International Journal of
AI ELECTRICAL CIVIL AND MECHANICAL ENGINEERING
Peer Reviewed, Referred & Indexed Journal
ISSN: 3070-0434 www.zesterapublications.com Original Research Paper

EXPERIMENTAL STUDY ON STRENTHENING OF CONCRETE BY REPLACING TURRITELLA AND BENTONITE

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ABSTRACT

Self-compacting concrete, also referred to as self-consolidating concrete, is in a position to go with the flow and consolidate under its personal weight and is de-aerated almost definitely whilst flowing in the formwork. It is cohesive enough to fill the spaces of almost any size and structure barring segregation or bleeding. This makes SCC in particular really helpful at any place putting is difficult, such as in heavily-reinforced concrete contributors or in complex work forms. The goals of this lookup is blended effects of turritella and bentonite included in self-compaction concrete in order to make bigger in strength and a higher bonding between combination and cement paste. SCC has an advantage over conventional concrete in that it can be easily placed without vibration or mechanical consolidation. The properties of SCC have been studied in many researches due to its importance and ability to solve the problems of concrete mix.

Turritella and bentonite is used to replace cement in stepped concentration of 0 %, 5%, 10%, 15%, and used to gain characteristic compressive strength of M30 grade concrete mix and cured normal water and nitric acid solution (HNO3) in for different ages (7 days and 28 days) were determined. Nitric acid used for the curing of normal water in the concentration of 1% and 5%.This lookup is aimed to look at the degradation of self- compacting concrete (SCC) due to nitric acid assault particularly based totally on measurement of compressive energy loss. The outcomes of excessive extent turritella and bentonite at 0% to 15% cement substitute degrees on the extent of degradation to nitric acid will be assessed in this study. Trial mixes with the various water cement ratio, substitute percentage, extent of notable plasticizer and viscosity bettering agent, have been equipped and tested. The test results for acceptance characteristics of self- compacting concrete such as slump flow and T50cm, V-funnel, T5 minutes and L-Box are presented.

Keywords: Bentonite, Compressive strength, Nitric acid, Super plasticizer, Self- compacting concrete, turritella

I. INTRODUCTION

GENERAL

Self-compacting concrete (SCC) is a new kind of high-performance concrete (HPC) developed in Japan in 1986. The development of SCC has made casting of dense reinforcement and mass concrete convenient. Fresh self-compacting concrete SCC flows into formwork and around obstructions under its own weight to fill it completely and self-compact (without any need for vibration), without any segregation and blocking. SCC mixes generally have a much higher content of fine fillers, including cement, and produce excessively high compressive strength concrete, which restricts its field of application to special concrete only.

Self-compacting concrete has been successfully used in Japan, Denmark, France, U.K., etc. It is widely been accepted because of its enhanced properties also it reduces noise pollution, saves time, labour and energy.

Cement used in concrete is a mixture of complex compounds. Cement is a major industrial commodity that is manufactured commercially in over 120 countries. Mixed with aggregates and water, cement forms the ubiquitous concrete which is used in the construction of buildings, roads, bridges and other structures. In countries, even where wood is in good supply, concrete also features heavily in the construction of residential

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buildings. Production of concrete using Portland cement is popular all over the world. This is due to mainly low cost of materials and construction for concrete structures as well as low cost of maintenance. But high amount of energy is required for manufacturing of cement which emits carbon dioxide (CO_2) which is very harmful for the environment. In order to minimize this problem, we use the concept of supplementary cementitious material. Some of agricultural and industrial waste ash which was fulfilled the criteria as supplementary cementitious materials. With the addition of turritella and bentonite weight density of concrete reduces by 72- 75%. Thus, the use of turritella and bentonite in concrete leads to around 8-12% saving in material cost. So, the addition of turritella and bentonite in concrete helps in making an economical concrete. Under the acid attack also turritella and bentonite concrete shows better compressive than the normal concrete.

An experimental study on mechanical properties, such as compressive strength, flexural strength of self-compacting concrete (SCC) and the corresponding properties of self-compacting concrete were studied. The age at loading of the concretes for 7- and 28-days curing.

Making concrete structure without compaction has been done in the past. Like placement of concrete underwater by the use of term i.e., without compaction. Inaccessible areas were concreted using such techniques. The production of such mixes often used expensive admixtures and very large quantity of cement. But such concrete was generally of lower strength and difficult to obtain. SCC is a high-performance concrete that consolidates under its self-weight, and adequately fills all the voids without segregation, excessive bleeding or any other separation of materials, without the need of mechanical consolidation.

