



## TAMAGO Tiles

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**Abstrak:** This project is applied to reduce the use of limestone in the process of producing tiles. Based on the studies that have been conducted, there is an increase in tile demand followed by an increase in the use of limestone which causes uncontrolled quarrying activities can cause pollution to the environment. The objective of this project is to produce eggshell -based tiles and study their strengths. The project also serves as an alternative to replace tiles produced from quarrying activities and expand the potential of eggshells. Eggshell as the main material for this project also has features such as environmentally friendly material and does not pollute the environment. This Tamago tile manufacturing process refers to the standard ratio and tile manufacturing process. As a result, the resulting Tamago Tiles meet the characteristics of the appropriate tiles. Tamago Tiles also goes through several tests such as Strength Test, Compression Test, Water Absorption Test and Fire Shrinkage Test. Based on these results, the results of the analysis and discussion that have been conducted, it can be concluded that the eggshell -based tiles or Tamago Tiles approach the strength characteristics of existing tiles at a rate of 90%. Therefore, these eggshell -based tiles are suitable to be an alternative option in the development of new materials in tile manufacturing. The strength rate can be further increased by adding appropriate ratios and additives in the future.

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**Kata Kunci:** *eggshell, tiles, alternative*

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### 1.0 Introduction

Floor finishing is the final work of the decoration and beauty of the floor. It seems very important to give comfortable and smooth surface. There are several type of floor finishes such as timber flooring, parquet, cement render and tiles. Tile is a thin object usually square or rectangular in shape. Tile is a manufactured piece of hard-wearing material such as ceramic stone, metal or glass that are commonly used to cover roofs, floor, walls or other objects such as tabletops. The functions of tiles are to provide and create a cheerful atmosphere in a building, also to provide comfort to users, works as a waterproof medium and absorb sound. There are some factors of election tiles such as shape, hardy and long lasting, comfort and safety, absorb the sound, fire resistance and reasonable price.

The word ‘Tamago’ actually means ‘egg’ in Japanese. It shows that this product are use eggshell as ingredient. The usage of eggshell to reduce consumption of limestone. Eggshell means is the thin, hard outer layer of an egg. According to Berita Harian (28<sup>th</sup> March 2021) on average, the total consumption of eggs by Malaysians is 291 per year in 2019. While eggs are use between 30 and 34 million a day in Malaysia which is the highest rate among Asian countries. This is because eggs are used in many recipes from fried eggs, traditional dishes, biscuits and variety of foods and others product. Eggs also are easy to have and affordable we can find it anywhere. Since the use of eggs in Malaysia is high, we decided to use eggshell residue to replace the limestone to reduce the use of limestone.

The purpose of this research is to produce tiles or floor coverings with eggshell dust and the potential uses waste. In addition to applying and adapting the waste inside products that require a change in a more user-friendly and environmentally friendly way. According to the dictionary of the 2nd edition hall (1984) supported by the Central website Reference Malay Language and Literary Heritage brings a user friendly the meaning is easy to control and understood by individuals, especially the general public. Eco-friendly in terms of understanding the dictionary of the 2nd edition of the board is a matter of material which does not affect or harm the environment

An investigation the effect on the strength of the eggshell dust as in additive in tiles mixed. In eggshell tiles production we used clay code BT1 Clay, PM42 new and Ball Clay 9 (BC9). For fine aggregates we used Talc, Pahang Feldspar 6 (PF6), Labu Feldspar 2 (LF2), Pahang Feldspar 3 (PF3) and pitches. We also add Sodium Try Poli Phosphate (STPP) and Sodium Meta Silicate (SMS) as deflocculant also we must put eggshell dust in our Tamago Tiles because we did the test for it potential in our tiles. The experiments will use to investigate are fire shrinkage, water absorption, strength test

and compression test. In order to achieve the objective, the following test and experiments are conducted. These eggshells first must be washed through by running water. Next, dry it using blower for a few minutes or expose under the sunlight until it is completely dry. Then, blend the eggshell until it turns into a powder form and sieve the eggshell powder using the sieve shaker machine. Take the eggshell powder at suitable size at sieve size 30  $\mu\text{m}$ . After that, mix all the materials as a few ratios to show how much that we can decrease the using of limestone and replace it with eggshell powder. Next, pour the mixture into the mould and compact it until there's no air bubble in the mixture. To make the tiles in the shape, let it dry in oven for 1 day. After that we do all the test to test is our Tamago Tiles are following the standards or not.

