DENTAL FILLERS

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INTRODUCTION TO DENTAL FILLERS

Definition

Dental fillers, also known as dental composites or tooth-colored fillings, are materials used to restore and repair teeth that have been damaged by decay or trauma.

Purpose

The primary purpose of dental fillers is to restore the function and aesthetics of damaged teeth, providing a natural-looking and durable solution.

TYPES OF DENTAL FILLERS

Composite Fillers

- Made of a mixture of glass or quartz filler in a resin medium.
- Match the color of the tooth, making them a popular choice for visible teeth.
- Can be used for small to medium-sized cavities and for repairing chipped or broken teeth.

Porcelain Fillers

- Made of a ceramic material that is crafted to match the color and texture of the natural tooth.
- Provide excellent durability and resistance to staining.
- Best suited for larger restoration or for patients with severe tooth decay.

Ceramic

A ceramic is any of the various hard, brittle, heat-resistant, and corrosion-resistant materials made by shaping and then firing an inorganic, nonmetallic material, such as clay, at a high temperature. Common examples are earthenware, porcelain, and brick.
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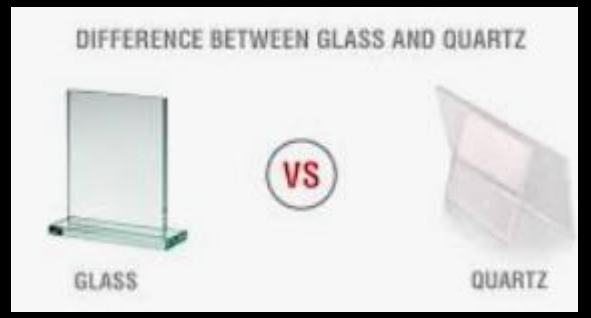
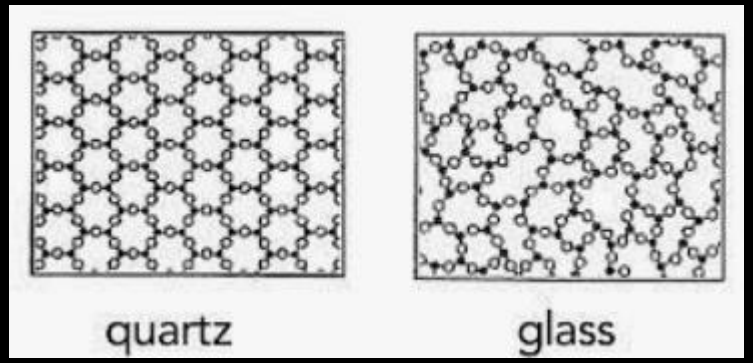




What is difference between glass and quartz?

Glass is an amorphous solid in which the constituent particles (SiO4 tetrahedra) have only a short range order. Quartz is a crystalline form of silica in which SiO4 units are arranged in such a way that they have long ranged order. Quartz can be converted into glass by melting it and cooling it rapidly.

Amalgam Fillers

- Made of a mixture of metals, including silver, tin, copper and mercury.
- Known for their strength and longevity.
- Typically used for large cavities in the back teeth where chewing forces are the greatest.

APPLICATIONS OF DENTAL FILLERS :

