

New Single-Shade Composite Ecosite One

M. Cowen, J.M. Powers



INTRODUCTION:

We recently tested a new single-shade composite **Ecosite One** from DMG America, which is primarily indicated for posterior cases in class I, II, V restorations and core build-ups. Among the claims DMG America makes is that the material can achieve over a 3 mm depth of cure in 10 seconds of curing time with a standard >1000 mW/cm² LED curing light for time savings, with excellent handling and polishing characteristics. In our testing, we measured the depth of cure claim, the polishability and the color stability after accelerated aging and staining.

Since the release of universal single-shade composite systems, simplifying shade selection for most cases has never been easier. Multiple studies have shown adequate color matching for the majority of shades. Single-shade composites benefit from additional surrounding dentition, as the chameleon effect relies on light reflecting through the material from the dentition in order to provide the chameleon effect. An added benefit of these single-shade composites is that a greater depth of cure can sometimes be achieved as the translucency of the composites are higher due to the need to allow light to pass through the composite to reflect off the surrounding dentition. Overall, single-shade composites can have a better color match in the long-term as their apparent shade can continue to change as the surrounding dentition changes color over time.

RESULTS SUMMARY:

- **Ecosite One** can be cured with 10-second exposures to over a 3-mm depth of cure.
- **Ecosite One** has an ideal hardness of 86 HV, which is about 37% higher than **OMNICHROMA**, and may contribute to better strength and wear characteristics.
- The polishability of **Ecosite One** is excellent in terms of the speed of polishing and final result, with similar polishing characteristics to **OMNICHROMA**.
- After intense simulated aging and staining, both **Ecosite One** and **OMNICHROMA** showed good color stability while **Ecosite One** had less change in translucency. **Ecosite One** in particular shows minimal change in color or translucency after aging in the 550-750 nm wavelength range responsible for yellow-red color, an important color range for apparent tooth shade. **This indicates a good ability to continue to match the color of the surrounding dentition over time.**

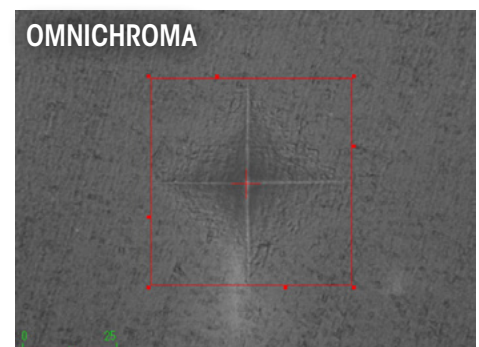
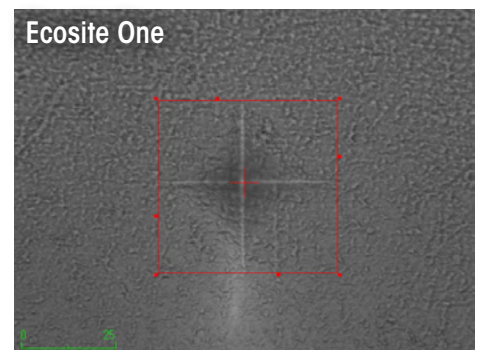
DEPTH OF CURE AND HARDNESS:

One 10-second exposure using a 1100 mW/cm² curing light produced approximately 4 mm depth of cure for Ecosite One and over a 5 mm depth of cure with a 20 second exposure. Keep in mind that this curing test is in a laboratory environment with perfect stability of the curing light centrally focused on the composite, so results achieved in a clinical environment might have a lower depth of cure. This should be a good safety margin as the IFU gives a 3 mm depth of cure after 10 seconds of curing with a >1000 mW/cm² LED curing light.

Hardness is a measurement determined by applying a certain load and measuring how much area of the material is deformed or how far the diamond indenter penetrates the surface. For composites, a hardness above 80 HV (Vickers hardness number), which is the approximate value of dentin, is suggested for composites to resist deformation and give better wear resistance.

