DURABILITY ENHANCEMENT FOR CEMENT USING MUD CLAM SHELL AS THE MAIN COMPONENT

A SCIENCE INVESTIGATORY RESEARCH PRESENTED TO THE FACULTY AND STAFF OF FRANCISCO RAMOS NATIONAL HIGH SCHOOL UNDER THE SCIENCE TECHNOLOGY AND ENGINEERING CURRICULUM

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March 21, 2024

Acknowledgement

The researchers would like to give their warmest gratitude to those people who helped them on making this study possible.

Foremost, to our God Almighty who never fails to lead and support us through all the difficulties, to clear our minds on thinking positively and for giving us knowledge and strength in this research.

Secondly, we are grateful to Francisco Ramos National High School for letting us experience this learning opportunity that taught us many things like teamwork, cooperation and resilience.

We would also like to express our sincere gratitude to Mrs. Jocelyn Serimogan for her invaluable guidance, support, and commitment to excellence throughout this study. Her experience played a vital role in this successful completion of our research project.

To Mrs. Jenelyn J. Minoza for the care and support. Ms. Angeline Calsarin Apoyon for allowing and trusting us to barrow the laboratory apparatuses.

Lastly, we extend our heartful gratitude to our parents to their unwavering support not just financially but also emotionally during this research process. Their encouragement, understanding and love provided a solid foundation, making this study possible.

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ELVINJEAN M. CULANAG, ORCHID FAITH SIAREZ, RAFFY P. BAYA, JAYZIER L. SANGGAYAN, & RHEA BEA P. TIGLEY **"DURABILITY ENHANCEMENT FOR CEMENT USING MUD CLAM SHELL AS THE MAIN COMPONENT"**

Abstract

One of the biggest issues facing the Philippines was pollution brought on by the enormous amount of seashell garbage. If not properly managed, the shell debris that is dumped from homes, farms, markets, and seashores can constitute a threat to the environment. Recycling these seashells can contribute on reducing the amount of wastes in the environment.

Mud clam shells can potentially enhance the durability of cement due to their composition, which often includes calcium carbonate. This can contribute to improved strength and durability in concrete mixes, acting as a supplementary cementitious material. Additionally, the unique microstructure of clam shells may help enhance the overall performance of cementious materials. To enhance the durability of a cement, powderized mud clam shell was used as the main component, together with sand and water. Its mechanical properties in terms of compressive strength and water absorption were determined to test its effectiveness on enhancing the durability of a cement.

Five treatments were conducted in this study.

The powderized mud clam shell were prepared in five treatments. The first three treatments contains 15g of manufactured cement with a 60g of sand, 25 ml of water and an increasingly amount of mud clam shell which are 15g, 25g and 45g. The fourth

treatment contains 60g of sand, 25 ml of water and 15g of mud clam shell only while the fifth treatment also contains 60g of sand, 25 ml of water and 15g of manufactured cement alone.

Chapter I

This chapter shows the background information of the study, the statement of the problem, objectives, hypothesis, the concept of the study, the significance of the study, the scope and delimitation, and definition of terms.

Background of the Study

Cement is a binder, a chemical substance for construction that sets, hardens, and adheres to other materials to bind them together. Cement is seldom used on its own, but rather to bind sand and gravel together. It is a building material that is a powder made of a mixture of calcined limestone and clay, used with water or sand with gravel to make concrete and mortar.

The majority of cement is used to construct homes, buildings and bridges. The majority of consumers spent more money on the resources they required to build their homes and used costlier materials. Every year, the cost of other every material needed to construct structures rises, and its resources gradually become scarcer. All standard buildings including single-story buildings, containment and retaining structures, and bridges, can be built with cement.

Mud clam is a edible bivalve species buried in the stiff mud of mangroves. It is a typical seafood in the mangroves zone of Cas Mau. Mud clam is Mollusca with two shells, has shape like clams and shellfish but larger in size. It lives and resides mainly on mangroves lands, riverside coastal mud flats and shrimp ponds of farmers.

Statement of the problem

This study was made to find out how durable the cement is with the help of mud clam shell.

