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AN INNOVATIVE EXPERIMENTAL TECHNIQUE OF ADDITIVE EXTRUSION MEND FOR CRATERS IN PAVEMENT

[1]Nagendra N, [2]Murali Mohan M V, [3]Aaqib Reyaz, [4]K Rupesh Kumar, [5]Betharasi Deepika, [6]Anusha K V
[1]Professor,[2]Proffessor,[3]Student
[1]Department Of Civil Engineering,

Abstract: Using lignin extract to mend craters has shown favorable results in addressing the challenges posed by pavement distresses on roads and highways. Traditional methods for repairing craters involve resource-intensive hot asphalt mixtures, resulting in temporary fixes. This project introduces an innovative approach using additive extrusion technology and lignin extracted from coconut coir for more efficient, cost-effective, and durable pavement repairs. By blending lignin with bitumen and incorporating urea formaldehyde polymer, this method helps in utilizing the full benefits of a pavement and offers a sustainable alternative to traditional materials. This eco-friendly solution not only strengthens road surfaces but also contributes to greener road maintenance practices, ensuring safer and increases the durability of pavements.

I. INTRODUCTION

Crater are holes or depressions in the surface of a road or pavement typically caused by the combined effects of traffic wear and weather conditions where water can seep into cracks in the pavement and then freeze, expanding and causing the pavement to crack and break apart. Craters can vary in size and depth from small and shallow depressions to larger more hazardous holes that can damage vehicles and pose safety risks to drivers. A Crater is a common road defect characterized by a bowl-shaped depression in the road surface, typically caused by the combined effects of moisture infiltration, freezing and thawing cycles, and vehicular traffic. These depressions can vary in size and depth, posing safety risks to motorists and cyclists by potentially causing vehicle damage and accidents. Potholes are a significant concern for road maintenance authorities, who regularly monitor and repair them to ensure road safety and minimize disruptions to traffic flow. Repair methods typically involve filling the pothole with suitable materials like asphalt patches to restore the road surface's integrity and reduce the risk of further damage.

Lignin, a natural polymer present in plant cell walls, contributes to the strength and rigidity of plants, especially in woody species. Its complex structure makes it resistant to degradation, and it is primarily extracted from wood during the pulping process in industries such as paper and pulp production. Apart from its structural role in plants, lignin has gained attention for its potential as a renewable resource in various sectors. For example, lignin can be converted into biofuels, such as lignin-based diesel or jet fuel, through processes like pyrolysis or enzymatic treatment. Bitumen, also known as asphalt or tar, is a byproduct of petroleum refining and has diverse applications in construction and industry. Its high viscosity and adhesive properties make it an excellent binder in asphalt concrete, used extensively in road construction for paving and surfacing roads, highways, and airport runways. Bitumen-based materials, like roofing felt and shingles, are widely used in waterproofing buildings and structures. Moreover, bitumen is utilized in industrial settings for manufacturing adhesives, sealants, coatings, and as a component in various products such as waterproof membranes, electrical cables, and corrosion-resistant coatings for pipes and tanks.

In this innovative approach to road construction the traditional bitumen, which is a petroleum-based binder used in asphalt, is replaced with coconut coir fibers. These fibers are extracted from the husks of coconuts and are known for their strength, flexibility, and sustainability. By using coconut coir, we reduce reliance on fossil fuels and promote the use of renewable resources. By combining coconut coir fibers with urea formaldehyde resin polymer, we create a composite material that not only offers environmental benefits but also maintains the necessary structural integrity and performance standards required for roads. The process starts by extracting lignin, a strong natural adhesive found in coconut coir fibers, which is like a strong glue. This lignin is combined with a urea formaldehyde polymer, which enhances the mixture's strength and durability. After mixing everything together, we use this new mixture to fill potholes in roads. It sticks well, lasts a long time, and can handle rough weather. This process gives us a better and eco-friendly way to fix potholes and keep our roads safe. Together, these materials create a robust and eco-friendly solution for filling potholes. The mixture adheres well to road surfaces, withstands wear and tear, and contributes to a longer-lasting repair. This approach not only improves road safety but also promotes sustainability by utilizing renewable resources and reducing environmental impact.

