International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 04 Issue: 08 | Aug -2017 www.irjet.net p-ISSN: 2395-0072

EFFECTIVE STUDY OF TISSUE IN CONCRETE

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Abstract - *According to the progressing survey, there is awareness on utilizing the bio-waste in an efficient manner. Concrete stands as the third main industry in contributing to the carbon-di-oxide emissions. Lignin being an aromatic polymer is present in all biological specimens and is found to be in higher concentration in coir dust. On adding lignin as a cement replacement material in various percentages, the results expect to create a greater impact in the compressive strength of the concrete. Using different concentration, not only the thickening time was affected, it also exhibited some variations in the compressive strength of the concrete.*

Key Words: Lignin, Extraction, Coir dust, Compressive Strength,

1. INTRODUCTION

The progressing economy has a high demand over development of infrastructure. They mainly insist on cost economical structures endured with safety concern. Since many decades, successful infrastructure has been stepped up with a main component concrete. Concrete being the heart of evolving infrastructure, many studies and researches has been progressing in order to accompany with best economical concrete powered with high strength. Emerging heat of hydration process has resulted in global warming emission of carbon-di-oxide (Co_2). The concrete industry is one of two large producers of carbon-di-oxide, creating up to 5% of worldwide man-made emissions of this gas, of which 50% is from the chemical process and 40% is from burning of fuel. The carbon-di-oxide produced for the manufacture of one ton of structural concrete (using 14% cement) is estimated at 410 kg/m^3 . The Co_2 emission from concrete production is directly proportional to the cement content used in the concrete mix, 900 kg of Co_2 are emitted for the fabrication of every ton of cement, accounting for 88% of the emissions associated with the average concrete mix. Cement manufacture contributes greenhouse gases both directly through the production of carbon-di-oxide when calcium carbonate is thermally decomposed, producing lime and carbon-di-oxide, and also through the use of energy, particularly from the combustion of fossil fuels.

Employing by-products in concrete would create a greater impact with respect to cost. Conventional usage of materials in all time demand industries would create greater opportunity towards economy. The main motive of our project is to design a concrete that possess high strength, safety, workability. Higher strength refers to the maximum compressive strength derived at end of the curing. Safety refers to the concrete which would not fail under heavy loads unless the load exceeds by a given margin. Workability means the concrete must enhance the execution process so as to ensure both their structure life and comfort.

These above criteria can be achieved with help of a natural product. Addition of polymer called lignin would help in gaining strength in concrete. Biological by-product being a conventional product from tissue of coir dusts, will be more helpful in both economic and to environment. Studies and certain researchers regarding employing of lignin in concrete have suggested that lignin helps in reducing the foot print of carbon.

2. THEORETICAL BACKGROUND

Concrete has been used in a wide variety of applications for many decades to provide shelter, facilitate transportation, store water, to protect cities, to treat waste, to express artistic values and so on. Various immense structures were constructed with high architectural importance. In 1872, Cleft Ridge Span Prospect Park (Brooklyn), Cast-on-site elements were erected by stone masons which implies that Concrete is treated as an artificial stone. In1897, Glenfinnan Viaduct (Scotland) was constructed with mass concrete having 21 spans and overall length as 380m. In 1927, Ford Parkway Bridge Minneapolis/St. Paul (USA), three main spans about 100 m long was constructed justifying the aspect that Reinforced concrete leads to slender structures. Bridges across the Teesta River (Darjeeling) 1933, 1941 consists of Arch bridges with 90 m span and 15 m rise, and 82 m span and 40 m rise, respectively which implies "Geography and terrain do not limit the use of concrete."

Mass produced concrete housing units were developed by Thomas Alva Edison. Edison houses Union (New Jersey) 1908, Houses were cast in iron moulds within 6hours .Forms was removed after 6days and the house was then ready for finishing. Repetitive use of concrete is highly cost-effective. Concrete can be tailored to have early strength. First reinforced concrete skyscraper, 64 m high, with 16 stories was established in Ingalls Building (Cincinnati) 1902. Until that time no concrete building taller than two stories had been constructed. Buffalo BillDam (Wyoming) 1910 serves to be One of the first large and tall arch dams thus showing that Concrete can be fabricated practically anywhere. The Isthmus of Panama (Panama Canal) of 1939 was 80 km and the canal cost $380 million in 1907. It has 12 locks, 304 m long and 34 m wide. 3.4 million m3 of concrete was used in this construction. Traditional Applications of concrete includes bridges and via ducts, houses and large buildings, dams, canals, roads and pavements. Concrete is generally preferred mainly because of the following reasons:

- It can be fabricated practically anywhere.
- It can be molded and cast into a wide range of shapes and geometries.
- It is relatively cheap.