- How can mud clam shells be used to produce a more durable cement?
- Can mud clam shells enhance the durability of the cement in terms on its compressive strength and water absorption?
- Is there a significant difference between the different amount of mud clam shells that are put in the manufactured cement and the manufactured cement without mud clam shell in terms on its durability?

Objectives

At the end of this study, it was expected that the following would be discovered.

- To make a more durable cement with the help of mud clam shell.
- To determine if mud clam shell can enhance the durability of the cement in terms on its compressive strength and water absorption.
- To determine the significant difference between the different amount of mud clam shells that are put in the manufactured cement and the manufactured cement without mud clam shells in terms on its durability.

Hypothesis

Alternative (Ha): There is a significant difference between the different amount of mud clam shells that are put in the manufactured cement and the manufactured cement without mud clam shells in terms on its durability.

Null (Ho): There is no significant difference between the different amount of mud clam shells that are put in the manufactured cement and the manufactured cement without mud clam shells in terms on its durability.

Conceptual Framework

The concept of this research was to produce a durable cement with the help of mud clam shell.

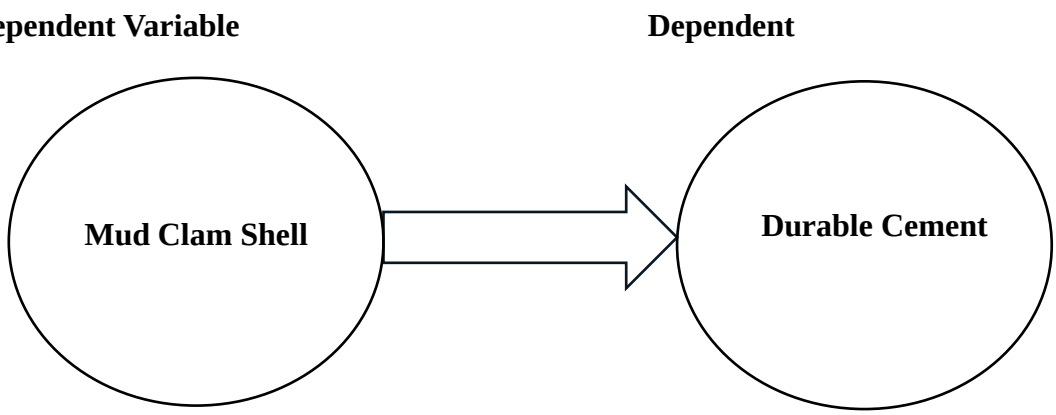

Figure 1. The conceptual Framework of the research

Significance of the Study

This study was made by the researchers to help the sector of society produce a more durable cement with the help of mud clam shell. Using mud-clam shell can potentially enhance the durability of the cement due to its compositions and characteristics which often includes calcium carbonate. Additionally, mud clam shells are often considered waste end up in landfills. By using them in cement, we can recycle these wastes can reduce the amount of material that ends up in landfills and make a proper use to it. It can also help people to save money from buying a lot of pricey cement for construction materials.

Locale, Scope, and Delimitation

This study is about Mud Clam Shell as a help on making a more durable cement. It dealt with the effectiveness of Mud Clam Shell in the cement. This study was conducted in August 2023.

This study focused on the investigation of Mud Clam Shell as a help on making a more durable cement. The idea is to make a durable cement using mud clam shell as the main component. The tests that were made in this study are compression test and water absorption.

Definition of terms

- **Calcium carbonate-** The main component of shells of marine organisms.
- **Cement** - A powdery substance made with calcined lime and clay.
- **Compressive strength-** the capacity of concrete to withstand loads before failure.
- **Durability-** The ability to withstand wear, pressure, or damage.
- **Mud Clam**- A Mollusca with two shells, has shape like clams and shellfish but longer in size.
- **Pozzolan-** A natural or artificial material containing silica in a reactive form.
- **Water Absorption –** Measures the amount of water that a concrete metal can absorbed.

Chapter II

Review of Related Literature

This chapter shows all the relevant studies and information of our study.