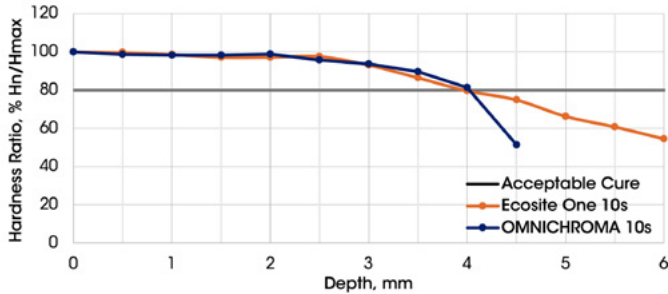
Hardness measurements were made on composites cured for 40 seconds as well as the 10 and 20 seconds in the depth of cure test followed by 24 hours of curing at oral temperature. There were no significant differences between these curing periods. This means that curing for 10 seconds with a 1,100 mW/cm² LED curing light sufficiently cured the composites at the top.

Ecosite One has a higher overall hardness than **OMNICHROMA** (86 vs 64 HV), which may have benefits in wear properties and higher modulus. A higher hardness is a particular benefit for posterior composites to maintain shape under occlusal forces and reduce wear over time.

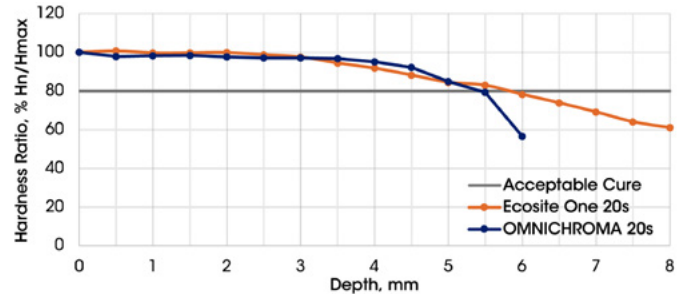


Hardness is also a useful measurement of the quality of cure for a composite, as it is closely correlated with the quality of the polymerization of a given composite. The point in which the hardness drops to 80% of the maximum hardness is commonly suggested as the minimum clinically acceptable curing level. These graphs depict the hardness ratio which is an indirect way of measuring the polymerization %; as the hardness drops, the polymerization % drops. Overall, **Ecosite One** and **OMNICHROMA** have similar curing profiles over the critical depth of cure region. Keep in mind that these are hardness ratios, and the starting hardness of **Ecosite One** at the 100% ratio is 86 vs 64 HV for **OMNICHROMA**.

Depth of Cure by Hardness Ratio
10-second cure @ 1100 mW/cm²



Depth of Cure by Hardness Ratio
20-second cure @ 1100 mW/cm²



POLISHABILITY:

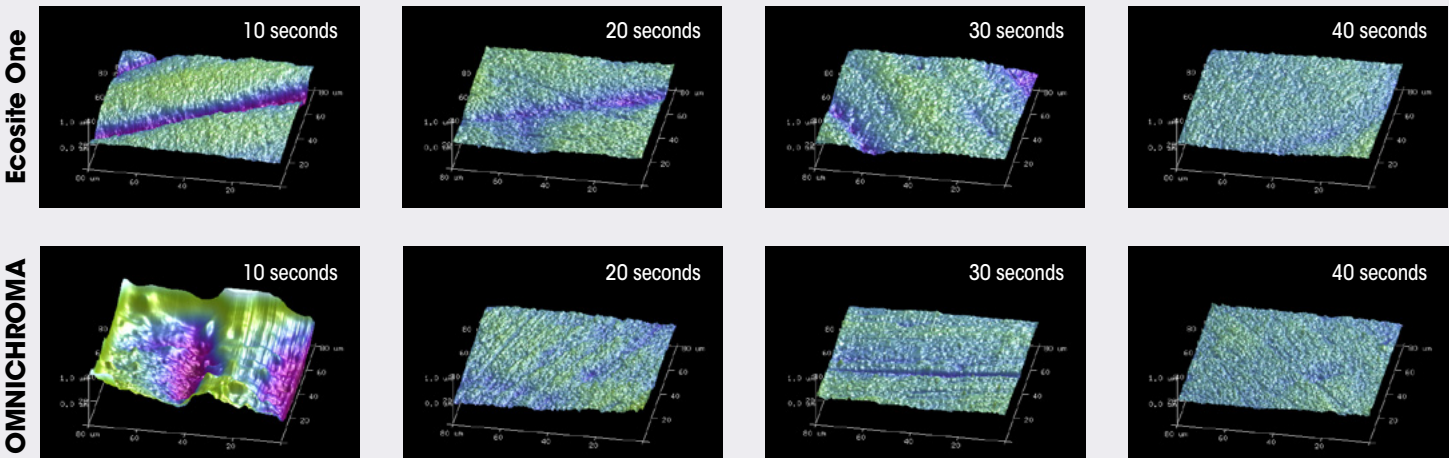
Polishing composites is an important step for not just esthetics, but also to reduce the ability of microbes to adhere to the surface. Bacterial adhesion and staining potential have been shown to attach to surfaces more when surface roughness is higher, so achieving a smooth surface after the adjustment of composite surfaces is paramount. A general threshold for an acceptable polish to minimize bacterial adhesion and acceptable gloss is about 60 gloss units (gu) and 200 nm (0.2 microns) surface roughness. Average surface roughness is the measurement of the variability of the surface texture, where a higher value indicates a rougher surface, and a lower value indicates a smoother surface.

