Study the Interesting from the plastic Waste to Improve the Physical and Mechanical Properties of the Construction Materials

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Abstract Plastic products have been considered as the world most consumer, which have led to use the waste plastic in the Construction Materials. This research studies the investigation the mechanical properties of the modified cement mortar with different additive from the waste plastic to Production light concrete with high mechanical and structure properties. The plastic waste in environment is considered to be a big problem due to its very low biodegradability and presence in large quantities. This work an effort has been completed to study for the result of waste Polyvinyl Chloride on the properties of the mechanical of mortar materials. The Polyvinyl Chloride can be used as energy enhance to produce the light concrete strength and used to help waste of the plastic to enjoy with the mixture, waste Polyvinyl Chloride is additional to the materials of the mortar by percentage of adding (0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8 and 0.9 %) that can be mix with alone for every samples with the water. The compressive strength between the mortar with various quantity of Polyvinyl Chloride plastic waste additive at different curing age, that the Polyvinyl Chloride plastic waste additive does not help in enhancing the compressive strength of the mortar but can be produce light mortar. The compressive strength drop to 32.1MPa for mortar mixture /PVCL For 28 days. The flexural strength of cured Polyvinyl Chloride mortar was found to be decrease with increasing the percentage of the addition and increasing with increase of the period of the curing for each percent of the addition. The modified mortar show a significant decrease in flexural strengths, that no improvement in the flexural strength as compared to ordinary concrete or mortar. The flexural strength drop to 4.5MPa for mortar mixture /PVCL For 28 days. Density of mortar with PVCL has decreased significantly for all mortars with the content of partial replacement of cement by PVCL plastic waste. It is evident that water absorption reduces considerably with increase in PVCL ratio. As seen, a 0.9 wt% PVCL addition can reduce the water absorption to 80% after curing age 28 days of the value obtained for the unmodified paste. The hardness of the mortar sample is reduced by increasing PVCL ratio at all age curing. The maximum hardness at 0.9% additional is about 92.8 for PVCL, respectively at 28 days. Ultrasonic wave propagation speed in a material depends on the porosity of that material; it depends on the density and elastic properties. The effects of PVCL addition on the porosity of composites were evaluated by ultrasound measurements carried out.

1. Introduction

Cement-based materials behave like typical porous, brittle materials [1–3]. Brittleness makes the cement material easy to crack under the action of external force, which adversely affects the bearing capacity and durability of cement concrete structures. Polymers have good elastic deformation properties,
flexibility, acid and alkali corrosion resistance, and good compatibility with cement materials, which can effectively improve the mechanical properties, deformation properties and durability of cement-based materials [4–9]. Karthikeyan at. el. This research presents the result of adding waste plastic on the properties of the mechanical of concrete. The fast urbanization and industrialization all over the world has resulted in large deposition of waste polymer materials. Waste plastic is one of the environmental pollutant. Most plastics are normally stable and non-degradable in the natural environment even after a long period of exposure. Large quantities of discarded end-of-life are accumulating as debris in landfills and in natural habitats worldwide. Dumping plastic materials is an important problem it causes wide range of problems. In order to reduce the plastic waste, it can be recycled in construction industry. Plastic is made out of inorganic compounds so it can be mixed in the concrete without significant effect on its properties of concrete. Concrete is the most common composite material involves of cement, water, fine and coarse aggregate. Inclusion of waste plastic in concrete can be improved the physical and mechanical properties of concrete. Concrete was prepared of W/C 0.35 with a percentage of waste plastic substituted by 10% of cement, fine and coarse aggregate used in concrete. Mortar cube, size(150x150x150)mm, 300 mm length, diameter cylinders150mm were casted[86].

Reuse of recycled plastic waste in concrete has been reported by a number of researchers in recent times. It was described by Khilesh (2014) investigates the adding of waste plastics along with harden fibers in solid concrete. Two type of blend be casted in cubes, one mix changing the percentage of plastic waste by weight of cement 0.2%, 0.4%, 0.6%, 0.8% and 1% and one more mix of harden fibers 0.1%, 0.2%, 0.3% 0.4% and 0.5% by mass of cement to improve the strength of the compressive of concrete. He observed that, the incorporate blend of plastic waste has revealed more force as compare to concrete blend. He achieved that the maximum compressive strength at plastic waste 0.6% mass of cement when use with harden fiber of 0.3%. [10].

