

20th November 2013

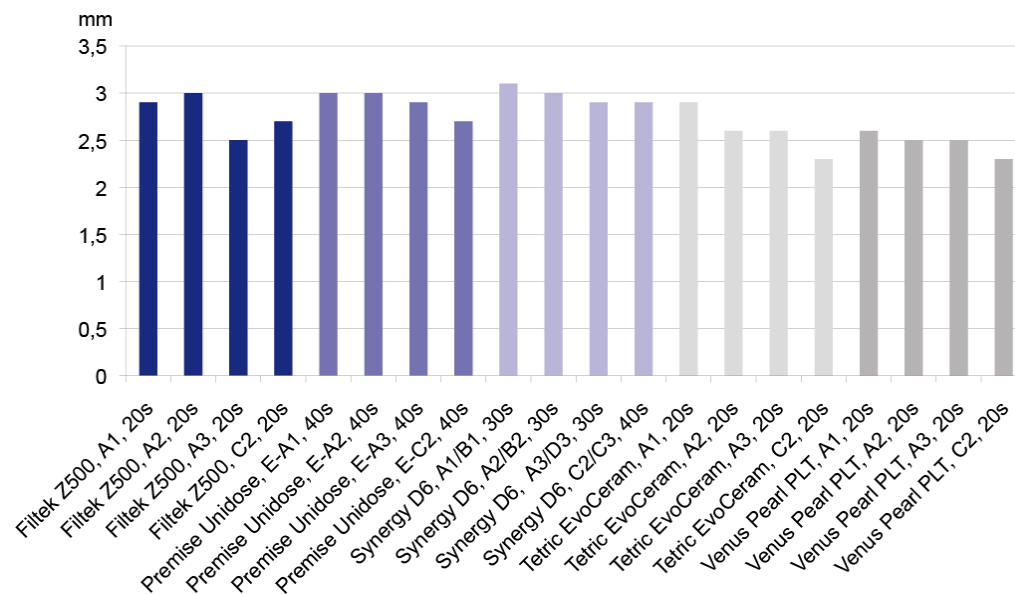
Product testing of five composites

Product testing of commercial dental polymer-based restorative composites has been conducted on behalf of the Norwegian Ministry of health and care services. Five products with four shades each were included (see Table 2). Testing was conducted according to selected properties as given in the international standard ISO 4049:2009 Dentistry - Polymer-based restorative materials, Table 1. All of the selected shades were tested for depth of cure and colour comparison. One shade of each product was tested for flexural strength and water sorption and solubility.

Table 1: The selected test methods and requirements in ISO 4049.

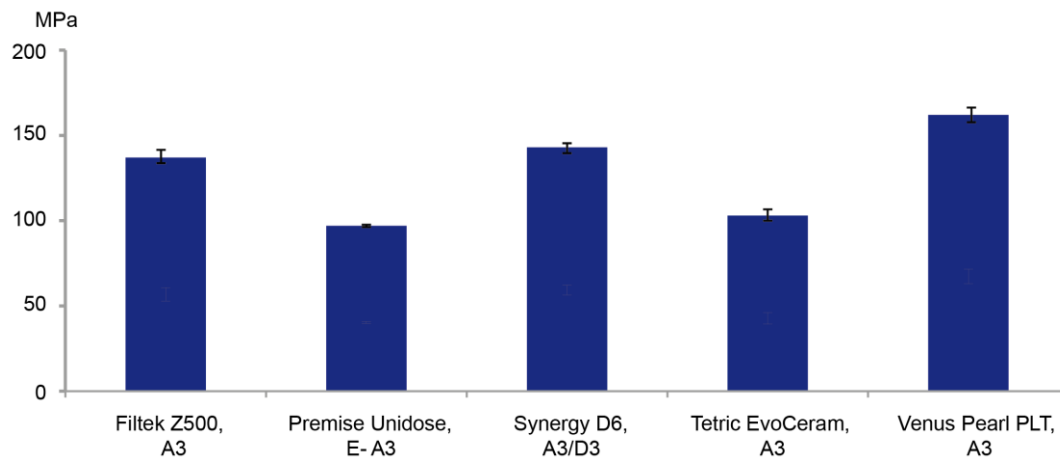
Test method	Requirement
Depth of cure	Minimum 1,5 mm, or as given by manufacturer
Flexural strength	Minimum 80 MPa (occlusal surfaces)
Water sorption	Maximum 40 µg/mm ³
Water solubility	Maximum 7,5 µg/mm ³
Colour comparison	Match shade guide and be stable after aging

