

Vinyl Polysiloxane Ether: A Breakthrough in Elastomeric Impression Material

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ABSTRACT

A meticulous impression is paramount for a precision fit of indirect restoration. Unfortunately, for many clinicians, making an impression for fixed prostheses is one of the challenging aspects in restorative dentistry. Advances in elastomeric chemistries have given birth to a new generation of impression materials: a combination of a polyvinyl and a polyether impression material, called vinyl siloxane ether.

The purpose of this article is to explore the new impression material which is effective and efficient to obtain predictable, accurate, high quality impressions in dental practice.

Keywords: Elastomer impression, Vinyl polysiloxanes, Hydrophilicity.

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INTRODUCTION

An accurate impression is the first most important step in the procedure of obtaining a perfect restoration. It is the aim of the impression to produce a dimensionally stable ‘negative’ which can serve as a mold for a cast.

It is long foregone that almost every impression material meets all the basic requirements for an impression material.

The recording of tissues in oral cavity is difficult due to factors, such as salivation, blood flow and sulcular fluid. This becomes critical especially in recording finish lines for fixed restorations, especially where margins lay intrasulcularly. Hence, most dental surveys conducted correctly rate hydrophilicity as the most important criteria to choose an impression material.¹ Where more can these materials improve? Not just hydrophilicity, immediate

hydrophilicity is the need of the hour. This has led to the dawn of a new elastomeric impression material, i.e. vinyl polyether siloxane.

Elastomers refer to a group of rubbery polymers, which are either chemically or physically cross-linked. There are four kinds of elastomers used as impression materials viz., polysulfide, condensation silicone, addition silicone and polyether. Of these, addition silicone and polyether are most commonly used. Traditional additional silicones were hydrophobic; due to which accuracy of impressions was questionable. The newer ones have added surfactants to counteract this. Polyether, on the other hand, is hydrophilic and records good detail, but it is the stiffest among all elastomers.

This newer elastomer that has been developed is called as vinyl polyether siloxane (VPES) combining features of both addition silicone and polyether. This new elastomer boasts of immediate hydrophilicity, at the same time combining favorable characteristics of both polyether and vinyl polysiloxane.

History of Elastomers

Figure 1 summarizes the history of elastomers. In the 1950s, polysulfides and condensation reaction silicones (C-type silicones) were used reliably in fixed prosthodontics.

In the late 1960s, polyether, a hydrophilic product cured by the cationic ring opening polymerization reaction, was introduced to the market. Its high mechanical properties, good elastic recovery, and small shrinkage made it superior to hydrocolloids and C-type materials. Ten years later, the hydrophobic addition-cured silicones [poly(vinyl siloxane)] (PVS) were introduced. The level of hydrophobicity was reduced by the addition of surfactants. PVS has a very high dimensional stability over time and temperature. It is known for its superior elastic recovery even in a moist environment.²

According to Christensen in 1997, ‘the past 20 years have brought significant improvement in polyether and (PVS) categories, and now they appear to be the most acceptable product categories for most prosthodontic uses. In 1997, three categories of impression materials dominate fixed, removable and implant prosthodontic uses: addition reaction silicone, polyether and reversible hydrocolloid listed in order of decreasing use.’⁹

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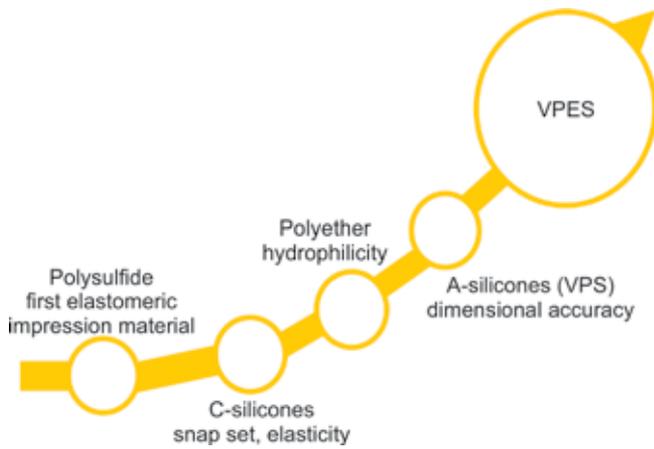


Fig. 1: History of elastomers

Very recently, a new material has been developed based on 'Best of both Worlds' concept *viz*, vinyl polyether siloxane.¹⁰

Chemistry of the Unique Vinyl Polyether Siloxane

It is a new chemical compound developed by combining polyether polymer and vinyl groups of VPS as described in Figures 2 and 3.