Subramani and Pugal (2015) have calculated partial substitution of waste plastic as a more coarse aggregate to improve the strength of the compressive, strength of the flexural and split strength of the tensile of concrete mixes. The replacement was made of three different ratios 5%, 10% and 15%. The mechanical and physical properties of concrete were improved 8%, 5% and 3% in comparison with controlled concrete at 15% replacement level. However strength obviously decrease when the percentage of waste plastic replacement more than 15%. They have concluded that more than 15% of plastic waste aggregate can be combined as coarse aggregate substitution in concrete without any long term detrimental special effects and with satisfactory force advance property. [11].

Harini and Ramana (2015) adopted waste plastic as partial substitute of very well aggregate and silica fume replacement of cement in concrete. Experiments had been conducted on properties of the strength of M 30 rank concrete. It was adopted with various plastic fraction 5%, 6%, 8%, 10%, 15%, 20% by volume. The strength of the compressive decreased when the proportion of plastics to aggregate was improved. The strength properties were studied for mix has partly replace cement with silica fume of 5%, 10%, 15% by weight. It was showed that when the cement was partially replaced by 10%, 15% of silica fume was upper than suggestion combine. [12].

M. Muzafaret. al. studied the partial substitution of more coarse aggregate in concrete by recycled plastics to investigate the property of concrete, for instance workability, compressive, tensile force and thermal characteristics of concrete. The results showed that when using plastic solid waste in concrete lead to lightweight concrete; in addition, properties such as compressive, strength of the tensile and the thermal conductivity of concrete are reduced. [13].

Jais J. et. al. studied the properties of polymers used for repairing works of concrete structures. Tow type of polymers have been added to mortar as a polymer modified mortar, SBR and Acrylic for different applications. The ratio of water cement was preservedat 50%. Compressive strength, flexural strength, bond strength and water permeability of these polymers modified mortars were investigated. Two ratios of sand/cement were adopted 1.3 and 1.2 while polymer/cement ratios were diverse as a percentage of
5%, 10%, and 15%. The flexural strength and bond strength results improved for two type of polymers modified mortar but the results of water permeability was lower than plain mortar. However the bond strength with 15% polymer addition was equivalent to that of bond strength of an epoxy based polymer bonding agent[14].

The study of this work focus on the effect of Polyvinyl Chloride on the properties of the physical and mechanical by the reinforcing the cement mortar.

2. The Experimental work

2.1. The Materials of this work

2.1.1. Cement
Cement type Portland can be employed in this work and have its fineness according to ASTM C204–05 [15] 3914 cm²/g. must save the cement in the dry place to lowering the effect of moisture of the environmental.

2.1.2. The waste of the plastic
The waste of the plastic which used in this study have been high density waste Polyvinyl Chloride from plastic which use in the environmental

2.1.3. fine aggregate (sand)
Can be use the sand which inside the zone (2) according to the necessities of IQS 45/1984 [16].

2.1.4. fluid (water)
The fluid which can be used in the this work is water, which used for all the mixture of the cement for the samples which contain the waste of the plastic and nanomaterials in casting and curing. The ratio of this fluid (C/W) is 45%

2.2. The mechanical and physical properties.

2.2.1. The strength of the Compressive
The strength of the Compressive test was applied according to the ASTM C109 - 02 that can be fulfilled [17].

2.2.2. The strength of the Flexural
The strength of the Flexural can be applied the steps of ASTM C 293 - 03 the force of the Flexural analysis was can be satisfied [18].

2.2.3. The Density of the mixture
The density of all samples calculating at the ending of every curing grow old (7, 14, and 28 days respectively), the mixture cubes were separate from the container which can be used for the curing and allowable to bleed dry. The cubes was weighting after the separate from container to set the density of the mixture cube [19].

2.2.4. Absorption of the water
The absorption of the water analysis cause to the strength known to the force of the passageway, the opening of the minute of the structure due amount of fluid which can be rushed in the formation of the physical for the substance. The whole amount of fluid saturated up by mixture which contain tension of fluid and the impede influence of the mixture. The mixture are level and affect by the absorption of the water analysis in the ending fraction of the treatment inside the period of 7, 14, 28 and 90 days after the method of dismantle, remove, reassembling, and finally relocation. The investigate absorption of the water of every sample were expressed as the add to in the mass proportion of the furnace dry mass [19].
2.2.5. hardness of the shore (ASTM D-2240)

Hardness of the shore is a standard element of determine the hardness and which can to seen from the given name of the term.

