ST. PAUL'S CO-EDUCATIONAL COLLEGE (HONG KONG)

MICROSCOPIC BUBBLES MAGIC

Names of team members: Lo Tsz Hei Jonathan, Chen Baile Peter, Chiu Kwan Wing Melody, Lai Cheuk Fai, Lam Sze Ho

Current models of conventional washing machines use much electricity and water. However, we do not have a choice, as such designs are the only ones available in the market. In our project, we would like to build a washing machine for clothes using ultrasound technology, in hope that we can lower the consumption of water and electricity during the washing process. We hypothesized that ultrasound is able to wash away stains on large amount of clothes using less amount of time, less amount of detergent and is more effective compared with conventional washing machine.

Our experiment was divided into four phases. Firstly, in order to prove the effectiveness and efficiency of ultrasound to clean stains off cotton clothes, we built an ultrasound tank using a transducer of 40 kHz. After justifying that ultrasound is able to remove stains, we tested the stain removal ability of our ultrasound tank. Secondly, in order to investigate the relationship between the stain-removal ability and the allocation of transducers, we built a larger ultrasound tank using 10 transducers of 40 kHz. We aimed to find the best allocation of transducers by testing the stain-removal ability of our ultrasound tank by turning on and off transducers of different directions. Thirdly, since we would like to increase the effectiveness of stain removal during the washing process, we built a new thin transducer using piezoelectric crystals and stainless steel which can be attached to clothes hangers. Then, we tested the stain-removing ability of the design. Last but not least, we integrated the tank and the new thin transducers mounted in partitions in phase 2 and 3, to build our washing tank. We then investigated the stain removal ability by using the partition of thin transducer as hanger alone for each clothes to be washed.

In Phase 1, we found out that the ability of ultrasound had been proven, and that ultrasound was able to wash away 99% of stains in 5 minutes. In Phase 2, we found that parallel transducers to clothes were the most effective in removing stains, and that stains were removed within 10 minutes. It also proved the feasibility of building an ultrasound tank with larger scale. In Phase 3, we have successfully made a thin transducer that was proved to be effective in removing stains. In Phase 4, outstanding results had been shown when combining the thin transducer design and the washing tank. When compared with conventional washing machines, the ultrasound washing machine was faster and used less energy and water.

To conclude, the ability of ultrasound in removing stains from clothes had been proven. Based on its abilities, an ultrasound washing machine that could wash away stains on large amount of clothes was constructed, using less time and energy when compared with conventional washing machines. To conclude, our invented ultrasound washing tank was effective, efficient and environmentally friendly.

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CLOUDY WITH A CHANCE OF TOMATOES

Names of team members: Lam Cheuk Wang, Seet Kwong Yan, Lee Tsz Ching, Lam Pui Chung, Leung Ho Ching

Nowadays, tomatoes are widely consumed throughout the whole world. One of the reasons behind is the rich content of lycopene in tomatoes. While we are cooking tomatoes for consumptions, some myths claim that some cooking methods will lead to a sharp decline of lycopene content. We tend to unveil the mystery of lycopene preservation and suggest the best method of tomato treatment.

Our investigation consists of 4 stages. At Stage 1, we investigated whether lycopene will be lost during cooking at a hot temperature. We discovered that mass of lycopene released will decrease as cooking temperature increases. At Stage 2, we explored the optimal cooking time and temperature of tomatoes. We conducted the experiment in both oven and microwave environment. The results show that the optimal cooking time and temperature of tomatoes in an oven is 30-45min and 200°C respectively, whereas heating tomatoes by microwave for 30s can release the greatest amount of lycopene. It is also reflected that oil will release lycopene from tomato cells at a much faster rate. At Stage 3, we examined the effect of storage temperatures on the release of lycopene. The results support our hypothesis that there are less amount of lycopene released in the frozen content than the one stored in room temperature. At the last stage, lycopene content among distinct types of tomatoes is discussed. We have made a conclusion that colour, money price and lycopene content have no direct relationship among all.

To maximize the release of lycopene from tomatoes, we would recommend consumers to store tomatoes under room temperature and follow our experimental results in planning their cooking.

KEEP 'CLAM' AND STABILIZE pH

Names of team members: Jeff Kwan, Alexander Chan, Edwin Tang, Pang Tsz Ching, Noel Cheong

Nowadays, the problem of ocean acidification is worsening with the threat of increasing pollution. Both carbon dioxide and acidic pollution are dissolving into the ocean so quickly that the natural buffering from rocks and rivers are unable to keep up, resulting in a relatively rapid drop in the pH level of surface waters.

