Question #69182, Chemistry / General Chemistry

In formulating an acrylic denture base resin, what measures must be taken in order to ensure that sufficiently high average chain length, together with increased stress cracking resistance, can be achieved within a commercially reasonable cure time?

Answer

1. 1. DENTURE BASE RESINS
2. 2. DENTURE BASE• Denture :- they are prosthetic device constructed to replace the missing teeth which are supported by surrounding hard & soft tissues• Two types of denture:• COMPLETE DENTURE• REMOVBLE PARTIAL DENTURE• DENTURE BASE -fabricated using common polymer
3. 3. • Commonly used denture polymers:¬ Individual processing system¬ Polymerization technique
4. 4. GENERAL TECHNIQUE1. Fabrication of accurate impression of the associated arch2. Dental arch generated3. Record base is fabricated on the cast4. Wax added to record base & teeth is positioned in wax5. Denture flask –tooth arrangement is encased in investing medium6. Denture flask is opened & wax is eliminated7. After through cleansing –a resin denture base material is introduced into the mold cavity denture base resin is polymerized8. Denture is recovered &prepared for insertion
5. 5. ACRYLIC RESINS• Denture base fabricated with POLY (METHYL METHACRYLATE) resins• Pure PMMA –colorless ,transparent solid• Advantage PMMA as denture base material is the relative ease with which it an be processed .• PMMA supplied –powder& liquid system• powder-prepolymerized PMMA resin• Liquid-non polymerized methyl methacrylate• Liquid & powder mixed in a proper proportions- workable mass is formed .
6. 6. HEAT –ACTIVATED DENTURE BASE• Used in fabrication of all denture base• Thermal energy required for polymerization –water bath or microwave oven• COMPOSITION• PMMA –powder & liquid• Powder –prepolymerized spheres of PMMA & small amount of benzoyl peroxide(INITIATOR)• Liquid –predominantly non polymerized methyl methacrylate with small amount of hydroquinone(INHIBITOR)• Cross linking agent is added to liquid
7. 7. methylmeth crosslinked Glycol acrylate polymethyl dimethacrylate methacrylate STORAGE- generally recommended specific temparature & time limits for storage of heat activated denture base
8. 8. COMPRESSION MOLDING TECHNIQUEHeat activated denture base are shaped via compression molding 1) The master cast and the wax dentures are placed in the flask, to insure that the cast fit in the flask2.The Inner surface of the flask iscoated with Vaseline, while thebase of the cast is painted withseparating medium (cold moldseal). To prevent the investmentmaterial (plaster of Paris) fromattaching to the cast
9. 9. 3) The first layer of gypsuminvestment is poured in thelowerhalf and the cast is placed on topof the investment4) After the set of the first gypsuminvestment layer, a plasterseparating medium is painted onit, to prevent the sticking of thesecond layer of gypsuminvestment to the first layer.
10. 10. 5) A mix of dental stone is placed over the surface of the teeth in the invested trial denture , which is referred to as coring.6)The upper half of the flaskis put inplace, then the second mix ofgypsum investment is placedonthe first layer and covers thewax, denture base and teeth.
11. 11. 7) Before the second layer setsthe lidor flask cover is put in place andtapped to sit properly allowingthe excess gypsum to flow out ofthe holes in the lid.2- Wax

elimination:After the complete set of the gypsumthe flask is ready for the next stepwhich is "Waxelimination", in which the flask isplaced in boiling water for 4 to 6minutes. Then it isremoved from the water and opened.Then the wax is washed away withboiling water. Afterthat the mold is washed with boilingwater containing detergent, then finallywashing it withclean boiling water.