1.1 Acid attack on concrete

Acid attack on concrete is the slow, corrosive whisper of chemicals that dissolve the very glue holding the material together. Concrete is largely made of calcium hydroxide, calcium silicate hydrates, and calcium carbonate—all of which react unfavourably with acidic substances. When acids come into contact with concrete, they begin pulling calcium out of the matrix, like a thief stealing the spine of the structure. This leads to softening, loss of mass, surface erosion, cracking, and gradual disintegration**.**

Common agents include sulphuric acid, which forms expansive gypsum; hydrochloric and nitric acids, which dissolve calcium compounds rapidly; and carbonic acid, which causes long-term carbonation. Industrial floors, sewage systems, drains, chemical plants, and wastewater facilities are particularly vulnerable because acids may linger there like an unwelcome fog. Over time, the concrete becomes powdery, breaks down, and loses its structural integrity. Protective coatings, dense mixes, low-permeability concrete, and the use of supplementary materials like fly ash, silica fume, and slag can help shield concrete from this chemical unravelling.

- Concretes made of Portland (OPC) are highly alkaline with pH values normally above 12.5 and are not easily attacked by acidic solutions.
- As the pH of the solution decreases the equilibrium in the cement matrix is being distributed, and the hydrated cement compounds are specially altered by hydrolytic decomposition which leads to the severe degradation of the technical properties of the material.
- At pH values lower than 12.5 portlandite is the first constituent starting dissolution.
- The final reaction products of the acid attack are the corresponding calcium salts of the acid as well as hydrogels pf the silicium, aluminium, and ferric oxides.
- The solubility of Al_2O_3 .aq, and Fe_2O_3 depends on the pH value of the acting

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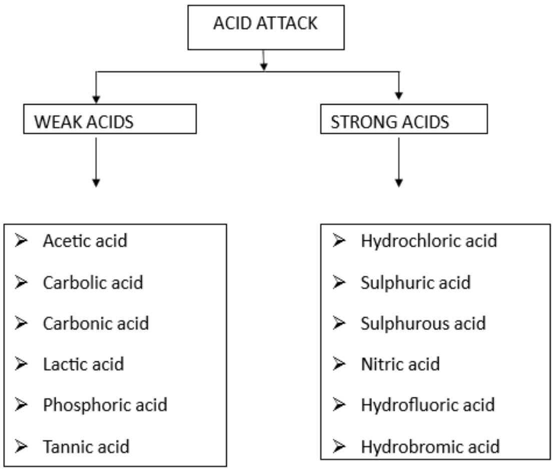
solution, while SiO2 is insoluble in acidic solutions except in HF.

Types of acids which attack on concrete



1.2 SULPHURIC ACID ATTACK:

- Sulphury acid attack causes extensive formation of gypsum in the regions close to the surfaces, and tends to cause disintegrating mechanical stresses which ultimately lead to spalling and exposure of the fresh surface.
- Owing to the poor penetration of sulphuric acid, the chemical changes of the cement matrix are restricted to the regions close to the surfaces.
- However, in some cases it is observed that deterioration process occurs accompanied by the scaling and softening of the matrix due to the early decomposition of calcium hydroxide and the subsequent formation of large amount of gypsum.
- The chemical reactions involved in sulphuric acid attack on cement-based materials.

1.3 NITRIC ACID ATTACK:

- Nitric acid usually occurs in chemical plants producing explosives, artificial manure and similar products.
- Nitric acid can be formed from the compounds and radicals of nitrates in the presence of water.
- Though HNO_3 is not as strong as H_2SO_4, its effect on concrete at brief exposure is more destructive since it transforms CH into highly soluble calcium nitrate salt and low soluble calcium nitro-aluminate hydrate.
- Pavlik reported that the corroded layer developed by the action of nitric acid solution with concentrations ranging between 0.025 to 0.5 mol 1-1 is soft, and porous with visible cracks.
- Nitric acid attack is a typical acidic corrosion for shrinkage of the corroded layer due to leaching of highly soluble calcium nitrate.
- Such volume contractions of the corroded layer, especially for the case of nitric acid, can result in the formation of visually observable cracks across the corroded layer.
- In the presence of these cracks the transport rate of acid and corrosion products to and from the corrosion front increases and this accelerates the process of deterioration

1.4 ACETIC ACID ATTACK:

- Concrete in use in agricultural applications may be attacked by the silage effluents containing mainly acetic and lactic acid.
- Acetic acid reacts with cement hydration products to form calcium acetate.
- Attack by Acetic acid resembles the process of corrosion in nitric acid. However, the growth of the corroded layer in solutions of acetic acid is relatively slower than that in the same concentrations of nitric acid solution.
- The chemical composition of the corroded layer is different from that in nitric acid solution of the same concentration due to higher pH values of the acetic acid solution, and due to its buffering effect in corroded layer.
- In lower concentrations of both acetic and nitric acid solutions, e.g. 0.025 mol 1-1, results in the formation of an additional zone, called as core-layer, which is relatively hard and located behind the corroded layer.

