The Team

Bataan Peninsula State University
College of Engineering and Architecture
Bataan, Philippines

TEAM CEMENT

A team that is passionate about sustainability
and pushes towards circular economy.

CRUZ
SHANNEN LYKA S.
Team Leader

PAMINTUAN
FRANCHESKA EDELLE
Team Member

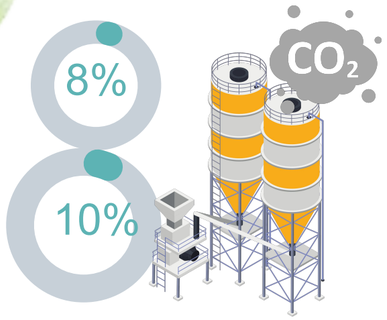
VILLANUEVA
RONAN B.
Team Member

LEIN C.

BS CIVIL ENGINEERING MAJOR IN STRUCTURAL ENGINEERING

Circular Innovation Overview

PROBLEM STATEMENT



CO2 EMMISION FROM CEMENT MANUFACTURING AND IMPROPER DISPOSAL OF WASTE

SOURCE: Annualreviews.org, 2019

Cement manufacturing contributes 8% to 10% of anthropogenic global carbon dioxide (CO2) gas emissions into the atmosphere

Fruit waste generated accounts for approximately 4.4 gigatonnes of greenhouse gas emissions.

1

EXPLOITATION OF NATURAL RESOURCES

SOURCE: Jhatial et al., 2018

Cement manufacture involves the extraction of elements such as calcium, silica, alumina, and iron from limestones, rocks, chalks, shales, and clay, thus depleting natural resources

2

MASSIVE FRUIT WASTE

Source: IFCO SYSTEMS, 2020

Roughly half of all fruits and vegetables produced around the globe are wasted. This amounts to over 1.3 billion tons of wasted food

3

3.5M

Tons of banana peel waste annually

Source: Forbes, 2022

3.8M

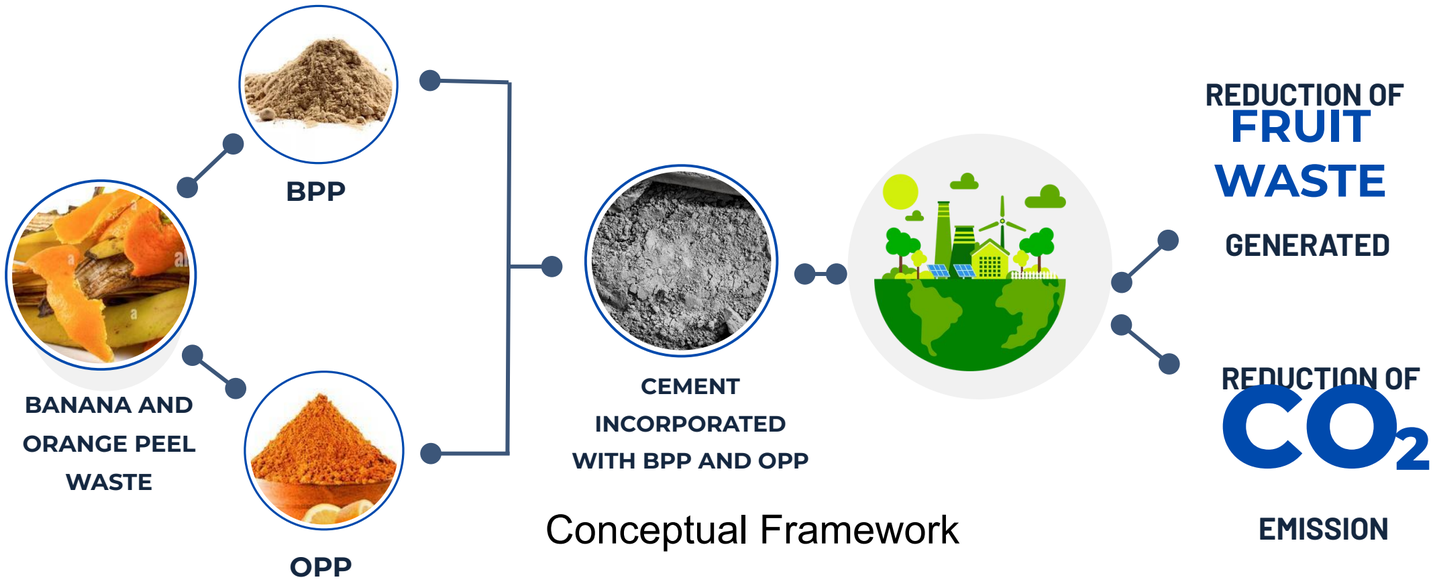
Tons of citrus peels go to waste each year