It satisfies the strength and serviceability requirements

3. LIGNIN

Lignin is considered as natures most abundant aromatic polymer co-generated during papermaking and biomass fractionation. There are different types of lignins depending on the source (hardwood, softwood, annual crops, etc.) and recovery process. As the renewable energy industry is expanding into developing the next generation of biofuels based on cellulosic biomass (e.g., corn stover, forest products waste, switch grass), abundant supply of sulphur - free lignin will become available as co-products for which value-added engineering applications are being sought.

Agricultural biomass is one of the sustainable resources having cost-effectiveness and can be transformed into bio-based energy such as biofuel and ethanol. Agricultural biomass such as corn products can be converted into biofuels or ethanol by hydrolysis and subsequent fermentation. Previous studies on the use of lignin-based products in infrastructure have focused on sulfite lignin (lingo-sulphonate‟s or lignin-sulphonate‟s) which is derived from the paper industry, while the lignin‟s obtained from biofuel or ethanol production is sulfur-free lignin

With the untapped potentials of coir dust, a widely available lingo-cellulosic by-product makes promising applications in civil engineering. This well known coir dust is obtained from the husk of a coconut. Husk being an abundant material in coconut, there would not scarcity for coir dust. Coconut is made up of various constituents of which the strength of husk is found to be due to lignin which is a complex polymer bonded with long chain. Structural studies have registered that lignin is a major polymeric component made of repeating phenyl propano chains. The tissue behind this evolution of lignin is schlerenchyma which is the strongest tissue among tissues present in biological specimens. The tissues which compete with schlerenchyma are collenchyma and parenchyma. These two tissues have comparatively lower strength than schlerenchyma due to the long and strong linkage of lignin chain. Strength of coconut is also accompanied due to the presence of cellulose membranes. Various methods are employed for the extraction of lignin from the tissue of coir dust. Based on which the one preferable for upcoming conventional can be preferred and employed.

4. METHOD OF EXTRACTION

Characterization and phytochemical actions are preformed over the coconut coir dust. Based on which studies have been performed regarding the percentage of lignin which could be extracted using water, acetone, water and acetone respectively. Amount of extract obtained from each method increased with decreased particle size: 150μm > 300μm > 600μm for every solvent system‟s. these solvents reveal the moisture, ash, lignin, cellulosic contents, and pH of aqueous solutions as: 25.20%, 9.0%, 53.5%, 35.99%, and 6.

4.1 Extraction of lignin using non polar solvents

Adding 150ml of acetone with Soxhlet extract with different masses (0.5g-1.5g) of different particle sizes is employed in the extraction of lignin from coir dust. The percentage of extract and percentage of residue with respect to mass of coir dust is analyzed and plotted.

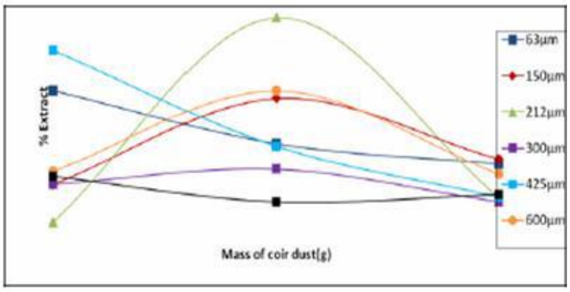

Figure 1: % Extract versus Mass of Coir Dust

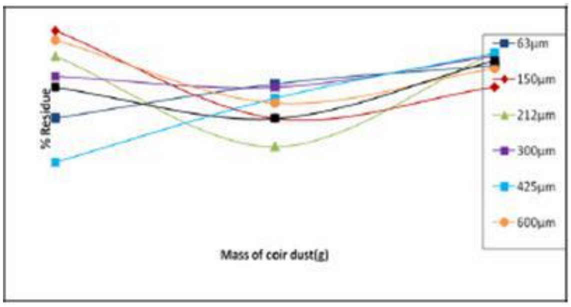

Figure 2: % Residue versus Mass of Coir Dust

The amount of extracts using acetone as solvent found to provide less extract when compared to water as solvent. The difference between two extracts is attributed to the difference between two solvents. Water is polar with high polarizability, boiling point, solubility parameter, and di-electric constant. The solubility parameter of water is 23.1 whereas that of acetone is 9.71 which is lower than that of water. Smaller particles yielded more extract compared to smaller sizes.