12. 12. 3- Mixing:Acrylic resin dough is made by mixing the powder (polymer) and liquid (monomer)to form dough which is packed into a gypsum mold for curing. The ratio of powderto liquid is important since it controls the workability of the mix as well as thedimensional changes on setting . The mixing should be done in a clean jar whichshould be covered to prevent evaporation of the monomer.:4- Packing:It should be done when the mixture reaches dough stage, as the dough is rolled into arod-like form and placed in the upper half of the flask then a polyethelen (nylon sheet) isplaced over the dough in the upper half and then the two halves of the flask are closed untilthey are almost in approximation, this is done to spread the dough evenly throughout themold. 5- Curing: It is polymerization of the hot cure acrylic to produce the final denture. The mater is cured by heating in a water bath; pressure is applied during curing reasons: 1- To decrease the effect of thermal expansion. 2- To decrease the polymerization shrinkage. 3- To increase the evaporation of monomer thus decreases porosity
13. 13. SELECTION & APPLICATION OFSEPARATING MEDIA• It must prevent direct contact between the denture base resin & mold surface• Failure to place appropriate separating medium leads to :• it may effect the polymerization rate as well as optical & physical properties of the denture base• Portions of the investing medium may become fused to denture base• Widely accepted method : thin sheet of tin foil ,painting –on separating media• Commonly used separating medium – water soluble alginate solutions
14. 14. POLYMER-MONOMER RATIO• Powder & liquid are mixed in proper proportions• Polymer monomer ratio – 3:1 by volume• Excess monomer – increase polymerization shrinkage
15. 15. POLYMER –MONOMER INTERACTION• When monomer &polymer are mixed in proper proportion –workable mass is formed• Workable mass result in 5 stages:I. SANDY-coarse or grainyII. STRINGY-stringiness or stickiness when material is touchedIII. DOUGHLIKE- ideal for compression moldingIV. RUBBERY or ELASTIC-mass rebounds when compressed or stretchedV. STIFF-resistant to mechanical deformation
16. 16. • DOUGH FORMING TIME• ADA specification- less than 40 min from start of mix• Working time• ADA specification – 5mins ,dough to remain moldable• Extended by refrigeration
17. 17. PACKING• The placement & adaptation of denture base resin within mold cavity is termed PACKING• OVERPACKING(placement of too much material)- excessive thickness & malpositioning of teeth• UNDERPACKING(use of too little material)- leads to denture base porosity
18. 18. • TO MINIMIZE OVERPAKING & UNDERPAKING:1. Performed in doughlike stage2. Rolled in ropelike form& bent in horseshoe shape3. Polyethylene sheet placed over the resin4. Designed pressed, until flask is closed5. Polyethylene sheet is removed6. Using gently rounded instrument , excess flash is removed
19. 19. INJECTION MOLDING TECHNIQUE1. Denture base fabricated by specially designed flask2. One half of flask is filled with freshly dental stone &master cast is settled in the stone3. Dental stone is allowed to set , sprues are attached to the wax denture base4. Wax elimination5. Flask is placed into a carrier6. After completion of these steps the resin is injected in the moldcavity7.Powder &liquid mixture is used ,resin is mixed &

introduced in roomTemparature8.Flask is placed in boiling water bath for polymerization of denture base resin(as it polymerizes additional resin is introduced into the mold cavity , this effects polymerization shrinkage)8. The denture is recovered , adjusted,finished ,polished

20. 20. ADVANTAGE: denture base fabricated by injection molding provide improved clinical accuracy
21. 21. POLYMERIZATION PROCEEDURE• Denture base resin generally contain benzoyl peroxide• When heated above 60 degree , molecules of benzoyl peroxide decompose to yield electrically neutral species containing unpaired electrons .These species are termed as FREE RADICALS• DECOMPOSITION of benzoyl peroxide molecules yields free radicals which initiate the chain growth,benzoyl peroxide is termed as initiator• Heat is termed as the activator• Denture base carrier heat applied to resin by immersing flask in a water bath
22. 22. TEMPARATURE RISE• Polymerization of denture base resin is exothermic• Resin occupies a position in centre of the mold->heat penetration takes longer time• Temp of resin exceeds the boiling point of monomer(100.8 C)• INTERNAL POROSITY• Boiling yields porosity within complete denture base• Heat is disipated ,surface tension of resin does not reach the boiling point of monomer ,because resin is a poor thermal conductor• Peak temp of this resin may rise above the boiling point of monomer, cause unreacted monomer• Unreacted monomer produce porosity within the processed denture
23. 23. POLYMERISATION VIA MICROWAVE• PMMA –using microwave energy• Formulated resin & non metallic flask is used• Conventional microwave oven –used to supply thermal energy• Advantage: polymerization is accomplished with speed
24. 24. CHEMICALLY ACTIVATED DENTURE BASE RESIN • Induce the denture base polymerisation • Does not require thermal energy, made in room temparature • chemically activated resins also referred-cold curing ,self curing or autopolymerizing resins • COMPOSITION • liquid(monomer) - Addition of tertiary amine like dimethyl-para-toluidine • Tertiary amines causes decomposition of benzoyl peroxide • Mold preparation &resin packing is same as heat activated resin
25. 25. DIFFERENCE BETWEEN HEATACTIVATED & CHEMICALLY ACTIVATED• Benzoyl peroxide is divided to yield free radical• Degree of polymerization is not as complete as heat activated• DISADVANTAGE:• The unreacted monomer cause 2 major difficulties:• It acts as plasticizer –decreased transverse strength of denture resin• Residual monomer serve as potential tissue irritant• ADVANTAGE:• Less shrinkage than heat activated resins-gives greater dimensional accuracy• Color stability is inferior to the color stability of heat activated resins• Working time is shorter than heat activated materials• Rate of polymerization process decreases- resin remains in dough stage for extended period , working time is increased
26. 26. FLUID RESIN TECHNIQUE• Pourable chemical activated resin• Resin is supplied in form of powder & liquid components• Very low viscosity resin• Completed tooth arrangement positioned in a fluid resin flask• Tooth arrangement is removed from irreversible hydrocolloid• Preparation of sprues and vents for resin• Repositioning of posterior teeth & master cast• Resin is poured into the mold cavity & allowed to polymerize• Flask is kept in pressureised chamber for 30 -45 mins• Recovery of complete denture prosthesisADVANTAGE:1. Improved adaptation to underlying soft tissue2. Decreased probability of damage to prosthetic teeth &denture bases during flasking3. Reduced material cost4. Simplification of flasking ,deflasking &finishing procedureDISADVANTAGE:1. Noticeable shifting of prosthetic teeth during processing2.

