

Study of the mechanism of manufacture of (alginate) based on the change of chemical and biological properties of polystyrene

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Abstract

Our current research includes the manufacture of alginate material used in the field of dentistry (it is a powder material that is used after converting it into an emulsion and then solid as a mold that works to locate defective teeth in order to repair them, whether they are fixed or mobile). This is done by altering some of the chemical and biological properties of polystyrene, which is an elastic plastic (a synthetic aromatic hydrocarbon polymer derived from a monomer known as styrene). We used polystyrene, zinc oxide, calcium sulfate, gypsum, wax printing compound, and tri-sodium phosphate, their percentages are: (35%, 30%, 17%, 10%, 5%, and 3%) respectively. Alginate can be manufactured as powder, or foam as a flexible paste. Since polystyrene can be transparent in its natural form in many cases, it can be colored in different colors with polar specifications, and it can be used in many industrial and medical fields. Alginate is used in protective packaging for food, industrial and pharmaceutical products. Alginates are among the most commonly used materials in dental clinics, and they are used every day to make molds for dentures.

Keyword: Alginate, Chemical properties, Polystyrene

Introduction

Alginates absorb water quickly, making them useful as an additive in dehydration products such as weight loss aids, and in the paper and textile industry. It is also used to treat water-repellent and flame-retardant fabrics. It is used as a thickening agent for thickening liquids, beverages, ice cream and cosmetics. Alginates are used in pharmaceuticals such as (Gaviscon, Bisodol and Asilone). It is widely used as a material used in dental impressions, in prosthetics and live casting, and is sometimes used to make copies of small-scale castings. It is widely used in the food industry to thicken soups and jellies. Calcium alginate is used in a variety of forms in medical products such as a burn dressing to help it heal and can be removed with less pain than traditional dressings. Alginate impression materials are hydrophilic in nature, and this property facilitates making of accurate impressions in the presence of saliva or blood (1). Because alginates absorb water quickly, they are used in lyophilization to turn into a new structure that has the ability to expand. It is used by the weight loss industry as an appetite suppressant, and in March 2010, researchers at Newcastle University announced that an alginate diet reduces human fat by 75% (2). Alginate is considered a stabilizing agent, a disintegrating agent in tablets and preservatives, and a viscosity-raising agent. Alginate is widely used in topical and oral pharmaceutical forms, and alginate is used as a binding and disintegrating agent at the same time in tablets and preservatives with concentrations ranging from (1-5%) as well as a viscosity-raising and suspension agent in many pastes and Creams and gels. And as a stabilizing agent in n/m emulsions. As for treatment, alginic acid was used as a carrier of histamine H₂ receptor blockers, which is used in the treatment of gastro-esophageal reflex disorders. Finally, it is widely used in cosmetics and food products as an emulsifier and stabilizer (3). The polystyrene, which we are about to change its chemical and biological properties, is an industrial resin, and it is widely used in plastic products, and it has wide uses, including for making Styrofoam containers, and other packaging and insulation materials. Aromatic with a great ability to form. It is considered a non-toxic and non-irritating substance although excessive oral consumption may be harmful. Inhalation of alginate dust may be an irritant

that leads to cases of asthma among workers in factories that produce it. It appears that this condition is more likely to result when exposure to lichen dust itself is greater than to pure algin dust. The World Health Organization has set the acceptable daily limit for alginate and alginate salts used as food additives at 25 mg/kg body weight estimated for alginate.

Materials and Methods

Materials:

The materials are (Polystyrene by 35% , Zinc oxide 30% , 10% gypsum , Wax printing compound 5% , Tri-Sodium Phosphate 1-3% , Calcium sulfate 17% reacts with the dissolution of sodium alginate to form calcium alginate which is not soluble in water , Automatic thermal ovens to raise and lower temperatures in different stages of the manufacturing steps , Other materials, adhesive, and for the cohesion of the mixture after manufacturing, and aromatic and antiseptic materials, in addition to packing, packaging and preservation materials for the produced material).

