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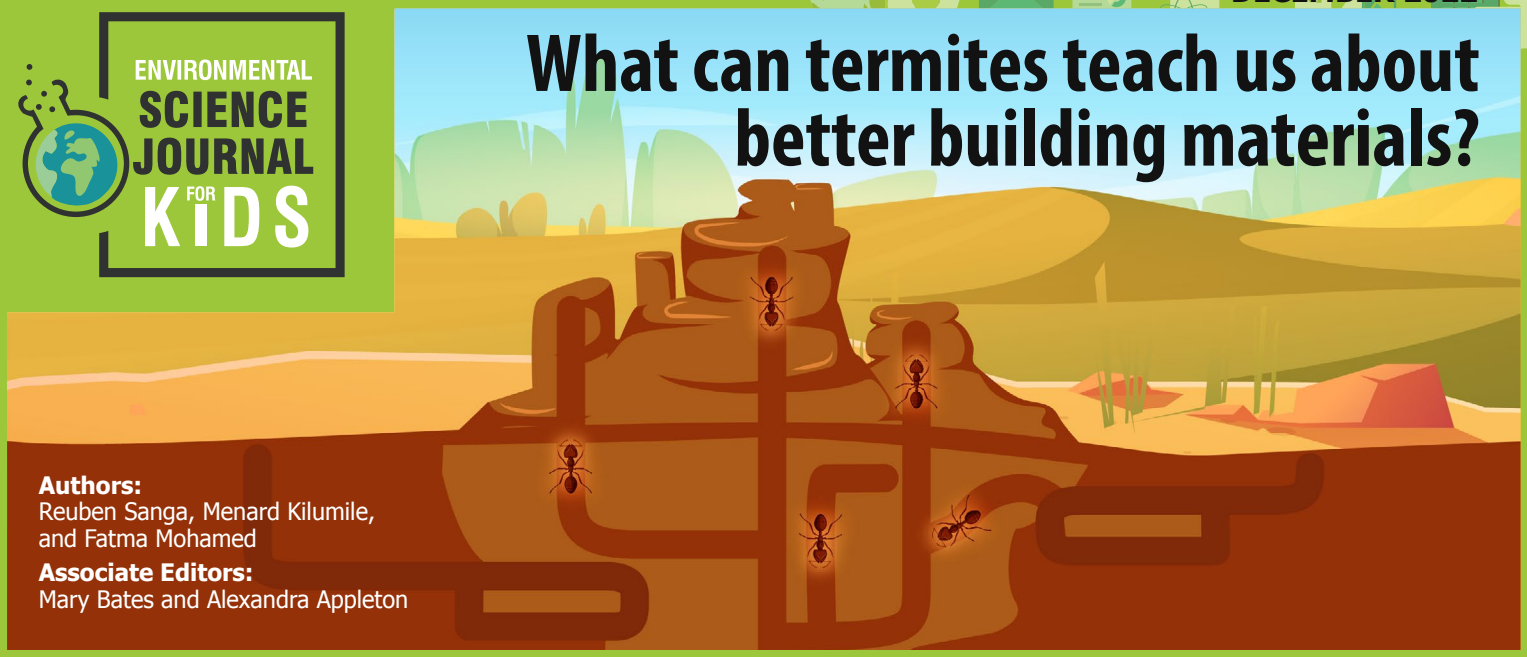
What can termites teach us about better building materials?



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Abstract

LOWER READING LEVEL

Across the world, we need more sustainable materials to make buildings. So, we turned to Nature for inspiration. Termites are insects that build large, stable mounds for their homes. They construct these mounds by mixing soil with their saliva. This mixture contains simple sugars that act like glue and make the mounds hard. We wanted to see if we could copy these mounds! Cassava is a vegetable that also contains simple sugars. We mixed soil with hot paste made from cassava flour. Then, we made bricks with different amounts of cassava paste. We tested the bricks to see if they would make good building materials. It turns out that bricks made with 1.5% cassava paste are strong and stable. They are even stronger than traditional bricks made only from clay! Our bricks could provide a safe and practical alternative to traditional clay bricks.

Introduction

Termites are natural engineers! These insects build tall mounds out of soil for their homes. To make their mounds, termites scoop up soil in their mouths and mix it with their **saliva**. Termite saliva can break down plants into simple sugars. The mixture of termite saliva and soil acts like cement and makes the mound stable. Some foods also contain simple sugars. One of these is a potato-like vegetable called **cassava**. We wanted to see if we could mimic the strength and stability of termite mounds. To do this, we created bricks using cassava flour instead of termite saliva.

Mound-building termites construct large structures to live in.
Photo: Bambiwa, CC BY-SA 4.0

Methods

First, we looked at the differences between soil from a termite mound and clay soil from the ground (Figure 1). We collected samples of both types of soil in Tanzania, a country in east Africa. We used a special machine to work out the chemicals that make up each type of soil. We also checked how much water the two soils contained.

Next, we were ready to create our own termite-inspired bricks.

We mixed cassava flour with hot water to make a thick paste. We combined this cassava paste with ordinary clay soil. Then we poured it into molds so it would dry into brick shapes. We made bricks with different amounts of cassava paste. Some bricks had 0% cassava paste, like traditional clay bricks. We also made bricks that contained between 1.5% and 6% cassava paste. These bricks mimicked termite mounds.

