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# Investigative Study on Partial Replacement of Sand by Teak Wood Dust in Concrete

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## ABSTRACT

In this thesis main aim is to study the partial replacement of the fine aggregate with TeakWooden Dust with the varying proportion in the concrete and to check the different properties ofthe concrete by comparing with the controlledconcrete. The replacement of Fine aggregate(sand) with certain Teak wooden dust in concrete that makes the structure lighter in weight.For making M20 grade of concrete replacing sand with teak wood dust in proportions of 0%,5%, 10%, 15%, 20%, 255 and 30%. The Workability, strength and durability test are studied inthis project. The most important properties of concrete are the compressive strength and Tensilestrength. Also, increasing the teak wooden dust incorporation caused decreases in unit weightsandstrengthvaluesofmortars withaparallel increaseinwater absorptionvalues atallages.

## 1. INTRODUCTION

The development in the construction industry all over the world is progressing. Many structuresare being built, both residential and non-residential. Attempts have also been made by variousresearchers to reduce the cost of its constituent and hence total construction cost by investigatingand ascertaining the usefulness of material which could be classified as local materials. Some ofthese local materials are agricultural or industrial waste which includesTWD, concrete debris,fly ash, coconut shells among others which are produced from milling stations, thermal powerstation, waste treatment plant and so on As a result of the increase in the cost of constructionmaterials, especially cement, crushed stone (coarse aggregate), fine sand (fine aggregate);thereis the need to investigate the use of alternate building materials which are locally available.

Sincemostbuildingconstructionworksconsistofconcretework;therefore,reductionincostofconcretep roduction willreducethecost of buildingconstruction.

### 1.1 CONCRETE

The concrete materials are used in few years and the materials are reduced on the earth. So wehavetousingonthereplacingofwastematerials.Utilizationofthismaterialindifferentstructures have placed a high demand for its constituent materials. In India watercourse sand hasbeen used as the primary components of concrete, since it is easily available and well gradednature.River sand is mainlyusedfor all kinds of civil engineeringconstructions.

Concrete is a composite material composed of cement, fine aggregate and coarse aggregate withwater. the role of cement is to bind the material and sand is to fill the pores left in between coarseaggregate. The coarse aggregate is to strengthen the concrete.Concrete is widely used forconstruction ofarchitectural structures,foundations, pavements, bridges overpasses,

highways,runways,footings for gates, fences andpolesandeven boats.

## 1.2 COMPOSITIONOFCONCRETE

Concrete consists of three major components, viz. water, Portland cement, and aggregates.Properties of the final product i.e. cement changes according to the change in the ratio of itscomponents and hence consequentially help the engineer in deciding the proper use of the sameaccording to his need. To get a certain specific property in cement, Admixtures are added andhence enhanceits required characteristic.

**Water**. Mixing water should not contain abominable organic substances or inorganic ingredientsin excessive proportions.In this project clean potable water is used.Thewater in the concretemix should be clean and free of impurities.The change in water content with respect of cementdecides the properties of the cement like how easily the concrete flows, but also affects the finalstrength of the concrete.Excess water implies to easier flow of concrete, but decreases itsstrength.

**Portland cement**: The cement used is Ordinary Portland Cement confirming to Indian StandardsIS12269–1987ofgrade43.Thetestsconductedoncementarestandardconsistency,initial setting time, final setting time, and specific gravity. On mixing the water, cement hardens andhence all the ingredients are bounded together.Portland cement is the most commonly usedcementwith thecomposition ofalumina,silica, lime, iron, andgypsum.

**Aggregates**: Crushed granite of 20 mm maximum size has been used as coarse aggregate. Thesieve analysis of combined aggregates confirms to the specifications of IS 383: 1970 for gradedaggregates. The concrete mixtures consist of both coarse and fine aggregates witch helps inincreasing the strength of concrete. Now a days, sand, gravel, crushed stone, recycled materials,including blast furnace slag, glass (mostly for decorative purposes), and ground-up concrete areusedas aggregates.

**Wooden dust / Saw dust:** TWD is also known as wood dust. It is the by-product of cutting,drilling wood with a saw or any other tool.it is composed of fine particles of wood. Certainanimals, birds and insects which live in wood, such as the carpenter ant are also responsible forproducing the saw dust. Wooden powder dust's are produced as a small alternatechips or smallfragmentsofwood duringsawingof logs of timberinto different sizes.

