UTILIZATION OF USED ENGINE OIL IN CONCRETE AS AN ADMIXTURE

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ABSTRACT:

Cement, aggregate, and water are used to create concrete structures. More difficult than at any other moment in recent memory, the building industries are proving to be. The engineering sector associated with the industries needs a chance to succeed in order to remain competitive. The usage of materials for building purposes is one of the areas that can be developed. In order to advance knowledge in the field of construction technology, this paper presents a special scope of investigation on engine oil in the concrete mix. The investigation of the characteristics of freshly-poured and fully-cured motor oil-containing concrete is presented in this work. In an effort to lessen the negative effects that disposing of used engine oil (UEO) in the environment has on marine, human, and undersea life as well as agricultural productivity, this study suggests using such waste material as a chemical additive in concrete manufacturing. In order to ascertain the impact of UEO on the various fresh and hardened characteristics of concrete, an experimental program is originally presented. To determine their impact on the qualities of new concrete, such as workability as measured by the slump, compaction factor, and initial setting time, concrete mixes of the M20 grade will be created with varying amounts of UEO and Superplasticizer. The effectiveness of concrete usually contains UEO (0%,0.25%,0.50%,0.75%,1%) and Water Reducing Agent (WRA) as Superplasticizer (0%,0.50%,1%) will then be thoroughly studied through the evaluation of the various material properties, including the concrete's compressive strength at 7 days and 28 days as well as its tensile strength and flexural strength.

Key words: Waste materials, Used-Engine oil, Environmental impacts, Superplasticizer, Admixtures.

I. INTRODUCTION

1.1. GENERAL

Utilizing greener technologies is becoming more popular nowadays. Many wastes are being used to replace the resources that are readily accessible on the market. Although the powerful superplasticizer function has been proposed by earlier researchers, the replacement admixture is a novel idea that has to be investigated. The building sector as well as the global use of concrete may be affected economically and technically by new types of cost-effective

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admixtures. This study was conducted in-depth at the same time as environmental concerns regarding the manufacturing of superplasticizers (SP) and the disposal of used engine oil (UEO) grew.

The concrete has outstanding workability related to SP's performance. However, the creation of SP is frequently linked to water contamination. Environmental standards were determined to have been broken by manufacturing waste that was dumped into the public sewer system, both liquid and solid. In addition to being dangerous, the chemicals employed in manufacturing processes have a negative influence on the environment.

Human and aquatic life are equally impacted by used oil. Oil builds up at the surface of bodies of water, creating a layer that filters sunlight, halting photosynthesis and preventing oxygen replenishment, killing out undersea life. Additionally, spent oil has certain hazardous components that can pass through the food chain and reach people. The breakdown of additives and the interactions of these compounds with other elements in nature are the major causes of contamination in used oil. In this situation, it is crucial to manage spent oil properly to avoid or reduce any potential environmental effects.

While this is happening, the global vehicle population is growing, which causes UEO output to rise. Every year, 380 million gallons of UEO are reportedly recycled. According to reports, only 45% of UEO is collected globally; the remaining 55% is released into the environment. In addition, 40% of all recycled oil is disposed of incorrectly.

Mindess and Young discovered the UEO's potential as an additive for concrete. They claimed that previous grinding equipment's oil leaks led to concrete that was more resistant to freezing and thawing. This suggests that adding UEO to the freshly mixed concrete might be like adding a chemical additive, improving some of the concrete's durability features while also acting as a different way to dispose of the used oil. Chin also mentioned that because of the SO3 concentration, UEO has comparable SP qualities.

One frequent and obvious type of contamination is oil. Due to the immiscibility of oil and water, even a tiny spill can result in severe contamination. Five liters of it may, according to studies, completely cover a small lake. Historically, encyclopedias on cement chemistry and concrete technology. It prompted a few academics to embrace and employ used-engine oil (UEO) in concrete mixtures in two independent trials. To get a comparable result to that obtained when employing air-entraining additives in concrete mixes, they added UEO to the constituents of concrete mixes.

Understanding the qualities of the material completely is crucial since the bond between the aggregate and cement paste is a crucial factor in determining the strength of concrete. To provide higher-quality and more sustainable construction materials, the concrete industry has thought of recycling industrial by-products for use as concrete additives.

Mineral additions and chemical additives are the two main categories of additives. Fly ash, slag, silica fume, and other pozzolans are mineral additions. On the other hand, chemical additives include things like air-entrainment, water reducers, superplasticizers, retarders, accelerators, and retarders. According to their uses, these additives are often used to produce different types of concrete techniques.

1.2. SCOPE OF THE WORK

This study uses used motor oil as a chemical additive in concrete to evaluate the qualities of the material both while it is new and after it has hardened. The findings of this study will be useful in deciding whether or not used motor oil may be used in concrete as an active compound. This analysis showed a novel method for using spent lubricant in concrete.

The most crucial need for every experimental inquiry carried out as part of a research program is the application of strong quality control methods in order to provide data that can be trusted. Thus, it would be possible to prevent inaccurate findings and a misleading trend by using the present code of rules and regulations for the choice of concrete-producing ingredients and mix ratios.

Use a water-to-cement fraction (w/c) of 0.50, 15 blends were cast. The proportions of water and used motor oil added to the cement were chosen based on its weight. preliminary investigation on the influence of UEO on several fresh concrete properties workability & setting time). Following the casting of various 150x150x150mm standard-sized cubes and the testing of their compressive strength after 7 and 28 days, the performance of concrete containing UEO (0%,0.25%,0.50%,0.75%,1%) and Water Reducing Agent (0%,0.50%,1%) will be carefully examined. The split tensile strength of standard 300mm-high, 150mm-diameter cylinders was assessed after 7, and 28 days of casting. Similar to this, 500x100x100mm standard beams or prisms are cast, and their flexural strength is measured after 7 and 28 days.