II. MATERIAL DETAILS

A. COCONUT COIR:

Coconut coir, derived from the fibrous outer husk of coconuts, is used in lignin extraction processes due to its high lignin content and relatively low cellulose content compared to other plant materials. Coir is a lignocellulosic material, meaning it contains both lignin and cellulose, making it a suitable source for lignin extraction. The high lignin content in coconut coir allows for efficient extraction of lignin using methods like the Klason method or organosolv processes. Additionally, coir is readily available as a byproduct of coconut processing industries, making it a sustainable and cost-effective source for lignin extraction. Its use in lignin extraction contributes to the utilization of agricultural waste and the development of eco-friendly processes in industries such as biofuel production, pulp and paper manufacturing, and lignin-based product development. In coconut coir, lignin contributes to its structural support and durability. Chemical compositions of original coconut husk were 26.60% (cellulose), 17.74% (hemicellulose) and 41.18% (lignin), respectively. Have a higher lignin content than another woody biomass.

Fig. 1. Coconut coir in small pieces

B.72 % SULPHURIC ACID:

Sulfuric acid is used in lignin analysis, such as in the Klason method, because of its strong acidic properties and selective ability to hydrolyze polysaccharides like cellulose and hemicellulose while leaving lignin relatively intact. This selectivity allows for the separation of lignin from other components in plant biomass, facilitating accurate quantification of lignin content. Additionally, sulfuric acid's solubility in water and high acidity ensures efficient hydrolysis of polysaccharides without significant degradation of the lignin structure. These qualities make sulfuric acid a preferred choice in lignin analysis, providing reliable and standardized results in research and industrial applications. The determination of 72% of sulphuric acid from 98% sulphuric is calculated by using dilution formula.

$C1V1 = C2V2$

Where, $C1=98\%$→concentration of stock solution.

$C2=72\%$→concentration of final solution

$V1=?$ →required volume from stock solution.

$V2= 500ml$→final solution volume (500ml)

$V1=C2V2/C1$ $V1 =72*500/98$ $V1=367.34ml$

Therefore ,363.34ml of 98% H_2SO_4 + 500ml distilled water =72% sulphuric acid solution

C.VACCUM FILTER:

A vacuum filter is a device used to separate solids from liquids or gases by passing the mixture through a porous medium, typically a filter paper, cloth, or other materials that allow the liquid or gas to pass through while trapping the solid particles. This method is efficient for separating suspended solids from liquids or gases and is often preferred when dealing with large volumes or when rapid filtration is required. Materials used to make vacuum filter are 600ml plastic bottle, Half whiskey bottle, 50ml syringe, 6mm vinyl tube, 2 Pressure control valves and Filter paper.

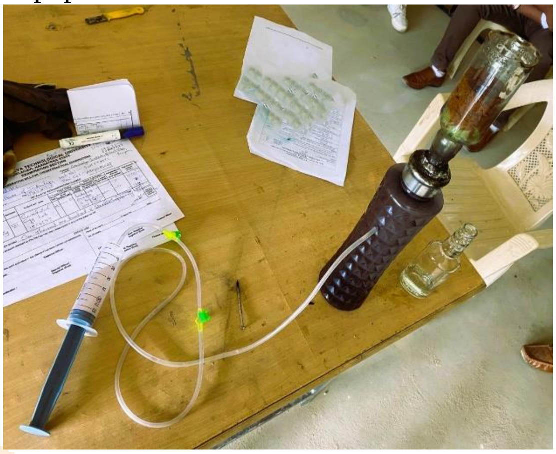

Fig. 2. Vacuum filter

D. UREA-FORMALDEHYDE:

This polymer is used to give binding properties as well as it has the excellent adhesive property when we combine this with the product which we are extracted it will give good strength and durability.

III. PROCEDURE FOR EXTRACTION OF LIGNIN:

Step 1): Cutting the coconut coir in small pieces and kept in oven for 24 hours

Fig. 3. Coconut coir in small pieces and kept in oven.

Step 2): Weigh out 70 grams of coconut coir and add 280ml of 72% sulphuric acid stir for 2 minutes and allow solution stand for 2 hours.

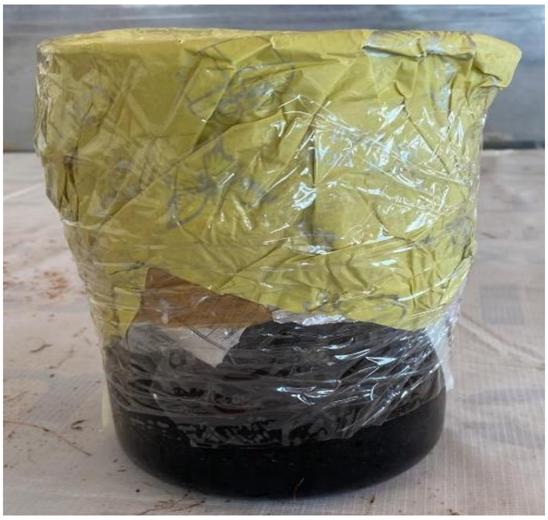

Fig. 4. Coconut coir and solution

Step 3): Dilute this acid concentration with 18 litres of hot water and seal the bucket for 24 hours.\

