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Combined Effect of Textile Waste and Meta Kaolin on the Properties of Polymer Concrete in Pavements

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ABSTRACT- The current era sees a significant impact on society, especially individuals concerned with sustainability and environmental well-being due to the utilization of unconventional materials in construction. The present scientific study concentrates on investigating how Textile waste combined with Meta kaolin affects mechanical attributes of polymer concrete. The enhancement of cement concrete pavement with polymer modification has recently captured the attention of those researching new road materials. Indoor testing methods that explore compressive strength, flexural strength, have been employed to investigate this innovative approach. These varying properties were measured using different levels of polymer content in a comprehensive study aimed at improving joint damage and reducing cracks in cement concrete pavements. The study analysed the actions of polymer concrete combined with discarded textiles trimmings. Each trial incorporated reused chopped fibers, representing 1% and 2% of total weight respectively.

KEYWORDS- Polymer, Meta kaolin, Concrete, Pavement, Strength

I. INTRODUCTION

The objective of the primary study is to employ polymers in order to produce cements. The focus revolves around finding suitable alternatives for traditional methods employed within cement production using alternative materials and processes stemming from different types of polymer compounds. This exploration into new forms of knowledge pertaining to how these elements can impact concrete durability, and stability among other aspects related to defining properties between batches.

For concrete reinforcement, fibers recovered from diverse waste streams are appropriate. In some instances, the usage of textile fibers may be able to address two issues, namely the removal of an environmental contaminant and the provision of an alternative material for the building sector. Textile fibers raise the flexural and compressive strength of polymer concrete to a small extent, and also remove the brittleness behavior symptoms when added to the mixture. Worldwide, a sizeable volume of post-consumer and textile sector fibrous waste is disposed of. This not only poses a threat to the environment, but it also wastes valuable resources. Minerals and polymers are combined to create polymer concrete. Polymer composite materials are typically brittle but exhibit increased ductility and strength when fibers are added. Fibers are yanked from the polymer matrix during an inter-facial failure, and bridging stresses are created on the fracture surface. The crack is protected by the bridging forces, which also lower the stress intensity factor near the crack tip. As the bridging pressure from fiber pull out is primarily controlled by the shear stress resistance between the fibers and the polymer matrix, inter facial shear strength plays a significant role.

The use of alternative cementitious material in concrete can compensate for indirect expenses incurred as a result of env ironmental, technical, and economic concerns associated wi th cement manufacture. So, Meta kaolin is used as a pozzolanic substance in the production of high strength concrete as a partial cement substitute. High strength concrete can sustain loads that ordinary concrete cannot. Meta kaolin improves the strength development of concrete at an early age. It improves the concrete's long-term durability and serviceability. It aids in the development of concrete's early age strength, enabling the early removal of form work and so increasing production pace. It makes concrete stronger and more resilient. The use of Meta kaolin enhances resistance to chemical, freeze-thaw, and sulphate attack.

II. BACKGROUND

A. *Polymer Concrete*

Polymer concrete is a composite material made up of aggregate, filler, and a polymeric binder, with the hydraulic cement of traditional concrete replaced with polymeric resins. Polymer concrete offers numerous benefits over cement Portland concrete, such as quick hardening, strong mechanical strengths, increased chemical resistance, and so on. Several countries have been actively developing polymeric materials for mortar and concrete during the last few decades. Polymer concretes are increasingly being used as an alternative to cement concrete in many applications, such as structure construction and repair, highway pavements, and bridge decks, due to their rapid setting characteristics, high strength-to-weight ratio, and ability to withstand a corrosive and aquatic environment. Furthermore, these novel materials conserve natural resources, so helping the environment. Polymer concretes are therefore categorized as building materials that contribute to the sustainability of construction

B. Textile Waste

The global textile market is now a trillion-dollar industry, expanding in tandem with the world's population and rising living standards. The industry was valued at USD 920 billion in 2018, with a compound annual growth rate (CAGR) of 4.4% expected to reach USD 1,230 billion by 2024. North America, Latin America, the European Union, Asia Pacific and China, as well as the Middle East and Africa, are the primary competitors in this industry, with China being the top textile producing and exporting giant. Cotton has been the most popular fabric in the Asian and American continents for the past 5000 years, and it was used as a raw material for textile manufacturing by 25% in 2019. In terms of recycling, textile refuse is divided into two categories: pre-consumer waste and post-consumer waste. Pre-consumer waste is a direct by-product of the textile manufacturing business, whereas post-consumer waste is clothing discarded by users because it is damaged or unsuitable. Both kinds of waste are important in the textile recycling industry, but pre-consumer waste has gained favour due to its ease of sorting and processing. The disposal of such harmful waste into landfills is a travesty as depicted in figure 1, both ecologically and financially. All things considered, textile waste disposal has become critical, and the need for long-term progress is reaffirmed.

