

# Composite Materials Processing Laboratory Manual



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## Laboratory Introduction

The composite materials processing laboratory will provide hands-on learning experience to supplement the lecture material presented. An important objective of the course is to give students experience in the planning and execution of experiments. The equipment used in this lab is similar to the equipment used in the plastics industry for processing and characterizing materials. The data collected will be analyzed according to accepted practice in industry. The written reports will include descriptions of the experimental work, the interpretation of data, and the experimental design.

The practicing engineer presents the results of the work in the form of written and oral reports. Since engineering work is usually accomplished by individuals working together, no idea, no analysis of a problem, and no record of work is of much value unless it is communicated effectively to others who can use the information. Thus, clarity in reports (including the definition of the problem, the procedures used, the calculations and analysis of the results, and the conclusions) is a quality very highly valued among engineers. The development of report writing is a primary objective in this course and will be a large percentage of the grade given for the laboratory portion of the course. The student will also be responsible for one oral presentation given at the end of the semester.

## Laboratory Safety

Safety and good laboratory techniques are emphasized in this course. These matters are crucial as an engineer is responsible for his own personal safety as well as the safety of others. The following is a list of safety rules that WILL be enforced:

- Safety goggles or safety glasses with side shields must be worn at all times in the laboratory.
- Eating and drinking in the laboratory are prohibited.
- No shorts or open toes shoes in the laboratory.
- All chemical containers in the laboratory MUST be labeled.

Along with the general laboratory safety precautions, the experiments have individual concerns as well. Below is a partial list of the safety concerns for the experiments that we will be performing:

Experiment 1:

- Use latex gloves when handling any chemicals.

Experiment 2:

- Use latex gloves when handling the uncured sample.
- Use thermal gloves around the hot platens and handling the cured sample.
- Pinch point hazard, the machine offers many potential pinch points. Watch where you put your hands.

Experiment 3:

- Use thermal gloves when handling the hot mold, hot nozzle and working around the vacuum oven.
- Pinch point hazard, the machine offers many potential pinch points. Watch where you put your hands.

Experiment 4:

- Pinch point hazard, the machine offers many potential pinch points. Watch where you put your hands.

Experiment 5:

- Use thermal gloves when working on or near the extruder.
- Do not stand directly in front of the die while the extruder's screw is turning.

## Reports

A good report is clear, concise, and correct. Careful preparation, including rewriting of initial drafts, is essential. Reports should be composed with the reader's needs in mind; it must be well organized and understandable and not be handicapped by incorrect or inconsistent terminology, poor grammar, incorrect spelling, or faulty English. Organization of the flow of ideas and integration of the components for logic and clarity are essential.

Each report should be a collaborative effort involving ALL members of the laboratory group. One copy of each report is to be submitted at the appropriate time, i.e. before starting work on the experiment for a given day. If the group decides to start work before the report is submitted the grade received on the report will be half of the graded value. If the report is not handed in by 5 PM on the following day, NO CREDIT will be given to the students for the report. Each report should be typed and should include a title page. The title page should contain the title of the report, the authors' names, group number, day of the lab, the name of the person to whom the report is being submitted and the date.

### Proposal (10 points.)

The proposal is due BEFORE work is started in the second laboratory class of each experimental cycle. The proposal should include:

- Title page
- Experimental objectives
- Updated experimental runs w/ variable settings
- Experimental time tables
- Sample data sheets
- Expected trends and outcomes
- Literature cited

### Data Report (15 points)

The data report is due BEFORE the third laboratory class in each experimental cycle. The data report should include:

- Title page
- Preliminary results
- Preliminary calculations
- Copies of signed experimental data sheets
- Assumptions
- Literature cited

### Final Report (75 points)

The final report is due one week after the final class period of the laboratory cycle. The final report should include:

- Title page
- Abstract
- Table of contents
- Introduction
- Results
- Discussion
- Conclusion and recommendations
- Literature cited
- Appendices

Below is a suggestion as to what information should be included in each section of the final report.

### Abstract

This section, which should be written after the main body of the report has been completed, presents the essentials of the report in a highly condensed form, including major results. Quantitative information is essential, but it is better not to include equations. The summary must be able to stand alone, without reference to other sections of the report; it should not exceed 250 words.

### Table of Contents

This section contains three sections.

1. List of Headings: The major headings should be listed with the accompanying page numbers.
2. List of Figures: Figure numbers, figure titles, and the respective page numbers must be given.
3. List of Tables: Table numbers, table titles and the respective page numbers must be given.

### Introduction

This section should define the problem. It should include relevant theory and background information based on literature sources.

### Procedure

State the variables that were measured and the instrument used. Indicate what ranges of independent variables were studied. One primary purpose of this section is to provide sufficient information so that the reader could repeat the experimental work in the same manner as in the original investigation. Be sure to state what was done, not what might, could or should have been done. Do not copy the laboratory manual. Using lists in this section often enhances clarity and conciseness.

## Results

The final results of the experiment (as oppose to raw data) are presented in this section. The final results may be presented in tables and figures. Note that graphical presentations are superior to tables. In general, it is unnecessary to present the same information in both tables and graphs. The results section must have a text part that tells the reader what to see or notice in the tables and graphs. The text part is also used to identify the assumptions used in the experiment. Frequently, reduction of raw data yields values for parameters that are not of primary interest. Such intermediate results along with a sample calculation should be tabulated in an appendix. In some experiments, it will be possible to predict the results from information contained in literature. In such cases, the predicted results should be presented in such a way that they can readily be compared with experimental results. Sources of error should be stated and the reliability of the measurements should be evaluated, statistically if possible. Remember (do not necessarily restate) your objectives when discussing the significance of your findings. Use present tense only.

For figures and tables use the following guidelines:

### Figures:

1. Each figure must be on a separate page, and have a number and descriptive title appearing at the bottom.
2. On graphs, axes should be clearly labeled, e.g. temperature(C), and the data points clearly indicated. Clearly identify the data points with a legend of symbols on the graph. If necessary, regression data should appear on the graph.
3. Titles should help to transmit important information; do not use titles such as "Flow Rate vs. Height".

### Tables:

1. Each table must have a number and descriptive title must appear at the top of each table.
2. Units of variables should be clearly indicated.

## Discussion

This is the apex of the report. The meaning, significance, and the validity of the results should be discussed. The trends in the data should be represented graphically. Special emphasis should be given to comparing the experimental and predicted results (where available), and to suggesting reasons for marked discrepancies between them. In this section answer the discussion questions from the handout.

## Conclusions and Recommendations

This section contains, all the significant information obtained as a result of the investigation and recommendations for modifications to the experimental technique aimed at improving accuracy and ease of operation.

## Literature Cited

Citations must include author, title, date and pages. Citations in the text should include the authors name and date. Citations should be listed on a separate sheet in alphabetical order according to the author.