Cement

Cement is a building material that is powder made of a mixture of calcined limestone and clay, used with water and sand or gravel to make concrete and mortar. It is a material that is used to build very strong, hard surfaces and structures. Cement is an ingredient in both mortar, which holds bricks together, and concrete, with which dams and roads and buildings are constructed. The main function of cement is to act as hydraulic binder, which increases the bond between fragmented particles, so it can enable their used in different fields. Hosam and Rehab (2018). It was originated from ancient Egypt when sand and gravel mixed with water to create a basic type of concrete used for building.

Cement is an essential element in the construction industry, favored for its ability to bind materials together in the creation of concrete.

Mud Clam

Mud clam is Mollusca with two shells, has shape like clams and shellfish but larger in size. Mud clam is an edible bivalve species buried in stiff mud of mangroves. Bayen et. al (2005). It is a non-seasonal species which can be found abundantly and widely distributed throughout the west Indo pacific region including Peninsular Malaysia

and Sarawak. Ingole et. al (2002). They live and resides mainly on mangrove lands, riverside, coastal mudflats and shrimp ponds of farmers in the province. Mud clam shells are mainly composed of calcium carbonate (CaCO3) which is also a key component in traditional cement.

Calcium Carbonate

Calcium carbonate is a pozzolan, which is a material that reacts with calcium hydroxide to form a cementitious material. Pozzolans are used to improve the workability, strength, and durability of a concrete. Several studies have compositions and physical properties of mud clam shells to determine their suitability as a cement. For instance, a study by Smith et al (2018), determines the elemental composition of mud clam shells and found them high level of calcium, making them a potentially viable component enhance the durability of the cement.

Properties of Mud Clam Shell

The strength and durability of any cement alternative is an important factor. Several studies have evaluated the mechanical properties of mud clam shell-based cement. In a study conducted by Johnson et. al (2020), it was found that mud clam shell-based cement exhibited comparable compressive strength to traditional cement. Moreover, the study also noted good durability qualities, which further suggested that mud clam shell-based cement would be an appropriate substitute or component on enhancing the durability for a variety of construction applications.

While using mud clam shell as a help to enhance the durability of the cement shows potential, there are still issues that must be resolved. For instance, the consistency and quality of the final cement can be impacted by variations in the chemical makeup of mud clam shells from various sources. Additional investigation is required to optimize the production process and asses the long-term durability of the cement with the help mud clam shells.

Screed mix ratio of sand and cement

However, the traditional standard screed mix ratio is 1:4 cement to sand, creating a soft, malleable texture that is easy to work with. The screed mix ratio of sand and cement is important for achieving optimal performance of a concrete.

Water Absorption Test

The water absorption test of concrete measures the amount of water that a concrete sample can absorb. This test is important for determining the durability and resistance to water of the concrete and helps to ensure that the concrete will perform as expected in its intended environment A. Z. Khan (2023).

Compressive Test

Compressive strength can be defined as the capacity of concrete to withstand loads before failure. One of the many test, it is the most important, as it gives idea about the characteristics of the concrete.

In the Philippines, load bearing blocks shall have a minimum compressive strength of 750 PSI (52.73 kg) while non-load bearing shall have a minimum compressive strength of 400 PSI (28.12 kg).

To sum it all up, the study stated that mud clam shell has the potential to be an effective component on enhancing the durability of a cement due to its chemical composition, strength, durability, and potential for reducing the wastes of seashells that cause environmental problem. However, further research is required to overcome challenges related to variability in composition and long-term durability. If properly addressed, the use of mud clam shell could help create a more environmentally friendly and long-lasting building sector.

Chapter III

Research Methodology

This chapter deals with the procedures and methods that were used in the study. This briefly discusses the research environment, materials and equipment that are used, procedure in making the Powederized mud clam shell, the data gathering, and research design.

A. Research Environment

The locale of the study will be conducted in Francisco Ramos National High School (Formerly Buayan National High School).

B. Materials and Equipment:

In this experiment, the materials needed are mud clam shell, coal, banana leaves, sieve, stainless tray, furnace, thong, big can, and water.

