**CHAPTER 1**

**INTRODUCTION**

General explanations of the study are provided in this chapter. The introductory part contains several subheadings such as background of the study, research problem, objectives of the study, significance of the study, scope and limitation of the study, and definition of terms.

**1.1 Background of the Study**

In the construction industry, as a result of growing concerns about the depletion of the planet's natural resources and global pollution, concrete has been used and has been driven to investigate employing by products and waste materials for construction. Its production is the most significant of all synthetic materials, with over 8.8 billion tons manufactured globally each year. (JG Backes, 2022). However, because cement is used as a concrete binder, the blend is regularly opposed by environmental groups. Several experimental experiments on the use of waste materials in cement manufacturing have been conducted. Waste seashells that gather along coastlines can be used as one of the components of concrete. They can be treated and recycled to be used as a substitute for cement. In general, seashells contain a lot of calcium, which improves the mechanical and physical properties of concrete. (Tayeh et al. 2019). Calcium carbonate (CaCO3) makes up 95% to 97% of a seashell's composition (de Alvarenga et al., 2012; Mosher et al., 2012). Also, using shells to reduce the storage of shell waste material lowers the demand for quarried aggregate and may improve the performance of a concrete mix design by allowing the addition of a different material to improve performance where the cement has been replaced by seashells by turning shell as ash, it has been concluded that a replacement limit applies, depending on the particle size from incinerated, and the resulting decrease in resistance to compression and workability. (Elliott and Fuller, 2015).

The majority of fishing communities, homes, shell market merchants, and neighboring seafood restaurants value these for their meat. Empty shells, on the other hand, are regarded useless and are thrown after being digested and/or sold for their flesh. Tons of solid trash are generated each year from these main sources, as well as other enterprises, houses, fast food chains, and regional seafood cafes. This becomes a major challenge for the Local Government Unit (LGU) and the province's solid waste management. Seashells are a waste material that accumulates quickly, especially in coastal regions and nations where a lot of seafood is consumed.

Concrete is the most widely manufactured construction material and the world's second most consumed material. Each person is predicted to require three tons of concrete each year (Gagg, 2014). Cement, together with coarse and fine particles, constitutes the majority of the composite material known as concrete. Cement, the most expensive of these components, acts as a binding agent that holds the aggregates together and hardens over time. It is manufactured around the world by burning naturally existing minerals such as limestone and clay, as well as industrial waste such as slag and fly ash. The global output of concrete has increased significantly over the last century, and this trend is anticipated to continue in the future (Imbabi et al., 2012; Low, 2005). The building sector is primarily responsible for natural resource depletion and environmental imbalances due to its uncontrolled mining activities. Furthermore, in light of the current environmental and economic crisis, this research focuses on developing products from marine shell trash as well as developing an alternative construction material that would reduce social and environmental difficulties. Seashells are one of the concrete elements that can be used in the construction industry. In reality, turning seashells into cement has various potential benefits. First, it gives a practical and cost-effective way for disposing of these pollutants. Substituting seashells for cement or aggregate in concrete mixtures reduces reliance on commodities that are already in short supply around the world. As a result, incorporating seashells into concrete mixtures can help safeguard the natural resources needed to produce concrete. Modified cement is a cementitious material that has the same or greater performance than Portland cement due to the mixing and optimization of waste components. Therefore, substituting different types of marine ash for cement in concrete may result in significant energy savings as well as positive environmental effects (Wan Ahmad et al., 2017).

The goal of this research is to provide a technical specification for a concrete hollow block employing Crassostrea iredalei (Oyster shell), Cerastoderma edule (Cockle shell), and Mytilus edulis (Mussel shell) as a replacement for cement in concrete hollow blocks. Particles, shape, and texture, resistance to crushing, and surface moisture, grading, light weight are all good indicators of the said seashells as a cement of concrete hollow blocks. More than 90% of the calcium carbonate (CaCO3) concentration of seashells is identical to that found in soil. Calcium carbonate is found in the limestone dust used to manufacture Portland cement. Calcite and aragonite make up a large component of the crystal formations visible in seashells, which outperform limestone powder in terms of strength and density. Meanwhile, the size of seashell particles is equal to the particle size of Portland cement and ranges between 36m to 75m. (Wan Ahmad Soffian Bin Wan Mohammad et al., 2017).

Moreover, the purpose of this study was to find a solution to the solid waste problem as well as a cost-effective novel hollow block, a superior composite material to satisfy enhanced work productivity, and long-lasting infrastructure. It has been demonstrated that employing shells as composite materials to build hollow blocks is less expensive and better for the environment.