The same kind of aggregate, river sand, crushed granite material, and a specific ratio of coarse to fine aggregate are all included in each and every mix. The IS 10262-2009 Code method is employed to determine the proportionate amounts of cement, coarse aggregate, sand, and water. Through this study, the primary mix is M20 can be used. Six cubes, six cylinders, and six prisms are cast for each mix, and they are all inspected to check if the concrete has hardened.

1.3. OBJECTIVES OF RESEARCH

The contribution of this investigation program detailed in this dissertation was to

1. 1. Discuss the impact of introducing waste motor oil on the characteristics of freshly prepared and cured concrete.
2. 2. To test the idea that adding used motor oil to freshly mixed concrete would be analogous to adding a chemical additive, improving some of the concrete's durability attributes while also acting as a means of getting rid of the waste oil.
3. 3. To better understand the impact of the strongest constituents of the concrete, it was imperative to monitor the effectiveness of concrete made with used motor oil and superplasticizer to regular concrete.

II. LITERATURE REVIEW

According to N. Shafiq & CO (2016), UEO can enhance the workability, air content, and strength of OPC concrete by acting as a chemical plasticizer akin to a superplasticizer. With UEO and superplasticizer, OPC concrete yielded 3.9- and 4.4 times higher slump values than the OPC control mix, respectively. Equivalent changes in compressive strength of 10% and 12%, correspondingly, were caused by the incorporation of UEO and SP. It can be because the concrete has the right amount of water for hydration. Comparing UEO with SP, the inclusion below 1% dose results in nearly the same potency. As a result, it can be said that UEO, like SP, has the ability to increase concrete strength when used as a water-reducing additive. In line with the results of the reinforcement corrosion, adding 0.5% of UEO had no negative effects when compared to the control mix, indicating that UEO might increase durability. Used motor oil and superplasticizer generated 3% less penetration than the control mix when mortar samples were submerged in sodium chloride solution. Concrete cubes were heated to 500°C in an oven for a whole day to test the impact of used engine oil on fire resistance. Results indicated a strong drop of 11% or less, which is considered to be extremely minor; as a result, UEO did not enhance combustibility to concrete.

As said by Muhd Fadhil Nuruddin & CO (2011), the effects of fresh motor oil and waste motor oil on concrete mixtures were quite comparable. motor oil dosage in concrete served as a chemical plasticizer, improving the fluidity of fresh concrete and causing it to droop at a rate that was double that of the control mix. This pattern was followed by concrete mixtures comprising 40% and 50% fly ash. In comparison to the air content of the control mix, the proportion of motor oil in 100% OPC concrete raised the fresh concrete's air content to between 30 and 50%. SIKA AER almost increased the air content compared to the commercial chemical air-entraining admixture. The overall porosity of concrete was lowered by 0.15 percent engine oil between 14% and 27%, and by 7% to 11% by SIKA AER and superplasticizer, respectively. Compared to the control/reference mixtures, engine oil had a detrimental impact on the compressive strength of concrete. The compressive strength of the respective concrete mixes incorporating superplasticizer or air entraining agent was lower than that of the engine oil-based concrete, though. The dose of used engine oil with the lowest coefficient of oxygen permeability was 0.15 percent. Used engine oil decreased the permeability in the control mix with 100% OPC to roughly 65% of the control mix's coefficient of oxygen permeability used engine oil decreased the coefficient of permeability in fly ash-based mixtures to about half of the reference mix. It was possible to get a reliable statistical connection between oxygen permeability and porosity to compressive strength ratio that is close to the commonly used Cabrera equation.

Salahaldein Alsadey (2018) was revealed that research has been done to examine how concrete with a typical strength of 30 N/mm2 is affected by used engine oil. The main conclusions and suggestions of the work are that used motor oil can serve as a superplasticizer-like chemical plasticizer to enhance workability above the control sample. Used motor oil provides lubrication to keep the concrete more workable, based on the findings of the slump and flow test. The outcomes on compressive strength utilizing used engine oil reveal that it maintains the mix's strength with a small loss of roughly 1-2% in its strength when levels of 0.8% and 1.0% were added at the age of 28 days. Used engine oil concrete offers strength at a level that is approximately the same as OPC concrete, at 1%. As a result, it can be said that used motor oil has the ability to strengthen concrete by lowering water content. It is advised that used engine oil be used in research as both chemical and mineral admixtures because it improves the workability of concrete. Their use in concrete containing silica fume or metakaolin should also be thoroughly investigated to see if ultra-high strength concrete (100 to 150 MPa) can be produced.

Bilal S. Hamad (2003) As seen by analysis, 20 concrete mixtures were made to test how used motor oil hindered the properties of concrete. Studies on the characteristics of both freshly poured concrete and hardened concrete were conducted in compliance with ASTM guidelines. With the exception of the addition of an air-entraining agent (none, commercial chemical air-entraining admixture, used engine oil, or new engine oil), all companion mixes had the same water-cement ratio (0.62). In contrast to the marketed chemical air-entraining additive, used motor oil increased the air content of the fresh concrete mix (nearly by a factor of two). Average decreases in flexural strength, splitting tensile strength, and modulus of elasticity values of 21, 17, and 6%, respectively, were brought on by used motor oil. The comparable losses when the chemical air-entraining admixture was used were 33, 42, and 35%, respectively. Used motor oil kept the concrete's compressive strength, whereas chemical air-entraining admixtures consistently lowered it by around 50% over time.

