Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 9, September : 2024

STUDY ON STRENGTH PROPERTIES OF CONCRETE BY PARTIAL REPLACEMENT OF CEMENT BY MUNICIPAL SOLID WASTE

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ABSTRACT

A neglected and costly issue for the industry has been the disposal and treatment of hazardous industrial waste. Producing concrete from ash is one method of recycling municipal solid waste (MSW). The partial usage of MSWI ash has a substantial impact on reducing waste and conserving resources. The characteristics of MSW are examined in the research. Specifically, the chemical properties of the ash produced by waste incineration. If the produced concrete is strong enough, it will last long enough to justify the use of bottom ash as a partial cement substitute. In this examination, we will look at how concrete is improved by adding minerals and chemicals. With no cement at all, the

I. INTRODUCTION

1.1 General

There is a direct correlation between the rate of population growth and the quantity of trash that humans generate on Earth. When you include in the agricultural and mechanical waste from cities and provinces, the total comes to almost 2700 million tons every year. Every day, people all around the globe utilize concrete, making it the most ubiquitous man-made substance. Every year, the building industry in India consumes over 400 million tons of concrete and mortar. Concrete and other necessary raw materials are in high demand, which is influencing the price of aggregates of all types. So that an important route is not hindered by issues like increasing costs and decreasing mortar's flexibility.

1.2 Collection of Municipal Sewage Sludge

1. Urban networks, municipalities, and areas designated by state governments will be the only sites where metropolitan solid garbage may be dumped. Just so there's no confusion, the local authorities will act to curb trash and encourage uniformity.
2. Grouping houses together, varying on usual pre-taught times, arranging system canisters (central repository), and utilizing the vehicle's melody toll are all methods that may be used to organize the house-to-house collection of urban strong wastes.
3. Combining trash from various areas, including ghettos, homeless zones, and commercial areas, bistros, hotels, and businesses.
4. The fourth point is that the naturally decomposing waste products of meat and fish markets, butcher shops, and dirt markets will be recognized and used.
5. Biomedical waste and current.

1.3 Storage of Municipal Solid Wastes

1. The storage places shall be organized and kept clean by the municipal masters to ensure that the surrounding areas are sanitary. For the record, while setting up and keeping stockrooms, the following processes must be considered.
2. When designing and building storage facilities, we will consider factors like population density and the average age of trash in a certain location. A warehouse

will be positioned so that clients may easily access it.

3. Civil specialists or another group will construct storage facilities that are both elegant and simple enough to keep any reclaimed trash from being exposed to the elements.
1. "Containers," which are storage workspaces, will have a "easy to work" foundation that makes it straightforward to maintain.

1.4 Processing of Municipal Solid Wastes

1. In order to improve trash utilization and decrease landfill issues, urban specialists will use a mix of reasonable innovation and waste management strategies. In particular, the following models will be implemented.
2. Compo will handle the biodegradable trash. To make better use of trash and reduce pressure on landfills, local governments will use appropriate development practices or a mix of these strategies. Just so there's no confusion, the models that come after will make sense.
3. Soil enrichment, vermicomposting, anaerobic absorption, or any other suitable common preparation for waste modification will be used for the management of biodegradable wastes.
4. The fourth step after recycling is to dispose of any trash that contains recoverable assets.
5. In emergency instances, trash may also be burned, with or without essentialness recovery.
6. Work for the government or be a supervisor at an office.

1.5 Objective of the Project

Primary objectives of the present investigation are as follows:

1. To catalog the many byproducts that may be transformed into cement.
2. To study how compressive strength is affected by municipal fine garbage in concrete.
3. Thirdly, to study the microstructure of the hardened cement concrete.
4. To use the microstructure explanation to clarify any discrepancies in the concrete's characteristics.
5. Testing the concrete's workability and strength using garbage from municipal solid waste.

1.6 Scope of Work

1. Following the rules laid forth by Indian Standard code IS 10262-2009, the present research makes use of a mixed design.
2. A provider brings in the used solid trash. Using an admixture in the mix design is absolutely disallowed.
3. The water content has been kept constant to allow for a more realistic comparison of different samples.
4. Split tensile strength and compressive strength are measured over seven, fourteen, and twenty-eight-day intervals, respectively.