Figure 1: Textile waste

C. Meta kaolin

Concrete is a superior building material that is widely used globally, resulting in large-scale cement production. Various researchers have demonstrated that the manufacturing of cement causes significant environmental pollution due to CO2 gas emissions. This is extremely dangerous. As a result, it became critical for researchers to find a better option that is both eco-friendly and reasonable in every way. As a result, they have begun working on an economical and environmentally friendly cement substitute that can partly supplement cement minerals or raw materials without compromising the strength parameter. Such materials are known as additional cementing materials, pozzolanic or mineral admixtures. In this experiment, we are using Meta kaolin as shown in figure 2, which is a type of supplementary cementing material that is used to create a high strength concrete while also increasing its durability. It is neither a by-product of an industrial process (as is GGBS) nor a completely natural substance. Thermal activation of kaolin soil produces it. This activation will result in a significant loss of water in its constitution, producing a structural rearrangement. Because of the pozzolanic and hydraulic reactions, Meta kaolin in concrete causes densification of the microstructure of the concrete, resulting in increased impermeability.

Finally, Meta kaolin is used as a pozzolanic material for partial cement substitution in the production of high strength concrete. High strength concrete can endure loads that ordinary concrete cannot. Meta kaolin improves the strength growth of concrete at an early age. It improves the concrete's long-term resilience and serviceability. The use of this supplementary cementious material in concrete can compensate for indirect expenses incurred as a result of environmental, technical, and economic problems associated with cement production.

Figure 2: Meta kaolin

III. NEED OF PROJECT

Numerous studies have been conducted on the usage of materials that are both environmentally friendly and highly effective. Utilizing recycled resources, such as textile waste replacements, is growing in popularity quickly because it reduces the brittleness of polymer concrete.

- The usage of the textile waste in conjunction with Meta kaolin as an additive has been shown to improve the concrete's compressive and flexural strength.
- Additionally, the use of textile waste enables the design to gain volume without significantly increasing its weight, making it a light construction.
- The sustainability of industries that rely on concrete would be better secured with the use of such materials. By boosting concrete's strength, a structure will be able to resist the majority of its loads according to plan.
- Utilizing such a material not only benefits the environment and energy efficiency, but also lowers the cost of construction of concrete structures.

IV. LITERATURE REVIEW

The compressive and flexural tensile strengths, impact resistance and flexural fatigue performance, impermeability, frost resistance and drying shrinkage characteristics, wear resistance, and resistance of polymer-modified cement concrete were investigated in this article. The compressive and flexural tensile strength values increase as the polymer content increases. The flexural tensile strength is greater than that of ordinary cement concrete, while the compressive strength is slightly reduced when the polymer percentage is low. The impact resistance and flexural fatigue performance of cement concrete have been enhanced, and when polymer content increases, so does the impact resistance and flexural fatigue performance. Polymer can significantly improve the impermeability, frost resistance, and drying shrinkage of cement concrete. [1]

Every year, a sizable volume of fibrous debris is dumped in landfills. This is a waste of resources as well as posing economic and environmental issues for society. Although it is ideal to recycle fiber waste into the same products, certain types of waste materials, especially multi-component systems, may not be amenable to this strategy due to the processing time, energy requirements, and pollution generated. To maximize the financial and environmental advantages, recycling of fibrous waste should be regarded from a systems viewpoint. In many parts of the world, textile recycling has a long history, and recently, numerous commercial textile and carpet recycling enterprises have emerged with varying degrees of success. As the essential infrastructure for collection and distribution is strengthened, fibre recycling is being increased. Networks for recycling across product categories are anticipated to grow. Due to their low volume, some industrial textile kinds, for instance, could not garner interest in commercial recycling, but if they joined a large network, they could be handled with ease. The combined effect would enable a thriving sector built on diversified strategies that recycle all sorts of waste that are gathered. New and better technology would result from research and development efforts, maximizing the value of recycling. [2]

