

WATER PENETRATION IN SOIL

Name of team member: Eleanor Clifton- Bligh

The ability for water to penetrate soil improves crop outputs, reduces the effect of wind and water erosion and is important for the efficient use of water resources.

Because of its small area of fertile land, Australia's agricultural industry is particularly vulnerable to the extreme climate events that are becoming more prevalent as a result of global warming. Soil additives, such as fertiliser and wetting agents, can protect soil quality and improve water penetration. Soil fertility increases after low intensity bush or grass fires and this subsequently reduces water runoff and evaporation. High temperature fires, however, can lead to the formation of a water repellent layer on the surface of the soil when oils in the leaves are vaporised and then condense.

This experiment investigated water penetration in silt, sand and clay based soils using three methods: (i) the depth of water penetration as a function of time (measured using an "ant farm"), (ii) water droplet penetration time (the time for a water droplet to disappear from the soil surface, measured using high definition video recordings), and (iii) soil moisture content as a function of time (measured using a moisture probe).

This report determines the effects of the addition of fertiliser, wetting agent, and of low and high temperature bushfires on water penetration in soil. The results of this experiment showed that water penetrated fastest and deepest in sand based soils, which also had the highest moisture content. The behaviour of silt based soils was similar, and clay based soils had the slowest water droplet penetration time, smallest penetration depth and lowest moisture content. The addition of either fertiliser or wetting agent led to similar improvements in the water penetration properties of all three soil types, and this has implications for farming practices. Water penetration was reduced, however, by the residue from eucalyptus leaves burnt at both low and high temperatures, with high temperature residues having the largest effect. This suggests that bushfires have significant and far-reaching environmental effects.

As the impacts of climate change manifest, Australia must manage these risks and work towards improving the water penetration properties of its soils.

BUILDING WITH BAGASSE: THE INVESTIGATION OF A NATURAL SUGARCANE INSULATOR

Name of team member: Claire Shi

The aim of this experiment was to investigate the effectiveness of natural sugarcane insulator in comparison to fibreglass insulation.

Sugarcane is a viable alternative to fibreglass as it is accessible able to many, safe for humans and the environment, and easy to make. This is especially important for those living in slum or rural environments, where other types of insulation are largely inaccessible.

In this experiment 'effectiveness' was determined by thermal conductivity, yield strength and water resistance. Thermal conductivity was measured by recording the temperature inside model 'houses'- each with a different insulator as the roof: no insulator (control), sugarcane and fibreglass. The temperature, standard deviation and difference in temperature from the control were tabulated and

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graphed. The sugarcane insulator performed better than expected. Though the hypothesis predicted the two insulators to be on par, the sugarcane insulator had lower thermal conductivity. The sugarcane insulator produced a lower, more stable temperature than the fibreglass, with a larger difference in temperature from the control. Yield strength was measured by recording the highest mass that the insulation slabs could hold before breaking. The insulation slabs were clamped on retort stands 20 cm from the ground and 50g masses were placed on top of the slab, one by one, until the slab broke.

The results showed that sugarcane insulator was stronger than fibreglass. To measure water resistance, the slabs of insulation were placed on an angle in a model 'roof'. Water was poured onto the 'roof' at the top and then collected and measured at the bottom. More water was collected from the sugarcane than the fibreglass.

Through this investigation, the natural sugarcane insulator was found to be more effective in terms of thermal conductivity, yield strength and water resistance.

DENTAL WHITENING AND ENAMEL LOSS

Name of team member: Madeleine Maloof

In efforts to attain the ideal image of perfect white teeth, an increasing number of consumers resort to inexpensive methods of tooth whitening. Over the counter, commercially sold whitening toothpastes are seemingly a great alternative to the expensive, in-chair, professional whitening.

The Dental Whitening and Enamel Loss experiment investigated, whether whitening toothpastes have a lower pH than non-whitening toothpastes, whether whitening toothpastes whiten teeth more than non-whitening toothpastes and whether whitening toothpastes cause a greater loss of dental enamel than non-whitening toothpastes.

During the experiment, ten molar teeth, three whitening toothpastes (Oral B 3D White, Colgate Optic White and White Glo Whitening) and two non-whitening toothpastes (Colgate Original and Oral B Original) were used. Each toothpaste was randomly assigned to two different teeth. Over 21 consecutive days, each toothpaste was brushed onto its corresponding teeth. In between brushing, the teeth were soaked in a saline solution. Images of the teeth were taken using a microscope on days 0 and 21 for visual comparison. A tooth colour shade guide was used to determine the colour of the teeth on days 0, 11 and 21. Each tooth was marked to indicate where the electronic caliper was to be placed for taking measurements on days 0, 11 and 21.

The results indicated that whitening toothpastes indeed whiten teeth, yet at the cost of dental enamel. For example, the whitening toothpastes improved tooth whiteness from 3-7 shades lighter with the non-whitening toothpastes bringing about little to no change. However, the whitening toothpastes caused more erosion of dental enamel (0.07 - 0.13mm) than the non-whitening toothpastes (0 - 0.01mm).

In conclusion, the three whitening toothpastes did whiten teeth (improve 'whiteness') more than the two non-whitening toothpastes tested. No relationship was found between the pH and toothpaste type, however, Oral B Original was significantly more acidic than the other toothpastes tested. All three whitening toothpastes caused a greater loss of the dental enamel than the two non-whitening toothpastes.