Mechanical Engineering Department

ME-471 Introduction to Polymer Processing Techniques

Catalog Data: ME 471 (3-0-3)

Introduction to Polymer Processing Techniques. (3-0-3)

This course is designed to familiarize students with the manufacturing techniques for converting polymer feedstocks into plastic end products. It involves a study of various plastics processing techniques. Included in these processes are extrusion, injection molding, blow molding, compression molding, thermoforming, rotational molding, casting, etc. The relationship between product and choice of process will be presented. This course also incorporates laboratory demonstrations.

Prerequisites: ME 304, ME 407.

Textbook: Plastics Product Design and Process Engineering, Harold Belfosky, Hanser/Gardner, (1995)

Supplement: Plastics Handbook, edited by Modern Plastics: McGraw-Hill, Inc.

Reference Books

Technology of Thermoforming, J.L. Throne, Hanser Gardner Publications, 1996
Polymer Process Engineering, R.G. Griskey, Chapmen and Hall, 1995.
Blow Molding Handbook, D.V. Rosato and D.V. Rosato, Hanser, 1988
Extrusion of Plastics, E.G. Fisher, J. Wiley, New York, 1976.

Supervisor: **Kwabena A. Narh**, Associate Professor of M.E. and Co-Director of the Plastics Processing Laboratory.

Prerequisites by Topic:

1. Fluid Mechanics and Dynamics
2. Heat Transfer
3. Differential Equations
4. Thermodynamics
5. Machine Elements

Course Objectives[1]:

Objective 1. Students will learn the fundamentals of the synthesis of plastic materials.

Objective 2. Students will learn the basic elements of polymer melts rheology, including effect of processing parameters on melt viscosity.

Objective 3. Students will learn the major parts of several polymer processing equipment.

Objective 4. Students will learn how each processing technique is used to convert polymer feedstock into plastic end products.

Objective 5. Students will participate in the actual manufacture of plastic parts using 5 polymer processing techniques.

Topics[2]

1. Fundamentals of Plastic Materials (4 hours)
2. Fundamentals of Melt Rheology (3 hours)
3. **PLASTICS MANUFACTURING METHODS:**

3.1. Screw Extrusion Processes: components of an extruder, extruder screws, extrusion dies - strand, monofilament, fiber, cast film, blown film, wire coating, cable sheathing, profile, and rod. Operation. (5 hours)

3.2 Injection Molding Processes - components of a molding machine, clamp side, plasticating side, cycle time, components of a mold, sprues, runners, gates, cavities, ejection system, types of molds. Operation (5 hours)

3.3 Blow Molding - sequence of operations (3 hours)

3.4 Thermoforming - vacuum, drape, plug-assisted, matched mold. Sequence of operation (3 hours)

3.5 Rotational Molding - sequence of operation (2 hours)

3.6 Relation of process to product. (3 hours)

3.7 Extrusion compounding - intensive mixers, twin-screw and kneaders, feeders, mixing devices. (3 hours)

3.8 Materials of construction of molds and dies, surface treatments and coatings (2 hours).

3.9 Project on Simulation of injection Molding.(12 hours)

Evaluation Method:

1. Quizzes
2. Exam
3. Homework
4. Project

Schedule: Lecture Recitation: 3 hours, per week

Professional Component: Engineering Science

Program Objectives Addressed: A, B, C, D, E

Course Outcomes[3] **:**

Objective 1.

1.1 Students will be able to identify different classes of plastics for engineering purposes. (1) (a,ej).

1.2 Students will be able to compare cost of a given volume of plastic product with a non- plastic product such as metal (1) (a,e,j).

Objective 2.

2.1 From a log viscosity vs. log shear rate plot, students will be able to determine the power-law index (1,2) (a,e,j).

2.2 Students will be able to determine the effect on flow behavior of polymeric fluids upon change of processing conditions (1,2) (a,b,e).

Objective 3.

3.1 Students will be able to list the major parts of each processing equipment (3) (a,b,k).

3.2 Students will be able to describe the functions of the main elements of each equipment (1,2,3,4) (a,b,k)

3.3 Students will be able to perform simple analytical calculations relating to the design of the auxiliary (1,2,3) (a,b,c).

Objective 4.

4.1 Students will be able to associate specific plastic products with a plastic processing equipment (1,2,3,4) (e,h,k).

Objective 5.

5.1 Students will be able to identify important process variables, for different products (1,3,4,5) (b,c)

5.2 Students will be able to record measurement data and troubleshoot any problems with the operation of the equipment (2,3,4,5) (b,d,g,j,k).

Prepared by: Kwabena A. Narh September 28, 2006

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[1] Capital Letters in parenthesis refer to the Program Objectives of the Mechanical Engineering Department. Listed in Sec 2 d Tables B-2-9, B-2-12. Table B-2-8 links Program Objectives with the ABET a-k Criterion.

[2] Topi**c** numbers in parenthesis refer to lecture hours. (three hours is equivalent to 1 week)

[3] Outcome numbers in parenthesis refer to evaluation methods used to assess the student performance. Lower case letters in parenthesis refer to ABET a-k outcomes.