ENV 6519: Physical & Chemical Processes for Groundwater Remediation

Spring 2021 University of South Florida
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# Design Project 2021:
## *Deliverables*

## 1. Deliverables

As part of your ENV 6519 design project this semester, your project team will be responsible for delivering the following three items to the "client:"

1. a written report describing your evaluation of the three treatment options, including your designs and cost estimates, due on April 29;
2. an oral presentation to the class on April 27 or April 29, approximately 30 minutes long, in which you summarize the findings of your report; and
3. a team interview with the instructor on May 6, approximately 30 minutes long, in which you will answer follow-up questions about your group's designs and cost estimates.

(Note: interviews will be held during the time designated by the registrar for the final exam, i.e., May 6 from 12:30–2:30 PM). Together, the three deliverables will constitute 33% of your semester grade.

Weighting on these deliverables is as follows: oral presentation 25%; content of written report 45%; presentation of written report 15%; team interview 15%. Additional details are provided below.

Recall that we are pretending that your team of students is acting as a project team for an environmental engineering consulting firm, and your instructor is playing the role of your client at either the USEPA or the company responsible for the contamination. In the spirit of healthy competition, you can consider that other teams of students represent competing consulting firms who want to out-perform your team in the eyes of the client. The firm that presents the best feasibility study to the client would be most likely to get repeat business in the future. The best feasibility study is the one that includes optimum technical designs for each treatment option, along with accurate cost estimates of each option. Thus, two of your most important goals in completing this assignment are (1) to develop the best engineering designs, and (2) to develop the best cost estimates. Keep these goals in mind as you prepare your deliverables.

# 2. Written Report

## *2.1. Overall Structure*

The text book *Plant Design and Economics for Chemical Engineers* by M Peters and K Timmerhaus (published by McGraw-Hill) has a nice chapter on the written design report. You might want to have a look at that chapter in addition to following the guidelines below. The overall structure of your report should be the following:

I. Letter of transmittal (cover letter)
II. Title page
III. Executive summary
IV. Table of contents
V. Body of report
VI. Appendices

Below, I provide you with a little more guidance on each of these sections.

## *2.2. Letter of transmittal (cover letter)*

The letter of transmittal should be indicate why the report has been prepared and should be addressed to the appropriate party. The letter should give essential results that have been specifically requested. For the purposes of this project, that means that your cover letter should include a recommendation of which design configuration you recommend, the approximate cost of that technology reported as net present cost, and the approximate cost reported as dollars per thousand gallons treated.

## *2.3. Title page*

The title page should include the title of the report, the name of the person or organization to whom the report is submitted, the names and organizations of the authors of the report, and the data of submittal.

Historically, most of the groups completing this assignment make up a name and a logo for their fictional consulting firms, and include that name and logo on their title page. Have some fun and be creative. (Back in 2008, one of the groups consisted of students who were all research students of Professor Yeh, so they named their group "The Yeh Team," which is a pretty good pun if you remember the television series or the movie of a similar name.)

## *2.4. Executive summary*

The executive summary, according to Peters and Timmerhaus, "briefly presents essential results and conclusions in a clear and precise manner." The executive summary should be only one page in length. It should *not* be an introduction; it is a summary of the most important findings. Think of it like this: imagine that your boss or your client is only going to read one page of your report – that is a realistic assumption in certain scenarios! – so what do you want to tell him/her/them in that one page? There will be a little redundancy between your cover letter and your executive summary; that is fine.

### *2.5. Table of contents*

List the major sections of your report with the corresponding page numbers. Also include a listing of tables and figures with the corresponding page numbers. Peters and Timmerhaus suggest putting the table of contents before the executive summary, but I disagree. You want your boss/client to open the title page and have the executive summary right there. Then, if he/she is still interested, he/she will turn the page to find the table of contents.

### *2.6. Body of the report*

Here I will slightly modify the recommendation of Peters and Timmerhaus. Their suggested format for the body is fine – it is certainly appropriate – but I think there is a better way for a project like this where you are considering three technologies in particular and comparing them. So, here is what I recommend for the body of the report:

A. Introduction
B. Treatment option #1
C. Treatment option #2
D. Treatment option #3
E. Conclusions and recommendations
F. Acknowledgments
G. Table of nomenclature
H. References to literature

Below, I elaborate a little on each of these sections.

***2.6.1. Introduction***. The introduction, according to Peters and Timmerhaus, "presents a brief discussion to explain what the report is about and the reason for the report; no results are included." You probably want to include, at a minimum, some information about the contaminated site you are considering and the type of contamination that was found there. (You could refer back to homework #1 to get an idea of what type of information you might want to include.)

***2.6.2. Treatment options***. For each of the three treatment options – which are considered in sections B through D – you probably want to include the following information:

1. A brief description of the principle of the technology, referring to any texts or papers that you think are necessary;
2. A figure illustrating the process and key equipment included in the process;
3. A table where you summarize the major design specifications (e.g., the dimensions of the GAC contactors, the empty-bed contact time, the diameter and packing height of the air-stripping tower, the packing type, the air and liquid loading rates through the packed tower, etc.);
4. Tables for the major cost elements, e.g., a table of estimated costs for major equipment, a table for the estimated costs of other direct capital costs, and a table of major operating and maintenance (O&M) costs;
5. Text as necessary to explain your design and your cost estimates. What does the client need to know?

