3.5 g of pyromellitic acid di(N-tert.-butyl-N-methacryloyloxyethylamide (p- and m-isomers (X) and (XI) according to Example 3)

0.02 g of camphorquinone

EXAMPLE 11

Use test, bonding strength

The activity and suitability of the adhesives (Examples 6–10) is checked by determination of the shear bonding strength to dentine. Human teeth which have been kept in 1% strength chloramine solution for a maximum of three months after the extraction are used. Before being used in the test, the teeth are kept in physiological saline solution for at least three and not more than ten days, after thorough washing under running water. On the day before their use in the bonding test, the teeth are embedded individually, lying on an approximal side, with epoxy resin (®LEKUTHERM X 20, hardener T 3) in cylindrical rubber moulds of 25 mm diameter and 12 mm height. The teeth are ground by wet grinding on SiC papers of grains 240, 320, 400 and finally 600 to the extent that an adequately large dentine surface close to the enamel is exposed for binding to a cylinder of plastic of 3.5 mm diameter. After rinsing with deionised water and drying in a stream of air, the conditioning solution ®GLUMA 1 Cleanser is applied with a cotton-wool pellet using a rubbing movement for 30 seconds and the teeth are rinsed with water and dried, before the adhesive is applied with a brush, left on the surface for 30 seconds and then dried thoroughly in a stream of compressed air. One drop of ®GLUMA 4 Sealer is then applied and blown into a thin layer with compressed air. The sample pretreated in this way is firmly clamped in a clamping device under a divisible Teflon mould having a cylindrical receptacle 3.5 mm wide and 1 mm in height. The cylindrical mould is then filled with the plastic filling material ®PEKAFILL (U) using a syringe, and the filling material is covered with a strip which is impermeable to O_2 and activated for 60 seconds under the supported light discharge opening of a ®TRANSLUX CL (Kulzer) polymerisation lamp. The sample is then immediately removed from the holder. The Teflon mould is removed and the sample is kept in warm water at 23° C. for 15 minutes, until shearing stress is initiated, this being effected with the aid of a pressure piston parallel to and close to the surface of the embedded tooth at an advanced speed of 1 mm/minute until separation occurs. The shear bonding strength to the dentine is the quotient of the pressure and contact area on the tooth, and is in each case determined on 5 samples and stated as the mean value and standard deviation thereof.

The dentine side of the separated sample is inspected under a reflected light microscope to evaluate the cause of fracture.

EXAMPLE 12

Use test, tooth cavity

To simulate the clinical use of adhesives and filling materials of plastics, cavities are prepared and filled in extracted teeth with a previous history as in Example 11. The adaptation of the filling material at the edge of the cavity is determined as a measure of the effectiveness.

The extracted teeth are subjected to wet grinding on an undamaged aproximal side on SiC paper of grains 240, 320, 400 and 600 until a sufficiently large area of dentine is exposed for accommodation of a cylindrical cavity about 3 mm wide. The cavity is prepared down to a depth of about 1.5 mm using customary dentistry preparation diamonds of medium grain size with copious cooling with water, and is then rinsed out with water and dried. The cavity is cleaned with an impregnated cotton-wool pellet for 30 seconds as in the preceding example and is then washed out and dried, before the adhesive is brushed on, left for 30 seconds and finally dried. The ®GLUMA 4 Sealer is then applied The excess is carefully removed with compressed air before the cavity is filled with the plastic filling material ®PEKAFILL (U) using a syringe. The excess is covered with a strip which is impermeable to O_2 before activation (60 seconds) using the ®TRANSLUX CL (Kulzer) photopolymerisation apparatus. Immediately after the polymerisation, the filled tooth is kept in warm water at 23° C. for 15 minutes. Thereafter, the excess is removed by grinding on moist SiC paper of grains 400 and 600. During this operation, about 0.1 mm of the height of the cavity is worn away. The tooth is rinsed with water, dried in a stream of air and immediately inspected under a reflected light microscope at 500-fold magnification. The maximum width of any gap present at the edge is measured with the aid of a screw eyepiece micrometer. The average maximum gap width of in each case 5 fillings is stated as the measurement value. Microscopic examination of individual teeth was in all cases concluded in less than 10 minutes. It was thus ensured that the gaps measured at the edges had not formed or were not influenced in width by dehydration of the dentine.

Results of the technological investigations

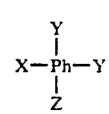
The good effectiveness of the formulation according to Examples 6 to 10 could be demonstrated by means of the use test described in Examples 11 and 12.

When the cause of fracture was evaluated under a light microscope, cohesive fractures in the dentine or in the plastic were often observed, that is to say the gluings produced using the adhesive components according to the invention were stronger than the glued parts of the join themselves. This shows the good performance of the adhesive components according to the invention.

Fillings which were exclusively free from gaps at the edges were even obtained by the method described using the formulation according to Example 6. The shear bonding strength was determined formally as 12.1 ± 3.5 N/mm^2, the fracture taking place in the dentine or plastic, as mentioned above, that is to say no adhesive failure being achievable.

We claim:

1. N-Alkyl-N-(meth)acryloyloxyalkylcarboxamides of the formula (I)



(I)

in which

X represents an N-alkyl-N-(meth)acryloyloxyalkylcarboxamide of the formula