C. Procedures and Making the Product

In order to make the product these are the steps needed. All materials were gathered: mud clam shells, sieve, furnace, stainless tray, banana leaves, thong, can, and water. First, the coal was set up in the furnace. Second, pieces of mud clam shell were put in the furnace with the coal. Third, the coal was lit and waited until the fire died. Next, the mud clam shells was dipped in the water for a split second right after the fire died. Then, it was put immediately in the can and was sealed with banana leaves, tying them

securely. After that, the can where the shells were was placed on the burning coal and waited for one hour. When the hour was up, the can was retrieved from the burning coal. After getting the can out of the coal, the banana leaves to see if the shells had been powdered. Lastly, we sifted the powdered shell in the sieve to refine it.

D. Data Gathering

Experimentation was used to gather the data where the 2 treatments were tested for its durability and water absorption.

Compression Test

The compressive strength of the concrete was tested by applying a gradually increasing load until failure occurs. The weight on the concrete was recorded after the concrete breaks. This was done over in each treatment and in every trial.

Water Absorption

The water absorption of the cement was tested by immersing the samples in the same level of water for 24 hours, which contains 5 treatments. Before immersing it in the water, the treatments are weighted using grams. After 24 hours, the treatments was immediately removed out of the water and wiped with a dry cloth. After that, it was re-weighted using grams. This was done over in each treatment and in every trial.

The water absorption is calculated by subtracting the initial weight of the sample from the final weight and divided the result by the initial weight then multiplying it to 100

E. Research Design

This research is Quantitative Research. This research will use ANOVA and T-TEST to determine the effectiveness of the varying amount of Mud clam shell that are put in the Commercial cement in terms on its durability and water absorption and also to determine if there is a significant difference between the mud clam shell with sand and the Commercial cement with sand alone in terms on its durability and water absorption.

Table 1: Compression test

Treatments	**Breaking Point (Kg.)**			**Mean**
	T1	**T2**	**T3**	
1 15g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water				
2 30g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water				
3 45g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water				

Table 2: Comparison controlled treatments and treatment 1 for compression test

Control Treatments	Breaking Point (Kg.)			Mean
	T1	T2	T3	
4 15g of Mud Clam Shell 60g of Sand 25ml of Water				
5 15g of Commercial Cement 60g of Sand 25ml of Water				
1 15g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water				

Table 3: Comparison controlled treatments and treatment 2 for compression test

Control Treatments	Breaking Point (Kg.)			Mean
	T1	T2	T3	
4 15g of Mud Clam Shell 60g of Sand 25ml of Water				
5 15g of Commercial Cement 60g of Sand 25ml of Water				
2 30g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water				

Table 4: Comparison controlled treatments and treatment 3 for compression test

Control Treatments	Breaking Point (Kg.)			Mean
	T1	T2	T3	
4 15g of Mud Clam Shell 60g of Sand 25ml of Water				
5 15g of Commercial Cement 60g of Sand 25ml of Water				
3 45g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water				

Table 5: Water absorption test

Treatments	Increase percentage			Mean
	T1	T2	T3	
1 15g of Mud Clam Shell 15g of Commercial Cement 60g of Sand 25ml of Water				
2 30g of Mud Clam Shell 15g of Commercial Cement 60g of Sand 25ml of Water				
3 45g of Mud Clam Shell 15g of Commercial Cement 60g of Sand 25ml of Water				

Table 6: Comparison controlled treatments and treatment 1 for water absorption

Control Treatments	Increase percentage			Mean
	T1	T2	T3	
4 15g of Mud Clam Shell 60g of Sand 25ml of Water				
5 15g of Commercial Cement 60g of Sand 25ml of Water				
1 15g of Mud Clam Shell 15g of Commercial Cement 60g of Sand 25ml of Water				

Table 7: Comparison controlled treatments and treatment 2 for water absorption

Control Treatments	Increase percentage			Mean
	T1	T2	T3	
4 15g of Mud Clam Shell 60g of Sand 25ml of Water				
5 15g of Commercial Cement 60g of Sand 25ml of Water				
2 30g of Mud Clam Shell 15g of Commercial Cement 60g of Sand 25ml of Water				

Table 8: Comparison controlled treatments and treatment 3 for water absorption

Control Treatments	Increase percentage			Mean
	T1	T2	T3	
4 15g of Mud Clam Shell 60g of Sand 25ml of Water				
5 15g of Commercial Cement 60g of Sand 25ml of Water				
3 45g of Mud Clam Shell 15g of Commercial Cement 60g of Sand 25ml of Water				

Chapter IV

Results and Discussions

This chapter presents the result, analysis, and discussion gathered from the test and statistical analysis.

