Study on Properties of Concrete Using Fish Scales

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Abstract— The Processing of fish results to enormous amounts of garbage. It is estimated that fish processing waste after filleting accounts for approximately 65% of the total fish weight. About 35% of the total fish weight remains as waste in the form of skins, scales and bones during preparation of fish fillets. In India fish production is about 95.7 lakhs of tonnes out of which 7.34 lakhs of tonnes of fish scale is produced every year but unutilized. The present work an attempt has been made to develop, explore and design the possibility of utilization of labeo rohitha fish scales in the form of flakes or short fibres in concrete as an additive. The workability, compressive strength, flexural strength and split tensile strength of different percentages was determined. These concrete fish scale composite has several useful conclusions have been arrived at 10% replacement and analysis comparison has been carried out in Neural Networks.

Keywords: Fish scales; Labeo rohitha; Fish scale composite; Neural Networks

I. INTRODUCTION

Basically, in India fish scale a biomimicry waste generated from the fish during their utilization as a source of food in many parts of the country. As on date, the utilization of fish scales as biomimicry fibre is very new to the concrete industry. This element has driven the authors to study the realism of fish scale as biomimicry fibre in concrete pavement mixes and take up a qualified study concerning the usual mix as per the desired specifications. In this paper, research is carried by considering the addition of a fish scale as biomimicry fibre at various percentages.

The influence of cementitious materials and fish scales on the concrete mix has appraised in terms of Mechanical properties and workability properties. The biodegradable materials are calm of waste from living organism and the actual plant, animal, or another organism when its life ends. E.g., Human &animal waste, plant products, wood, paper, food waste, leaves, remains from the death of the living creatures.

Mother nature has increasingly served as a source of encouragement for the engineers across the globe over a large number of decades in terms of acquiring the materials for various purposes among them construction occupies a critical concern. This trend of utilization of these was called with a different header, for example, biomimicry or bio-inspiration. Probably, more than 50% of the remaining material from the total fish capture is not used as food and involves almost 32 million tonnes of waste towards them, such as fish scales because of their unique combination of flexibility, Specific strength, and toughness. (Zhu et al.2012, Yang et al. 2014). The concept of utilization of this aquatic resource in concrete is not known, but the use of some natural biomimicry materials is an inimitable one among the existing.

