2006 Water Treatment from Your Kitchen and Beyond Competition

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University of the Pacific
Stockton, California

Table of Contents

1 INTRODUCTION

For millions of people in the world, accessible and potable drinking water is a luxury they will never have. Many water sources that once provided clean drinking water to small villages have fallen victim to pollution loading from municipal, agricultural, and industrial runoff. Some say that the growing water problem is causing half of the deaths of children in the world[1]. These areas also do not have any modern water conveyance systems. With no distribution systems, people must carry their water by hand. This responsibility often goes to the children who spend most of their days collecting water. With most of their time spent on collecting water, children do not have the time for any formal education.

2 COMPETITION HISTORY

The ASCE student chapter at the University of California, Davis realized that student members interested in Environmental Engineering were left out of traditional Civil Engineering competitions, such as the Concrete Canoe and the Steel Bridge Competition. To challenge interested students, the UC Davis ASCE student chapter officers appointed an "Environmental Engineering Chair", who organized environmentally related activities. After two years of brainstorming and planning, the ASCE student chapter at the University of California, Davis hosted the First Annual Environmental Engineering Competition, titled "Water Treatment from Your Kitchen." Since then, the competition has been held annually, hosted each year by the school that won the competition during the previous year. Past years winners and hosts are listed below.

Year	Competition Host	Winner
1998	UC Davis	University of Nevada, Reno
1999	University of Nevada, Reno	Humboldt State University
2000	Humboldt State University	UC Davis
2001	UC Davis	University of the Pacific
2002	University of the Pacific	Cal Poly State University, SLO
2003	Cal Poly State University, SLO	Oregon State University
2004	Oregon State University	University of Nevada, Reno
2005	University of Nevada, Reno	University of the Pacific

Table 1: Past Winners of Water Treatment from your Kitchen Competition

[1] http://www.clearwaterproject.org/

3 PROBLEM STATEMENT

A village located in South America gets its water from a local creek, located approximately 2 miles away (3.22 km). Water in the creek has become contaminated over time due to agricultural and industrial runoff. The contamination has begun to affect the health of the children in the village. The children are responsible for collecting water from the creek and transporting it back to the village. Because most of their time is spent collecting and transporting water, the children do not have time for proper schooling.

You have been asked to design and build a treatment system to produce and convey potable water to the village. The system will be packed into a crate in the United States, transported to the village, and assembled on site. The system needs to be able to operate with minimal labor and maintenance and must be repairable with easily obtained materials. There is no local source of electrical power. The village is often cut off from the closest large town during the rainy season, so the system must be able to operate without a constant supply of fuel, treatment materials, chemicals, etc.

The goals of this project are to develop a reliable and sustainable system that will provide 'potable' water for the village by 1) cleaning the water to specified standards, 2) delivering the water from the creek to the village via a conveyance system, thereby relieving children of daily responsibilities for obtaining water, and 3) using a minimum of non-reusable raw materials and generating a minimum amount of waste by-products as a result of conveyance or treatment. The benefits are twofold: a safer water supply for the village and opportunities for the children to attend school instead of working all day to meet the basic need for water.

3.1 MATERIALS AVAILABLE

Materials to be used must be easily obtainable, i.e. purchased at a local hardware store. Remember that sustainability is a leading factor in this competition; not all parts available in the US will be readily available in a developing country. Teams must supply their own setup equipment/materials which must fit into a 4'x4'x6' volume simulating a shipping crate. Each team must also provide their own final unmarked effluent collection container(s).

4 INFLUENT CONSTITUENTS

Each team will be required to treat a total volume of 10 gallons (~38 liters) of contaminated "creek water". The contaminants that will be mixed into the 10 gallons of water are listed below. NOTE: The mixture will be made the night before the competition (approximately 15 hours).

Constituent	Quantity
Kaolinite Clay	2 cups
White Sugar	2 cups
Grass Clippings	2 cups
Distilled Vinegar	1-1/2 cups
Potting Soil	4 cups
Salt	1/4 cup
Fine Sand, fine sand, 0.2 to 0.02 mm	1 cup
Soap (Liquid Tide)	1/2 cup
Vegetable Oil	1 cup
Green Food Coloring	1/2 table spoon

5 JUDGING CRITERIA AND SCORING

Designs will be evaluated considering sustainability and cost. System performance will be evaluated using measurable water quality properties and volumes recovered after treatment. Each team will also be required to give a public presentation to be scored based on content.

Parameter	Goal	Max Points Possible
Design Quality & Sustainability	Most Sustainable	50
Construction Cost & Operation	Lowest	25
Total Volume Recovered	10 gallons	20
Time to recover 1st two liters	Lowest Time	10
Electrical Conductivity (EC)	Lowest	15
pH	6.5 – 7.5	15
Turbidity	Lowest Value	15
Dissolved Organic Carbon	Lowest Value	15
Dissolved Oxygen (DO)	Greatest	15
Person Hours (pro-rated)	Lowest	-10 per person hour
Presentation		20
	Total Points	**200, Less Labor Costs**

5.1 POINT DESCRIPTION

5.1.1 Sustainability

The sustainability portion of the scoring will be based on an average of points awarded by each of the judges. A maximum of 50 points will be possible. Judges will use the following to determine a sustainability score: material reusability, durability, maintenance requirements, operating costs, simplicity of design, reliability and reproducibility.