## 1.3 MOTIVATION

In India major initiatives are taken for developing the infrastructure such as express highways,industrialprojects,powerprojectsetc.tomeettherequirementofglobalization.Intheconstruction of building and other structures the concrete plays a major role .The natural sand isone of the important ingredient of concrete which increases the cost of construction as well asscarcein river sand.

In orderto conserve the natural sand and to reduce cost of concrete production the alternativematerialcan beusedsuchas quarrydust ,whichcan partialreplacethe natural sand.

Saw dust is also known as wooden dust. It is the result of cutting, drilling wood .it is composed of fineparticles of wood, certain animals, birds and insects which live in wood such as carpenter ant are

alsoresponsiblefor producingthe woodendust.

### 1.4 OBJECTIVE

- Effectofuseofwoodendustonworkability.
- woodenpowderinconcretethatmakesthestructuremorelight inweight.
- Effectoncompressionstrength ofconcrete byusingwooden dust.
- Togiveasolutionregardingdisposalofwoodendustwhichcreatesenvironmentalpollution mainlylandfill.

## 2. LITERATUREREVIEW

**1. DIXSON JESON.P, KARTHIKEYAN.S AND MANIKANDAN.G:** Saw dust Ash (SDA)generated from rice mills is usually delivered to landfills for disposal. Using of TWD ash inconcrete is an interesting possibility for economy on waste disposal sites and conservation ofnatural resources. They analyse the possibility of using saw dust ash as a replacement in the fineaggregate (sand) for a modern concrete. The test results indicate that light weight of concrete andit is possible to manufacture concrete containing sawdust ash with characteristics similar tothose of natural fine aggregate concrete provided that the % of saw dust ash as fine aggregate(sand) is fixed to 5% respectively. The Project is observed by 5%, 10% and 15% moderatelyreplacement of Fine Aggregate with Saw Dust Ash and 25% partial replacement of Cement withSilica Powder. The 5% of Compressive Strength is more than the Conventional Concrete TargetStrength. The other percentage mix has a low Compressive and Tensile Strength this may be dueto low bulk densityof Saw Dust Ash.

**2. DILIP KUMAR ETAL :**For making the concrete blocks we are using coarse aggregate,fineaggregate,cement,waterandTWDtomixit.UsingsomepercentageofTWDinplaceof sand in concrete is used. We replace replaces 10%, 15% and 20% of TWD instead of sand whileother thingsare same.After making theconcreteblocksI amgoing tosee thedifference inweight between the originally concrete block and the TWD concrete block. The unit density ofthe concrete block is tested also. Research paper has proved that saw dust Concretecan be usedas a Structural Concrete at suitable replacement percentage .and also affects the cost of theconstruction. Based on the limited study carried out on the strengthbehavior of saw dust thefollowingconclusionsaredrawn.Attheinitialages,withtheincreaseinthepercentagereplacement of saw dust, the strength as well as compressive strength increases. Moreover withtheuseofsawdust,theweightofconcretereduces,thusmakingtheconcretelighterwhichcanbeused as alight weightconstruction materialinmanycivil engineeringpurposes.

**3. K.GOPINATH, K.ANURATHA, R.HARISUNDAR, M.SARAVANAN:** The use of sand(riversand)playsa major role inalltypeofconstruction, especially in cementconcrete&cement mortar. The ultimate aim of the saw dust concrete is to recycle the waste material fromsaw mill & utilizing in concrete ingredients in the state of partial replacement. Sequentially, theshortage of river sand is partially rectified by the replacement of TWD for the sand. So, the riversand abundantly gets destructed due to the huge consumption. To enhance the progress of riversand, we prefer a scope on saw dust concrete. In this project, we introduce two reproductive formofTWD,andwe namedasDryTWD(DSD)andTWDAsh(SDA).Dry TWDwasusedpartially

replacement for fine aggregate and TWD Ash was used for moderately replacement forcement. Dry TWD & TWD Ash were mixed with concrete separately, in this study, totally 16mortar cubes & 48 concrete cubes are casted. And these are subjected to test, such as Slump test& Compressive test, then it is compared with normal mix of concrete & mortar. Comparing thedensity and Compressive strength of different ratio of concrete and mortar is well studied andmay utilize in construction applications. TWD mortar is used as plastering and TWD Concretemayuse in structural memberlikebeam,column,etc.