## 2.0 Literature Review

### 2.1 Tamago Tiles

Tamago Tiles is the name of our project where we make an innovation of standard tiles. The change of usage the limestone to eggshell dust because the eggshell dust has similar characteristics with limestone. The Tamago Tiles mix use of cement, sand, water, limestone and eggshell dust.

First, cement use in tiles because cement is a binder a substance used for construction that sets hardens and adheres to other materials to bind them together. Cement use to bind all the materials together. Next, sand is a mixture of small grains of rock and granular materials which is mainly defined by size, being finer than gravel and coarser than silt. Sand use as material to be bind with cement because they need each other.

Water is use in making tiles to mix well all the materials. Water make easier for mixing the all materials. Water is a chemical reaction agent in cement to bind all the materials. Limestone is a carbonate sedimentary rock that is often composed of the skeletal fragments of marine organisms such as coral, foraminifera, and mollusks. In this research still use limestone because want to keep the durability of the tiles. Eggshell dust are use as the additional to reduce of limestone. We choose eggshell dust because it has a similar texture with limestone also same characteristics.

### 2.2 Previous Product



**Figure 1:** Plastic and Eggshell Tiles

Compressive strength of tiles increases with increasing cement content. Compared to plastics and eggshells, cement contributes most significantly to the compressive strength of tiles, which decreases with increasing quantity of plastics. Addition of eggshells does not significantly affect the compressive strength of tiles. Plastics have a tendency to reduce the compressive strength of tiles. Hence, they should be used cautiously.

The presence of plastics seemed to enhance abrasion resistance. The presence of plastics in tiles under study enhanced impact resistance as they resisted impact due to a falling steel ball weighing 438g. Water absorption decreased with increased amounts of cement. However, plastics and eggshells had no significant effect on water absorption of the tiles. The most appropriate mix in the study was that which gave a compressive strength of 17.9 N/mm<sup>2</sup>, a water absorption rate of 11.4% as well as tiles that are

resistant to impact and abrasion. The density of tiles increased with increase in the quantity of cement. Cement was the major contributing material to density of cubes. The density of cubes decreased with increased plastic quantity. The effect of eggshells and plastics on the density of the cubes was very insignificant

Economically, the tiles made using cement, plastics and eggshells mixture are affordable compared to Ceramic tiles available commercially and the production process is cheap since it does not involve more expensive industrial equipment. Wastes (plastics and eggshells) are the major materials that are needed to manufacture of these tiles.

a) Collection and processing of plastics



*Figure 2: Plastic*

Plastics were collected especially from hospitals and other dumping sites, were washed and shredded into pieces of 1 mm average diameter. Plastic is a strong material and it is resistant to both chemical and physical attacks making it hard to disintegrate. It is also resistant to the penetration of water which is why it is considered one of the major threats to the fertility of our soils. This has made it a suitable component in this material since it increases on the water penetration resistance of the material. Plastics also increase the bonding in the composite material. Plastics were mainly used as fill materials to increase the bulk and reduce on the use of other materials like cement and eggshells.

b) Collection and processing of eggshells



*Figure 3: Eggshell Dust*

The eggshells were obtained from poultry farmers, hotels, cafeteria; they were subjected to thorough cleaning involving soaking in water for 24 hours allowing easy removal of dirt and membranes during cleaning. The major component of eggshells being calcium carbonate makes them a very important material. The eggshells are resistant to water penetration making its combination with plastics suitable for their use.

