



MATERIAL ENGINEERING DEPARTMENT

MSE 302

MATERIALS PROCESSING LABORATORY II



2016-2017
Spring Term

LABORATORY SCHEDULE

WEEK	EXPERIMENT NAME
1	INTRODUCTION TO LABORATORY <ul style="list-style-type: none"> • General safety, materials-chemicals safety, • Laboratory safety rules, • Laboratory excursion
2	No lab
3-4	DRY PRESSING <ul style="list-style-type: none"> • Pressing at various pressures, • Using powder with-without binder • Sintering • Density measurement • Metallography • Characterization (hardness and microstructure)
5-7	POWDER SYNTHESIS BY CHEMICAL METHOD & XRD CHARACTERIZATION <ul style="list-style-type: none"> • Precipitation (Measure pH) • Evaporation (Measure temperature) • Characterization (Microscopy) • Phase analysis
8	Mid-Term/no lab (Tentative)
9 (class)-10 and 11	RHEOLOGY OF SUSPENSIONS <ul style="list-style-type: none"> • Sedimentation as a function of pH and dispersant • Sedimentation as a function of time • Viscosity measurement
12	SLIP CASTING <ul style="list-style-type: none"> • Casting slurry with and without binder • Sintering
13	TAPE CASTING <ul style="list-style-type: none"> • Casting and lamination • Burn-out and sintering
14	CHARACTERIZATION OF SLIP-CAST AND TAPE-CAST SAMPLES <ul style="list-style-type: none"> • Shrinkage • Density measurement • Hardness measurement

GENERAL INSTRUCTIONS

1. It is **extremely important** that you read each experiment and basic references prior to the lab. The lab instructor will ask general questions during the lab to test your understanding of the subject of the lab.
2. You will use this flyer as laboratory notebook and you must take notes (the procedure of the experiment, important parameters, calculations, data, results and discussions) onto this flyer. **You should deliver your flyer to the instructors for grading at the determined date.**
3. **You are responsible to prepare only one formal report. Each group will prepare the report for a different experiment that will be determined by the instructors.** The grading for the report will be; 30% format, 30% experimental procedure, 20% results & discussions and 20% conclusions.
The report should be typed and consist of:
 - i. A **Title page**
 - ii. An **Abstract** that summarizes the aims and results of the experiment
 - iii. A **Table of Contents**
 - iv. An **Introduction** that briefly introduces the concept of the experiment clearly states the aims of the experiment.
 - v. An **Experimental Procedure** section that carefully summarizes the methods you used, the material(s) you studied and the apparatus you used. Figures are often used here to show experimental arrangements, etc. Did you face any problems performing an experiment? How were they overcome?
 - vi. A **Results & Discussions** section. Present your data. Again try to think of graphical plots and tables to show your data and to illustrate important points, trends, etc. Which calculations were used? Interpretation of your data.
 - vii. **Conclusions**-A brief synopsis of your results. Make sure they are not too speculative.
 - viii. **References** (TUBITAK Style, complete citation)
 - ix. **Appendix**-raw data, calculations, etc., i.e., items that may be of interest, but not always necessary (usually make reading report difficult).
4. Students must attend each lab on the specified date. Lab reports must be submitted on time, otherwise ten percent for each day late will be deducted from the mark.
5. Some of the data from the experiments will be exchanged between groups. Therefore, it is essential that each group record their own data The data from all groups should then be transferred to the tables provided in the lab manuals of each student.

SUBMISSION OF THE REPORTS

EXPERIMENT #	REPORT SUBMISSION
1	March 21, 2017
2	April 4, 2017
3	May 9, 2017
4	May 16, 2017
5	May 23, 2017
Formal Report	May 30, 2017

EXPERIMENT #1 DRY PRESSING

AIM OF THE EXPERIMENT; to learn one of basic shaping method of ceramic, investigate the critical parameters (binder amount, pressing pressure, etc.) during pressing step and observe the effect of these parameters on final properties of ceramics (firing shrinkage, bulk density, apparent porosity, etc.).

MATERIALS AND EQUIPMENT WILL BE USED;

- Three types of alumina powder (with/without binder) ($\rho_{\text{Al}_2\text{O}_3} = 3.96 \text{ g/cm}^3$),
- Uniaxial press, steel die,
- Precision balance, caliper,
- Spatula, soft tissue.

EXPERIMENTAL PROCEDURE;

STEP 1: Weigh 0.5 g Al_2O_3 powder and fill the die with the powder and place it to the press.

STEP 2: Compact the powder up to 50 (Group A), 100 (Group B), 150 MPa (Group C) and 200 MPa (Group D). Press strokes in ton so you must convert MPa to ton, diameter of the die is 10 mm. For every pressure value, press two samples from powder with binder and two samples from powder without binder.

Necessary load for applying desired pressure value;

STEP 3: Eject the samples from the die and **clean die thoroughly with ethanol and tissue. Make sure that die is clean exactly before the next usage.**

STEP 4: Measure the diameter and height of the green samples by caliper. Weigh all the samples. And calculate green density values.

Green density values;

STEP 5: Place the samples to Al₂O₃ crucible and put it to the furnace. Sinter samples at 1540°C for 1 h. by applying a heating rate 5°C/min.

STEP 6: Measure the diameter and height of the fired samples. Measure the bulk density of all samples via Archimedes' displacement method. Calculate firing shrinkage, weight loss and bulk density values of the samples.
Firing shrinkage, weight loss and bulk density values;

STEP 7: Choose one sample from each of the Al₂O₃ powder. Mount, grind and polish the sample. Measure the hardness values.

STEP 8: Grind and polish the other samples by using sample holder. Etch them via thermal way at 1490°C for 30 min. Measure the grain size from the optical microscopy images and calculate the average grain size of the all samples by using at least 20 grains. Compare all the results with the other groups.

RESULTS;

Table 1. Properties of the samples

Property	SAMPLE															
	Group A				Group B				Group C				Group D			
	w/binder		w/o binder		w/binder		w/o binder		w/binder		w/o binder		w/binder		w/o binder	
Green density (g/cm ³)																
Weight loss (%)																
Firing shrinkage (%)																

Bulk density (g/cm ³)																
Relative density (%)																
Average grain size (μm)																

DISCUSSIONS;

The groups should exchange the results and then;

- Discuss the effect of pressure on the properties of the samples,
- Are the experimental results compatible with the literature? Explain in detail,
- Make comments in general.