In this study, when 5, 10, and 15 percent of sea shells were utilized as a cement replacement, the findings will demonstrate various results in the concrete mix design, notably CHB, diminish social and environmental difficulties, and differentiate compressive strength when compared to the regular sample. While there is current work on the compressive strength of concrete using sea shells, the porosity of concrete using sea shells has not been widely addressed, and the paper addresses this area of sustainable concrete research.

**1.2 Statement of the Problem**

One of the waste products that are quickly building up in landfills and seashores and creating an environmental issue is seashells. And in terms of cement production, it gives a huge impact on the environment in every stage of its production. Air pollution from dust, gases, sound, and vibration from quarry crushing and milling are a few of these. With the help of recycling and maximizing waste resources, modified cement is one way to address this issue. As a result, replacing cement in concrete with different types of sea shell ash may result in significant energy savings as well as positive environmental effects. This study focuses on the utilization of different kinds of seashell trash as a cement replacement for the development of concrete hollow blocks. Using seashells in concrete promotes cost-effective concrete production.

1**.3 Objectives of the Study**

This study aims to create an innovative hollow block that uses seashells as a cement replacement.

1. To test the effect of using varied amount of seashell as replacement of cement.
2. To determine the significant difference of the CHB using seashells ash as replacement in terms of the compressive strength.
3. To determine the cost difference of the produced seashell ash CHB with the current commercial CHB.

**1.4 Hypothesis of the Study**

*hо* : There is no significant difference between the compressive strength for each sample and percentage.

**1.5 Significance of the Study**

Examine existing solid waste management techniques, concentrating on the disadvantages of landfills, the expense of recycling, and the disadvantages of cement making. Also, seashells can be used in the construction industry as one of the actual components. They can be recycled and used as cement, filler, and fine aggregate, or coarse aggregate replacement. Recycling seashells into concrete provides a number of potential benefits. To begin with, this gives a powerful and cost-effective technique of removing these wastes. Furthermore, using seashells as a cement or material replacement in concrete mixtures will reduce dependency on these resources, which are currently depleting globally. As a result, incorporating seashells into concrete mixtures can aid in the conservation of natural resources. Utilizing this raw material in concrete reduces pollution produced by natural resource extraction for concrete components. Waste product for concrete production can be considered a sustainable method of constructing by producing a concrete that is less hazardous to the environment than conventional concrete.

**1.6 Conceptual Framework**

The study’s concept is shown in the figure below. The framework provides the researchers with a method to use in order to achieve their goal. In addition, it highlights the essential factors and how well they achieve their particular purposes. As what has shown in the figure below, the incinerating of seashells namely; *Crassostrea iredalei* (Oyster shell), *Cerastoderma edule* (Cockle shell), and *Mytilus edulis* (Mussel shell) to create fly ash is the independent variable. The dependent variable is the mechanical properties which are shown on the right side. These factors are connected by an arrow, indicating the flow and the relation between them.

Independent Variable

Dependent Variable

Calcination of seashells to create fly ash as partial cement replacement

Mechanical Properties:

\*Compressive strength

\* Water Absorption

Development of Concrete Hollow Blocks from Seashells FlyAsh namely: Crassostrea iredalei (Oyster shell), Cerastoderma edule (Cockle shell) and Mytilus edulis (Mussel shell) as partial cement replacement

*Figure 1.0 Schematic Diagram of the Research Study*

**1.7 Theoretical Framework**

Because most people demand strong, wide, and pleasant shelters, concrete hollow block is recognized as one of the most important and widely used building materials. As a required component of concrete, the production of Portland cement (PC) can have negative environmental repercussions, such as the production of a significant amount of CO2 and depletion of land resources such as limestone. Cement production contributes for 4.5% of worldwide CO2 emissions (377 million metric tons in 2007), with chemical operations accounting for 50% and fuel combustion accounting for 40% (NRMCA, 2008). For every 10,000 kg of cement produced, approximately 900 kg of CO2 is generated throughout the manufacturing and hydration processes (Mahasena et al., 2003).

The reduction of fossil fuel use is the primary priority in all construction research areas. Because of the depletion of natural resources and the consequences for the environment, research efforts are focused on developing alternatives for waste-derived cement. Huge amounts of these materials are produced each year, and their production is increasing. Furthermore, in 2017, construction accounted for 21% of total global final energy use, trailing just industry and transportation. Dissipation accounted for 9% of total global energy use. All of these energy improvements enhance electricity generation, which raises CO2 emissions.