This study looked into the mechanical behavior of polymer concrete reinforced with leftover textile trimming. Different resin/sand weight ratios were examined in two series of polymer concrete formulations. Recycled textile fibres were employed in each series at a rate of 1 and 2% of the total weight. At room temperature, flexural and compressive tests were carried out, and load vs. displacement graphs were drawn all the way to failure. In the study, the effects of the resin/sand weight ratio and the fibre content on the behavior of polymer concrete reinforced with textile fibres were both taken into consideration. [3]

Following initial processing, the waste cloths are chopped into tiny pieces, roughly 20mm x 20mm in size, and used in concrete in varying percentages. The addition of these waste materials improves the energy absorption as well as the flexural and tensile characteristics. Physical and engineering requirements are thoroughly investigated, and results are compared to the control concrete. [4]

Here, we conducted an experiment to investigate the usage of Meta kaolin as a partial cement replacement. The strength qualities of concrete were significantly improved by the addition of Meta kaolin. It was found that 7.5% replenishment was the ideal amount. The results showed that adding 7.5% of Meta kaolin to concrete increased its split tensile strength by 7.9%, flexural strength by 9.3%, and compressive strength by 14.2%. [5]

In this review study, 49 papers were evaluated in order to completely formulate the application-based characterisation of textile waste fibres in order to determine its suitability as a composite material in sustainable construction and geotechnical practices. This study's findings aid in the formulation of experimentation procedures and methods for developing novel composite materials based on blended textile waste fibres and numerous other industrial by-products for specific purposes. [6]

In this experiment, adding Meta kaolin to the concrete will hasten the cement pastes' ability to set but decrease its workability. The two qualities, however, are inversely influenced by polymer. When used in conjunction with MK, the polymer composed of 80% SBR and 20% PVA produces an optimised result. When employing polymer and Meta kaolin additives, the ideal water to cement ratio is 0.45. A concrete mixture that is optimised for strength and durability is produced by adding 5% optimised polymer and 15% cement substitution utilising Meta kaolin. [7]

This research review revealed that Supplementary Cementious Materials as Meta kaolin can efficiently replace cement. The SCMs outperform conventional mixtures in terms of strength and durability. Meta kaolin typically requires more super plasticizer in terms of workability and setting time, and it speeds up the setting of pastes compared to control mixtures. Because of its high price compared to cement, Meta kaolin may not be as cost-effective to employ, but it is more cost-effective in terms of strength and durability. [8]

The goal of this study was to test the mechanical and durability properties of short randomly selected textile waste fibre as a potential reinforcement for cement composites aimed at producing components with little structural responsibility. Cotton and polyester from the garment and textile waste sectors are used to make these recycled fibres. The usage of these plate composites for building components can help to valorize this waste while lowering the environmental impact of construction. Maximum compressive and flexural strengths were observed for composites containing 8% TWF. Flexural stiffness was shown to be greatest in composites containing 6% TWF, while toughness was greatest in composites containing 10% TWF. [9]

This paper investigated the many types of textile building materials and their qualities. Textile materials are more acoustically efficient and have higher thermal properties than traditional building materials. The mechanical qualities of plaster mortars are improved by the addition of textile fibres. The use of textile waste as a supplementary raw material is an intriguing practice for generating environmentally friendly composite materials that can be used in place of traditional ones. [10]

An experimental study on the long-term durability qualities of concrete amended with MK and polymer was published in this work. Several long-term durability experiments were performed to better understand the behavior of modified concrete in an exceedingly demanding environment. The results show that replacing Portland cement with 15% Meta kaolin and an additional 5% polymer (by weight) provides the best improvement in mechanical characteristics and durability for Portland cement concrete. [11]

This study looked at the effect of mix design parameters on the fresh and hardened characteristics of local Meta kaolin-based Geo-polymer concrete. Workability, compressive strength growth with age, splitting tensile strength, water absorption, horizontal surface abrasion, and density (wet and dry) were all evaluated attributes. There were seventeen GPC mixtures and two reference cement concrete mixes evaluated. Workability was observed to improve with increasing the sodium silicate to NaOH (solids) ratio to a certain point, then decrease due to increased mix viscosity.

