.4 Discuss problems iron poses in the zeolite softening process.
- 2.1.5 Explain the need for blending water.
- 2.1.6 Sketch a diagram of a zeolite unit, identify the proper actions to remove the unit from service, regenerate, and return to service.
- 2.1.7 Explain why a zeolite softener needs to be regenerated.
- 2.1.8 Discuss methods used to determine when regeneration is necessary.
- 2.1.9 Describe the regeneration process.
- 2.1.10 Discuss the methods of disposal for wastes resulting from regeneration of ion exchange units.

Section 2.2 - Maintenance

- 2.2.1 List the maintenance items that should be performed on a daily, weekly, quarterly, semi-annual, and annual basis.

Chapter 3 - Monitoring and Troubleshooting

Section 3.1 - Monitoring

- 3.1.1 List the units of measurement and conversion factors associated with water hardness.

- 3.1.2 Identify the appropriate values for hard and soft water.

- 3.1.3 Identify the laboratory tests used for process control in zeolite softening, and discuss how often each test should run.

- 3.1.4 Briefly summarize the EDTA titration method of testing hardness, and list the test necessary for Langelier index determination.

- 3.1.5 Describe the purpose of a hydrometer in zeolite softening.

Section 3.2 - Troubleshooting

- 3.2.1 Indicate the possible cause(s) and solution for the depth of media increasing in a zeolite softener.

- 3.2.2 Indicate the possible cause(s) and solution for the depth of media decreasing in a zeolite softener.

- 3.2.3 Indicate the possible cause(s) and solution for finished water having a salty taste after regeneration of a zeolite softener.

- 3.2.4 Indicate the possible cause(s) and solution for a loss of softening capacity in a zeolite softener.

- 3.2.5 Indicate the possible cause(s) and solution for erratic softening capacity in a zeolite softener.

- 3.2.6 Indicate the possible cause(s) and solution for corrosion in a zeolite softener.

- 3.2.7 Indicate the possible cause(s) and solution for finished water being too hard in a zeolite softener.

Chapter 4 - Safety and Calculations

Section 4.1 - Safety

- 4.1.1 Describe the safety factors to consider in the zeolite softening process.

Section 4.2 - Calculations

- 4.2.1 Given the necessary data, calculate water hardness.

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- 4.2.2 Given the necessary data, calculate pounds of salt needed to remove hardness or to regenerate a zeolite softening unit.
- 4.2.3 Given the necessary data, calculate the exchange capacity of a zeolite softening unit.

References and Resources

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1st Edition (1990). Kenneth D. Kerri. California State University, 6000 J Street, Sacramento, CA 95819-6025. Phone (916) 278-6142.

<http://www.owp.csus.edu/>

2. STANDARD METHODS FOR THE EXAMINATION OF WATER AND WASTEWATER.

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<http://www.standardmethods.org/>

3. WATER TREATMENT PLANT OPERATION.

2nd Edition (1989). Volumes 1 and 2. Kenneth D. Kerri. California State University, 6000 J Street, Sacramento, CA 95819-6025. Phone (916) 278-6142.

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4. WISCONSIN ADMINISTRATIVE CODE NR 809 SAFE DRINKING WATER.

Wisconsin Legislative Reference Bureau, One E Main St, Suite 200, Madison, WI 53701-2037 Reference Desk: 608-266-0341

http://docs.legis.wisconsin.gov/code/admin_code/nr/800/809

5. WISCONSIN ADMINISTRATIVE CODE NR 811 REQUIREMENT FOR THE OPERATION AND DESIGN OF COMMUNITY WATER SYSTEMS.

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12. PLAIN TALK ABOUT DRINKING WATER.

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13. PUBLIC INFORMATION - HOW TO BUILD A SUCCESSFUL PUBLIC INFORMATION/PUBLIC RELATIONS PROGRAM.

AWWA No. 20242 (1989). American Water Works Association, Member Service Department. 6666 W. Quincy Avenue, Denver, Co 80235. Phone (303) 794-7711.

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14. SAFE DRINKING WATER ACT SERIES:

SURFACE WATER TREATMENT RULE. AWWA No. 70055 (1990).

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15. TREATMENT TECHNIQUES FOR CONTROLLING TRIHALOMETHANE IN DRINKING WATER.

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