

Abstract

Iraq is facing a serious challenge in disposing of waste in many landfills throughout the country. Potential environmental troubles, in high disposal costs are being resulted by the landfill situation. In this research, the utilization of wastepaper that was taken from schools , libraries and paper shredder machine in concrete mixes to be used for construction projects.

A study has been conducted to look into the performance of waste papers for enhanced concrete characteristics. The waste paper included ash paper , pulp paper were used partially replaced as 5%, 7% and 10% in place of cement in concrete mixes. Also, the mix of 5% pulp paper and 5% ash paper in place of cement in concrete mixes.

On other hand, paper waste papers were used as added material as 0.6%, 0.8% and 1% by volume of concrete in concrete mixes. The mixing weight ratio that used in the conventional concrete was with a mix proportion of (1: 1.6 : 2.37 from cement , sand and gravel , respectively with water / cement ratio (0.48). Workability, dry density, oven density, compressive strength, splitting tensile strength , flexural tensile strength, thermal conductivity test, water absorption, scanning electron microscopic plus energy x-ray spectrometer (EDX) tests were carried out for mixes utilizing standard samples at age of (7, 14 and 28) days.

The results indicated that the addition of waste paper increases most of the mechanical strength significantly at 28 days of testing age. The most efficient content of paper waste used in this study was (0.8%) by concrete volume. This percentage increased the compressive strength , splitting tensile strength and flexural strength by about (22.56% , 17.53% and 4.819%) , respectively at 28

days age relative the normal concrete, while the results showed a decrease in the dry density , oven density and thermal conductivity .

On the other hand, the results manifested that the mechanical strength of papercrete concrete mixes at 28 days. The air dry density and compressive strength for all blends are ranged between (2368- 2498) kg\m³ and (19.098- 28.18) MPa , respectively. The analysis of result refers that the papercrete concrete blends with (5%) showed a considerable increasing in some mechanical properties as relative to reference mixes, while further increase in waste paper pulp reduces the strength gradually. The water absorption of papercrete concrete was found to be high and increased with increasing replacement of wastepaper content , while dry density and thermal conductivity of papercrete were low and decreased with increasing wastepaper pulp content.

In addition, the results depicted that the replacement of ash wastepaper increases most of the mechanical properties significantly at 28 days of testing age. The most efficient content of ash wastepaper utilized in this research was (5%) by weight of cement. Its level of addition increased the compressive strength, splitting tensile strength and flexural tensile strength by about (22.129%, 4.160% and 34.78%) , respectively at 28 days of curing as relative to conventional blends. Also, the combination blend of pulp wastepaper and ash wastepaper revealed a significant improvement in compressive strength, splitting strength and flexural strength by about (10.344%, 3.768% and 5.630%), respectively at 28 days of testing age relative to conventional mixes. Scanning Electron Microscopy (SEM) was used to study the microstructure of concrete mixes. SEM images appeared enhancement in the morphology of reference concrete especially , in concrete mix content was 5% for ash wastepaper.

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List of Symbols

<i>Symbols</i>	<i>Definition</i>
A	Mix
Al_2O_3	Alumina
C_2S	Diacalcium silicate
C_3A	Tricalcium aluminate
C_3S	Tricalcium silicate
C_4AF	Trtracalcium aluminoferrite
CaO	Lime
C-S-H	Calcium silicate hydration
F-10	Reference Mix+10% ash wastepaper
F-5	Reference Mix+5% ash wastepaper
F-7	Reference Mix+7% ash wastepaper
Fe_2O_3	Iron oxide
MgO	Magnesia
Mix-5	Reference Mix+5% pulp paper+5% ash paper
P-10	Reference Mix+10% paper pulp
P-5	Reference Mix+5% paper pulp
P-7	Reference Mix+7% paper pulp
SiO_2	SiO_2
SO_3	Sulphate
w-0.6	Reference Mix+0.6% paper
W-0.8	Reference Mix+0.8% paper
W-1	Reference Mix+1% paper

List of Abbreviations

<i>Abbreviation</i>	<i>Name</i>
ACI	American Concrete Institute
ASTM	American Society for Testing and Materials
BS	British standards
EDX	Energy Dispersive X-ray Fluorescence Spectrometer
IQS	Iraqi Standards
OPC	Ordinary Portland cement
Papercrete	Concrete containing waste paper
SEM	Scanning electron microscope
W\C	Water to cement ratio
Hypo Sludge	Paper industry waste
WPA	waste paper ash