As per Wasiu O. Ajagbe (2011), the content of oil in the sand controls how often COIS lowers the compressive strength of concrete. At a higher amount, the strength decreases. When contrast to concrete healed in the crude oil medium, the addition of COIS as the fine aggregate has a stronger influence on the concrete's compressive strength. When sands with a little more than 5% crude oil spill are incorporated, concrete lost and over 50% of its compressive strength. Crude oil contamination of 5% to 10% should be considered for low-strength concrete, such as Sand - crete block. To achieve the required strength, a design mix containing 5% COIS is required.

Robert McLaughlan (2019) has come to the conclusion that, albeit not considerably, increasing LCO concentration in mortar caused enhanced response inhibition (lower peaks) and delayed reaction. The hydration of different hydration stages changed (C3S, C3A, and C2S). The compressive strength and setting time, therefore, underwent alterations. In general, it was found that the LCO concentration increased together with the mortars' setting time. It was discovered that adding LCO to mortars reduced their compressive strength. The loss in compressive strength and LCO dosage are negatively associated; that seems to be, the higher the dosage, the greater the loss in strength. Moreover, the observed compressive strengths revealed a wide range of values, demonstrating that a variety of real-world end-user scenarios for mortar that had been influenced by LCO still were practicable. Due to this, correlations between oil content and mortar efficiency should yet be proven, even if stabilizing oil-contaminated material from the oil industry or polluted locations appears to be a feasible method of treating oil-contaminated materials. This is crucial for the development of construction materials that have properties that allow for reuse rather than disposal. Additional investigation is needed on the permeation and leachability behavior of stabilized mortars in order to better understand the causes of decreased strength and the potential release of oil from such mortars.

Deepti Singh (July 2016) planned to analyze slump and air content to identify the characteristics of fresh concrete, and compressive strength at ages 3, 7, and 28 days as well as flexural strength at ages 28 days to determine the qualities of hardened concrete. A control mix was created without any admixtures, and six different concrete mixtures were created with amounts of BEO (Burned Engine Oil) ranging from 0.20 to 0.40 to 0.60 percent, as well as commercially available air-entraining admixtures. The cement used was regular Portland cement, OPC43 Bangur Cement, which met the requirements outlined in IS-8112:1989. The sand was utilized as fine aggregate, while 10mm and 20mm aggregates were employed as coarse aggregates in compliance with IS-383:1970 requirements. Spent engine oil was recovered at the TVS mechanic shop in Phoolbagh, Gwalior, and Duraspred, a readily usable air-entraining supplement, which was employed in this experiment. Dura Build Care, New Delhi, provided the material. Concrete of grade M35 was made using cement, sand, and the coarse aggregate weight-to-mixture ratio of 1: 1.4: 2.498. With the addition of BEO to the concrete mix, an improvement in the air content of fresh concrete was observed. Positive effects were obtained, and they became better as they got stronger. Between 40% and 125%, more air was added by BEO. Results on compressive strength reveal that BEO preserved the mix's strength with a minor loss of just 2-8%, whereas the same quantity of commercial air-entraining admixture caused a strength loss of roughly 7–20% at the age of 28 days. As a result, concrete made with BEO had greater compressive strength than concrete made with commercial air-entraining admixture. When BEO was used in the concrete mix, the flexural strength decreased by around 2-9%, however, when commercial air-entraining additive was used, the flexural strength of the concrete mix decreased by roughly 9–20%. BEO appears to be a very effective air-entraining additive, saving roughly 32% of the cost of admixture.

Mohammed Noori Hussein's (2014) this research concluded that concrete with an average compressive strength of 0.75% and used motor oil will reach 29.7 MPa in 28 days. The most workable concrete is that made using used motor oil, followed by that made with fresh engine oil. Concrete that has been mixed with fresh motor oil is likewise more workable than the control sample. The results of the slump test show that adding motor oil will make the concrete easier to deal with. Engine oil will function in the concrete as a lubricant to make it more workable. However, compared to the control sample and concrete, Concrete having fresh lubricating oils showed improved compacting factors than concrete with old engine oil. The final compressive strength of concrete without motor oil is the greatest. Concrete with used engine oil and concrete with new engine oil have poorer compressive strengths in contrast to the control sampling as the use of lubricating oils in the concrete will lessen the bonding among aggregate and C-S-H gel. The outcomes of the research also reveal that concrete with used lubricating oils has a stronger compressive strength over concrete with new engine oil including use engine oil has a lower viscosity than new engine oil. Furthermore, the concrete with a 0.48 W/C ratio has a compressive strength that is greater than the control sample because less voids in the concrete improve compressive strength when the W/C ratio is low.

III. METHODOLOGY

The blends were created with the goal of giving concrete its maximum strength. The mix proportions of the different materials used in the concrete mixes are provided based on the IS 10262-2009 Code approach.

3.1. MATERIALS USED

A. Cement:

Owing to its own usage as an essential ingredient in concrete, mortar, stucco, and the majority of non-specialty grout, the kind of cement used is ordinary Portland cement which is most often used globally. Portland cement from the outside was the cement type used in this investigation. The physical parameters of Portland cement are displayed in Table 1. The 53 Grade Ordinary Portland Cement from Penna, a locally accessible brand, was the cement used throughout the experiment. It was lump-free and brand-new.

