



## Research- Using ground Bakelite as alternative solution for the Partial replacement of fine aggregate

Ravi Shankar Gupta

Student of B.Tech(4<sup>th</sup> year)

Department of civil Engineering

Bansal institute of Engineering and Technology

Lucknow, India

[guptaravishankar629@gmail.com](mailto:guptaravishankar629@gmail.com)

Avinash Bhagat

Student of B.Tech(4<sup>th</sup> year)

Department of civil Engineering

Bansal Institute of Engineering and Technology

Lucknow, India

[Abhaybhagat2255@gmail.com](mailto:Abhaybhagat2255@gmail.com)

Shakti Kumar

Asistent Proffesor

Department of civil Engineering

Bansal Institute of Engineering and Technology

Lucknow, India

[shaktikumar.kumar21@gmail.com](mailto:shaktikumar.kumar21@gmail.com)

**Abstract**— India is very fast developing nation, and construction plays vital role in developing the nation. In construction, concrete is the majorly useful material. Fine aggregate used in concrete like traditional UHPC causes several environmental issues like floods due changes the direction of river flow, effect on biological diversity, falling water table also . In current time millions of tons of waste materials disposed in open environment which causes several health as well as waste disposal problems. We can use waste material like Bakelite as the partial replacement of fine aggregate. The purpose of this study is to find whether the use of Bakelite in concrete improve its compressive strength as a partial replacement in conventional M25 grade concrete Mix. From 2010 to 2020, river sand usage in Indian construction sector increased from 630 to 1400 Tons . This type of usage is very harmful for our next generation also that's why many states in India like Bihar, Tamil Nadu, Madhya Pradesh, Rajasthan, Uttar Pradesh and Maharashtra have banned the river sand mining for use in concrete. Paver Blocks & Solid Blocks are manufactured using waste Bakelite as a partial replacement of fine aggregate with the percentage of 3%,6%,9%,12%,15%,18% . Tests are conducted to examine its strength, Workability and compared with conventional material.

**Keywords**— Bakelite, Fine Aggregate, Concrete Cubes, Compressive Strength, Workability.

### INTRODUCTION

1. Bakelite is a thermoset plastic which is formed from an poly condensation reaction of phenol with formaldehyde and it is most commonly used for Telephone casing, automobile parts, Electrical Insulators and kitchenware appliances for heat resistant [1]. The reason behind providing the heat resistance is that Bakelite cannot be remelted into another product. A Belgian- American chemist named Leo Bake land is the one who developed the product in the year 1907 [2]. Later in December 1909, Bakelite was patented. The growth of Bakelite consumption increases Bakelite waste. Bakelite waste is prohibited from disposing of direct land filling and open burning, which becomes a waste management problem [3]. Concrete is the most widely used material in construction industry. It is understood that concrete is the second most used material after water. The purpose of this study is the use of waste Bakelite aggregate as fine aggregate to replace natural sand material partially. The objectives of the study are to determine % of fine aggregate which can be replaced by Bakelite waste without compromising the compressive strength of the conventional concrete of the grade M20, to study the effect of Bakelite waste

on the slump value, compaction factor and compressive strength of the M20 grade concrete, utilization of waste Bakelite to reduce the dumping problem [3].

## LITERATURE REVIEW

RR Bhopi and M Sinha partially replace the fine aggregate with Bakelite. The experimental investigation are when the percentage of Bakelite is increased the value of slump decreases. There is a decrease in the compaction factor when we increase the Bakelite percentage. We can replace the fine aggregate up to 20% with Bakelite waste by weight in the concrete of M25 grade without compromising compressive strength. As the percentage of Bakelite is increased the concrete becomes lighter in weight.

