WATER REUSE RESEARCH NEEDS ASSESSMENT

Edited by

Susan Martella

Summary Report of a Seminar
August 4, 1996
Monterey, California

Jointly sponsored by

U.S. Bureau of Reclamation
American Desalting Association
WateReuse Association

Water Treatment Technology Report No. 19

U.S. DEPARTMENT OF THE INTERIOR
Bureau of Reclamation
Denver Office
Technical Service Center
Environmental Resources Team
Water Treatment Engineering and Research Group

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY (Leave Blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	February 1997	Final

4. TITLE AND SUBTITLE

Water Reuse Research Needs Assessment

5. FUNDING NUMBERS

None

6. AUTHOR(S)

Susan Martella, Editor

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

U.S. Bureau of Reclamation
American Desalting Association
WateReuse Association

8. PERFORMING ORGANIZATION REPORT NUMBER

None

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

U. S . Bureau of Reclamation
Denver Federal Center
PO Boc 25007
Denver CO 80225-0007

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

Water Treatment Technology Report No. 19

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Available from the National Technical Information Service, Operations Division, 5285 Port Royal Road, Springfield VA 22161

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

This report summarizes the proceedings from the workshop entitled "Ensuring the Reliability of Membrane Systems for Potable Water Reuse" which was held in Monterey CA, just prior to the 1996 Biannual Conference and Exposition of the American Desalting Association. The Workshp was co-sponsored by reclamation, ADA, and the WateReuse Association.

14. SUBJECT TERMS--

water reuse/water reclamation/membrane systems/potable water

15. NUMBER OF PAGES

9

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
UL	UL	UL	UL

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WATER REUSE RESEARCH NEEDS ASSESSMENT

INTRODUCTION

A workshop entitled "Ensuring the Reliability of Membrane Systems for Potable Water Reuse" was held in Monterey, CA, just prior to the 1996 Biannual Conference and Exposition of the American Desalting Association. The workshop was co-sponsored by ADA, the WateReuse Association, and the Bureau of Reclamation. The purpose of the workshop was to examine the application of membrane systems for production of highly treated reclaimed water suitable for reintroduction into a domestic water supply reservoir. The workshop provided a platform for the reuse community, including the membrane industry, water agencies, and regulatory professionals, to brainstorm about research needs related to membrane systems and potable water reuse, and to identify methods for adapting membrane technology from salt removal to the removal of viruses and other water-borne pathogens.

During a break-out session of the workshop, participants organized into five working groups (designated Groups I-V), each led by a facilitator. The purpose of the break-out session was to obtain a better perspective of the most pressing research needs of the water reuse community, so that the Bureau of Reclamation could use this perspective to direct its research in support of water reuse, as authorized under Public Law 102-575, Title XVI.

Each group was given a list of three questions to stimulate the brainstorming:

1. What are the immediate research needs for water reuse?
    - From the technology perspective?
    - From the public health perspective?
2. What long-term research issues should be addressed?
3. What barriers are preventing implementation of water reuse?
    - From the technology perspective?
    - From the public perception perspective?
    - From the regulatory perspective?

During each group session, the facilitator prepared a "flip-chart" list of the ideas generated by the group relating to each of the three questions. Appendix B is a copy of each group's input. Most groups basically followed the list of questions supplied in organizing their ideas, but some groups broke the questions down into subcategories.

At the conclusion of the brainstorming session, working from the list of ideas generated, each group voted on what they considered to be the top priority needs for research related to the role of membrane systems in potable water reuse. Some groups chose to select one or two ideas from each of the three question areas, while other groups chose to tally the votes cast for each idea. The *italic* type within Appendix B in some cases denotes the idea(s) selected to be the top priority(ies) within each question area, and in other cases indicates the number of votes that each idea received.

GROUP RESULTS

Following is a brief narrative of the top priority responses from each group:

Group I.-This group identified the gathering of benchmark data from which to launch new research as the most important immediate research need. The most significant long-term research issues identified were (1) addressing public perceptions of reuse and (2) providing improved research communication to avoid redundant and failed research. The barrier preventing implementation of water reuse was determined to be the lack of public education on the subject.

Group II.—This group identified the most important immediate research need to be an assessment of what needs exist for both direct and indirect water reuse. The most significant long-term research issue was considered to be the identification and removal of viruses and pathogens, through quality detection methods, to ensure long-term reliability of the water source. The barriers preventing implementation of water reuse were determined to be the lack of current technology, and the negative public perception regarding reuse.