Egg shells were first put in boiling water for 5-10 minutes to remove the membrane and then sun dried for 3-4 days and then some were pounded using a motor and pestle and others crushed using a milling machine. The pounded eggshells were sieved through a 1.2mm sieve. The eggshells were used to increase the bulk and reduce on the use of other materials.

c) White cement as a binder



**Figure 4:** White cement

This is a third component that binds the plastics and eggshells to make a material which is resistant to water penetration. In this case, white cement was used to bring out the colours of plastics and eggshell respectively. White hydraulic cement is good ingredient because it is resistant to water infiltration and will increase the strength of the material. White cement was basically used for aesthetics properties. However, the common ordinary Portland cement (OPC) can be used.

**2.3 Differentiate Previous Product with This Product**

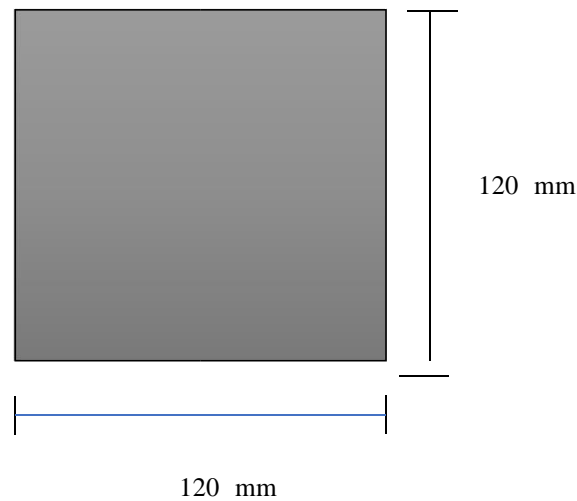
**Table 1:** Differentiate previous product with this product.

Eggshell and Plastic Tiles	Tamago Tiles
The material used for this tiles is plastic dust, eggshell dust and white cement.	The material we are used for this tiles is clay, talc, feldspar, pitches, eggshell dust, Sodium Try Poli Phostphate and Sodium Meta Silicate
To test the strength of the tiles they did a test of water absorption rate test and density of the cubes.	The test of the strength of the tiles are strength test, compression test, fire shrinkage test and water absorption test.
Cost of the tiles made using cement, plastics and eggshell mixture is lower than the cost of ceramic tiles and it is available commercially and hence they are affordable for medium and low cost housing	Cost of the tiles made using our mixture is lower than the cost of plastic and eggshells tiles and it is available commercially and hence they are affordable for corridor floor, porch floor and washroom floor.

### 3.0 Methodology

#### 3.1 Design Product

The tiles that been produced is a square shapes with dimension 100 mm x 50 mm. The thickness of tiles is 6 mm. Tiles contain an eggshell dust but at the surface of the tiles will put a piece of eggshell as a design. The eggshell at the surface to make people know that the tiles are contains eggshell.



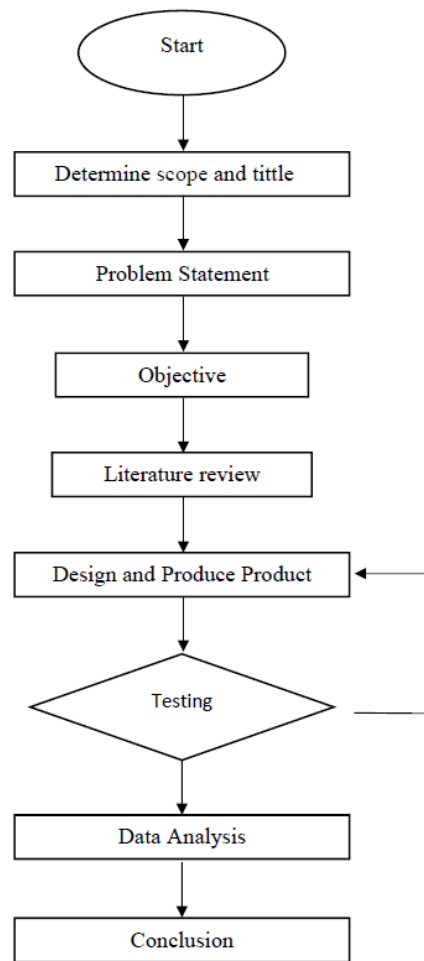
**Figure 5 : Length x Width**



**Figure 6 : Thickness**

#### 3.2 Design Process



Methodology of product is the process of study that has been done to make this Tamago Tiles. Figure 7 show how the process.