However, MK-based GPC is extremely sensitive to aggregate content, with a slight increase resulting in a considerable loss of workability. The compressive strength normally increases with an increase in the sodium silicate to NaOH ratio and alkaline solids to MK ratio until a specific limit based on the molar ratios of the mix, beyond which strength begins to decrease. Water absorption for geo-polymer mixes was comparable to or greater than that of cement concrete, based on a comparison of MK-based GPC and cement concrete mixes. [12]

In this experiment, textile waste is mixed with the concrete, and the maximum slump in the planned concrete is 12 mm. It demonstrates that the water demand of the concrete with textile waste is higher, affecting workability and necessitating more effort for adequate compaction. Increasing the amount of textile waste resulted in a lower unit weight (density) of the final concrete. The proposed concrete's compressive strength increases with increasing textile waste dosage, reaching 0.7% for 14-day cured specimens and 0.6% for 28-day cured specimens. Based on the results of the experimental study, it is proposed that textile waste be used as fibres in concrete. The dosage of used textile waste, on the other hand, can be optimised at 0.6% of the total volume of concrete. [13]

In this experiment, textile pieces were cut into approximately 1.01.0 cm pieces and crushed in a windmill. The fibres were mixed to a mixture of polyester resin and marble particles. Cotton fibre concentrations were 0.5, 1.0, and 1.4% by weight. The findings support previous research that suggested combining recycled fibres with concrete to improve mechanical characteristics while reducing waste and lowering raw material costs. [14]

V. METHODOLOGY AND MATERIALS

A. *General*

The materials to be used in the production of concrete are cement, fine and coarse aggregates, polymer, textile waste and Meta kaolin as partial replacement of cement. In this section, the details of these ingredients and the casting procedure are discussed.

- Cement: In this test Ordinary Portland cement (OPC) of grade 43 is used having physical properties as shown in table 1, produced by Saifco cement factory, Saman khunmoh Srinagar (J&K), and its technical parameters are fully in line with 'the General Portland Cement'. The quantity per bag is 50kg. The cement is manufactured by grinding clinker with gypsum, water and performance improvers such as fly ash etc.

Table 1: Physical properties of cement

Sr. No.	properties	Observations
1	Bulk density	1440 kg/m3
2	Specific gravity	3.14
3	Initial setting time	30 min
4	Final setting time	260 min
5	Standard consistency	32%
6	Fineness	6.95 %

- Fine aggregates: The fine aggregate uses river sand confirming to grading zone II and a fineness modulus of 2.70. It is medium sand with an apparent density of 1.692 g/cm3. The sand was sieved first through 4.75mm sieve to get rid of any particles greater than 4.75mm and was then washed to get rid of dust. The sieve analysis of fine aggregates is shown in table 2.

Table 2: Sieve Analysis of fine aggregates

Sieve size	Weight of sample retained (g)	Cumulative weight retained (g)	Cumulative % retained	Percentage passing
4.75	70.6	70.6	3.53	96.47
3.35	151.2	221.8	11.09	88.91
2.36	207.9	429.7	21.48	78.52
1.18	112.5	542.2	27.11	72.89
0.60	380.2	922.4	46.12	53.88
0.30	450.5	1372.9	68.64	31.36
0.15	473.7	1846.6	92.33	7.67
pan	34.2	2000	100	0

- Coarse Aggregates: The pavements used for continued high traffic volume require the aggregates of size 20mm which are feasible for gaining the maximum strength. So the coarse aggregate used in this experimental investigation is 20mm size, crushed and angular in shape. The specific gravity of coarse aggregate is 2.86 and water absorption is 0.50% as shown in table 3.

