# Investigating the Ideal Mixing Ratio of Palm Oil Fiber to Decanter Cake for Optimal Briquette Production to Use as a Biofuel.

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## 1. Introduction

Palm oil, the most produced vegetable oil globally, accounts for a value of USD 49192.07 million market share, and it is predicted to increase up to USD 81356.01 million by 2030[1]. Malaysia and Indonesia contributed a huge portion of this world's palm oil production. Its cultivation primarily occurs in the tropics, within 10 degrees of the equator, where the oil palm (Elaeis guineensis) exhibits the highest yield per land area among oil crops. The demand for palm oil has surged due to its versatile applications, encompassing both food (e.g., baking, frying, and confectioneries) and non-food sectors (including soaps, detergents, and biofuels), marking a significant increase in its global market share from 24% to 36% between 2000 and 2018. This growth trajectory, however, has sparked environmental and health concerns, particularly related to deforestation, biodiversity loss, and comparative health metrics against other vegetable oils [2].

In Sri Lanka, the palm oil industry is represented by two major processors, AEN Plantation and Watawala Plantation PLC, with significant production capabilities, especially in terms of fresh fruit bunches processed per hour. Despite its economic benefits, the industry generates substantial waste, including empty fruit bunches (EFB), mesocarp fibers, shells, and palm oil mill effluent (POME), posing serious environmental challenges. These waste products, accounting for a considerable portion of the output per tonne of palm oil, necessitate effective management strategies to mitigate pollution risks [3] (Oseghale, 2017).

Emerging solutions for waste management within the palm oil sector include the production of biomass briquettes from by-products such as EFB, palm kernel shells, and decanter cakes. These briquettes, serving as an alternative fuel source, highlight an innovative approach to addressing the surplus waste issue, particularly the overstock of empty fruit fibers faced by many plants [4]. This method not only offers a solution for the efficient disposal and utilization of palm oil mill waste but also presents an opportunity for generating additional revenue streams through the sale of biomass fuel. By leveraging decanter cake as a binding agent for the briquettes, the industry can further optimize waste utilization, reduce storage challenges, and contribute to environmental sustainability [5]. This study underscores the potential of such waste management practices in transforming by-products into valuable resources, thus enhancing the sustainability profile of the palm oil industry.

In Sri Lanka, there are two sectors dedicated to processing palm oil. Located near Nakiyadeniya, the palm oil processing mill is run by Watawala Plantations PLC. In 1980, the mill was put into operation on a limited scale. By 1992, it had grown to a capacity of 15,000 fresh fruit bunches per hour. Along with AEN Palm Oil Processing (Pvt.) Ltd. 10,000 fresh fruit bunches may be processed every hour at the plant, which is situated at Mohamaddi Estate, Baduraliya. And AEN Palm Oil Processing (Pvt) Ltd. produces 18,000 MT of palm oil annually as a result of these reasons. Owing to this output, solid waste in the form of 9600 MT of EBF, 8160 MT of fibers, 1920 MT of nut shells, and 720 MT of press cakes is generated. Additionally, the Nakiyadeniya palm oil mill generates 5263 MT of EFB fiber and 3839 MT of decanter cake annually. The mesocarp fiber serves as boiler fuel, while other solid waste DC is converted into fertilizer and EFB fiber for the palm oil field. But they may use the empty fruit bunch fiber and that decanter cake to make briquettes. That boilers may run on biomass fuel made from briquettes. Even if the fiber palm oil is disposed of on the plants, there is no appropriate way to do it, and the ecology is negatively impacted. However, briquettes that the boilers may use as biomass fuel can be made by utilizing this solid waste responsibly.

## 2. Materials and Method

For this study, EFB fiber, Mesocarp fiber, and decanter cake are used to prepare fuel briquet. Two types of briquets are prepared for this experiment. One type of briquet is created by mixing EFB fiber with decanter cake and another type is created by mixing Mesocarp fiber with decanter cake. The decanter cake is utilized as 75%, 70%, 60%, and 50% of the mixture used to create the briquettes, and 25%, 30%, 40%, and 50% of EFB fiber or Mesocarp fiber was used respectively. This combination is bonded quickly due to its proportion and palm oil content.

Once the mixture was prepared, it was fed into the briquette production machine. The mixture was then subjected to pressure by the hydraulic jack within the machine, compressing it into the desired shape and density. The pressure applied by the hydraulic jack was crucial in the compaction process, ensuring that the briquettes were tightly bound and had sufficient strength. The same hydraulic pressure was applied to prepare all briquets.

