# DENTAL COMPOSITE FORMULATIONS

## IITM Technology Available for Licensing

## Problem Statement

- Polymeric biomaterials are used in dental composites as **restorative materials or adhesives for cavity filling , gap filling reshaping of teeth etc**.
- Conventional dental composites has disadvantages due to **polymerization shrinkage**, **seepage of fluids and microorganism** to **pulp tissue** ,diluents contributing to **greater elution** and **cytotoxicity**, **post operative sensitivity, endocrine disruption etc.**

## Technology Category/ Market

**Category – Medical and Surgical Devices**
**Applications** –Dental cements,restorative dentistry, polymeric materials
**Industry –** Dental/ medical
**Market** -The global dental fillings market size was valued at **USD 5.2 billion in 2018** and is expected to grow at a compound annual growth rate (**CAGR) of 7.2%** from **2019 to 2026.**

## Key Features / Value Proposition

***Technical Perspective:***

- Provide a novel dental composite ,that includes a composition for **organic resin matrix and filler modification for polymeric biomaterial**
- **Moderate self adhesive nature** minimizes the use of unfilled bonding agents which may increase post-operative sensitivity and cytotoxixity
- The **matrix shrinks less** as predominant polymerization is based on ring opening
- Composition satisfies the concept of increased ratio of molar volume to number of double bonds.

***User Perspective:***

- **Highly hydrophobic, good crosslinking ,low elution, biocompatible and hydrolytically stable**
- **Used for cementation of implants, endodontic sealers, root repair materials, root end filling materials, and luting cements**

## Technology

The invention discloses a ***dental composite comprising***

A matrix comprising a **hybrid of two macromers** with
i. Any of the many **methacrylate terminal groups**
ii. Any of the many **ring-opening** polymerizable group

**Co-polymerization of the hybrid** with any of the many biologically and chemically compatible **cross-linkers** and plurality of **adhesive monomers**

- ✓ **Photoinitiator compounds**
- ✓ **Hydrogen donor**
- ✓ **Unsilanized filler**
- ✓ **Additives**

***Matrix further comprises:***

**i) Cationic ring opening polymerizable macromer** | ii) Free-radical polymerizable

iii) An accelerator | **iv) Photoacid catalyst**

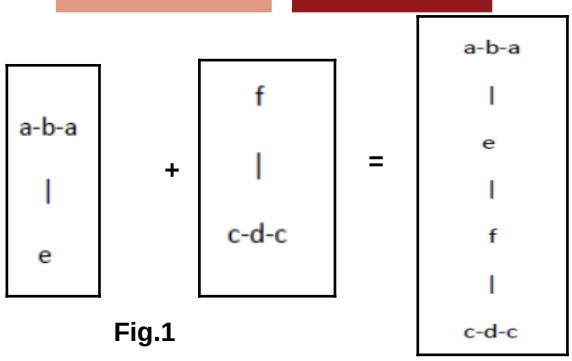


**Fig.1**

- ✓ The Macromer resin “a” has a first functional moiety “b” and Macromer resin “c” has a second functional moiety “d”
- ✓ The polymerizable monomers are represented as “e”, “f” and “g” as shown in the Fig. 1

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- The first functional moiety "b" includes at least one of a **free-radical polymerizable Methacrylate group** and the second functional moiety "d" includes at least one of a **ring-opening polymerizable cyclic Epoxy group**
- The additives of the said composite comprises stabilizer, inhibitor, coloring pigments, oxygen scavengers, antibacterial, anti-caries agents, others that induce smart properties by one of self-healing, repair, and debonding
- **Photoinitiator** can be diketone or a propanedione or an acylphosphene oxide or any one Norrish Type II photoinitiator
- **Adhesive monomers** are mixture of an acid ester, acid, and hydrophilic monomer

## Preparation of the Organic resin matrix

- The constituents are mixed in a cyclic mixer to obtain a **homogeneous product**
- **To the above product 1% to 2% diketone, photoacid and a hydrogen donor** are added and mixed in a cyclic mixer and stored in **a brown/black container**
- Adding 1% to 2% of acidic monomer (dipentaerythritol pentaacrylate phosphoric acid ester (**PENTA)**), acid like butane tetracarboxylic acid, and hydrophilic monomer like hydroxyethyl methacrylate **(HEMA)** in a tertiary butanol vehicle
- Obtaning the **organic resin matrix**

## Composition of Dental composite

- The dental composition includes the organic resin matrix combined with unsilanized filler
- It can be 20-35% of organic resin matrix and 65-80% of unsilanized filler; or at a range of 30% of the prepared organic resin matrix and 70% unsilanized Quartz filler

## Images

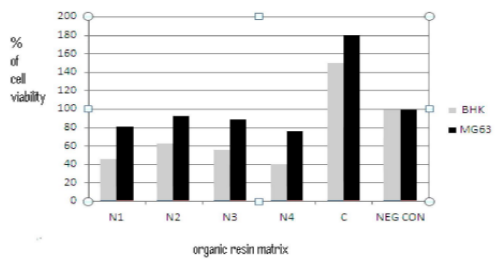


**Fig. 2A** is an example graph depicting cytotoxicity levels in 5 experimental dental organic resin matrix and conventional dental organic resin matrix

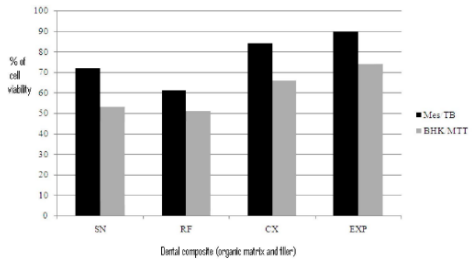


**FIG. 2B** is an example graph depicting cytotoxicity levels in experimental dental composites and conventional dental composites

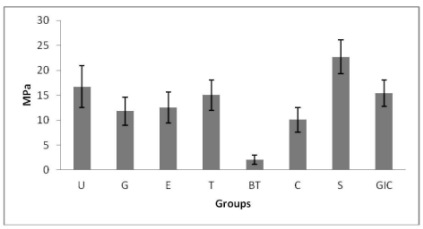


**FIG. 3** is a graph depicting micro-tensile bond strength of the experimental organic matrix based four composites U, G, E, T and conventional dental composite and a control commercial self-adhesive restorative cement

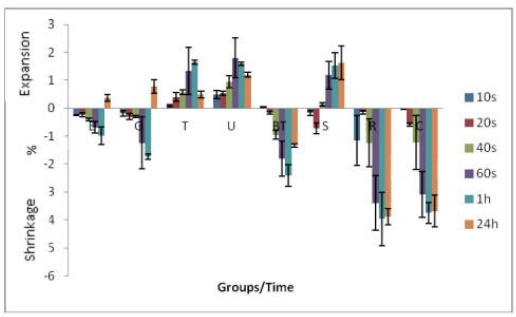


**Fig. 4** is an example graph depicting dimensional change of composites during polymerization measured at different instants showing expansion and shrinkage of the experimental and conventional dental composites

## Intellectual Property

- **IITM IDF Ref. 975**
- **IN343192-Granted**
- **PCT/IN2014/000408**

## TRL (Technology Readiness Level)

**TRL- 4,Technology Validated in lab**

## Research Lab

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