Table 3: Specific gravity and water absorption of coarse aggregates

S. No.	Details	Results
1	Weight of (container + sample) in water (A1)	2097
2	Weight of container + water (A2)	788
3	Weight of saturated dry aggregates in air (B)	2008
4	Weight of oven dried sample (C)	1998
5	Weight of standard aggregate in water=A=A1-A2	1309
6	Specific gravity= C/B-A	2.86
7	Water absorption = 100* (B-C)/C	0.50

- Water: Water is used in the mix tap water free from all types of harmful chemicals and Organic material, confirming to IS 456-2000. The PH of water used is 6.
- Polymer: The polymer used in this experiment is combination of 80% of Styrene Butadiene Rubber (SBR) and 20% Polyvinyl Acetate (PVA). Both polymers used in this experiment have been ordered from India Mart.
- SBR: acts as a water-resistant bonding agent and additive for use in sand/cement casts and repair compounds. It is suitable for use both externally as well as internally in regions with intermittent or constant water contact. Properties of SBR are mentioned in table 4.

B. *Benefits*

- Flexural and tensile properties have been significantly enhanced.
- Allows for a reduction in water content and significantly reduced shrinking.

- Improved abrasion resistance, increased durability and toughness, and excellent adherence to steel and concrete.
- Improved resistance to corrosion.
- PVA comprises a vinyl acetate photopolymer with a medium viscosity that is polyvinyl alcohol stabilized and externally plasticized. PVA Bonding Agent provides great adhesion to cement and concrete; it facilitates the formation of a firm connection between cement and a range of materials and provides outstanding adhesion to concrete, allowing for easy restoration of concrete surfaces without a requirement for laborious preparation of the surfaces. PVA Bonding agent is an excellent concrete floor sealing agent. Properties of PVA are mentioned in table 5.

Table 4: Styrene butadiene rubber properties

Particulars	Value
Brand	Nexo
Colour	White
Model name	SBR
Product type	Polymer admixture
Resistance type	Water, chemical and abrasion

Table 5: Polyvinyl acetate

Particulars	Value
Application temperature	5C- 24C
Tack development	10-90min at 15C
Bonding	Max. Strength is attained in 24 hours.
Colour	White
Form	Liquid
Specific gravity	1.2 approx.
Composition	Polyvinyl acetate emulsion.

C. Meta kaolin

Meta kaolin is a clay mineral that has been de-hydroxylated. Meta kaolin particles are smaller in size than cement particles. Meta kaolin is formed by heating kaolin natural clay to temperatures ranging from 650 to 900°C. It has excellent performance, strong strength, increased resistance to chemical attack, and increased durability. The MK used here has been ordered from India Mart, AJ Corporation Mumbai. The properties of Meta kaolin are shown in table 6.

Table 6: Properties of Meta kaolin

Parameters	Value
Color	white
Physical form	powder
Specific gravity	2.5
Bulk density	0.38 g/cm3

- Textile waste The textile cut cloths collected from the local tailoring shops and mixture of two types of cloth which are cotton and silk whose pieces were cut into small sizes from 2cm-6cm.

D. M-40 Grade Concrete Mix Design

- **Design stipulation**
  - Characteristic compressive strength required in the field at 28 days = 40Mpa
  - Target mean strength at 28 days (as per IS:10262) = 48.25Mpa
  - Maximum size of Aggregate= 20mm
  - Degree of workability (slump)= 100mm
  - Degree of quality control= Good
  - Type of Exposure = Very severe
  - Source of material:
  - Cement: Saifco (OPC Grade 43)
  - Coarse Aggregate: Chadoora Budgam
  - Fine Aggregate: Local river
  - Water: plant site
  - Admixture: India Mart

- **Physical Properties of Coarse & Fine Aggregate**

  Coarse aggregate 20.0 MM
  Water Absorption (%): 0.50
  Specific gravity: 2.86
  Fine Aggregate
  Water Absorption (%): 1.15
  Specific gravity: 2.56
  Fineness modulus: 2.70

- **Specific gravity of cement: 3.14**

- **Percentage passing of Fine aggregates**

Table 7: Percentage passing of Fine aggregates

IS Sieve size in mm	% passing	Specific limit as per IS
4.75	96.47	90-100
3.35	88.91	75-100
2.36	78.52	65-90
1.18	72.89	55-90
0.60	53.88	35-59
0.30	31.36	8-30
0.15	7.67	0-10

- **Target mean strength of concrete**
  As per IS: 10262
  f'ck= fck+1.65*S
  f'ck= 40+ 1.65*5
  =48.25

- **Selection of water cement ratio**

  Exposure= very severe
  Min. cement content= 340N/mm2
  W/c ratio= 0.45, which can be reduced by 0.05 if admixture is used.