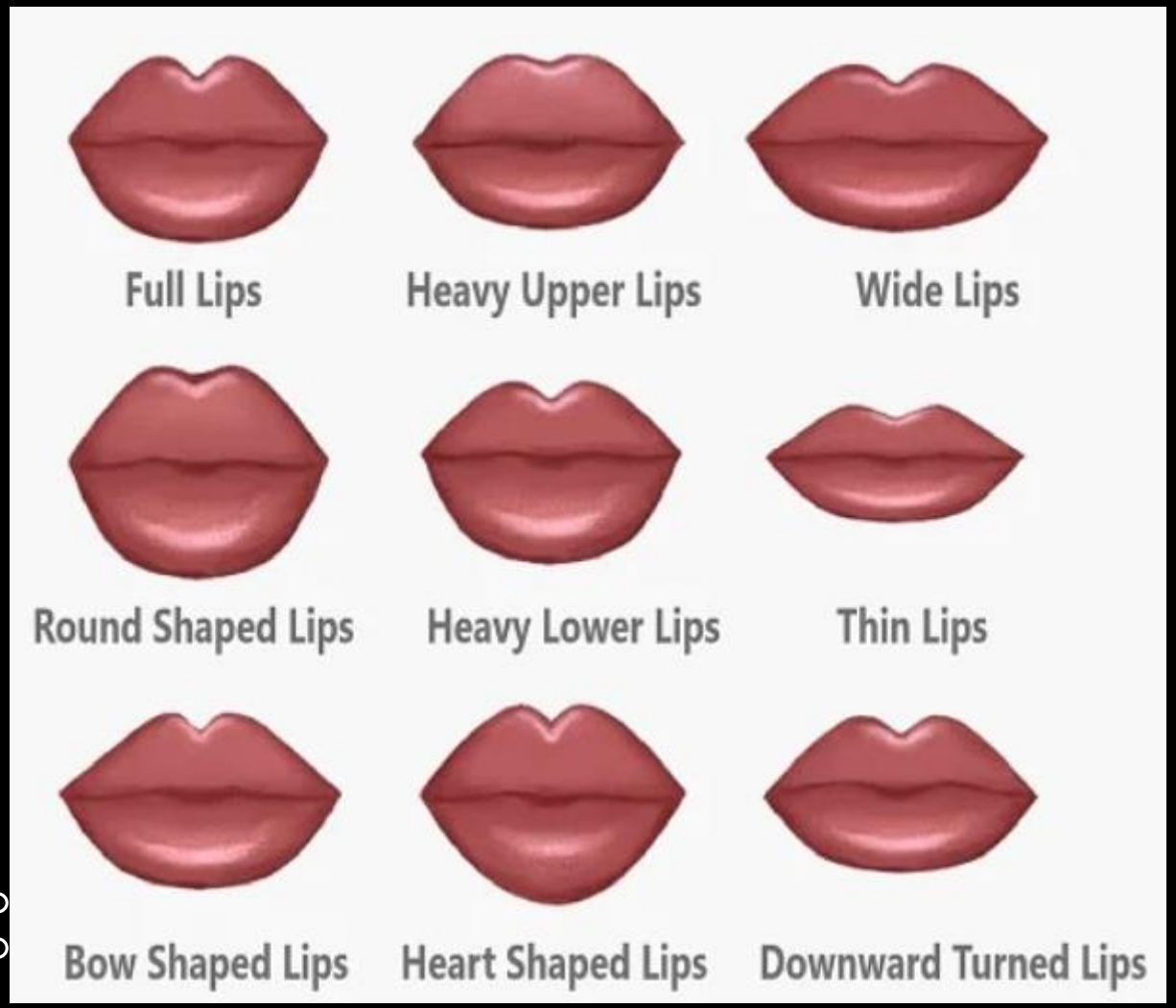
Common Dental Issues

- Cavities: Dental fillers are commonly used to fill cavities and restore the structure and function of the affected tooth.
- Chipped Teeth: Dental fillers can be used to repair chipped or broken teeth, restoring their appearance and preventing further damage.
- Gaps: Dental fillers can be used to fill in gaps between teeth, improving the overall alignment and appearance of the smile.

Cosmetic Uses

- Smile Aesthetics: Dental fillers can be used to enhance the appearance of the smile, improving the shape and contour of the teeth.
- Lip Augmentation: Dental fillers can be used to enhance the volume and shape of the lips, creating a fuller and more youthful appearance.

Lip augmentation is an in-office cosmetic procedure that creates fuller, more youthful-looking lips. There are different types of lip augmentation to fit your needs and goals. Some procedures are nonsurgical, using fillers to plump up the lips temporarily. 14 Apr 2022



BENEFITS OF DENTAL FILLERS

Dental fillers offer a range of benefits for patients seeking to improve their oral health and enhance their smiles. These benefits include:

Key Benefits

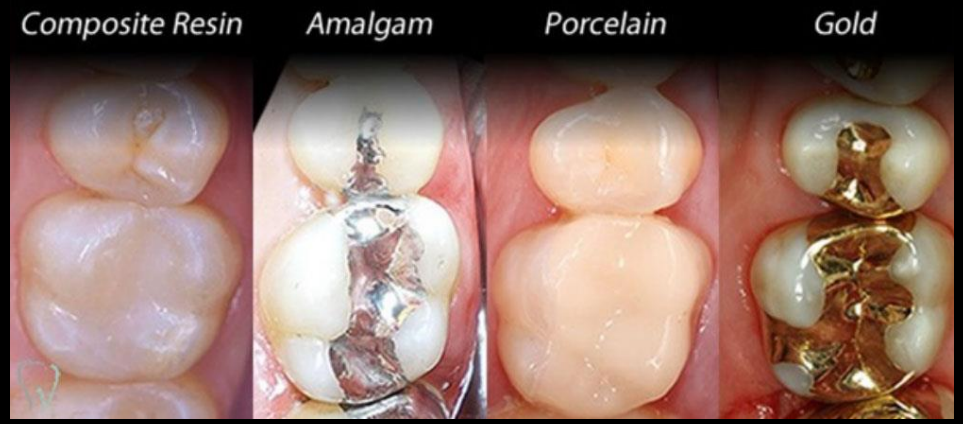
Restoration of Tooth Structure and Function	Dental fillers help restore the integrity and strength of damaged teeth, allowing for improved chewing and speaking abilities.
Enhanced Appearance and Confidence	Fillers can improve the appearance of teeth by filling in gaps, cracks, or discolorations, resulting in a more aesthetically pleasing smile. This can boost a patient's self-confidence and overall satisfaction with their smile.
Minimization of Further Dental Complications	By filling cavities or repairing damaged teeth, fillers can prevent the progression of dental issues such as tooth decay or infection. This helps to avoid more extensive and costly dental treatments in the future.
Preservation of Natural Teeth	In cases where a tooth has suffered minor damage or decay, dental fillers can help preserve the natural tooth structure, eliminating the need for extraction or more invasive procedures.

CHEMISTRY OF DENTAL FILLERS

Composition of Dental Fillers

Dental fillers are typically made of a combination of materials, including:

- Resin-modified glass ionomer cement (RMGIC).
- Glass ionomer cement (GIC)
- Composite resin



Glass ionomer cement (GIC) is a self-adhesive restorative material. Chemically, it combines fluoro-aluminosilicate glass powder and polyacrylic acid liquid. It has a broad spectrum of restorative and pediatric dentistry uses and exhibits a potent anti-cariogenic action

What is resin-modified glass ionomer cement?

Resin-modified glass ionomers (RMGI) were developed in an attempt to improve mechanical properties, decrease setting time, and attenuate moisture sensitivity. Simplistically, RMGIs are a hybrid of glass ionomers and composite resin, and thus contain acid-base and polymerizable components.