Those prepared briquettes were subjected to measure the calorific value and compressive strength to compare the fuel qualities of each sample. Calorific value was measured using a bomb calorimeter and compressive strength was measured using a hydraulic compression machine.

## 3. Results and Discussion

CV of decanter cake and Mesocarp fiber mixer. These calorific values are compared with existing biomass samples (rice straw) that are used as biofuel.

Normally rice straw is used as biomass for different types of combustion operations to take the required heat value for their

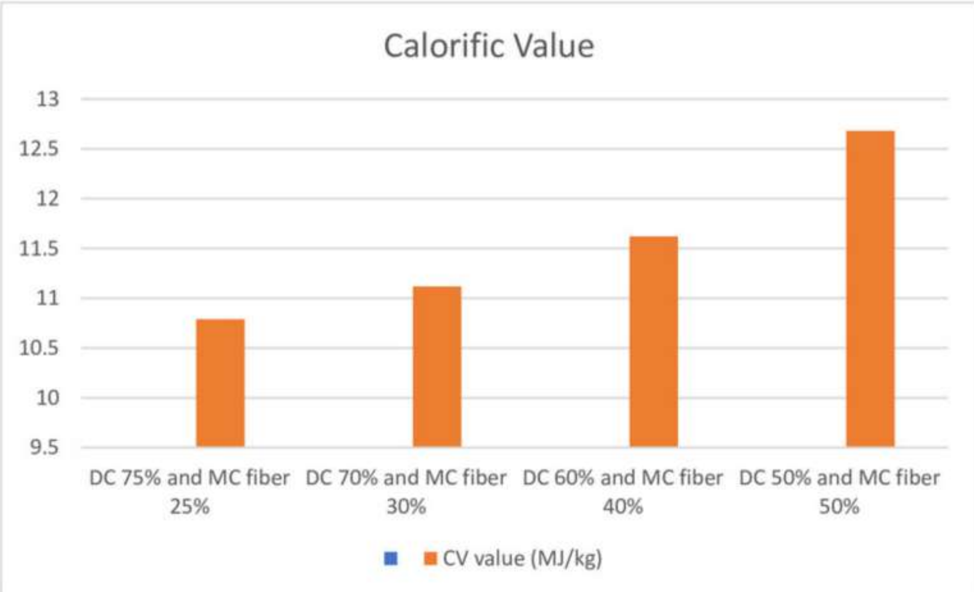
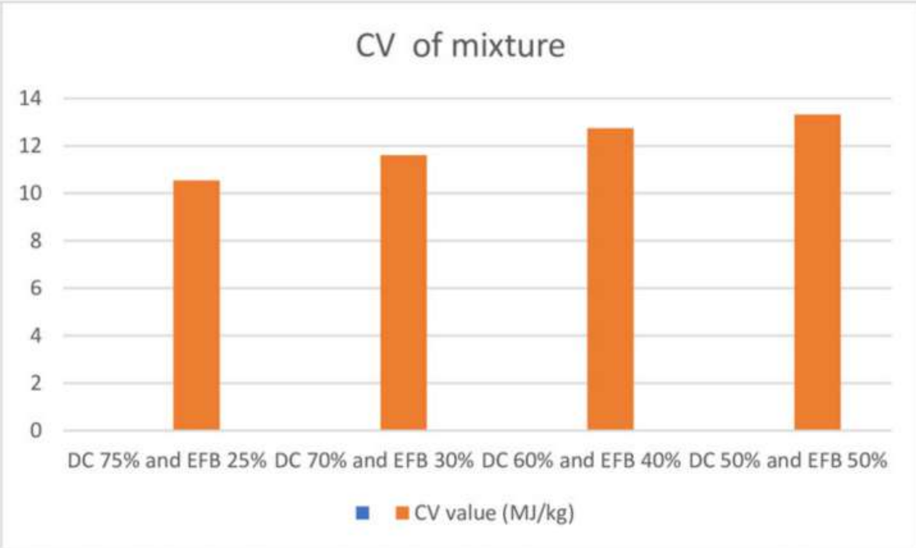



*Fig. 1. CV of DC and MC fiber mixer*

applications. Its calorific value is around 11.5-15 MJ/Kg [6]. If some fuel can supply that much heat value that fuel can be used as biofuel for combustion applications.

When we compare these calorific values highest Calorific value is shown in Sample number 04(DC50% and 50% MC fiber). But in this study, we are trying to provide a waste management solution for decanter cake waste, then If we can consume more decanter cake volume it will be better. When we consider those factors sample number 03(DC 60% and 40% MC fiber) provides a favorable solution for that, Its calorific value is higher than the calorific value of normal biomass. Then there is a potential to use that mixer as biofuel for industrial applications.

