Instructor Notes

This course was developed by John Shadwick, Training Station Director, Tennessee Association of Utility Districts, under a contract with the Southeastern Regional Small Public Water Systems Technical Assistance Center (SE-TAC). It is designed as a performance-based training course. Filter evaluation procedures were taught by having the learners actually evaluate at least two filters at each site. The first day, learners were coached through the evaluation process. On the Second day, learners conducted an evaluation while trainers observed and corrected any errors made by learners. The general flow of training was as follows.

Day 1

Demonstration/Explanation of Procedures ..... 1.0 to 1.5 hours

Coaching Learners in Sampling/Data Gathering ..... 1.5 to 2.0 hours

Coaching Learners in Lab Analyses ..... 2.0 to 2.5 hours

Coaching Learners in Data Evaluation and Reporting..... 1.0 hour

Day 2

Organization for Day's Work..... 0.25 to 0.5 hours

Learners Conduct of Filter Evaluation..... 4.0 to 5.0 hours

Reporting Out to Plant Superintendent ..... 1.0 to 1.5 hours

Procedures

The procedures used in this course were developed, and modified in some cases, from the AWWA Manual, Filter Evaluation Procedures for Granular Media, by Daniel K. Nix and John Scott Taylor. It is recommended that all instructor/facilitators obtain and study a copy of this manual before conducting training, and that all learners be advised to obtain copies.

Other references used in preparation for these training sessions include:

- Integrated Design and Operation of Water Treatment Facilities, Second Edition, Susumu Kawamura. John Wiley and Sons, Inc. New York. 2000.
- Water Treatment Operator Handbook, Nicholas Pizzi. AWWA. Denver. 2002.

Filter performance standards and design covered in the student workbooks and PowerPoint presentations are those specified in Tennessee's *Division of Water Supply Regulations 1200-5-1-.08 and 1200-5-1-.31*, and Tennessee's *Design Critreia for Community Public Water Systems 4.2 Filtration*.

In preparation for this training TAUD staff evaluated eight filters at four surface water treatment plants. By doing so, staff members were able to:

- develop good technique and their own skills;
- discover difficulties learners might encounter and solutions to overcome them; and,
- simplify some of the procedures.

The training was conducted at eight water treatment plants. Twenty filters were evaluated. It should be noted that problems were found in all 28 filters. Almost all had problems with backwash rate and bed expansion. Two had lost all of the sand, only 18 inches of anthracite remained on the filters.

Site Selection

Site selection can be problematic. The site selected will determine how the class is conducted. Most plants that would benefit most from hosting this workshop have limited space, making it difficult to use visual aids. This was not necessarily bad. At most plants we had to demonstrate the procedures and coach the learners without using visual aids. Larger plants had space for setting up audio-visual equipment. Learners who viewed a demonstration of the procedures followed by coaching had no more difficulty developing the necessary skills that those who were able to view visual presentations followed by demonstrations and coaching.

Equipment/Supplies

The amount of equipment required is quite large. This equipment was provided for each team of four to six people.

- portable turbidimeter with cells
- 1-liter Erlenmeyer Flask
- 1-pint "mason" or "jelly" jar
- a box of 1-gallon plastic bags (25 to 30 bags)
- core sampler
- 3 to 4 sheets of plywood (2' X 2')
- 5-foot Ruler
- carpenter's level
- mudball sampler
- 5-gallon plastic bucket
- plastic pan
- a No.12 (10-mesh) sieve
- thirty 100-mL sample bottles
- stopwatch
- materials and tools to construct a hook gauge (1"x2"x8' furring strip, hammer, pliers, ruler, 16d finishing nails)
- two 4-inch clamps
- one 250-mL graduated cylinder
- "simulated mudballs"

- tray for carrying sample bottles
- 'loaner" calculators
- handouts
- scratch paper
- two 2"x2"x8' boards when handrails did not allow for the hook gauges to hang vertically

Other equipment necessary for conducting the training safely included at least two ladders long enough to allow safe entry and egress from the filter, and rope to tie off the ladder.

Order of Sampling Testing

Because one or more filters have to be taken out of service in order to collect samples and make measurements, the speed and order in which sampling is done is critical. Teams must have their equipment ready and be organized.

Before the filter is drained, the teams should accomplish these tasks.

1. Set up hook gauges for drop tests.
2. Establish a fixed point for expansion measurements.
3. Make the initial bed measurements.
4. Wash plywood sheets with strong hypochlorite solution.

Once the teams are ready, the bed can be drained. As it is drained, the drop test (hook gauge) test data is gathered.

When the water is drained from the filter, the teams should perform these tasks.

1. Observe the filter for defects/uneven draining.
2. Set up ladders for safely climbing into and out of filter.
3. Place pieces of plywood for standing/walking in filter.
4. Measure the levelness of the troughs.
5. Take 10 depth media measurements per team.
6. Take the core samples for sludge retention profile - before backwash.
7. Remove all people and equipment from the filter.

As the filter is refilled, observe the distribution of backwash water.

While the filter is being backwashed, these tasks must be performed.