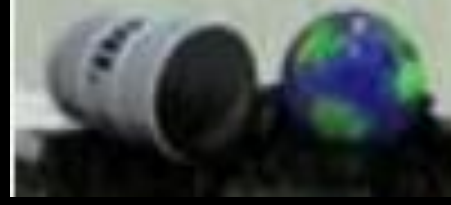
What is the difference between GI and RMGI?

RMGI's are more translucent and esthetic than self-curing GI's. The fluoride release is less than self- curing GI's but they have proven release of fluoride ions during acidic attack and can be recharged with exposure to external sources of fluoride.


Resin-modified glass ionomer (RMGI)
• Improve properties
– Set on demand
– Fewer desiccation and hydration problems
– Immediate finishing
– Better esthetics
– Tensile strength, fracture toughness
– Resistance to microleakage
– Bond to resin composite

Advantages

- **Less shrinkage** than polymerizing resin
- **No free monomers**, Non-irritating to pulp
- Coefficient of **thermal expansion** similar to dentin
- High compressive **strength**



CHEMICAL REACTIONS IN DENTAL FILLERS

Dental fillers undergo various chemical reactions during the filling process, including:

- Hydrolysis of the resin matrix, which releases calcium and other ions into the tooth structure.

- Cementation of the filling material to the tooth structure, which involves the formation of a strong bond between the filling material and the tooth structure.

COMPARATIVE ANALYSIS

Dental Fillers vs. Dental Implants

Advantage of Dental Fillers:

- Non-invasive procedure
- Quick and simple process
- Immediate results

Limitations of Dental Fillers:

- Temporary solution
- May require multiple treatments
- Not suitable for severe tooth damage or missing teeth

DENTAL FILLERS VS. DENTAL CROWNS

Advantage of Dental Fillers:

- Preserves more natural tooth structure
- Less invasive procedure
- Faster treatment time

Limitations of Dental Fillers:

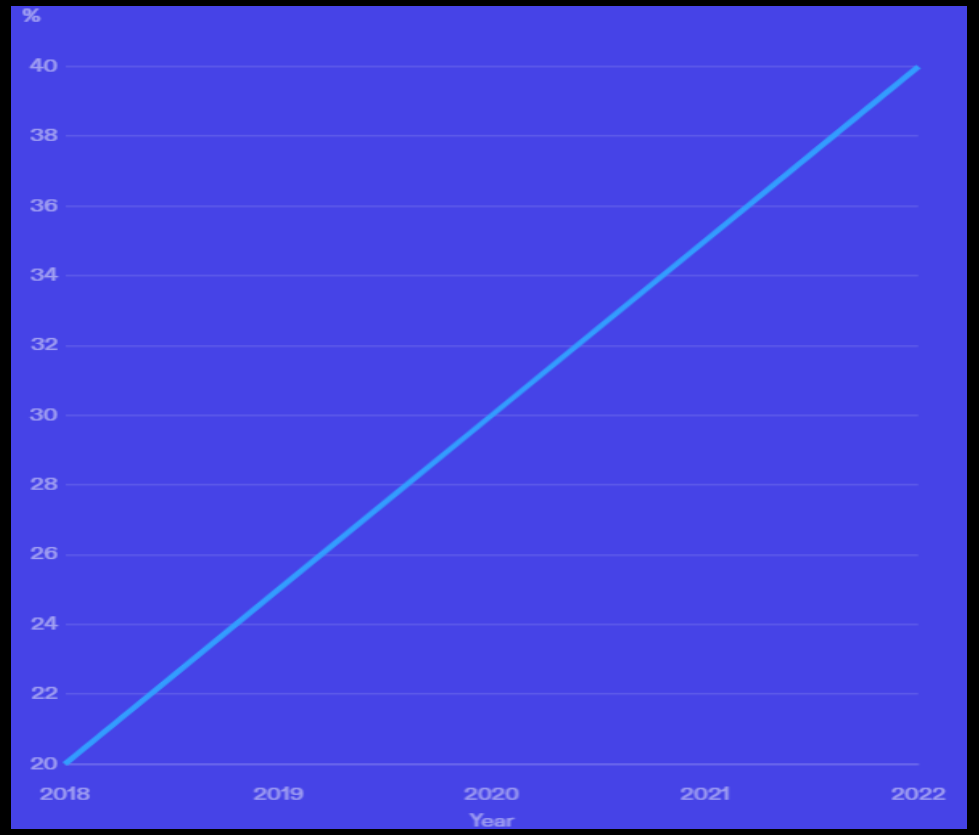
- Not suitable for extensive tooth decay
- May not provide as long-lasting results as dental crown
- May require touch-up treatments over time

FUTURE TRENDS

Emerging Technologies

- Nanotechnology: The use of nanomaterials in dental fillers is gaining traction, allowing for improved aesthetics and durability.
- Bioactive Materials: Researchers are exploring the use of bioactive materials in dental fillers, which can promote natural tooth regeneration and repair.
- Digital Dentistry: Advancements in digital dentistry, such as computer-aided design and manufacturing (CAD/CAM), are revolutionizing the production and customization of dental fillers.Temporary solution

Dental Fillers Market Share



CONCLUSION

- Dental fillers are an important tool in modern dentistry, providing solutions for various dental issues.
- They come in different types, including composite resin and porcelain, each with its own advantages and applications.
- Dental fillers offer numerous benefits, such as restoring tooth structure, improving aesthetics, and preventing further damage.
- However, it is essential to consider factors like durability, cost, and potential allergic reactions when choosing the right filler.
- Overall, dental fillers play a crucial role in enhancing oral health and creating beautiful smiles.

