# Manufacturing of roofing tiles by using plastic waste and agricultural waste

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**ABSTRACT -** Most available agricultural waste, rice husks and plastic waste, HDPE were selected as raw materials. HDPE is a huge waste material in Sri Lanka. Therefore, it is very important to select HDPE as a raw material for roofing tile. According to the paddy statics in Sri Lanka the production of rice for the year 2017, is roughly equals to 2,383,000MT. Therefore, it can be assumed that much of rice husks are generated as agricultural waste. Hence, those materials were applied to make new composite material. Main objective of this research is reduced the waste emission and making durable and environment friendly roofing material of HDPE waste. Rice Husk was grinded, and a fine dust was obtained. After that, equal size of rice husk (3mm) was obtained by sieving. Materials were mixed in plasticorder mixture according to 0%, 5%, 10%, 15%, 20%, 25% weight percentage of rice husk. Total weight of sample must be 40g for this equipment and it helps to obtain well-mixed sample of rice husk and HDPE. Mixed materials were subjected to the compression mould machine. Total weight of sample must be 80g for this equipment and it helps to obtain required thickness of material sheets for the experiments. Two samples from plasticorder were needed to prepare one material sheet from compression mould.

## INTRODUCTION

As roofing materials clay tiles have less durability as they are easily breakable therefore leading into frequent replacement of them. Asbestos are associated with harmful health effects such as fibrotic lung disease called asbestosis and lung cancers caused by long-term exposure to asbestos. Hence, asbestos production will be banned from year 2024 by Sri Lankan government. Therefore, as of today, new composites are being introduced as roofing materials. Therefore, this research is carried out to produce an agricultural waste and plastic waste composite-based roofing tile.

## METHODOLOGY

HDPE bags were rolled and pressed in a hot press at a 160 $^0$C temperature and 1000 psi pressure for 10 minutes. Immediately after hot pressing, the obtained sheets were cooled at a cold press for 8 minutes. The obtained sheets were then shredded using a shredding machine. The shredded pieces were again pressed in the hot press utilizing same temperature and pressure followed by cold press and again shredded. The step was repeated for three times to obtain the final shredded pieces.

## RESULTS AND DISCUSSION

Adding rice husks to the waste HDPE will reduce the tensile properties of waste HDPE significantly. While maximum stress of waste HDPE is around 55 MPa, the maximum stresses of rice husk added samples are below 20 MPa. This may be due to the inelastic properties of the rice husk. While the waste HDPE shows excellent elastic properties, adding inelastic rice husks to waste HDPE has

reduced the elastic properties of the composite. With increment of weight percentage of rice husk in the samples, the tensile properties have gradually reduced while showing a slight increase at 25% weight percentage of rice husk. Adding rice husk to the waste HDPE has reduced the tear resistance of the whole material. This may be due to the improper binding of the HDPE polymer chains and rice husks. Rice husks decrease the tear resistance. With increment of weight percentage of rice husk in the samples, the tensile properties have gradually reduced while showing as light increase at 25% weight percentage of rice husk.

This may be due to the tighter packing of rice husks between the HDPE polymer chains, so that it is somewhat tear resistance than other weight samples. With increment of weight percentage of rice husk in the samples, water absorption properties have increased. When considering the values of water absorption, results are slightly same with small deviation. Composition of 5%, 10%, 15% have equal hardness value. With weight percentage increment of rice husk in the samples, hardness values have increased slightly. Finally, composition of 25% has high hardness value.

**CONCLUSION**

Grinded rice husks were used for better dispersion with HDPE waste than Rice Husk without grinding. Because Surface area of grinded rice husks is greater than normal rice husks. However, rice Husk dust tends to aggregate on the bottom surface of the tiles thus leading to irregular dispersion of rice husk dust within HDPE waste.

According to Tear test results comparison, with weight percentage increment of rice husk in the samples, the tensile properties have gradually reduced while showing a slight increase at 25% weight percentage of rice husk. This may be due to the tighter packing of rice husks between the HDPE polymer chains, so that it is somewhat tear resistance than other weight samples. According to water absorption test results comparison, with weight percentage increment of rice husk in the samples, water absorption properties have increased. When considering the values of water absorption, results are slightly same with small deviation. According to hardness test results comparison, composition of 5%, 10%, 15% have equal hardness value. With weight percentage increment of rice husk in the samples, hardness values have increased slightly.

Finally, composition of 25% has high hardness value. Composition of 10% weight percentage of rice husk is the most suitable composition for our roofing tile. Therefore, final product of roofing tile can be produced from 10% weight percentage of rice husk.

| Test | Test Method | Results |
|---|---|---|
| Water Absorption | ASTM D 647 | Increases with increasing rice husk percentage |
| Tear | ASTM D 1004 | Tear resistance decreases with increasing rice husk percentage. Slight increase in 25% |
| Hardness | Shore D | Increases with increasing rice husk percentage. |
| Tensile Strength | ASTM D638 | Decreases with increasing rice husk percentage. Slight increase in 25% |

Table 1

Finally, composition of 25% has high hardness value. Composition of 10% weight percentage of rice husk is the most suitable composition for our roofing tile. Therefore, final product of roofing tile can be produced from 10% weight percentage of rice husk.

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