S.No	Property	Test result
1	Normalconsistency	29%
2	Specific gravity	3.11
3	Initial setting time	65min
4	Final setting time	550min
5	Soundness	3mm
6	Fineness (sieve)	95%

Table 1: Cement's Physical Characteristics

B. Fine aggregates:

As a fine aggregate, locally - sourced natural sand with a maximum size of 4.75 mm was used, which complies with IS 383-1970 grading zone II. Through sieve analysis, the fineness modulus and grain size distribution of river sand was calculated. The table lists the physical properties of fine aggregate, which may be purchased from nearby vendors.

S.No	Property	Test result
1	Specific gravity	2.64
2	Fineness modulus	2.52
3	Zone	II
4	Water absorption	1%

Table 2: Fine aggregate physical characteristics

C. Coarse aggregates:

Locally attainable crushed granite with a maximum particle size of 20 mm was used as coarse aggregate. The following table lists the physical parameters of coarse aggregate as determined by laboratory testing carried out in accordance with IS: 2386 (part 3) – 1963.

S.no	Property	Test result
1	Specific gravity	2.77
2	Water absorption	0.5%

Table 3: Physical characteristics of Coarse aggregate

D. Water:

Oils, acids, alkalis, salts, biological matter, and other pollutants that might harm concrete should not be present in the water used to mix concrete, including the free water on the aggregates.

E. Used engine-oil:

Used engine oil is depicted in Figure 1 of this study. In the making of concrete, they serve as additives. The auto shop is a good place to get old engine oil. From service stations, used engine oil (UEO) was collected in this work. At the service stations without adequate disposal, it was randomly collected.

S.No	Chemical composition	Used engine oil (%)
1	Fe_2O_3	0.43
2	CaO	15.9
3	SO_3	37.0
4	P_2O_5	8.95
5	ZnO	17.7
6	$C1^-$	15.9

Table 4. Chemical Composition of Waste Engine Oil.

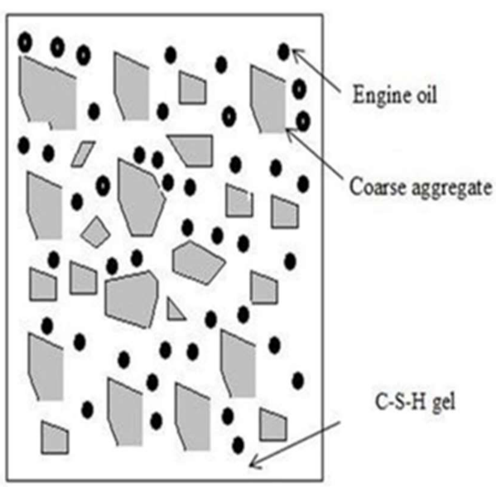

Fig.1.Composition of concrete

Fig.2. Used engine oil

F. Super plasticizer:

In order to make high-strength concrete, superplasticizers (SP) are added to fresh concrete to enhance its workability and enable the water content to be dropped. Fosrac Conplast SP 430 Dis is the material utilized in this investigation.

Fig.3. Super plasticizer (Conplast SP 430Dis)

3.2. MIX PROPORTIONS

To attain M20 grade strength, the concrete was designed in accordance with IS 10262- 2009, and a water-to-cement ratio of 0.5 was employed. Fifteen distinct mixes of Concrete with varying proportions containing UEO (0%,0.25%,0.50%,0.75%,1%) and Water Reducing Agent (0%,0.50%,1%) were tested to analyze the strength characteristics in terms of Compressive Strength, Flexural Strength, and Split Tensile Strength. Six cubes, six cylinders, and six prisms are cast for each mix and tested for hardened properties. The table shows the designed proportions of the basic ingredients in concrete.

S. No	**Material**	
1.	Cement	340 kg/m^3
2.	Fine aggregate	610 kg/m^3
3.	Coarse aggregate	1240 kg/m^3
4.	W/c ratio	0.5
5.	UEO	0%, 0.25%, 0.5%, 0.75%, 1%
6.	WRA	0%, 0.5%, 1%

Table.5. Mix proportions of different mixes

A. Casting of specimen

The necessary components were weighed for these mixed proportions. Separate dry blends of cement and coarse and fine aggregates were made. All components were blended into a homogenous mix after being added to the water and engine oil. Before being added to the dry components in the mixer, substances like spent engine oil and WRA are diluted with water.

The final casting of the mixtures was carried out right away after the testing for fresh characteristics. Test samples were cast, and they were then kept in the casting chamber for 24 hours at a temperature of around 20°C. The specimens were removed from the mould after 24 hours and were placed in a water-curing chamber until testing or as specified by the test.

Fig.4. Casting of Specimen

B. Curing:

The test samples are maintained in moist air for 24 hours, following which they are marked, taken out of the moulds, and remain immersed in water throughout the duration of the test. The curing water should be 27+-2°C in temperature and ought to be examined every seven days.