Group III.—This group identified three most important immediate research needs: (1) acquiring better technical understanding of pretreatment for reverse osmosis membranes, (2) acquiring better understanding of health requirements, and (3) refining precise and robust analytical health system techniques. The barriers preventing implementation of water reuse were determined to be the lack of product reliability, education of the media in order that they may validate the technology, and the accountability of state-certified laboratories.

Group IV.—This group identified creating an inventory of uses available for treated water, and generally improving the efficiency of the technology as the most important immediate research needs. The most significant long-term research issues were considered to be improved technology for detection of impurities, changes in incentives and rate structures to encourage reuse, and the establishment of technology to allow reclamation at the point of use. The barriers preventing implementation of water reuse were determined to be public perceptions of the health risks, regulation of concentrate disposal, and maintaining awareness of the power of special interest groups with respect to reuse.

Group V.-This group determined that the regulation of brine or waste disposal, including heavy metals, was the top priority issue. Other areas of concern include the need for long-term health studies, including epidemiological studies; the need to address wetlands issues regarding reuse; ensuring that government has appropriate involvement; the lack of public health system monitoring equipment; viral and microbial removal; public education; and the negative public perception of the source of the reused water.

CONCLUSIONS

In summary, ensuring public health through advanced epidemiological research, improvements in monitoring equipment, and proper government regulation; and education of the general public, media, and regulators regarding potable reuse were the most often identified issues of concern regarding potable water reuse research related to membrane systems. Also noted as significant issues were the needs to address waste disposal and to coordinate technological product research to ensure reliability and reuse success.

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APPENDIX B-GROUP IDEAS

Group I
Facilitator: Ron Linsky, National Water Research Institute

-1-

1. Viruses
   a. Leaks through membranes
   b. Disinfection process
   c. Faster methodologies
2. Cost effectiveness
   a. On-site testing
   b. Water/wastewater streams
   c. User and supplier
3. Alternative or new uses
   a. Introduction to new industrial uses
   b. Education programs for new industry
4. Clearinghouse of current research (on-line)
5. Unify technology-bring together for optimization
   a. More industry cross fertilization
6. Development of a membrane product that can withstand disinfection products
7. Interactive organizations-more partnerships
8. *Benchmark data from which to launch new research*

-2-

1. *Public perceptions (needs) - supply, quality*
2. Cost effective processes
3. Water rights issues
4. What drives long term research?
5. Direct potable reuse
6. *Improved research communication to avoid redundant and failed research*

-3-

1. Valid research
2. Lack of education
3. *Public education*
4. Public health

Group II
Facilitator: Steve Duranceau, Boyle Engineering Corp.

-1- Immediate Research Needs

1. Needs assessment for direct reuse (potable), indirect reuse (salt water barriers, agriculture, industry)
   a. Health virus/pathogen barrier
   b. Technology identification, usefulness and durability of technology
   c. Purpose to see what's out there
   d. Delineate by region, climate, environment
   e. What's the market(s) and demand for reuse
2. Define, delineate, quantify water quality criteria and acceptability
   a. What constitutes industry water quality criteria for reuse?
   b. What constitutes industry water quality criteria for agriculture?
   c. Direct reuse
   d. Residential reuse
   e. Pharmaceutical
3. Use of membranes and delineation of concentrate uses/acceptability
4. Water quality-where's it needed/required?
5. How to deal with "at risk" groups of individuals
   infants
   elderly
   immune deficient persons
   cancer patients
   general population
6. Ownership—Who controls? Who's responsible? Reuse alters permitting, water rights, cost, liability
7. Technology transfer workshop (all sectors-public, private)
8. Document real case studies/existing progress (public/private)

-2- Long Term Research Issues

1. Virus/pathogen occurrence/removal-detection methods, confirmation (QA/QC), long-term reliability
2. Technology integrity evaluations (see e.) (no cost)
3. Affordability/economics/liability

4. Ownership and water rights-long term (needs changes, climate changes, demographic changes)
5. Demonstration projects (see b.) (cost)
   a. Specific technologies-cost and performance/efficiency
   b. Specific markets—developing public-private partnerships
   c. Sustainability
   d. Public involvement/education
6. Monitor changes/periodically evaluate needs developed in Immediate Research Needs. (benchmark progress)
7. Effects/impacts on distribution system integrity, reuse quality, and at point of use
8. Develop low-cost, reliable reusable reuse water quality monitoring techniques

-3- What Barriers are Preventing Implementation?