Air entrapment within the denture base material3. Poor bonding between the denture base material &acrylic resin teeth4. Technique sensitivity

27. 27. LIGHT ACTIVATED DENTURE BASE RESINS• Composite matrix of urethane dimethacrylate ,microfine silica ,&high molecular weight acrylic resin monomer• Activator –visible light• Initiator –camphorquinone• Supplied in sheet &rope form packed in light proof pouches• light activated resin cannot be flasked in conventional manner• Opaque investing media provides the passage of light• Teeth is arranged & the denture base sculpted using light activated resin• Denture base is placed into a light chamber &polymerized
28. **DENTURE BASE MATERIALS :**
29. **DENTURE BASE MATERIALS BOOKS TO BE REFFERED PHILLIPS SUBBARAO MANNAPALLI**
30.
31. **DENTURE BASE MATERIALS :**
32. **DENTURE BASE MATERIALS VULCANITE (1855)– Rubber with 32 % Sulphur & Metallic oxides. Advantages – It is nono-toxic, non-irritant, has excellent Mechanical properties material is sufficient hard to polish. Limitation – Absorbs saliva – becomes unhygiene, leads to bacterial growth & unpleasant odour Poor esthetics Dimensional changes Thermal expansion Contraction of 2-4% by volume during addition of sulphur to the rubber**
33.
34. **DENTURE BASE MATERIALS :**
35. **DENTURE BASE MATERIALS NITROCELLULOSE– Dimensionally unstable Contains unpleasant tasting plasticizers Excessive warpage High water absorption Poor colour stability**
36.
37. **DENTURE BASE MATERIALS :**
38. **DENTURE BASE MATERIALS PHENOL FORMALDEHYDE Becomes discoloured & unesthetic It is thermoset type – so it is difficult to repair PORCELAIN – This material is tolerated well, But it is difficult to fabricate Can be easily broken**
39.
40. **CLASSIFICATION OF DENTURE BASE MATERIALS :**
41. **CLASSIFICATION OF DENTURE BASE MATERIALS METALLIC Cobalt – Chromium Gold Alloys Aluminium Stainless Steel Titanium TEMPORARY Self-cure Acrylic resin Shellac Base Plate Hard Base Plate Wax NON-METALLIC Acrylic Resin Vinyl Resin PERMANENT Heat-cure Acrylic resin (1937) METALLIC**
42.
43. **CHEMISTRY OF SYNTHETIC RESINS :**
44. **CHEMISTRY OF SYNTHETIC RESINS**
45.
46. **CLASSIFICATION :**
47. **CLASSIFICATION Synthetic Resins are often called as PLASTICS A substance that although dimensionally stable in normal use was plastic at some stage of manufacture Thermoplastic – they soften again when reheated (above GTT) Thermosetting – they are resistant to change after further application of heat**
48.
49. **Third Group – ELASTOMERS Founded on Naturally occurring LATEX isolated from Hevea brasiliensis tree :**