Stain Remover-Vanish

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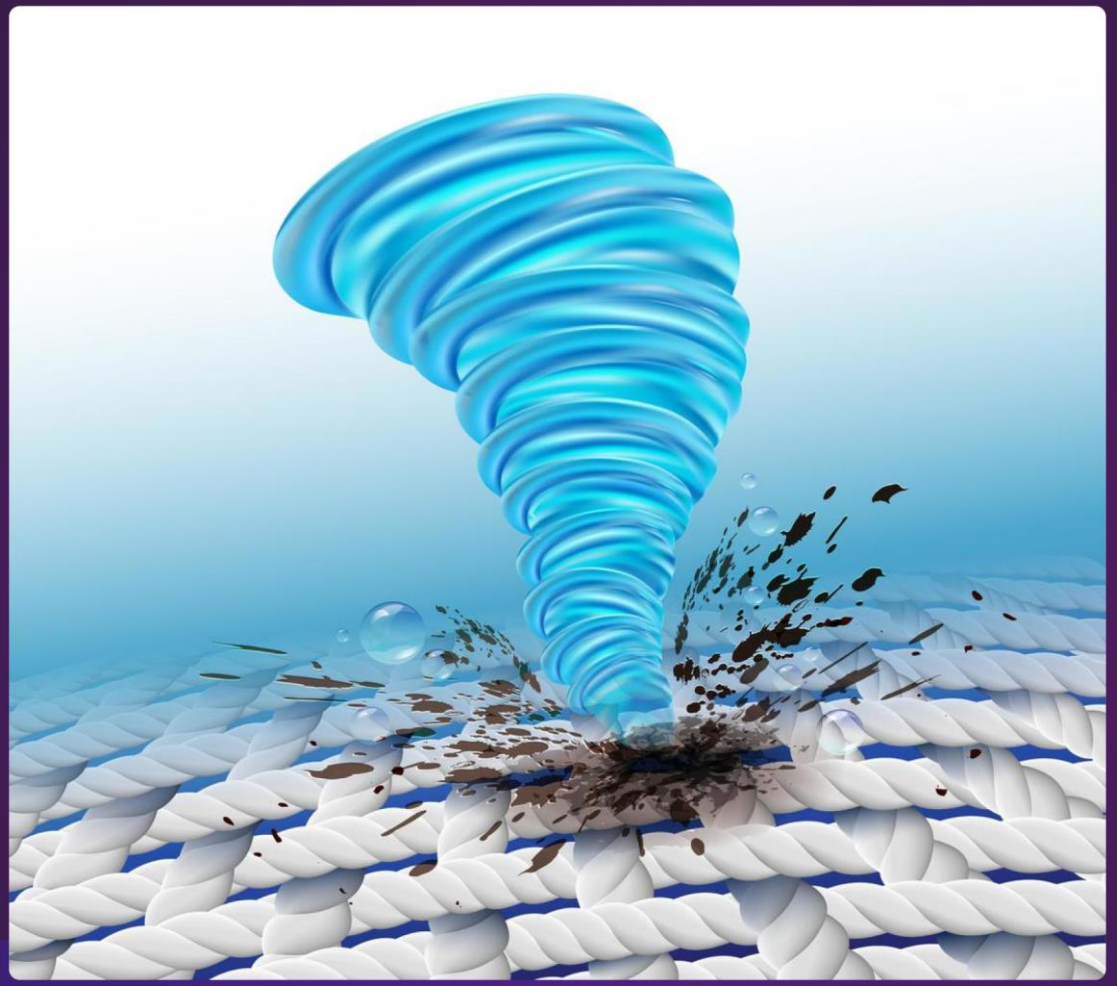


Inventor: Judson Dunaway

History. Drackett purchased the product from inventor Judson Dunaway of Dover, New Hampshire, who introduced Vanish in 1937

Introduction

Stains vary in their chemical make-up; whilst some stains can be removed with soap and water others need a more specialist approach. Their constituents can be characterised into **enzymatic, oxidisable, greasy and particulate components** although the majority of stains will contain a mixture of these.

Vanish is a brand with a variety of products; most of these contain a blend of chemical agents including **bleach, surfactants and enzymes to tackle the different components of stains.**

Rarely a day goes by without some incident involving a stain, from a blob of ink on a shirt to a glass of red wind spilt on a brand new white tablecloth. Some stains can be removed simply with soap and water but others are more problematic.

Vanish is an expert laundry additive and spot cleaner that specializes in removal of tough stains in only 1 wash with its active oxygen formula. It also whitens your whites and brightens your coloured garments with its active brighteners to give you dry clean-like results for your everyday clothes.

Types of Stain

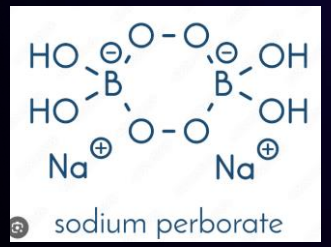
Enzymatic	Oxidisable	Greasy	Particulate
Blood Egg Grass	Tea Coffee Red wine	Olive oil Dripping Cuff and collar stains (on shirts) Motor oil Butter	Clay Mud Ground in dirt

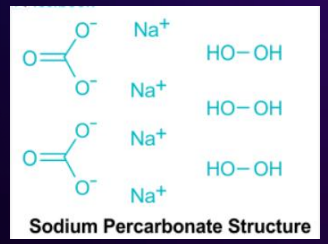
Enzymatic stains: these stains are removed with the help of enzymes.

Oxidisable stains: these stains are removed with an oxidizing agent, bleach, and are also called bleachable stains.

Greasy stains: these stains are removed with the use of surfactants.