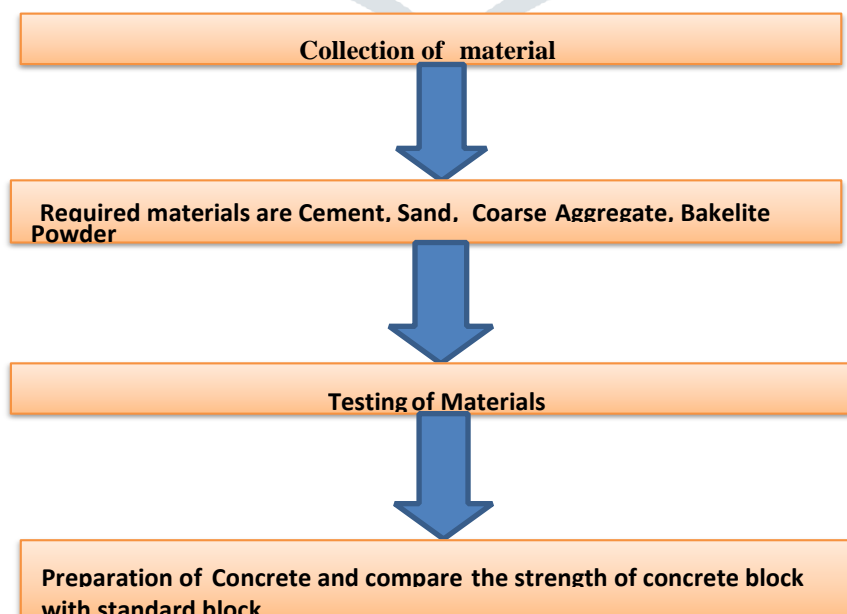
Akhil Verma Determine strength of concrete cubes using Bakelite powder instead of natural sand. The optimum result is found to be after replacement of Bakelite powder Strength of concrete with Bakelite powder replacements at optimum ratio was tested to be 24.51 MPa. This concrete can be used up to 3 floor house/buildings, surface water tanks and for structure of aesthetic value. High quality control with respect to material and casting is required for this type of concrete manufactures.

L Arun Raja and P Kumar Study on Flexural behaviour of Concrete by Partially Replacing Fine Aggregate with E-Plastic Waste. It is also concluded that the use of industrial wastes such as E-Plastic waste in concrete provides some advantages, like reduction in the use of natural resources, disposal of wastes, prevention of environmental pollution and energy saving.

Gyandeep Gupta, Mr. Rajneesh Partial Use of Bakelite Powder in Concrete Structures as an Alternative to Natural Sand. Partial Use of Bakelite Powder in Concrete Structures as an Alternative to Natural Sand at 20% replacement of natural sand with Bakelite powder the compressive strength of the concrete decreases but it is still better from the normal M25 concrete with 0% replacement, but at 30% replacement the compressive strength of the concrete is below 25Mpa so we can replace the sand with Bakelite powder to an extent of 20% only. The range of replacement of natural sand with Bakelite powder should be between 5% to 20% in which maximum compressive strength is obtained at 15% replacement.

S. Sakthi Sasmitha , Dr. R.N Uma A Critical Review on the Application of Bakelite as a Partial Replacement of Fine and Coarse Aggregate. The present study reveals the properties and use of Bakelite as a construction material in Cement, and solid blocks with appropriate specifications. The use of waste material into construction industry creates a challenging job and better performance along with the development of construction sector. Incorporation of plastic waste in building material gives a cost effective and light weight sustainable component in construction which alters the strength and durability property. This study helps to develop a replaceable material (waste Bakelite) for fine and coarse aggregate in order to minimize disposal of plastics which creates a waste management problem.

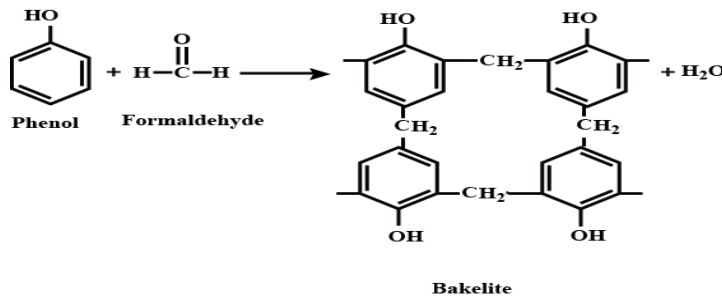
## Methodology



## Material and its properties

## 1. Bakelite:

Polyoxybenzylmethylenglycolanhydride is thermosetting phenol formaldehyde resin made from the Elimination reaction of phenol and formaldehyde. And the chemical formula of Bakelite is written as  $(C_6H_6O \cdot CH_2O)_n$ . Waste Bakelite is obtained from machine parts of electrical appliance (bulb holder and wire casing), Kitchen Appliance (Handle of pressure cooker and pans) [4].



Composition (wt%)			
Ultimate		Proximate	
Total carbon	53.4	Fixed carbon	31.70
Hydrogen	4.0	Volatiles	47.55
Oxygen	11.6	Moisture	3.01
Sulfur	0.017	Ash	17.74

Table 1 Chemical composition of Bakelite .