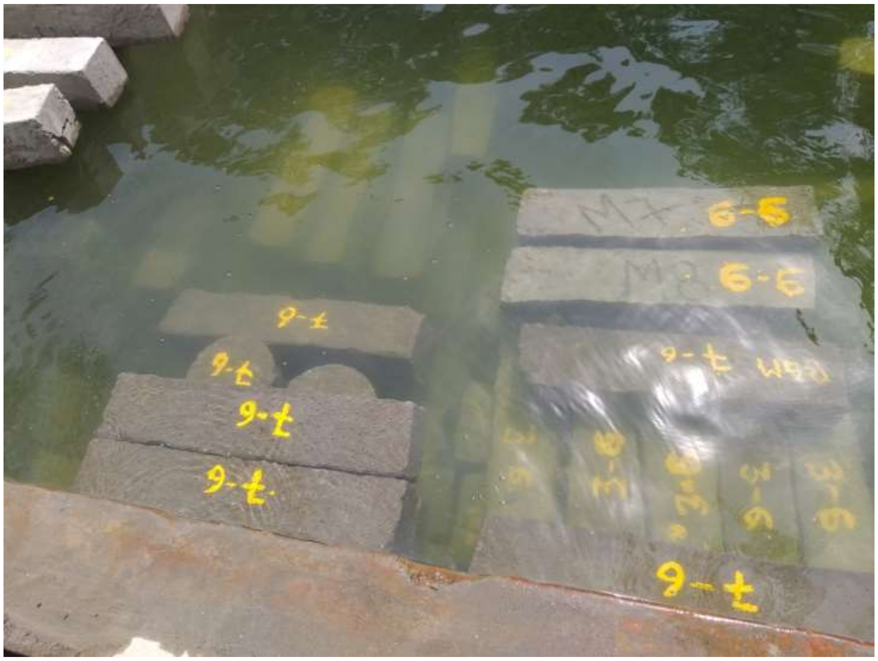

Fig.5. Curing of Specimen

IV. RESULTS & DISCUSSIONS

4.1. GENERAL:

Listed below is a discussion of the properties that were evaluated while concrete was in its fresh condition and its hardened state, along with the experimental findings that were made.

4.2. FRESH PROPERTIES OF CONCRETE:

The workability test is connected to the test of newly laid concrete. To determine the workability of concrete, four different types of tests are often employed. The four distinct test types are the flow test, the Vee bee test, compacting factor test, and the slump test. The slump test and the compacting factor were chosen as the workability tests for this investigation.

Concrete's fluidity and consistency are indicated by its slump value. It measures how easily concrete can be shaped. Higher slump values indicate more workable concrete, whereas lower slump values indicate less workable concrete. The values for slump for various concrete mixtures are displayed below.

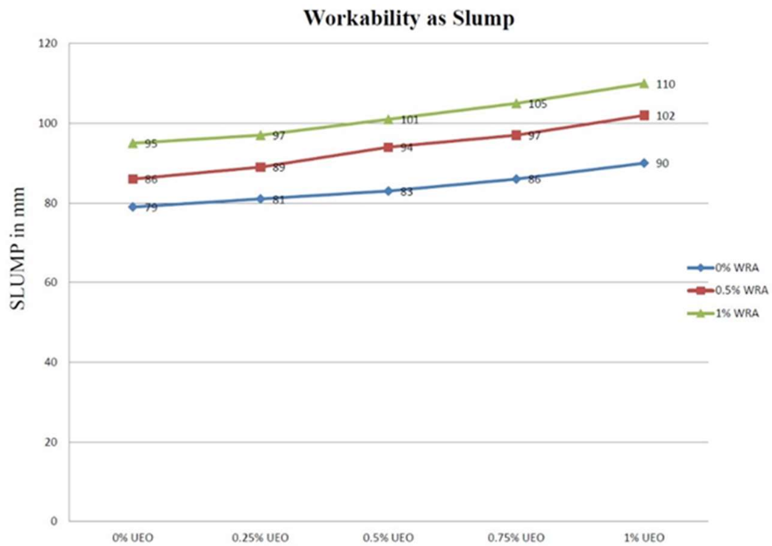

Fig.6. Slump values of different mixes in mm.

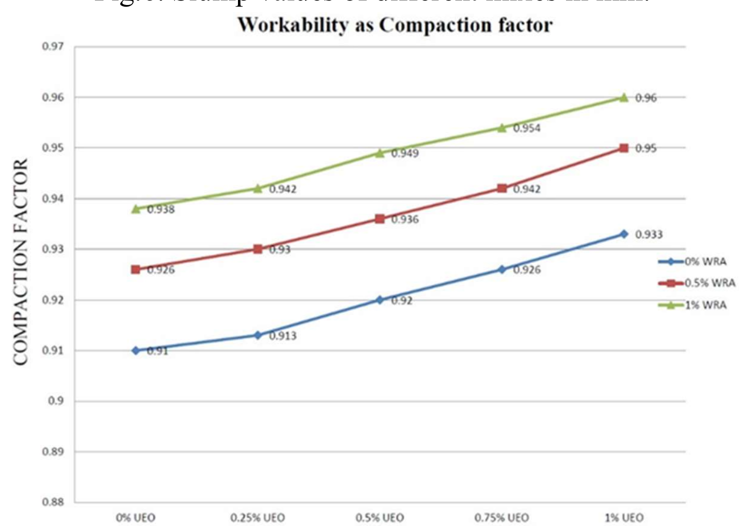

Fig.7. Compaction factor Values of different mixes.

The findings demonstrate that, with compare to the slump of the control mix, the mix's slump values were enhanced by the inclusion of used engine oil. When the dose of used engine oil was raised by 1%, the range of enhanced slump value rose from 79mm to 110mm (UEO and WRA). When the dose of old engine oil was raised to 0.25 percent, 0.50 percent, 0.725 percent, and one percent, The value of the slump gradually increased. Similarly, the results obtained from the compaction factor test also follow the same trend as the slump test. A similar phenomenon was observed when Conplast SP 430Dis was used as Superplasticizer. The increase in workability is mainly due to the presence of UEO as it exhibits the flow properties and the Conplast SP 430Dis act as the water reducer for having similar w/c combination in order to keep everything workable. It concludes that the combination of UEO and WRA will give effective results.

4.3. HARDENDED PROPERTIES OF CONCRETE:

From the explanation above, it is clear that adding UEO as an additive has a reasonable influence on the different properties of concrete when it is still fresh. Therefore, it is crucial to consider whether these effects will lead to changes in the varying characteristics of concrete during its hardened condition. The experimental program was carried out as a consequence.