**4.**

**5. KAMLESH SAINI:** Saw dust is also known as wooden dust. It is the result of cutting, drillingwood .it is composed of finearticles of wood, certain animals, birds and insects which live inwoodsuch as carpenter ant arealso responsible for producingthe wooden dust.It is produced asa small irregular chips or small garbage of wood duringsawing of logs of timber into different sizes. In this paper main objective is to study the partialreplacement of the wooden dust with the varying proportion in the concrete and to check thedifferent properties of the concrete by comparing with the normal concrete. The compressivestrength, split tensile strength and flexural strength were reduced as the wooden dust is increasedmore than 25%. We are trying to find the optimum proportion of the wooden powder by whichthe maximum strength is achieved and the concrete will have light in weight compared to thenormalconcrete andenvironment friendly.

## 3.MATERIALANDMETHODOLOGY

### 3.1 MATERIALSUSED:

**3.1.1 Teak Plant :**Teak is tall evergreen tree. It has yellowish blonde to reddish brown wood. Itattains the height of about 30 meter. The fruit is a drupe. It has bluish to white flowers. Itproduces the large leaf similar to the tobacco leaf. The bark is whitish gray in colour. It isgenerally grown straight with the uneven texture, medium lusture and the oily feel. The uppersurface of the tree is rough to touch and the inner surface has hairs. The fruit is enclosed by thebladderlikecalyx,whichislight brown, ribbed and papery.It is used in the furniture making, boat decks and for indoor flooring. It is widely used to makethe doors and house windows. It is resistant to the attack of termites. Itswood contains scentedoil which is the repellent to insects. The leaves yield the dye which is used to colour the clothesandedible. Teak isprobablythe best protected commercial species in the world.

**3.1.2**

**3.1.3 TeakWood Dust**

Teak Wood Dust (TWD) is the waste material from the timber saw mills. Where the timbers aresawed for the specific purpose and the waste powder which extract from them is called saw dust.The TWD is acquiredin abundance in tropicalcountries. ThisTWD is used asfuel limitedly.The main method of disposal is by open burning method. In some countries, the usage of TWDforthe construction has beenin process forseveralyearsago.

Fig1: Teak Wood Dust

This is the light weight material which can be carried easily. The chemical and physical properties of one tree to another tree saw dust will varies from one tree to another tree. In this project, the saw dust is carried out from sawmillin two forms

1. Powderform
2. Chipsform

The powder form wooden dust is used for replacement of fine aggregate (sand) with a treatment,this is named as Dry TWD. The chips form or skin form of TWD is used to replacement for cement after a burning process this form of TWD is named as TWD Ash.

**BENEFITS OF TEAK WOOD DUST (TWD) CONCRETE**

Woodendustconcretehasdifferentuniquepropertieswhichmakeitcompetitiveamongotherconstructionmaterials:

1. TWD concrete is made of green, ecologically pure stuff.
2. TWD Concrete controls interior humidity level.
3. TWD Concrete is frost proof.
4. TWD Concrete has favorable thermal and sound proofing properties.
5. TWD Concrete is not subject to mold and fungi.
6. TWD Concrete is light weight.
7. It is an economical alternative to conventional building concrete method and material.
8. Duet material's inert nature, it does not react with any ingredients of concrete and steel.
9. It can save labor and natural resources.
10. At the end of its initial service life, concrete can be crushed and reused as aggregate for new concrete continuing the cycle of environmental benefits.

### 3.1.4 CEMENT

Cement is a binder material due to its cohesive and adhesive property. Cement is also classifiedas hydraulic and non-hydraulic cement. Hydraulic Cement is a product used to stop water andleaks in concrete and masonry structures.It is a type of cement,same as mortar, that setsimmensely fast and hardens after it has been mixed with water. Hydraulic cement is used widelyin the construction industry sealing structures below grade and in situations where

structures canbeaffected or submergedin water.

