**CHAPTER 2**

**REVIEW OF RELATED LITERATURE**

This chapter presents foreign reports, articles, researches and other publications serving as related literature and studies in the present study.

**2.1 Effects on Depletion of Limestone to the Environment.**

Wan Ahmad Soffian Bin Wan Mohammad et.al, (2017), they emphasized that cement manufacture has a significant environmental impact at every level of production. These include air pollution from dust and gases, as well as noise and vibration from quarry crushing and milling. Using modified cement as one remedy to this problem is an option. Modified cement is a cementitious substance that equals or exceeds the performance of Portland cement by combining and optimizing recycled and waste components. This will reduce the consumption of raw resources indirectly and eventually become a sustainable construction material.

According to R. Yamuna Bharathi, S. Subhasshini, T. Manvitha and S. Herald Lessly (2016), the concerns about resource depletion and environmental contamination have prompted the development of innovative materials based on sustainable resources. A variety of by-products are used as aggregate in concrete. As a result of seashell waste, the shellfish industry faces substantial financial and operational hurdles in providing replacements to conserve natural coarse aggregate and fine aggregate as a component in concrete for future generations. Because of its rough texture and calcium content, seashell is a good semi coarse and fine material that can be utilized as a cost-effective replacement for aggregates such as gravel and sand that are commonly used in construction. Experiments were carried out on conventional concrete and seashell-concrete combinations. The seashell content ranges between 3% and 9%. Workability is evaluated because this study aids in understanding the behavior of concrete mixed with seashells and determining the optimal combined mixture proportion that can be suggested as a workable substitute construction materials for affordable houses, particularly in coastal regions and those near fresh water, which are uncovered as trash.

**2.2 Chemical Properties of Seashells**

A comprehensive experimental program was carried out to recycle high-content seashell waste as fine aggregate or cement substitute. Furthermore, this endeavor contributes significantly to the protection of natural resources and the reduction of the numerous harmful substances discharged into the atmosphere during cement manufacture (Edalat-Behbahani, 2019). Calcium carbonate, which is often derived from sedimentary limestone rock, is one of the most abundant bio minerals on the planet and is widely employed in a variety of applications due to its biocompatibility and low cost. However, there is another, more sustainable option. Calcium carbonate can be obtained from biogenic waste shells such as poultry eggshells and seashells (Awogbemi et al., 2009; Yoo et al.,2020).

The first phase of this study was devoted to studying the possibilities for 100% fine aggregate replacement in mortars and concretes with mechanical properties and chemical analysis comparable to those made using sand from natural resources. First, a number of mortar/concrete mixes were used to demonstrate the success of this method. The second section compared the physical and chemical properties of ten different types of blended cement to those of conventional Portland cement (OPC), which contained up to 15% by mass of seashell powder. (M. Emam-Jomeh and Z. Soltan-Zaden, 2019)

**2.3. Properties of Seashells Ash**

According to (Yan Zhang, Da Chen, Yunchao Liang, Kaicheng Qu, Kehua Lu, Shijia Chen and Mengjie Kong, 2020), Recycling and waste product utilization are constantly prioritized to reduce the detrimental effects on the environment. The key engineering aspects of modified concrete containing varying amounts of discarded seashells were examined in this study. Unlike typical concrete, which was mixed immediately with other raw materials, the cement in this case was first placed in the widely scattered waste facility Babylonia areolate. The foam-filled shell (Fitness-For-Service) and additional raw materials were then used to replace all or part of the coarse aggregate. Flow ability, compressive and splitting strength, drying shrinkage, and rapid chloride ion permeability were all evaluated. According to the most recent experimental data, as FFS developed, the behavior of workability and durability either improved or degraded slightly. Despite the fact that the strength reduced as the FFS increased, the rate of strength loss was slower than in previous foam concrete. Cross-sectional images of FFS concrete were investigated to confirm the aforementioned findings. From the standpoint of technical properties and environmental considerations, the first engineering application for the proposed foam concrete comprising waste shell is slated to take place on the embankment project in Zhejiang province, China.