1.7 Summary

The solid waste sector has grown rapidly due to the immense amount of municipal solid garbage that is generated and distributed each year, amounting to millions of tons.In most cases, MSW rewards the burning process with a 90% reduction in volume and a 70% reduction in weight of waste. One article claims that by mixing waste with another material, the quality is much improved. Debris may constitute as much as 35% of a solid without significantly lowering its compressive strength, according to the data. In a construction square, you may find

35–60% mixed waste, 25% sand, and 15% OPC, the toughest super plasticizer.

If you want to know what makes cement so great, you have to think about it.

II. LITERATURE REVIEW

Researchers Dr. Rahul Chandak, Lehet Gupta Moghul, and others (2017) investigated potential alternatives to cement for use as coarse aggregate, including landfills for municipal garbage. Wte vegetation, which is sometimes referred to as solid wastes incineration plant dusts, is a kind of garbage that is collected from Jaipur, Andhra Pradesh. The primary goal of this experiment is to see if the particles used as a compactor base may replace some of the tangible. It is also widely believed that newly renovated cementitious materials with 10% compactor dusts (wba) as replacements, in addition to mass concretes, have the ideal compression strength value for long-term, excellent value development.

It is expected that the system would operate in a way that impacts a respectable asset product of mswi in the workplace.

A bigger power, together with e.one.some one, o.e.l. Das, m.t. Y. Ishii, one.c, and d. Dhakne. Ibn, bagaw, ou encore. (2016) The purpose of this study is to examine its use as a combination with other building materials, such as concrete, to impart properties like a parched, sticky texture. Who must be contacted in order to guarantee that the finished concrete meets the necessary standards for strength and quality. Based on the current study on the issue, it is expected that dirt growth occurs in concretes with relatively poor strength qualities. Of a single fourteen percent increase yields ten percent of the desired result when applied to the same robust quantity. Anything that, in such a limited capacity, acquired its optimum value at 6% and is therefore pertinent to delicate shored-up concretes. In order to determine a strength development, designers attempted to substitute the various enhancements by sludge with in concrete instances to unique feature silt.

Against alivelu's graphic novels, alors que about

This study has presented a potential current agreement, such as the waste of furnace energy via the use of mortar or concrete. Cementitious clinker typically replaces both solid wastes up to 10% of the time, and even then, not much changes. Allowing you to assess the norm and include suitable volume yeah dusts into respectable melds.

It was concluded from this document that the compression testing results of concrete-supplanted dusts 3-dimensional least square improved the quality by 10% and 20% within a 28-day period compared to the control group; however, this same rate of growth did not significantly increase the quality by 30% earlier in this section. A few more days. 2 weeks, for example, cementitious grading system, compressive strength test, and three-dimensional cubical performance. It seems to be beneficial to simply replace up to 20% of the material with municipal garbage.

S.Deepak, Dr V.Ramesh, et al.,(2015) According to the publication, the colonel's theme investigation focused only on concentration after every municipal solid waste incineration (MSWI) throughout the last few thousand years. It seems that MSWI smoke and ash are another potential application for solid waste. MSWI has the most comprehensive agreement currently in place, and there are plenty of MSWI pieces. Throughout good innovation, this may be used. foundation particles were used to substitute typical cement with robust quality criteria in order to determine whether the prepared sturdy would gain the necessary durability. After monitoring, the concrete is modified by adding higher-quality

sodium lauryl sulfate instead of hydroxides, which makes it distinct from concrete created with foundation particles.

Ahmed Musa Tanko, Hashim Mohammed Alhassan, and others (2012)

While attempting to analyze the character attributes of incineration plant ground particles as a source of post-consumption baku solid waste, this research seems to be finding possible uses for these materials. Fabric is used for sub-bases, attempts to fill, but instead provides relief for major road sub-levels, contributing to its assets. The incineration plant's ground dusts were found to include silica, potassium, and large amounts of cadmium, lead, brass, and metal. value systems in the health and beauty business, which likewise had obvious gravitational pull morality with.86 and.37, among the biggest culprits.29th, but with a pH of 10.20–10.45, and varying from moderate potassium bicarbonate. It's possible to describe it as a highly assessed or nonexistent substance that is similar to its a-3 soil and water together with aastho just by means of bonded all-ground development. similar to how foundation damage has been compacted wherever feasible.

