# 3M ™ CONCISE ™ RESTORATIVE MATERIAL

## Technical Profile

# 3M™ CONCISE™ TECHNICAL PROFILE

## Product Description

Concise™ Restorative composite consists of two pastes which are mixed in equal volume proportions. Both pastes have the same concentrations of matrix resins and filler powder. The pastes differ from each other in that Paste A contains the accelerator and Paste B the catalyst.

Concise™ is a chemically activated, strong, esthetic and long-lasting anterior restorative material. Retention and sealing are provided through the use of the acid etch technique and an adhesive system.

Concise™ is recommended for use in Class III and V restorations, for limited use in Class I restorations in premolars not subjected to occlusal stress, and Class IV restorations. Concise™ contains 78% ( by weight) quartz filler with an average particle size of 9 µm ( the particle sizes ranges from 1 to 40 µm).

## Composition and Curing Mechanism

The major component is a dimethacrylate (Bis-GMA) described in U.S.Patent 3,066,112 by R.L.Bowen. The diluent resin used is also a dimethacrylate, triethyleneglycol dimethacrylate (TEGDMA). No methyl methacrylate is present. The resin part is about 22 percent by weight of the composite.

The filler powder is a form of ground quartz with average particle diameter of about 9 µm. A small percentage of microfill particles is added to the filler fraction (Lutz & Phillips, 1983; Pilliar, Vowles & Williams, 1987). It is treated with a silane so that it is chemically bound to the resin during cure. The solid fraction is about 78 percent by weight of the composite. This corresponds with approximately 67 percent by volume (Willems *et al*, 1993; Cross, Douglas & Fields, 1983).

Other ingredients are present in very minor amounts. The catalyst is benzoyl peroxide. The accelerator is a tertiary amine of the dimethyl- paratoluidine type. Inhibitors are present in parts-per-million. Titanium dioxide and stable iron oxides are present for pigmentation and provide a consistent shade.

Approximately equal volumes of pastes A and B of Concise™ are mixed thoroughly for 20 seconds. The resultant paste has a working time of 60-90 seconds ( depending on temperature) after which time polymerization will have proceeded sufficiently far to turn the fluid paste to a gel. In two minutes the paste will have hardened sufficiently to allow removal of excess material, and after a further two minutes final finishing and polishing procedures can be carried out.

Simply described, when the two pastes are mixed, the accelerator immediately begins "activating" the catalyst causing it to form free radicals. The reaction of these radicals with the dimethacrylate resin molecules is temporarily prevented ( working time) because the radicals react first with the inhibitors. When the small amounts of inhibitors are consumed, the catalyst free radicals then react with the resins and the vinyl coating on the filler particles to form chains of resin and coated filler with cross-linking between chains beginning (gel time). This reaction continues during the hardening time, linking filler particles and resin molecules into a highly cross-linked system ready for finishing.

## Easy Handling

### *Finishing and polishing*

Delay contouring and finishing for a minimum of five minutes after matrix removal. Contour and polish restorations using Sof-Lex™ discs and strip systems, tungsten carbide or diamond finishing burs and mounted points.

Albers (1992) extensively describes the different finishing and polishing tools and techniques. His tips give useful guidance in addition to the instructions for use of the Sof-Lex system. Albers' tips are summarized in the next paragraphs.

Slightly overfill the composite. This allows for removal of the outer air inhibited layer which is softer than the inner parts of the restoration. Use micron diamonds (40-60 µm) for bulk reduction on surfaces unreachable with discs. Use slow or stall out speeds with copious amounts of water. This provides a smooth surface with minimal resin damage. Diamonds are generally better than discs for placing surface texture.
Medium or course diamonds leave a rough surface. This can extend the following finishing and polishing time.
Avoid stones when approaching the final contour because loosened particles (caused by heat and vibration) may result in more surface porosity.
Burs cut the composite surface, which increases the likelihood of resin matrix fatigue fracture.

