



New England Water Treatment Technology Assistance Center

University of New Hampshire • Durham, New Hampshire

PROJECT SUMMARY REPORT

Costing Summaries for Slow Sand Filtration and Ceramic Media Filtration

Objectives

The objective of this project was to assemble information regarding construction, and operation and maintenance costs for slow sand filtration and ceramic media filtration treatment technologies applicable to small water systems in the New England Region. This information is useful in the decision process of selecting a treatment technology for a small water system. The project results are anticipated to assist community decision makers and engineering consultants in their comparisons of treatment technologies.

Methodology

Detailed questionnaires were sent to existing slow sand filtration and ceramic media filtration treatment facilities in the New England region. Slow sand filtration questionnaires requested general information about the plant such as design capacity, filter area, and raw water quality. Information regarding the operation and maintenance budget for items such as chemicals, electricity, labor, and sand were also requested. Construction costs and related information such as the type of building, roofing material, and number of cells in the filter were also requested.

Questionnaires sent to ceramic media filtration facilities concentrated on operation and maintenance costs with some general plant information requested. The construction cost data were obtained directly from the engineering companies that designed the plants.

Construction costs were updated using the Engineering News-Record Construction Cost Index (ENR CCI). All the costing data obtained was calculated in year 2000 dollars (ENR CCI = 6221) prior to analysis and comparison. Item costs that could not use the ENR CCI were updated using the Consumer Prices Index (CPI). For ceramic media facilities total construction cost was broken down into construction cost and filter cost. Construction costs were updated using ENR CCI and filter costs using CPI.

Results

SLOW SAND FILTRATION

Data was collected from 20 slow sand filtration facilities in Maine, Vermont, Massachusetts, Connecticut, and New Hampshire. Fifteen of the facilities were constructed in the 1990s. Design capacity ranged from 0.036 to 50 million gallons per day (mgd) and filter areas ranged from 82 to 46,452 square meters. Eighteen of the facilities had a design capacity less than 5 mgd and filter area less than 5,000 square meters.

Plots were generated of construction costs versus filter area (Figure 1) and construction costs versus design capacity. The best fit line calculated from both plots was a linear regression showing an increase in construction cost with a corresponding increase of filter area and design capacity. Variability in construction costs may be



explained by initial site work costs based on pre-existing site conditions, and the inclusion of costs such as piping used for connecting the raw water source to the treatment plant or connection of the plant to the distribution system. Unit construction costs were plotted versus design capacity and filter area (construction costs/design capacity vs. design capacity and construction costs/filter area vs. filter area) and the resulting equations indicate that the unit costs decrease with the size or capacity of the facility illustrating the economy of scale.

Slow sand filtration operation and maintenance total costs were compared to average flow rates through the filters. The resulting plot did not illustrate a significant relationship between these two variables, however the general trend implied increasing costs with increasing flows. The operation and maintenance costs were broken out to include only a sum of chemical, electricity, and labor costs versus actual flow and a more defined relationship was exhibited showing increasing costs with increasing flow rates.

CERAMIC MEDIA FILTRATION

Construction costs were obtained from five ceramic media filtration facilities built in New England since 1990. Plots were generated for total construction costs versus design capacity (Figure 2), and unit cost (construction cost/design capacity) versus design capacity. Economy of scale was observed from these plots.

Operation and maintenance costs were received from only one ceramic media facility thereby limiting the feasibility of analyzing operation and maintenance costs.

The curves generated from the costing data collected for construction costs of slow sand filtration facilities and ceramic media filtration facilities were compared to a costing curve for membrane filtration developed by Elandee, et al. in Figure 3.

C o n c l u s i o n s

Construction costs were comparable between slow sand filtration and ceramic media filtration facilities. Construction costs increased exponentially with design capacity and filter area. These costs are comparable to membrane filtration construction cost curves from a previous study by Elandee, et al. Operation and maintenance data could not be compared due to the lack of data for ceramic media filtration.

R e f e r e n c e s

Elandee, J.R., Byrgman, R.A., The Cost of Membrane Filtration for Municipal Water Supplies, AWWA Membrane Conference Proceedings, San Antonio, Texas, 2001.

P r i n c i p a l I n v e s t i g a t o r s

M.Robin Collins, Ph.D., P.E.
Alix Montel
New England Water Treatment Technology Assistance Center
University of New Hampshire
Durham, NH

D i s c l a i m e r

This project was funded by the U.S. Environmental Protection Agency grant number X827736-01-0. Mention of specific trade names herein does not imply endorsement on the part of the USEPA or the University of New Hampshire.



