King Fahd University of Petroleum and Minerals

Civil Engineering Department
CE 544 – Unit Operations and Processes Lab

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Catalog: Unit Operations and Processes Laboratory. Credit 3. Analytical methods utilized for assessment of water and wastewater quality; laboratory evaluation for the design of physical, chemical, and biological unit operations and processes for water and wastewater treatment.

Goals: The course is designed to enhance the capabilities of graduate students in applying the theories of water and wastewater treatment to actual systems through designing and testing laboratory models of various treatment units with particular emphasis on impact assessment of various design parameters as well as water quality factors on treatment efficiency. Students will also get familiar with several conventional and state of the art analytical techniques for water testing.

Text Book: Standard Methods, AWWA (Not Available).

Replacement: Wastewater engineering: Treatment and reuse, Metcalf & Eddy, 4th Edition, 2003, McGraw Hill.

References: Environmental engineering unit operations and unit processes laboratory manual (Association of Environmental Engineering Professors, 1972). [***Note*** A newer version has been requested and would be made available upon arrival.]

Water works engineering: Planning, design and operation. S.R. Qasim, E.M. Motley, and G. Zhu, 1st Edition, 2000, Prentice Hall.

WebCT: Lectures will be posted on the CE 544 WebCT site.

Safety: The given lab Safety Instructions should be observed.

Points-Distribution:

Project	20%
Lab Reports*	40%
Major	20%
Final	20%
Total:	100%

* Please follow the given Laboratory Report Format instructions

Course Outline:

Class & Lab Topic	Week
Introduction	1
Coagulation & Flocculation -Using Metallic Salts -Aluminum Sulfate -Determination of Optimum Coagulant Dosage -Determination of Optimum pH -Tapered Flocculation -Ferric Chloride -Determination of Optimum Coagulant Dosage -Determination of Optimum pH -Tapered Flocculation	2, 3
Adsorption -Adsorption Equilibria -Study of a Continuous Flow Adsorption System	4
Field Trip for Project	*5*
Water Softening -Chemical Precipitation	6
Sedimentation -Flocculent Settling -Process Efficiency w.r.t. Overflow Rate & Settling Time	7
Field Trip	*8*
Major 1	***9***
Ion Exchange -Removal of Toxic Metal Species -Resin Selectivity Study	10
Filtration -Filtration	11
Heterogeneous Catalysis -Degradation of Organic Contaminants	12

Laboratory Report Format

The laboratory report should be written in a typical research paper type format. Assume that it has to be submitted for possible publication in a refereed journal. Writing reports in a professional manner will certainly help you when you would be seeking to publish your graduate research in a journal of international repute. Some general guidelines are given below.

(1) **Cover Page**

This should indicate the course and experiment title, date of experiment, and the name and number of student.

(2) **Abstract**

The abstract should portray the objective(s) and conclusions of your work in a very professional manner, without going into many details. A well-written and concise abstract tells the reader a lot about your work. People may decide to read your work or not, based on how you have presented it in the abstract. A confusing abstract will definitely leave a very bad impression on the reader. On the contrary, an organized abstract will indicate that your work is worth reading.

(3) **Introduction**

First, introduce a short description of the unit operation or process which is under study. Then mention the objective of your work and the means employed to achieve that objective. You must justify, that why you have chosen to study this specific topic. Also describe what advantages would possibly be achieved from such a study. All these things should be mentioned briefly, but very clearly.

(4) **Materials & Methods**[*]

Describe in detail all materials and the analytical methods used during the study.

([*]Help could be taken from the lab-procedure provided for the each lab.)

(5) Results

Describe your results as presented in the pertinent Figures and Tables (obtained using the experimental data). There should be a flow in your description so that the reader should be able to follow your presentation very easily. Bad organization and out of context

presentation of data, would leave the reader confused (Imagine the reader is one of your referees!)

(6) **Discussion**

The step after presenting the results, is giving possible explanations for the observed findings, and comparing the different data-sets to draw any meaningful and useful conclusions from your work. You should also describe, if noted, any discrepancies between the theoretical expectations and the experimental results.

(7) **Conclusions**

A good conclusions section (in addition to the abstract) tells a lot about your achievements, in a very short time. Make sure that you present this portion in a very professional style.

(8) **Data Tables and Figures**

The data tables and figures should be prepared using appropriate software.

(9) **References**

Provide the references used.

General Safety Instructions for using the Environmental Laboratory

The safety instructions provided below are meant to avoid any possible lab-hazards, which may result while using various materials and equipments in the Environmental Engineering laboratories (labs). While in the labs, please always seek guidance from the laboratory personnel. Precaution is a **MUST** for using these labs.

1. It is strictly prohibited to smoke and consume food/beverages in the labs.
2. Avoid loose clothing, and wear aprons while conducting the experiments.
3. No running in the labs.
4. Wear protective shoes and avoid open-toed sandals.
5. Avoid damage to your clothing or other belongings.
6. Get to know the location of first aid, eye station, safety shower, fire blanket, fire extinguishers and gas masks.
7. (a) Safety glasses should be worn at all the times while in the laboratory. (b) Normal eyeglasses are not usually adequate for eye protection. (c) Do not wear contact lenses in the laboratory.
8. Various microbiological cultures, media and samples are handled in this laboratory. Hence care should be taken to avoid any accidental cross contamination.
9. (a) While transferring liquids, remember 'ACID TO WATER'.
   (b) Use gloves while pouring corrosive liquids.
   (c) Use funnel while filing bottle/flask. Prevent air block by raising funnel.
   (d) Avoid mouth contact with any laboratory equipments including pipettes. Use safety filler to fill pipettes.
10. (a) While handling glassware, avoid direct heating on the flame.
    (b) Never try to free 'frozen' stopper or ground joint by force.
    (c) Broken or chipped glassware should be discarded.
    (d) Properly support glassware using stand, clamps, etc.

(e) Use proper rings to place round bottom flasks.

11. Use only chemicals and reagents having proper labels.

12. (a) Avoid injury from spilled chemicals.

(b) Chemicals in eye: rapid treatment is vital. Run large amount of water over eyeball until medical help is available. Alkali materials in the eyes are most dangerous.
(c) For alkali spills on bench wash with water followed by dilute acetic acid. Use sodium carbonate flowed by water for acid spills.

13. (a) Reduce fire hazard.

(b) Use safety shower for fire victims.

(c) While fire on clothing, do not run or fan flames.

(d) Put off flames using the fire blankets.

(e) Spillage of a flammable solvent can also cause fire.