50. **Third Group – ELASTOMERS Founded on Naturally occurring LATEX isolated from Hevea brasiliensis tree Thermoplastic Resins Thermosetting Resins Are fusible, soluble in organic solvents Better flexural & impact properties Most plastics in Dentistry belong to this group PMMA, Polyvinyl, Polystyrene These become permanently hard when heated above critical temp. & they do not soften again on heating Usually cross-linked in state These are insoluble, infusible Crosslinked PMMA, Silicones. Superior abrasion resistance Superior Dimensional Stability**
51.
52. **IDEAL REQUIREMENTS :**
53. **IDEAL REQUIREMENTS Tasteless, odourless, non-toxic, non-irrtant Esthetically satisfactory – transparent, translucent, easily pigmented, colour should be permanent Dimensionally stable, should not expand during Processing & subsequent use by the patient Should have adequate Strength, Resilience, Abrasion Resistance**
54.
55. **IDEAL REQUIREMENTS :**
56. **IDEAL REQUIREMENTS Insoluble & Impermeable to oral fluids Low specific gravity Softening temp. should be well above temp. of any hot food Easy to fabricate Good thermal conductivity Radioopaque**
57.
58. **USES :**
59. **USES Preparation of Dentures Artificial teeth Tooth restorations Orthodontic space maintainance Crown & Bridge facings, Temporary Crowns Maxillofacial prosthesis, Athletic Mouth Protector Inlay patterns Implants Dies, Impression trays Endodontic filling materials**
60.
61. **Basic Nature of Polymers :**
62. **Basic Nature of Polymers 1. Polymer – Molecule that is made up of may parts Chemical possessing a molecular weight of more than 5000 Monomer – Molecule from which polymer is constructed Molecular Wt. of various mers X no. of mers (determines its physical properties) Degree of Polymerization --- total no. of mers in polymers . Strength increases with increase in Deg. Of Poly.**
63.
64. **STUCTURE OF POLYMERS (SPATIAL STRUCTURE) :**
65. **STUCTURE OF POLYMERS (SPATIAL STRUCTURE) 1 LINEAR – linear homopolymer, random copolymer, block 2 BRANCHED – branched homopolymer, random copolymer, graft copolymer 3 CROSS-LINKED- homopolymer crosslinked with single crosslinking agent**
66.
67. **Polymerization – series of chain reaction by which a macromolecule or polymer is formed from a single molecule :**
68. **Polymerization – series of chain reaction by which a macromolecule or polymer is formed from a single molecule Condensation Addition Slow method Repeated Elimination of small molecules By- products – NH3, H2O, halogen acids Functional groups are repeated (Amide, Urethane, Ester or Sulfide) Here by-product formation is not necessary In Dental procedures No change in chemical composition & no by-products Giant molecules (unlimited size) Simple, but not easy to control**
69.
70. **Slide 15:**

71. **CHEMICAL STAGES OF POLYMERIZATION INDUCTION (INITIATION) PROPOGATION TERMINATION CHAIN TRANSFER**
72.
73. **CHEMICAL STAGES OF POLYMERIZATION :**
74. **CHEMICAL STAGES OF POLYMERIZATION INDUCTION (INITIATION) Is the time during which the molecules of the initiator becomes energized or activated & start to transfer the energy to the monomer. Impurity --- increases length of this period Increase temp. --- shorter is length of Induction period Initiation energy is 16000 to 29000 cal/mol.**
75.
76. **CHEMICAL STAGES OF POLYMERIZATION :**
77. **3 INDUCTION SYSTEMS HEAT ACTIVATION –free radicals are liberated by heating Benzoyl peroxide CHEMICAL ACTIVATION – atleast 2 reactants --- chem. Reaction--- liberate free radicals Benzoyl peroxide + Aromatic Amine(dimetyl-p-toluidine) LIGHT ACTIVATION – photons of light energy activate the initiator – free radicals . Under visible light Camphoroquinone & an amine --- free radical CHEMICAL STAGES OF POLYMERIZATION**
78.
79. **Slide 18:**
80. **CHEMICAL STAGES OF POLYMERIZATION PROPOGATION – After growth has started 5000 to 8000 cal/mol. Is required & the Process continues**
81.
82. **Slide 19:**
83. **CHEMICAL STAGES OF POLYMERIZATION TERMINATION- direct coupling or exchange of H2 atom**
84.
85. **Slide 20:**
86. **CHEMICAL STAGES OF POLYMERIZATION CHAIN TRANSFER . Chain termination can also result from chain transfer. Active state is transferred from activated radical to inactive molecule And new nucleus of growth is created**
87.
88. **INHIBITION OF POLYMERIZATION :**
89. **INHIBITION OF POLYMERIZATION Occurs when there is Complete exhaustion of monomer Or Formation of High Molecular Weight polymer Inhibited by : IMPURITIES (react with Activated Initiator / Nucleus) Hydroquinone (0.006%) is in Monomer for storage OXYGEN retards polymerization Influence the length of Initiation period & degree of polymerization**
90.
91. **COPOLYMERIZATION :**
92. **COPOLYMERIZATION Is required to improve physical properties Two or more chemically different monomers polymerize to form COPOLYMER TYPES Random Graft Block**
93.
94. **Applications of copolymerization :**
95. **Applications of copolymerization ETHYL ACRYLATE+ PMMA = FLEXIBILITY BLOCK & GRAFT Polymers = Improves IMPACT STRENGTH (good adhesive properties + surface characteristics) CROSS-LINKING (chemical bond between linear polymers) Applications – Improves strength, reduces solubility & water sorption Highly Cross-linked Material provides - increased resistances ------ to solvents, crazing & surface stresses**
96.