II. LITERATURE REVIEW

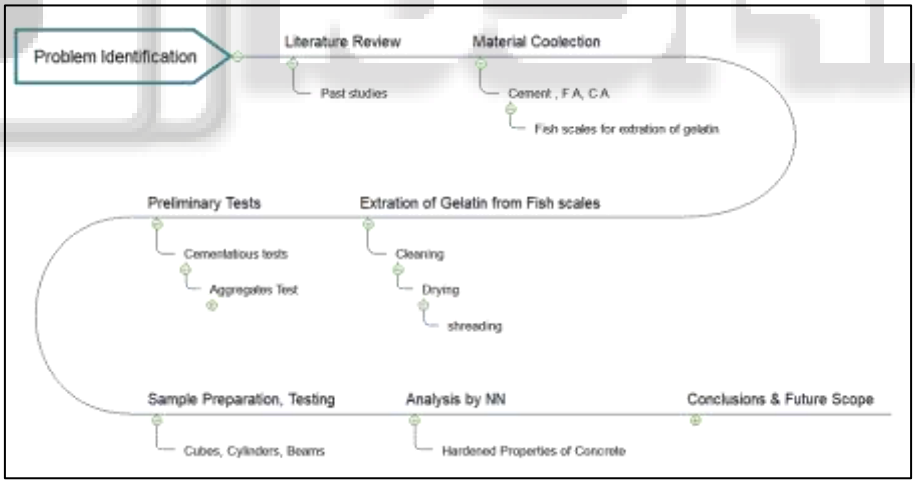
1) Nirmalraj et al. (2018) by his study he studied about utilizing the characteristic natural waste fish scales and chicken quills blended in with epoxy substance to make the strengthened composites. Epoxy tar (Araldite LY 556) and relating hardener (HY951) are utilized with particular extents. He watched better estimations of elasticity and hardness. These composites are used in the low burden applications.
2) Zhu et al. (2017) clarifies that the fish scale was found of Protective materials and structures found in common life forms may move new armours with improved protection from entrance, adaptability, light weight, and other fascinating properties, for example, straightforwardness and breathability. This scale is around 200–300mm thick and comprises of a hard-external hard layer upheld by a milder cross-handle of collagen fibrils. Puncturing tests with a sharp needle demonstrated that a solitary fish scale gives a high protection from infiltration which is better than polystyrene and polycarbonate, two building polymers that are regularly utilized for light straightforward bundling or defensive gear. Under cut, the scale experiences a grouping of two particular disappointment occasions: First, the external hard layer splits following an all around characterized cross-like example which creates four "folds" of hard material. The avoidance of the folds by the needle is opposed by the collagen layer, which in biaxial strain goes about as a holding film. Strikingly this second phase of the entrance procedure is exceptionally steady, so an extra half infiltration power is required to inevitably cut the collagen layer. The mix of a hard layer that can fall flat in a controlled manner with a delicate and extensible support layer is the way in to the protection from entrance of individual scales.
3) Manikandan et al. (2017) clarifies that the gelatine and collagen can be separated from fish scales. The creator clarifies the properties concerning warm, physical, mechanical, biodegradable and cytocompatible. The properties can be portrayed with by utilizing Micro–figured tomography examination. He clarifies that it can utilized as the regular manufactured bio degradable common material in tissue designing.
4) Prasad et al. (2017) studies that the fish scale is alluded as bio squander where the bio polymeric movies are separated from fish scales. The use of fish scales polymeric movies are utilized as the Sealing/bolting the Internal obsession gadgets. In this paper, creator clarifies biofilms were set up through twin screw mixing cum dissolvable throwing strategy. Poly lactic corrosive (PLA) is biodegradable polymer though hydroxyapatite (HAp) is a bio pottery otherwise called bone materials, which empowers the new bone development close to break locales. Creator clarifies blend of materials utilized

in this assembling biopolymer as (PLA) and bio fired as (HAP).

5) Ololade et al. (2017) studied that the fish scales has the plentiful source biopolymer which contains 30%-40% of protein (collagen), 30%-half calcium and potassium carbonate and 20%-30% chitin which are extricated and important. So the creator clarifies that this fish waste can be used in different businesses. He considered and did trial research on pharma remedial mixes.
6) Das et al. (2017) studied that the sizes of l. Rohitha contains the rich source gelatine/collagen. This gelatine is broadly used as the biopolymer in different parts. Creator clarifies it has high potential bio polymer properties. The logical strategies, for example, checking electron microscopy (SEM), UV-vis spectroscopy, and X-beam diffraction (XRD) for the assurance of crystalline and surface morphology and Fourier change infrared spectroscopy (FTIR) for basic assurance.
7) Bora et al. (2016) studied about fibre polymer composites by utilizing fish scales. The fish creation in India 95.7 lakhs tons are delivered in which 7.34 lakh tons fish scales are delivered each year. So the creator used fish scales with Lap bull L12 leave and hardener K-6 arranged the various composites. The pre-owned fish scale biodegradable in nature and having building applications for better destroy properties
8) Sridhar et al. (2015) studied about utilization of fish scale as a characteristic fibre. The fish scale is blended in with vinyl ester pieces and this was exposed to various extents. though fish scale rates were 5 to 30 % weight (FS5%, FS10%, FS15%, FS20%, FS25%, FS30%) and composited fish scale vinyl ester were in the relating proportions, for example, 5:95 (1), 10:90 (2), 15:85 (3), 20:80 (4), 25:75 (5) and 30:70 were gauged and exacerbated by hand. According to apportion mechanical tests are done. The flexural, malleable, strength properties for all examples decided.
9) Olatunji et al. (2014) discussed the utilization of silicon manufacture for miniaturized scale needles practical and this strong smaller scale needles puncture the outside of the skin making reasonable harm the epidermis due to it thick/strong nature. So as to correct this sort of situation they are utilizing fish scales as a bio polymer to set up the smaller scale needles. So, the assembling cost diminished and these strings are bio-perfect in nature and bio degradable in nature. Creator inferred that fish scale biopolymer can penetrate and debase into skin and thusly are acceptable possibility for transdermal applications.
10) Shiqun et al. (2013) expected to clarifies that the commitment of powdered fish scales In Novel concretes glue impromptu creation of HAP–M–PALC (hydroxyapatite–magnesia–bearing phosphoaluminate) properties that outcomes in builds the quality properties. Creator saw that the split rigidity and HAP–M–PALC glue solidified properties due substance bond responses.