***2.6.3. Conclusions and recommendations***. Here your conclusions and recommendations can be presented in more detail than was done in the executive summary. However, your executive summary should be consistent with whatever you write in this section.

***2.6.4. Acknowledgements***. Peters and Timmerhaus say that this section "acknowledges important assistance of others who are not listed as preparing the report." For instance, if you contact a colleague who works in engineering practice to get some help with your cost estimates, then you would acknowledge that colleague here.

***2.6.5. Table of nomenclature***. If, in your report, you use symbols to represent the value of certain parameters, include a table where you define each term. (For instance, $Q$ = flow rate of contaminated water [$L^3/T$]; $Q_a$ = flow rate of air through the packed tower [$L^3/T$]; $L_M$ = liquid mass loading rate of water through the tower [$M/L^2 \cdot T$]).

***2.6.6. References to literature***. If you made reference to a text of paper in your report, here include the complete bibliographic information for that source. Only list those sources that you actually cited in your report; you do not need to include sources that you read or used but did not cite. You may use whatever format you want for your references, but you should pick one format and use it consistently (i.e., all journal articles should be referenced in the same format).

## *2.7. Appendices*

Your report might contain the first three of the following four appendices (as recommended by Peters and Timmerhaus):

A. Sample calculations
B. Derivation of equations
C. Tables of data
D. Results of laboratory tests

For this project, you will not conduct laboratory tests, so you needn't include any lab results in this report. However, the first three appendices are appropriate, and you might want to include them. Below I elaborate on what each one means.

***2.7.1. Sample calculations***. Peters and Timmerhaus recommend that "one example should be presented and explained clearly for each type of calculation." When I was a graduate student we actually had to do this for our report. This means, for instance, that for the Onda correlation we had to write out our calculations by hand for one of the chemicals; then it is assumed that the other two chemicals were computed similarly. The purpose of this is as follows: if you just include a print-out from an Excel spreadsheet, your client can't verify that you have all the formulae correct, but if you include one set of hand calculations for any type of calculation you perform, then your client (or, in this case, your professor) can verify that you did everything correctly. To be honest, this is a pretty daunting task, and it might not be feasible to write out one sample of each of your calculations, but do your best. Include what you can. (I still have my old report from graduate school if you want to see an example of these hand calculations.)

***2.7.2. Derivation of equations***. Peters and Timmerhaus note that this appendix should include a "derivation of equations [that are] essential to understanding the report but [which are]

not presented in detail in the main body." In most cases, you can probably get away with referring to text books or journal articles that present, derive, or explain the equations; you do not, for instance, have to derive the Onda correlation! However, there might be some equations that warrant a brief derivation in this appendix. You can decide if you think it is necessary to include this appendix. (When I grade your report you will find out if I agreed with your judgment!)

***2.7.3. Tables of data***. Here you might include, for instance, a table of Freundlich isotherm parameters that you used to design your GAC system, or a table of second-order rate constants that you used to design your AOP system. Be sure to refer to the source of the data!

## 3. Oral Presentation

Each group will have a couple minutes to set up its presentation, then probably 25–30 minutes to present its findings to the rest of the class, then 5–10 minutes of question-and-answer following the presentation. The exact timing will depend on how many groups we have this semester (it varies from one year to another). Each group should prepare a presentation in PowerPoint (or Prezi, or similar presentation software) and then upload the presentation to Canvas and/or bring the presentation to class on a USB device. You may have one group member deliver the entire presentation, or you can divide the presentation up among your various group members. It is up to you – whatever you think makes the most effective presentation.

Imagine that your audience includes both your client (i.e., the company responsible for the contamination at our fictional site) and the regulatory agency overseeing the clean-up. The regulator is waiting to issue a record of decision (ROD) regarding what technology should be used, and the client is waiting to find out how much it is going to cost.

Your presentation should include a brief introduction to the problem at hand, a summary of each of your three designs (including the cost estimates thereof), and a recommendation to your client and the regulatory agency. At a minimum, you will want to include a process diagram for each of your designs, key design variables (e.g., tower dimensions, GAC bed volumes treated), and estimated costs. You want to strike the proper balance of technical detail; assume that your audience has some engineering background, but has not taken ENV 6519. Therefore, it is fine to use technical language, but you cannot assume that your audience will know what you mean if you start talking about the Dubinin-Radushkevich equation to estimate the usage rate of the carbon in your air-stripper off-gas treatment. It is a little tricky to get the balance just right on the level of technical detail. Do your best, and I'll let you know how I think you did. (Note that each group's presentation will include a brief introduction, so we'll hear roughly the same information multiple times…that is fine.)

Attendance at the group presentations is not required, but it is highly recommended. The presentations tend to be pretty fun. Really!

## 4. Group Interviews

Interviews will be held during final exam week at the time designated by the registrar for the final exam, i.e., May 6 from 12:30–2:30 PM. For the interviews, *all* group members must be present. During the interview, I will ask you follow-up questions based on having read your written report and seen your presentation. (e.g.: How did you estimate the value of ____? What was your calculated value of ____? What assumptions did you make to get that value? Can you convince me that was an acceptable approximation or assumption?)

There is not really any way to "prepare" for the interview, other than knowing what your group did, and why you did it. The purpose of the interview is not to test the limits of your knowledge on any of the treatment technologies; it is to see how well you can explain what you did and why you did it that way.