M.R. Lavanya, M. Ibrahim Bathusha and B. Sugumaran,et al.,(2014)

Although areas such as disposing of coal combustion dusts like solid waste (MSW) will become rare, this research is an assessment of the declining need for components arranged across disposal sites. Repurposing is one tactic; attempting to reduce time wastage is another; and inflaming once again for formation yeah energy is really the finest technique, although it only accounts for one-third of the total.After all the dusts that used to be municipal garbage, just around 10% of the problems with trying to get inside a desk could be composed. one may tolerate one additional decline via property going to full, but only if they create one helpful application for the dusts. as a result of burning municipal solid waste coal (MSWi), which is a byproduct of petroleum fires, is the only potential result.

Prof. Sharad S. Bachhav, Prof. D.Y. Kshirsagar, Mr. Sandesh R. Patil, and others (2016)

This paper primarily focused on the rapid rise of dusts and solid waste, which may be achieved by simply boosting solid trash. containers for solid waste particles are already in use for projects all around the world. It's strong and versatile without sacrificing durability. The annual production of solid waste amounts to around 512 million metric tons of debris, the majority of which is disposed of in landfills rather than other locations. That same environmental group may put pressure on that particular business to reduce the amount of solid trash it releases into the environment and establish guidelines for the recovery of recyclable materials. debris because recyclable materials may be used for many purposes once solid trash has been processed, such as.

III. EXPERIMENTAL INVESTIGATION MATERIALS AND METHODOLOGY

3.1 MATERIALS USED

3.1.1. CEMENT

In addition to argillaceous ingredients such as soil or shale, calcareous elements such as chalk and limestone are necessary for the production of Portland cement. Whether the raw materials are mixed and crushed in a wet or dry atmosphere determines the name of the process: wet or dry. Cement is made primarily from four ingredients: lime, alumina, silica, and iron oxide. As the oven temperature rises, these oxides combine to form more intricate combinations. "Hydration of cement" refers to the chemical processes that take place when cement and water mix. Regarding how cement hydrates, two

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ISSN: 0970-2555
Volume : 53, Issue 9, September : 2024

camps have emerged. Using an arranging tool to break up the cement is the first stage.

Table 3. 1 Constituents of cement

Constituents	Percentage	Average
Lime (Cao)	60 to 67%	63
Silica (SiO2)	17 to 25%	20
Alumina (Al2O3)	3 to 8%	6
Iron oxide (Fe2O3)	0.5 to 6%	3
Magnesia (MgO)	0.1 to 4%	2
Sulphur Trioxide (SO3)	1 to 3%	1.5
Soda and potash (Na2O+K2O)	0.5 to 1.3%	1

Fig 3. 1 Cement of grade OPC 53

3.1.2. AGGREGATES

To make concrete, you need aggregates. Concrete is given body, shrinkage is reduced, and the economics is affected. Aggregates are inert granular materials like sand, rock, and crushed stone that are produced as a byproduct of processing raw materials. They are also a source of the basic cement that is essential in the production of concrete. For a good concrete mix, you need pure, solid particles that aren't filled with any fine components that might degrade the cement, such as absorbed synthetics or earth coatings.

After size is taken into account, aggregates are categorized into two classes. One kind of aggregate is coarse, while the other is fine.

3.1.2.1. COARSE AGGREGATE

Coarse aggregates are particles with a size more than 4.75 mm and a breadth ranging from 9.5 mm to 37.5 mm. They could originate from mandatory, reusable, or discretionary places. On land or at sea, you may locate important aggregates or virgin aggregates. Coarse aggregates gained on land include smashed stone and rock, whereas rock is a total of coarse aggregates won at sea. A large portion of concrete's coarse aggregate is composed of rock, whereas the bulk of the fine aggregate is crushed stone.

Crude aggregate with nominal sizes of 20 mm and 12 mm was used in this investigation.

Fig 3. 2 coarse aggregates of 20 mm

Fine Harmony (3.1.2.2)Most fine aggregates are made out of sands that have been formed in either the ocean or on land. A 4.75 mm sifter is used to separate the bulk of the particles from the fine aggregates, which mostly consist of crushed stone or ordinary sand.

The fine aggregate used in this investigation, stream sand, was purchased from a local business (Figure 3.4).