**Figure 7: Design Process Flowchart**

### 3.3 Instruments

**Table 2: Instrument use in production**

No.	Instruments	Name of Instruments
1.		Lab Dryer
2.		Mor Machine

3.		Grinder
4.		Sieve
5.		Vernier Caliper
6.		Compression Machine
7.		Fire Shrinkage Machine

### 3.4 Product Processes

The process of Tamago Tiles as long as ordinary tiles. It include the step of materials preparation, mixing, weighing, moulding, drying and testing. So the Tamago Tiles has gone through all the processes and it shows in Figure 8.



Figure 8: Product processes

## 4.0 Data Analysis

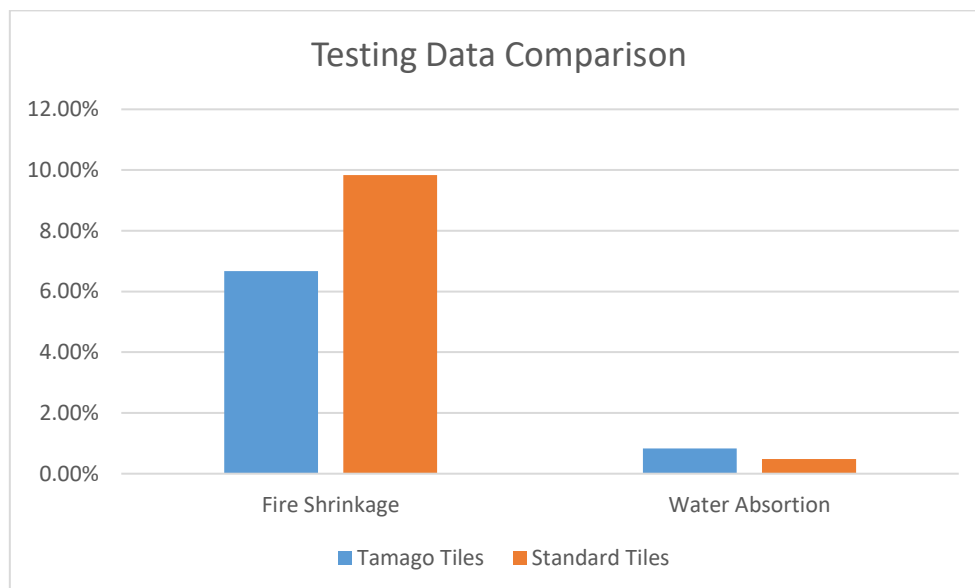
### 4.1 Analysis of Testing Data

Table 3 shows the data of Tamago Tiles from the testing. It include the testing of fire shrinkage, water absorption, strength and compression.

Table 3 : Testing Data Comparison

Tamago Tiles	Test	Standard Tiles
Low (6.67%)	Fire Shrinkage	High (9.84%)
High (0.83%)	Water Absorption	Low (0.48%)
Low (0.3kg)	Strength	High (0.4kg)
Low	Compression	High

The Tamago Tiles testing data are compare with the standard tile testing data shows in Figure 9. It is to ensure the Tamago Tiles within the standard due of standard parameter.



**Figure 9:** Testing data comparison

## 5.0 Conclusion

There are several test that have done on Tamago Tiles. The purpose of all the test are to make sure that Tamago Tiles are suitable and reach the standard tiles. After done the testing which is fire shrinkage, water absorption, strength and compression, Tamago Tiles still can manage in range of the parameter. As the comparison, Tamago Tiles get better result fire shrinkage which it shows that eggshell help to prevent shirinkage. But in other three testing, the Tamago Tiles get a little bit lower than standard tiles. It still manage to get almost 90% compare to standard tile.

As recommendation for next research:

- i. Increase the amount of eggshell in the mixing ratio.
- ii. Add another material to gain more strength.

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