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- Chemical compositions of the core layers in both acetic and nitric acid attacks are similar.
- Core-layer originates due to portlandite dissolution in unaffected part of the cement paste and diffusion of Ca^{2+} and OH- ions towards corrosion zone where they meet the acid diffusing from the opposite direction.
- Formation of the core layer is noticeable only when the concentration of acid is low because in such a case the rate of diffusion of ions from the acidic solution is high enough to dissolve portlandite, but not sufficiently high to decalcify the other hydrates.

1.5 HYDROCHLORIC ACID ATTACK:

- The chemicals formed as the products of reaction between hydrochloric acid and hydrated cement phases are some soluble salts and some insoluble salts.
- Soluble salts, mostly with calcium, are subsequently leached out, whereas insoluble salts along with amorphous hydro gels, remain in the corroded layer.
- Besides dissolution, the interaction between hydrogels may also result in the formation of some Fe-Si, A1-Si, Ca-Al-Si complexes which appear to be stable in pH range above 3.5.
- The reaction essentially causes leaching of from the set cement.
- After leaching out of C-S-H and ettringite start to decompose, with release of Ca^{2+} to counteract the loss in and the set cement starts to disintegrate accelerating the dissolution.
- There are few indications through experiments about the formation of Friedel's salt, $C3a.CaC_{12}.10H_2O$, by the action of CaC_{12}, formed due to reaction of HCL with CH and C3a.
- Hydrochloric acid attack is a typical acidic corrosion which can be characterized by the formation of layer structure.
- Chandra divided the cross section of damaged prisms into three main zones; undamaged zone, hydroxide mixture zone or brown ring, and attacked zone.
- By hydroxide mixture zone, he referred to a layer formed by undissolved salts seen as a dark brown ring.

II. LITERATURE REVIEW

R.Venu , B.suraj ,G.VenkataRamana (2018):
The characteristics of SCC have been studied in many researches due to its importance and ability to solve the problems of concrete mix. Turritella and bentonite and sugarcane bagasse ash (SCBA) is used to substitute cement in s percentages of 0 %, 5%, 10%, 15%, 20% and used to obtain characteristic compressive strength and cured ordinary water and nitric acid solution (HNO_3) in for exclusive a long time (7days, 28days) is to be determined. Nitric acid used for the curing in the attention of 1%, 3%, 5%. This research is to look into the degradation of self-compacting concrete due to assault of nitric acid based totally on measurement of compressive strength loss. The take a look at consequences want to be should acceptance the characteristics of self-compacting concrete such as slump flow, V-funnel, U-box and Box are presented and cured in 1% of acid solution.

B.Ranganath, G.Sailaja Kumari (2018):
In this study the past decades covered the Sulphate attacks from different aspects to improve the resistance of concrete to acid attacks, used mineral additives such as Fly ash and Silica fume. In this study, the different admixtures were used to study their sole and combined effects on the resistance of concrete in addition to their effects on mechanical and durability properties by the replacement of admixtures by 10%, 20% & 30% by the weight of cement. Here 5% of HNO_3 used.

Sagar W. Dhengare, Dr.S.P.Raut, N.V.Bandwal, Anand Khangan (2015):
The utilization of industrial and agricultural waste produced by industrial processes has

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been the focus on waste reduction. Ordinary Portland cement (OPC) is partially replaced with finely sugarcane bagasse ash. The concrete mixtures, in part, are replaced with 0%, 10%, 15%, 20%, of SCBA respectively. In addition, the compressive strength, the flexural strength, the split tensile tests were determined. The mix design used for making the concrete specimens was based on previous research work from literature. The water –cement ratios varied from 0.44 to 0.63. The tests were performed at 7, 28, 56 and 90 days of age in order to evaluate the effects of the addition SCBA on the concrete. The test result indicates that the strength of concrete increase up to 15% SCBA replacement with cement.

