IMPRESSION MATERIALS

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PROBLEM ANALYSIS

What are tolerable limits for "error" in indirect procedures?

a.	Impressions	= +/- 0
b.	Casts, Dies	= +/- 0
c.	Waxing	= +/- 0
d.	Investing	= **+ 1.5%**
e.	Casting	= **– 1.5%**
f.	Finishing, Polishing	= +/- 0
g.	Cementation	= +/- 0

Prepped Tooth Width ← 8 mm (=8,000 μm)

8,000 μm x 0.5% = 40 μm = 20 μm/side
Typical clinical error = >100 μm/side

DIGITAL IMPRESSIONS

How much longer will we use regular impression materials?

CONVENTIONAL			DIGITAL
a. Impressions	+/- 0	a.	Digital Impression
b. Casts, Dies	+/- 0	b.	Digital Replica
c. Waxing	+/- 0	c.	Oversized Digital Design
d. Investing	**+ 1.5%**	d.	(Eliminated)
e. Casting	**– 1.5%**	e.	Digital Fabrication
f. Finishing, Polishing	+/- 0	f.	Finishing, Polishing
g. Cementation	+/- 0	g.	Cementation

CLASSIFICATION SYSTEM

Based on properties of set materials.

		Properties:	*Reaction:*	*Set:*
Rigid:				
1.	Impression Plaster	Rigid	Irrev	(Chem)
2.	Impression Compound	Rigid	Rev	(Phys)
3.	Zinc Oxide/ Eugenol	Rigid	Irrev	(Chem)
Water-Based Gel:				
4.	Alginate (Irreversible Hydrocolloid)	Flexible	Irrev	(Chem)
5.	Agar-Agar (Reversible Hydrocolloid)	Flexible	Rev	(Phys)
Elastomers (and their HYBRIDS):				
6.	Polysulfide (Rubber Base, Thiokol)	Flexible	Irrev	(Chem)
7.	Silicone (Conventional, Condensation)	Flexible	Irrev	(Chem)
8.	Polyether	Flexible	Irrev	(Chem)
9.	Polyvinyl Siloxane (Addition Silicone)	Flexible	Irrev	(Chem)

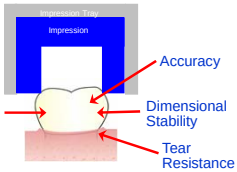
KEY PROPERTIES

3 major concerns.

a. Accuracy = ability to replicate the intraoral surface details. (Low contact angle (wetting) and flow produce adaptation.)

b. Dimensional Stability = ability to retain its absolute dimensional size over time.

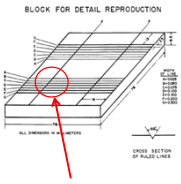
c. Tear Resistance = ability to resist tearing in thin sections (such as through the feather-edged material within the gingival sulcus.



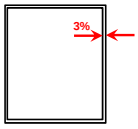
HOW DO YOU RUN THE TESTS?

Tests for accuracy, dimensional stability, and tear resistance?

Accuracy



Dimensional Stability



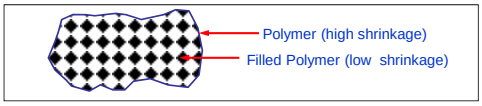
Tear Resistance

http://www.youtube.com/watch?v=g7FDEMJSjmQ

GENERAL FORMULATION

Elastic impression materials.

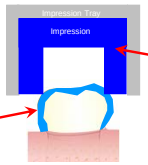
1. Flexible Matrix (Continuous Phase):
   a. Multifunctional Pre-Polymer or Polymer
   b. Crosslinking Agent
   c. Curing Agent (Catalyst or Initiator)
   d. Modifiers (Accelerators, Retarders, Plasticizers, Flavoring Agents, Colorants)
   e. Wetting and flow aids.
2. Filler or Extender (Dispersed Phase):



SHRINKAGE MANAGEMENT

Elastomeric impressions.