Source: Dan Nosowitz 2017

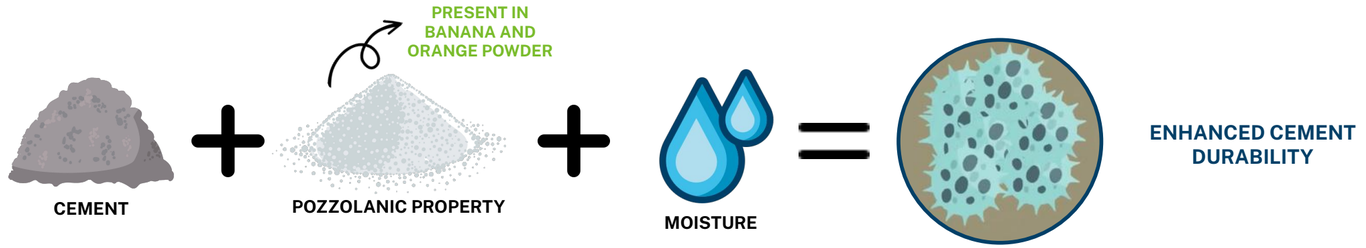
Circular Innovation Overview

OUR SOLUTION

BANANA AND ORANGE PEEL WASTE UTILIZATION AS PARTIAL CEMENT REPLACEMENT MATERIAL IN PRODUCING IMPROVED QUALITY AND ECONOMICAL CEMENT WHILE MINIMIZING CARBON DIOXIDE EMISSION AND FRUIT WASTE GENERATED.



Conceptual Framework



Circular Innovation Overview

OUR SOLUTION

CEMENT WITH ORANGE PEEL POWDER REPLACEMENTS

CEMENT WITH BANANA PEEL POWDER REPLACEMENTS

Circular Innovation Overview

OUR ACTIVITIES

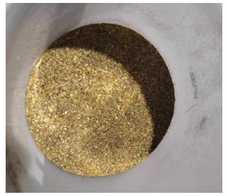



COLLECTION OF SAMPLES




SUNDRYING




POWDERING



PREPARATION OF CEMENT MIXTURES

Project Goals

OUR GOALS

TO UTILIZE WIDELY AVAILABLE BANANA AND ORANGE PEEL WASTE AS PARTIAL CEMENT REPLACEMENT MATERIAL IN PRODUCING IMPROVED QUALITY AND ECONOMICAL CEMENT WHILE MINIMIZING CARBON DIOXIDE EMISSION AND FRUIT WASTE GENERATED.

01

C02 REDUCTION

To reduce carbon dioxide emissions caused by cement manufacturing process and the incineration of massive volumes of fruit waste

02

WASTE UTILIZATION

To utilize widely available banana and orange peel waste as partial cement replacement materials

03

GREEN CEMENT

To develop a more cost-effective and environmentally sustainable cement.

04

DISCOVER OPPORTUNITIES

To investigate the potential use of banana and orange peel waste as a partial cement replacement to assess the effect on the physicomechanical characteristics of cement blended with BPP and OPP