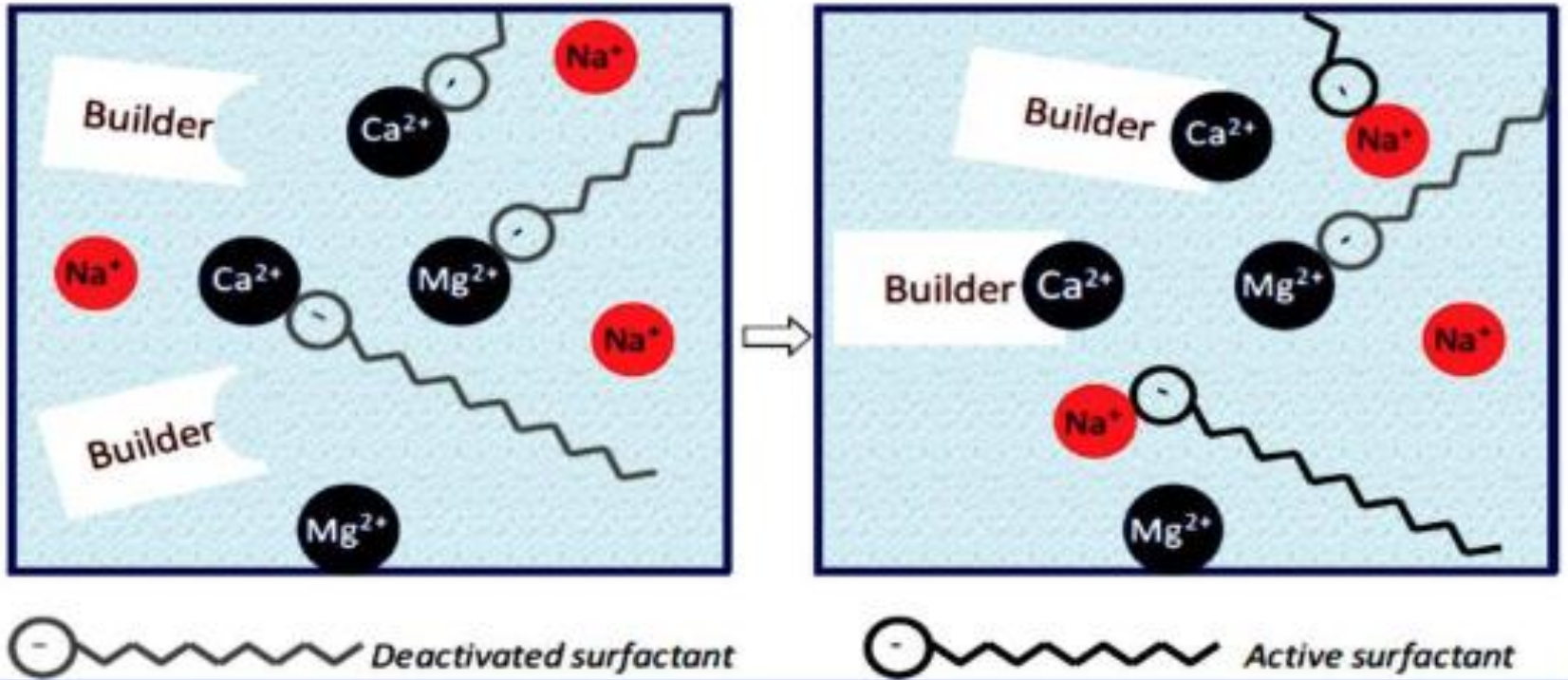
Particulate stains; these are best removed by chemicals called builders (see Finish).





2. Builders

- Detergent builders are materials, which can be used to bind cations (mainly calcium, Ca^{2+}, and magnesium Mg^{2+}) by **complexation or precipitation results softening water ((water softeners))**
- Ca^{2+} and Mg^{2+} would have caused them to work less efficiently or precipitate from solution (soap scum).
- Builders enhance the quality of the water, thereby making the detergents work in a more effective and efficient manner.



Detergent builders types:

- **Sequestrating**: *These are* ***water-soluble builders*** *that form* ***soluble complexes*** *with* Ca^{2+} *or* Mg^{2+}.

Ex. sodium tripolyphosphate (STPP) tetrasodium pyrophosphate, citrates, tartrates, succinates, gluconates, polycarboxylates, ethylenediamine and triethanolamine.

- **Precipitating**: *These builders are* ***water-soluble*** *until they form a complex with* Ca^{2+} *or* Mg^{2+} *and* ***precipitate*** *(fall out) of solution. The main example is sodium carbonate.*

- **Ion exchange**: These builders are **insoluble in water** and form insoluble complexes with Ca^{2+} or Mg^{2+}. Examples are zeolites and sodium disilicate .

