Utilization of municipal solid waste (MSW) is becoming a global practice in the struggle to control the ever-increasing environmental pollution. Among all the constituents of the MSW produced in Pakistan, demolition and construction (D&C) waste contributes about 8% each (Pak-EPA, 2017) [1]. Recycled Concrete Aggregate (RCA) is a component of D&C waste that has poor structural performance [2]. It can be concluded that plastic coated aggregates result in durable and long life asphalt concrete [3]. This leads us to conclude that coating the aggregate will result in better durable long life asphalt concrete. This research is based on the idea to enhance the strength of RCA for structural application by using another waste material (polyethylene plastic bags). This study has investigated different techniques of coating RCA with shredded waste plastic bags (melting point of plastic is from 200-250°C), which can be melted using solar ovens (up to 315°C), to improve the mechanical and durability properties of RCAs in concrete.

RESULTS

Durability Properties of Aggregates

The overall mechanical properties of aggregates were improved. The hardness of aggregates increased with coating and in full coated samples, the hardness was double as compared to un-coated RCAs. Aggregate soundness tests were performed using sodium sulphate solution of 25% saturated for 6 cycles. Table 2 shows soundness test results. The results shows exceptionally well with negligible loss in weight of aggregates after sulphate attack. After soundness test the detached particles of old cement matrix in un-coated RCA is shown in Figure 3, no deterioration was observed in coated RCA as shown in Figure 4. Figure 4 shows the abraded RCA after Los Angeles Abrasion test.

Materials and Methods

In order to get the required standards sieve analysis (ASHTO T27), water absorption and specific gravity (ASTM C127), soundness test (ASTM C88), Los Angeles abrasion test (ASHTO T196-87) were conducted on natural aggregates, uncoated RCAs, partially coated RCAs and fully coated RCAs. Slump test (ASTM C143), compressive and tensile strength test (ASM C39) were performed on natural aggregate concrete (NAC), partially coated recycled concrete (PRAC) and fully coated recycled concrete (FRAC).

32 participants were surveyed of which 2 from demolition site and others were engineers from construction site. More than 70% participants surveyed were of the opinion that “people are unsure whether the use of construction and demolished waste materials are useful and it is easier to dispose these waste materials”.

DISCUSSION

Improving the mechanical performance of RCAs by utilizing D&C waste has a lot of potential. All the important parameters, except compressive strength, of RCAs were significantly improved. The plastic coating of RCAs result in increased workability and durability of concrete. However, the plastic coating of RCAs resulted in decreased bonding between RCAs and cement paste, leading to lower compressive strength.

This research has produced PCRCAs that can be adopted with the following enhancement in properties:

- Significantly reduced absorption up to 200%.
- Gives three times more slump than uncoated RCAs.
- Abrasion resistance increased to 100%.
- Significantly increased resistant to sulphate attack.
- Satisfactory compressive strength for producing load bearing concrete.

MECHANICAL PROPERTIES OF RCAs

Figure 4 shows the development of compressive strength of different age ranging from 7 to 56 days. Table 4 illustrates the compressive, split tensile strength and young’s modulus of natural aggregate concrete (NAC), uncoated recycled aggregate concrete (URAC), partially coated recycled concrete concrete (PRAC) and fully coated recycled concrete concrete (FRAC).

FUTURE RECOMMENDATIONS

There is weak bond between PCRCAs and cement paste in concrete leading to a low strength of concrete than uncoated RCA concrete.