K Meeravali, K V G D Balaji, T. Santhosh Kumar (2014):

They studied on, "Partial replacement of Cement in Concrete with bentonite behavior in HNO_3 Solution". In this paper concrete cubes are casted with different percentages of Sugarcane Bagasse ash replaced with cement by weight (i.e. 0%, 5%, 10%, 15%, 20%, and 25%), and these cubes are exposed to 5% HNO_3 environment. Compressive strength of cubes for 7days, 28 days and 60days are observed.

Divyachopra et al (2015):

Carried out a study on strength, permeability and micro structure of self-compacting concrete containing Turritella and bentonite. The cement is replaced by Turritella and bentonite as supplementary cementations material. SCC was tested for fresh and hardened state for four different mixes. The Turritella and bentonite is replaced by cement by varying percentages from 0, 10, 15 and 20. To improve the workability high range water reducer super plasticizer is used up to 25% without loss of workability. By the replacement of 15% Turritella and bentonite shows good workability and up to 33% of strength increased. The replacement increased to 20% the strength decreased but 20%Turritella and bentonite mix shows increase in porosity, but it is still less than the control mix. In this study porosity decreased with increases in age. This is basically due to large formation of C-S-H gel, dense structure is formed, so porosity decreased. From XRD and SEM analysis shows the formation of C-S-H gel at the replacement of 15% Turritella and bentonite concrete helps increase in compressive strength. Pores and cracking were at maximum for the control mix.

Kannan et al (2013):

Carried out an experiment of chloride and chemical resistance of self-compacting concrete using Turritella and bentonite and Metakaolin (MK) as filler materials and replacement of cement. Seventeen different mixes for various proportions were designed including ordinary SCC and tested for suitability. The percentage replacement of Turritella and bentonite and MK adopted in this study were 5%, 10% 15%, 20%, 25% and 30% in separate and combined percentage replacement of Turritella and bentonite and MK were 5%, 10%, 15% and 20% with the addition of super plasticizer (SP). The fresh state is tested for all mix and the flow properties are observed. From the results it was observed that compressive strength increased at a replacement of 15% (Turritella and bentonite), 20% and 30% (MK) in combination of both. The durability test to determine the acid resistance is carried out by immersing the cube in H_2SO_4 solution, the result shows that there is a better improvement during individual replacement of Turritella and bentonite and MK at 25% and 5% respectively and 40% of combination of turritella and bentonite and MK. The SEM analysis clearly states that there were no pores while Turritella and bentonite and MK are combined together.

III. DATA COLLECTION

MATERIALS USED IN THE PRESENT WORK

Self-compacting concrete has material requirements same as standard concrete, but it requires admixtures like turritella and bentonite

Received: 06-03-2026 | Accepted: 14-04-2026 | Published: 20-04-2026

International Journal of
AI ELECTRICAL CIVIL AND MECHANICAL ENGINEERING
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ISSN: 3070-0434 www.zesterapublications.com Original Research Paper

to enhance the workability. Type of materials required and their applications and properties for self-compacting concrete are discussed. The super plasticizer and nitric acid also discussed in the present project. The materials used in the present work are cement, fine aggregate, coarse aggregate, turritella and bentonite nitric acid, super plasticizer.

Following are the materials used for the self-compacting concrete. They are

CEMENT

Cement is a binding agent, typically a fine powder made from limestone, clay, and other materials, that hardens when mixed with water to bind aggregates like sand and gravel together. This process creates mortar and concrete, which are essential for construction, and it is used to bind stones, bricks, and other building units, fill gaps, and secure infrastructure.

Turritella and bentonite admixture used in the replacement of cement in the percentages of 0%, 5%, 10%, 15%, and 20%.The cement used was ordinary Portland cement (OPC) of 53 grades. It is made from a mixture of lime stone ($CaCO_3$) and clay, shale, other alumina silicate. The initial setting time OPC is 30 minutes (minimum) and final setting time is 600 minutes (maximum). The chemical compositions of OPC are

CaO	60-67%
SiO2	17-25%
Al2O3	3.0-8.0%
Fe2O3	0.5-6.0%
MgO and SO_3	0.1-4.0% and 1.3- 3.0%
Alkalis (K2O, Na2O)	0.4-1.3%