Sof-Lex discs and strips give an excellent finish and polish. Use the coarse discs with water and a very light touch because heat and friction can weaken the composite and enamel-resin interface. Keep discs constantly moving on the surface to prevent heat and flat spots.
Flexible discs cut composite more rapidly than enamel. Therefore, they can ditch composite very easily. Use discs with more rigid backing (Sof-Lex XT) when polishing margins of materials with different cutting rates (enamel/composite; metal/composite).
Polishing pastes, flour of pumice, tin oxide, rubber wheels and 12-fluted burs generally increase the surface roughness.

Farah & Powers (1998) give a good update of currently available diamonds, carbides, discs, mounted points and pastes. Appendix B gives an overview of the available instruments and their respective areas of use.

## Assets

### *Color Stable*

The color stability of Concise™ restorative to UV light satisfies the relevant ISO standard.

Contrary to light-cured composites, Concise™ restorative does not show perceptible color changes upon curing (Seghi, Gritz & Klim, 1990).

### *Adequate Smooth Surface*

Generally, the scientific community relates a minimized plaque retention to a smooth surface. Benderli *et al* (1997) found that more plaque retention was observed on a proprietary microfill composite resin that releases fluoride compared to Concise™!

A smooth surface should remain smooth after functioning under oral conditions for some time. The 'golden standard' is the surface roughness enamel after occlusal enamel-to-enamel contacts. Willems *et al* (1993) report for the intrinsic roughness of enamel a value of 0.64 µm. Concise™ has an intrinsic surface roughness after tooth brush abrasion of 1.44 µm (Willems *et al*, 1993), which indicates that it makes sense to re-polish the restorations at recalls (see section Maintenance and Repair).

A slightly rougher surface is a concern to some authors in that a restoration may unacceptably abrade an opposing tooth. Enamel against enamel represents the golden' standard. Concise results in the same tooth profile reduction as enamel (Ratledge, Smith & Wilson, 1994). Suffice it to say that a microfill product such as Silux Plus actually is better than enamel.

### Minimal Stress in Restoration

Stress built-up during polymerization of a composite restoration depends on several factors: An effective bond of the adhesive (a loose restorations has no internal stress), polymerization shrinkage, the modulus of elasticity as well as the water absorption and the related hygroscopic expansion of the composite. The polymerization shrinkage of proprietary contemporary composite materials is essentially in the same ballpark. The volumetric polymerization shrinkage for Concise™ is in the range of 1.8-2.4% (Matschinske, Tappe & Sandner, 1989; Matschinske, Tape & Matschinske, 1991), which is somewhat smaller than that of major part of the market products. At last, the mode of curing is important. Chemically curing materials such as Concise™ have lower internal stress levels developing than light curing materials of similar composition. Due to their lower curing rate, both the adhesive bond strength has more time to develop to adequate levels and internal stresses developing in the restorations can relax for a longer time.

### Density

The density (Figure 1) of a material represents the number of grams per $cm^3$ (more generally expressed: mass per unit of volume).

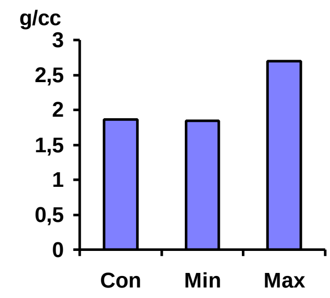


*Figure 1. Density (in g/cc) of Concise™ (C) and minimum (Min) and maximum (Max) of competitive traditional anterior and universal composite resin restoratives.*[1]

When the price per gram is multiplied with the density, one obtains the price per $cm^3$. A cavity represents a certain volume that needs to be restored. So, to compare prices, it makes sense to compare them on a price/volume-basis.

Figure 2 gives a conversion factor that relates to the price per volume. When one defines the price of Concise™ as 1 (per unit of volume), one obtains the price per unit of volume by multiplying the price per gram with the conversion factor. For instance, in case of a product with a conversion factor 1.2, one needs to multiply the gram-price by 1.2 to obtain a comparable price on a cc(ml)-basis. Suffice it to say that Silux Plus is much lower priced than the price per gram suggests.

