

## I BET YOU DIDN'T KNOW...

Bamboo could be used to make cricket bats

Dr Paul Tyler, PSTT  
PSTT College Fellow, links  
**cutting-edge research** with  
the **principles of primary science**



✉ [paul.tyler@pstt.org.uk](mailto:paul.tyler@pstt.org.uk)

For nearly 200 years, cricket bats have been made from English willow (Figure 1) which is shipped all over the world for cricket bat production. However, willow trees take at least 6 years to mature, and often closer to 15 years before the willow is ready to be used. This has led to a widespread shortage in high quality willow to make crickets bats, and an *unsustainable* demand for willow worldwide.

### Questions children might like to consider:

- What does 'unsustainable' mean?
- Why do you think the demand for willow is becoming unsustainable?
- Can you think of other materials where global demand is unsustainable? You might need to research this.

Figure 1. White Willow (*Salix Alba*) takes a minimum of 6 years to mature before it is used to make cricket bats.



So, is there another suitable material with similar properties to willow that could be used? Scientists have been testing a new material to see if it is suitable to make cricket bats.

The Marylebone Cricket Club (MCC), who regulate the laws of cricket, insist that the blade of a cricket bat must be made of wood (Figure 2). This ruling came after Australian cricketer Dennis Lillie used an aluminium bat in 1979. This law in cricket narrows down the search for potential replacement materials.

Figure 2. A wooden cricket bat.



Bamboo is a grass with similar *cell* structure to wood; it is fast growing and cheap. It is widely grown in India and China (Figure 3). Could bamboo be the answer to producing high-performing cricket bats that are cheaper and more sustainable?

Figure 3. Bamboo is already used for lots of sustainable products from toilet paper to toothbrushes and drinking straws to building materials.



#### Questions children might like to consider:

- Why is bamboo such a good, sustainable material?
- What other products is bamboo already used for?
- Can you think of other products bamboo could be used for in the future?

#### Properties of a cricket bat

There are some key properties that a cricket bat must have to be useable:

- It should be light enough for the batter to swing quickly in both vertical and horizontal planes (Figure 4).
- It should be strong enough not to break on impact with a hard cricket ball.
- It needs to transfer *energy* efficiently from the batter's movement to the ball.
- It should be elastic enough not to transfer vibrations through the batter's hands.

Figure 4. Batters need a bat light enough to be able to swing it quickly horizontally and vertically.



#### Questions children might like to consider:

Think of a sport you play and the equipment you use to play it.

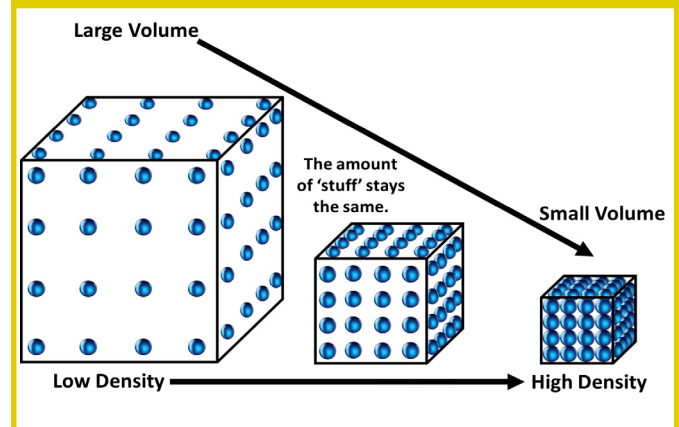
- What are the important properties of the equipment?
- How do those properties affect the choice of materials used?

#### Making a bamboo cricket bat

Unlike willow tree wood, bamboo is hollow when it grows. So, to make it into planks of bamboo that can be fashioned into bats, it must be processed. First the bamboo is caramelised, a process that involves subjecting it to high heat until it breaks down into a gooey *resin*. It is then dried in planks which are later cut into the right size and formed into the familiar bat shape.

Because of the manufacturing process, the bamboo bats that the scientists created this way were much heavier than willow bats. This is because the bamboo has a higher density than willow. *Density* is a measure of how much 'stuff' (or mass) is packed into a volume (Figure 5). For example, a balloon full of air is much less dense than a same sized balloon filled with water (the mass of air is less than the mass of water taking up the same space).

Figure 5. Density is a measure of how much 'stuff' is packed into a certain space.



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#### Measuring performance

Five key properties of the new laminated bamboo cricket bat that was created were measured and compared to a traditional willow bat.

**Compression** – tested by using heavy weights, about 10,000kg, to 'squash' the material whilst filming it to determine the point, and method, of breaking (Figure 6). Compression testing also gives a value for a measure called the Modulus of Elasticity (MoE) – basically how easily the material can be *deformed*. Think about squeezing a piece of plasticine® which changes shape easily, low MoE, compared to trying to squeeze a piece of wood that doesn't change shape, high MoE.



