

Utilization of Rice Husk in Construction of Highway

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Abstract— The potentiality of rice husk as a good source of high technological materials in road construction is the subject of this research. Every year approximately 770 million tons of paddy are produced globally. This gives around 120 million tons of rice husk (RH) and 21 million tons of rice husk ash (RHA) annually. Besides these, it can be utilized in several other applications. The main reason behind this trend is the excessive production of waste like fly ash, plastics, rice husk ash (RHA) which is not only hazards but also creating deposition problems. Using some of these waste materials in construction practice will reduce the problem in a great extent. This paper will let us study how husk waste can be used in construction of roads. Step by step procedure of various tests conducted on the experimental model section of road block. This project will also conclude about how the use of rice husk in road construction increases the strength, flexibility, durability etc. of the road. As rapid growth in population and industrialization is taking over on huge scale, the use of resources has to be done keeping in need of the future generation some new technologies are made for waste utilization and cost reduction is of primary focus.

Key words: Rice Husk, Paddy, Hazards

I. INTRODUCTION

Rice is an important staple food for approximately half of the world population [1]. More than seventy countries mainly China, India, Indonesia produce rice. Rice husk is one of the most widely available agricultural wastes in many rice producing countries of the world. Rice hulls (or rice husks) are the hard protecting coverings of grains of rice and removed from rice seed as a by-product during the milling process. Rice husk used as a valued added raw material for different purposes. It is estimated that about 70 million tones of RHA is produced annually worldwide. This husk contains about 75 % organic volatile matter and the balance 25 % of the weight of this husk is converted into ash during the firing process, is known as rice husk ash (RHA).

Rice Husk Ash is a Pozzolanic material. It is having different physical & chemical properties. The product obtained from R.H.A. is identified by trade name Silpoz which is much finer than cement. However, the performance of the roads is poor due to the poor quality of road construction at many places. There are potholes on and other defects found on these roads including cracks on road surface, ruts formation and road undulations.

Wherever paving blocks are used it is found that at many places the removals of the paving blocks have been observed. The conditions of road are deteriorating over the period of time because of presence of poor quality of materials, improper construction procedure and lack of proper maintenance. The study is limited to Pune region but same may be applicable for other cities.

A. Properties of Rice Husk

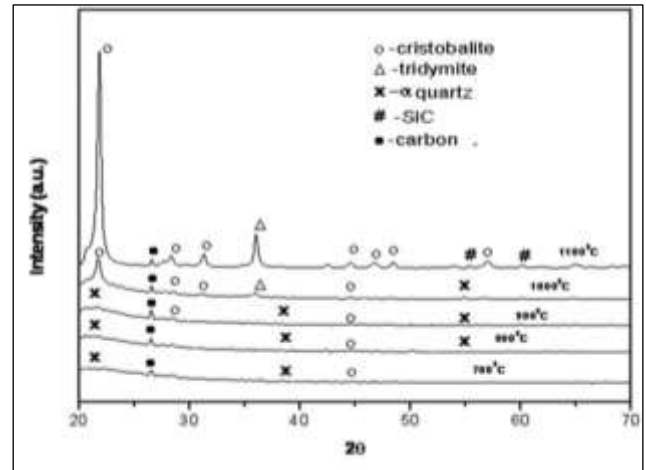


Fig. 1: Properties of Rice Husk

Composition	Percentage
Cellulose	31.12
Hemicellulose	22.48
Lignin	22.34
Mineral ash	13.87
Water	7.86
Extractives	2.33
Chemical analysis of mineral ash	
SiO ₂	93.19
K ₂ O	3.84
MgO	0.87
Al ₂ O ₃	0.78
CaO	0.74
Fe ₂ O ₃	0.58

Table 1: Typical Composition of Rice Husk

II. TYPES OF FAILURES IN ROAD

Following are the reasons for the failure of road

- 1) Due to use of improper material
- 2) Due to poor drainage conditions of the road
- 3) Due to poor procedure followed for the construction of road.

In this paper the failure due to poor drainage of road is focused and the remedial solution in terms of rice husk layer is elaborated.

A. Loss of aggregates Because Of Poor Drainage

The major failure of road occurs because of the loss of aggregates from the surface which presents a rough appearance. In some portion, the aggregates are intact and at other locations aggregates have been lost as shown in Fig. 1. The reasons of loss of aggregates are:

- Aging and hardening of the binder whereby its adhesive property is lost.
- Insufficient quality of binder for the given size and quality of aggregates used.
- Aggregate having no affinity to the binder because of improper gradation.

- Insufficient rolling of road before opening it for the traffic.
- Use of wet or dusty aggregates.
- Cold spraying of bitumen or delaying the spreading of aggregates over sprayed bitumen.



