Wisconsin Department of Natural Resources
Municipal Waterworks Operator Certification

Iron and Manganese Removal Study Guide

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Subclass I

Wisconsin Department of Natural Resources
Bureau of Science Services
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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, keyword search "operator certification". It can also be found in the annual DNR "Certified Operator" or by contacting your DNR regional operator certification coordinator.

Table of Contents

Chapter 1 - Principle, Structure, and Function

Section 1.1 - Principle of Iron & Manganese Removal

1.1.1 Identify the characteristics of an atom, an element, and a compound.

1.1.2 Define an ion, anion, and a cation.

1.1.3 Explain where iron and manganese are found and how they get into water.

1.1.4 Discuss problems associated with water containing high concentrations of iron and manganese.

1.1.5 Describe different methods used to control iron and manganese problems.

1.1.6 Define these processes: coagulation, flocculation, and sedimentation.

1.1.7 Identify concentrations at which iron and manganese begin to pose problems.

1.1.8 Compare primary versus secondary contaminate levels.

1.1.9 Define oxidation reaction as related to iron and manganese.

1.1.10 Differentiate between ferrous and ferric iron, and bivalent and quadrivalent manganese.

Section 1.2 - Structure and Function

1.2.1 Discuss the common types of Iron removal systems that utilize oxidation.

1.2.2 Discuss the methods of oxidizing iron and manganese.

1.2.3 Draw a line diagram of a pressure aeration filtration system for iron and manganese removal.

1.2.4 Draw a line diagram of an open air aeration system for iron and manganese removal.

1.2.5 Sketch a typical pressure filtration unit.

1.2.6 Define the following filtration process unit parts:

A. Compressor
B. Aerator/atomerator
C. Rate of flow controller
D. Media
E. Gravel support bed
F. Underdrain system
G. Loss of head gauges
H. Air relief valve
I. Surface wash system
J. Air scour system
K. Raw and finished water sampling taps

1.2.7 Explain the need for freeboard space in a filter.

Chapter 2 - Operation and Maintenance

Section 2.1 - Operation

2.1.1 Explain the normal operation and backwashing of a pressure filtration unit.

2.1.2 Explain the normal operation and backwashing of a gravity filtration unit.

2.1.3 Identify different types of media used in pressure and gravity filters.

2.1.4 Discuss suitable numerical values for filter flow rates and headloss.

2.1.5 Describe the backwashing process.

2.1.6 Discuss suitable backwashing rates, and explain why backwash rates vary according to media used.

2.1.7 Explain how to determine when a filter must be backwashed.

2.1.8 Discuss the disposal of backwash wastes from a filter unit.

Section 2.2 - Maintenance

2.2.1 Summarize the storage of filtration units.

2.2.2 Prepare a calendar of maintenance events that should be routinely performed.

Chapter 3 - Monitoring and Troubleshooting

Section 3.1 - Monitoring

3.1.1 Describe iron and manganese related bacteria.

3.1.2 Discuss the laboratory tests used for process control for iron/manganese removal systems.

3.1.3 Discuss the monitoring frequency for the laboratory tests performed on iron and manganese removal systems.

Section 3.2 - Troubleshooting

3.2.1 Explain the cause of mud balls, and provide a solution to the problem.

3.2.2 Explain the cause of loss of media, and provide a solution to the problem.

3.2.3 Explain the cause of channeling in the media, and provide a solution to the problem.

3.2.4 Explain the cause of air binding in a gravity filter, and provide a solution to the problem.

3.2.5 Explain the cause of increased media thickness, and provide a solution to the problem.

3.2.6 Explain the cause of increased poor iron removal, and provide a solution to the problem.

3.2.7 Explain the cause of white water, and provide a solution to the problem.

3.2.8 Explain the cause of iron/manganese bacteria in the filter media, and provide a solution to the problem.

Chapter 4 - Safety and Calculations

Section 4.1 - Safety

4.1.1 Describe safety problems when repair work is required at Iron/Manganese removal plants.

Section 4.2 - Calculations

4.2.1 Given data, calculate the percent removal of iron.

4.2.2 Given data, calculate the pounds of chlorine used per day.

References and Resources

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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.

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

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12. PLAIN TALK ABOUT DRINKING WATER.

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70076 (1991). 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.

AWWA No. 20221 (1982). American Water Works Association, Member Service Department. 6666 W. Quincy Avenue, Denver, CO 80235. Phone (303) 794-7711.

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