

**ChE 415**  
**Winter 2008**  
**Multiphase Mixing**

**Design Objective**

*Team 1*

Design a 850 gallon agitated stirred-tank reactor that will contain from 2 to 10 weight percent catalyst solid. Assume the solid can be modeled using polyethylene terephthalate (PET) pellets. Your design must utilize an axial-flow impeller style.

*Team 2*

Design a 850 gallon agitated stirred-tank reactor that will contain from 2 to 10 weight percent catalyst solid. Assume the solid can be modeled using polyethylene terephthalate (PET) pellets. Your design must utilize an axial-flow impeller style.

*Team 3*

Mitchell - Your company has a need to design a 1300 gallon agitated stirred-tank reactor that will utilize from one to 2 vvm (vessel volumes per minute) of gas. Your design must utilize a radial-flow impeller style.

Tuttle - Your company has a need to design a 950 gallon agitated stirred-tank reactor that will utilize from 0.5 to 1.5 vvm (vessel volumes per minute) of gas. Your design must utilize a radial-flow impeller style.

**Experimental Objectives**

The experimental objectives extend past the information required for the design problem. All experimental objectives are to be investigated using as wide a variety of parameter values as possible. The experimental objectives are to:

*Teams 1 and 2*

- a) select an axial-flow impeller design
- b) determine the relationship for power draw as a function of stirrer speed, impeller size and solids concentration.
- c) determine a correlation for the minimum stirrer speed for off-bottom solid suspension.

*Team 3*

- a) select a radial-flow impeller design
- b) determine the relationship for power draw as a function of stirrer speed, impeller size and gassing rate.
- c) develop correlations for the minimum stirrer speed to prevent flooding and the minimum speed for complete dispersion as a function of gassing rate and the impeller diameter to tank diameter ratio.

**Description of Equipment**

The equipment consists of a series of cylindrical tanks, a wide-variety of shafts, impellers and sparge rings, a one hP mixer, and a torque and rpm sensor. Operation of the equipment will be presented during a pre-prelab lab visit.

**Useful References**

McCabe, Smith, and Harriot, Unit Operations of Chemical Engineering

Oldshue, Fluid Mixing Technology

Ludwig, Applied Process Design for Chemical and Petrochemical Plants. Vol 1

Perry's Chemical Engineer's Handbook

a couple of articles Darin will provide.

**Hints for Prelab**

Be sure that you understand the following items by the prelab meeting.

- 1) What is the difference between torque and power, and how they are measured.
- 2) Focus on how the analysis can be done non-dimensionally, to allow scaleup.
- 3) Use your early trials to select an impeller style then more extensive testing can be done on that type.

### **Prelab Report Grade Breakdown**

The grade breakdown for the prelab is as follows

Section	Weighting
Prelab Discussion	10%
Design and Experimental Objectives	10%
Introduction / Experimental Plan Overview	10%
Experimental Methods / Schematic and Description of Apparatus	10%
Experimental Methods / Test Matrix	10%
Experimental Methods / Operating Procedure	5%
Experimental Methods / Safety Concerns	5%
Data Analysis / Expected Data and Results	15%
Data Analysis / Sample Calculations	10%
Data Analysis / Statistical Methods	15%

### **Postlab Report Grade Breakdown**

The grade breakdown for the postlab report is as follows

Section	Weighting
Report Overall – Experimental Uncertainty	10%
Report Overall – Quantitative vs. Qualitative	10%
Objective	5%
Presentation of Results – Presentation Style	10%
Presentation of Results – Actual Results	15%
Presentation of Results – Experimental Methodology	5%
Presentation of Results – Sample Calculation	10%
Discussion – Statistical Analysis	15%
Discussion – Analysis of Results	15%
Conclusions	5%

(Last updated 6 January, 2008 - Darin Ridgway)