Fig. 2: Loss of aggregates Because Of Poor Drainage

B. Loss of Aggregate

Because of loss of aggregates during rainy season the portions from which the aggregates are lost have been filled with water and this causes the main reason for deterioration of road. The water pressure causes the soil and aggregates to move from its place. Passage of traffic again put the water with high pressure inside the pavements and soil particles enter the pavements. Thus the width of pothole goes on increasing. Low content of bitumen causes the accumulation of aggregates on road sides.

This is called as failure due to poor drainage of the roads. The failure pattern is as shown in figure 3 below



Fig. 3: Loss of Aggregate

III. USE OF RICE HUSK IN ROAD CONSTRUCTION

As it was discussed earlier every year approximately 770 million tons of paddy are produced globally. The research is being done for usage of this rice husk as one of ingredient of road layers. The sub base layer of road can be prepared by using rice husk.



Fig. 4: Rice Husk

The model view is shown here:-



Fig. 5: Use of rice husk in sub base course

Basically this concept is initially followed in rigid pavement of M15 grade concrete and the combination of rice husk and fixing agent in proper proportion. The layer is provided below the first layer which absorbs the percolated water through road cracks.

When heavy vehicles passes on this road surface rice husk which under the concrete layer gets compressed and the precipitated water is thrown out which maintains the water level under safe limit or may all water can be expelled out due to the sponging action of rice husk layer. And even after this action the rice husk layer retains its original position. Hence, it gives a flexible effect.

A. Results and Discussion

In this research project, models were prepared for testing purpose as well as to obtain respective results from the tests. The first layer of 10 cm was of M15 grade concrete mixed with 1:2:4 proportion as well as reinforcement was also provided. Second layer (10 cm) consists of 1 kg of rice husk + 1 kg adhesive. The last layer (10 cm) was again of M15 concrete and reinforcement. Three models were prepared and were kept for different number of days for curing. Following is the table shown for the results for compression test:

PERIOD OF CURING	ULTIMATE LOAD (KN)	ULTIMATE LOAD (TONS)	COMPRESSIVE STRENGTH (N/mm ²)
7 DAYS	1010	102.95	13.46
14 DAYS	1000	101.936	13.33
21 DAYS	1050	107.033	14.00

Average compressive strength=14 N/mm²

The graphical representation is as follows

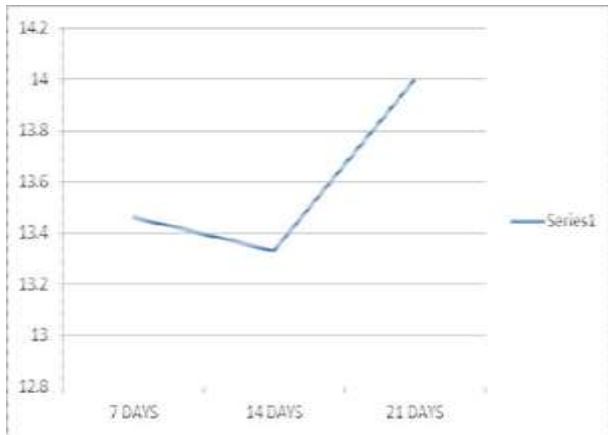


Fig. 6: Line graph showing compressive strength

The following tables show the test results of various periods of curing of model prepared using rice husk.

Crack no.	Load resisted	Layer affected
1	110KN	TOP
2	240KN	TOP
3	300KN	TOP
ULTIMATE LOAD	1000KN	TOP

Table 1: Load Carried for 14 Curing Days

TABEL3 Crack no.	Load resisted	Layer affected
1	200 KN	BOTTOM
2	220 KN	TOP
3	240KN	TOP
ULTIMATE LOAD	1100KN	TOP

Table 2: Load Carried for 21 Days Curing

Table 03: -LOAD CARRIED FOR 71 DAYS CURING DAYS

B. Advantages

Compressive strength is comparatively more than normal rigid pavements. ($14 \text{ N/mm}^2 > 10 \text{ N/mm}^2$) Flexibility is good compared to normal roads. Combination of rigid as well as flexible pavement. Durability is enough compared to normal roads. Material like rice husk is available free of cost. Hence overall cost is reduced.

Can be implemented in the heavy rainfall areas where rice is a major crop so that the husk production is more and its availability for road construction is more.

Effective and innovative method which is useful in rainy season.

IV. CONCLUSION

The rice husk contributes a significant role for processing the main food of the people of the country. The energy is used in a primitive way which causes the wastes of this valuable resource. Therefore the use of rice husk in road construction is an effective method compared to construction method of normal roads. Hence, this will solve many problems like collection of drain water on road surface in rainy season, flexibility of a rigid pavement etc.

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