2 Builders- Increases cleaning capacity,T exture of soap, prevention of precipitation in hard water.

Sodium metasilicate, Na_2SiO_3,

Borax-sodium borate

Washing soda

Starch

3Antioxidants- Sodium thiosulphate , EDTA, Sodium hyposulphite

4 Fillers-Magnesium carbonate, chalk

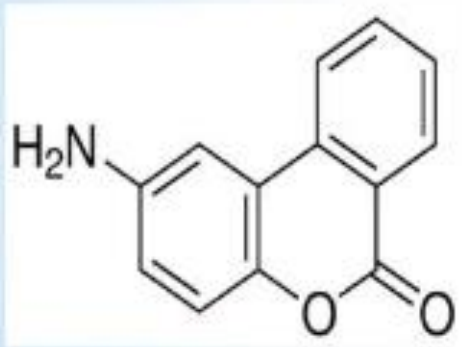
5 Coloring matter

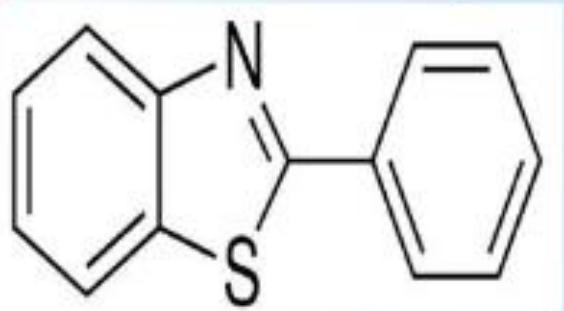
6 Perfumes

7 Fixatives

8 Optical brightners- phenyl benzothizole,

benzocoumarin





Types of Stain Removers

Bleach-based stain removers

Colour in the dyes and pigments of stains is caused when molecules absorb light. Light is absorbed by molecules which have sections called chromophores.

Often, chromophores are organic compounds with systems of alternating double and single carbon-carbon bonds. These are called conjugated systems. The electrons in the π-orbitals of the double bonds overlap, creating a system of delocalised electrons across a large part of the molecule.

The color is caused by light absorbed when electron transitions occur within this system. Breaking or shortening this delocalized system destroys the colour.

β-carotene. Note the delocalized system of 11 alternating double and nds.

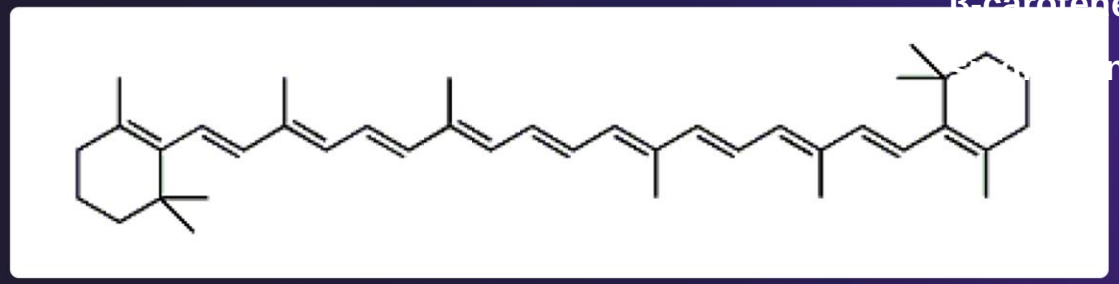


Figure : β-carotene. Note the delocalised system of 11 alternating double and single bonds

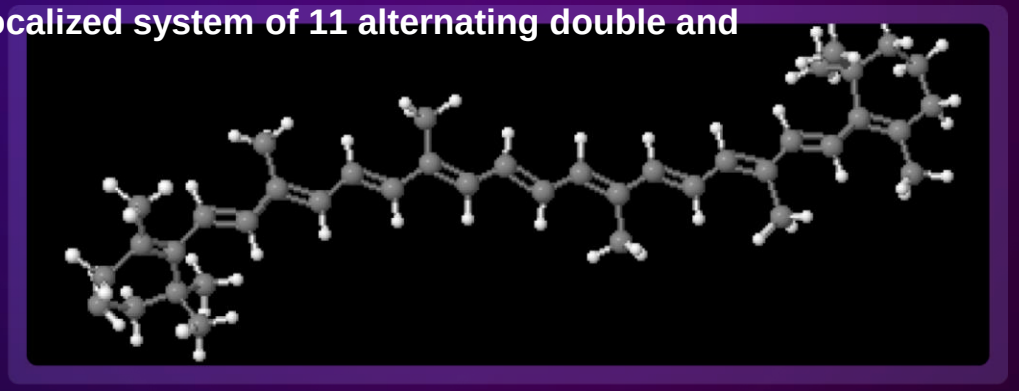
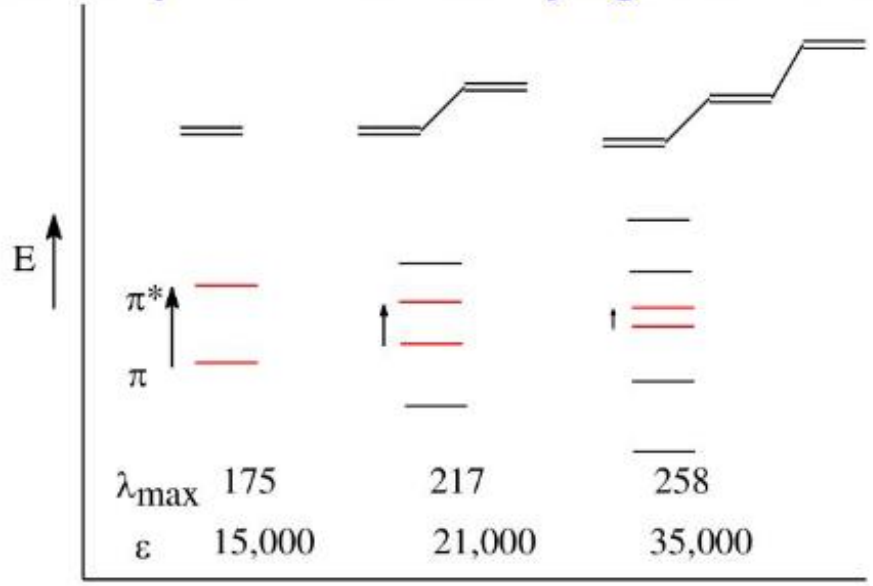