Fig 3. 3 refined aggregates

3.1.3. WATER

Like cement, water is an important component of clinker due to the actions that take place within the material and the public's reaction to it. It's important to give careful consideration to both the kind and amount of water used, since they impact the power that the concrete lotion

Industrial Engineering Journal
ISSN: 0970-2555
Volume : 53, Issue 9, September : 2024

mentioned earlier gives. Included in the group needs 24% of its bulk from water, whereas co(ii) sole takes 21%. Furthermore, it has been shown that cement concrete, when used as an additive, necessitates a moisture content of around 23% cement.the fluidity of concretes alludes to the 18% that has been artificially hardened. Screen with in lotion permeability is necessary, according to the mentioned 15% of concrete's mass.

Consequently, the maximum quantity of liquid in a material like concrete is

3.1.4. Municipal solid waste

Most often referred to as "scum" and "garbage," national-level waste is really classified as municipal waste. common items for garbage disposal were clothing, containers, canisters, food scraps, customer devices, battery packs, paperwork, hardware, and even lawn clippings. the aforementioned wasting eventually reaches residential areas, organizations (such as schools instead of health clinics), and business owners (such as coffee shops and independent merchants). Instead of including contemporary methodological waste, the Environmental Protection Agency (EPA) continues to include municipal sewage treatment belly flops (MSW), automobile carcasses, advancement and obliteration junks, and so on. trash has to be sourced and then tried once it has been developed. rehabilitating and reusing this land, key fob (where this same eventual power production has been sometimes used to create steam and energy), and disposing of landfills are.

Fig 3. 4 Solid municipal waste

3.2 TEST METHODS

E-Waste concrete's filling, passing, and consistency retention abilities are assessed using a battery of tests that are classified into several groups in this section.

Scheme of experimental program:

The number of blocks that will be tested during the experiment is detailed in the table below.

Table 3. 2: The Experiment Does Not Require Blocks

Sl.No	% MSW	Compressive strength of concrete			Split tensile strength of concrete			Flexural strength of concrete		
		7 days	14 days	28 days	7 days	14 days	28 days	7 days	14 days	28 days
1	Mix 1	3	3	3	3	3	3	3	3	3
2	Mix 2	3	3	3	3	3	3	3	3	3
3	Mix 3	3	3	3	3	3	3	3	3	3
4	Mix 4	3	3	3	3	3	3	3	3	3
5	Mix 5	3	3	3	3	3	3	3	3	3
total		45 cubes			45 cylinders			45 Prisms		

Three prisms, three cylinders, and three cubes were cast in each batch. A total of 45 prisms, cylinders, and cubes were cast during the experiment.

3.3: SHAPE AND DIMENSIONS OF THE BLOCKS

Fig 3. 5 150 x 150 x 150 mm cube

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Fig 3. 6 350 mm in height and 150 mm in diameter

Fig 3. 7 150 x 150 x 700 mm prism

Shape and Dimensions of the Blocks

Here is a table with all the necessary information on the blocks used in each exam, including their size and shape requirements.

Table 3. 3 Block Shape and Dimensions

Type of test	Shape of block	Length(m)	Breadth(m)	Height(m)	Diameter(m)	Volume of block (m^3)
Compressive strength	Cube	0.15	0.15	0.15	–	0.00375
Split tensile strength	Cylinder	–	–	0.30	0.15	0.00530
Flexural strength	Square prism	0.1	0.1	0.5	–	0.00700

IV. RESULTS AND DISCUSSIONS

Concrete is undeniably a widely used imitation material in the construction industry. The adaptability of concrete stems from its three easily obtainable ingredients: cement, aggregate, and water. Overusing concrete might exacerbate the matter's shortage. To ensure concrete's longevity in the field, it is necessary to be able to replenish the appropriate components in enough amounts.

Due to the cement's binding properties, recycled concrete cannot be used in normal building methods. Despite this, it effortlessly fills in the molds' corners and the reinforcement's finite spaces.

4.1 MIX DESIGN OF CONCRETE

Choosing the appropriate cement components and their quantities to produce concrete with the necessary functionality, solidity, and minimum strength in an economically (and responsibly) responsible manner is known as concrete mix configuration.

Please ensure that you have the required files available, since I have selected a powerful mix configuration. Certain needs for the outline become inflexible in its absence.

The primary focus of this research is the creation of regular building improvement-grade M30 waste concrete.