[1] Competitive data competitive anterior and universal products from Momoi & McCabe (1994) and De Gee, Feilzer & Davidson (1993)

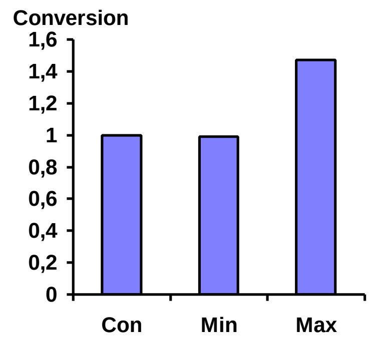


*Figure 2. Conversion from gram- to ml-price for of Concise™ (Con) and minimum (Min) and maximum (Max) of competitive composite resin restoratives.*

### *Water Sorption and Solubility*

Water sorption and solubility are within the limits required by the relevant ISO-standard. Usually, market products are within the ISO acceptance limits. A negative clinical influence of a somewhat higher water sorption or solubility within the ISO acceptance limits is not known.

### *Compressive Strength*

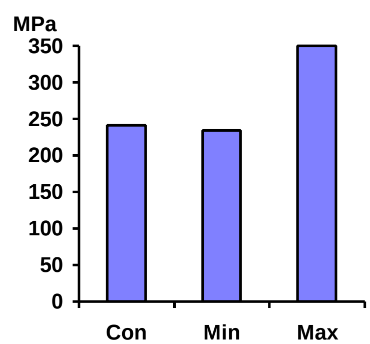


*Figure 3. Compressive strength of Concise™ (Con) and minimum (Min) and maximum (Max) of competitive traditional composite resin restoratives. Data from Willems et al (1993).*[2]

Enamel and dentine have compressive strength numbers of 384 and 297 MPa respectively (Craig, 1989). Phillips (1982) reports 305 and 248 MPa as fracture strengths of a molar and premolar respectively. Clinical performance results confirm that the compressive strength of Concise™ is sufficient for its indication for anterior use.

## Clinical Performance

Concise™ is one of the best documented composite systems on the market. Literature gives numerous results of clinical results. The table in Appendix A gives a brief summary of published clinical reports.

The clinical performance not only depends on Concise™. Certain aspects strongly depend on the choice of the dental adhesive or selection of an elastic resin modified glass ionomer liner. For more information on these products, we refer to dedicated 3M product profiles.

## Maintenance and Repair

Esthetic restorations need to be maintained. Both by the dentist and the patient. Plaque should be routinely removed so as to avoid adjacent soft tissue becoming inflamed. Discoloration, staining, soft tissue response, fracture or other deterioration effects may impair the functional aspect of the restoration. Both dentist (craftsmanship, maintenance during check-ups) and patient (nutrition, oral hygiene, life style) play a pertinent role and may cause the restoration to fail after a short period of time. For instance, an undercured composite in combination with a specific diet (red wine, coffee, cola, tea) may give unacceptable discoloration. Alcohol consumption may soften the resin matrix of (undercured) composite or compromise a bonding agent. High alcohol mouth-rinses will have a similar effect and may adversely affect the esthetics. Periodic refinishing or polishing of the restoration surface by the dentist

[2] Internal data for Concise by 3M are higher (see Appendix C). This is probably due to test differences.

will exert a positive influence. Proper brushing, flossing, oral irrigation and interdental stimulation form other useful tools of the 'maintenance armamentarium'.

Composite repair is a viable solution to correct surface discoloration of existing restorations, to restore small areas of (recurrent) caries along the margin of an otherwise sound composite restoration or in a situation when complete removal of a very large composite restoration would jeopardize the integrity of a tooth. Pounder, Gregory & Powers (1987) describe a viable repair technique for Concise™. They apply an intermediate enamel or dental adhesive bonding agent to a 600-grit rough surface.

The following paragraphs give some practical tips by Albers (1992).

Avoid mechanical cleaning devices on composites because they may badly "pit" the restoration. When there is a need for re-polishing, avoid coarse prophypastes.

Fillers of macrofilled composite resin restorative may be dissolved and pitted by aciludated phosphate fluoride (APF) gels. It would be best to use non-APF fluorides on patients with Concise™ restorations.