Depth of cure



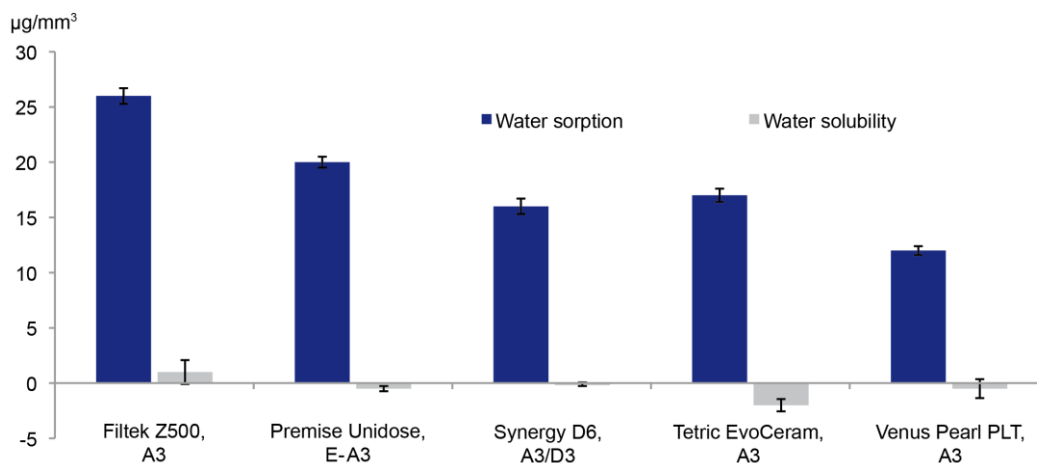
All the tested products and shades complied with the requirements for depth of cure in ISO 4049 as the values were all above 1,5 mm and minimum as given by the manufacturer, see Table 3.

Flexural strength



All the tested products complied with the requirements for flexural strength in ISO 4049 as the values were all above 80 MPa (materials suitable for restorations involving occlusal surfaces).

Water sorption and solubility



All the tested products complied with the requirements for water sorption (blue) and solubility (grey) in ISO 4049 as the values of sorption were all below 40 µg/mm³ and the values of solubility were all below 7,5 µg/mm³.

Colour comparison

All the tested shades of the different products complied with the requirements to colour comparison with shade guide. Two of the A1-shades did not comply with the requirements on colour stability, as “more than a slight change” in shade was observed after irradiation and water sorption, Table 2.

Table 2: Colour stability after water sorption (Aging, water) and irradiation (Aging, water & light).

Product	Shade	Aging, water	Aging, water & light
Filtek Z500	A1	OK	Not acceptable
	A2	OK	ok*
	A3	OK	ok*
	C2	OK	ok*
Premise Unidose	E-A1	OK	OK
	E-A2	OK	OK
	E-A3	OK	OK
	E-C2	OK	OK
Synergy D6	A1/B1	OK	ok*
	A2/B2	OK	OK
	A3/D3	OK	OK
	C2/C3	OK	OK
Tetric EvoCeram	A1	OK	Not acceptable
	A2	OK	ok*
	A3	OK	ok*
	C2	OK	ok*
Venus Pearl PLT	A1	OK	OK
	A2	OK	OK
	A3	OK	OK
	C2	OK	OK

* Slight change in colour observed, but acceptable according to ISO 4049

Conclusions

The results of the product testing of five different products of restorative composites with four different shades each showed that all the tested materials complied with the requirements of the tested physical properties (flexural strength, depth of cure, and water sorption and solubility).

Two A1-shades of two different products had more than a slight change in the observed colour upon aging, which is not acceptable according to ISO 4049. The other shades of the tested products complied with the requirements on colour stability.

All the tested shades and products complied with the requirements on colour comparison with shade guide.

None of the tested products were certified according to ISO 4049.

Materials and methods

Test specimens were prepared according to the described methods in the standard. Curing of the specimens was performed with one light-emitting diode (LED) lamp for all the products tested. The bluephase 16i LED-lamp with a light-emitting tip measured to be 10,9 mm in diameter, and with the "High Power" mode was used (877 mW/cm^2 - considered as a medium strength light intensity). The light intensity and wavelength were within the manufacturers' recommendations as given in the instructions for use (IFU). The irradiation times were also based on IFU's, see Table 3.

Table 3: Curing times used for the different products and shades, and curing depths given by the manufacturers.

Product	Manufacturer	Shade	Curing time	Layer thickness
Filtek Z500	3M ESPE	A1, A2, A3, C2	20 s	2,0 mm
Premise Unidose	Kerr Hawe	E-A1, E-A2, E-A3, E-C2	40 s	2,5 mm
Synergy D6	Coltene Whaledent	A1/B1, A2/B2, A3/D3	30 s	2 mm
		C2/C3	40 s	2 mm
Tetric EvoCeram	Ivoclar Vivadent	A1, A2, A3, C2	20 s	2 mm
Venus Pearl PLT	Heraeus Kulzer	A1, A2, A3, C2	20 s	2 mm