
Wastewater Treatment Competition

Object:

To design, construct, and operate a small scale **flow-through** wastewater treatment **apparatus** according to the constraints provided herein (i.e. time, materials, effluent quality, etc.) to produce 4 liters of effluent from 20 liters of raw synthetic wastewater influent.

General Rules:

Materials

- All materials¹ must be purchased from a maximum of two retail stores *not* specializing in any way in water treatment or environmental clean up; grocery stores, hardware stores, craft stores, etc. are acceptable.
- All receipts from the purchase of materials must be included in the appendix of the Technical Review Paper (see below)
- Any battery or manually operated tool² may be used in the construction of the apparatus and may be obtained by any means.
- No materials used may be marketed for water treatment or environmental clean-up.
- All materials used must be brought to the competition as purchased and with no prior assembly or alterations.

Construction/Treatment

- Each team may consist of up to, but no more than 5 students participating in construction and treatment, however only one team captain must be designated.
- The team captain is the only team member that may interact with judges during the competition.
- Teams must construct a *flow-through apparatus*, not a series of batch reactors.
- All team members must provide and be equipped with proper clothing (long pants, long sleeved shirts, closed toed shoes), as well as protective eyewear, hardhats, and latex gloves.
- Before time begins, all materials and tools must be in a designated area and not in contact with any team member.
- Time³ begins at a signal from the judges and time ends at a signal from the team captain.

¹ "Materials" is defined as any object used in the treatment apparatus.

² "Tool" is defined as any object use for the construction of the treatment apparatus or to monitor effluent quality.

³ "Time" is defined as the interval between the beginning of construction of the apparatus and the end of treatment of the effluent.

- Time will be measured with a stopwatch and quantified by person-minutes⁴
- Any blunder will be assessed a time penalty (see “Scoring”).
- Any **intentional** physical contact by any team member with the raw influent, effluent, or any intermediate process water will result in a 25% point deduction.
- Each team is responsible for disassembly of their treatment apparatus after judging is completed.
- All substances added to influent or process water during treatment must be less than 12.5% by volume of any water treated.
- All substances added to the influent or process water which will be present in the final effluent must be measured to the nearest 10 ml and reported to the judges before addition.
- Dilution is prohibited and will result in disqualification.

Influent and Influent Composition

- All or any of the following constituents may be present in any absolute or relative concentration in the influent water:
 - Sand, silt, or other grit
 - Fats, oils, or grease
 - Bottle caps, packing peanuts, cans, or other large common items
 - Salts
 - Tuna, milk, soda, or other common food items
 - Humus
- Presence and concentration of the above materials will be at the discretion of the judges and the exact composition of the influent water will be unknown to team members.
- All teams will treat influent of the same composition.
- Influent will be provided to the teams in multiple plastic containers which hold a total of 20 liters.

Technical Review Paper

- Every participating team must submit one Technical Review Paper per team, not to exceed 1,500 words (not including references).
- The Technical Paper should describe the teams’ preparation for the competition (including design considerations, development, and proposed implementation of the treatment apparatus).
- The Technical Paper must be divided into the following sections:
 - Abstract
 - Introduction
 - Materials/Methods
 - Discussion
 - References
 - Appendix (including receipts for materials)

⁴ “Person-minute” is defined by minutes multiplied by participating team members. (i.e. two people working for five minutes is measured as 10 person-minutes.)

Scoring:

- An overall total of 100 points will be awarded; 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 (first, second, and third place awards) will also be given. These include:
 - The team with the best overall effluent quality will be awarded “Best Overall Effluent” award.
 - The team with the highest score for the Technical Review Paper will be awarded “Best Technical Review Paper”.
 - The team with the lowest weight recorded at weigh-in of materials and tools will be awarded “Lightest Overall Apparatus”
 - The team with the fastest construction and treatment time will be awarded “Fastest Construction/Treatment Time”.
 - The team with the highest score for Construction/Treatment will be awarded “Best Construction/Treatment”.

Construction/Treatment (30 points)

- Time (15 points)
 - Each team will be given 15 points at the beginning of construction and 1 point will be subtracted for every 10 person-minute interval taken for construction and treatment.
- Materials/Tools (15 points)
 - Each team will be given 15 points and 1 point will be subtracted for each 5 kg of materials and tools used.
- Penalties
 - Each construction or treatment blunder⁵ will result in a 2 point penalty, up to a maximum of 24 penalty points.
 - The removal of personal protective equipment *or* failure to wear personal protective equipment will result in a 5 point penalty for each infraction.
 - Dilution will result in disqualification.
 - Batch reactors will result in disqualification.

Effluent Quality (60 points)

- pH (15 points)
 - Each team will be given 15 points and 2 points will be subtracted for each S.U. deviation from neutral pH (pH 7.0).
- Turbidity (10 points)
 - 1 point will be awarded for each 10% reduction in effluent turbidity from the original influent turbidity.
- Dissolved Oxygen (15 points)
 - Each team will be given 15 points and 1 point will be subtracted for each 0.4 mg/l reduction below 4 mg/l of dissolved oxygen.

⁵ “Blunder” is defined as dropping of tools or materials during construction, or spilling of influent, effluent, or process water.

- In addition, teams can earn 1 point for each 0.4 mg/l *increase*(from the *initial DO of influent measured by the judges*); up to 5 points.
- Total Chemical Oxygen Demand – COD (10 points)
 - 1 point will be awarded for each 10% reduction in effluent total chemical oxygen demand from the original influent total COD.
- Temperature (10 points)
 - Teams will be given 10 points, and 1 point will be deducted for every 2 degree deviation from the original influent temperature.

Technical Review Paper (10 points)

- Grammar/syntax (5 points)
- Technical/scientific merit; proper format (5 points)
- No points will be awarded on the basis of length; however, papers exceeding 1,500 words will not be reviewed.

** Please submit any questions regarding these rules to: Char Yoder at cayoder@cincinnatiastate.edu **