



2017 Ohio Valley Student Conference

Thursday, April 6, 2017 through Saturday, April 8, 2017

Environmental Competition

Overview:

Nitrate contamination of water sources from agricultural runoff has become one of the most important concern in the United States. The maximum contaminant level (MCL) for nitrate is 10 mg/L measured as nitrogen (equals to 44.3 mg/L nitrate), and the major health concern of higher nitrate exposure through drinking water is the risk of methemoglobinemia, or “blue baby syndrome,” especially in infants and pregnant women. Small rural communities that cannot afford cost prohibitive water treatment technologies such anion exchange and reverse osmosis are particularly impacted by nitrate contamination. Furthermore, due to the production of high-strength brine residuals, sustainable application of these listed technologies is often limited by a lack of local residual disposal options. The lack of affordable and feasible nitrate treatment alternatives can force impacted utilities to remove nitrate contaminated sources from their available water supply. In many instances, this action can severely compromise a water utility’s ability to provide an adequate supply of safe and affordable potable water.

Objective:

The goal of this competition is to design a small scale treatment apparatus that will reduce the high concentration of nitrate in source river water. The practical objective is to develop a treatment design that is not only effective but innovative and sustainable within the constraints described below.

Deliverables:

Each team must recover 2 liters out of the 4 liters of provided water within the 45 minutes of treatment time. Treatment will be scored based on nitrate concentration, pH, turbidity and 2 liter recovery time will play role in scoring as well. Both batch and flow through treatment systems are permitted. The overall score will also include creativity and sustainability as factors. Additionally, technical paper and creativity will be considered as separate subaward categories.

Guidelines:

Water Source

Water will be collected from source of drinking water reservoir in spring after rain (pH ~6.5-8.5, Turbidity ~200 NTU, TSS ~80 mg/L). The exact composition of the water will be unknown and the water will be spiked with potassium nitrate to a concentration of 80 mg/L as NO₃-N. Before the contest begins, the source water will be mechanically stirred to ensure homogeneity and each team will be issued four (4) liters of the water. The teams have to pour **all** the source water within 1 minute of treatment portion start into their treatment system – **points will be subtracted for slower rate (1 point per 10 s).**

Materials



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- All materials that will be used to treat and/or will be added to the water must be purchased at a general retail store (ie Walmart, Home Depot). Materials cannot be pre-manufactured water treatment systems (i.e., Brita filters, pool filters, etc.)
- All receipts from the purchase of materials, and equipment must be included in the appendix of the Technical Review Paper (see below). All materials must be listed with a cost associated in the technical paper. Failure to account for all items will result in a technical paper **penalty of 5 points**.
- Any electric, battery, or manually operated tool may be used in the construction and operation of the apparatus and may be obtained by any means, however an estimated cost must be included in total cost. The cost should be estimated based on rate of 6.15 cents kWh.

Construction/Treatment

- Pre-assembly of apparatus components is permitted; however, teams are advised that access is limited to standard entry doors. If transport is deemed unsafe the team will be asked to disassemble the apparatus and reassemble during the construction phase of the competition.
- Each school may enter one (1) team, consisting of up to but no more than five (5) ASCE undergraduate student chapter members. One (1) member should be designated as team captain.
- Each team will be provided with a two (2) foot deep by four (4) wide countertop area, with sources of electrical power. The treatment system must fit in the allotted space or floor area the same size.
- All team members must provide and be equipped with proper clothing (long pants, closed toed shoes), as well as protective eyewear, and latex gloves.
- Before time begins, all materials and tools must be in a designated area and not in contact with any team member.
- Teams will be given a maximum of 15 minutes to complete their set-up and teams will have a maximum of 45 minutes to complete the treatment of the water.
- Each team member used during treatment time will be listed under cost as \$20.00 per person (any design that needs team member to operate apparatus during treatment must record the appropriate cost).
- All substances added to the intake or process water which will be present in the final effluent must be measured to the nearest *ml* if liquid or nearest *gram* if dry and reported to the judges before addition.
- After judging is finalized each team is responsible for the cleanup and disassembling of their treatment system.
- Any **intentional** physical contact by any team member with the raw intake, effluent, or any intermediate process water will result in a **25 point deduction**.
- All substances added to intake or process water must be for the purpose of treating the water. Any form of dilution is prohibited and will result in **disqualification**.