FINE AGGREGATE

- Fine aggregate is granular material, primarily sand or crushed stone, with particles smaller than 4.75mm that are used in construction. It plays a critical role in concrete, mortar, and plaster by filling the voids between larger, coarse aggregate particles, which increases density, enhances workability, and improves the overall strength and durability of the final product
- The river sand, passing through 4.75mm sieve and retained on 600µm sieve, conforming to Zone II was used as fine aggregate in the present study.
- The sand is free from clay, silt and organic impurities. The aggregate was tested for its physical requirements such as gradation, fineness modulus, and specific gravity and bulk modulus.
- Fine mixture normally consists of natural, crushed, or manufactured sand. Natural sand is the traditional issue for everyday weight concrete.
- In some cases, manufactures light weight particles are used for mild weight concrete and mortar. Heavy weight particles made of metallic elements are now and again used to produce heavy weight concrete for nuclear protective purposes.

COARSE AGGREGATE

- Coarse aggregate refers to larger, granular materials like crushed stone

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or gravel, used in concrete to provide strength and volume.

- It typically refers to particles larger than 4.75mm, and its size, shape, and quality significantly impact the final properties of the concrete mix.
- Coarse aggregates are sourced from natural deposits or produced by crushing rock and must be properly cleaned and graded for optimal performance.
- A Machine crushed angular granite metal of 12mm nominal size from the local source is used as coarse aggregate.
- It is free from impurities such as dust, clay particles and organic matter etc. It is an important compound of concrete. It decreases the shrinkage and economical of the structures.
- Coarse aggregates can be normal weight, light weight or heavy weight in nature. Normal weight coarse aggregates can be made of herbal gravel or beaten stone. Light weight coarse aggregate is generally made of increased clay such as shale, pumice or blast furnace slag.

WATER

- Water, a compound with the chemical formula H_2O, is an inorganic substance essential for life that exists as a liquid, solid (ice), and gas (steam).
- It is a transparent, odourless, and tasteless liquid at room temperature that is the main constituent of Earth's oceans, lakes, and rivers, as well as the fluids of all living organisms.
- Its properties, such as high polarity and the ability to act as a "universal solvent," are crucial for biological processes and regulating Earth's climate.
- The water used for the study was obtained from a free-flowing stream. The water was clean and free from any visible impurities. The pH value should not be less than 6.
- Water used in this work is found to be free from oils, acids, alkali, salts, sugar and organic matter. Portable water is used to combine more than a few mortars and concretes. The equal water is also used for curing.

IMPORTANCE OF WATER

Water that can be used in the concrete work has to have the following properties:

- It should be free from injurious quantity of acids and alkalis or other such natural and inorganic impurities.
- It ought to be free from injurious quantity of oils.
- It has to be free from iron, vegetable count number or any different substance that can have an unfavorable impact on the concrete and reinforcement.
- It should be in shape for ingesting purpose.

TURRITELLA AND BENTONITE

Turritella and Bentonite is obtained by burning turritella and bentonite in a controlled manner without causing environmental pollution.

When properly burnt, it has high SiO_2 content and can be used as a concrete admixture. Turritella and Bentonite exhibits high pozzolanic characteristics and contributes to high strength and high impermeability of concrete.

The chemical composition of turritella and bentonite is found to vary from one sample to another due to the differences in the type of paddy, crop year, climate and geographical conditions

Turritella and bentonite are distinct natural materials—Turritella refers to a type of marine snail with coiled shells, while bentonite is an absorbent clay mineral formed from volcanic ash. When combined and burned in a controlled manner, they can be used as a pozzolanic admixture in concrete to improve its strength and impermeability.

Turritella

- **What it is:** A genus of medium-sized marine sea snails with tightly coiled shells.
- **Composition:** Primarily composed of calcium carbonate (from the shells).
- **Form:** Found as fossils in various geological formations, sometimes referred to as "turritella rock" or "turritella shale"

Bentonite

- **What it is:** An absorbent, swelling clay, most commonly consisting of the mineral montmorillonite.
- **Formation:** Typically forms from the weathering of volcanic ash in seawater.
- **Properties:** Has a high capacity to absorb water and swell, which makes it useful in various industrial applications, such as drilling mud, thickeners, and landfill liners

NITRIC ACID (HNO_3)

- ✓ Nitric acid or muriatic acid is a colorless inorganic chemical system with the formula $H_2O:HNO_3$. Nitric acid has a distinctive pungent smell.
- ✓ It is classified as strongly acidic and can attack the skin over a wide composition range, since the hydrogen chloride completely dissociates in an aqueous solution. Nitric acid is the simplest chlorine-based acid system containing water. It is a solution of hydrogen chloride and water, and a variety of other chemical species, including hydronium and chloride ions. It is a naturally-occurring component of the gastric acid produced in the digestive systems of most animal species, including humans.
- ✓ It is an important chemical reagent and industrial chemical, used in the production of polyvinyl chloride for plastic. In households, diluted Nitric acid is often used as a decaling agent. In the food industry, nitric acid is used as a food additive and in the production of gelatin.
- ✓ Nitric acid is also used in leather processing. The HNO3 adding water in the curing tank in the percentages of 1% .