III. Experimental Procedure

A. Methodology



B. Fish Scales

Fish scales is a rigid material which covers the skin of the fish. Huge amounts of fish waste are discarded every day. One of the challenges is to collect enough of these scales and transfer them to the processing lab. Fish scale is widely used biopolymer in various industries due to its excellent biocompatibility, biodegradability properties. In the present study, fish scales were extracted from fish wastes, as an alternative source.

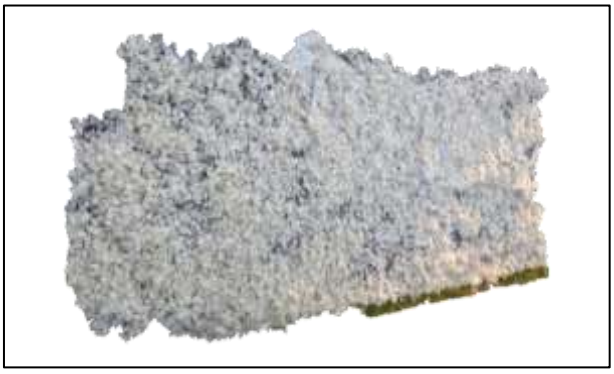


Fig. 1: Fish Scales collected

C. Gelatin

Fish scales is a rigid material which covers the skin of the fish. Huge amounts of fish waste are discarded every day. We decided to make use of these fish scales to produce a bio-degradable polymer. One of the challenges is to collect enough of these scales and transfer them to the processing lab. Fish scale is widely used biopolymer in various industries due to its excellent biocompatibility, biodegradability properties. In the present study, gelatine extracted from fish scales, was used as an alternative source to cement.

Gelatin was extracted by alkali treatment method. Dried scales were initially cleaned with 5% sodium chloride (NaCl) solution (1/10, w/v) for 30 min at room temperature. Alkali solution was changed every 30 min to remove lipids from the scales. This step was repeated three times for 30 min in a linear shaker and dried. Dried thin films were ground using a grinder and gelatine powder was obtained.

Formulae use for yield of gelatine was

$$\text{Yield of gelatine (\%)} = \frac{Weight\ of\ dried\ Gelatin\ (g)}{Dry\ weight\ of\ Fish\ scales\ (g)}$$

D. Artificial Neural Networks

Artificial neural networks are computers whose architecture is modeled after the brain. In other words it is a computational system inspired by the structure, processing method and learning ability of a biological brain. They typically consist of many hundreds of simple processing units which are wired together in a complex communication network. Each unit or node is a simplified model of a real neuron which fires (sends off a new signal) if it receives a sufficiently strong input signal from the other nodes to which it is connected. An artificial neural network (ANN) is applied to several civil engineering problems, which have difficulty to solve or interrupt through conventional approaches of engineering mechanics. These include predicting the mechanical properties of concrete, tide forecasting, earthquake-induced liquefaction and wave-induced seabed instability. ANN model can provide reasonable accuracy for civil engineering problems, and a more effective tool for engineering applications. In this project the artificial neural networks have been established using MATLAB software, Neural Network Toolbox. The regression analysis has also been carried out using MATLAB software.

The adopted network architecture consists of the following.

1) Seven neurons (Ni =7) in the input layer, which represent the variables of cement content (CC: kg), fine aggregate content (F.A; kg), coarse aggregate content (C.A; kg), water content (W; kg), and fish scale content (J; kg).
2) One neuron in the output layer, which represents the value of the corresponding compressive strength (MPa), split tensile strength (MPa), or flexural strength (MPa).
3) One hidden layer with 10 neurons.