Table 9: Result for Compression test

Treatments	Breaking Point (Kg.)			Mean
	T1	T2	T3	
1 15g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water	14	13	15	14
Treatment 2 30g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water	9	10	12	10.33
Treatment 3 45g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water	21	21	22	21.33

From the table above, the researchers made 3 treatments of their cement to test its durability through compression test. Where the higher average of compression, the higher the concretes durability. Treatment 1 has an average of 14, treatment 2 has an average of 10.33, treatment 3 has an average 21.33. Treatment 3 shows the highest average of compression percentage among the other treatments while treatment 2 shows the lowest average of compression. Therefore, treatment 3 has the highest compressive strength while treatment 2 shows the lowest.

Table 10: One-way analysis of variance (ANOVA) for Compression test

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	5.555556	2	2.777778	0.087719	0.917171	5.143253
Within Groups	190	6	31.66667			
Total	195.5556	8				

The results show at alpha level 0.05, where P value (0.917171) is greater than the alpha level (0.05), therefore the null hypothesis is accepted, this implies that there is no significant difference among the three treatments in terms on its durability when the compression test was conducted.

Table 11: Results of the Comparison controlled treatments and treatment 1 for compression test

Control Treatment	**After Breaking Point (Kg.)**			**Mean**
	T1	**T2**	**T3**	
4 15g of Mud Clam Shell 60g of Sand 25ml of Water	7	4	5	5.33
5 15g of Commercial Cement 60g of Sand 25ml of Water	11	14	13	12.66
1 15g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water	14	13	15	14

From the table above, the researchers made a control treatment to determine if there is a significant difference in the treatment 4, 5 and 1 in terms on its durability through compression test. Where the higher average of compression, the higher the concretes durability. Treatment 5 shows the highest average among the other treatments, while treatment 4 shows the lowest. Therefore, treatment 5 has the highest compressive strength and treatment 4 has the lowest.

Table 12: One-way analysis of variance (ANOVA) for the Comparison controlled treatments and treatment 1 for compression test

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.666667	2	0.333333	0.014151	0.985982	5.143253
Within Groups	141.3333	6	23.55556			
Total	142	8				

The results show at alpha level 0.05, where P value (0. 985982) is greater than the alpha level (0.05), therefore the null hypothesis is accepted, this implies that there is no significant difference among the three treatments in terms on its durability when the compression test was conducted.

Table 13: Result of the Comparison controlled treatments and treatment 2 for compression test

Control Treatment	Breaking Point (Kg.)			Mean
	T1	T2	T3	
4 15g of Mud Clam Shell 60g of Sand 25ml of Water	7	4	5	5.33
5 15g of Commercial Cement 60g of Sand 25ml of Water	11	14	13	12.66
2 30g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water	9	10	12	10.33

From the table above, the researchers made a control treatment to determine if there is a significant difference in the treatment 4, 5 and 2 in terms on its durability through compression test. Where the higher average of compression, the higher the concretes durability. Treatment 5 shows the highest average among the other treatments, while treatment 4 shows the lowest. Therefore, treatment 5 has the highest compressive strength and treatment 4 has the lowest.

Table 14: One-way analysis of variance (ANOVA) for the Comparison controlled treatments and treatment 2 for compression test

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	1.555556	2	0.777778	0.048276	0.953237	5.143253
Within Groups	96.66667	6	16.11111			
Total	98.22222	8				

The results show at alpha level 0.05, where P value (0. 953237) is greater than the alpha level (0.05), therefore the null hypothesis is accepted, this implies that there is no significant difference among the three treatments in terms on its durability when the compression test was conducted.