5.1.2 Total Volume Discharged

The system that produces the most effluent at the end of the 1-hour period will be awarded the full points in this category. The remaining designs will be awarded a proportional amount of points based on the total volume of the effluent recovered. For example, if Design A produces the most effluent, it will be awarded the maximum points. If Design B produces half the effluent possible, it will be awarded half the maximum points possible.

5.1.3 Water Quality

Water quality will be judged using measurable water properties. The 5 measurements to be made are pH, electrical conductivity, turbidity, dissolved oxygen, and dissolved organic carbon. These will be measured from a sample obtained from the final treated effluent. For dissolved organic carbon, water will be filtered before the test through Whatman 934-AH glass microfiber filters. Full points will be awarded for the best measured values for electrical conductivity, turbidity, total organic carbon, and dissolved oxygen. pH will be based on an ideal measured value of 7.0. Each measurement below the best will receive a proportional amount of points.

5.1.4 Presentation

Each team will present their design to the judges and other groups in a 10 minute presentation followed by a 2 minute question and answer session. The presentation shall include an overall project description, design process, a detailed description of principles and methods implemented, cost analysis, and a sustainability analysis.

The following will be available for use: Laptop with PowerPoint, TV, DVD/VCR, and a LCD Projector.

5.2 PENALTIES

In order to limit the amount of physical labor involved in the treatment process, there will be a 10 point penalty for each person hour accrued during the 1-hour treatment process. Teams will be required to keep a log of how many minutes each team member is involved in the treatment process. NOTE: This includes any physical transportation of the contaminated water from the central source to the treatment area.

5.3 SITE PLAN

The site plan to be used for the competition can be seen below:

NOTE: Site plan is not to scale; all labeled dimensions are in feet.

