

The Exciting New Chemistry of a Self-Etching Adhesive Requires New Treatment Approach



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The current trend in clinical adhesive dentistry is the migration to self-etching adhesive systems. These systems emerged in the late 1980s and have been further developed and studied by various manufacturers and independent researchers for the past 20 years.

SINGLE-BOTTLED SELF-ETCHING SYSTEM

One of the latest self-etching systems released is I-Bond (Heraeus Kulzer, Inc). This product is

unique in that it is the first and currently only single-bottled, self-etching system on the market. Whereas all its self-etching predecessors contain dual-component systems that must either be applied in two separate steps or mixed in a well before application, I-Bond offers a timesaving advantage. This light-curing, all-in-one, unfilled adhesive contains dimethacrylate monomer and 4-META dissolved in acetone and water.

Much confusion exists among dentists familiar with current self-etching systems, and the following clinical steps should provide clarity for most of the current clinical concerns with systems such as I-Bond.

CASE No. 1

Step 1: Preparation of Enamel and Dentin

Studies have shown proper preparation of enamel and dentin are extremely important when using any adhesive system.¹⁻⁷ Because all self-etching systems demonstrate more shallow etching patterns on unground enamel in comparison with phosphoric acid etching, diamond abrasion of enamel cavosurface margins was indicated to remove the aprismatic layer and expose the ends of the prisms and micromechanical retention.^{1,3,6} When and where

to bevel was site-dependent and depends on the orientation of the enamel rods.⁷ Conversely, dentin was best prepared with traditional carbide burs as diamonds create excessively thick smear layers that may prove to be an insurmountable obstacle for some self-etching systems and even some total-etch systems.⁶ When beveling enamel, deep long bevels that expose the ends of enamel prisms and provide adequate thickness to withstand occlusal stress were indicated.⁸

Step 2: Application of i-Bond Self-Etching Adhesive

The application of I-Bond self-etching adhesive involves just a few basic steps. However, strict attention to how and where the product is applied and its dwell time on the prepared surfaces before light-curing must be followed exactly to assure optimal results.

I-Bond can be dispensed in either the unit-dose compule or the multiuse bottle. Both can be shaken before being dispensed. Phase separation with any primer/adhesive combination was possible, and according to the manufacturer, shaking the bottle or compule just a few times allowed the chemical components to blend back to their desired mixture before dispensing (Figure 1).

When the enamel and dentin surfaces were prepared, the shaken compule was opened and I-Bond was dispensed into a disposable dish. It is important to immediately cap the bottle to prevent the organic acetone solvent from evaporating and to prohibit ambient moisture in humid climates from entering the bottle.^{9,10}

The provided microbrush was placed into the compule or well, using an agitating motion to further stir the mixture, and a copious amount of I-Bond was applied to the enamel surface (Figure 2). It was important to extend the coat of I-Bond slightly beyond the diamond abraded enamel surface. Failure to properly extend any self-etching system onto the unprepared enamel surface and completely cover the prepared enamel surface may lead to inadequate marginal seal and possible marginal staining.¹¹ [QA: Reference needed from Dr. Lee] If dentists noted any early marginal staining with any self-etching system, it is quite possible that this simple technique has been overlooked (Figure 3).

When several passes over the enamel cavosurface were accomplished, the brush was saturated again. A copious amount of I-Bond was applied to the internal dentin aspects of the preparation,



Figure 1—I-Bond must be shaken before being dispensed to prevent phase separation and ensure adequate mixture of the complex chemistry.



Figure 2—With the unit dose of I-Bond, remove cap after mixing; place capsule into holding stand; dip and stir microbrush, using agitating motion.



Figure 3—When applying I-Bond, saturate beyond the bevel at the cavosurface margin.



Figure 4—After "rimming" the preparation with I-Bond, the brush was dipped again and fully saturate the internal cavity.



Figure 5—The solvent in all adhesives must be completely volatilized.



Figure 6—I-Bond was light-cured for 20 seconds with a halogen light.



Figure 7—The completed posterior direct composites with Venus.