**Flexibility** – measured by bending the bat at different points along its length until it breaks.

**Hardness** – measured using the Vickers-Hardness Test, this involves pressing a pyramid-shaped diamond onto the surface of the material using a precise force. The area of the dent left by the diamond is then measured.

**Damping** – measure of how quickly a material stops *vibrating* after being struck by a hard object. It is measured by using a sensitive microphone to listen for vibrations in the material.

**Coefficient of Restitution (CoR)** – a measure of the speed that 2 objects move apart after they have *collided*. Think about a bouncy ball hitting a hard floor and bouncing up. This is a very elastic collision and has a CoR close to 1, which means that the ball bounces back close to the height from which it was dropped. In contrast, a bean bag hitting the same hard floor doesn't bounce at all; this is a very inelastic collision and has a CoR close to 0. In their tests, the bamboo bat was held in place and a hard cricket ball was hit against it at different speeds. The speed of the ball bouncing off the bat was measured at different points and compared to a willow bat. In this way, the scientists could tell whether the bamboo bat would behave in a similar way to a wooden bat and therefore make a good replacement.

#### Questions for children to consider and investigate:

- What properties of materials can you think of?
- Why is it important to consider the properties of materials when selecting a material for a particular purpose?
- Can you think of some examples of a material being used and the properties that make it suitable for that use?

## Conclusions

In many of the tests, the bamboo cricket bat performed in a similar way to the traditional willow bats. It had higher compression and flexibility and a harder surface. The CoR of the bamboo was higher than for wood, meaning the ball rebounded faster off the surface of the bat when they collided. The vibration properties were very similar to willow and the failure point of both bats was also similar.

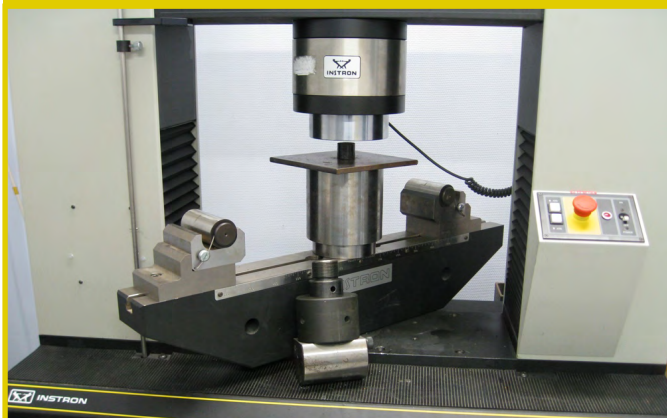
The major difference was the increased weight of the bamboo bat due to the higher density of the material compared to willow. This meant it was harder for batters to play certain shots. In tests though, they reported that the bat felt comfortable when hitting the ball and the ball seemed to rebound faster off the bat.

The weight issues of the bamboo bat could be addressed by improving the design of the bat to retain some of the positive qualities while reducing the overall weight.

At this time, the MCC have rejected the possibility of players using bamboo bats as they say that the blade of the bat must be made of wood. However, this is due to be discussed again at the next laws committee meeting and there could still be a future for bamboo cricket bats.

Practical activities and investigations which enable children to mirror the research of the scientists are described in the accompanying [Teacher Guide](#).

Figure 6. A compression machine is used to test how much a material can be squashed by a force pressing down on it.



## GLOSSARY

### cell

the smallest unit that can live on its own, they make up all living organisms

### coefficient of restitution

a measure of the speed that two objects move apart after hitting each other

### collided

to crash into, or hit, another object

### compression

a force that squeezes something together

### damping

a process that stops something vibrating

### deformed

to make something have a new shape by twisting, pushing or pulling it

### density

a measure of how much material is packed into a certain space

### elastic

the ability of a *deformed* material to return to its original size and shape when the forces causing the change in shape are removed

### energy

the ability to do work, energy can be stored or transferred from one thing to another

### flexibility

the ability of a material to bend and return to its original shape

### hardness

a measure of how hard a material is

### resin

thick, sticky liquid substance

### unsustainable

can't last forever, an unsustainable resource is used up and can't be replaced

### vibrating

very quickly moving back and forth or up and down

## Acknowledgement:

This resource contributes to XAIDA – a project supported by the European Union's Horizon 2020 research and innovation programme under grant agreement No 101003469.

## The paper that inspired this article was:

*Replacing willow with bamboo in cricket bats*

By Ben Tinkler-Davies<sup>1</sup>, Michael H Ramage<sup>2</sup> and Darshil U Shah<sup>2</sup>.

Published in *Proceedings of the Institution of Mechanical Engineers Part P: Journal of Sports Engineering and Technology* 1-11 (May 2021)

<https://journals.sagepub.com/doi/full/10.1177/17543371211016592> Last accessed 4.10.21

1. Division of Mechanics, Materials and Design, Department of Engineering, University of Cambridge, UK
2. Centre for Natural Material Innovation, Department of Architecture, University of Cambridge, UK