1. Take samples for backwash water analysis.
2. Take second/final measurement for bed expansion.
3. Perform the rise test, hook gauges will need to be dropped to a lower level to allow operator time to shutoff backwash pump properly before the filter overflows.
4. Raise hook gauges for drop test.

After the filter has been backwashed, drain the filter a second time, and perform these tasks.

1. Repeat drop test.
2. Observe the filter for defects/uneven draining.
3. Set up ladders for safely climbing into and out of filter.
4. Place pieces of plywood for standing/walking in filter.
5. Take the core samples for sludge retention profile – after backwash.
6. Take samples for mudball analysis.
7. Remove all people and equipment from the filter.
8. Backwash filter.
9. Disinfect filter if necessary.

This allows the filter to be returned to service as quickly as possible.

The remainder of the day is used to analyze samples, perform calculations, analyze data, and prepare report for plant superintendent/chief operator.

Tasks and Objectives

In order to complete the training, the learner must demonstrate their ability to perform the skills listed below:

Task: Perform physical observation/inspection of a filter.

Conditions: Given several sheets of 2' X 2' plywood, electrical tape, probe, Carpenter's level, measuring tape, and a copy of the procedure.

Standards: The learner will look for and note the presence of any of the following problems:

a. mounding of media

b. cratering of media

c. presence of mud or silt

d. cracking of media

e. separation of media from walls

f. presence of algae

g. structural damage or defects

h. presence of media in troughs

i. media depth

j. levelness of backwash troughs

k. freeboard measurement

Task:	Observe a filter for problems during backwash.
Conditions:	Given a copy of the Backwash Observation form and a copy of the procedure.
Standards:	The learner will identify and note any of the following problems if they occur during backwash. a. media boiling b. uneven distribution of backwash water c. media carryover d. backwash trough capacity
Task:	Perform a backwash bed expansion analysis.
Conditions:	Given a calculator, formula, and a device to measure the filter bed expansion (ruler gauge, tube samples, or Secchi disc).
Standards:	The learner will determine the bed expansion to the nearest percent and identify if the expansion is with acceptable range (20-30%).
Task:	Perform a Backwash Rise Rate analysis.
Conditions:	Given a “hook” gauge, stopwatch, formulas, Filter Evaluation form, and a copy of the procedure.
Standards:	The learner must determine the following: a. The backwash flow meter reading is correct. b. Use the Backwash Flow Rate Interpretations table to identify any problems caused by incorrect backwash rates.
Task:	Perform a Backwash Water Turbidity analysis.
Conditions:	Given a stopwatch, sampling bucket, bench-top turbidimeter, 30-100ml sample bottles marked in one-minute intervals, copy of the procedure, Backwash Turbidity Evaluation form, graph paper, and straight edge.
Standards:	The learner will determine the time in minutes needed to backwash the filter (the time required for the backwash water turbidity to feed within the 10-15 NTU (Nephelometric Turbidity Units) range.

Task:	Determine the filtration rate for a filter using a "hook" gauge.
Conditions:	Given a calculator, the formula, Filtration Rte Analysis form.
Standards:	The learner will calculate the filtration rate to the nearest tenth of a gallon per minute per square foot and state whether or not the filter is operating within the allowable limits.
Task:	Perform Filter Effluent Turbidity analysis.
Conditions:	Given a copy of the procedure, de-ionized water, turbidimeter (online or bench top), one hundred 100-ml sample bottles, and a computer with spreadsheet program.
Standards:	The learner will develop a graph showing filter effluent turbidity trends during the run and determine: a. if the turbidity exceeded 1.0 NTU at any time; b. if the turbidity exceeded 0.3 NTU at any time; c. if the turbidity exceeds 0.1 NTU at any time, determine at what time in the run that the filter effluent turbidity exceeded 0.1 NTU.
Task:	Perform a Sludge Retention Profile for a filter.
Conditions:	Given a copy of the Sludge retention Profile Evaluation procedure, a Sludge Retention Profile Evaluation Form, 36 one-gallon re-sealable plastic bags, sludge retention core samples, 100-ml graduated cylinder, 500-ml flask, 500-ml beaker, tap water, bench-top turbidimeter and procedure.
Standards:	The learner will graph the sludge retention profile for the filter (before and after backwash) and determine the condition of the filter media.
Task:	Prepare a filter profile.
Conditions:	Given turbidity data collected during a filter run, from start up through the end of a backwash cycle, including turbidity measurements taken while a second filter is being backwashed, and a computer with spreadsheet program.
Standards:	The learner must develop a filter profile graph, prepare a draft report stating findings found during the filter evaluation and recommend appropriate changes in filter operations.

Task:	Make recommendations for filter optimization.
Conditions:	Given data collected during the training session.
Standards:	The learner must prepare a draft report stating findings found during the filter evaluation and recommend appropriate changes in filter operations.

The following tasks will be demonstrated in class.

Task:	Perform a Top of Gravel Footprint analysis (Method 1).
Task:	Perform a Top of Gravel Footprint analysis (Method 2).

Comments

This course has been one of the most popular and well received training efforts we have conducted. Learners were busy for the entire too day period. There is no dead time. It is a demanding course for the facilitator/trainers and learners.

If you want more information, please feel free to contact John Shadwick at this address. E-mail contact is best.

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