Methods:

The process occurs through a set of chemical reactions necessary to produce the required substance, which we are studying in our current research, and these reactions include: a reaction between tri-sodium phosphate and calcium sulfate, until the amount of tri-sodium phosphate runs out, and the reaction that immediately follows the first reaction begins and is responsible for the gel formation between each of the sodium alginate and calcium sulfate. Provided that the amount of Tri-Sodium Phosphate determines the total time appropriate for the reaction during work, in other words, its permeability means the beginning of the second reaction), it controls the content of the alginates generated from Trisodium Phosphate when it is manufactured, and it is possible to determine in production whether the alginates are normal or fast hardening). Although alginate is a product of alginic acid extracted from brown marine algae, its manufacture by chemical techniques is possible if the necessary proportions are fixed to reach the product to be manufactured locally and focus on not causing any imbalance during the chemical reactions that take place at manufacturing. The product is of several types, and of these types are sodium and potassium alginate, the most used in the field of dentistry, whether in laboratories or dental clinics. Sometimes the

raw materials needed for manufacturing are available, and through experiments, the specified proportions and quantities are fixed, but the defect is facing a problem in obtaining the desired result, due to the difference in reaction temperatures in the environment in which the work is taking place during the mixing of the components in each step One of the steps required during the reaction. It is worth noting that it is necessary for the product to be exposed in some stages to a gradation at very high temperatures that may range between (500-1000) degrees Celsius, and the reason for this is due to the extraction of the O2 atom in some stages of the reaction, and to reach the result required.

Results and Discussion

There are a number of main and important factors that have a direct impact on the strength and resistance of the substance (alginate), which is one of the basic materials in the necessary uses for the preparation of the dental mold that represents the copy of the real face of the patient's mouth, for the purpose of treating the defect that the patient suffers from. His teeth, so what is the alginate material is a print taken for the patient’s mouth and after it hardens, the substance (ston) is poured over it, and the dentist controls the type of treatment for the case that he sees through the impression that appeared for this mold.

| No. | Essential materials | Percentages |
|-----|-----------------------|-------------|
| 1. | Polystyrene | 35% |
| 2. | Zinc oxide | 30% |
| 3. | Calcium sulfate | 17% |
| 4. | gypsum | 10% |
| 5. | Wax printing compound | 5% |
| 6. | Tri-Sodium Phosphate | 1-3% |

Figure (1): the percentages of an essential materials that used for alginate manufacturing.

The most important of these factors that must be met in the event of mixing the manufactured substance with water are: The amount of proportions as shown in **table;(1) and in figure;(1)**

that the mixture consists of when mixing the alginates with water. In the event of an increase or decrease in the amount of water in the mixture, it will lead to a defect in the product left by this mixture. The time that the mixture takes also affects the resistance of the manufactured material, so that prolonging or decreasing the time required for mixing decreases, or increases the resistance, i.e. the texture is very soft or hard. In addition to observing the standard time required to remove the alginate impression from the mouth, the resistance increases if the impression is removed from the mouth after a few minutes of hardening (ie the longer it remains in the mouth, the higher its hardness). The reaction mechanism must be within fixed and unchangeable conditions. Immediately after the first reaction, the second reaction occurs so that the mechanism of action is accurate with a well-defined working time during which no change in viscosity occurs, precisely (4) , because it is the very influential factor in the texture of the manufactured material.