Furthermore, the seafood business dumps more than 7 million tons of seashells into landfills each year. Because of their high disposal costs and lack of biodegradability, shells have an impact on both the environment and restaurant owners. As a result, research into concretes that use seashells instead of cement could be a viable technique for reducing CO2 emissions while maintaining appropriate mechanical and thermal qualities. At least 95% of seashells contain calcium carbonates (CaCO3), with calcium carbonate levels comparable to those seen in the limestone powders used to make Portland cement.

CaCO3 (calcium carbonate) makes up 95-97% of uncooked seashells (de Alvarenga et al., 2012; Mosher et al., 2012). Seashell remains include trace levels of mineral and organic components. When calcium carbonate (CaCO3) is heated over 600 degrees Celsius, it transforms to calcium oxide (CaO), the amount of which depends on the amount of CaCO3 in the shell. CaO is required for enhancing concrete density and strength. Crassostrea iredalei (Oyster shell), Cerastoderma Edule (Cockle shell or blood clams), and Mytilus edulis (Mussel shell) are the three seashells used to manufacture ash as a cement alternative.

The following research aims to determine the mechanical properties of fresh and hardened concrete including compressive strength that should be ascertained or considered suitable for construction in order to determine the effectiveness of incorporating seashells’ ash into concrete.

**1.8 Scope and Limitation of the Study**

The *Crassostrea iredalei* (Oyster shell), *Cerastoderma edule* (Cockle shell), and *Mytilus edulis* (Mussel Shell) utilized in the research are only available in the Philippines. These seashells are used in the study are obtained within the Province of Misamis Occidental wherein this place is near to coastal area. The present study is limited to incinerating the shells to create fly ash to partial replacement to cement and to determine their compressive strength.

**1.9 Operational Definition of Terms**

For a clear and thorough comprehension of the study the following are operationally defined:

**Ash** - flames produce a solid by product. Ash explicitly refers to all non-aqueous, non-gaseous byproducts of combustion.

**Cement -** a binder, a chemical component used in construction to solidify, harden, and link diverse materials together.Compounds derived principally from silica (silicon dioxide, SiO2), alumina, and lime (calcium oxide, CaO) (aluminum oxide, Al2O3). The other oxides are made from an argillaceous (clayey) material, whereas lime is made from a calcareous (lime- containing) raw material. Smaller amounts of additional raw materials, such as silica sand, iron oxide (Fe2O3), and bauxite (which contains hydrated aluminum, Al (OH) 3), may be used to create the necessary composition.

**Concrete -** a composite material made primarily of Portland cement, water, and aggregate (gravel, sand, or rock). When these ingredients are combined, they make a workable paste that progressively hardens over time.

**Concrete Hollow Block -** a concrete block with hollow holes between its walls. Hollow blocks are formed of the same materials as poured concrete walls and are used to construct various sorts of walls for various purposes such as retaining walls, decorative walls, classic walls, and so on.  
**Seashells** - a hard, protective outer coating typically formed by a sea creature or organism. Mollusk exoskeletons include snails, clams, oysters, and others.  
**Crassostrea iredalei** - Crassostrea iredalei (oyser shell) is a widely distributed epifaunal species found in protected bays, coves, or estuaries with firm and sticky blue mud, semi sandy, or hard nonshifting eroding bottoms. They form attachments to hard objects in brackish shallow intertidal or subtidal seas at depths ranging from 0 to 300 metres (0 to 984 feet). The species' larvae are pelagic, whereas the adults are sessile.

**Cerastoderma edule –** Cockle shell is an edible burrowing bivalve mollusc with a strong ribbed shell. It has a solid shell that is medium in size, higher than long, and elongate-ovate in outline. For local shellfish gatherers, the highly sought-after shell meat cerastoderma edule serves as both a food source and a source of income. These can be found in seagrass and seaweed, on the surface of silt, or sticking to rocks or other hard things.

**Mytilus edulis –** has an equivalve, solid shape with beaks on the front end, and is about triangular in shape. Mytilus edulis (mussel shell) has a broad distribution due to its ability to endure significant changes in saltiness, evaporation, temperature, and oxygen tension. It was taken from wild beds for food, bait for fish, and fertilizer. As a result, this species inhabits a diverse range of microhabitats, extending its zonal range from high intertidal to subtidal zones and its salinity range from estuarine to totally oceanic seawaters.