### 3.1.5 FINEAGGREGATE:

Fine aggregates are fine particles of stones obtained by further crushing of coarse aggregate ornatural sand. Aggregatewhich passes through4.75mmsize of ISsieve are termed as fineAggregates.

### 3.1.6 COARSEAGGREGATE:

Coarse aggregates are the stone pieces which are obtained by crushing the stones in a crusher orfrom the river banks. Coarse aggregates are retained by 4.75mm of IS sieve. They are the mainconstituents of any concrete. Coarse aggregates along with fine aggregates and fluid cementtogetherform concrete.

To obtain similar strength or workability in a concrete, coarse aggregate of large sizerequireslesscementthan smaller size.By using largesize coarse aggregate heatof hydrationgetsreduced with lower cement content which results in less thermal stress and shrinkage effect on concrete. TESTONMATERIAL

### 3.2INITIALANDFINALSETTINGTIME

**(a) INITIALSETTINGTIME: (ASperIS:4031 (part5)1988)**

Initial setting time of cement experiment calculate duration in which cement loses its plasticity.This test is to be conducted on the same mould in continuation. This test is to be conducted todeterminethetotaltimetakenforthesettingofcement.Aftertheinitialsettingofcementis complete minor external disturbances will not produce any change in the shape of concrete.Initialsettingtime should not beless than 30 minutes.

**(b) FINALSETTINGTIME: (As perIS: 269-1958)**

Final setting time is that time period between the time water is added to cement and the time atwhich1mmneedlemakesanimpressiononthepasteinthemouldbut5mmattachmentdoesnot makeanyimpression.

Thistimeshould notbemorethan10 hours whichis referred toasfinal settingtime.

Prepare a paste of 300gm of cement with 0.85 times the water required to a give a paste ofstandardconsistencyIS 4031(part 4)1988.

### 3.3 IMPACTTEST:

Aggregate impact value is the ratio between the weights of the fine passing 2.36 mm in sieve andthe total sample. It is the resistance of an aggregate to sudden shock or impact. It is sometimes,usedas an alternativeto its crushingvalue.

Wetakeaggregate passing12.5mm sieveandretainedon 10mmsieves.

# 4.RESULTANDDISCUSSION

## 4.1 NORMALCONSISTENCYTEST

## 4.2

**Table1:NormalConsistencyResult**

| S.NO. | WEIGHTOF SAMPLETAKEN (g) | WATERADDED TOWGTOFCEMENT(%) | WEIGHTOFWATER ADDED | | NONPENETRATION (mm) |
|---|---|---|---|---|---|
| | | | IR | FR | |
| 1. | 30 | 26 | 40 | 28 | 12 |
| 2. | 30 | 29 | 40 | 22 | 18 |
| 3. | 30 | 33 | 40 | 13 | 27 |

**Normalconsistency= 33%.**

**Table2.TEST RESULTSOFCEMENT**

| CEMENTTEST | RESULT |
|---|---|
| Fineness Test | 5.8% |
| Consistency Test | 33% |
| Initial Setting Time | 30min30 Sec |
| Final Setting Time | 10 Hours |

## 4.3 RESULTOFCOURSEAGGREGATETEST:

### 4.2.1 BULKDENSITY TEST

Weight of compacted aggregate = 4760 Kg

Volume of container $=3X10^{-3}m^3$

Bulkdensity of aggregate $= \frac{weightofcompactedaggregate}{volumeofcontainer}$