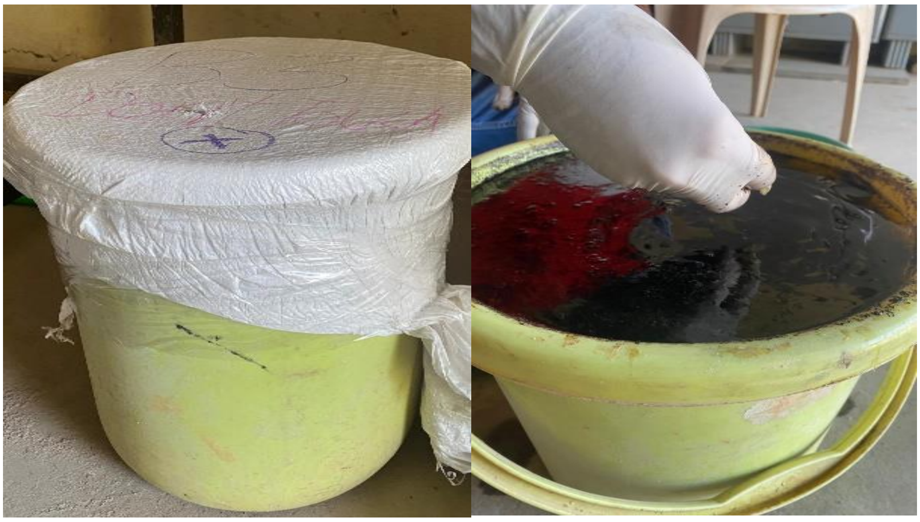

Fig. 5. Mixture mixed with hot water.

Step 4): Open the cover from the bucket, remove solvent and collect precipitate by vacuum filter.

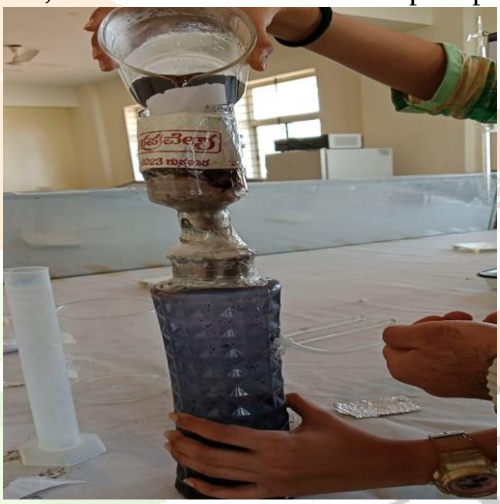

Fig. 6. Extraction of lignin

Step 5): Boiling of extracted lignin water.

Fig. 7. Lignin water boiling

Step 6): Adding urea formaldehyde polymer, pebbles and extracted lignin into the boiling water.

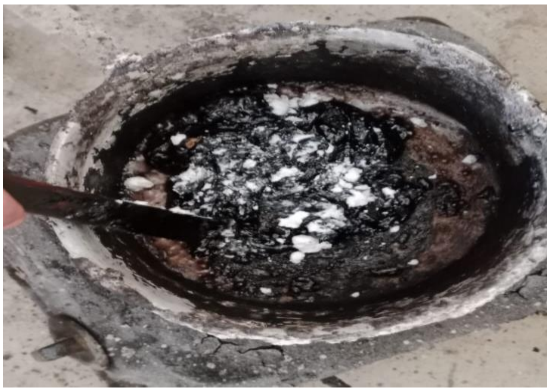

Fig. 8. Mixture of all.

Step 7): Final mixture.

Table .1.List of mixtures

bitumen	Urea formaldehyde	Extracted lignin	Boiling lignin
40%	15%	30%	15%

Fig.9. Pothole Present in our Campus.

Step 8) Filling of Pothole with this mixture which was present in our college Campus.

