**SYLLABUS**

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| COURSE: | DENF 2671 Biomaterials II: Indirect Restorative Materials |
| SEMESTER: | Fall |
| CREDIT HOURS: | 0.5 |
| REVISED: | 2006 |
| REPRINTED: | 2009 |
| COURSE DIRECTOR: | Rade Paravina, D.D.S., Ph.D. |

## GOAL

In this lecture course, you will learn about the materials and techniques used to fabricate indirect restorations. Indirect restorations are fabricated in the laboratory and then inserted in the mouth. When this course is completed, you will be able to describe the use, composition, properties, and manipulation of the materials used to fabricate indirect metallic and non-metallic restorations.

Specifically, you will learn about composition and properties of alginate impression materials; elastomeric impression materials; gypsum materials; casting investments; noble metal casting alloys; crown and bridge cements; and athletic mouth protectors.

OBJECTIVES

I. COMPOSITION, PROPERTIES AND MANIPULATION OF ALGINATE IMPRESSION MATERIALS

1. Describe the two functions of dental impression materials.

2. Identify desirable qualities of an impression material.

3. Describe:

   3.1 the uses of alginate hydrocolloids
   3.2 why alginates are not used for crown and bridge impressions

4. Describe the chemistry of alginate hydrocolloid. Include:

   4.1 definition of sol phase
   4.2 definition of gel phase
   4.3 definition of irreversible gelation
   4.4 cause (chemical) and effect of syneresis
   4.5 cause and effect of imbibition
   4.6 reactive components in the powder and their function
   4.7 acceleration or retardation of setting reaction
   4.8 modification of powder to reduce dust

5. Describe the properties of alginate hydrocolloid and cite typical behavior. Include:

   5.1 working time
   5.2 setting time
   5.3 permanent deformation
   5.4 flexibility
   5.5 tear strength
   5.6 dimensional stability
   5.7 properties described in ANSI/ADA Specification No. 18

6. Describe the manipulation of alginate hydrocolloid. Include:

   6.1 technique for proportioning (water/powder ratio)
   6.2 mixing technique
   6.3 technique for loading the tray
   6.4 technique for placing the tray in the mouth
   6.5 technique for removing the tray
   6.6 preparing the impression for a gypsum model
   6.7 technique for storage of the impression
   6.8 technique for disinfection of the impression

7. Describe the effects of incorrect manipulation of alginate hydrocolloid on its properties. Include:

   7.1 incorrect water/powder ratio
   7.2 undermixing
   7.3 overmixing
   7.4 wiggling the impression during removal

7.5 storing the impression in air or water

II. COMPOSITION, PROPERTIES AND MANIPULATION OF ELASTOMERIC IMPRESSION MATERIALS

1. Describe the four major types of elastomeric impression materials (addition silicone, polyether, polysulfide, and condensation silicone). Include:

   1.1 various chemical and common names
   1.2 consistencies available
   1.3 types of packaging
   1.4 technique for mixing of two-paste, liquid-paste and two-putty systems
   1.5 automatic mixing systems
   1.6 technique for storage of impressions
   1.7 techniques for disinfection of impressions

2. Describe single and double impression procedures.

3. Describe the chemistry of the four major types of rubber impression materials. Include:

   3.1 components and their function
   3.2 simplified setting reactions with by products, if any
   3.3 common and unique factors which affect the setting reactions
   3.4 clinical importance of by-products

4. Describe the setting properties of the four major types of rubber impression materials and cite typical behavior. Include:

   4.1 viscosity
   4.2 working and setting times
   4.3 dimensional change

5. Describe the properties of the four major types of rubber impression materials after setting and cite typical behavior. Include:

   5.1 recovery from deformation
   5.2 strain in compression
   5.3 flow (after setting)
   5.4 tear strength
   5.5 detail reproduction
   5.6 wettability
   5.7 effects of disinfection
   5.8 properties described in ANSI/ADA Specification No. 19

6. Describe the effects of incorrect manipulation of polysulfide impression materials on their permanent deformation. Include:

   6.1 improper proportions of base and catalyst
   6.2 not thoroughly mixing
   6.3 failure to use tray adhesive
   6.4 failure to seat impression quickly enough
   6.5 removing the impression from the mouth too early
   6.6 wrapping the impression tightly in paper during storage
   6.7 using a second pour
   6.8 allowing the impression to remain in the mouth longer than normal

7. Recognize inadequate elastomeric impressions based on trouble-shooting.

III. NOBLE METAL CASTING ALLOYS

1. Describe the ideal properties of noble metal casting alloys.

2. Describe the typical elements used to formulate noble metal casting alloys.

3. Define carat and fineness and describe the use of each in dentistry.

4. List the types of dental high noble alloys in ANSI/ADA Specification No. 5 and describe the uses of each in dentistry.