Table 15: Result of the Comparison controlled treatments and treatment 3 for compression test

Control Treatment	Breaking Point (Kg.)			Mean
	T1	T2	T3	
4 15g of Mud Clam Shell 60g of Sand 25ml of Water	7	4	5	5.33
5 15g of Commercial Cement 60g of Sand 25ml of Water	11	14	13	12.66
3 45g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water	21	21	22	21.33

From the table above, the researchers made a control treatment to determine if there is a significant difference in the treatment 4, 5 and 3 in terms on its durability through compression test. Where the higher average of compression, the higher the concretes durability. Treatment 3 shows the highest average among the other treatments, while treatment 4 shows the lowest. Therefore, treatment 3 has the highest compressive strength and treatment 4 has the lowest.

Table 16: One-way analysis of variance (ANOVA) for the Comparison controlled treatments and treatment 3 for compression test

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	0.222222	2	0.111111	0.001689	0.998313	5.143253
Within Groups	394.6667	6	65.77778			
Total	394.8889	8				

The results show at alpha level (0.05), where P value (0. 998313) is greater than the alpha level (0.05), therefore the null hypothesis is accepted, this implies that there is no significant difference among the three treatments in terms on its durability when the compression test was conducted.

Table 17: Results for Water Absorption

Treatments	Increase percentage			Mean
	T1	T2	T3	
1 15g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water	10.83%	10.56%	24.06%	15.15%
2 30g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water	8.30%	11.86%	19.52%	13.22%
3 45g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water	8.20%	9.50%	13.16%	10.28%

From the table above, the researchers made 3 treatments of their cement to test its durability through water absorption test. Where the higher the percentage is, the lower the water resistance and durability the concrete is considered to be. Treatment 1 has a percentage of 15.15%, treatment 2 has a percentage of 13.22% and treatment 3 has an percentage of 10.28%. Treatment 1 shows the highest percentage among the other treatments while treatment 3 shows the lowest percentage. Therefore, treatment 1 has the lowest water resistance and durability while treatment 3 has the highest water resistance and durability because the lower the water absorption, the more water resistant and durable the concrete is.

Table 18: One-way analysis of variance (ANOVA) of Water Absorption

ANOVA

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	166.8943	2	83.44714	7.451296	0.023651	5.143253
Within Groups	67.19407	6	11.19901			
Total	234.0884	8				

The results show at alpha level (0.05), where P value (0.023651) is less than the alpha level (0.05), therefore the null hypothesis is rejected, this implies that there is a significant difference among the three treatments in terms on its durability and water resistance when the water absorption test was conducted.

Table 19: Result of Comparison controlled treatments and treatment 1 for water absorption

Control Treatment	**Increase percentage**			**Mean**
	T1	**T2**	**T3**	
4 15g of Mud Clam Shell 60g of sand 25ml of water	18.78%	17.62%	20.02%	18.80%
5 15g of Commercial Cement 60g of Sand 25ml of Water	27.37%	9.76%	19.27%	18.8%
1 15g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water	10.83%	10.56%	24.06%	15.15%

From the table above, the researchers made a control treatment to determine if there is a significant difference in the treatment 4, 5 and 1 in terms on its durability and water resistance through water absorption test. Treatment 4 has a percentage of 18.80% , treatment 5 has a percentage of 18.8% while treatment 1 has 15.15%. Therefore, treatment 4 and 5 has the lowest water resistance and durability while treatment 1 has the highest water resistance and durability because the lower the water absorption, the more water resistant and durable the concrete is.

Table 20: One-way analysis of variance (ANOVA) for the Comparison controlled treatments and treatment 2 for compression test

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	135.5096	2	67.75481	4.04737	0.077141	5.143253
Within Groups	100.4427	6	16.74046			
Total	235.9524	8				

The results show at alpha level (0.05), where P value (0.077141) is less than the alpha level (0.05), therefore the null hypothesis is accepted, this implies that there is no significant difference among the three treatments in terms on its durability and water resistance when the water absorption was conducted.