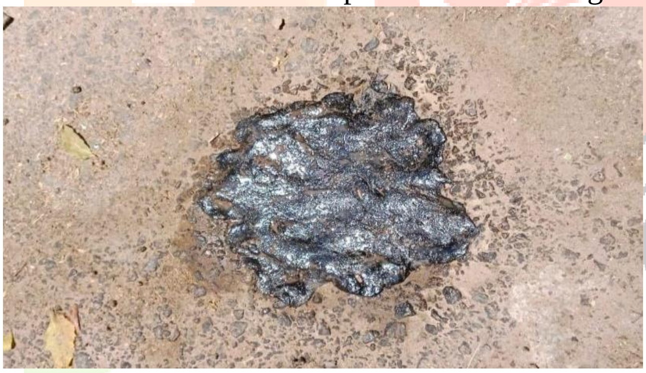

Fig. 10. Filling of pothole with our product

IV. CONCLUSIONS

1) This process gives us a better and eco-friendly way to fix potholes and keep our roads safe. Together, these materials create a robust and eco-friendly solution for filling potholes.
2) The mixture adheres well to road surfaces, withstands wear and tear, and contributes to a longer-lasting repair. This approach not only improves road safety but also promotes sustainability by utilizing renewable resources and reducing environmental impact.
3) By combining coconut coir fibers with urea formaldehyde resin polymer, we create a composite material that not only offers environmental benefits but also maintains the necessary structural integrity and performance standards required for roads.

3.FUTURE SCOPE

1) Improved Sustainability: This leads to reduced dependence on fossil fuels and lower carbon emissions in the construction industry.
2) This innovation leads to cost-effective and long-lasting solutions for maintaining safe and environmentally friendly roads.
3) Further investigation to be done to standardize the mixture for optimum results and suitability for any terrain conditions.

V. ACKNOWLEDGMENT

Thepreferredspellingoftheword "acknowledgment" inAmericaiswithoutan "e" afterthe "g".Avoidthestiltedexpression, "Oneofus(R.B.G.)thanks..." Instead,try"R.B.G.thanks".Putapplicablesponsoracknowledgmentshere;DONOTplacethemonthefirstpageofyourpaperorasafootnote.

REFERENCES

[1] Alfred Tcherbi-Narteh , Dereca Watkins, Mahesh Hosur, Md. Nuruddin, Shaik Jeelani, (2014), "Extraction and characterization of lignin from different biomass resources", Journal of material science and engineering, ISSN 26- 32, vol-4.

[2] Ashley Whittaker, Marzia Traverso, Olubukola O.Tokede, Rose Mankaa, (2020). "Life cycle assessment of asphalt variants in infrastructures" Journal of Architecture and Built Environment, ISSN190-199, vol-25.

[3] Chi Xu 1, Duanyi Wang, Enbei Guo, Haoyang Luo, Haoyang Yu, Shaowei Zhang, Zeyu Zhang. (2021). "Effect of Lignin Modifier on Engineering Performance of Bituminous Binder and Mixture".Journal of Civil Engineering and Transportation, ISSN 1307-1083 vol-13 .

[4] Chaochao Liu, Dongdong Ge, Hainian Wang, Junfeng Gao, Miao Yu, Zhanping You (2019). "High-temperature rheological behavior and fatigue performance of lignin modified asphalt binder" Journal of Civil and Environmental Engineering, ISSN 117-063, vol-230.

[5] D. Irawan, N. Muslimah and Z. Arifin, (2018), "lignin isolation from coconut coir with variation of time and concentration of NAOH in the process of alkaline delignification", Journal of Chemical Engineering, ISSN 0974- 1496 vol-11, pp-1458-1460.

[6] Elenaaudenzi, Fabrizio Cardone, Francesco Canestrari, Xiaohu Lu (2021). "The Use of Lignin for Sustainable Asphalt Pavements" Journal of Civil and Building Engineering and Architecture, ISSN 129-773, vol-362.

[7] Evgeniy Korolev, Guocheng Su, Jiangmiao Yu, Mijash Vaidya, Sanjeev Adhikari, Svetlana Shekhovtsova. (2021), "Experimental study of soda lignin powder as an asphalt modifier for a sustainable pavement material" Journal of Civil Engineering and Transportation, ISSN 123- 884, vol-298.

[8] Guanyu Ji, Lei Xin, Wenze Gao, Xuancang Wang,Yi Zhang, Yuchen Guo and Zhenyang Fan(2020),"Mechanical Performance Characterization of Lignin- Modified Asphalt Mixture" Journal of highway engineering. ISSN 1009-3324, vol- 10.

[9] Hui Yao, Yiran Wang, Junfu Liu, Mei Xu, Pengrui Ma, Jie Ji and Zhanping You (2022), "Review on applications of lignin in pavement engineering" Journal of Department of Civil and Environmental Engineering, ISSN 803-524, vol-8.