ChE 415
Fall 2004
Multiphase Mixing

Design Objective

Team 1

Your company has a need to design a 1000 gallon agitated stirred-tank reactor that will utilize from one to 2 vvm (vessel volumes per minute) of gas. Your design must utilize either a radial-flow disc turbine or hydrofoil style impeller. The design should include the vessel, impeller, and motor.

Team 2

Design a 700 gallon agitated stirred-tank reactor that will contain from 2 to 10 weight percent catalyst solid. Assume the solid can be modeled using polyethylene teraphthalate (PET) pellets. Your design must utilize an axial-flow impeller style. The design should include the vessel, impeller, and motor

Team 3

Design a 1000 gallon agitated stirred-tank reactor that will contain from 3 to12 weight percent catalyst solid. Assume the solid can be modeled using polyethylene teraphthalate (PET) pellets. Your design must utilize an axial-flow impeller style. The design should include the vessel, impeller, and motor

Team 4

Your company needs 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 either a radial-flow disc turbine or a hydrofoil style impeller. The design should include the vessel, impeller, and motor

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:

1) determine the relationship for power draw as a function of stirrer speed and gassing rate or solids concentration.
2) [for solid-liquid systems] determine a correlation for the minimum stirrer speed for off-bottom solid suspension.
2) [for gas-liquid systems] 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 (on reserve in Alden Library)
Ludwig, Applied Process Design for Chemical and Petrochemical Plants. Vol 1
Perry's Chemical Engineer's Handbook

Items 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.

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 2 September 2004 - Darin Ridgway)