

ENV 6438: Physical & Chemical Processes for Drinking Water Treatment
Department of Civil & Environmental Engineering
University of South Florida

Cunningham

Spring 2020

Homework #1

Due Wednesday, Jan. 22

Topic: Drinking water standards

For each question, list any books, articles, or web sites that you used to gather information.

(You do not have to list the ones that are given in the questions themselves.)

1. (15 pts) Answer the following *in your own words*. No credit for copying!
 - a. Define *primary* and *secondary* drinking water standards as these terms are used under the Safe Drinking Water Act. Be sure to specify the most important difference(s) between the two.
 - b. Primary drinking water standards are generally specified in one of two ways. What are the two ways?
 - c. Define *maximum contaminant level* (MCL) and *maximum contaminant level goal* (MCLG), specifying the most important difference(s) between the two. Find an example of a contaminant that has an MCL equal to its MCLG, and an example of a contaminant where the MCL is greater than the MCLG. Why is the MCLG never greater than the MCL?

2. (15 pts) Answer the following *in your own words*. List any resources that you use to answer these questions.
 - a. Why is there no MCL for microorganisms such as *Giardia lamblia*, *Legionella*, and viruses?
 - b. What types of treatment are required to require these microorganisms? What are the required levels of inactivation for *Giardia*, viruses, and *Legionella*?
 - c. Recently, EPA has been instituting a set of “enhanced surface water treatment rules” (ESWTR). What is the main objective or purpose of this set of rules?

3. (15 pts) Get a copy of the annual report that your city sends you about the quality of your drinking water. Turn in a photocopy of the report. Is your city in violation of any of the applicable regulations? Are there any contaminants that look like they might be cause for some concern? Explain briefly.

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4. (15 pts) Read the following article:
Cothorn CR, Coniglio WA, Marcus WL, 1986. Estimating risk to human health.
Environmental Science & Technology, 20(2), 111–116.
- I'll try to get a PDF copy to distribute, but you should be able to access this article from a USF computer by going to <http://pubs.acs.org> and searching for it there. After reading the article, answer the following questions (in your own words, of course).
- a. Summarize the approach and the specific steps used by EPA in setting a drinking water standard for trichloroethene (TCE).
 - b. In your opinion, is it reasonable to establish a MCL for this contaminant? In other words, is there need to regulate TCE specifically in public water supplies?

The following question are about particular contaminants or episodes that have been in the news a lot in recent years. Pick any two of these questions to answer. Each is worth 20 points.

5. Arsenic regulation in drinking water was a subject of debate in the US in the early 2000's. A new arsenic rule was passed by EPA in 2001. You can read or skim the actual rule at this site: <https://www.gpo.gov/fdsys/pkg/FR-2001-01-22/html/01-1668.htm> but it might be helpful to refer to the following web sites, which are written to be a bit more helpful.
- <http://www.epa.gov/dwreginfo/chemical-contaminant-rules>
<https://www.fas.org/sgp/crs/misc/RS20672.pdf>
<https://www.epa.gov/dwreginfo/drinking-water-arsenic-rule-history>
- Answer the following questions *in your own words*.
- a. What change was made to the MCL for arsenic in the early 2000's? Why was this change delayed for a while, and why was it ultimately approved?
 - b. What are some of the benefits of lowering the arsenic standard? What are some of the costs?
 - c. Briefly explain why we are concerned about arsenic levels. What human health effects are associated with arsenic exposure?
 - d. Where does arsenic in drinking water come from?

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6. The United States Environmental Protection Agency (US EPA) is considering whether to regulate perchlorate in drinking water. See this web site:
<http://www.epa.gov/dwstandardsregulations/perchlorate>

You can also read the following articles – all of these are pretty short and fast to read. If I can get PDF copies to put on Canvas, I will. Otherwise you will have to find these yourself.

- Hogue C, 2007. Perchlorate pending. *Chemical & Engineering News*, 85(20), 39.
Hogue C, 2009. EPA action on perchlorate gets mixed review. *Chemical & Engineering News*, 87(2), 31.
Hogue C, 2009. EPA reanalyzes perchlorate data. *Chemical & Engineering News*, 87(32), 24.
Hogue C, 2011. Changing course on perchlorate. *Chemical & Engineering News*, 89(6), 6.
Hogue C, 2015. California moves to limit perchlorate. *Chemical & Engineering News*, 93(10), 30.
Morrison J, 2016. EPA agrees to set limits on perchlorate. *Chemical & Engineering News*, 94(42), 17.
Hogue C, 2019. US EPA proposed limit on perchlorate in drinking water. *Chemical & Engineering News*, 97(22), 18.

Based on what you have read, do you think it is appropriate for EPA to set an MCL for perchlorate at this point? Why or why not? If so, do you have a recommendation for what MCL might be appropriate? (Hint: *if* question #4 is required this year, answer question #4 before answering question #5; it might help.)

7. Report briefly on the Milwaukee *Cryptosporidium* outbreak. Some questions you probably want to answer include:
- What caused the contamination of the public water supply?
 - What were the major public health effects of this outbreak (i.e., illnesses, deaths, other health outcomes)?
 - What should have been done differently to prevent this outbreak?
 - How have the EPA and other regulatory agencies responded to make sure it does not happen again?
 - How have cities and water providers responded to make sure it does not happen to them in the future?

List the resources that you use to prepare your answer.

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8. Report briefly on the “Flint water crisis” that occurred in the 2010s in Flint, Michigan. Some questions you probably want to answer include:
- What caused the contamination of the public water supply, and what were the major contaminants of concern?
 - What were the major public health effects of this outbreak (i.e., illnesses, deaths, other health outcomes)?
 - What should have been done differently to prevent this outbreak?
 - How have the EPA and other regulatory agencies responded to make sure it does not happen again?
 - How have cities and water providers responded to make sure it does not happen to them in the future?

List the resources that you use to prepare your answer.

9. A group of contaminants that is in the news a lot these days is perfluorinated alkyl substances (PFAS). This group includes perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS). For now, let’s focus on just PFOS and PFOA, neglecting other members of the group. Be sure to cite the sources that you use to answer the following questions.
- a. For what industrial purposes have PFOS and PFOA been used historically?
 - b. Cite a few examples of PFOS or PFOA being found in municipal water supply source water (e.g., in an aquifer, lake, or reservoir that is used as a source of a city’s water supply). At what concentrations were the chemicals detected in these water supplies?
 - c. What is known about the toxicology of PFOS and PFOA? Have any state or federal regulatory agencies proposed drinking-water standards for PFOS or PFOA?
 - d. Based on your answers to parts (b) and (c), can we make a judgement about whether PFOS and PFOA represent a significant threat to public health in the USA?