97. Plasticizers :

98. Plasticizers Increases solubility of polymers in monomer Reduces brittleness But it also reduces Strength & Hardness & Softening point EXTERNAL – penetrates macromolecules & neutralizes secondary bond. It Evaporates / Leaches out INTERNAL - Copolymer

99.

100. Types of resins :

101. Types of resins Acrylic resin Vinyl resin Polystyrene Epoxy resins OTHER RESIN SYSTEMS Polycarbonates Polyurethanes Cyanoacrylates

102.

103. ACRYLIC RESINS :

104. ACRYLIC RESINS Are Derivatives of Ethylene & contain a vinyl group in their structural formula Acrylic resins used in dentistry are esters of 1 Acrylic acid 2 Methacrylic acid Available as Methyl methacrylate [liquid] & Poly (Methyl methacrylate) [powder]

105.

106. Poly (Methyl Methacrylate) Resins :

107. Poly (Methyl Methacrylate) Resins Widely used --- easy to process It is Thermoplastic resin Liquid [monomer] Methyl Methacrylate is mixed with Powder [polymer] Monomer plasticizes the polymer to dough-like consistency which can be easily moulded Types ---- based on method used for its activation Heat activated resins Chemically activated resins Light activated resins

108.

109. HEAT – ACTIVATED DENTURE BASE RESINS :

110. HEAT – ACTIVATED DENTURE BASE RESINS AVAILABLE AS Powder+ Liquid & Gels – Sheets &cakes COMPOSITION Liquid Methyl Methacrylate Dibutyl pthalate --- plasticizer Gylcol dimethylacrylate [1-2%] ---- cross-linking agent Hydroquinone ---- inhibitor Stored in tightly sealed Amber coloured bottle – to prevent evaporation , premature poymerization [by light or U.V radiation]

111.

112. COMPOSITION :

113. COMPOSITION Powder Poly (Methyl Methacrylate) Other copolymers (5%) Benzoyl Peroxide ---- Initiator Compounds of Mercuric sulphide, Cadmium sulphide ---- Dyes Zinc / Titanium oxides --- Opacifiers Dibutyl pthalate --- plasticizer Dyed organic filler Inorganic particles like glass fibers / beads

114.

115. Slide 30:

116. High mol. Wt. polymers dissolves slowly in monomer So, to increase in solubility Additive – (Ethyl acrylate copolymer) Plasticizer – Dibutyl phthalate Adding low mol. Wt. PMMA POLYMERIZATION REACTION Powder (Poly)+ Liquid (mono) +heat = polymer + heat

117.

118. Technical consideration :

119. Technical consideration COMPRESSION MOULDING TECHNIQUE Prep of wax pattern [waxed dentures] Prep of Split mould [Investing & Dewaxing] Applictn of Separating Media Mixing of powder & liquid Packing Curing Cooling Deflasking Finishing & polishing

120.

121. COMPRESSION MOULDING TECHNIQUEPrep of wax pattern [waxed dentures] :

122. COMPRESSION MOULDING TECHNIQUEPrep of wax pattern [waxed dentures] Prosthetic teeth are selected & arranged – esthetic & functional requirements Impression making, cast generation, record bases Articulator mounting, teeth arrangement, wax contouring Waxed dentures are sealed to master casts – removed from articulator

123.

124. Prep of Split mould [Investing] :

125. Prep of Split mould [Investing] Master cast is coated with thin layer of separator Base flasking Counter flasking – dental stone in intimate contact with all external surfaces, Incisal & Occlusal surfaces are slightly exposed – to facilitate deflasking Third Pour – to fill remaining flask Lid is gently placed & stone is allowed to set

126.

127. Prep of Split mould [Dewaxing] :

128. Prep of Split mould [Dewaxing] On complete setting – record base & wax has to be removed Flask is immersed in boiling water for 4 mins Base flask & counter flask segments are separated Residual wax is removed by wax solvents Mold cavity is cleaned with mild detergent solution & rinsed with boiling water

129.

