# Water Treatment Unit Operations—Design Paramters

CENG 340–Introduction to Environmental Engineering
Instructor: Deborah Sills
**In Class: 21 October, 2013**

## Introduction

You have been asked to design a water treatment facility to meet the following criteria:

- Design capacity = 3.25 MGD
- Source is river water with an initial turbidity of 10 NTU, an alkalinity concentration of 50 mg/L, at 10 $^0$C and pH = 7.
- Unit operations: coagulation (rapid mix), flocculation, sedimentation, rapid sand filtration, disinfection
- Additional Constraints: units must be sized according to acceptable ranges. Design must accommodate maintenance and repair.

The following values were taken from Table 10.13 in the textbook:

Table 1: Typical values used in design of water treatment systems (adapted from Mihelcic and Zimmerman).

| **Unit Operation** | **Design Basis** | **Calculate** |
|---|---|---|
| Coagulation–rapid-mix tank | $\theta$ = 1–2 min<br>$\bar{G}$ = 600–1000 s$^{-1}$<br>Coagulant type | Volume<br>Number of tanks<br>Mixing Power (P)<br>Coagulant dose<br>Alkalinity req'd |
| Flocculation Tank | $\theta$ = 10–30 min<br>$\bar{G}$ = 20–50 s$^{-1}$ (horiz. paddle)<br>$\bar{G}$ = 10–80 s$^{-1}$ (vertical shaft) | Volume<br>Number of tanks<br>Mixing power (P) |
| Sedimentation tanks | $\theta$ = 2–4 h<br>OFR = 700–1400 gpd/ft$^2$<br>weir loading rate = 20,000 gpd/ft | |
| Filtration (rapid sand) | Hyd. loading rate = 2–6 gpm/ft$^2$<br>Depth = 2–6 ft | Area<br>Volume<br>Number of filters |
| Chlorination | $\theta_{\min}$ = 15 min (at peak hourly rate)<br>$\theta_{\min}$ = 30 min (at peak hourly rate) | Volume<br>Chlorine dose |
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