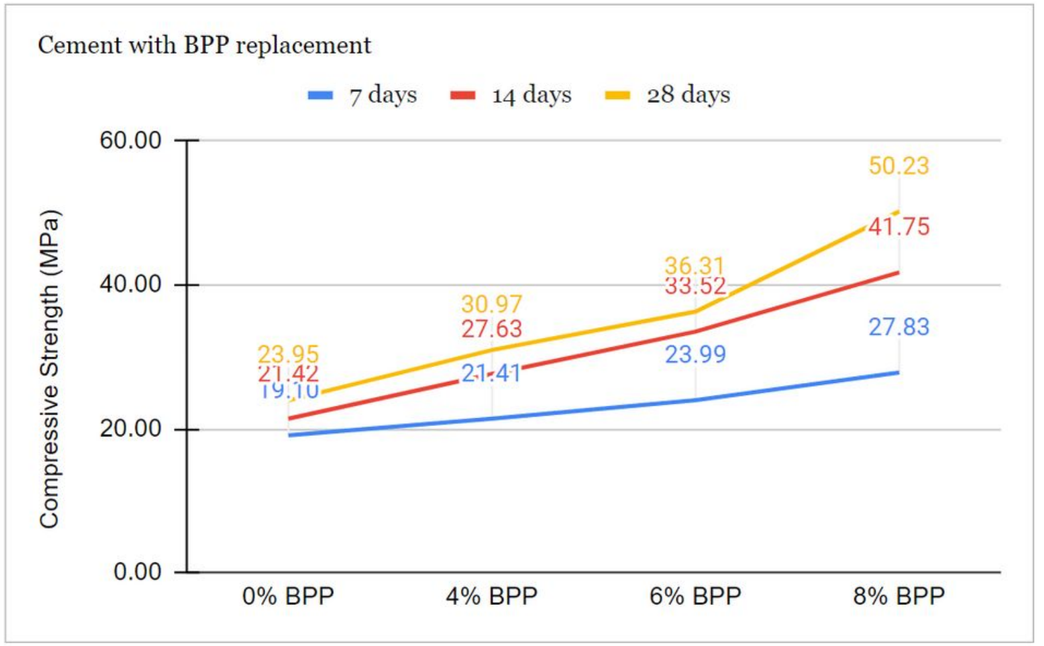
Impact & Results

TESTING PHASE

Impact & Results

RESULTS

INFLUENCE OF BANANA PEEL POWDER ON THE PHYSICOMECHANICAL PROPERTIES OF CEMENT AS PARTIAL REPLACEMENT BY 4%, 6% AND 8%



Increase of compressive strength of cement with BPP per percentage replaced

- The table illustrates that incorporating **4% BPP** in ordinary Portland cement (OPC) resulted in the compressive strength rising from 19.1Mpa to 21.41Mpa after 7 days of curing, 21.42Mpa to 27.63Mpa after 14 days of curing, and 23.95Mpa to 30.95Mpa after 28 days of curing.

- **6% BPP** replacements increases of 26%, 56%, and 52% respectively

- 28 days curing age of **8% BPP** replacement, after 50.23 Mpa was achieved, the strength had improved by approximately 46% to 110%

Impact & Results

RESULTS

INFLUENCE OF ORANGE PEEL POWDER ON THE PHYSICOMECHANICAL PROPERTIES OF CEMENT AS PARTIAL REPLACEMENT BY 4%, 6% AND 8%

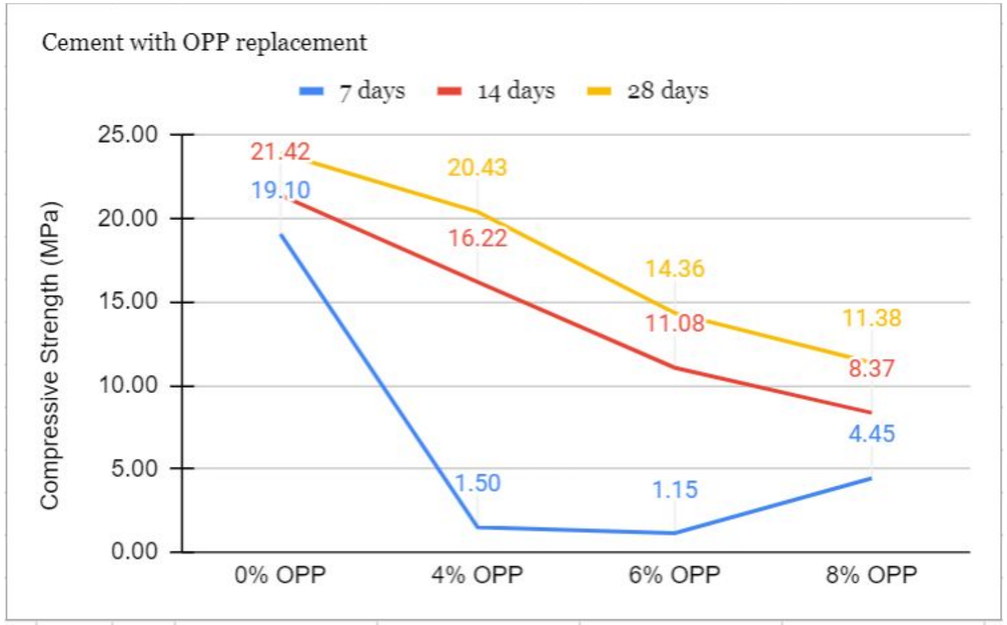


Figure 5.9 Decrease of compressive strength of cement with OPP per percentage replaced

When 4% OPP is incorporated, the compressive strength decreases from 23.95 MPa to 20.43 MPa after 28 days of curing. Similarly, the strength decreases to 14.36 MPa for 6% OPP content and to 11.38 MPa for 8% OPP content.

Based on the obtained results, it was determined that **BPP possesses significant potential as a material for partially replacing cement.** On the other hand **the addition of orange peel powder to cement leads to a significant reduction in strength.**

Impact & Results

POTENTIAL BENEFITS

Micro Grant

A table is provided, outlining the expenses incurred for materials, equipment, prototypes, as well as additional costs associated with experiments and testing.