- **Water Content**

  For 20mm aggregate= 186kg for 50mm slump
  For every 25mm 3% more can be added.
  186+ 6% of 186= 197 kg

- **Determination of cement**

  Cement= 394kg/m3

- **Quantities for 1 Cubic meter of concrete**

  Cement: 394 kg/cum.
  Water: 197 kg/cum.

Coarse aggregate: 1121 kg/cum.
Fine Aggregate: 744 kg/cum

E. Methodology Tests Conducted

Slump Test

The slump is a measure representing the workability of concrete. The concrete slump test shown in figure 3, determines the consistency and workability of fresh concrete on the spot. This test is critical in assuring the quality of instant concrete in a construction project. It is nearly universally utilized on building sites. The instruments used for Slump test were frustum cone, tamping rod, base plate and measuring ruler. The replacement of cement by Meta kaolin and also by the addition of polymers, the workability gets affected which we'll analyze in the next chapter.

Figure 3: Slump test for fresh concrete

F. Compressive Strength

Compressive strength is a structure's ability to resist or withstand compression. The capability of a material to withstand rupture in the form of fissures and cracks determines its compressive strength. According to IS: 516-1959 Compressive testing machine (2000Kn) shown in figure 4, 15 cm x 15 cm x 15 cm steel cube molds, or 15 cm x 30 cm cylinders are utilized.

To evaluate the specimens' compressive strength, 150 mm* 150 mm* 150 mm cubes were cast and tested on a compression testing apparatus. The CTM employed in the lab has a load capacity of 2000 KN at 140 kg/sq. cm/min. A total of 21 samples were collected and tested over the course of 28 days. In place of cement 0%, 5%, 10% and 15% of Meta kaolin was used along with polymer 0f 5% to cast the cubes; 1% to 2% of textile fibre was also used.

Figure 4: Compressive strength test

G. Flexural Strength

A flexural strength test is often performed to assess the bending capacity of a beam or slab. Flexural testing indirectly contributes in determining a slab's or beam's tensile strength. Flexural testing can also predict how long concrete will endure. It is used to determine the loading or onset cracking point at which structural cracks emerge for the first time. The equipment used to assess flexural strength of a specimen is universal test machine shown in figure 5. In total, 21 beam samples measuring 100 mm x 100 mm x 500 mm were cast. After 28 days of curing, the flexural strength of the beams was measured. The flexural test was carried out using the center-point loading method. The beams were installed according to standard technique, with the reference loading direction parallel to the casting direction. Deformation was measured at the center of the beams. The maximum tensile stress in a beam at peak load is described by the equation: = PL /BH2, where P is the peak load in newton, L is the beam span length in millimeters, B is the beam width in millimeters, and H is the beam height in millimeters.

Figure 5: Flexural strength test

H. Split Tensile Strength

The split tensile test is the indirect method used to determine the tensile strength of concrete. The split tensile test can be used to determine the uniform stress distribution. This test is quite useful for learning more about the behavior of concrete. The tensile strength of specimens is determined using a universal testing machine as shown in figure 6. The testing apparatus has a capability of 700KN. A total of 21 cylinders were cast. The splitting tensile strength is calculated using the following equation: $fct = 2F/\pi LD$ where fct denotes the tensile splitting strength in mega Pascal and F denotes the maximum load in Newton.

Figure 6: Split tensile test

VI. RESULTS AND DISCUSSIONS

This chapter consists of outcomes of the tests and experiments carried out towards the objective of the project. It consists of the outcomes from the slump test, compressive strength, tensile strength test and flexural strength test.

The outcomes and Results are accompanied by graphs and tables to have a detailed analysis of the experiments. The results are better explained by these graphs and tables to meet the basic and detailed objective of the project.

I. Slump Test

In this experiment as shown in figure 7, workability of polymer concrete increases with the increase of polymer content but decreases with the increase of Meta kaolin.

In textile waste mixes, a reducing trend in slump is observed. Reduced slump indicates that the concrete with textile waste demands more water to maintain the workability. Otherwise, more effort for compaction will be required.