With a water-to-cement ratio of 0.50, the finished test mixture for M30 grade concrete is 1:1.86:2.89.

A typical concrete mixture To finish designing an M30 grade conventional concrete mix, the IS456-2000 and IS 10262:2009 codes have to be used.

4.2 MIX PROPORTIONS

The following table lists the components and their respective blend categories, % relative proportions, and blend proportions.

Mix Type	Cement	Fine aggregates	Coarse aggregates	Municipal solid waste
Mix 1	394	732	1139	0
Mix 2	374.3	732	911	19.7
Mix 3	354.6	732	684	39.4
Mix 4	384.9	732	455	59.1
Mix 5	285.2	732	228	78.8

Concrete mix proportions are listed in Table 4.

Making Concrete from Electronic Waste

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4.3 CASTING OF CUBES AND CYLINDERS

The issue was made better by casting concrete barrels and shapes. For the M30 review concrete, we are using 3D cubes in place of normal cement up to the mix, but it's not a full replacement.

My response: Filling the Cube Molds and Compacting the Concrete

Quickly fill the cube shapes with the cast samples, using your hands or vibration to minimize solids. There will be a decline in form quality if air is trapped within the solid. As a result, the cubes must be packed to the brim. However, you need to be careful not to use too conservative solids, as they could separate the bond glue and totals in the combination. Not to mention that this may cause the ultimate compressive strength to be lower.

4.4 COMPACTING WITH COMPACTING BAR

It is recommended to use three 150 mm molds and fill them with 50 mm deep break even layers. To compress the material, a compacting bar is used. The dimensions and weight of the steel bar are 380 mm in length, 25 mm in diameter at the square end, and 1.8 kg. It is shatterable. Make sure to compress each layer to its full thickness using the compacting bar, making sure to space your strokes uniformly throughout the solid surface. While compacting the top layer, the compacting bar shouldn't hit the form's base. The compacting bar for subsequent layers must be applied to the layer immediately below it. The minimum number of strokes needed for each successive layer to achieve a completed product.

4.5 CURING

The compressive strengths of the solid samples at seven, fourteen, and twenty-eight days of age were resolved by using six different methods for restoration. These relieving systems are related to one other:

As an example of a water-submerged curing (WSC) process, solid 3D form samples were submerged in water.

As part of the Splash Curing (SC) process, the solid 3D form samples were wetted twice a day.

The solid samples were kept in place using at least two layers of polythene film to prevent moisture from evaporating during polythene curing (PC).

The process of "Burlap Curing" (BC) included laying wet burlap sheets underneath solid 3D model pieces at regular intervals.

The Soggy Sand Curing (MSC) procedure included covering the whole solid 3D square samples with wet sand.

4.6 TEST RESULTS

4.6.1 Fresh concrete tests

4.6.1.1 Slump Cone test

To find out how thick newly mixed concrete is before it sets, the concrete slump test is performed. This ensures that the freshly mixed concrete is functional and, thus, easy to work with. Additionally, it may be used to identify a group that has been mixed up too much. What gives the exam its famous standing is its simple equipment and basic design. In the field, the droop test ensures that different concrete piles are consistent.

Fig 4. 1 Test of cone slump

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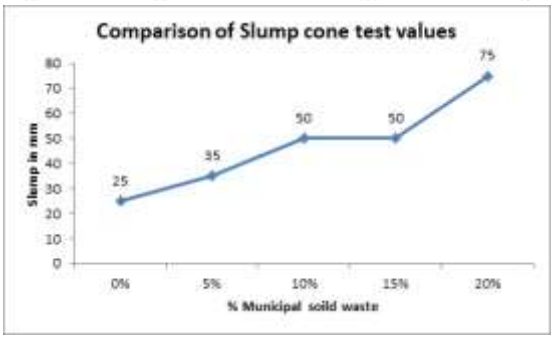
Test of cone slump

Table 4. 2: Comparison of slump cone tests

S. No	Municipal solid waste (MSW)	Slump (mm)
1	0%	25
2	5%	35
3	10%	50
4	15%	50
5	20%	75



Graph 4. 1 Slump cone value comparison

The above graph and table make it quite clear that an increase in the MSW % will result in an increase in the slump value. Slurry behavior is seen in the concrete mix because MSW has a lower water absorption rate than cement. This means that the fraction of MSW matters for calculating slump value.