Figure 4: 3D representation of β-carotene

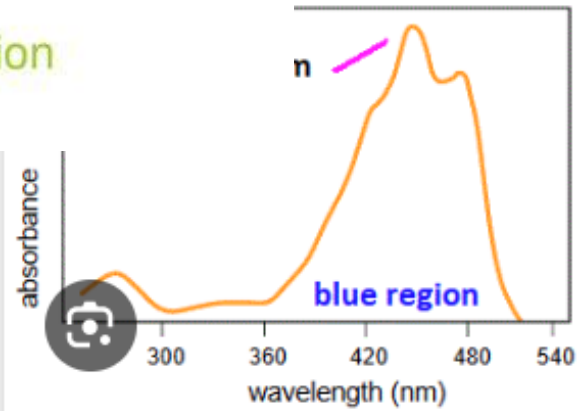
UV Absorption of Conjugated Alkenes



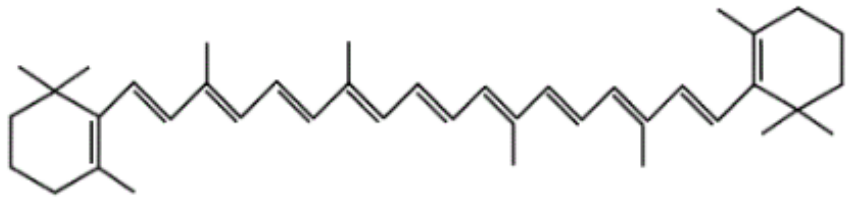
ε units = L mole^{-1} cm^{-1}

Increasing conjugation gives:

- longer wavelength absorption
- more intense absorption



The visible absorption spectrum of carotene



visible uv absorption spectrum of polyenes alkenes carotene buta-1,3-diene hexa-1,3,5-triene octa-1,3,5,7-tetraene deca...

Visit

Types of Stain Removers

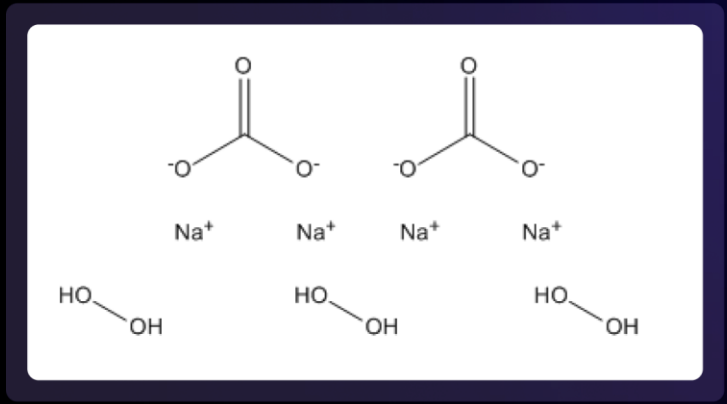
Oxygen-based bleaches

Oxygen bleaches are based on sodium percarbonate, This is a white powder of formula $2Na_2CO_3.3H_2O_2$.

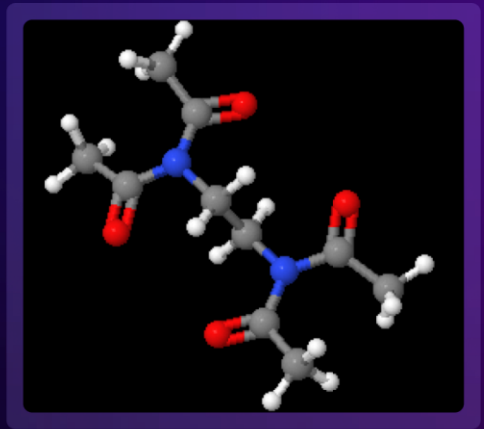
Activating the bleach

Although hydrogen peroxide is a good bleach, it is not effective below about 40 °C. This is not a problem in products used in washing machines where the temperature can be easily raised.

However, most stain removal products need to work at room temperature, around 25 °C. This problem is solved by using a bleach activator which is in effect a booster for the bleaching process. The substance used is tetraacetylethylenediamine (TAED), Figure below.