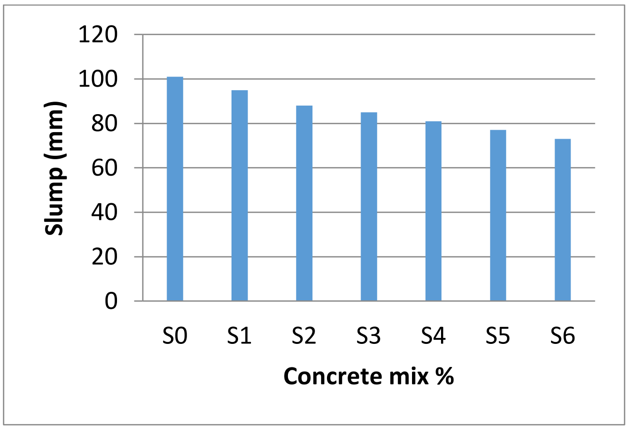

Figure 7: Workability of concrete

- **Compressive Strength**

The effect of the polymer of composition of the SBR and PVA was studied in table 8 and figure 8. Polymer consisting of 80% SBR and 20% PVA along with 15% of Meta kaolin displays the highest compressive strength. Before testing any specimen, it is necessary to understand the equipment, their capacity, the type of loading, their size, etc. To evaluate the specimens' compressive strength, 150 mm* 150 mm* 150 mm cubes were cast and tested on a compression testing apparatus. The samples were collected and tested over the course of 28 days. In place of cement 0%, 5%, 10% and 15% of Meta kaolin was used along with polymer 0f 5% to cast the cubes; 1% to 2% of textile fibre was also used.

According to the test results, the compressive strength is slightly increased but not to a greater extent. It can be seen that the mixture of 5% polymer and 15% MK with 2% of textile waste displayed the highest compressive strength. It also can be seen that both 7-day and 28- day compressive strengths increase with the increase of MK.

Table 8: Compressive strength results

Mix identi ty	polymer	Meta kaolin	Textile	Compressive strength (Mpa)	
				7 days	28 days
S0	0	0	0	30.74	48.8
S1	5	5	1	31.05	49.3
S2	5	10	1	31.43	49.9
S3	5	15	1	31.75	50.4
S4	5	5	2	32.19	51.1
S5	5	10	2	32.63	51.8
S6	5	15	2	32.94	52.3

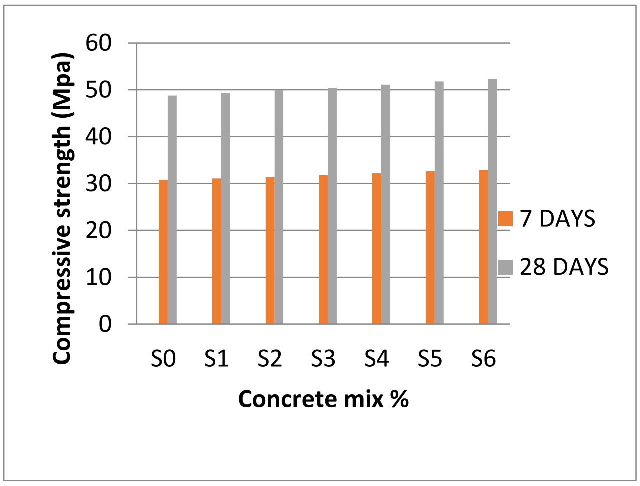

Figure 8: 7 days and 28-day compressive strength comparison

- **Flexural Strength**

In table 9 and figure 9 it can be shown that the flexural strength has been increased with increase in fiber reinforcement in the polymer concrete. Although polymer concrete samples without textiles failed and were broken into pieces and textile reinforced samples remained intact due to the fibres withholding the concrete matrix. It also can be seen that using MK will enhance the flexural strength as well. However, using both MK and polymer together, the mixture shows a decrease in flexural strength. To explain this, further study is needed.