### PHYSICAL PROPERTIES OF WBFA

PROPERTIES	WBFA(waste Bakelite fine aggregate)
Fineness Modulus	3.65%
Water Absorption	5.34%
Specific Gravity	2.5
Density	1750Kg/m <sup>3</sup>

### Fine Aggregate:

Fine aggregate, which may be granular material or crushed stone, is a fundamental component of concrete. The quality of the fine aggregate and the density of the fine aggregate both have a significant impact on the hardened qualities of the concrete. The sand is of river sand screened and washed to remove all the organic and inorganic compounds that are likely to present in it. Sand has been sieved 2.37mm (passed) and retained.[10]

TABLE 3 PHYSICAL PROPERTIES OF FINE AGGREGATE

PROPERTIES	NFA(Natural Fine Aggregate)
Fineness Modulus	3.31
Water Absorption	3.85%
Density	1800(kg/m <sup>3</sup> )
Specific Gravity	2.65



### 3. Coarse Aggregate:

The coarse aggregate are usually derive from nature and may have been naturally reduce to desired size by crushing here we will use 10mm size of aggregate.



### 2. Cement:

In this project we use the ordinary PPC(Portland pozzolana Cement) cement. Portland- pozzolana cement is produced by grinding together Portland cement clinker and artificial pozzolana (Fly ash) with addition of gypsum or calcium sulphate.



### 3. Water:

Potable tap water available in laboratory with pH 7.0 and confirming to requirement of IS 456-2000 was use for Mixing concrete and curing the specimen as well.

