

## Development of Teak Leaf Plate Molding Machine for Producing Plastic Alternative Products\*

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### Abstract

Single use plastic is one of the biggest problem in the world right now, it is the main source of non-degradable material in the world. The usage of plastic and plastic derivatives in Indonesia most times cannot be avoided as long as no alternatives products are available. Only a small portion of the plastic is recycled, the rest end up in the land and in the ocean. Plastic need hundreds of year to decompose and some even can't decompose like expanded polystyrene. A new machine is in need for in producing an alternative product for plastic. This machine is designed, develop and fabricated in Indonesia. PID control system is used to control both upper and lower die. Set points for both die can be set individually. The temperature of upper and lower die varies by different leaves and how many layer of leaves. The leaf plates made by the machine then tested along with plastic plates, expanded polystyrene plates and plastic laminated paper plates. The result of this test will conclude how good the leaf plates as an alternative for other disposable plates. Teak leaf plate molding machine is built and performing quite well. The temperature from upper and lower die can be controlled precisely. The plates that produce by the machine in tensile strength test also perform quite well. Teak leaf plates tensile break average at 29.3 N, slightly lower than plastic one and higher than expanded polystyrene one.

*Keywords: Teak leaf, Teak leaf plate, Molding machine, Disposable plate, Plastic alternative*

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### 1. Introduction

Single use plastic is one of the biggest problem in the world right now, it is the main source of non-degradable material in the world. The usage of plastic and plastic derivatives in Indonesia most times cannot be avoided as long as no alternatives products are available. Single use plastic made crockeries and containers are found end up in the sea. Every year 4.8-12.7 tons of new plastic waste end up in the ocean (Jambeck et al. 2015) and becoming micro plastic debris with bad impact to the marine life (Isensee and Valdes 2015).

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Only a small portion of the plastic is recycled (less than 10%) (Geyer et al., 2017), the rest end up in the land and in the ocean (AC et al. 2014). Plastic need hundreds of year to decompose (Webb et al., 2013) and some even can't decompose like expanded polystyrene (Kroeker et al., 2016)(Kannan et al., 2007).

A new machine is in need for in producing an alternative product for plastic. One of the machine is a teak leaf plate molding machine for producing leaf plates made of teak leaves (Martinus, Mohammad, and Djausal 2019). Similar type of machine has developed in India(Mohanraj et al. 2017). But, in India they use different type of leaves mostly on sal and siali leaves(Gaikwad and Kalokhe 2016). This machine is designed, develop and fabricated in Indonesia to suite teak leaves as the main plate material. The teak leaf plates made by the machine then tested along with plastic plates, expanded polystyrene plates and plastic laminated paper plates. The result of this test will conclude how good the teak leaf plates as an alternative for other disposable plates.

## 2. Materials and methods

In this research we design a new machine, build it and produce a product using it. The process in building a new machine is following this steps.



Figure 1. Steps in Building the New Machine

On the preliminary research we choose what kind of the leaves to be used in the machines(Martinus et al. 2019). The teak leaves then chosen as it is widely available in teak tree plantation (Suroso 2018) and as production goes there will not be material shortage.

The design of the teak leaf plate molding machine need to provide a good structure, to withstand more than 2 Tons pressure. Control system also need to be precise as leaves are very thin and prone to charred and burnt. A charred and burnt product is not desirable. Control system then develop to precisely control upper and under die temperature.

Teak leaf plate is made using hot press molding (Shamsuri 2015), a process that use both pressure and heat to mold the leaves into plates. Materials for the machine are frame made of IWF beam, steel upper and lower die, hydraulic pressure delivery system, thermocouples, PID controller, SSR, heating elements, and power supply unit.

The plate itself then tested using a tensile strength test apparatus. This test will compare the teak leaf plates against plastic plate and expanded polystyrene plate. From this test we will know how the teak leaf plate perform against other product (other product it tries to replace). Below shown how the test is done.

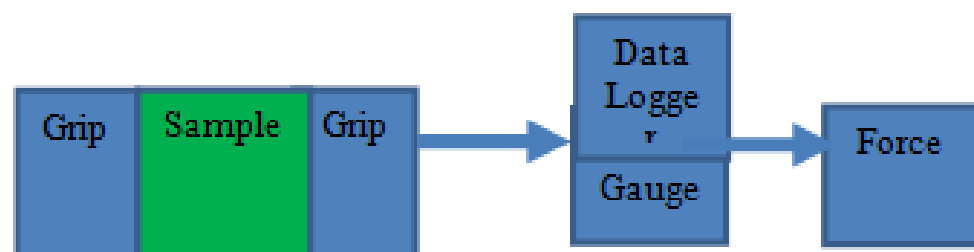


Figure 2. Tensile strength test