2.2.6. The analysis of the SEM

The analysis of the SEM calculate to learning the broken microstructure piece of the sample, This analysis is employing on the sample after finishing the curing of 90 day By employ the way of VEGA3/ Test scan SEM machine.

3. Results And Disscation

The results and discussions are applying on the experimental work which includes all physical, microstructure and mechanical properties (setting time, flow test, density, absorption ratio, compressive strength, flexural strength, hardness test, SEM test and ultrasonic pulse velocity test (UPV)). The strength of the compressive is consider one of the largely important property of hardened concrete. Usually it is the major distinguishing value to calculate the concrete quality in the national and international codes. For this cause, it is of individual importance to study whether the change in the mix composition will effect on the early on and later strength of the compressive. Figure 1 shows the difference of strength of the compressive between the mortar with various quantity of Polyvinyl Chloride plastic waste additive at different curing age (7, 14, and 28) for the cement. Too, the figure shown that the waste Polyvinyl Chloride additive does not aid in improving the strength of the compressive of the mortar but can be produce light mortar. Although the waste Polyvinyl Chloride particle have packed up the void space in the mortar, they are not totally included into the mortar mix. This cause the bond among the mortar and waste Polyvinyl Chloride particles turn out to be weak. This was unlike with the previous study by Nehdi and Sumner (2002) who employ waste latex paint (WLP) in fluid shape. The strength of the compressive of concrete samples with different proportion of WLP and virgin latex at 28 days curing period are upper than that of control. This was probable suitable to polymerization of the latex monomers that form a latex film filling pores in the inside structure of concrete.

**Figure 1.** The effects of PVCL% on compressive strength of the mortar

The strength of the Flexural is an main property of any mortar if it use in the building of bridge decks, pavements etc. This analysis was conduct at the period of 7, 14, and 28 days for the mortar for all samples with and without addition. In the general form, the flexural strength of cured PVCL waste with mortar was found to be decrease with increasing the percentage of the addition and increasing with increase of the period of the curing for each percent of the addition. The latex modified mortar show a major decrease in strengths of the flexural, that no enhancement in the strength of the flexural
as compare to normal or mortar. This is interpreted in terms of the contribution of the low strength of the tensile of the polymer itself and no development in the in general link in the aggregate-binder. The properties of the strength for the modified mortar are subjective by a amount of factor interact with each other. The nature of components use, the control factor for blend proportioning, curing methods and analysis method. The produce of curing condition on the strength of the flexural of modified mortar and base on unlike dosage and kind of polymers is use. Favourable curing surroundings for modified mortar and be different from that of mortar and for the reason that of the two phase binder with unlike property. Best strength of the cement paste is obtain under wet conditions, whereas force development in the polymer depend on a age where the combination dry out. Modified mortar base on latex may even lose some strength of the tensile when rewetted, but the strength is usually regain after a new age of drying out. Figure 2 shows the flexural strengths of the cement mortar with the PVCL at the ages of 7,14, and 28 days along with the flexural strength. The figures depicts the flexural-strength of the prepared specimens at ages of 7,14 and 28 in order to examine the manifestation of the flexural-strength properties in the modified cement mortars before and after performance the addition. As shown in the figures, the flexural strengths of modified mixture decreased by approximately at all age of the curing when compared to that of control mixture. In particular, the flexural strength of modified decreased by more than 7% over that of AC even after all age of the curing, indicating that there was an no enhancement effect in the aged materials. The reason for this result was that. The PVCL film inside the polymer cement mortar was accelerated by the increase polymer particle size, resulting in a more elaborate form of film. This technique, in turn, inhibited the evaporation of water inside the mortar, and increase part from the water which causing hydration to occur over a long period. As a result, the strength tended to increase as the age increased and decrease with increase the percentage of the addition for each age curing. The decreased total pores and the increased micro pores with air entrainment control, together with the increase polymer particle size, made it possible to penetrate quickly between the aggregates and cement, decreasing the binding abilities.

![Figure 2](image.jpg)

**Figure 2.** The effects of PVCL% on flexural strength of the mortar

The density is one of the most important factors to control many physical Characteristics in lightweight mortar and through the amount and density of lightweight mixture. The Previous studies confirm that the density of lightweight mortar decreases with increase in volume of PVCL waste or plastic which causes a decrease in density and for all the mixture. The increase in PVCL leads to decrease in density of the mortar and mixture and produce the lowest value of density. Density of mortar and with PVCL has decreased significantly for all mortars with the content of partial replacement of cement by polymer and plastic waste, which shown in figure 3. This reduction in mortar and density contained in PVCL
may be due to the replacement of heavy material cement with a lighter PVCL. The density of the plastic mortar has been reduced to 1.83 for the mortar and 2.3 for the PVCL. The result shown that density of produced mix mortar PVCL was different depending on the percentage of mixture.