1. Technology
   a. Cost and performance
   b. Treatment of process residuals/disposal
   c. Verification of reliability
   e. Distribution of product
2. Public perception
   a. How to deal with propaganda (i.e., TV shows, newspaper, grassroot activists)
   b. Re-establish public trust in science
   c. Dealing with cost issues
   d. Health issues
   e. Education of risk/science/why/how
   f. Misperceptions
   g. Need to provide a framework/basis of what the different types of waters are - what's the current acceptable standard
      drinking
      reuse
      wastewater
      landfill leachate
      Relative to degree of hazard
      Assuming distrust of baseline, must reaffirm thrust in what's being provided to the public
   h. Aesthetics
   i. Method of marketing - water community needs to provide positive accurate information to public and monitor progress of information releases to avoid distortions/misperceptions
3. Regulatory perspective
   a. Residuals disposal permitting-i.e,. membrane concentrate from a WWTP
   b. Impact of NPDES
   c. Establish definitions to avoid miscommunications
   d. Conflicting OHSA, EPA, state, local regulations that do not comprehensively cover this area - they can be contradictory Which group will control?
   e. States rights
   f. Currently not a reuse regulatory agency (not that we want one)
   g. Product/consumer liability of its impacts
   h. Ownership and liability
   i. Standards for compliance with regard to microorganisms? currently chlorine, CT, residual controls but THM, HAA, DBP, etc., and how that relates to exposure routes
   j. Bottom line, since we currently don't have the technology to identify, reliably, viruses and pathogens, the regulatory is undefined

Group III
Facilitator: Stan Ponce, Bureau of Reclamation

-1A- Technical Standpoint

1. Train operational personnel better-wastewater & freshwater
   a. Dual/certification getting from 1 st point - wastewater to freshwater system
   b. Separate certification for these processes - Federal plan, *Federal certification 2*
2. *Better understanding ofpretreatment for RO membranes 15*
3. Condense and simplify processes to make costs more competitive with desalinization of saltwater

-1B- Health Perspective

1. Microbiological research in wastewater
2. *Better understanding of the requirements (microbiological and viral components) 12.5*
3. Cost effectiveness of system performance
4. *Analytical techniques that will be precise and robust 8.5*
   a. fast
   b. consistent (repeatable)
5. Opportunities for self contained operational systems
6. Educate public/commercial (Miller beer situation)

7. Demonstration projects-side by side-freshwater, wastewater recycle

-2- Long Term Research Needs

1. Reliability equipment-how often do you need to regenerate membrane before it's replaced?
2. What's the (maximum) limiting ratio of freshwater to recycled water?
3. Flexibility to varying degrees of water quality (use)
4. Long term reliability of treatment facilities and operator capability
5. Disinfection by products

-3A- Cost and Reliability

1. *Lack of reliability--we spend more on cost 4*
2. Infrastructure
   a. Capital costs to develop a distribution system

-3B- Public Perspective

1. Confidence in drinking water supply industry is low
2. *Educating media so they don't have "firepower"— validate technology 9*

-3C- Regulatory

1. Realistic, safe limits
2. *Accountability of state-certified laboratories to be consistent 8*
3. Accessing need to recycle water for consumption (drinkable) vs. industry reuse
4. Regional distribution versus separate need

Group IV
Facilitator: Stan Hightower, Bureau of Reclamation

-1A- Technologies - Near Term

1. Good monetary evaluation of benefit-sand filter vs. UF, etc. 6
2. Energy consumption improvements 8
3. Concentrate disposal 4
4. Technologies for broadest use possible 3
5. How technology fits with today's and tomorrow's regulations 4
6. Clear set objectives
7. Cost comparisons-reuse vs. natural water 4
8. Resource water development-industry inventory of sources 2
9. Groundwater improvement-groundwater recharge I
10. Effectiveness of each technology against each contaminant 8
11. Inventory of technologies available
12. Improve efficiency in every respect 9

-1B- Public Health-Near-Term Needs

1. Cost/benefit-health, etc. 7
2. Not just drinking water and separate reuse specialist -better coordination of both 3
3. Public perception problems 7
4. Emphasis- "If you use it, put it back clean" (like Lake Erie) 6
5. Independent risk studies (from EPA) *5*
6. Consumer advocate group to evaluate rules 5
7. Easy effective test to evaluate virus removal 8
8. Inventory of uses available once cleaned up *10*

