THE DENTAL ADVISOR
Improving Patient Care Through Research & Education

TRANSLATING THE SCIENCE
Number 16 - September 2013
www.dentaladvisor.com

Important Properties of Composites

Ron Yapp | Dental Consultants, Inc., Ann Arbor, Michigan

The four properties presented in the table are useful to the clinician in determining how a composite will potentially perform when placed in a patient's tooth. Following is a brief description of these properties, the tests that are used to determine them and why they are clinically relevant. The products presented in the table are excellent examples of composites where these properties are within an acceptable range.

Flexural Strength and Flexural Modulus describe a material's resistance to bending. The three-point bending test (Figure 1) is useful in determining the strength of a specimen at the point of load application. The flexural modulus (stiffness) is the amount a material will deflect elastically for a given applied load. Composite restorative materials must have acceptable flexural strength and stiffness to support the significant loads associated with eating hard foods (e.g., nuts and hard candy) without fracturing.

Radiopacity is a measure of a materials ability to attenuate x-rays passing through it. It is often presented as the equivalent to "millimeters of aluminum" because aluminum has an x-ray attenuation which is similar to tooth tissue. A typical method of determining radiopacity is to position a standard in the form of a step wedge of pure aluminum with steps increasing by 0.5 mm per step into the x-ray view alongside the subject material (Figure 2). The thickness of the material and the grey level of the image on the x-ray film of the specimen and of the step wedge are measured and compared using an x-ray densitometer to determine a thickness of aluminum which attenuates light to the same degree as the specimen. It is an important property of dental materials that allows them to be visualized on an x-ray film and to be found and/or identified (if they were inadvertently swallowed or inhaled).

Depth-of-cure (DOC) is the depth of a composite material that may be successfully cured with a particular curing light for a specific amount of exposure time. A typical method of measuring DOC is to confine the material into a cylindrical shape using flexible Teflon or rubber washers that can be stacked to various heights to form a mold. The composite is then placed into the resulting cylindrical hole to form a column that is then cured with the curing light for a set period of time. The ratio of the hardness of the bottom and top of the composite cylinder is determined for that particular column height (Figure 3). The maximum DOC is the column height where the hardness ratio is 0.8 or greater. The DOC is helpful when determining if a restoration may be cured as a single layer as in bulk-fill materials or must be used in multiple layers to achieve adequate polymerization.

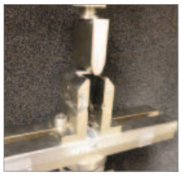
Figure 1

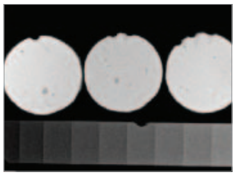
Figure 2


Figure 3

Property Summary

Product	Type	Manufacturer	Flexural Strength, MPa	Flexural Modulus, gpa	Radiopacity, mm Al	Depth-of-cure, mm *
SureFil SDR flow	Bulk-fill Flowable	DENTSPLY Caulk	130	6.3	2.8	10
e-on Universal	Universal Composite	Benco Dental Co.	141	14.1	2.5	nt
Simile Nano-Hybrid Composite	Universal Composite	Pentron	133	8.2	2.3	nt
TPH Spectra	Universal Composite	DENTSPLY Caulk	151	8.4	4.2	nt

**Follow manufacturer's DFU for incremental layering of the composite*