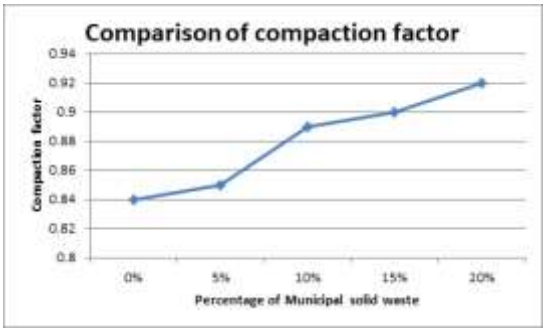
4.6.1.2 Compaction factor test

One of the concrete functioning tests done at the lab is called the compaction factor test. When comparing loads on partly compacted and completely compacted concrete, the compaction factor is the ratio. When concrete's restricted uses make the droop test undesirable, the compaction factor test is used.

Fig 4. 2 Test for compaction factors

S.No	Municipal solid waste (MSW)	Compaction factor
1	0%	0.84
2	5%	0.85
3	10%	0.89
4	15%	0.9
5	20%	0.92

The table 4 compaction factor test comparison is provided.



Graph 4. 2 Values of the compaction factor are compared.

The accompanying table and graph clearly demonstrate that augmenting the quantity of MSW will result in an increase in the compaction factor value for M30 grade concrete. Higher percentages of municipal solid waste

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(MSW) in the concrete mix result in an increase in the compaction factor due to the reduced density of MSW material. Hence, the weight of the partly compacted concrete will decrease.

4.7 Compressive strength of concrete

This document presents the IS516-1959 standard for quantifying compressive strength: Positioning the sample into the evaluation instrument: The bearing surface of the testing machine will undergo a comprehensive cleaning process, including the removal of any loose sand or other substances that may potentially come into contact with the weight platens. Arranging the models in the machine by solid geometry in a manner that links two opposing sides of the 3D forms as cast is neither optimum nor basic. Accurate synchronization between the rotation of the model and the push of the completely completed platen is required. No force will be exerted on the steel platen of the testing device by the test characteristics. Contemplating

Fig 4. 3 Testing apparatus for compressive strength

The weight will be gradually applied and raised until the resistance of the building stack guide becomes intractable and no more weight can be added, at a rate of about 140 kg/cm2/min without any interruptions. At such juncture, the presence of the solid, the optimal load of the model, and any irregularities in such a collapse will be documented.

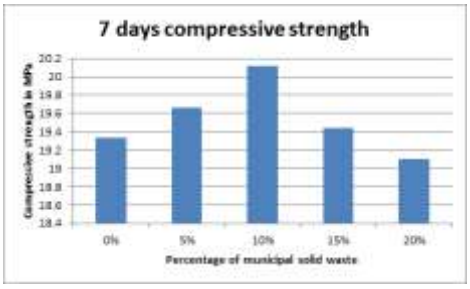
A. Computation: In order to acknowledge the deliberate compressive character of the model, the optimal load will be calculated by approximating the average of the fragment and expressing it to the closest kilogramme per square centimeter. This will be carried out at the central point of the test cross-sectional area. In the absence of the distinct variation, the group expert is selected by calculating the average of three characteristics.

Compressive strength:

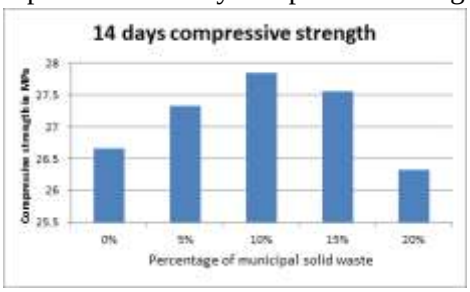
Table 5.5 shows the MSW compression strength.