SUPER PLASTICIZER

Superplasticizers (SPs), also known as high-range water reducers (HRWRs), are additives used for making high-strength concrete or to place self-compacting concrete. Plasticizers are chemical compounds enabling the production of concrete with approximately 15% less water content. Superplasticizers allow reduction in water content by 30% or more. These additives are employed at the level of a few weight percent. Plasticizers and superplasticizers also retard the setting and hardening of concrete.

Complect sps 430 in liquid structure with 65% free water is used. High range water reducing admixture called as super plasticizers are used for improving the flow or workability for decreased water-cement ratio without sacrifice for compressive strength. These admixtures when they disperse in cement agglomerates significantly decrease a viscosity of the paste by forming a thin film around the cement particles.

A superplasticizer is a chemical admixture used in concrete to improve its workability, strength, and durability. By dispersing cement particles, it makes the concrete more fluid and easier to place without increasing water content. This allows for the creation of high-strength concrete, reduced water-cement ratios, and can be beneficial for projects with complex designs or difficult access.

USES OF TURRITELLA AND BENTONITE

Turritella and bentonite are primarily used together in the construction industry as

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admixtures in concrete to create lightweight concrete with reduced weight density and cost savings. Bentonite also has other uses, including as a drilling mud, a waterproofing agent, and an ingredient in cosmetics and ceramics, while Turritella's primary modern use is in construction as a pozzolanic additive, though sometimes associated with decorative stones like Turritella Agate.

Concrete & Cement Products – Bentonite enhances workability and reduces cracking. Foundry Sand Molds – Essential for shaping metal parts in casting.

- Impermeable Dams & Dike Cores – Creates barriers to control water flow
- Turritella and Bentonite is used in concrete improvement as a choice of cement inconcrete.
- Due to the increasing charge of environmental air pollution and the considerationof sustainability issue have made the thought of utilizing turritella and bentonite.
- They have a very low bulk density of ninety to 150kg/m3. These penalties in anextended price of dry volume.
- The turritella and bentonite itself has a very rough surface which is abrasive in nature. These are for this cause resistant to herbal degradation.

PROPERTIES OF CONCRETE WITH TURRITELLA AND BENTONITE

The turritella and bentonite itself has a very hard surface which is abrasive in nature.These are consequently resistant to natural degradation. This would end result in improper disposal problems. So, a way to use these by-products to make a new productis the first-rate sustainable idea. Among all industries to reuse this product, cement, and concrete manufacturing industries are the ones who can use turritella and bentonite ina better way. The turritella and bentonite has true reactivity when used as a partial substitute for cement. These are distinguished in nations the place the rice production is abundant. The properly turritella and bentonite are located to be active inside the cement paste. So, the use and sensible utility of turritella and bentonite for concrete manufacturing are important.

The following homes of the concrete are altered with the addition of turritella and bentonite :

- The warmth of hydration is reduced. This itself help in drying shrinkage and facilitate durability of the concrete mix.
- The discount in the permeability of concrete structure. This will assist in penetration of chloride ions, hence warding off the disintegration of the concrete structure.
- There is a higher make bigger in the chloride and sulphate assault resistance.
- The turritella and bentonite in the concrete react with the calcium hydroxide to deliver greater hydration products.

IV. ANALYSIS AND RESULTS

Design mix concrete is the type of concrete used in the construction to produce the grade of concrete having the required workability and characteristic strength nominal mix will reduce the cement content which is used in the concrete reduce the water cement ratio also will increase the strength. The test results of M30 grade self-compacting concrete cubes were tested in the different percentages like 0%, 5%, 10%, 15%, exposed to nitric acid solution in the concentration of 1% and 5%.The admixtures such as turritella and bentonite is combined used in the various percentages of 0%, 5%, 10%, 15% and super plasticizer added in the concrete because of reduce the water content will increase strength. The graphical representation of compressive strength for 7 days and 28 days is discussed. The different tables show the compressive strength percentage of admixtures such as turritella and bentonite will produce compressive strength N/mm2

