An-Najah National University Effluent Treatment Processes for Energy Industry (10626584) Tutorial 03- Mixing and Power Consumption- Spring 2019 Instructor: Amjad El-Qanni, PhD

1. The contents of a tank are to be mixed with a turbine impeller that has six flat-blades. The diameter of the impeller is 3 m, and the impeller is installed 1.25 m above the bottom of a 6 m deep tank. If the temperature is 30 °C and the impeller is rotated at 30 r/min, what will be the power consumption?

- 2. It is desired to mix some chemicals with incoming wastewater that is to be treated. Mixing is to be accomplished using a flat-paddle mixer 500 mm in diameter having six blades. If the temperature of the coming water is 10 °C and the mixing chamber power number is 1.70, determine:
 - a) The speed of rotation when the Reynolds number is approximately 100,000.
 - b) Why it is desirable to have a high Reynolds number in most mixing operations?
 - c) The required mixer motor size, assuming an efficiency factor of 20 percent.

3. (Example 9.8 - MWH's Water Treatment)

Vertical turbines are to be used for flocculation in a water treatment plant with a design flow rate of 75 ML/d (20 million gallon per day (mgd)) and design temperature of 10 °C. Flocculation is to be designed with four parallel trains, and each train is to be made of four stages in series. The total detention time in flocculation is to be 20 min. Determine the following design features for the first stage in each flocculation train:

- a) The dimensions of the stage.
- b) The diameter of the impeller (assume a turbine having three pitched blades with camber, a foil).
- c) The water power required to achieve a G of 80 s⁻¹ (the power that must be input to the water through the impeller shaft).
- d) The maximum rotational speed.
- e) The pumping capacity of the impeller and circulation time in the tank.

At 10 °C, the absolute viscosity of water is 1.31×10^{-3} kg/m·s and the density of water is 999.7 kg/m³. The circulation time is the volume of the flocculation chamber divided by the impeller pumping rate.
