2007 Ohio Valley Regional Conference
Water Treatment (Environmental)
Competition Rules

Currently, over 1 billion people in the developing world lack access to safe drinking water. A major obstacle to providing drinking water to the developing world is the lack of appropriate drinking water technology. The goal of this competition is to develop a *flow-through* water treatment process to treat drinking water appropriate for the developing world. You will be given approximately 20 liters of "typical" river water to treat to drinking water quality.

Materials

1. The treatment system should consist only of commonly available household items or construction materials. All materials must be purchased from retail stores (e.g., hardware stores, grocery stores, craft shops). Items from shops specializing in water treatment or pool supplies are not acceptable. Any item typically sold for water treatment use cannot be used.
2. Teams are encouraged to submit a list of items to the organizers prior to the competition for pre-approval, but this is not required. On the day of the competition, the judges will review each item and decide if any items do not meet the requirements. These items will then be ineligible for use in constructing or using the apparatus.
3. You must turn in a copy of receipts for each item used to construct your water treatment system and the total cost of your apparatus.
4. Items used in constructing your water treatment system must be "as new" and cannot be altered prior to arriving at the competition.

Raw Water

The raw water to be treated will have a composition typical of river water. The major constituents will include pH (6-9), hardness (at least 100 mg/L $CaCO_3$), alkalinity (at least 50 mg/L $CaCO_3$), turbidity, dissolved and total organic carbon.

Construction/Treatment

1. Each team may consist of up to 5 students with one student designated as the team captain.
2. Each team will be provided a standard 6-foot long table. The entire treatment system must fit within the footprint of the table.
3. All team members must bring and wear appropriate clothing (long pants, long-sleeve shirt, closed-toed shoes), protective eyewear, hardhats and latex gloves.
4. All materials to be used must be in the designated area prior to the beginning of the construction period. No items outside the team's designated constructed area will be allowed once the construction time begins.
5. The requirements for the system are:
    a. The apparatus must be able to receive the entire 20 liters of influent water in a single batch.
    b. The apparatus must be a *flow-through* system and not a collection of batch processors.
    c. The apparatus should treat as much water as possible, as quickly as possible and produce, at a minimum, 10 liters of treated water.

6. Team members will be given a maximum of 30 minutes to construct their treatment system. After 30 minutes, the team must exit the designated area. Two team members may stay with the apparatus. The remaining team members will be given the raw water sample and the treatment period will begin. No batch pre-processing of the water is allowed prior to adding the raw water to the apparatus. Each team will have no more than 45 minutes to complete the treatment. If over 45 minutes is used, 5% will be deducted from the team's total score.
7. The total time for treatment will be determined when the team captain signals the treatment is finished.
8. After judging is finalized, each team is responsible for disassembling their treatment system.
9. The amount and type of all substances that will be added to the influent or process water and will be present in the final treatment water must be reported to the judges prior to addition.

Technical Paper

A technical paper must be submitted at the beginning of the construction period. The technical paper must not exceed 1500 words (not including references and appendices). The technical paper should include the following: Summary; Introduction and Background; Description of Apparatus; Appropriateness for Developing World; References; Appendix (including material receipts). Papers exceeding 1500 words will not be reviewed. Papers should be written in 12-point, times new roman font.

Scoring

An overall total of 100 points will be awarded with the team with the most points deemed the overall winner. Second and third place overall awards will also be given. Awards for subcategories (first, second, and third-place awards) will also be given. The subcategories used for scoring include:

1. <u>Technical Paper (20 points)</u>
   a. Grammar/syntax-5 points
   b. Technical/scientific merit-10 points
   c. Sustainability-5 points

2. <u>System design and construction (40 points)</u>
   a. Total construction time (10 points max)- 5 points will be awarded for constructing the apparatus within the required 30 minute time interval. An additional 1 point will be added (up to 5 additional points total) for each 5 minute interval less than 30 minutes construction is completed. For example, if a team finished construction in 24 minutes, they would receive an additional 1 point.
   b. Total treatment time (10 points max)- 5 points will be awarded for finishing treatment within the required 45 minute time interval. An additional 1 point will be added (up to 5 additional points total) for each 5 minute interval less than 45 minutes treatment is completed. For example, if a team finished in 32 minutes, they would receive an additional 2 points.
   c. Total cost of apparatus (5 points max)- 5 points will be awarded to the team with the lowest total cost of apparatus. 4 points will go to the team with the second lowest cost; 3 points to the third lowest cost; etc.
   d. Aesthetics (5 points) 5 points will be awarded to the apparatus with the best aesthetics. 4 points will go to the team with the second best; 3 points to the third best; etc.
   e. Appropriateness/Ease of Use (10 points)-10 points will be awarded to the apparatus most appropriate for use in the developing world. 8 points will go to the team with the second most appropriate design; 6 points to the third most appropriate; etc.
   f. Penalties-any penalties incurred during the system design and construction phase will be result in points being subtracted from the system design and construction score.

3. Treated water quality (40 points)
    a. pH- (10 points) 10 points will be awarded to each team having a final pH of 7.0 ± 0.5. 2 points will be subtracted for each 0.5 pH units outside of this range. For example, a final pH of 7.6 would result in a score of 8 points while a final pH of 8.1 would give a score of 6.
    b. Turbidity (15 points) Points for turbidity will be awarded based on the following:
        i. Less than 1 NTU-15 points
        ii. 1-3 NTU-13 points
        iii. 4-8 NTU- 11 points
        iv. 9-12 NTU-9 points
        v. 13-18 NTU-7 points
        vi. 19-23 NTU-5 points
        vii. 24-28 NTU-3 points
        viii. Greater than 28 NTU- no points
    c. Ultraviolet absorbance (10 points). Points will be awarded in order of final UV absorbance of treated water for the different teams, with the team having the lowest absorbance receiving the maximum 15 points. 2 points will be subtracted in order of finish. For example, the team with the 4th highest UV absorbance will receive a score of 9.
    d. Total dissolved solids (5 points). Points will be awarded in order of final total dissolved solids of treated water for the different teams, with the team having the lowest TDS receiving the maximum 5 points. 1 point will be subtracted in order of finish. For example, the team with the 4th highest TDS will receive a score of 1. The raw water will have a TDS of less than 500 mg/L. A penalty of 2 points will be assessed if the final treated TDS is above 500 mg/L.