Table 9: Flexural strength at 7 & 28 days

Mix identity	polymer	Meta kaolin	Textile	Flexural strength (Mpa)	
				7 days	28 days
S0	0	0	0	5.22	8.29
S1	5	5	1	5.27	8.38
S2	5	10	1	5.34	8.48
S3	5	15	1	5.39	8.56
S4	5	5	2	5.47	8.68
S5	5	10	2	5.54	8.80
S6	5	15	2	5.59	8.89

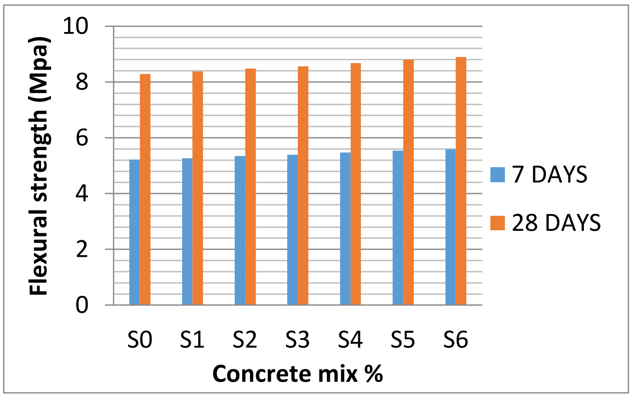

Figure 9: Flexural strength at 7 & 28 days

- **Split Tensile Strength**

The splitting tensile strength tests are well-known indirect tests used for determining the tensile strength of concrete. The influence of Textile fabric fibre on splitting tensile strength is described in table 10 and Figure 10. The splitting tensile strength increases with an increase in curing period. It can also be observed that the splitting tensile strength increases with an increase in fibre content. The textile waste isn't able to increase the compressive strength of concrete to a greater value but it can reduce the brittleness of polymer concrete leading to a smoother failure.

Table 10: Split Tensile strength result

Mix	polymer	Meta kaolin	Textil e	Tensile strength (Mpa)	
				7 days	28 days
S0	0	0	0	2.76	4.39
S1	5	5	1	2.79	4.43
S2	5	10	1	2.82	4.49
S3	5	15	1	2.85	4.53
S4	5	5	2	2.89	4.59
S5	5	10	2	2.93	4.66
S6	5	15	2	2.96	4.70

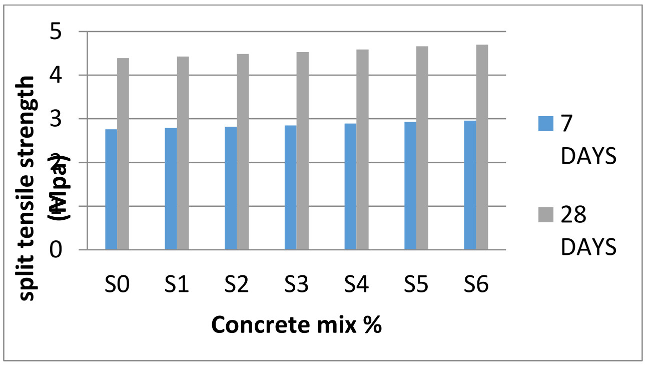

Figure 10: Split tensile strength at 7 & 28 days

VII. CONCLUSION

This study examined the compressive strength, flexural strength, and tensile strength of cement concrete that had been treated with polymers and included textile waste and Meta kaolin. The following is the primary finding from the evaluation of the test value of 5% polymer content with Meta kaolin 0%, 5%, 10% and 15% substituting conventional cement and 1%, 2% textile waste content.

- By reducing joint damage and cracks in concrete pavements, the addition of polymer to concrete has improved its properties.
- Meta kaolin will shorten the setting time it takes for cement pastes to cure, but it will make concrete less workable. The two qualities, however, are inversely influenced by polymer as it tends to decrease the setting time and increase the workability, thus balancing the mix.
- When used in conjunction with MK, the polymer mix of 80% SBR and 20% PVA produces an optimised result.
- The addition of 5% optimised polymer and 15% cement replacement using Meta kaolin results in an optimised concrete mixture for both strength and durability.
- Both the 7-day and 28-day compressive strengths improve as MK increases.
- The waste from textile cutting creates a special composite material that can be used in lightweight construction when combined with polymer concrete.
- Although adding textile fibres to the mix prevents unreinforced polymer concrete from showing symptoms of brittleness, they increase the compressive strength of the material very slightly.
- By using those fibres in particular applications, it may be possible to eliminate an environmental hazard and provide the construction industry with a substitute material.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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