5. Describe the important physical and mechanical properties of noble metal casting alloys.

   5.1 melting range
   5.2 density
   5.3 strength
   5.4 hardness
   5.5 elongation

IV. GYPSUM MATERIALS

1. List the five types and uses of gypsum products in dentistry.

2. Describe the major types of gypsum products (dental plaster; stone; low-expansion, high-strength stone; and high-expansion, high-strength stone). Include:

   2.1 chemical formula of each type
   2.2 shape and porosity of each powder
   2.3 modifying chemicals that may be present

3. Describe the chemistry of setting of the major types of gypsum products. Include:

   3.1 chemical reaction of calcium sulfate hemihydrate with water
   3.2 amount of water needed to react chemically with 100 g of each type
   3.3 amount of water required to mix 100 g of each type
   3.4 effects of using incorrect amount of water
   3.5 mechanism of setting involving dissolution and precipitation centers and growth of crystals
   3.6 comparison of volumetric and linear changes on setting

4. Describe and compare the properties of the major types of gypsum products and cite typical behavior. Include:

   4.1 working and setting times
   4.2 compressive strength
   4.3 surface hardness and abrasion resistance
   4.4 reproduction of detail
   4.5 setting expansion
   4.6 properties described in ANSI/ADA Specification No. 25

5. Describe the effects of manipulative variables on the setting of the major types of gypsum products. Include:

   5.1 spatulation

5.2 temperature of water
5.3 humidity of powder during storage
5.4 colloidal systems (blood, saliva)

6. Describe the manipulation of the major types of gypsum products. Include:

6.1 technique for dispensing water and powder
6.2 technique for mixing by hand
6.3 technique for mixing with a power-driven vacuum mixer
6.4 technique for pouring the impression
6.5 time required for hardening

7. Describe the effects of manipulative variables on the properties of the major types of gypsum products. Include:

7.1 water/powder ratio
7.2 hand mixing versus power-driven vacuum mixing
7.3 use of accelerators (NaCl or 4% $K_2SO_4$) or retarders
7.4 use of hardening solutions
7.5 use of surfactants
7.6 use of vibration during pouring the model
7.7 immersion in water during setting

V. CASTING INVESTMENTS

1. Define a casting investment.

2. List the properties required of an "ideal" casting investment material.

3. List the three basic components of casting investment materials.

4. List the three types of refractory materials used in casting investments.

5. State the purpose of binder materials used in casting investments, and list the three types used.

6. State the typical composition of calcium sulfate-bonded investments, including percentages of each component.

7. Explain why calcium sulfate-bonded casting investments cannot be used for burnout temperatures exceeding 700 °C (1300 °F), and what types of alloys should not be used with these investment materials as a result.

8. List the physical properties of casting investments described in the Revised ANSI/ADA Specification No. 2.

9. Compare the expansion of the three types of silica refractory materials over the temperature range 370-700 °C and explain how this helps compensate for casting shrinkage.

10. Describe what occurs to water mixed with calcium sulfate-bonded investment during the investing process and during the heating process.

11. Describe what dimensional changes occur to calcium sulfate-bonded investments due to thermal changes, and problems these changes could cause in casting. Include temperature ranges:

11.1 heating from room temperature to 700 °C
11.2 cooling back to room temperature
11.3 reheating to 700 °C

12. List and define the three types of dimensional change that occur in calcium sulfate-bonded investments.

13. Define and describe the effects of the following variables on setting/ hygroscopic expansion of calcium sulfate-bonded investments.

13.1 time of immersion
13.2 water/powder ratio
13.3 spatulation rate and spatulation time
13.4 water bath temperature
13.5 investment age
13.6 role of water

14. State the types of metals that require use of high-temperature investments.

15. Describe how high- temperature investments achieve expansion.

16. Describe the uses of soldering investment.

17. List two critical properties of soldering investments.

VI. CROWN AND BRIDGE CEMENTS

1. Zinc phosphate cement

1.1 state its uses
1.2 describe the composition of powder and liquid
1.3 describe its setting reaction and resultant microstructure
1.4 describe its manipulation (videotape #608)

2. Zinc polyacrylate cement

2.1 state its uses
2.2 describe the composition of powder and liquid
2.3 describe its setting reaction and resultant microstructure
2.4 describe its manipulation (videotape #606)

3. Zinc oxide-eugenol cement

3.1 state the types and their uses
3.2 describe the composition of powder and liquid
3.3 describe the setting reaction and resultant microstructure
3.4 describe the manipulation (videotape #605)