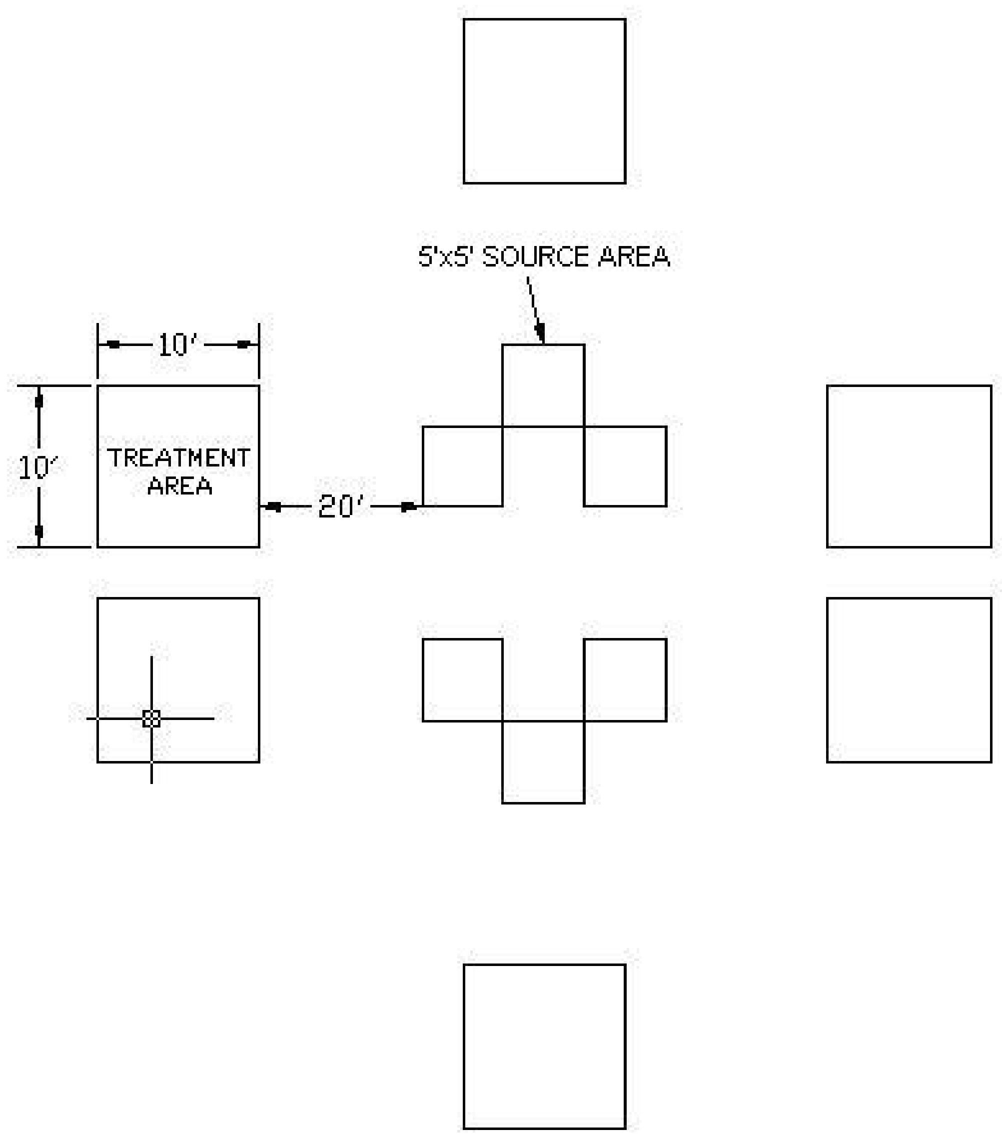

Figure 1: Site Plan

6 RULES AND CONSTRAINTS

6.1 GENERAL RULES

1. Each team will receive 10 gallons (~38 liters) of the contaminated water at their source area ("stream").

2. Each team will have a 10'x10' treatment area in which to set up their system. The source area from which the water will be conveyed will measure 5'x5', as shown in **Figure 1**.

3. Before setting up, all elements of the system (including replacement parts if needed) must fit in a 4'x4'x6' volume simulating a shipping crate. This also includes any tools and materials used during setup.

4. A maximum of 0.5 liter of tap water will be allowed in the system to be used as a primer. This water will be added during the inspection period.

5. Teams may physically move water from their collection area to their treatment area, but each trip will incur a point penalty based on calculated man hours (see **5.2 PENALTIES**). Also, each person will be allowed to carry only two (2) liters of water per trip and only one transport container may be used at any one time.

6. Any design that violates the set rules will be disqualified.

7. Any design that is dangerous or hazardous to the competitors or judges will be automatically disqualified.

6.2 TIME CONSTRAINTS

After initial delivery of the systems to each designated area each team will have one (1) hour to setup their treatment and conveyance systems. Judges will then have thirty (30) minutes to evaluate each of the designs for rule conformance and pre-treatment scoring. Available conveyance and treatment time will be one (1) hour.

7 INFORMATION AND TIPS FOR PARTICIPANTS

1. Start work on the design early, leaving adequate time to procure materials, construct and test the system, and practice setup.

2. Design a water treatment system that can be constructed, set-up, and used safety.

3. During construction and assembly, use appropriate tools and safety equipment. Wear eye, head and hand protection where necessary. Safety is of the utmost importance!

4. Test the design before the competition to eliminate potential problems that you may face during the main event.

5. To expedite the competition, have a preset plan for setting up and breaking down the system.

6. Practice the presentation to assure clarity, fluidity and organization.

7. If using PowerPoint, be sure the presentation file is in PC format copied on a CD or USB-type storage device. Bring more than one copy of the presentation disk for backup. Please inform the competition committee of any additional needs that your team may have.

8. When packing for the competition, be sure to bring safety equipment and your tools necessary for construction.

9. Check the website regularly for questions and changes that my have been made prior to the competition day.

10. A school may enter up to two teams, but each team must register separately and pay individual registration fees.

11. The 2007 competition will be hosted by the winner of this year's competition. If a design from the hosting school wins first place, the honor of hosting the next competition will go to the second place school. GOOD LUCK!

8 REGISTRATION AND DATES

Registration Deadline: March 10, 2006

Late Registration Deadline: March 24, 2006

The competition will begin at 9:00 a.m. on Saturday April 8, 2006 in front of Anderson Hall on the University of the Pacific campus. There will be a one-hour setup time from

9:00 – 10:00 a.m., followed by a one-half hour inspection and evaluation period for the judges. The one-hour treatment period will begin at 10:30 a.m. You are advised to arrive by 8:30 a.m. to unload your treatment system and transport it to your assigned treatment area.

To register, please fill out the registration form and return it to the address below with the registration fee. All information pertaining to the competition will be posted on the website. Remember that up to two teams may be entered by each participating school, but that each team must register independently. This is to help pay for the contaminants, equipment, food and any addition costs that may incur. **The registration fee for this competition is $40.00. Registration forms received after March 24 will have a registration fee of $55.00. Checks must be made out to: UOP ASCE Student Chapter.**

9 CONTACT INFORMATION

9.1 UNIVERSITY OF THE PACIFIC – COMPETITION CONTACTS

Competition Co-Chair: Matt Conners - Civil Engineering Student Email: m_conners@pacific.edu
Competition Co-Chair: Steven Granados – Civil Engineering Student Email: s_granados@pacific.edu
Competition Advisor: Dr. Camilla Saviz Associate Professor, Civil Engineering 3601 Pacific Ave Stockton CA, 95219 Email: csaviz@pacific.edu

Table 2: 2006 Competition Contacts

9.2 WEBSITE ADDRESS

http://www1.pacific.edu/eng/student-organizations/ASCE/ENVIRO_COMP/Enviro_comp_06.htm