Effects of Varying Curing Time and Water-Cement Ratio to the Strength of Concrete with Heavy Metal Contaminated Coco Peat

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Keywords: coco peat, heavy metal contamination, waste management

Introduction

Industrial wastewater is a major source of heavy metal pollution. This includes effluent from mining operations. Due to the growing mining industry in the Philippines, there is an increase need for wastewater treatment. However, small-scale miners cannot afford the costs of the construction of wastewater treatment facilities. Hence, they directly discharge their untreated wastewater to the nearest bodies of water, such as river and sea, in the vicinity. This is the case for the small-scale miners in Paracale, Camarines Norte.

As a solution to this, a recent study entitled A Research Project Removing Heavy Metals From Wastewater of Small-Scale Gold Miners of Camarines Norte (Philippines) Using Coco-peat as Sorbent Material (Tanchuling, et. al., 2012), was conducted in which coco peat was used as a filter bed to absorb the heavy metals in the effluent. However, the heavy metals were not disposed but instead transferred to the coco peat. To keep the spent coco peat (heavy metal contaminated) from causing environmental hazards, it should be treated and disposed properly.

The goal of the study is for the concrete, with contaminated coco peat, to meet the specified strength requirement by changing the factors affecting strength. The study aims to increase the strength of concrete with higher percentages of contaminated coco peat by extending curing time, decreasing water to cement ratio, and adding a commercial additive. The concrete mix will also be optimized by determining the ideal water to cement ratio for each percentage of coco peat replacement.

Material and Methods

Concrete Specimen Proportioning and Mixing

Concrete cylinders with diameter of 4 inches and height of 8 inches were made. The concrete was assumed to be for general use with a preferred range of slump of 20 to 80 mm. The coarse aggregate that was used has a maximum aggregate of 20 mm. The water to cement ratio for concrete with varied curing time and with a commercial additive was 0.41. Values of 0.35, and 0.30 were used for the water to cement ratio for each of the remaining sets. ASTM C270-07 Standard Specification for Mortar for Unit Masonry was used as a basis for the hydrated lime proportion.

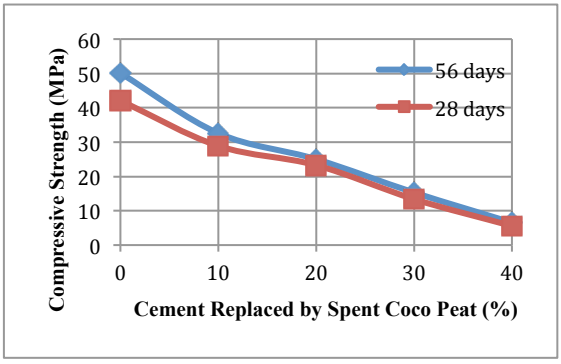
Compressive Strength Test

For concrete specimens with varied curing time, they were subjected to compressive strength test after 56 days of curing while the remaining specimens were subjected to the same test after 28 days of curing. This was accomplished with the use of the UTM with ASTM C39/C39M-14 Standard Test Method for Compressive Strength of Cylindrical Specimens as basis. The compressive strength was calculated by dividing the maximum compressive force measured by the UTM to the cross-sectional area of the concrete perpendicular to the force applied.

Results and Conclusions

56-Day Curing Time

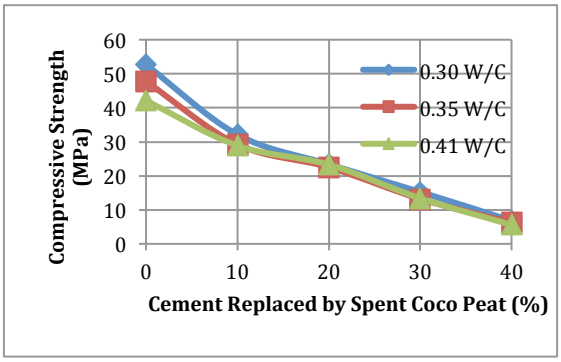
After 56 days of curing, five concrete samples with 0.41 W/C were subjected to Unconfined Compressive Strength Test. The average compressive strength for each percentage of cement replaced by spent coco peat is shown below along with the result of the previous study.



The average compressive strength of concrete increased when the curing time was increased. Considering that the minimum required strength for concrete after curing for 28 days is 24 MPa, only 0%, 10%, and 20% cement replaced by spent coco peat passed the strength requirement. Using linear interpolation, the optimum percentage of cement replaced by spent coco peat was known to be 21.06%.

4.2.2 0.30 and 0.35 W/C

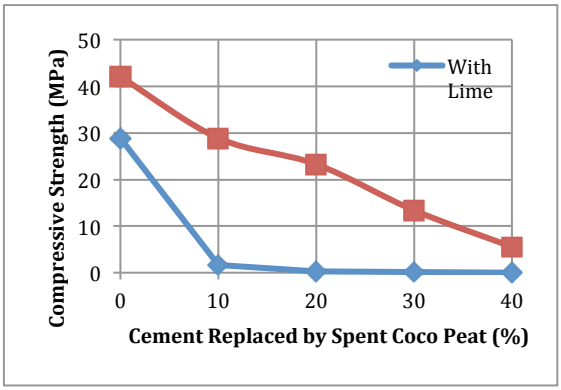
After 28 days of curing, ten concrete samples with 0.35 and 0.30 W/C were subjected to Unconfined Compressive Strength Test. The average compressive strength for each percentage of cement replaced by spent coco peat is shown below along with the result of the previous study.



The average compressive strength of concrete increased when the W/C was increased. For 0.30 and 0.35 W/C, the values for the optimum percentage of cement replaced by spent coco peat were known to be 19.27% and 18.42% respectively.

With Hydrated Lime

After 28 days of curing, five concrete samples with equal amount of hydrated lime were subjected to Unconfined Compressive Strength Test. The average compressive strength for each percentage of cement replaced by spent coco peat is shown below along with the result of the previous study.



The average compressive strength of concrete decreased when lime was increased. The optimum percentage of cement replaced by spent coco peat was known to be 1.79%.

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