Figure 1 - Slow Sand Filtration Construction Costs versus Filter Area

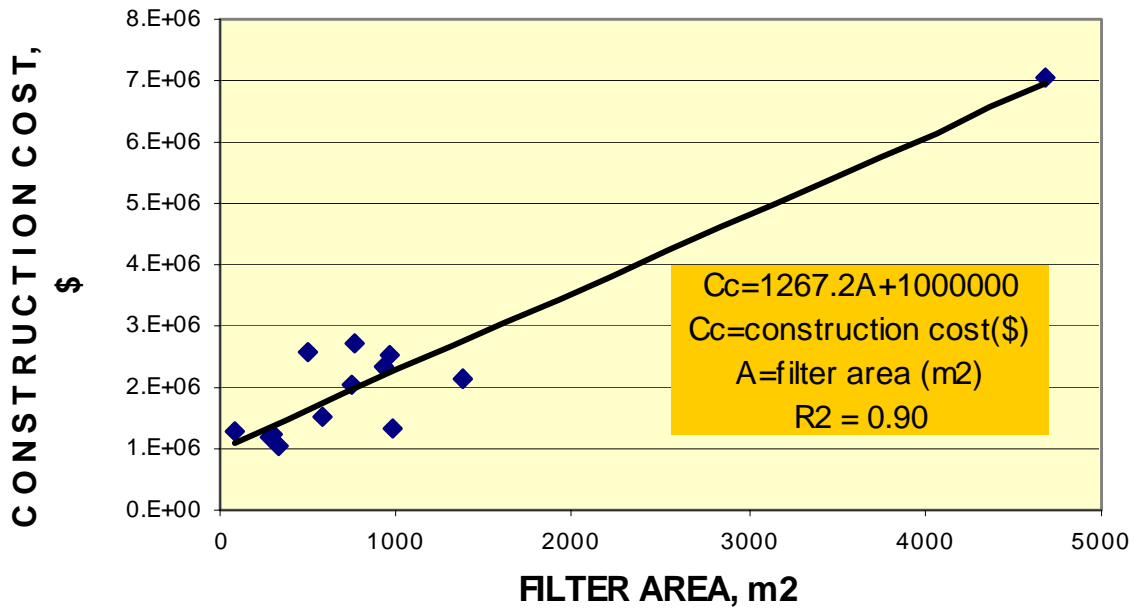


Figure 2 - Ceramic Media Filtration Construction Costs versus Design Capacity

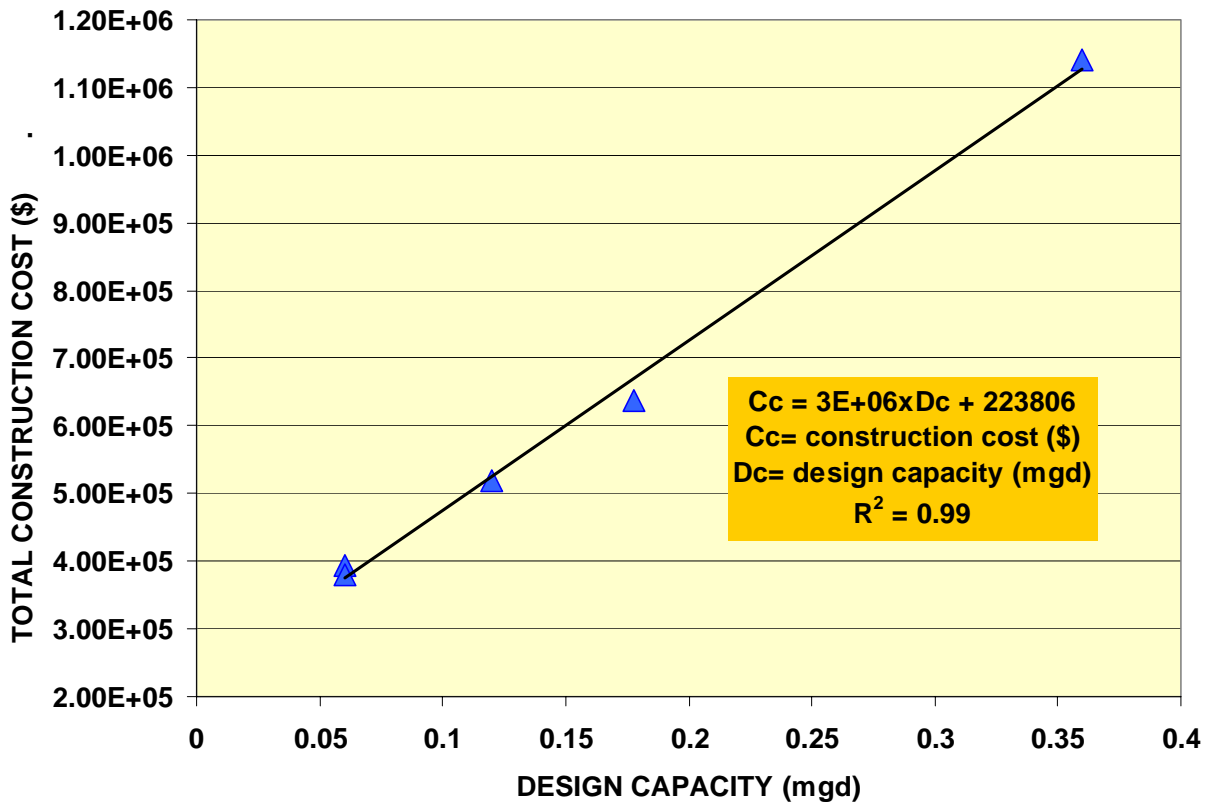




Figure 3 Comparison of Costing Curves from this Study with Previous Study by Elandee, et al.