A. Compressive strength test:

A material's ability to support loads that tend to compress it is measured by its compressive strength. Incorporating different doses of UEO into OPC concrete resulted in a minor reduction in the 28-day compressive strength, as seen in Figs. 8 and 9. These results were shown in Fig. 6.

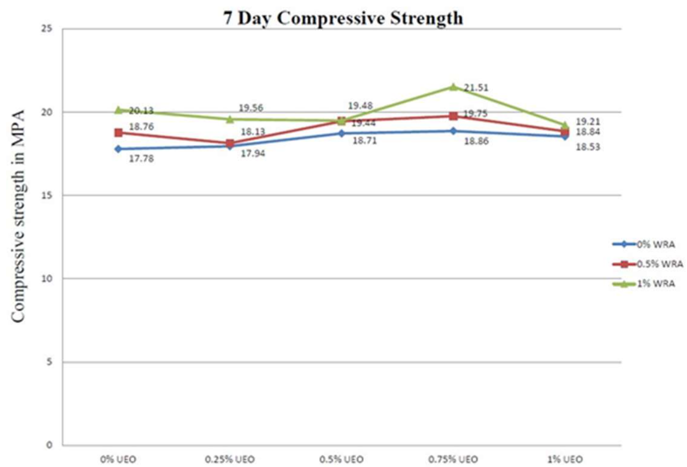

Fig.8. Compressive strength after 7 days

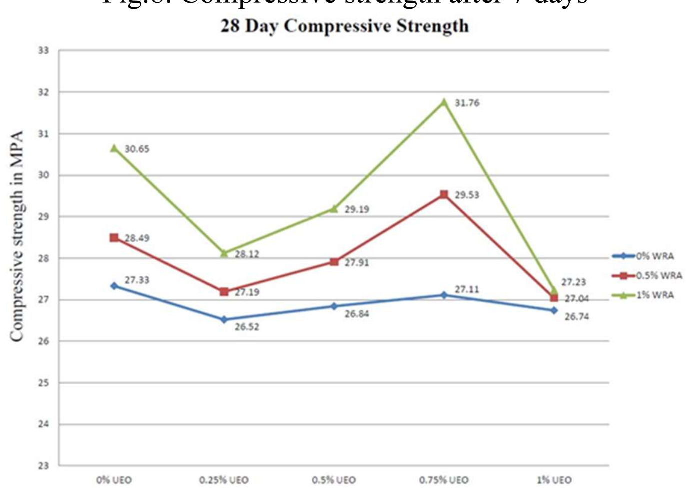

Fig.9. Compressive strength after 28 days

Comparatively to conventional concrete, the findings show that the compressive strength of concrete deteriorates between 0% and 0.25% between the ages of 7 days and 28 days, and after that from 0.25% to 0.75% the compressive strength is subsequently increased at the standard rate in both the mixes containing UEO and WRA. With the addition of WRA to UEO, we can observe a slight rise in the graph which represents a rise in the strength of concrete. While the mix proportion of UEO & WRA together in the conventional mix at 0.75% & 1% respectively was used the maximum Concrete attains its compressive strength. when compared with the conventional mix. Therefore, it can be extrapolated that utilizing UEO itself results in a minor loss in compressive strength and that introducing WRE to UEO has likely to improve concrete strength.

B. Split tensile strength test:

Testing for splitting tensile strength was done, on cylindrical specimens of Standard 300mm-height, and 150 mm diameter positioned horizontally on the compression testing machine. Application of the load till failure.