Table 21: Result of Comparison controlled treatments and treatment 2 for water absorption

Control Treatment	Increase percentage			Mean
	T1	T2	T3	
4 15g of Mud Clam Shell 60g of sand 25ml of water	18.78%	17.62%	20.02%	18.80%
5 15g of Commercial Cement 60g of Sand 25ml of Water	27.37%	9.76%	19.27%	18.8%
2 30g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water	8.30%	11.86%	19.52%	15.15%

From the table above, the researchers made a control treatment to determine if there is a significant difference in the treatment 4, 5 and 2 in terms on its durability and water resistance through water absorption test. Treatment 4 has a percentage of 18.80% , treatment 5 has a percentage of 18.8% while treatment 2 has 15.15%. Therefore, treatment 4 and 5 has the lowest water resistance and durability while treatment 1 has the highest water resistance and durability because the lower the water absorption, the more water resistant and durable the concrete is.

Table 22: One-way analysis of variance (ANOVA) of the Comparison controlled treatments and treatment 2 for water absorption

ANOVA

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	64.28207	2	32.14103	1.262508	0.348633	5.143253
Within Groups	152.7485	6	25.45809			
Total	217.0306	8				

The results show at alpha level (0.05), where P value (0.348633) is less than the alpha level (0.05), therefore the null hypothesis is rejected, this implies that there is a significant difference among the three treatments in terms on its durability and water resistance when the water absorption was conducted.

Table 23: Result of Comparison controlled treatments and treatment 3 for water absorption

Control Treatment	Increase percentage			Mean
	T1	T2	T3	
4 15g of Mud Clam Shell 60g of sand 25ml of water	18.78%	17.62%	20.02%	18.80%
5 15g of Commercial Cement 60g of Sand 25ml of Water	27.37%	9.76%	19.27%	18.8%
3 45g of Mud Clam Shell 15g of Commercial Cement 60g of sand 25ml of water	8.20%	9.50%	13.16%	10.28%

From the table above, the researchers made a control treatment to determine if there is a significant difference in the treatment 4, 5 and 3 in terms on its durability and water resistance through water absorption test. Treatment 4 has a percentage of 18.80%, treatment 5 has a percentage of 18.8% while treatment 3 has 10.28%. Therefore, treatment 4 and 5 has the lowest water resistance and durability while treatment 1 has the highest water resistance and durability because the lower the water absorption, the more water resistant and durable the concrete is.

Table 24: One-way analysis of variance (ANOVA) of Water Absorption

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	47.5862	2	23.7931	0.743703	0.514588	5.143253
Within Groups	191.9564	6	31.99273			
Total	239.5426	8				

The results show at alpha level (0.05), where P value (0.514588) is greater than the alpha level (0.05), therefore the null hypothesis is accepted, this implies that there is no significant difference among the three treatments in terms on its durability and water resistance when the water absorption was conducted.

Chapter V

Conclusion and Recommendation

This chapter presents the conclusion and recommendation of the study.

Conclusion

After the preparation and tests, the researchers are convinced that Mud Clam shells have a potential to be a component in making a more durable cement. The result of compressive and water absorption is varying on the amount of Mud Clam shells that is used in the formulation. The alternative hypothesis is rejected in terms of its compressive test where there is no significant difference among the treatments and the control treatments during the compressive test in different trials. On the other hand, the null hypothesis is rejected in terms of its water absorption test where there is a significant difference among the treatments and the control treatments during the water absorption test in different trials.

Recommendation

This study revealed the effectiveness of Mud clam shells as the main component in making cement. It is recommended to conduct more tests on the other traits of the cement to further support the effectiveness of the product in terms of its durability. Enhancement of molding the product is also recommended for a better and convenient experimentation and to also get a more accurate and exact results.

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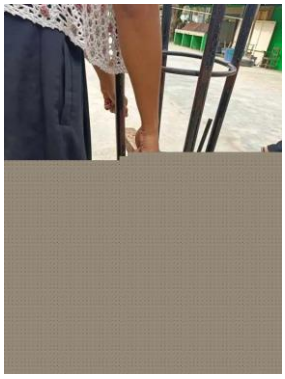
Appendix




Making of the Cement

Compressive Test

Water Absorption Test

Curriculum Vitae

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