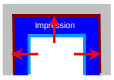
Use 2-step techniques:
(a) Light-Heavy Body, OR
(b) Wash-Putty



Load tray with heavy-bodied IM

Cover prep with light-bodied IM from syringe

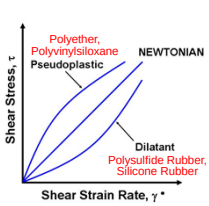
During setting shrinkage, distortion of impression is toward tray.



Dies tend to be oversize and so the casting is oversize.

MIXING AND DELIVERY

Elastomeric impressions.

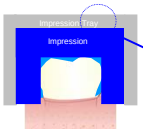


Mixing Options:
- 2 Pastes on Mixing Pad
- 2 Pastes in Mixing Gun
- 2 Pastes in Mixing Machine

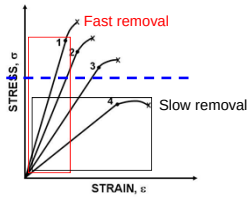
DISTORTION

Distortion during tray removal.

Strain rate sensitive elastomers !

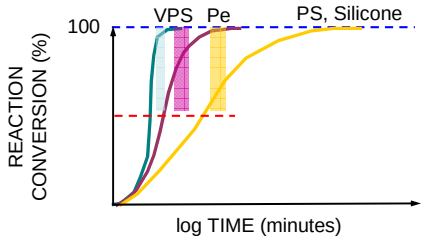


VERY FAST (SNAP)



IMPRESSION MATERIALS

Distortion related to setting reaction.

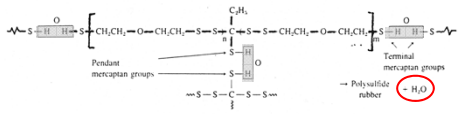


POLYSULFIDE RUBBER

Chemistry and setting reaction.

CONTINUOUS PHASE:
Polymer = Mercaptan Functional Polysulfide
Crosslinking Agent = Sulfur and/or Lead Peroxide
Catalysts = PbO2 or Copper Hydroxides (Type I)
Zinc Peroxide or
Organic Hydroperoxide (Type II)

DISPERSED PHASE:
Fillers = TiO2 or Zinc Sulfate or
Lithopone or Calcium Sulfate Dihydrate



SETTING REACTION:
Stepwise (relatively slow), Exothermic, Affected by temperature

POLYSULFIDE RUBBER

Manipulation and technique considerations.

a. Two-step techniques recommended: Reduces a
surface tension effects.
b. Material adversely affected by H_2O, saliva, and b
c.* Set impression should be removed quickly - do r
d. No syneresis or imbibition, but distortion due to c
e. Ideally need uniform thickness and at least 2 mm
(1) Adhesive must be thin
(2) Adhesive must be dry
f. Paste-Paste Mixing Recommendations:
(1) Dispense pastes at the top of the mixing pad
(2) Mix pastes with tip of spatula only for 5 seconds
(3) Transfer mass to fresh surface at center of mixing pad
(4) Wipe spatula off with paper towel; Strop mass for 15s to constant color
(5) Load syringe or tray
(6) Use pad excess to monitor setting time
g. *Pouring of models:*

SILICONE RUBBER

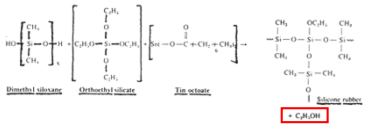
Chemistry and setting reaction.

CONTINUOUS PHASE:

Polymer	= Polydimethyl Siloxane
Crosslinking Agent	= Alkyl Orthosilicate or Organo H-Silane
Catalysts	= Organo Tin Compounds (e.g., tin octoate) (but not dibutyl tin dilaurate)
Modifiers	= Colorants, Flavorants

DISPERSED PHASE:

Fillers	= Silica



SETTING REACTION:
Stepwise (relatively slow), Exothermic, Affected by temperature
H_2O by-products

SILICONE RUBBER

Manipulation and technique considerations.

a. Limited shelf-life: Unstable in tubes.
b. Requires mechanical retention or special tray adhesives
c. No syneresis or imbibition, but continued polymerization shrinkage.
d. Better dimensional stability than RHC but more expensive
e. Pouring of models:
(1) More flexible so more chance for distortion during removal
(2) Wait 20-30 minutes before pour for stress relaxation to occur

POLYETHER RUBBER

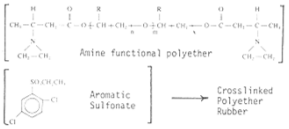
Chemistry and setting reactions.