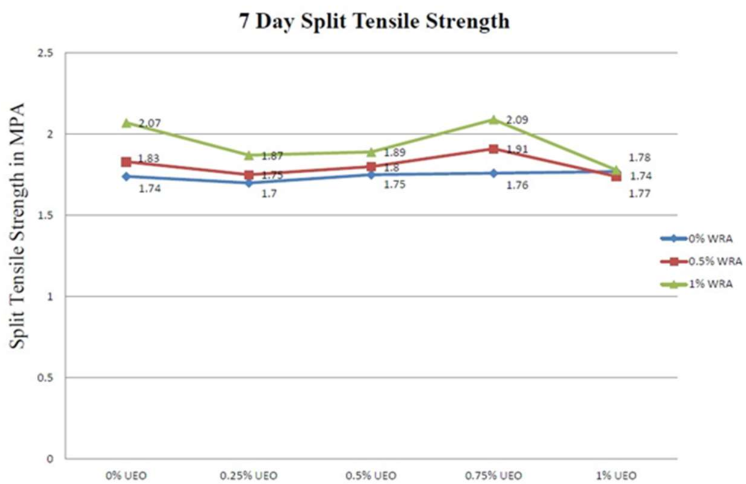

Fig.10. Split tensile strength after 7 days

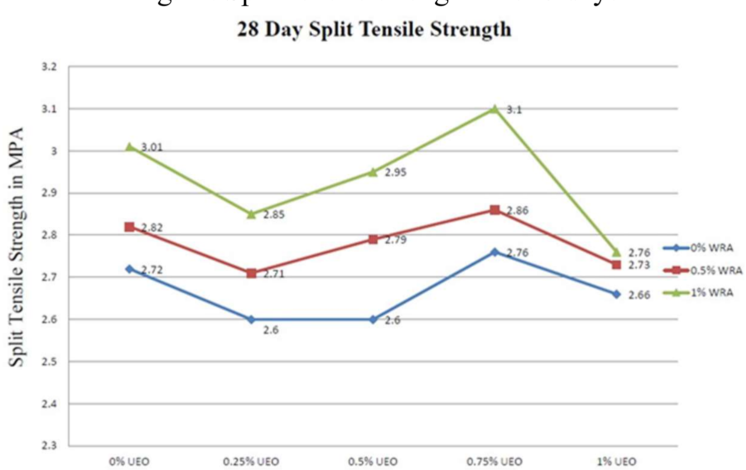

Fig.11. Split tensile strength after 28 days

When compared with normal concrete, the findings show that the Split tensile strength of concrete deteriorates between 0% and 0.25% between the ages of 7 days and 28 days, and after that from 0.25% to 0.75% the compressive strength is subsequently increased at the standard rate in both the mixes containing UEO and WRA. With the addition of WRA to UEO, we can observe a slight rise in the graph which represents a rise in the strength of concrete. While the mix proportion of UEO & WRA together in the conventional mix at 0.75% & 1% respectively was used the maximum tensile strength of concrete is achieved when compared with the conventional mix. Therefore, it can be extrapolated that utilizing UEO itself results in a minor loss of tensile strength and that introducing WRE to UEO has likely to improve concrete strength.

C. Flexural strength test:

Testing was performed after 7 and 28 days of water curing to ensure compliance with IS 516-1959. The specimen was held on two rollers supports on the testing machine, with a 400 mm spacing between the centers. Until its breakdown, the load was applied hydraulically through two equal rollers placed at the third point of the supporting span.

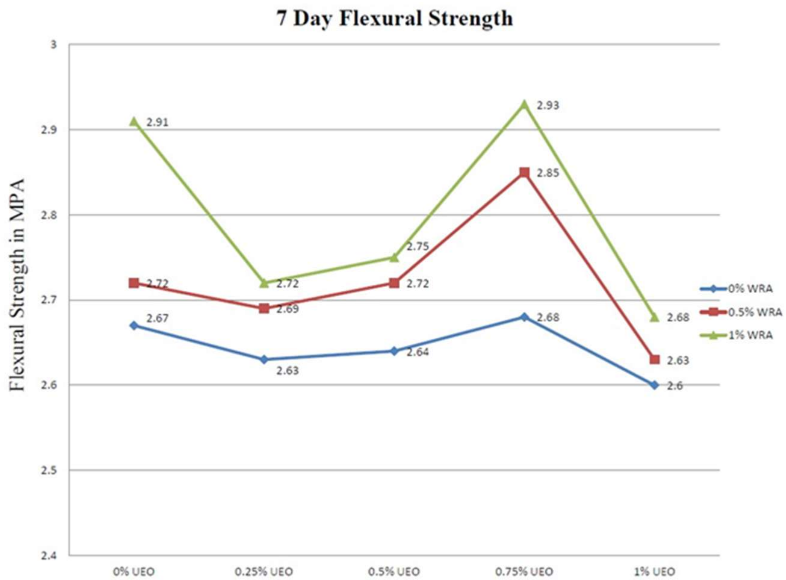

Fig.12. Flexural strength after 7 days

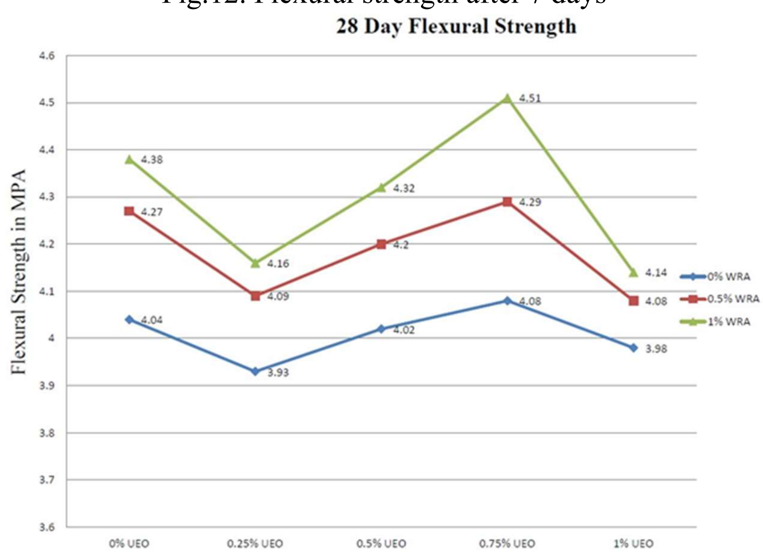

Fig.13. Flexural strength after 28 days

When compared with normal concrete, the findings show that the flexural strength of concrete deteriorates between 0% and 0.25% between the ages of 7 days and 28 days, and after that from 0.25% to 0.75% the compressive strength is subsequently increased at the standard rate in both the mixes containing UEO and WRA. With the addition of WRA to UEO, we can observe a slight rise in the graph which represents a rise in the strength of concrete. While the mix proportion of UEO & WRA together in the conventional mix at 0.75% & 1% respectively was used the maximum flexural strength of concrete is achieved when compared with the conventional mix. Therefore, it can be extrapolated that utilizing UEO itself results in a minor loss of tensile strength and that introducing WRE to UEO has likely to improve concrete strength.