No.	Particulars	Total
1	Travel Expenses	Php 3,374.00
2	Supplies and Materials Expenses	Php 5,454.00
3	Representation Expenses (Meals)	Php 2,930.00
4	Testing (Chemical and Physical Testing)	Php 18,320.00
5	Printing Expenses	Php 2,000.00
Grand Total		Php 32,078.00

With the help of Micro Grant, we have successfully fulfilled all the requirements necessary for our research to achieve its objectives.

Lessons Learnt

Engaging in this research presents a wide range of advantages and learning possibilities. It enables us to attain a profound comprehension by extensively exploring a subject, amassing extensive information, and examining various facets.

Furthermore, it broadens our knowledge in diverse fields, nurturing our understanding of theories and advancements. This research also strengthens our aptitude for problem-solving as it assists in identifying, analyzing, and formulating solutions to problems. Moreover, it educates us on source evaluation, empowering us to distinguish between dependable and biased information. Through data analysis, this research allows us to refine our abilities in data collection, organization, interpretation, and constructing evidence-based arguments. Lastly, the ultimate accomplishment lies in substantiating the veracity of our research.

As researchers, there is no greater satisfaction than being able to validate the study we have conducted. The ability to provide evidence and support for our findings brings an unmatched sense of fulfillment. It not only affirms the credibility of our work but also contributes to the existing knowledge in our field. This confirmation solidifies our role as contributors to the advancement of understanding and serves as a testament to the impact of our research endeavors.

Stories

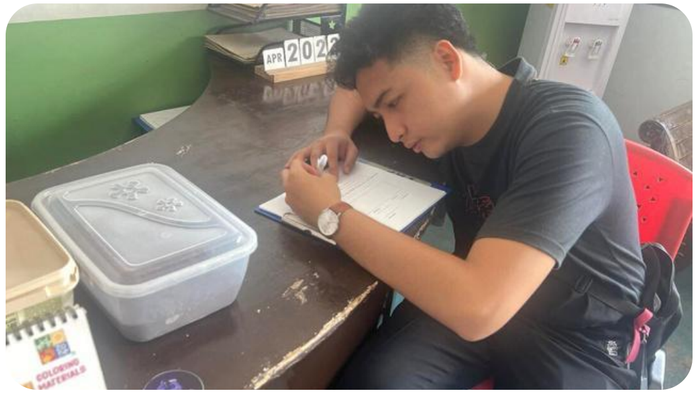
The support of Circular Cities Asia has been truly invaluable in bringing this research project to fruition. Their generous provision of a micro grant has not only made it possible for us to embark on this endeavor but has also alleviated any apprehensions regarding potential funding limitations.

With the assurance of financial support, we can now dedicate our full attention and resources to conducting this research with unwavering focus and commitment.

The micro grant serves as a vital catalyst, empowering us to delve deeper, explore innovative methodologies, and pursue comprehensive data analysis, all without the constraints of financial constraints.

Stories

From collection and preparation of fruit peels



To a successful transformation of waste into something valueable

We are immensely grateful to Circular Cities Asia for their belief in our research and for their unwavering commitment to advancing knowledge and sustainable solutions in our field.

Stories

"Conducting this research has been an enlightening experience, as it has revealed to me the vastness of unexplored knowledge in the world. Throughout my journey as a researcher, I have gained valuable insights and honed my problem-solving, critical thinking, and data analysis skills. This unforgettable experience has played a significant role in completing my college life and has contributed to my personal and intellectual growth."

RONAN B. VILLANUEVA
Civil Engineering Student

"This research has opened my eyes to the vast unexplored possibilities and the endless opportunities for creativity and innovation. It is my hope that our work can serve as inspiration to others and make a meaningful contribution to the collective knowledge of the world."

SHANNEN LYKA S. CRUZ
Civil Engineering Student

"Throughout this journey, I have discovered a newfound passion. The process of acquiring new knowledge and utilizing it to generate further insights brings me a profound sense of fulfillment. While this study has its share of challenges, it is not devoid of enjoyment. Moreover, it has fueled my aspirations to become a proficient expert in my field and has emphasized the importance of continuous improvement."

FRANCHESKA EDELLE LEIN G. PAMINTUAN
Civil Engineering Student

Next Steps

OUR NEXT STEPS

1

In order to ascertain the optimal percentage, additional incorporation of BPP and OPP is necessary.

2

We intended to perform an alternative form of chemical analysis to investigate the occurrence of any chemical reactions related to the pozzolanic reaction.

3

Perform a comprehensive analysis specifically focused on the water absorption characteristics of both BPP and OPP.