130. Application of Separating Media :

131. Application of Separating Media To prevent water from the mould to enter into Acrylic resin [affects rate of polymerization & colour of resin] To prevent Monomer penetrating into the mould [plaster to adhere to the acrylic resin & produce rough surface] Can lead to compromises in Physical & Esthetic properties TYPES Tinfoil Tinfoil substitutes - Cellulose lacquers, Solution of Alginate compounds, Evaporated milk, Soap, Sodium silicate, Starches

132.

133. Mixing of powder & liquidPolymer:Monomer ratio :

134. Mixing of powder & liquidPolymer:Monomer ratio Accepted ratio – 3:1 by volume or 2:1 by weight If more Monomer [lower polymer/monomer ratio] Greater poly. Shrinkage Additional time is reqd. to reach the packing consistency Tendency for porosity If less Monomer [lower polymer/monomer ratio] Less wetting – Granular acrylic Dough will be difficult to manage – not fuse into continous unit of plastic

135.

136. Physical stages of Polymerization :

137. Physical stages of Polymerization Stage 1 – Sandy / Wet sand stage – polymer gradually settles in monomer, forms a fluid, incoherent mass. Also described as ‘coarse or grainy’ Stage 2 – Stringy / Sticky stage – monomer enters into polymer, if the mixture is touched --- it forms cobweb like structure Stage 3 – Dough-like / Gel stage : mass becomes more saturated, smooth & dough like. It does not adhere to container or spatula. Mass is plastic & homogenous at this stage. Time reqd – 10 mins

138.

139. Physical stages of Polymerization :

140. Physical stages of Polymerization Stage 3 – Rubbery / Elastic Stage: Monomer disappears by penetration into the polymer & evaporation. Mass is cohesive, rubber-like, non-plastic & cannot be moulded as it rebounds when compressed or stretched, it does not flow freely Stage 5 – Stiff – due to evaporation of free monomer. Mix appears very dry & is resistant to mechanical deformation

141.

142. Dough-forming Time :

143. Dough-forming Time Time reqd for the resin mixture to reach a dough-like stage ADA specification no. 12 – in less than 40 mins Clinically – most resins reach a doughlike consistency in less than 10 mins Depends on Controlled by manufacturer 1 Deg. Of polyn. – higher the polyn, lower the Dough-forming Time 2 Particle size – Smaller the particle size, shorter the Dough-forming Time Controlled by operator 3 Polymer:Monomer ratio : If this is high (less monomer), there is shorter dough forming time 4 Temperature – Higher the temp., shorter dough forming time 5 Plasticizer – reduces the dough forming time

144.

145. Working time :

146. Working time May be defined as the time that a denture base material remains in dough like stage At least 5 mins Affected by temp., extended via refigeration (moisture can degrade properties) Can be avoided by storing in air tight container

147.

148. PACKING :

149. PACKING Introduction of denture base resin into mould cavity Overpacking: excessive thickness, malpositioning of teeth Underpacking : noticeable denture base porosity Rope-like form ----- packed into flask Polyethylene sheet is placed ---- flask is assembled Application of pressure --- resin dough flows evenly into mold space Flask portions are separated – sheet is removed with a rapid, continuous tug Excess resin – flash Second trial closure Final closure – no polyethylene sheet

150.

151. Polymerization Procedure / Curing :

152. Polymerization Procedure / Curing DB Resins – Benzoyl Peroxide{Initiator} – when heated above 60*C – decompose to form Free Radicals - reacts with Monomer to initiate chain-growth polymerization Heat is termed as Activator After Final closure – flasks are kept at Room temp. for 30 to 60 mins – Bench Curing Longer flow period – equalization of pressure in Mold Allows time for more uniform dispersion of monomer Longer exposer of resin teeth to monomer- better bond

153.

154. Curing cycle / Heating process :

155. Curing cycle / Heating process 1. Processing denture base resin in Constant temp water bath at 74*C (165*F) for 8 hrs or longer, with no terminal boiling 2. Processing the resin at 74*C for approx. 2 hrs & then increasing the temp. of water bath to 100*C & processing for 1 hour more Other Methods of supplying heat for activation Steam, Dry air Oven, Dry heat (electrical), Infrared heating, Induction/Dielectric heating, Microwave radiation [Specially formulated resin & Non-metallic Flask: Speedy process]

156.

157. Internal Porosity :

158. Internal Porosity Resin & Dental stone – Poor thermal conductors, heat of reaction cannot be dissipated, so temp. of resin rises above that of stone & surrounding water Temp. exceeds the boiling pt. of Monomer (100.8*C) Porosity – not seen on surface, as heat is dissipated Centrally, heat generated in thick portions cannot be dissipated --- boiling of unreacted monomer ---- porosity

159.