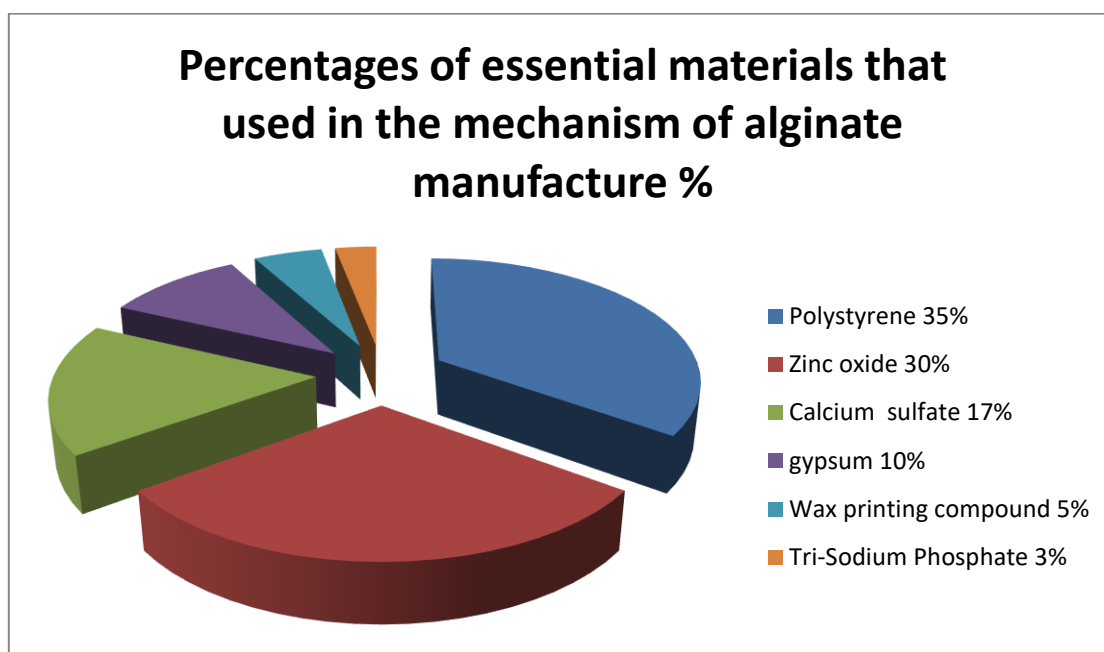


Figure (1): schematic representation of an essential materials that used for alginate manufacturing.

The manufacturing of alginate material must be accurate and have the ability to show the smallest details inside the mouth in order to correctly diagnose the case presented to the specialist doctor. During the removal of the impression, in addition to that, its final texture must be acceptable (not scratching the gums when it comes in contact with the tissue of the

mouth), as well as its taste and smell acceptable to the patient. Thus, it is safe when taking the edition known as the gene edition. In view of the contact of the printing materials with the gum tissue and the mouth of the patient while taking the alginate print, and given the consideration of the basic conditions and characteristics that must be provided in the print in order to be successful, the alginate printing material must possess a set of general specifications in order to secure the health aspect of the patient on the one hand, and in order to On the other hand, it guarantees obtaining a good edition from a technical point of view, as it is difficult to have all the ideal specifications in this field. It must have the ability to preserve in order to ensure its durability, to be easy to deal with, and the very important thing is its reasonable cost so that it competes in its prices with products of other global origins, and it must also have sufficient flow and stability in properties provided that it is not variable with suitable hardening time. The texture of the produced material is commensurate with the ideal specifications required in terms of viscosity and the cohesion of its particles to a degree that allows the dental technician or the dentist to remove it easily after the process of pouring the sixty substance into the mold formed after taking a print of the patient's jaw in order to clarify his true teeth. It is the type and texture of the paste that will best meet the requirements of the alginate impression material (5). Since the strength of the manufactured material is low and not very rigid, it is possible to reproduce it within various other techniques, being easily torn because it is loose in very good for only one casting per impression (6, 7). Some water sources may contain large amounts of various minerals It has a clear effect on the accuracy and fineness of the alginate as well as the time required for solidification. In such cases, the dental technician or dentist can use distilled or demineralized water (8). There is a very important thing that must be mentioned, which is that the manufactured Alginate is non-toxic, non-irritating to inflammation, and does not affect the general health of the patient, and this is what was reached in our current study. It must be taken into account that the material is moldable in several forms, in addition to having sufficient strength, so that it does not deform or crumble during removal from the oral cavity, in order to perform the desired purpose during the treatment and diagnosis of the case. Its homogeneity should be easy to distribute, equal in mixing, and not stick to solid casting materials, so that it can be removed easily, in addition, it must be acceptable in terms of taste, color and smell by the patient.

Conclusion: The process of manufacturing alginate is an important part of indirect dental restorations that are often ignored as a step in the treatment process for many cases experienced by the patient who had a defect in his teeth and for which he went to the dentist. And accuracy here is very important, taking into account the non-repetition of impressions, until the patient gets bored, in addition to the lack of damage to the raw material, which is expensive for the dental technician or the dentist. Until this time, gene impressions can be relied upon following a consistent and appropriate technical profile to avoid error. Therefore, the production of the material encourages researchers to delve into the field of manufacturing in order to reach the highest scientific ranks that lead to the application on the tangible reality and benefit from it in developing the economic and scientific aspect at the same time, in order to provide locally made materials that benefit both the doctor and the dental technician .

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