$= \frac{4760}{3X10^{-3}}$

**Bulkdensityof aggregate =1587Kg/m$^3$**

### 4.2.2 SPECIFICGRAVITYOFCOURSEAGGREGATE

Weightof basket ($W_1$) =2.522Kg

Weightofbasket withcourseaggregate ($W_2$) = 5.370

KgWeightof basket with courseaggregate in water($W_3$) =

6.83KgWeightof basket in water ($W_4$) = 5.13Kg

SpecificGravity $= \frac{W2-W1}{W1)-(W3-W4)^{(W2-}}$

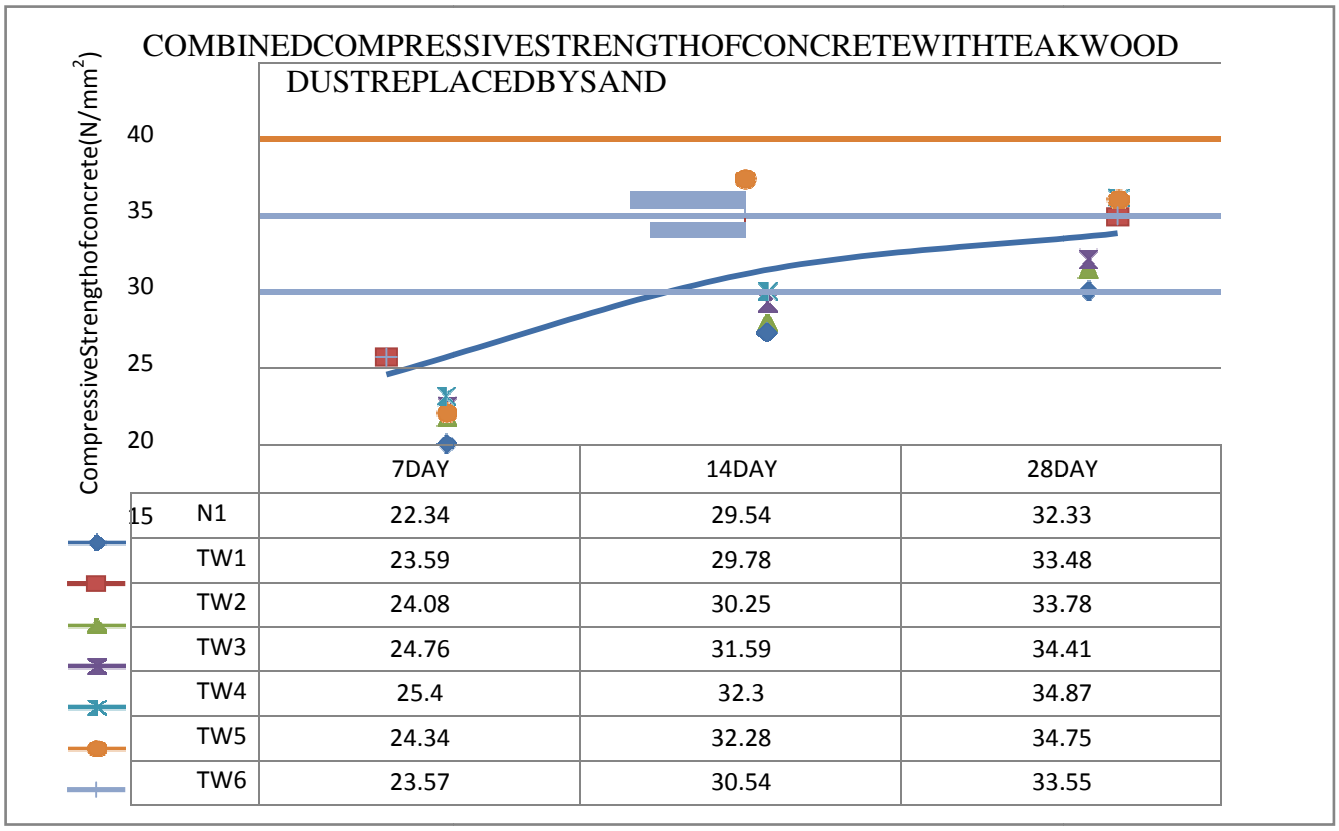
$= \frac{5.370-2.522}{(5.370-2.522)-(6.83-5.13)}$

**SpecificGravity =2.48**

## 4.4 COMBINEDCOMPRESSIVESTRENGTHTESTRESULT

The cement is replaced with the alternative material Saw Dust in various quantity such 0%,5%, 10%, 15%,20%,25%and30%toimprovethe strength.The CompressiveStrengthare 32.33MPa,33.48MPa,33.78MPa,34.41MPa,34.87MPa,34.75MPaand33.55MPa,for $N_1$, $TW_1$, $TW_2$, $TW_3$, $TW_4$, $TW_5$and $TW_6$respectively at 28th day of curing.Themaximum Compressive Strength gained in the ratio of $TW_4$, the strength is 24.23MPa,32.30MPa and 34.87 MPa at 7th, 14th and 28th day of curing which is more than controlledconcrete 'N1' that is 22.34 MPa, 29.54 MPa and 32.33 MPa at 7th , 14th and 28th day ofcuring respectively. It indicates that the Compressive Strength increases upto a certain limitfurtherit starts decreasing.