V. CONCLUSION

These findings must be unique to this study. However, the outcomes of this study should contribute meaningfully to our understanding of how used motor oil affects the characteristics of concrete. Following are the study's key findings and suggestions for further research:

1. Used engine oil has a higher degree of workability than the control sample due to its ability to act as a chemical plasticizer akin to a superplasticizer. According to the outcomes of the slump and compaction factor test, the used motor oil acts as a lubricant in the concrete, making it easier to work with.
2. Hardened strength attributes utilizing used engine oil showed that the mix's strength was maintained with just a minimal loss of 1-2% in strength. With respect to control trials, concrete containing reused engine oil has a marginally weaker compressive strength because the use of engine oil would impair the bonding among aggregate and C-S-H gel. Prior to 0.25% of UEO, this difference is insignificant; after that, it grows to 0.75%; after that, it drops again at 1% of UEO. The outcome of this study also demonstrates that used motor oil-infused concrete has comparable compressive strength characteristics to control-mix concrete. The results of hardened strength properties using superplasticizer similarly that it has slightly lower compressive strength that is negligible up to 0.25% of UEO and after that strength increases to 0.75%, after this at 1% of UEO strength again decreases compared to the control sample It may due to the optimum or enough water content for hydration process in concrete.
3. When comparing the strength of UEO and SP, incorporation levels below 1% are nearly equivalent. As a result, it can be said that UEO, like SP, has the ability to increase concrete strength when used as a water-reducing additive.
4. When UEO and WRA were used in a standard mix at 0.75% and 1%, respectively, the findings reveal that the maximum hardened characteristics of concrete were reached.
5. When evaluated at 28 days compared to the typical concrete mix, the highest compressive strength was discovered at 0.75% of UEO with 1% of WRA, and the compressive strength is enhanced by 16.2%.
6. When evaluated at 28 days as compared to the typical concrete mix, the greatest Split Tensile strength was discovered at 0.75% of UEO with 1% of WRA, and the Split Tensile strength is enhanced by 13.9%.

7. When evaluated at 28 days as opposed to the usual mixed concrete, the highest flexure strength was discovered at 0.75% of UEO with 1% of WRA, and the flexure strength is enhanced by 11.6%.

Recommendations:

a. More study is necessary before proposing the use of motor oil waste as an additive in the concrete segment, notwithstanding the favorable implications of the test findings. Examining the impact of spent motor oil on the reinforcement concrete structural behavior components is one field of research.

b. The function of water curing techniques and time on the impact of used motor oil on the characteristics of concrete.

c. Used motor oil's compatibility with other wastes or byproducts used in concrete, including pozzolans (fly ash, silica fume, etc.).

d. Analyzing the impact of adding used motor oil on concrete's resistance to corrosion, sulfate attack, carbonation, and some harsh environments. Estimation of probable byproduct leaching from the produced concrete mix.

VI. REFERENCES

[1]. Hamad, B. S., Rteil, , A. A. and El-Fadel, M. (2003), "Effect of used engine oil on the properties of fresh and hardened concrete", Construction and Building Materials, Vol. 17, pp. 311-318.

[2]. Samarin, A. (1999), " Wastes in concrete: converting liabilities into assets", Proceedings of the International Seminar on Exploring Wastes in Concrete, Edited by Dhir, R., and Jappy T., Scotland, pp. 1-21.

[3]. Ibrahim, T. H. and Al-Zubaidy, A. H. (2007), "Assessment of using unleaded fuel in harsh environment of the United Arab Emirates", Journal of Environmental Management, Vol. 85, pp. 171-178.

[4]. Lomborg B. (2001), The Skeptical Environmentalist: Measuring the Real State of the World (2nd edition), United Stated of America, The press Syndicate of The University of Cambridge.

[5]. Hamad, B. S. and Rteil, A. A. (2003), "Effect of used engine oil on structural behavior of reinforced elements", Construction and Building Materials, Vol. 17, pp. 203-211.

[6]. Shafiq, N., Nuruddin, M.F. and Kamaruddin, I. (2006), "Effectiveness of used engine oil on improvement of properties of fresh and hardened concrete" Proceedings of the 6th Asia-Pacific Structural Engineering and Construction Conference (APSEC 2006), Kuala Lumpur, Malaysia, 5-6 Sept. 2006, pp. 159-166.

[7]. Ho, D.W.S, Mak, S.L. and Sirivivatnanon (26-27 August 1991). "Performance of Concrete Incorporating Chemical and Mineral Admixtures". 16th Conference on Our World In Concrete & Structures.

[8]. McCarter, W. J., (1993), "Influence of Surface Finish on Sorptivity on Concrete", Journal of Materials in Civil Engineering, Vol. 5, No 1, pp. 130-136.

[9]. Hall, C., (1989), "Water Sorptivity of Mortars and Concretes: A review", Magazine of Concrete research, Vol. 47, No. 147, pp. 51-61.

[10]. Claisse, P. A., Elsayad, H. I. and Shabaan, I. G., (1997), "Absorption and Sorptivity of Cover Concrete", Journal of Materials in Civil Engineering, pp. 105-110.

[11]. SERGI, G. (1986). "Corrosion of steel in concrete: Cement matrix variables", Ph.D. Thesis, Aston University, England, UK, 395 pp.

[12]. Parrott, L.J., (1992), "Variations of Water Absorption Rate and Porosity with Depth from an Exposed Concrete Surface: Effects of Exposure Conditions and Cement Type", Cement and Concrete Research, Vol. 22, pp. 1077-1088.

[13]. Rahman, A. A. and Glasser, F. P. (1989), "Comparative studies of the carbonation of hydrated cements', Advances in Cement Research, Vol. 2, No. 6, pp. 49-54.

[14]. Du, L. and Folliard, K. J. (2005), "Mechanisms of air entrainment concrete", Cement and Concrete Research, Vol. 35, pp. 11463-1471.

[15]. Ramachandran, A. I. (1969), "Application of different thermal analysis in cement chemistry", Pub. Chemical Publishing Company, London.