The most direct solution to the problem of ocean acidification would be to apply a pH buffer to the situation. A pH buffer, by definition, is used to keep pH levels stable and will vary minimally when a small amount of strong acid or base is added to it.

Armed with the knowledge that acid rain corrodes calcium carbonate substances, we decided to conduct an investigation on stabilizing pH values with simple materials left over from our meals: shells. According to Food and Agriculture Organization of the United Nations annual consumption of shell, in 2013, 12,505,508.37 tonnes of crustaceans were consumed as food worldwide. This shell waste produced by the seafood industry amounts to a substantial number and thus can be utilized in our

attempt to combat ocean acidification.

In our study, we have chosen two types of shells in two different form, namely abalone whole shell and shell powder, clam whole shell and shell powder. We conducted the experiment in 2 types: non-disturbing and disturbing. The non-disturbing samples are for checking how shells react with acid when they are put in a stable environment like the fish tanks, while the disturbing samples are for simulating the acidification of the ocean and testing whether shells will maintain the pH value of the water as nitric acid is added to the system regularly over weeks.

It is discovered that using shell as a pH buffer is a viable option. Clam shells can recover the pH value of the systems to 8.2 as quickly as 8 hours and that using clam shells is both cost effective and efficient. Moreover, it is discovered that the larger the mass and surface area the shell is, the better it helps combating the acidification of water.

To conclude, the goal of our project is to replace or minimize the use of expensive artificial chemicals to neutralize industrial waste as it is harmful to the environment and the marine ecosystem. In order to help combat ocean acidification, the use of clam shells is a viable option in terms of a small, localized industrial outlet in rivers.

X-PLOSION

Names of team members: Isaac Won, Chiu Yin Tsang, Brandon Chan, Harry Ko, Trevor Cheung

Lately, there have been numerous reports revolving around phones overheating during charging and subsequently causing explosions. One of the most notorious accidents is the explosion of a Samsung Note 7 which nearly burnt a girl when she was sleeping. Later on, these phones were banned from being on board planes from a large number of airlines worldwide.

Recent research conducted by various investigators indicates that the root cause of these accidents is the most important component in a phone -- batteries. Lithium-ion are ubiquitous in the market due to its high compatibility, yet prone to overheating. As excessive heat is generated, a thermal runaway reaction comes to effect, triggering a series of exothermic reactions whilst releasing inflammable gases.

Another concern is the effect of overheating to phones. In-depth investigations conducted by technology sites reveals that phones throttled their processing speed as compensation for the high temperature of batteries, which, in turn, deteriorates phones' performance, and more importantly, users' experience.

Infra-red is present in all objects that emit heat, such as phones. As temperature and intensity of infra-red emitted has a positive relationship, the detection of high intensity of infra-red indicates a high temperature.

We aspire to create a safety design that monitors the temperature of a charging phone. Our design tackles the problem with the use of infra-red sensors, which effectively detect the temperature level of the charging phones. The IR-sensor produces a voltage dependent on the intensity of infra-red radiation detected. A LM324, composed of 4 op-amps, compares the voltage from the infra-red sensor and that

from the sliding contact of a potentiometer, and serves as a potential divider. Once voltage exceeds our safety threshold, the relay system would break the circuit, preventing the phone from further charging. A buzzer connected to the circuit would subsequently be activated, warner the users. The circuit would not reset itself until a reset button is pushed, which prevents the phone from the vicissitudes of cooling down and heating up, safeguarding users from the midst of danger.

FLAVONOIDS CONTENT IN DIFFERENT PARTS OF VEGETABLES AND FRUITS

Names of team members: Fu Ting Hin Bryan, Lam Ching Wang Michael, Yeung Man Lok Anson

Cardiovascular diseases are the number one cause of death globally. Meanwhile, flavonoids, a group of chemicals commonly found in vegetables and fruits, has been proved to be able to help reduce the risk of heart diseases. Nevertheless, we always peel away the skins or throw away other unwanted parts of vegetables and fruits. When we do so, are we actually discarding the flavonoids present in these plant tissues as well?

To investigate whether unwanted parts of fruits and vegetables may actually be rich in flavonoids and even contain more flavonoids than the usually eaten parts, experiments were carried out using the aluminium chloride complexation test.

Since flavonoids react with aluminium chloride to form a complex, and its absorbance can be detected by spectrometer, reflecting the flavonoid concentration, we can compare the absorbance change of different parts of vegetables and fruits. In our investigation, samples such as apples, carrots, celery and sweet potatoes were used.