4.2 Extraction of lignin using different solvent systems

The extraction lignin from 1g of coir dust of size 150μm using different solvent mixtures-water was found to produce high extract than compared to other methods. Acetone/water $\left(\frac{70}{30}\right)$ was to find to give maximum extract of 20% from 1g of coir dust. Whereas acetone/water $\left(\frac{50}{50}\right)$ resulted in lower extraction of about 4.2%. The high efficiency of the solvent combination in the extraction of lignin from coir dust is attributed to the interplay of the properties of the two solvents- water and acetone. It is found that there is synergistic interplay of the properties of two solvents. These properties that play in dissolution include polarity, di-electric constant, polarizability, polarizing power, hydrogen bonding, and solubility parameter. The following table was attributed based on different source of extractions.

Table 1: Extraction of Coir Dust using Different Solvent Mixtures

SOLVENT	MAS OF EXTRACT	% EXTRACT
WATER	1.131±0.05	13.1
ACETONE	0.066±0.001	6.60
ACETONE/WATER(70/30)	0.20±0.001	20.0
ACETONE/WATER(50/50)	1.042±0.001	4.20

Method 2 of extracting lignin using different solvents at different concentrations aided good result. This process was carried in laboratory using soxhlet apparatus which resulted in high lignin concentration. Moreover further constituents along with lignin were separated and led to production of pure form of lignin. This lignin found to have more strength with long chain polymer's with brown color appearance. Large amount of batches of coir dust were treated with acetone/water concentration for higher amount of lignin for the purpose of cement replacement.

5. RESULTS AND DISCUSSION

Many procedures have been introduced for the sake of improving the properties of concrete by employing various additives and chemicals. The most widely methods involved the replacement of aggregates materials. Aggregates tend to increase the strength and durability of concrete with their natural strength. Rather than replacing aggregates, cement replacement technique would bring a greater impact in the properties of concrete. Employing by-products tends to be more conventional thereby rising up more applications.

5.1 Pronouncement

The physical properties of the sample are observed in laboratory test. The part of results of various test are presented in table.

Table 2: Preliminary tests

PARAMETERS	CEMENT	F.A	C.A		LIGNIN
			12mm	20mm	
Specific gravity	3.13	2.65	2.75	2.72	0.430
Sieve analysis	-	4.5%	2.7%	3.0%	-
Water absorption	-	0.13	0.045	0.050	0.079