| | 7DAY | 14DAY | 28DAY |
|---|---|---|---|
| N1 | 22.34 | 29.54 | 32.33 |
| TW1 | 23.59 | 29.78 | 33.48 |
| TW2 | 24.08 | 30.25 | 33.78 |
| TW3 | 24.76 | 31.59 | 34.41 |
| TW4 | 25.4 | 32.3 | 34.87 |
| TW5 | 24.34 | 32.28 | 34.75 |
| TW6 | 23.57 | 30.54 | 33.55 |

**Graph 1 :**Combined Compressive Strength of Concrete withteak wood dust replaced bysand

## 4.5 COMBINEDSPLITTENSILE STRENGTHTESTRESULT

The cement is replaced with the alternative material Saw Dust in various quantity such 0%,5%, 10%, 15%, 20%, 25% and 30% to improve the strength. From graph 2 it is observedthattheSplitTensileStrengthare2.48MPa,2.72MPa,2.94MPa,3.14MPa,3.39MPa,

3.08 MPa and 2.76 MPa, for $N_1$, $TW_1$, $TW_2$, $TW_3$, $TW_4$, $TW_5$ and $TW_6$ respectively at 28thday of curing. The maximum Split Tensile Strength gained in the ratio of TW4, thestrength is 1.50 MPa, 1.97 MPa and 3.39 MPa at 7th, 14th and 28th day of curing which ismore than controlled concrete 'N1' that is 0.94 MPa, 1.58 MPa and 2.48 MPa at 7th , 14thand 28th day of curing respectively. It indicates that the Split Tensile Strength increasesuptoa certain limit further it starts decreasing.


| | 7DAY | 14DAY | 28DAY |
|---|---|---|---|
| N1 | 0.94 | 1.58 | 2.48 |
| TW1 | 1.08 | 1.66 | 2.72 |
| TW2 | 1.40 | 1.72 | 2.94 |
| TW3 | 1.48 | 1.84 | 3.14 |
| TW4 | 1.5 | 1.97 | 3.39 |
| TW5 | 1.34 | 1.68 | 3.08 |
| TW6 | 0.89 | 1.49 | 2.76 |

**Graph2:**Combined Split Tensile Strength of Concrete with teakwood dust replaced by sand

## 5.Conclusion and Discussion

Fromthetestresults,graphsandtherelativechemicalcompositionofthespecimenanumberofconclusi onscan bedrawn. The conclusions drawn are:

1. From the test result it is observed that the Workability of concrete with partial use of teakwood increases upto a limit than it decreases. The workability is in increasing order upto20%of sand replaced withTeak wood.
2. The Compressive Strength of partially replaced sand by teak wood in concrete of grade M20forproportionsof0%,5%,10%,15%,20%,25%and30%are32.33MPa,33.48MPa, 33.78 MPa, 34.41MPa, 34.87 MPa, 34.75 MPa and 33.55 MPa respectively at 28th day

ofcuring.The Compressive Strength increases upto 20% of use of teak wood further it startsdecreasing.

3. The Split Tensile strength of partially replacedsand by teak wood in concrete of grade M20for proportions of 0%, 5%, 10%, 15%, 20%, 25% and 30% are 2.43MPa, 2.72MPa,2.94MPa, 3.14MPa, 3.39MPa, 3.08MPa and 2.76MPa respectively at 28th day of curing.TheSplittensileStrengthincreasesupto20%use ofteakwoodfurtheritstartsdecreasing.
4. With the use of 20% of teak wood in concrete gives the maximum result in compression as25.40MPa,32.3MPaand34.87MPaat7thday,14thdayand28thdayofcuringrespectively.
5. With the use of 20% of teak wood gives the maximum result in Split Tensile Strength as1.5MPa,1.97MPaand 3.39MPaat 7thday, 14th dayand 28th dayofcuringrespectively.
6. Water absorption capacity increases with increasing percentage of wooden powder. Largerabsorptionof water causes the reduction in thestrength.
7. Teak wood is obtained at very low no cost, the cost of concrete can potentially be reduced by replacings and with TWD in concrete.

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