

ABSTRACT

Nowadays, due to the needs and wants in the development of infrastructures, both in rural and urban areas, the utilisation of building materials had increased and caused tremendous demand for consumption of such materials. This scenario was considered for investigation because during the process of production some of the building materials were utilized extensively as natural resources and as raw materials. Hence, it is imperative to provide a workable solution with the existing alternative materials or industrial waste products instead of natural resources. In recent years, both electronic wastes and glass wastes have contributed a huge amount to the total waste stream. The Indian government is dedicated to the cause of bringing rapid and sustainable development in rural and urban areas in order to process such wastes. Last year, domestic hazardous wastes were completely increased at an alarming rate due to the novel Coronavirus disease (COVID-19) pandemic. Rapid techno and social age have led to generations of huge waste in the cities. Industrial wastes products, both Waste Glass Powder (WGP) and Waste Electronic Plastic (WEP) are abundantly available these days through which excessive and increased productivity could be obtained as a vital waste resource, due to a single use policy. In India, more than 3,000 dump sites that are to be reclaimed are closed and these dump sites had created irreversible cause of damage such as generation of leachates, emission of greenhouse gases, and pollution of groundwater to its surrounding environment.

At present, WGP and WEP are utilised individually as ingredients for concrete manufacturing. Combined utilisation of these wastes were not studied so far, which was identified as a gap through the literature study. Hence, in this context, the present investigation was carried out in order to assess the combined utilisation of WGP & WEP in concrete manufacturing. In the present investigation, experimental investigations were carried out in the concrete mix ratio of M20 on

both WGP & WEP at various ratios viz. 5%, 10%, 15% and 20%, individually and combined application. These WGP & WEP are used to replace the binder and filler material on volume basis in the matrix respectively. Standard laboratory tests were carried out on both fresh and hardened concrete, along with further studies on microstructural characteristics of the concrete specimens using SEM and XRD techniques.

Results from the present investigation on fresh concrete properties obtained through the slump and density tests have showed better characteristics with the replacement up to 20% by WGP & 15% by WEP. The above observation might be due to the pore filling characteristics showed by WGP that have improved the porosity in the matrix. Further, it was inferred that the workability properties of concrete in WEP did not show appreciable changes as compared with concrete containing WGP.

The hardened compressive strength test results of the experiment with the combination of both WGP and WEP have showed some improvements. However, both flexural and tensile strength test results were not significant. This might be due to the implementation of WEP that has caused an increase in volume, porosity and size of the specimen, but then subsequently has caused a decrease in strength. Further, the WEP has caused higher demand for water absorption rate of concrete.

The presence of WEP has improved the resistive property of chloride ion penetration. However, beyond the replacement of 20%, further investigation is required. Further, it was observed that in order to resist sulphate attack, a better combination with the replacement of 5% WEP and up to 20% WGP, was obtained and it neutralized the effect caused due to the replacement of WEP. A similar effect was observed with the test on acid attack that the specimens when immersed in 5% of $MgSO_4$ for 90 days have showed better characteristics with up to 20% replacement of WGP and it neutralized the effect caused due to the replacement of WEP. Microstructural

characteristics have showed significant improvement in filling pores and porosity reduction was due to the replacement of WGP. The author suggests that further studies could be conducted for the long-term effects on corrosion in order to save our environment.

Keywords: Waste glass powder, Waste electronic plastic, Strength, Durability and Micro-structure.