CV of Decanter cake (DC) and Empty fruit branches mixture (EFB)

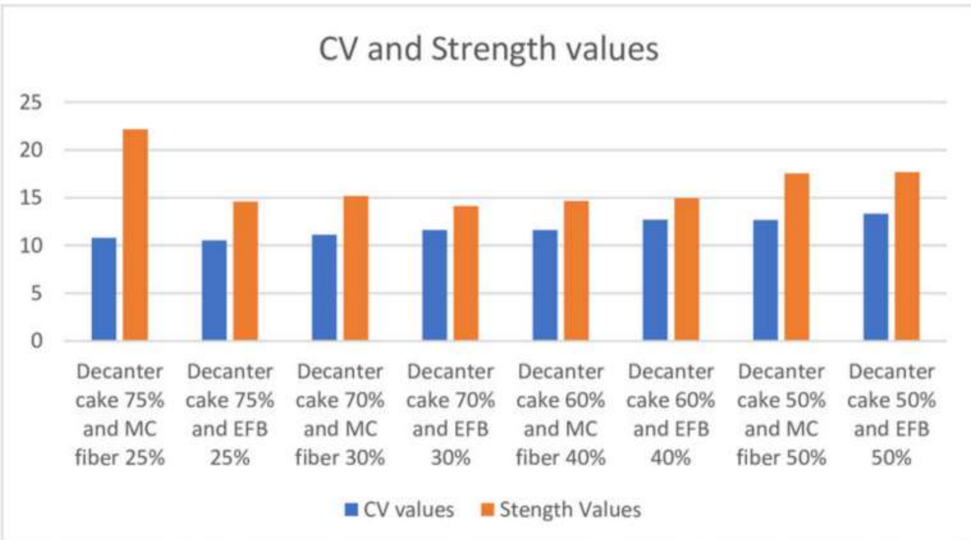



When we compare those calorific values except sample number 01(DC 75% and 25% EFB) others are showing higher calorific values than the normal biomass sample. Our expectation is to consume more decanter cake quantity while maintaining fuel quality (CV value and strength) so the best mixing ratio is showing sample number 02 (DC 70% and EFB 30%). The thing

***Fig. 2. Calorific values of DC and EFB***

is if normal biomass (rice straw) can use as a biofuel for industrial application this mixer also can be used as fuel for the industrial applications.

CV and compressive strength of total samples




Compressive strength is also very important when we use biomass briquets because it will help to store and transport the materials. Normally optimum strength for a briquet varies between ( 10-22) MPa [7] According to these results, the highest CV and highest strength values are shown in samples with 50% DC and 50% MC and the sample with 50% DC and 50% EFB, But

***Fig. 3. CV values and strength values af total mixer***

they will consume low decanter cake volume. When we consider the sample with 70% DC and 30% EFB, the CV of this sample is higher than the normal biofuel sample (rice straw) and its strength is also at an acceptable level it will consume a higher decanter cake volume. Then it realizes that the best mixing ratio is 70% decanter cake mix with 30% empty fruit branches (EFB).

In this research, the main focus is to give waste management solutions for decanter cake then if we can consume more decanter cake while keeping its fuel quality that mixer will be the best one. Then there is no need to find the briquet strength of pure EFB, decanter cake, and mesocarp fiber. Because without creating briquets empty fruit branches and mesocarp fiber can be used as the fuel for the boiler operation. Currently, this palm oil manufacturing company is using mesocarp fiber as fuel for the boiler and not using empty fruit fiber as fuel but according to these calorific values, there is a potential to use these empty fruit branches also as fuel for the boilers.

## 4. Conclusion

The mixture of 50% EFB fiber and 50% DC has a high CV and strength. but the mixture of 70% DC and 30% EFB fiber is suitable as the best solution for managing this heavy waste produced in the palm oil industry. This blend offers a way to manage a lot of DC for which there is no sustainable solution, and its CV value and strength are in good condition compared to other briquettes. It's feasible to obtain more. In addition to providing a viable method of managing our resources and generating additional revenue for these firms, it also has the potential to mitigate the adverse environmental effects. In the future as further analysis proximate and ultimate analyses are needed to be done to get an idea about the physical and chemical properties of the fuel mixer.

**Keywords:** Biofuel, Calorific Value, Decanter Cake, Empty Fruit Bunch Fiber, Palm Oil.

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