6. COMPARATIVE STUDY

6.1 Compressive strength of OPC and 10% Lignin

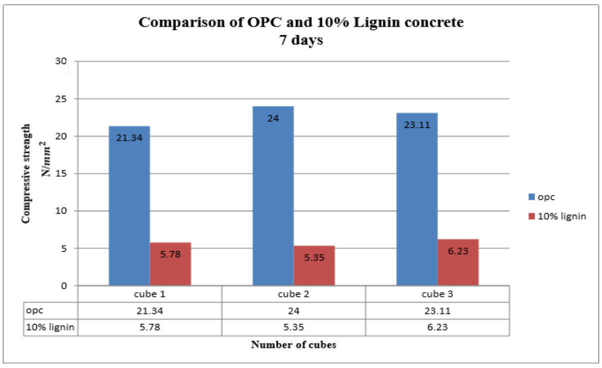

Figure 3: Comparison of OPC and 10% Lignin Concrete – 7 Days

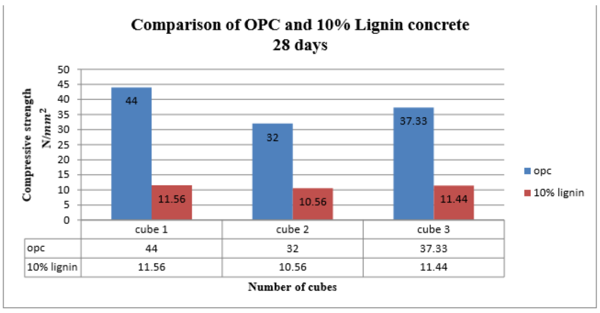

Figure 4: Comparison of OPC and 10% Lignin Concrete – 28 days

6.2 Compressive strength of OPC and 20% Lignin

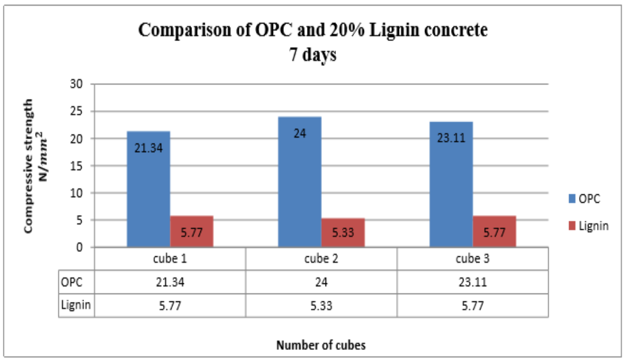

Figure 5: Comparison of OPC and 20% Lignin Concrete – 7 Days

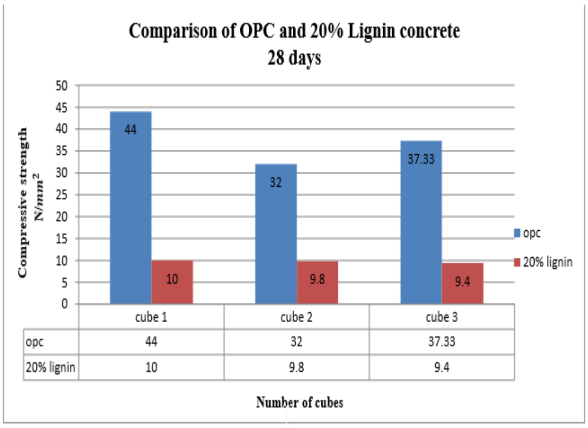

Figure 6: Comparison of OPC and 20% Lignin Concrete – 28 days

6.3 Compressive strength of OPC and 30% Lignin

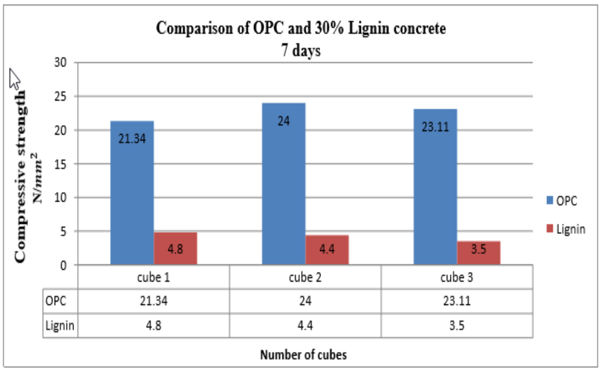

Figure 7: Comparison of OPC and 30% Lignin Concrete – 7 days

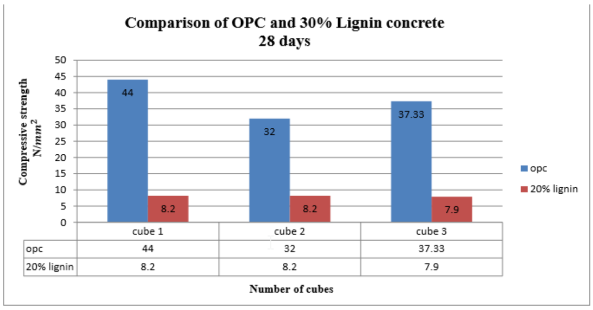

Figure 8: Comparison of OPC and 30% Lignin Concrete – 28 days

7. CONCLUSION

Concrete with various percentages of cement replacement as lignin were produced. They divulged with brown appearance which was totally different from Ordinary Portland Cement concrete. Compared to Ordinary Portland Cement concrete, cement replaced concrete experienced a less impact. The reason behind this was that lignin consumed water in addition to the water cement ratio derived in the design mix. Moreover, specific gravity of lignin was low compared to the specific gravity of cement. In turn weight of the cube decreased compared to OPC resulting in low compressive strength. Since there was no problem of lignin bonding with cement, there existed a slight rise in compressive strength in lignin concrete on ageing.

8. REMEDY

The expected objectives can be achieved from the following remedies,

- The presence of cellulose content resulted in more water absorption. In order to overcome this defect, futher extraction methods should be carried out in such a way that the cellulose content should be removed from the lignin.
- The stability of polyproplene can be increased when treated which may also result in the removal of cellulose content.

In case of utilizing the lignin with cellulose content, admixtures containing polycarboxylate may be used.

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