160. External Porosity :

161. External Porosity 1. Lack of Homogenity – Portions containing more monomer will shrink more than the adjacent areas, results in voids & resin appears white.(proper powder:liquid, homogenous mix – pack in dough stage) 2. Lack of adequate pressure – Lack of dough during final closure (Flash indicates adequate material) OTHER PROBLEMS : Crazing[Cracks] & production of Internal Stresses

162.

163. Cooling :

164. Cooling After Curing – Denture flasks should be cooled slowly to room temp. Rapid Cooling – warpage of denture base because of differences in thermal contraction of resin & stone Slow Cooling – Minimizes potential difficulties So, Bench-Cooling for 30 mins, then flask should be immersed in cool tap water for 15 mins Cooling overnight is ideal

165.

166. Deflasking, Finishing & Polishing :

167. Deflasking, Finishing & Polishing Deflasking – has to be done with care to avoid flexing & breaking of Acrylic denture Finishing – Metal Trimmer, Acrylic/Alpine Stone, Dry & Wet Sand paper Polishing – suspension of finely ground pumice in water

168.

169. Injection molding Technique :

170. Injection molding Technique Mold space can be filled by injecting resin under pressure in specially designed flasks Sprue hole / Vent hole are formed in stone mold Soft resin (dough stage) is contained in injector & is forced into mold Resin under pressure until it has hardened Polystyrene resin – polymer is first softened under heat & injected while hot, then it solidifies in mold upon cooling No trial closures are required

171.

172. Injection molding Technique :

173. Injection molding Technique Advantages Disadvantages Dimensional accuracy Low free monomer content Good impact strength High capital costs Difficult mold design problems Less craze resistance Less creep resistance Special flask is required

174.

175. Polymerization by Microwave energy :

176. Polymerization by Microwave energy It is cleaner & faster than polymerization with conventional technique Fit of denture is comparable or superior Acrylic resins are less prone to porosity Advantages : good appearance, high glass transition temp, ease of fabrication, low capital cost & good surface finish Disadvantages : Radiolucency, Free monomer content/formaldehyde may cause sensitization, fatigue life too short & low impact strength

177.

178. Chemically Activated Denture Base Resin (Autopolymer, Self-cure, Cold-cure) :

179. Chemically Activated Denture Base Resin (Autopolymer, Self-cure, Cold-cure) Composition Liquid Methyl Methacrylate Dimethyl-p-toluidine ---- Activator Dibutyl phthalate----------- Plasticizer Glycol dimethacrylate ----- Cross linking agent Hydroquinone ------------- Inhibitor

180.

181. Chemically Activated Denture Base Resin (Autopolymer, Self-cure, Cold-cure) :

182. Chemically Activated Denture Base Resin (Autopolymer, Self-cure, Cold-cure) Composition Powder Poly (Methyl Methacrylate) Other copolymers - 5% Benzoyl Peroxide --------------- Initiator Compounds of mercuric sulphide, Cadmium sulfide ------

-------- Dyes Zinc / Titanium Oxide ------------- Opacifiers Dibutyl phthalate ---------- Plasticizer Dyed organic fillers Inorganic particles like glass fibers / beads

183.

184. Uses of Autopolymerizing Resin :

185. Uses of Autopolymerizing Resin With fillers (pumice), for construction of custom trays For denture repair, relining & rebasing For making removable orthodontic appliances For adding a post-dam to adjust upper denture

186.

187. Slide 54:

188. Advantages Disadvantages Better initial fit Less thermal contraction For repairing dentures, as it avoids warpage due to re-curing Colour stability is inferior, due to subsequent oxidation of the tertiary amine Lesser degree of polymerization, so these have slightly inferior physical properties

189.

190. Manipulation :

191. Manipulation 1. Sprinkle – On technique 2. Adapting technique 3. Fluid resin technique 4. Compression moulding technique 5. Injection moulding technique

192.

193. Fluid resin technique (pour-type acrylic resin) :

194. Fluid resin technique (pour-type acrylic resin) These have high molecular wt powder that are smaller in size & when they are mixed with monomer, the mix is very fluid They are used with lower powder-liquid ratio – 2 : 1 -2.5 : 1 This aids to prevent undue increase in viscosity during mixing & pouring stages This technique commonly involves use of Agar Hydrocolloid for the mould preparation Fluid mix is poured in the mould quickly & allowed to polymerize under pressure at 0.14 Mpa (20 psi).

195.