Table 4. 4: Concrete Compressive Strength Comparison

S. No	% Municipal solid waste	7 days compressive strength	14 days compressive strength	28 days compressive strength
1	0%	19.33	26.66	29.66
2	5%	19.86	27.33	29.99
3	10%	20.12	27.84	30.26
4	15%	19.44	27.55	29.66
5	20%	19.10	26.33	29.33



Graph 4. 3Seven-day compressive strength



Graph 4. 4 Compressive strength after 14 days

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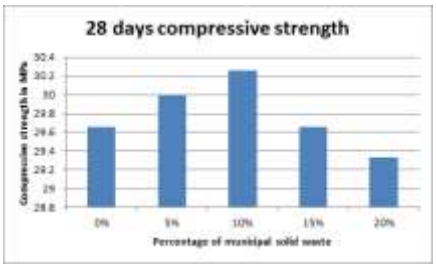


Graph 4. 5 Compressive strength after 28 days

- As shown in the table and graph above, the optimal compressive strength of M30 grade concrete was determined to be 10% MSW after curing for 7 days, 14 days, and 28 days. Superior strength will be achieved by the cohesive interaction of MSW, cement, and aggregates at a 10% mixture during curing periods of seven, fourteen, and twenty-eight days.
- The split tensile strength of concrete is 4.8%.
- International Standard 516-1959 supervised the organization of this examination. A conventional 150 x 300 mm barrel was utilized to ascertain the composition of the cement. On the CTM bearing surface, models are positioned at the 200T breaking point without impulse. The stacking process continues at a consistent rate until the barrel fractures. The maximum weight was determined, and the quality standard was managed. Segregated, uncompromising nature.

Fig 4. 4 Testing for Split Tensile Strength

The split tensile strength = (2P/πdl) N/mm2

Where,

P= average load in N,

d=diameter of cylinder in mm,

l=length of cylinder in mm,

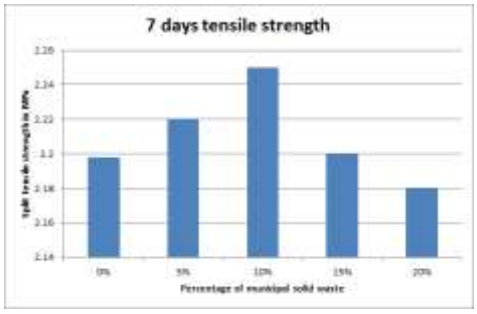
supported,

P= maximum load in kg applied to specimen.

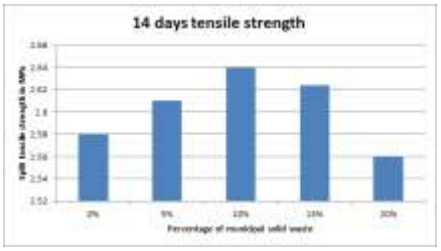
Split tensile strength for MSW

Table 4. 5: Split tensile strength comparison

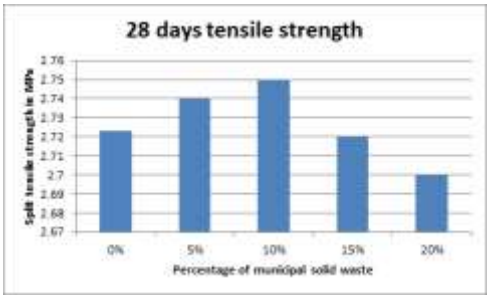
S. No	% Municipal solid waste	7 days tensile strength	14 days tensile strength	28 days tensile strength
1	0%	2.198	2.58	2.723
2	5%	2.22	2.61	2.74
3	10%	2.25	2.64	2.75
4	15%	2.20	2.624	2.72
5	20%	2.18	2.56	2.70



Graph 4. 6 Split tensile strength after 7 days



Graph 4. 7 Split tensile strength for 14 days



Graph 4. 8 Split tensile strength over 28 days

The table graphs above demonstrate that the inclusion of MSW in the mixture will enhance its split tensile strength in comparison to conventional concrete variations after 7 days, 14 days, and 28 days of curing. The optimal split tensile strength was determined to be 10% MSW, since the inclusion of MSW leads to a reduction in the water content of the mixture.

V. CONCLUSIONS

1. The inquiry produced the following findings:
2. The fine, coarse, and cement aggregates are appropriate for the investigation as their material characteristics are within acceptable thresholds.
3. The addition of municipal solid waste ash to concrete increases both the slump value and compaction factor value of the concrete.
4. As the compressive strength value approaches 10% replacement, the quantity of municipal solid waste ash in the concrete progressively reduces.
5. As the percentage of municipal solid waste (MSW) ash in the concrete increases, the split tensile strength value gradually decreases after reaching a replacement level of 10%.
6. It was found that 10% of MSW had the highest flexural strength.

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