When the bricks were dry, we tested them to see if they would be good for constructing buildings.

- We measured their **compressive strength**. To do this, we put pressure on the top and bottom of the brick until it broke.
- Bricks always shrink while drying. We measured if the bricks cracked as they shrank.
- We put the bricks in a machine that shook them with grains of sand to see how much they wore down.
- We worked out how much unwanted water the bricks absorbed from the environment.

a)

b)

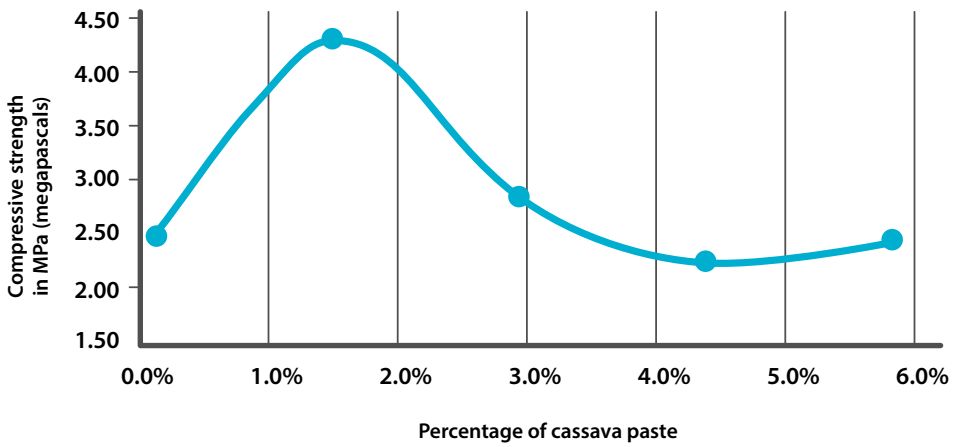
Figure 1:
Soil samples from
a) a termite mound
b) nearby clay soil

Results

The termite mound sample and the clay soil sample contained similar chemicals. But the termite mound sample had less moisture than the clay soil sample.

We then compared our termite-inspired bricks to traditional clay bricks. Traditional clay bricks dry in the sun. They have a compressive strength of 1.5–2.5 **megapascals**. Bricks dried locally in special ovens are stronger. They have a compressive strength of around 3.5 megapascals.

We found that our bricks containing 1.5% cassava paste had a compressive strength of 4.28 megapascals. This is a lot higher than clay bricks (Figure 2). Bricks that had more than 1.5% cassava paste had lower compressive strengths. Bricks made from 1.5% cassava paste did not shrink very much as they dried. They also didn't wear down much and did not absorb too much moisture.



What kind of brick had the highest compressive strength?

Figure 2:
Compressive strength of bricks containing different amounts of cassava paste.

Discussion

We showed that bricks made from cassava paste can make good building materials. The bricks containing 1.5% cassava paste were the strongest of all the materials we tested. The bricks made with 1.5% cassava paste did well in our other tests, too. They did not shrink much, they were sturdy, and they did not absorb a lot of water.

The bricks made with more than 1.5% cassava paste were not stronger. This may be because greater amounts of cassava paste produce more gas. Gas makes the bricks swell and crack. This weakens their compressive strength.

Making traditional clay bricks uses a lot of energy. It also harms the environment and people's health. Our experiments show that termite mounds can inspire better building materials. Clay bricks made with cassava paste are strong and stable. Plus, they are better for the environment!. Looking to Nature for solutions can help us create better buildings in the future.

Conclusion

Making construction materials can hurt the environment. We need to find alternative materials that are safer for the Earth and for our health. Scientists and engineers are looking to Nature for inspiration. Why not check out how other bugs build their homes? You could head to the bug house in your local zoo. Or sit down with an animal encyclopedia in the library. Who knows – in the future, you might live in a house inspired by insect engineers!

Glossary of Key Terms

Cassava – a root vegetable, like a potato, that people eat throughout the tropics. We mixed flour made from cassava with hot water to create a thick paste.

Compressive strength – the ability of a material to hold out against the pressure of a force that pushes on it. High compressive strength is needed for construction materials.

Megapascal – a unit to measure pressure. Bricks made with cassava paste had a compressive strength of over 4 megapascals. This made them stronger than traditional clay bricks.

Saliva – clear liquid made by glands in the mouth. Saliva helps your body digest food by digestion by breaking it down as you chew.

Termites – insects that live in groups and feed on plants. Termites mix their saliva with soil to build tall mounds in which they live.

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Check your understanding

1. If you were given the choice between traditional clay bricks and bricks containing different amounts of cassava paste, which kind would you choose to use in constructing a building? Why?

2. Why is it good for bricks used in building construction to have a high compressive strength?

3. What kind of tests would you perform on a brick to determine if it would make a good building material?

4. We looked to Nature for inspiration. Can you think of another example when Nature inspired human researchers or designers?

5. In small groups, research the challenges of using different environmentally-friendly materials and sustainable sources of energy in construction. Design your own building, labeling it clearly and explaining the choices you have made.

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