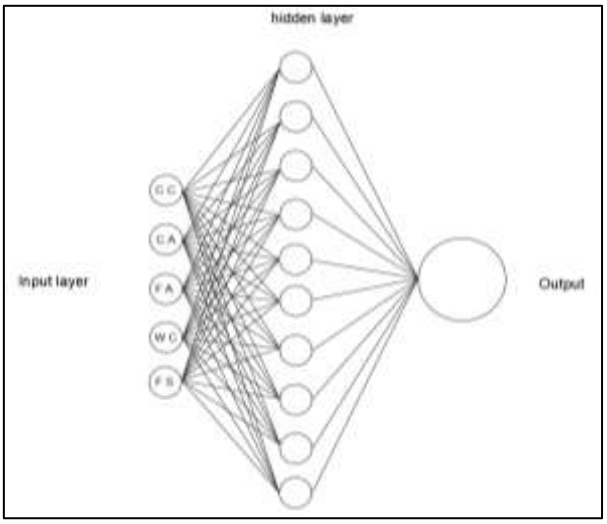


Fig. 1: Architecture of ANN

IV. RESULTS

% gelatine	Slump (mm)
0	32
5	26
10	22
15	25
20	11

Table 1: Slump Flow Value

% gelatine	Vee Bee (sec)
0	3
5	5
10	5
15	7
20	9

Table 2: Vee-bee Value

Mix	Compressive Strength (Mpa)	
	7 days	28 days
C.C	20	33
GM_5	18.22	29.25
GM_{10}	20.12	31.24
GM_{15}	19.52	29.32
GM_{20}	17.42	26.25

Table 3: Compressive Strength Results

Mix	Flexural Strength (Mpa)	
	7 days	28 days
C.C	3.12	5.33
GM_5	3.22	5.25
GM_{10}	3.32	5.24
GM_{15}	3.52	5.32
GM_{20}	2.42	5.25

Table 4: Flexural Strength Details

Mix	Split Tensile Strength (Mpa)	
	7 days	28 days
C.C	2.32	2.93
GM_5	2.22	2.85
GM_{10}	2.12	2.64
GM_{15}	2.52	3.02
GM_{20}	2.12	2.55

Table 5: Split Tensile Strength

A. Prediction using NN

Mix Designation	Compressive Strength		Split Strength		Flexural Strength	
	Actual	Predicted values NN-LM	Actual	Predicted values NN-LM	Actual	Predicted values NN-LM
C.C	20	20.12	2.32	2.27	3.12	3.28
GM_5	18.22	18.02	2.22	2.24	3.22	3.02
GM_{10}	20.12	20.5	2.12	2.14	3.32	3.33
GM_{15}	19.52	19.65	2.52	2.37	3.52	3.42
GM_{20}	17.42	17.38	2.12	2.18	2.42	2.5

Table 6: Comparative analysis on actual and predicted values for 7 days curing

Mix Designation	Compressive Strength		Split Strength		Flexural Strength	
	Actual	Predicted values NN-LM	Actual	Predicted values NN-LM	Actual	Predicted values NN-LM
C.C	33	33.24	2.93	2.94	5.33	4.28
GM_5	29.25	29.23	2.85	2.88	5.25	5.72
GM_{10}	31.24	31.5	2.64	2.59	5.24	5.42
GM_{15}	29.32	29.22	3.02	3.24	5.32	5.34
GM_{20}	26.25	26.38	2.55	2.48	5.25	5.33

Table 7: Comparative Analysis on Actual and Predicted Values for 28 Days Curing

V. CONCLUSION & FUTURE SCOPE

A. Conclusion

On the basis of the analysis carried out the following conclusions were drawn-

1) The addition of gelatine from fish scales the workability properties.
2) The age of 28 days with the provision of 15 % of gelatine from fish scales as in the concrete mix has attained its target strength.
3) The compressive strength values got increased 2.35 % when the addition of gelatine @ 15 %when it is compared with conventional concrete at 28 days.
4) The flexural strength values are found to be increased when the addition of fish scales @ 15 %when it is compared with conventional concrete at 28 days
5) The split tensile strength values are got increased increases when the addition of fish scales @ 15 %when it is compared with conventional concrete at 28 days
6) From the overall it is concluded that fish scales volume fractions of 5 -15% was found to be optimum based on structural requirement.
7) The prediction of compression strength, split tensile strength and flexural strength values using NN-LM has attained its maximum performance.

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