4. Glass ionomer cement

4.1 state its uses
4.2 describe the composition of powder and liquid
4.3 describe its setting reaction and resultant microstructure
4.4 describe its manipulation (videotape #605)

5. Hybrid ionomer cement

5.1 state its uses
5.2 describe the composition of powder and liquid
5.3 describe its setting reaction and resultant microstructure
5.4 describe its manipulation

6. Compare and rank the following properties of crown and bridge cements and state their clinical significance:

6.1 working and setting times
6.2 film thickness
6.3 solubility in the mouth
6.4 compressive strength
6.5 modulus of elasticity
6.6 bonding to tooth structure
6.7 bonding to restorative materials (alloys, ceramics, composites)
6.8 biologic response (toxicity to the pulp)
6.9 fluoride release and its effects
6.10 properties described in ANSI/ADA Specification Nos. 30 and 96

VII. ATHLETIC MOUTH PROTECTORS

1. Indicate sports for which athletic mouth protectors are routinely used.

2. List the three types of mouth protectors.

3. Describe important physical and mechanical properties of mouth protectors.

4. Describe the five steps in the fabrication of a custom mouth protector.

5. List the main advantages of a custom mouth protector.

6. Describe five recommendations for the care of a mouth protector.

RESOURCES

I. Media Resources

A. Printed media

1. Required textbook

Powers, J.M., and Sakaguchi R.L., eds.
*Restorative Dental Materials*, 12th ed.
Mosby, 2006

| | |
|---|---|
| Chapter 8, | pp. 179-182 - Athletic Mouth Protectors |
| Chapter 12, | pp. 270-303 - Impression Materials |
| Chapter 12, | pp. 303-308 - Die Materials |
| Chapter 13, | pp. 314-332 - Gypsum Products & Investments |
| Chapter 15, | pp. 360-383 - Noble Dental alloys |
| Chapter 17, | pp. – Casting and Soldering Procedures |
| Chapter 20, | pp. 480-507 - Cements |

2. BlackboardCourseInfo
http//:blackboard.uth.tmc.edu

II. Human Resources

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STUDY PLAN AND REQUIREMENTS

The following study plan for this course is recommended:

1. Read the assignments in the textbook before attending the lecture.

2. Be sure to review the "Selected Problems" at the end of each chapter in the textbook.

3. You are responsible for the material in the reading assignments and the oral and written information (handouts) presented at the lectures. Changes in the course schedule and content are sometimes necessary. The handouts and slides can be viewed and copied in Blackboard.

4. Each student will be required to critically analyze a dental product ad as an assignment as described below.

**Assignment: Critique of Advertisement in Dental Magazine**
(20% of course grade)

*Instructions*:

Find an advertisement about an impression material, gypsum material, dental alloy, or crown & bridge cement in a recent dental magazine or journal. Write a critique of that ad mentioning two concerns you have about claims made in the ad. Justify your concerns by submitting a brief statement taken from a textbook or journal article. Submit your written critique along with a copy of the ad.

Date Due: refer to schedule

**DENF 2671 INDIRECT RESTORATIVE MATERIALS**
**2009 Fall Semester Schedule**

Wednesdays, August 19 – October 21
Session time: 9-9:50 am; Room 132
**Final Exam: November 4**

| DATE | SESSION TOPICS | READING ASSIGNMENTS |
|---|---|---|
| Aug 19 | Introduction, Alginate - Composition & Properties (SL) | pp. 270-283 |
| Aug 26 | Elastomeric Impression Materials – Types & Composition (RDP) | pp. 283-399 |
| Sep 2 | Elastomeric Impression Materials - Properties and Manipulation (RDP) | |
| Sep 9 | Noble Metal Casting Alloys (GNF) | pp. 360-383 |
| Sep 16 | **MID-TERM EXAM** **Room 207** | |
| Sep 23 | Gypsum and Die Materials – Composition (GNF) | pp. 303-308, 314-332 |
| Sep 30 | Casting Investments - Types, Composition, Properties, Manipulation (GNF) | pp. 412-441 |
| Oct 7 | Athletic Mouth Protectors (SL) | pp. 179-182 |
| Oct 14 | Crown and Bridge Cements (SL) | pp. 480-507 |
| Oct 21 | Review Session (RDP)<br>**Critique Assignment Due**<br>***Course Evaluation*** | |
| Oct 28 | *No class* | |
| **Nov 4** | **FINAL EXAM** **Room 207** | |

## EVALUATION METHODS

The mid-term exam will consist of 20 multiple-choice questions. The mid-term exam will cover the material presented and will be worth 30% of the course grade.

The final exam will consist of 40 multiple-choice questions. The final exam will cover the material presented in the entire course and will be worth 50% of the course grade.

The critique assignment will be worth 20% of the course grade.