CONTINUOUS PHASE:

Polymer	= Amine-terminated Polyether
Crosslinking Agent	= Aromatic Sulfonate
Catalysts	=
Modifiers	= Colorants, Glycol Plasticizers, Flavorants

DISPERSED PHASE:

Fillers	= Silica

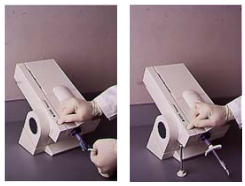


SETTING REACTION:
Stepwise (relatively slow), Exothermic, Affected by temperature

POLYETHER RUBBER

Manipulation and technique considerations.

a. Excellent impression accuracy and dimensional stability.
b. Stiff and therefore difficult to remove without rocking.
c. Break seal and rock slightly to prevent tearing: Low tear resistance.
d. Negatively affected by H_2O, saliva, and blood.
(1) Since hydrophobic, moisture increases marginal discrepancy
(2) Increased water absorption occurs if use thinning agents
e. Can be dispensed from automated extruder and mixer (ESPE PentaMix)



POLYVINYL SILOXANE

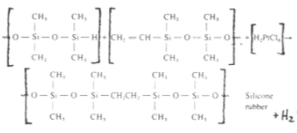
Chemistry and setting reactions.

CONTINUOUS PHASE:

Polymer	= Double-bond-functional Silicone Polymer
Crosslinking Agent	= Chloroplatinic Acid
Catalysts	=
Modifiers	= Colorants, Flavorants, Plasticizers

DISPERSED PHASE:

Fillers	= Silica



SETTING REACTION:
Chain (very fast), Exothermic, Affected by temperature
Hydrogen gas released by decomposition of crosslinking agent.

POLVINYLSILOXANE

Manipulation and technique considerations.

a. BEST impression material for dimensional stability:
   Pouring should be delayed at least 4 hours for H_2 out-gassing.
   Pouring can be delayed up to 7-to-10 days (or indefinitely).
b. Stiffness makes removal difficult.
c. Most material dispensed using auto-mixing gun and mixing tips

COMMERCIAL PRODUCTS

1980-1995

Manufacturer:	*Polysulfide:*	*Conv. Silicone*	*Polyether:*	*Polyvinyl Siloxane (PVS)*
Bayer		Zantorpren + Optisil		
Bisco				
Bosworth	Super Rubber	Silene, Plastosil		
Buffalo Dental	Static X	Input		
Cadco	Image			
Caulk Dentsply	Rubbergel		Polyjel-F,	Reprosil-H, Hydrosil, Regisil-2X
Coe Laboratories	OmniFlex, Coe-Flex	Accoe		
Columbus Dental		Columbus System		
Coltene-Whaledent		Coltokit, Coltex, Coltoflex, Rapid		President
Davis		Verone		
Denmat				
DMG Hamburg				
ESPE-Premier			Impregum-F, Permadyne.	Permagum, Zylox
Flexico		Silflex		
Flexiplast Inc		AccoFlex		
FW Wright	Elite	Calendonian		
GC Chemical	Surflex	Flexicon		ExaFlex-H, ExaMix-H
Getz Dental		Silc		
Healthco	Healthco			
Ivoclar-Vivadent				
Keitenbach		Lastic 55		
Kerr -Sybron	Permlastic, Unilastic	Citricon, Elasticon, Traycon		Reflect, Extrude, Stat-BR
Hereaus-Kulzer				
Lactona	Neoplex			
Miles Dental Labs	NeoFlex			
3M-ESPE			Imprint	Express-H
NuDent	Formtex			
Parkell				
Royce Dental	Neogalt			
Pfingst and Co		Siccoform		
SS White	Mim			
Sterndent		Sir		
Surgident		Neo-Sil		
Toshiba		Tosicon		
UniTek		Delicron		

Predominantly POLYSULFIDE and SILICONE elastomers before 1995.