196. Slide 57:

197. Advantages Disadvantages Better tissue fit Fewer open bites. Less fracture of porcelain teeth during deflasking procedure Reduced material cost Simplification of lab procedure for flasking (no trial closure),deflasking & finishing of denture. Air occlusion(bubbles) Shifting of teeth during processing Infraocclusion (closed bites) Occlusal imbalance due to shifting of teeth Incomplete flow of denture base material over neck of anterior teeth Formation of films of denture base material over cervical portions of plastic teeth that had not been previously covered with wax Poor bonding to plastic teeth.. Technique sensitivity.

198.

199. Slide 58:

200. Autopolymerizing Heat cured Heat is not necessary for polymerisation Porosity is greater. Have lower average molecular weight. Higher residual monomer content. Material is not strong.(coz of their lower molecular weight mols.) Poor color stability. Easy to deflask. Rheological properties: A) Show greater distortion. B) More initial deformation. C) Increased creep & slow recovery. Heat is necessary for polymerisation Porosity is less Higher average molecular weight (5 lakhs-10 lakhs) Lower residual monomer content Material is strong Good color stability Difficult to deflask A) Show lesser distortion B) Less initial deformation C) Less creep & quicker recovery

201.

202. Light activated denture base resin :

203. Light activated denture base resin Composition Urethane dimethacrylate matrix Acrylic copolymer Microfine silica fillers Photoinitiator system –

Camphoroquinone amine Supplied in pre-mixed sheets having clay-like consistency Provided in opaque light packages – to avoid premature polymerization Adapted to cast when in plastic form Polymerized in light chamber with light of 400-500 nm from high intensity quartz halogen bulbs

204.

205. Properties of Denture Base Resin :

206. Properties of Denture Base Resin Methyl Methacrylate Monomer: Clear, transparent, volatile, has sweetish odour. Melting pt: -48*C Boiling pt: 100.8*C Heat of polymerization: 12.9Kcal/mol Volume shrinkage during polymerization: 21% Poly (Methyl Methacrylate) Tasteless, odourless, clear transparent, has adequate compressive & tensile strength, has low hardness-can be easily scratched & abraded Shrinkage ---- thermal shrinkage on cooling & polymerization shrinkage Volume shrinkage is 8% & Linear Shrinkage is 0.53%

207.

208. Resin Teeth – PMMA copolymerized with a cross linking agent :

209. Resin Teeth – PMMA copolymerized with a cross linking agent Resin teeth High fracture toughness Crazing, if not crosslinked Clinically significant wear Easily ground & polished Silent on contact Dimensional change (water sorpn) Cold flow under stress Loss of Vertical dimension Self adjusting Chemical bond to denture Minimal abrasion of opposing Porcelain teeth Brittle Crazing by thermal shock Insignificant wear Grinding is difficult (glaze) Sharp impact sound Dimensionally stable No permanent deformation Stable VDO Difficult to fit in diminished interarch space Mechanical retention necessary Abrades opposing teeth

210.

211. Recent Advances :

212. Recent Advances High Impact strength materials: butadenestyrene rubber-reinforced PMMA Rapid heat polymerized resins: hybrid acrylics that are polymerized in boiling water immediately after packing (place in boiling water & then full boil for 20 mins)

213.

214. Denture Reliners :

215. Denture Reliners Heat cure --- compression molding & low curing temp. There is a tendency for previously cured material to warp Self cure --- directly in mouth, but fades, smells SOFT/RESILIENT LINERS Purpose is to Absorb some of the energy produced by masticatory impact Used – irritation in mucosa, area of severe undercut, congenital/acquired defects of palate Plasticized acrylic resin-PEMA/PMMA/Copolymer + aromatic ester-ethanol liquid containing 60-80% plasticizer (dibutyl phthalate) Vinyl resin, Silicone rubbers – RTV, heat cured silicones, Polyurethanes Problems: inadequate bonding, loose stiffness as plasticizer is leached out, loss of denture base strength, trimming, polishing is difficult, disagreeable taste & odour, cannot be cleaned easily (fungal growth)

216.

217. Materials in Maxillofacial prosthesis :

218. Materials in Maxillofacial prosthesis To correct facial defects resulting from cancer surgery, accidents / congenital deformities Ideally – easy, inexpensive to fabricate, biocompatible, strong, stable, skinlike in appearance, soft & must be colour stable, easy to clean PMMA Latexes – but they are weak, degenerates rapidly with age Plasticized polyvinylchloride – has got plasticizers, crosslinking agent & UV stabilizers Silicone rubber --- RTV & heat-vulcanized Polyurethane polymers