

CE 330 Water for the World

James A. Smith

MWF 12:00 to 12:50 pm

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Course Description

Potable water is essential for human life. Throughout most of the industrialized world, advanced water treatment systems incorporate fundamental physical, chemical, and biological principles into engineering designs to produce high-quality water at relatively low cost to consumers. By contrast, the World Health Organization (WHO) estimates that almost one-quarter of the world's population (about one billion people) have no adequate water supply and less than one percent of the population in developing countries is served by sewage treatment facilities. Life-threatening water-borne diseases, particularly among children, are common in economically disadvantaged communities throughout the world.

In this course, we will examine complex issues associated with providing potable water to the world's population. Topics will include the use of surface and ground water as potable water supplies, the fundamentals of water chemistry, the science and engineering principles used in the design of modern water and wastewater treatment and distribution systems, and the problems associated with providing potable water in economically disadvantaged communities, refugee camps, and developing and underdeveloped countries, including shortages of resources, lack of government support, inadequate institutional structures, and lack of local interest/acceptance. Case studies will be used as appropriate to demonstrate these issues.

Course Objectives

1. To develop a global perspective on water supply and treatment
2. To apply basic physical, chemical, and biological principles to design and understand water treatment technologies
3. To highlight the differences between water supply, treatment, and management systems in the industrialized world and the developing and underdeveloped world
4. To leave with a "big-picture" understanding of current issues associated with provision of potable water to the world's population

Course Outline

I Introduction

- Course logistics
- Global water problems
- The “Tragedy of the Commons”

II Water use

- The hydrologic cycle
- Surface and ground water
- Global water shortages
- Global water demand
 - Domestic
 - Agricultural
 - Industrial

III Water fundamentals

- The properties of water
- Water chemistry
- Material balances

IV Water quality

- Turbidity
- Waterborne pathogens
- Industrial and agricultural organic pollutants
- Other water quality constituents

V Water treatment

- Coagulation
- Coagulation and flocculation reactors
- Sedimentation
- Filtration
- Chlorination
- Advanced water treatment processes (time permitting)

VI Water treatment technologies for economically disadvantaged communities

- Solar distillation
- Solar disinfection
- Filtration methods
- Natural coagulants

VII Case studies

- Water supply and quality at a refugee camp in Cariari, Chad
- Cryptosporidium in treated water in Milwaukee, WI
- Arsenic in ground-water supplies in Bangladesh
- Trichloroethylene in ground water in Woburn, MA
- Sustainable solutions in Ciudad Juarez, Mexico

Grade Determination

Test 1 (20 percent)
Test 2 (20 percent)
Final exam (30 percent)
Homework (30 percent)

Prerequisites

Chem 151 or equivalent, APMA 213 or equivalent, CE 315 Fluid Mechanics

Required Text

Clarke, R., and King, J., 2004, *The Water Atlas*, The New Press (New York and London), ISBN 1-56584-907-8, 127 p.

Viessman, W., and Hammer, M.J., 2005, *Water Supply and Pollution Control*, 7th ed., Pearson Prentice-Hall, Upper Saddle River, NJ, 0-13-140970-0, 867 p.

Assignments

Reading assignments will include the course notes, parts of the required textbooks, and several journal, newspaper, and magazine articles. Homework assignments will include technical problem sets and short writing assignments.

Additional References

Barde, J.P., and Pearce, D.W. (eds.), 1991, *Valuing the Environment: Six Case Studies*, Earthscan Publications, London, ISBN 1-85383-074-7, 271 p.

Black, M., 2004, *The No-Nonsense Guide to Water*, New Internationalist Publications Ltd., Oxford, ISBN 1-84467-509-2, 144 p.

Clarke, R., 1991, *Water, The International Crisis*, Earthscan Publications, London, ISBN 1-85383-105-0, 193 p.

Cosgrove, W.J., and Rijsberman, F.R., 2000, *World Water Vision: Making Water Everybody's Business*, Earthscan Publications Ltd., London, ISBN 1 85383 730 X, 108 p.

DesJardins, J., 1999, *Environmental Ethics: Concepts, Policy, Theory*, Mayfield Publishing Co., Mountain View, CA, ISBN 1-55934-986-7, 620 p.

Easton, T.A., 2005, *Taking Sides: Clashing Views on Controversial Environmental Issues*, 11th Edition, McGraw-Hill, ISBN 0-07-305140-3, 359 p.

Hardoy, J.E., Mitlin, D., and Satterthwaite, D., 2001, *Environmental Problems in an Urbanizing World*, Earthscan Publications, London, ISBN 1-85383-719-9. 448 p.

Harper, C.L., 2004, *Environment and Society: Human Perspectives on Environmental Issues*, 3rd Edition, Pearson Prentice Hall, NJ, ISBN 0-13-111341-0, 482 p.

Hrudey, S.E., and Hrudey, E.J., 2004, *Safe Drinking Water: Lessons from Recent Outbreaks in Affluent Nations*, IWA Publishing, London, ISBN 1 84339 042 6, 486 p.

Satterthwaite, D. Hart, R., Levy, C., Mitlin, D., Ross, D., Smit, J., and Stephens, C., 1996, *The Environment for Children: Understanding and Acting on the Environmental Hazards that Threaten Children and Their Parents*, Earthscan Publications, London, ISBN 1 85383 326 6, 284 p.

United Nations Human Settlements Programme, 2003, *Water and Sanitation in the World's Cities: Local Action for Global Goals*, Earthscan Publications, London, ISBN 1-84407-004-2, 274 p.

Williams, C.W., 1998, *Environmental Victims*, Earthscan Publications, London, ISBN 1 85383 534 X, 188 p.