Figure 8—Preoperative view of a failing class IV composite to be replaced on tooth No. 9.

taking care to thoroughly saturate the dentin walls and floor¹² (Figure 4). Though speculative by some studies, agitating or scrubbing the microbrush onto the dentin surface may aid the penetration of the acidic monomers through the smear layer and into the dentin.¹³

According to the manufacturer, three consecutive coats of I-Bond should be applied to all tooth surfaces to permit a dwell time of at least 30 seconds. This is extremely important. As with any dentin bonding system, whether total-etch or self-etch, time is required for the adhesive to fully penetrate

the collagen filigree, pass into the dentin tubules, and reach micro-mechanical undercuts created by the acidic component. Failure to allow sufficient dwell time to occur is a common mistake in a frantic-paced dental practice for understandably practical reasons. The complex chemical reactions must run to completion particularly with self-etching systems take time, and dentists are advised to pay particular attention to the recommended dwell time of the product for clinical success.

No rinsing, drying, or curing between layers is recommended by the manufacturer. I-Bond is a

single-bottle adhesive, so there are no two components to be mixed, no separate primer to be applied, and this single product is used for the entire process. This is a dramatic advantage over multi-component, self-etching systems and a breakthrough in simplicity for modern dental adhesion.

After a dwell time of 30 seconds with I-Bond, the remaining volatile acetone solvent was evaporated. Failure to completely eliminate the solvent in any adhesive system can destroy or hamper the bonding chemistry.¹⁰ With I-Bond, the manufacturer recommends a gentle, continuous air stream—not a blast of air—over the adhesive layer. This gentle air stream was continued for several seconds, while the dentist visualizes the behavior of the adhesive. Gentle rippling of the adhesive layer under the air stream means that solvent was still present. Air was continually applied until rippling was no longer present, and the adhesive appeared to be “still” on the tooth surface. Depending on the thickness of the layers applied, this may take anywhere from 5 to 10 seconds (Figure 5).

After the solvent was volatilized, the dentist light-cured the I-Bond adhesive for 20 seconds with a halogen light (Figure 6). The dentist must monitor the quality of halogen light output, and it is recommended to routinely check the output of all halogen lights with a curing radiometer on a monthly basis to ensure they are functioning properly. The light-cure catalyst in I-Bond is camphorquinone and is compatible with most plasma arc and LED (light emitting diode) lights, and curing time may be reduced after consulting the manufacturer.

When the I-Bond self-etching adhesive was light-cured, complete dentin tubule penetration and seal as achieved, roughly a 5- μ m hybrid zone established, and the dentin and enamel surfaces were ready to receive a direct composite restoration.¹¹ [QA: reference to come from Dr. Lee] Figure 7 shows the completed posterior case with Venus (Heraeus Kulzer, Inc).

CASE NO. 2

In the second clinical case shown, Figure 8 shows a class IV composite that was stained and in need of replacement. Figure 9 shows the enamel bevel created with a coarse, flame-shaped diamond bur extending 3 mm to 4 mm [QA: Legend for Figure 9 says 2- to 3-mm bevel] beyond the cavity preparation. Figure 10 shows the application of I-Bond in three consecutive coats after shaking the unit-dose compule. I-Bond was extended slightly beyond the diamond-abraded surface to ensure a complete marginal seal. A three-layered, three-opacity, direct-composite restoration (Venus, Heraeus Kulzer, Inc) shades A2 Opaque, A2 Body, and T1 was completed with internal brown and white Effect Color Tints (Heraeus Kulzer, Inc) (Figure 11). The completed polychromatic restoration is shown in Figure 12, demonstrating not only the ease of use of I-Bond self-etching bonding system, but also the beauty achieved with Venus direct composite.

CONCLUSION

Consumer demand for simplified systems without the common complexities related to total-etch systems have been answered in self-etching adhesive systems like I-Bond. By eliminating the



Figure 9—A 2-mm to 3-mm bevel was extended past the existing margins to permit roughening of the enamel sufficient to be “etched” by the self-etching system.



Figure 10—I-Bond was applied with three consecutive coats slightly beyond the prepared surface.



Figure 11—Venus was applied in three opacities and shades, along with Effect Color tints.



Figure 12—The completed polychromatic, internally stained restoration.

separate etching step, the issue of “how wet is wet” is no longer an issue, and the fear of collagen fibril collapse has been eliminated. With I-Bond’s simplified one-bottle system, time, and labor in placing adhesives have been greatly reduced along with the common pitfalls that create post-operative sensitivity. With proper enamel and dentin preparation, high-bond strengths can be achieved; and with proper application of I-Bond, beautiful, well-sealed restorations also can be achieved. ○

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