### Tests

#### **Test For Coarse Aggregate**

Crushing Test, Impact Test, Water Absorption Test

#### **Test For Fine Aggregate**

Fineness Modulus, Specific gravity,

#### **Test For Cement**

Fineness Test, Setting Time Test, Specific gravity Test

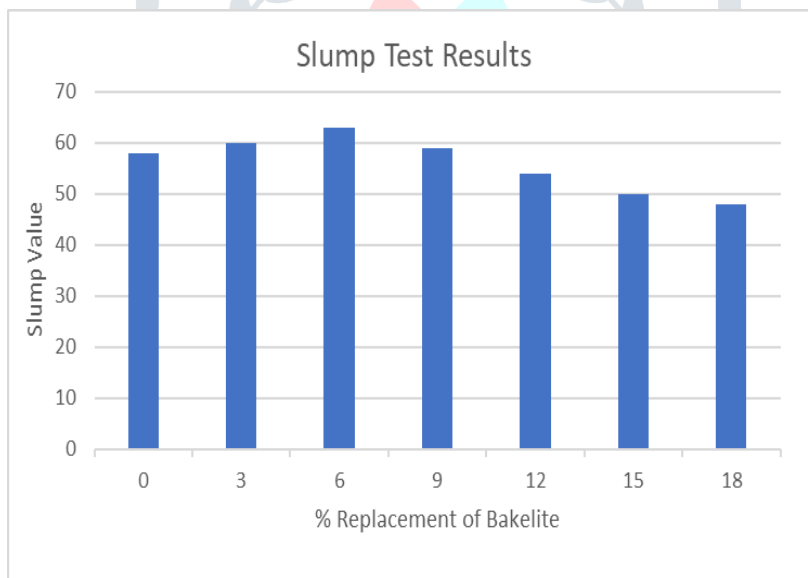
## Test For Concrete

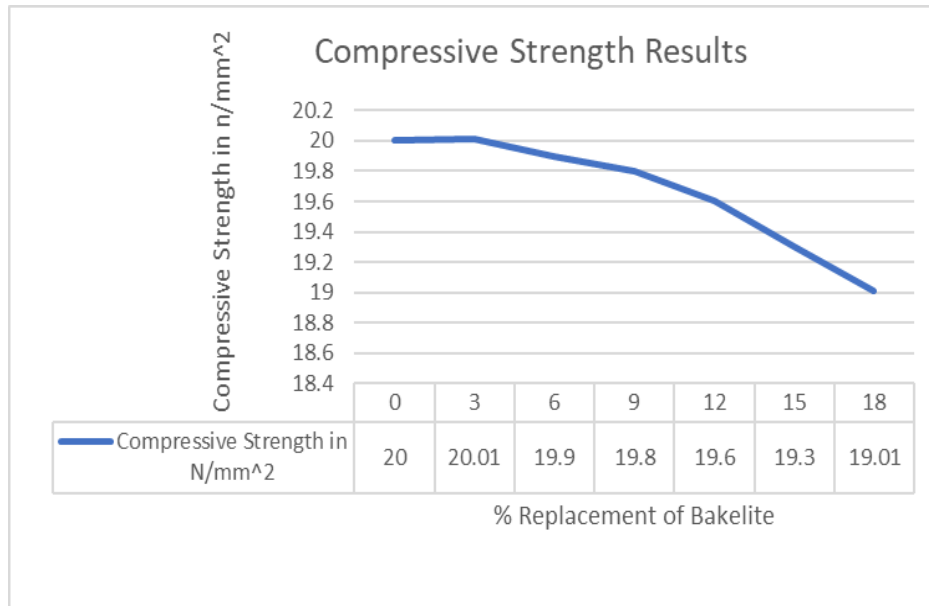
Slump Test, Compressive Strength Test



### Results-

1. The Workability of Concrete increases with increases Some Presentage of fine Bakelite and after it this is decreases.
2. We can Replace Fine aggregate upto 18% with Fine Bakelite without Compromising the Compressive Strength of Concrete.





### Conclusion:

The conclusions can be drawn from the experimental investigation are when the percentage of Bakelite is increased the value of slump decreases. The compressive strength of the concrete increases from 20Mpa to a maximum compressive strength of 19.7Mpa at the 15% replacement of natural sand with Bakelite powder. It is also concluded that the use of industrial waste such as Bakelite in concrete provides some advantages like reduction in use of fine aggregate, disposal of wastage prevention of environmental pollution. We can replace the fine aggregate up to 18% with Bakelite waste by weight in the concrete of M20 grade without compromising compressive strength. As the percentage of Bakelite is increased the concrete becomes lighter in weight. This concrete can be used up to 3 floor house/buildings, surface water tanks and for structure of aesthetic value. This type of concrete mix is not ideal for high rise buildings and heavy structures.

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- 29) *Sithiphat Eua-Apiwatch1 and \*Worasit Kanjanakijkasem2, Department of Civil Engineering, Faculty of Engineering, Burapha University, Thailand; Department of Mechanical Engineering, Faculty of Engineering, Burapha University, Thailand*
- 30) *S.Sakthi Sasmitha1, Dr.R.N.Uma, 1.Student M.E. (CEM), Civil Engineering Department, Sri Ramakrishna Institute of Technology/Anna University, Coimbatore, Indian., 2.Head of Department, Civil Engineering Department, Sri Ramakrishna Institute of Technology/ Anna University, Coimbatore, India.*
- 31) *S.Sakthi Sasmitha1, Dr.R.N.Uma2 ,Student M.E. (CEM), Civil Engineering Department, Sri Ramakrishna Institute of Technology/Anna University, Coimbatore, India.Head of Department, Civil Engineering Department, Sri Ramakrishna Institute of Technology/ Anna University, Coimbatore, India.*
- 32) *1.Clement M, 2.Rohini K,3.Krishna Kumar P,4.Boopathi M :1.Assistant Professor, 2 UG student,3.Associate Professor & Head,4.PG student Department of Civil Engineering, Rathinam Technical Campus, Eachanari, Coimbatore, TamilNadu, India*
- 33) *Murali K,Sambath K:1(Professor in Civil Engineering, Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu, India) 2(PG Scholar, Department of Construction Engineering and Management, Sri Ramakrishna Institute of Technology, Coimbatore, Tamilnadu, India)*
- 34) *Mohan R a, Vijayaprabha Chakrawartha, T. Vamsi Nagaraju b, Siva Avudaiappan c,d,e,\*, T.F. Awolusi f, Angel Roco-Videla g,\*\*, Marc Azab h, Pavel Kozlov i a Department of Civil Engineering, Alagappa Chettiar Government College of Engineering and Technology, Karaikudi, Tamil Nadu, India b Department of Civil Engineering, SRKR Engineering college, Bhimavaram 534204, India c Departamento de Ingeniería Civil, Universidad de Concepción, Concepción 4070386, Chile d Centro Nacional de Excelencia para la Industria de la Madera (CENAMAD), Pontificia Universidad Católica de Chile, Av. Vicuña Mackenna 4860, ~ Santiago 8331150, Chile e Department of Physiology, Saveetha Dental College and Hospitals, SIMATS, Chennai 600077, India f Department of Civil Engineering, Afe Babalola University, Ado Ekiti, Nigeria g Facultad de Salud y Ciencias Sociales, Universidad de las Américas, Providencia, Santiago 7500975, Chile h College of Engineering and Technology, American University of the Middle East, Egaila 54200, Kuwait i Polytechnic Institute, Far Eastern Federal University, Vladivostok 690922, Russia*
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