![Figure 3. The effects of PVCL% on density of the mortar](image)

When brought in contact with water, cement paste absorbs water because of its porous microstructure. The lower the absorption of the water, the lower the permeable pore volume. Measurement of absorption of the water of cement pastes enhanced by PVCL is therefore a easy way to confirm the results obtained for density and total porous hole volume. The effect of polymer addition on absorption of the water for hardened cement paste is shown graphically in figure 4. It is evident that absorption of the water reduces considerably with increase in PVCL ratio. As seen, a 0.9 wt% PVCL addition can reduce the absorption of the water to 80% after curing age 28 days of the value obtained for the unmodified paste. This indicate that the PVCL adding result in decrease of the porosity of the paste. Other study also show that the polymer is filling the void in the cement medium. Polymer-modified cement pastes are therefore expected to be more resistant towards penetrating aggressive environments than control cement paste. Too, The cause for this watching is that the fine particle of pozzolan mass the channels between capillary pore in cement paste and cause more homogenous division follow-on in less pore structure and porous voids. Then the addition PVCL changed the absorption of the water property.
Shore D Hardness is a standardized test consisting in measuring the hardness of the surface for the materials. Figure 5 shows the cement mortar hardness with different percentages of PVCL at 7, 14 and 28 days. Obviously 28 days have a higher degree of hardness for each percent of the addition (the hardness of the cement mortar for 0.9 % from PVCL greater than that for the other age ). The hardness decreases with the increase of the ratio of PVCL because the hardness will be carried out according to polymer type and quantity. The hardness of the mortar sample is reduced by increasing PVCL ratio at all age curing. The maximum hardness at 0.9% additional is about 92.8 and 91.4 for PVCL, respectively at 28 days. When the cement is replaced by PVCL that lead to decrease the hardness in all age. The results of hardness at an early age (7, 14, 28 days) shall be less than the reference mortar.

The addition of plastic materials to the concrete mix accounts for the porosity and running dispersal of the transmitted ultrasonic speed. The ultrasonic transmission speed value also increased when the density of concrete was light, thus causing a reduction in the transmission of ultrasonic speed. Therefore, wave of the Ultrasonic spread speed in a substance depends on the porosity of that substance; it depends...
on the solidity and flexible property. The effect of PVCL adding on the porosity of composite were evaluate by measurements of the ultrasound carried out. Wave of the Ultrasonic velocities of mortar specimen at 7, 14, and 28 days are known in figure 6. It be see in figures that, the wave of the ultrasonic velocity value of specimen decrease as the quantity of PVCL increased in mixture. This is attributed to the decrease in unit weight with the enhance of quantity of PVCL with substitution the cement in mix. Too, the compression and density of concrete decreases, the ultrasonic wave velocity and strength of concrete decrease. Plastic material was added to the mortar mixture, which caused a decrease in the transmission speed of the ultrasonic machine.

![Ultrasonic velocities of mortar specimens](image)

**Figure 6.** The effects of PVCL% on ultrasonic pulse velocity of the mortar

### 4. Conclusion

The addition of the Polyvinyl Chloride plastic to the mortar does not help in improving the strength of the compressive of the mortar but can produce light mortar. The modified mortar show a more significant decrease in strength of the flexural, that no development in the strength of the flexural. This is interpreted in terms of the contribution of the low strength of the tensile of the PVCL waste itself and no improvement in the overall bond in the aggregate-binder. Density of mortar with PVCL waste has decreased significantly for all mortars with the content of partial replacement of cement by PVCL plastic waste, this led to produce light weight mortar. The addition of PVCL to the mortar cause to reduce the absorption ratio. This indicates that the PVCL addition results in reduction of the porosity of the pastes. Therefore the addition of PVCL can be improve the absorption ratio. The hardness decreases with the increase of the ratio of PVCL because the hardness will be carried out according to polymer type and quantity. Ultrasonic wave propagation speed in a material depends on the porosity of that material; it depends on the density and elastic properties. The ultrasonic wave velocity values of specimens decreased as the amount of PVCL increased in mixture.

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