Our polishing test starts with a rough composite surface prepared with 320-grit paper to simulate adjustment with a medium bur. The polishing test was conducted with the **3M™ Sof-Lex™ Diamond Polishing System**, which is a two-step polishing system. The surface is finished for 10 seconds with the pre-polishers which create a starting average roughness of about 500 nm and gloss of 10 gu for each composite. This was followed with 10, 20, 30, and 40 seconds of polishing with water with the 2nd step polisher, with three gloss and surface measurements taken on three independent samples for each step.

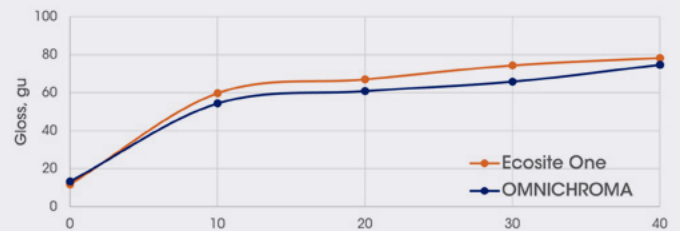
Ecosite One has a higher gloss value at a similar relative surface roughness indicating that it is inherently glossier. In terms of polishing efficiency,

Ecosite One shows a good balance of hardness to resist wear while exhibiting high polishability. This is important as some composites with a high hardness take longer to polish, especially those with larger filler particle sizes. Both materials can reach the goal of roughly 200 nm of surface roughness after 10 seconds of polishing.

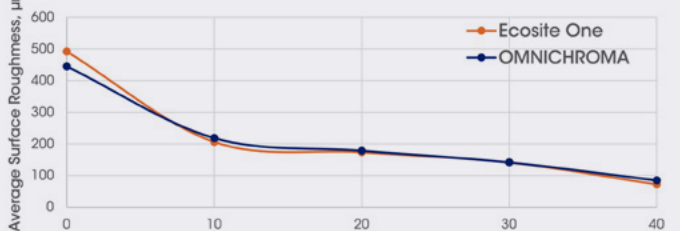
AFM scans show the surface topography on a small section of the polished specimens. The surface roughness of these small areas may better correlate with light reflectance, or glossiness, but are subject to small area sampling bias.



Gloss



Surface Roughness



COLOR STABILITY:

The long-term color stability and stain resistance of composites is an extremely important factor for patient acceptance of composite restorations. The science of how the new category of one-shade composites match color over time is a subject of active investigation. One of the primary attributes that allows the one-shade composites to blend with the surrounding dentition is the increased translucency compared to conventional composites. This increased translucency or ability for light to pass through the composite allows light to reflect off the surrounding dentition and appear to make the composite match the shade of the teeth.

Ecosite One has a much more neutral starting shade with a similar translucency level as **OMNICHROMA**. In shade matching tests with **Ecosite One**, the chameleon effect is apparent at placement and appears to match most shades well, unlike **OMNICHROMA** in which the chameleon effect is not apparent until after light-curing.

OMNICHROMA has no pigments contained in the composite, but has spherical particles that generate a reddish yellow color from the structure of the filler particles. Color is mixed with the light reflected off the surrounding dentition in an additive process to produce the final perceived appearance.