Properties of Vinyl Polyether Siloxane

The properties of vinyl polyether siloxane (VPES) material and comparisons between VPES, addition silicone and polyether are summarized in Tables 1 and 2.

Indications

The vinyl polyether siloxane is targeted toward one step impression users.

This material has to be used only in a one step multiple mix technique. It is available in viscosities of medium (Monophase), heavy and light. Some companies even provide normal and fast setting materials with putty viscosity available in the normal setting material.

The multiple mix technique involves fabrication of a custom tray, and loading of two viscosities of materials to record the tissues. In case of the heavy-light body combination; heavy body is dispensed using a dynamic mixer (Fig. 4) onto the impression tray by the assistant, simultaneously the operator injects the light viscosity onto the tooth of interest. The tray with heavy body is seated in the mouth and once set it is retrieved to obtain the impression. Tooth number 14 was prepared for a ceramometal crown and the corresponding impression was made with a combination of heavy and light body VPES in a stock tray (Fig. 6).

In case of the monophase viscosity, the same material is loaded onto the tray and a special syringe with a plunger (Fig. 5) provided by the manufacturer. Due to shear thinning ability and a unique thermosensitive rheology system; the syringe material when extruded out of the syringe, flows onto the prepared teeth accurately. The tray with tray viscosity monophase is then seated in the mouth and the impression is finished.

Some of the specific indications according to viscosity are listed below:

Medium Viscosity

1. Transfer (implantology)
2. Crown and bridge
3. Inlay/onlay

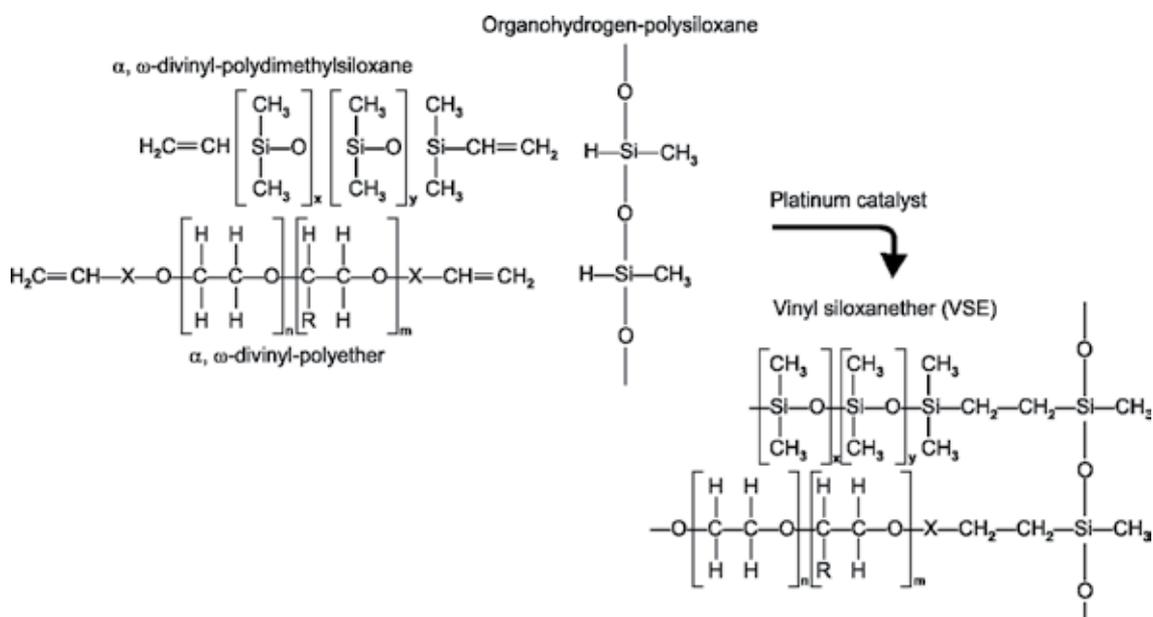


Fig. 2: Combination of polyether polymer and vinyl siloxanether vinyl group

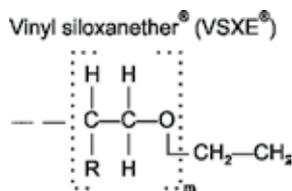


Fig. 3: Vinyl siloxanether molecule

4. Veneer
5. Functional impression.

Heavy Viscosity

1. Carrier (tray) product
2. Crown and bridge
3. Inlay/onlay
4. Veneer
5. Implant impressions.

Light Viscosity

1. Precision impressions
2. Crown and bridge
3. Inlay/onlay
4. Veneer
5. Implant impressions.

Advantages

- Excellent flowability due to a thermosensitive rheology system allows the material to get into the narrowest sulcus crevices while ensuring high stability.³
- Remarkable hydrophilicity (dynamic surface conditioning through a synergistic hydrophilic system) means an optimal wetting in a moist environment⁴ and the lowest achievable contact angle (less than 10° after 1 second).
- Constant product properties throughout the whole clinical working period.



Fig. 4: Dynamic mixer



Fig. 5: Special syringe with plunger



Fig. 6: Tooth preparation and impression with VPES

- Optimized elastomeric properties: dimensionally accurate recovery and easy removal from the mouth.
- Balanced setting behavior with the double-snap effect for a long working time at a short intraoral time.
- Easy and fast, true-to-detail fabrication of casts without fracture risk.
- It is odorless and tasteless, hence accounts for a pleasant feel in the mouth. This ensures there is no gag reflex, no erratic movement on part of the patient.
- Easy handling in the familiar Plug and Press[®] system.
- It is compatible with commercially available disinfectants.

Table 1: Summarizes the comparative properties of the various consistencies of VPES material

	Medium	Medium soft	Heavy	Light
Working time (35°C)	1 min 20 sec			
Intraoral setting time (35°C)	3 min 30 sec			
Total setting time	5 min 30 sec			
Hardness (Shore)	≈ A 60	≈ A 50	≈ A 60	≈ A 48
Linear dim. change	≈ -0.2%	≈ -0.2%	≈ -0.2%	≈ -0.2%
Recovery from deformation	≥99%	≥99%	≥99%	≥99%
Strain-in-compression	≈ 2.3%	≈ 3.3%	≈ 2.8%	≈ 3.5%

Table 2: Comparative properties

Property	Addition silicone	Polyether	Vinyl polysiloxane ether
Working time	2-4 min	3	1 min 20 sec
Setting time	4-6.5	6	5 min 30 sec
Automatic mixing	Y	Y	Y
Custom tray	N	N	N
Multiple casts	Y	Y	Y
Dimensional stability	-0.15%	-0.2%	≈ -0.2%



- It gives the operator the option of immediate pouring of casts or else the impression may be disinfected and transported to the laboratory for pouring at a later time; boasting of the same level of accuracy.

Dimensional Stability

Stober et al⁵ have stated that vinyl siloxanether monophase impressions and vinyl siloxanether dual-viscosity impressions display acceptable accuracy for clinical use with immersion disinfection, since the results for vinyl siloxanether were comparable to the results for representative polyether and vinyl polysiloxane materials.⁶

Techkouhie A et al⁷ suggest that PVS has the smallest change (−0.15%), followed by polyether (−0.2%). The vinyl siloxane ethers have a dimensional change of $\approx -0.2\%$ which is acceptable.⁸

CONCLUSION

Over the last 100 years, elastomeric impression materials were continuously developed and optimized for improved precision, patient comfort and ease of use. Vinyl polysiloxane ether is a recently developed material and further studies are needed. It represents the dawn of the next generation of materials, overcoming the drawbacks of all previous impression materials. We clinicians can expect more improvements ahead in the times to come.

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