10.542 – Biochemical Engineering
Spring 2005

Practice Problems for Quiz #3 – Scale-Up, Scale-Down
These problems do not need to be turned in.

1) As the "resident Biochemical Engineer" with an industrial pharmaceutical company, you have been asked to consult on the following problem. The production scale fermentors are used to produce an antibiotic which employs a mycelia organism. There is evidence in these fermentors that fluid shear is a critical parameter that influences the antibiotic formation. It has been proposed to you that design calculations be performed so that the shear at the impeller tip be doubled from that of the present operating conditions. There are diverse opinions as to how to increase the shear. You have been asked to elucidate quantitatively the following suggestions:

   a) The plant manager does not want to change the horse power of the electric motor which is presently on the fermentor. If this constraint must be fulfilled, what would you do to the impeller diameter and speed?

   b) The director of research states that the obvious way to double the shear is to double the impeller speed. If this is done, what would be the impact on the impeller diameter and power requirement?

   c) A very astute plan operator suggests that you decrease the impeller diameter to 75% of the present impeller. If this is done, what must be the changes in the impeller speed and power?

   d) Considering all of the cases above, what would you suggest as a feasible scheme?

2) Scale-down handout, Problem SAQ 3.2

3) Scale-down handout, Problem SAQ 3.3