**2.4. Durability and Mechanical Properties of Seashell**

According to the study titled Durability and mechanical properties of partially-replaced seashell cement: J. Carol. (2019) investigates the feasibility of generating seashell ash powder from ground and burned bivalve clam shells. This ash is used to replace cement in weight levels ranging from 5% to 15%. These mixes are also examined and compared to a SC0 that contains no powdered seashell ash (SC0). However, the fresh and hardened qualities of all blends are investigated using a variety of tests, including unit weight and compressive strength. Thus, the inclusion of thermally changed seashells increased the amount of calcium hydroxide, and the findings also show that at 7 days of age, the compressive strength of the 5% replacement is marginally higher than the SC0, while at 7 days it can achieve its maximum strength. Additionally, as the percentage of replacement increases.

The strongest durability against sulfate and alkaline attacks is reached with a 5% replacement of cement with seashells, which reported the least weight loss and the best compressive strength after immersion in 5% NaOH(aq) and MgSO4(aq) solutions. The 5% replacement mix is the best replacement proportion. A 5% seashell replacement was proposed to minimize excessive compressive strength loss. The use of seashells as a cement substitute in masonry cement mortar has also been the subject of a few researches. As cement replacement materials, Lertwattanaruk Pusit et al. employed clam, oyster, mussel, and cockle shell whereas Noel D. Binag had used oyster, mussel, and mollusk shell in cement mortar. A maximum proportion of cement substitution was used in both studies, which was a percentage of 5%. Another investigation, conducted by Safi et al., concluded that combining the oyster shell did not result in a substantial reduction in compressive strength due to good adhesion between seashells and cement paste. Crushed shells have greater permeability qualities than concrete that does not contain seashells. This is due in part to the forms and arrangement of the mixture potentially reducing the tortuosity of pores in concrete. However, replacement of more than 15% by weight of cement could reduce concrete strength, permeability, and porosity when curing reached 28 days.

As defined by Australian Academy of Science (2016), shells are composed of calcium carbonate minerals such as calcite or argonite. Animals construct their shells by obtaining the required chemicals from their surroundings, such as dissolved calcium and bicarbonate. Shells exist in a variety of shapes and sizes, ranging from huge clams more than a metre wide to microscopic shells scarcely visible under a microscope. The majority of shells seen on the seashore are either bivalves (shells with two pieces joined together) or gastropods (snail-like shells).

**2.5 Experimental Methods on Seashells**

According to Muhammad Hamza Ahsan (2020) Cement-based composites may experience greater temperatures due to fire over their service life, and the safety and usability of concrete qualities may be significantly damaged following fire exposure. As a result, it was proposed that seashells be added to cementitious composites for better fire resistance in high-strength concrete. In this study, Manzoor Hussain and Asad Hanif (2020) used seashell powder as a fine aggregate substitute in concrete and measured the mass loss of modified and controlled samples, the deterioration caused by high temperature exposure, and several parameters such as compressive strength, stress-strain response, elastic modulus, compressive toughness, and strain ductility. Seashell modified samples outperformed the control sample in terms of compressive strength. Visual inspection demonstrated that SS-HSC fractured less than HSC at higher temperatures. Plastering reinforced concrete with seashells also boosted the core's strength and fire resistance. Finally, utilizing seashells in high-strength concrete is effective for fire-resistant concrete. Muhammad Shadid Siddique (2020).

According to Morgan Agro (2021), the high and continually increasing cost of concrete has made construction highly expensive in developing countries where concrete is frequently used. The high cost of traditional building materials is a fundamental factor influencing global housing delivery. The use of natural stone in construction also helps the reduction of natural stone exploitation, such as granite and marble.

**Research Gap**

The use of shells in concrete contributes to environmental sustainability and waste optimization. The ideal percentage to replace cement with seashell ash was discovered to be 15-25% environmental friendly. Due to alternative use of limestone and also it improves bonding at the interface of the cement paste and aggregates. Using seashell cement significantly improves the compressive strength of concrete at lower levels of substitution.

Also, the burning temperature of shell ash serves as a recommendation to continue this investigation. Try cement at a temperature greater than 700 ºC if you want to achieve similar physical properties.