Table 5.1 Mix proportions of M30 grade SCC

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Type of concrete	Cement (Kg/m^3) 440	Fine aggregate (kg/m^3) 503.04	Coarse aggregate (kg/m^3) 739.68	Water (kg/m^3) 220	Superplasticizer 0.20%
SCC	1	1.14	1.68	0.5	0.20%

To design and produce mix proportions for self-compacting concrete (SCC). The characteristic compressive strength of M30 grade design mix concrete was used. The mix proportions of self-compacting concrete were 0.5:1.00:1.14:1.68 (cement: FA: CA: water) by weight. The super plasticizer was 0.2% used in this mix proportions as shown in table 14

Table 5.2 Fresh concrete properties of M30 grade SCC

	Slump Flow (mm)	T50 (sec)	V- funnel (sec)	T5 minutes	L-Box
Test results	705	3.8	9	11	0.95

The self-compacting concrete has the properties such filling ability, passing ability and resistance segregation. Various workability test methods are available for self-compacting concrete such as slump flow, T50cm, V- Funnel, and L- Box as shown in Table 6.2. The workability test results of slump flow = 705mm, T50cm = 3.8sec, V- Funnel = 9sec, T5 minutes = 11sec, and L-Box = 0.95 as shown in Table 6.2

Table 5.3 Compressive strength results for cubes cured in water after 7 days

% of Turritella and Bentonite	Load (KN)		Area (mm^2)	Average load (KN)	Compressive Strength (N/mm^2)
	T1	T2			
0%	400	380	22500	390	16.81
5%	320	360	22500	340	15.1
10%	320	280	22500	300	13.3
15%	318	279	22500	297	13.2

The test results of compressive strength after cured in water for 7 days with various combined percentages of rice husk ash such as 0%, 5%, 10%, 15% and produced target mean of the compressive strength for 7 days at 0% is 26.81N/mm2 and 20% is 23.25N/mm2. The loads of cubes were tested in different trials such T1, T2 calculated average load find out average compressive strength (N/mm2). The graphical representation of compressive strength for 7 days plotted between horizontal axis taken combined percentage of rice husk ash and vertical axis taken as target mean compressive strength (N/mm2). The graph represented by the line with various combined percentages of RHA such as 0%, 5%, 10%, 15% and compressive strength (N/mm2) as shown in figure 14

Table 5.4 Compressive strength results for cubes cured in water after 28 days

% of Turritella and Bentonite	Load (KN)		Area (mm^2)	Average load (KN)	Compressive Strength (N/mm^2)
	T1	T2			
0%	880	900	22500	890	39.10
5%	680	720	22500	700	31.12
10%	610	650	22500	650	28.65
15%	580	620	22500	600	26.22

The test results of compressive strength after cured in water for 28 days with various combined percentages of rice husk ash such as 0%, 5%, 10%, 15% produced target mean of the compressive strength for 28 days at 0% is 39.10N/mm2 and 15% is 26.22N/mm2. The loads of cubes were tested in different trials such T1, T2 calculated average load find out average compressive strength (N/mm2).

The graphical representation of compressive strength for 28 days plotted between horizontal axis taken cd percentage of rice husk ash and vertical axis taken as target mean compressive strength (N/mm2). The graph represented by the line with various percentages of RHA such as 0%, 5%, 10%, 15% and compressive strength (N/mm2) as shown in figure 15

Table 5.5 Compressive strength results for cubes exposed to 1% by volume of HNO3 solution after 28 days

% of Turritella and Bentonite	Load (KN)		Area (mm^2)	Average load (KN)	Compressive Strength (N/mm^2)
	T1	T2			
0%	700	740	22500	720	32.15
5%	630	670	22500	650	28.15
10%	580	620	22500	600	26.66
15%	520	580	22500	550	24.66

The test results of compressive strength for cubes exposed to 5% by volume nitric acid solution after cured in water for 28 days with various combined percentages of rice husk ash such as 0%, 5%, 10%, 15% produced target mean of the compressive strength for 28 days at 0% is 23.34N/mm2 and 15% is 16.11N/mm2. The loads of cubes were tested in different trials such T1, T2 calculated average load find out average compressive strength (N/mm2).

The graphical representation of compressive strength for 28 days plotted between horizontal axis taken combined percentage of turritella and bentonite vertical axis taken as target mean compressive strength (N/mm2). The graph represented by the line with various percentage of turritella and bentonite such as 0%, 5%, 10%, 15% and compressive strength (N/mm2) as shown in figure 16 .