COMMERCIAL PRODUCTS

1996-2004

Manufacturer:	*Polysulfide:*	*Conv. Silicone*	*Polyether:*	*Polyvinyl Siloxane (PVS)*
Bisco				Twinz VPS
Denmat				1st Impression-VPS
Dentsply			Polyjel NF	Aquasil Ultra, Hydrosil, Regisil, Reprosil
DMG Hamburg				Honigum, Status-Blue, Silagum
GC America				ExaFast, ExaMix, ExaBite, ExaJet, ExaFlex+ExaMix
Ivoclar-Vivadent				Virtual VPS
Kerr (Sybron)	Permlastic			Stand-Out, Fill-In, Take-1, Extrude
Hereaus-Kulzer			P2, Xantopren/OptiSil	CutterSil, FlexTime, MemoSil, MemoReg
3M-ESPE			Impregum, Permadyne, Ramitec	Dimension (Garant, Penta), Express, Imprint
Parkell				Blue Mousse, Cinch, Quick Cinch, Green Mousse, Mach-2, Mach-Slo, MucoSoft

Predominantly POLYETHER and PVS elastomers after 1996.

IMPRESSION MATERIALS

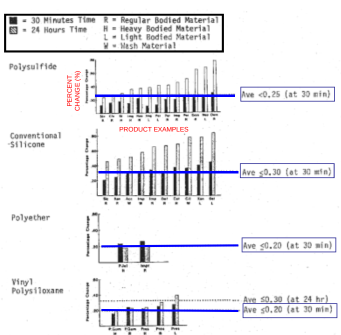
Comparison of key properties

Poor >---------------------------------> Good

1. Accuracy (Reproduction of Detail):
   a. Wetting of Tissues: ALG < SIL, PS < PE <= RHC, PVS
   b. Wetting by Dental Stone: SIL, PVS < PS < PE <= ALG, RHC
2. Dimensional Stability: ALG <= RHC < PS, SIL < PE, PVS
   (Resistance to Distortion):
   a. Polymerization Shrinkage
   b. Thermal Shrinkage
   c. Loss of Components
   d. Stress Relaxation
3. Tear Resistance (Elasticity): ALG, RHC, PE < PVS, SIL < PS
   a. Elastic Deformation
   b. Strain Rate Sensitivity

DIMENSIONAL STABILITY

Comparison of products.



QUICK REVIEW

Review of uniaxial analysis, normalization, and stress-strain.

- **Which indirect procedural step involves the greatest shrinkage?**
  COOLING OF A CAST ALLOY
- **What are the 3 major categories of all impression materials?**
  RIGID; WATER-BASED; ELASTOMERS
- **What are the 4 types of ELASTOMERIC impression materials?**
  POLYSULFIDE, SILICONE, POLYETHER, VINYL POLYSILOXANE
- **What are the 3 most important PROPERTIES?**
  ACCURACY, DIMENSIONAL STABILITY, TEAR RESISTANCE
- **What are the major categories of COMPONENTS?**
  PRE-POLYMER, CROSSLINKING AGENT, CURING AGENT, MODIFIER, WETTING/FLOW AIDS.
- **During shrinkage, in what direction does distortion occur?**
  TOWARD THE TRAY.

QUICK REVIEW

Review of uniaxial analysis, normalization, and stress-strain.

- **What TERM describes materials that flow better under stress?**
  PSEUDOPLASTIC
- **What TERM describes effects of distortion time on properties?**
  STRAIN RATE SENSITIVITY
- **What type of setting reaction does POLYETHER undergo?**
  STEPWISE POLYMERIZATION
- **What type of setting reaction does PVS undergo?**
  CHAIN REACTION POLYMERIZATION
- **Which impression material has the best OVERALL properties?**
  PVS.
- **Which impression material is the most ACCURATE?**
  POLYETHER.

THANK YOU