Where small repairs are feasible, one should be careful with large repairs. Christensen (1995) explains the problems very well: " After a few hours in the mouth, resin restorations cannot be expected to bond well to new repair resin, because the chemical activity of the original restorative resin has been exhausted. If resin repair is being considered, and either the repair segment or the remnant of remaining resin is not expected to be self-retentive within the tooth, the entire restoration should be replaced. If the old restoration can be considered retentive by itself, irrespective of the new portion, a repair can be considered. Usually, total replacement is better than repair." For instance, Mitsaki-Matsou *et al* (1991) report indeed that the repair bond strength ranges from 19% to 52% of the strengths of the unrepaired resins after storing the samples at 37 °C for periods up to one year.

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## Appendix A

| Reference | Remark |
|---|---|
| Baratieri, Moneiro & Andrada (1991) | Case, reattachment fragments, 3 years |
| Crumpler *et al* (1988) | Class III, five years |
| Davis (1986) | Anterior, three years |
| Dijken (1990) | Abrasion/erosion, four years |
| Eames & Rogers (1979) | Porcelain repairs, one year |
| Faunce & Myers (1976) | Laminate veneer, case/technique |
| Hansen (1988) | Class II, fifteen years |
| Hurwitz (1980) | Interim post/composite, case/technique |
| Jokstad *et al* (1994) | Class III, IV and V, ten years |
| Käyser *et al* (1992) | Metal/composite build-up |
| Mettler, Friedrich & Roulet (1978) | Posterior, wear, one year |
| Raadal (1978) | Preventive restoration, 2.5 years |
| Roulet, Mettler & Friedrich (1978) | Posterior, wear, one year |
| Roulet, Mettler & Friedrich (1980) | Posterior, wear, three years |
| Simonsen & Stallard (1977) | Preventive restoration, one year |
| Simonsen (1980) | Preventive restoration, three years |
| Simonsen (1997) | Closed diastema case, nineteen years |
| Smales & Gerke (1992) | Class III, IV and V five years |
| Smales (1983) | Incisal angle restorations, five years |
| Smales (1991) | Anterior, sixteen years |
| Smales (1991) | Anterior, sixteen years |
| Smales, Webster & Leppard (1992) | Anterior, eighteen years |
| Varpio (1985) | Class II, pedodontics, six years |

## Appendix C. Finishing and Polishing Tools

Available finishing and polishing armamentarium and its area of use (adapted from Farah & Powers, 1998)

| Tool | Shape or Abrasive | Area of Use |
|---|---|---|
| *Gross Reduction* | | |
| 25-45 µm diamonds | Flame<br>Needle, needle<br>Needle with rounded end | Labial/Lingual<br>Labial/Proximal<br>Occlusal |
| 8-12 µm fluted carbides | Concave, tapered<br>Egg<br>Needle | Cervical, labial<br>Lingual<br>Occlusal/Proximal |
| Discs | Aluminum Oxide | Labial/Lingual/Proximal |
| Strips | Aluminum Oxide<br>Diamond - 45 µm | Proximal<br>Proximal |

| | | |
|---|---|---|
| *Finishing/Polishing* | | |
| 8-25 µm diamonds | Flame, flame<br>Needle with rounded end, needle<br>Needle | Labial/Lingual<br>Occlusal<br>Proximal |
| 30-fluted carbides | Egg<br>Needle | Lingual<br>Proximal/Occlusal |
| Discs | Aluminum Oxide | Labial/Lingual/Proximal |
| Strips | Aluminum Oxide<br>Diamond - 15 µm | Proximal<br>Proximal |
| Mounted points | Aluminum Oxide | Labial/Lingual/Occlusal |
| Paste | Aluminum Oxide | Where accessible |

## Appendix C. Summary composition and physical properties

| Aspect | Unit | Time | Concise™ |
|---|---|---|---|
| **Resin** | | | Bis-GMA<br>TEGDMA |
| **Filler** | | | |
| ***Type*** | | | Silica (Quartz) |
| ***Loading*** | Vol.% | | 62 |
| | Wt.% | | 78 |
| **Density** | g/cc | | 1.86 |
| **Compressive Strength** | MPa | 1 h | 260 |
| **Diametral Tensile Strength** | MPa | 24 h | 55 |
| **Water Absorption** | $\mu g/mm^3$ | | <50 |
| **Visual Opacity** | | | 0.35 |
| **UV Color Stability** | | 24 h | Pass |
| **Radiopacity** | | | No |