Structure of sodium percarbonate

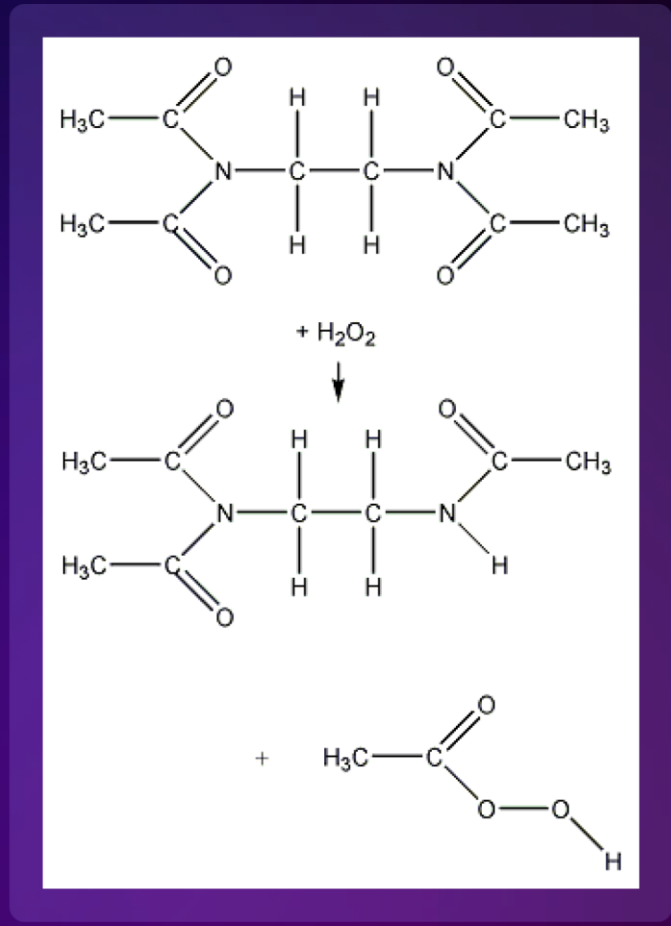


3D representation of TAED

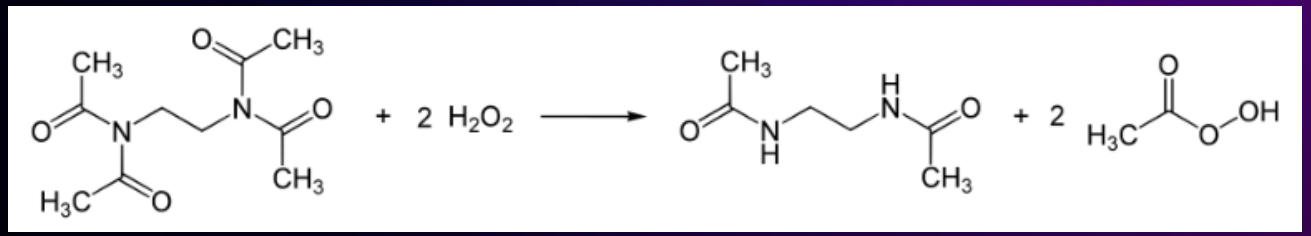
TAED reacts with the hydrogen peroxide released by the sodium percarbonate to produce peroxyacetic acid (peracetic acid, perethanoic acid), which is a better bleach than hydrogen peroxide itself.

Even if TAED boosts the oxidation reaction, it is not a catalyst because TAED is consumed during the oxidation process. One molecule of TAED reacts with two molecules of peroxide leading to two molecules of peracetic acid and a molecule of DAED (DiAcetylEthyleneDiamine) which is no longer reactive.

Peroxyacetic acid, CH_3COOOH, has a peroxide, O-O bond. Activators help the bleaches work. They speed up the bleaching reaction so that it can take place effectively at lower temperatures than without them. This makes the bleaches more compatible with the enzymes in the stain removal formulation.



The reaction of TAED with hydrogen peroxideTAED



Types of Surfactants

Anionic surfactants : They have a negatively charged head group. Common types include soaps and alkylbenzene sulfonates.

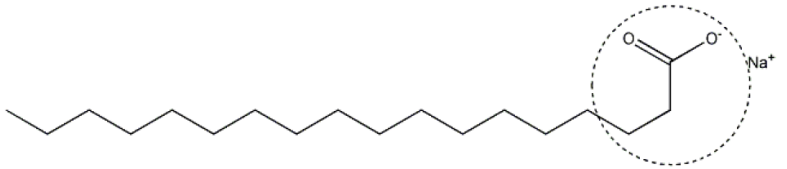


Figure 13: Sodium stearate (a soap) – an anionic surfactant

Cationic surfactants : have a positively charged head. Common types include alkyl ammonium chlorides.

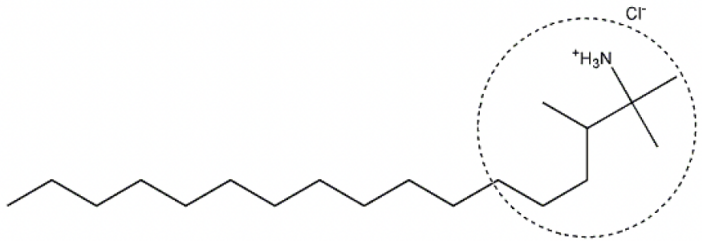


Figure 15: Trimethylhexadecyl ammonium chloride – a cationic surfactant

Non-ionic surfactants: They have a polar, but uncharged, head. Common types include polyethylene ethoxylates.

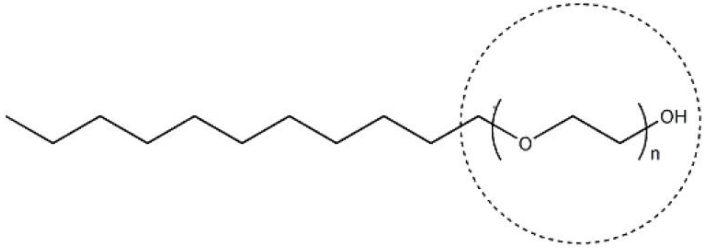


Figure 16: A polyethylene ethoxylate – a non-ionic detergent

Application methods

The way Vanish products are applied changes according to product type. We can divide the product range basically into three categories:

Products which are intended to be used during the wash in a washing machine: these are normally in the form of powders. A scoop of product is added in the washing machine drawer together with the usual detergent. Some products can be added directly in the washing machine drum: an example for this is the Vanish dye magnet. In this case the product is contained in a sachet that slowly delivers the active ingredients during the wash.

Products that can be used in the wash and as pre-treaters: these are usually liquid formulations. The liquid can be added in the washing machine drawer, together with the detergent. Usually liquid products are supplied with a dosing cup or other device to allow them to be put in the drum. Clearly, in this case, the active ingredients are considerably diluted by the washing water.

Products that can be used as pretreaters: To pretreat a stain, the liquid is usually poured directly on the stain. In this case there is no dilution of the active ingredients, and this will enhance the performance of the product. Products that are intended to be used as pretreaters only are usually applied using trigger sprays, aerosols or soap bars to apply the product directly to the stain before the wash.

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