V. DISCUSSIONS OF RESULTS

International Journal of
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- Total 30 cubes were cast of which one fourth were placed in normal water, another one fourth were placed in 1% and 2% nitric acid solution.
- Four samples from each environment were tested at the age of 7, 28 days respectively. The results are presented graphically below. Graph 1 to 4 represent the compressive strength of concrete specimens with cement replacement level by 0%, 5%, 10%, 15% by Turritella and Bentonite respectively cured in normal water and indifferent percentages of nitric acid solution. From all graphs it is seen that the compressive strength increases with the age of days.
- The test results of compressive strength after cured in water for 7 days and28 days with various percentage of Turritella and Bentonite such as 0%, 5%, 10%, 15% and produced target mean of the compressive strength for 7 days and 28 days at 0% are16.81 mm2, 39.10N/mm2 and 15% are 14.22N/mm2, 26.22N/mm2. The loads of cubes were tested in different trials such T1, T2 calculated average load find out average compressive strength (N/mm2).
- The graphical representation of compressive strength for 7 days and 28 days plotted between horizontal axis taken combined percentage of Turritella and Bentonite and vertical axis taken as target mean compressive strength (N/mm2). The graph represented by the line with various percentage of RHA such as 0%, 5%, 10%, 15% and compressive strength (N/mm2).
- The test results of compressive strength for cubes exposed to 1%, by volume nitric acid solution after cured in water for 28 days with various percentage of Turritella and Bentonite such as 0%, is 32.10N/mm2 and 15% is 24.66% and produced target mean of the compressive strength for 7 and 28 days at at 0% are16.81N/mm2, 39.10N/mm2 and 15% are 14.22N/mm2, 26.22N/mm2. The loads of cubes were tested in different trials such T1, T2 calculated average load find out average compressive strength (N/mm2).
- The test results of compressive strength for cubes exposed to 5%, by volume nitric acid solution after cured in water for 28 days with various percentages of rice husk ash such as 0%, is 24.34 N/mm2 and 15% is 16.11% and produced target mean of the compressive strength for 7 and 28 days at 0% are16.81N/mm2, 39.10N/mm2 and 15% are 14.22N/mm2, 26.22N/mm2.

VI. CONCLUSIONS

- The compressive strength of concrete (with 0%, 5%, 10%, 15%) weight replacement of cement with Turritella and Bentonite cured in normal water for 7days and 28 days have reached the target mean strength.
- Comparative study on rice husk ash concrete with various replacement percentage of Turritella and Bentonite showed that, and shows better strength than other replacements due to high pozzolanic activity.
- From results M30 grade Turritella and Bentonite concrete for nitric acid solution exposure in 28 days, the various replacement showed better compressive strengths.
- The compressive strength decreased with the increase in concentrations of nitric acid in curing water.
- At various replacements of Turritella and Bentonite gives maximum

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ISSN: 3070-0434 www.zesterapublications.com Original Research Paper

strengths and shows good resistance to nitric attack.

- Utilization of Turritella and Bentonite its application is used for the development of the construction industry, material science.
- It is the possible alternative solution of safe disposal of Turritella and Bentonite
- Turritella and Bentonite becomes more economical without compromising concrete strength than the standard concrete. It becomes technically and economically feasible and viable.
- To compare graphs and tables values of normal water curing and nitric acid solution curing and attack the nitric acid solution then decreased the compressive strength of the self-compacting concrete.
- The workability test results of slump flow and T50cm, V- funnel, L- box, T5 minutes value ranges of self-compacting concrete are presented.
- To evaluate the test results of compressive strength of self compacting concrete with Turitella and Bentonite to nitric acid solution after 7 days and 28 days.

SCOPE OF THE FUTURE WORK

The scope of this study is focused on the properties of SCC with Turritella and Bentonite Five volume percentages of Turritella and Bentonite is utilized to investigate the influence of volume percentage of turritella and bentonite to properties of concrete. The scope and limitations of this study are:

- The type of cement used is Ordinary Portland Cement (OPC) of 53 grade concrete mix.
- The size of crushed aggregate used is 10mm or 12mm.
- All the concrete specimens are subjected to wet curing.
- The appropriate tests and evaluations of concrete specimens are done in laboratory scaled sample.
- The testing and evaluation of concrete mainly on workability, compressive strength of concrete specimen.

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