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Fabrication and characterization of novel glass-ionomer cement prepared from oyster shells

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Glass ionomer cement (GIC) is one of the most widely used restorative materials for temporary fillings and reconstructions in dentistry, but it has relatively poor mechanical properties that make its use limited, especially in places subject to high pressure. Thus, to extend the applicability of GIC, samples based on SiO_2, P_2O_5, Al_2O_3, CaF_2, and NaF were prepared with the addition of calcium oxide CaO extracted from natural sources (oyster shells) in different ratios of 0, 5, 10, 15, 20, and 25% wt. The suggested glass samples were evaluated, and their physical and mechanical properties were compared. XRD, SEM, and FTIR were performed on the samples. 24 specimens were prepared for each test in order to assess the mechanical properties as per the specific requirements. The tests included measuring bending strength, elastic modulus, adjusted direct tensile strength, absorption, water solubility, and diffusion coefficients after the specimens were stored in distilled water for 60 days. All calculations were carried out in accordance with standard procedures. The findings indicated a slight improvement in the bending resistance of the recommended GIC. Glass modified with 20% by weight of calcium oxide was the best among the ratios in terms of the results obtained and compared to the traditional commercial type. The malleable strength of the sample was 54.121 MPa, while the flexural modulus increased, the tensile strength reached 10.154 MPa, and the solubility was 25.87 µg/mm^3 after storage for 60 days. These indicate that the developed material is suitable for use as a dental restoration material when compared to international commercial cement specifications.

Keywords GIC, Dental fillings, Oyster shells, Physical properties, Dental restoration, CaO

Dental health is a major indicator of public health, well-being, and freedom from disability, with approximately two billion of the world's population suffering from permanent tooth decay. Furthermore, about 530 million children suffer from dental caries of milk teeth (milk or baby teeth), and this is one of the most common non-communicable diseases and causes of public health problems[1]. Thus, the development of new and better restorative materials is inevitable. Glass ionomer cement (GIC) is an important restorative dental material. It was proposed by Wilson and Kent in 1969 and first applied in 1972[2]. It is widely used in dental applications, repairing cracks in the teeth, as an adhesive for crowns and bridges, as well as for the manufacture of dental linings and bases. Generally, GIC consists of two parts powder and liquid. The powder is an aluminosilicate that contains fluoride and the liquid is polyacrylic acid[3]. Its working principle is based on the interaction between glass powder (fluorosilicate glass) capable of ion filtration and the liquid represented by weak polymeric acids. Despite the many advantages, GIC has weak mechanical properties and high sensitivity to moisture in the preparation stage that made it use in dental restoration. Thus, with the presence of friction and chewing force, the compressibility and insufficient bending resistance of GIC will lead to corrosion[4]. Therefore, the ongoing development of GIC in recent years aims to enhance its poor mechanical properties. Optimizing the powder/liquid (p/L) ratio, particle size and distribution has resulted in better physical properties, and some studies have shown that high-viscosity materials have superior physical properties compared to conventional ones[5]. Researchers also concentrated

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