-2A- Long Term Research Needs (Technology)

1. Same as short term plus: *11*
2. Water shortage going to give reuse more emphasis 5
3. Reclamation at point of use-every hotel, every business, etc. 17
4. Cost of water going up 5
5. Agricultural water vs. municipal water-true cost 7
6. Energy consumption 5

-2B- Long Term Research (Public Health Perspective)

1. Better job of figuring out what is in the water (coffee has TOC & color but we drink it) 18
2. Meter to determine water out vs. in 5
3. Change our incentives and rate structure to encourage reuse *17*

-3- Barriers Preventing Implementation

1. Technology perspective-identifying disinfection strategy
   a. Cheaper dual distribution system *1*
   b. Costs/benefits 2
   c. Energy consumption 3

d. Environmental impact 6
e. Longevity *10*
f. Risk concerns-nothing perfect 3
g. Process verification-how do we know? 3
h. Demonstration projects on-line to develop experience and confidence 5
i. Laboratory methods-not all proven, difficult, time consuming (tests for contaminants) *10*
j. Uses for reused water 5
k. Ultimate waste disposal-after we keep using & reusing 4
l. Beneficial uses of concentrates 5

2. Public perception
   a. Mandated users not willing users 7
   b. Health concerns (real or perceived) 13
   c. Confidence in technology itself 6
   d. Reliability *1*
   e. Lack of education 9
   f. Not in my backyard, somebody should use but not me 8
   g. Different approach to planning (municipal, etc.) *1*
   h. Water is a finite source not an infinite source *5*

3. Regulating perspective
   a. Limit or check the power of interest groups concerning water reuse *11*
   b. Now have groundwater disinfection rules—need similar rules for water reuse 7
      Source/use specific 5
   c. Conflicting regulations 8
   d. Concentrate disposal 12
   e. Water rights issues downstream 6
   f. Balance of benefits of technology/conflicting rules *1*
      - Regulations restrict use of some technology
      - Establish decision tree including side stream
   g. Government needs to be more of a facilitator instead of inhibitor (a pain in the neck) 9

Group V
Facilitator: Lisa Henthorne, Bureau of Reclamation

-1- TFC reliability & cost (membranes in general)

1. More microfiltration, ultrafiltration options
2. Other pretreatment options
3. Target cost of reuse vs. imported water-particle removal-look at assisting manufacturer-will help TFC (overall cost keep down)

-2- *Disinfection 2*

1. Chlorinated water behaves different than chloramination-cascades through system
2. Look at overall system
   a. Will affect disinfection required
   b. Can keep cost down

-3- *Why is government involved in projects? 4*

1. Help w/cost-distribution system is big item
2. Helps public perception
3. *Treatment is only 20% of cost-distribution is the biggest cost 2*

-4- Public health

1. *Monitoring equipment isn't available, acute and chronic illnesses 4*
2. *Viral removal, microbial removal 4*
3. *Real time is most desirable I*
4. *Surrogate may have to do I*
5. Pinhole problems-membrane technology is still superior in many ways

-5- Regulations

1. *Technology outpacing the speed of regulation I*
2. Microfiltration is obviously BAT for many applications-impacts on utilities
3. May be a challenge for utilities
4. Not identifying MF/UF as BAT may **exclude it and** utilities-may be using substandard technology
5. NF has been named as BAT in some applications
6. Is membrane tech ready?—double pass
7. *Can we validate each unit operation in the system? Would this would help ensure public health? 2*

-6- *Public Education 4*

1. *General public 4*
2. Decision makers (local, state, Federal)
3. Regulators
4. *The earlier the better 2*
5. Media
6. Specifically targeted mechanisms

a. Brochures
b. *Videos I*
c. *Workshops, public meetings 1*

7. Why are people hesitant to utilize reuse?
8. Getting over the hurdle-asier to make this decision if no other options available
9. *Public perception of where the water supply comes from-no illusion of where wastewater comes from* 4
10. *Psychological barrier 2*
11. *Breakdown by educating the decision makers 1*
12. *Long-term health studies including epidemiological studies (4 years study) 7*

-7- Wetlands

1. *Bird guys come in-who does it belong to? 5*
2. Land intensive-a problem in some areas

-8- Regulatory Issues

1. Concentrate on more intricate uses-let more standard (or accepted) through
2. *Brine or waste disposal including heavy metals IO*