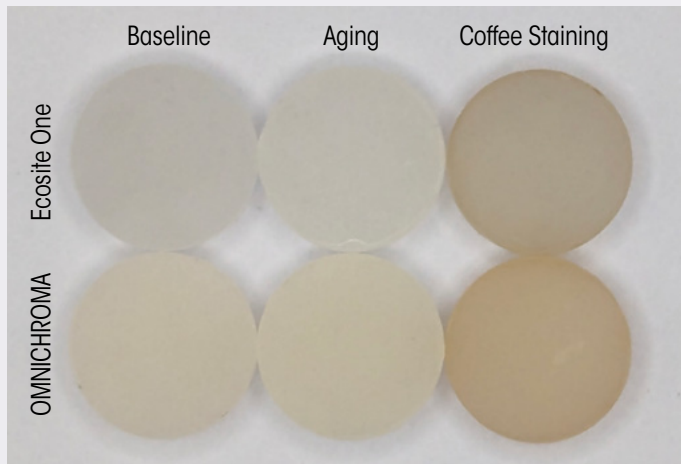
Color Stability and staining tests were conducted at the John M. Powers, PhD Houston Center for Biomaterials and Biomimetics at the UTHealth Houston School of Dentistry using ISO 4892 standard procedures to simulate several years of aging and staining in coffee. The accelerated aging test is a cyclic test with changes in humidity, water exposure, intense light and temperature. The coffee staining test involved 7 full days of immersion in coffee, which is the worst-case scenario for staining compared to real use scenarios in which the coffee will be diluted by saliva and surface stains cleaned by toothbrushing. The specimens were then compared to baseline readings to determine the change in color and translucency.

Example of Ecosite One with slot prep in various shades of denture teeth



RESULTS:

Ecosite One had a slightly lower change in translucency than **OMNICHROMA** after aging and staining which might indicate less impact on the chameleon effect over time. An image of the specimens side by side shows the color change for the different groups. **The overall change in color after accelerated aging was similarly low for both composites. Ecosite One**, which starts from a more neutral (lower b* meaning less yellow) value, ends with a lower b* than **OMNICHROMA** after coffee staining.

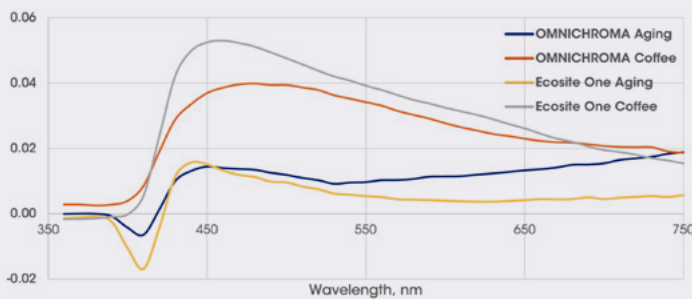


Ecosite One shows less apparent color change on the reflectance curves after aging, particularly in the 550-750 nm range.

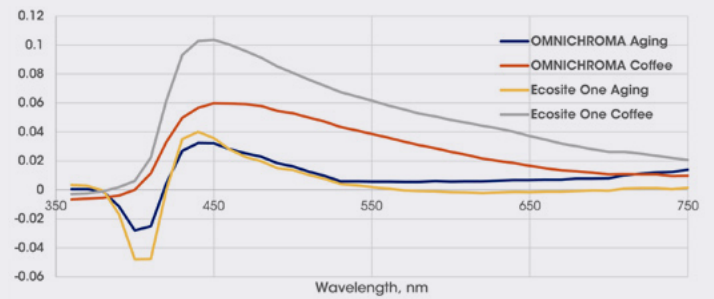
The curves below are useful for showing the relative differences between materials. The curves on the left are the difference in the change in translucency (white minus black backgrounds), and color appearance (white background) after aging and staining. A value near 0 indicates no change, a value below zero indicates an increase in color or transmission at that wavelength, a value above 0 indicates a decrease in color or translucency at that wavelength.

The reflectance curves may not directly correlate with Translucency Parameter (TP) or ΔE^*_{00} values as the L* a* b* values are not weighted equally across the color space as it is specialized to human color perception. The average TP changes for **Ecosite One** were 0.4 after aging and 0.9 after staining compared to 0.8 and 1.1 for **OMNICHROMA**, which are below the threshold for human perceptibility of translucency change.

Reflectance Curve Translucency Change



Reflectance Curve Color Change



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