Technical Paper

- Every participating team must submit one Technical Review Paper per team, **not to exceed 1,500 words** (not including references and tools list).
- The Technical Paper should describe the teams' preparation for the competition (including design considerations, development, and proposed implementation of the treatment apparatus).
- The Environmental Technical Review Paper must be submitted at the beginning of the captain's meeting on the day of competition.
- The Technical Paper must be divided into the following labeled sections:



1. **Abstract**
2. **Introduction**
3. **Materials/Methods**
4. **Discussion**
5. **References**
6. **Appendix (including receipts for materials and tools)**

Judging

- Teams will be judged by a panel of water quality professionals.
- Samples of the treated water will be tested for Nitrate-N, pH, and turbidity at the Ohio State University’s environmental laboratories. Scoring of the results is explained below.
- The creativity and sustainability of the treatment process will be evaluated by a panel of judges. Creativity refers to the uniqueness of the system. Sustainability refers to the total life-cycle cost and environmental impact (What resources are used, and what is the waste generated by the system? Are the materials used safe for humans and the environment? Could any materials used result in any harmful byproducts in the effluent? What is the potential for recycling the system components at the end of its functional lifetime?). These will be ranked in order from greatest to least and awarded points accordingly.
- The decisions of the judges are final, and the team captain is the only team member that may interact with judges during the competition.

Judging Criteria – 100 points overall

| Parameter | Subcategory | Score |
|-----------------------|--|--|
| Treated water quality | Nitrate | Lowest concentration will get 40 points, 2 points will be subtracted per place thereafter. |
| | pH | Closest to original source water get 10 points, 1 point will be subtracted per place thereafter. |
| | Turbidity | Lowest concentration 10 points, 1 point will be subtracted per place thereafter. |
| Time of treatment | Min to recover 2 L | Shortest time 10 points, 1 point will be subtracted per place thereafter. |
| Sustainability | Life cycle cost and environmental impact | 20 points best design, 1 point will be subtracted per place thereafter. |
| Creativity | System uniqueness | 10 points, 1 point will be subtracted per place thereafter. |

Penalties:

Except of the deductions described above in the document, some other penalties include:



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- **Presentation Display Poster** Each team must have a 17” X 20” poster which will present their final treatment system description, summary of cost, and environmental impact. Failing to provide poster within these constraints will result in 5 points deduction
- Construction need to be completed within 15 minutes. After 15 minutes teams will be penalized 2 points per minute taken to complete construction, the maximum time allowed for construction is 25 minutes.
- Failure to recover 2 liters after 45 minutes will result in 10 points deduction. Failure to produce effluent in sufficient concentration to analyze (250 ml) will result in disqualification.
- Any **intentional** physical contact by any team member with the raw intake, effluent, or any intermediate process water will result in a **25 point deduction**.

Awards:

- An overall total of 100 points are available to be awarded for treatment quality, time needed and creativity and sustainability; the team with the most points will be deemed the overall winner. Second and third place overall awards will also be given.
- Awards for sub-categories will also be given. These sub-categories have no impact on the overall awards. The sub-category awards include:
 - Best Environmental Technical Paper - The team with the highest score for the Technical Review Paper will be awarded “Best Technical Review Paper”.
 - Most Creative Apparatus - The team with most creative design will be awarded “Most Creative Apparatus”

Acknowledgement

The rules of this competition are based on previous OVRC and other ASCE student environmental competitions with modifications.