COMMENTARY

INFLUENCE OF TEMPERATURE ON THE SPREADING VELOCITY OF SIMPLIFIED-STEP ADHESIVE SYSTEMS David H. Pashley, DMD, PhD*

The authors have provided a simple laboratory technique for measuring the functional spreading capacity of adhesive systems on a glass slide inclined at 45° to the horizontal as a way to predict their spreading behavior on cavity walls. Almost all bonding systems are solvated with acetone, ethanol, water, or a combination in concentrations as low as 20 vol% (Excite, Ivoclar-Vivadent, Amherst, NY, USA) or as high as 75% (Prime & Bond NT). Adhesives solvated with acetone have relatively low viscosities the instant they are applied, but the concentrations of acetone and the nonvolatile comonomers change drastically within seconds as the acetone evaporates. This causes rapid increases in the viscosity of the adhesives that may limit its ability to flow down axial walls of cavity preparations, requiring multiple applications for complete coverage.

The goal is to have good spreading and enough residual solvent to permit rapid diffusion of solvated comonomers into an acid-etched demineralized dentin matrix. If acetone evaporates too rapidly, the concentration of the comonomers may be so high that a viscous surface layer slows the inward diffusion for hybrid layer creation. The use of nonvolatile HEMA in adhesive blends tends to minimize such increases in viscosity. At the other extreme, if the viscosity remains low owing to the presence of less-volatile water-ethanol mixtures, the adhesive may flow off axial walls and accumulate at line angles. These variables (ie, types of volatile solvent and monomers, their concentrations, vapor pressure, and viscosity) can influence the film thickness of adhesives.

The recent reports from Dr. Sabina Dickens's laboratory at the National Institute of Standards and Technology showing higher microtensile bond strengths using blends of pyromelltic glycerol dimethacrylate and HEMA at a constant mass ratio (3:3:1) while acetone content was varied from 27 to 67% are very interesting. The highest bond strengths were obtained using 37% acetone (64 MPa), and the lowest bond strengths were seen using 67% acetone (38 MPa). High acetone content (67%) produced lower adhesive layer thickness (10 μ m) than did lower acetone content adhesives (27% = 40 μ m).¹

Using scanning electron microscopy, they saw more small cracks and large interfacial gaps at the bonded interface in the higher–acetone content model adhesives (57 and 67% acetone). These defects were not seen in the lower–acetone content adhesives. The authors felt that these defects served as preexisting flaws that made the bonds fail at lower stresses. In a follow-up article, they found that the higher the acetone content, the higher the residual acetone content of the adhesive.²

Clearly the ability of an adhesive to spread without becoming overly thin or overly viscous is important during resin bonding. If, in future work, Pazinatto and colleagues place their inclined glass slide in an analytic balance connected to a computer, they could gravimetrically follow the rate and extent of the solvent evaporation during the spreading of the adhesive.³ This simple technique can be useful in comparing products and optimizing techniques.

REFERENCES

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