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Utilization of marble dust and fly ash in composite mortar as partial cement substitute

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Abstract

The entire world is running towards infrastructural development, which is responsible for the depletion of non-renewable natural resources and to conserve them, it is necessary to find alternate green resources. Some industrial wastes like marble waste have the potential to be used in infrastructural development due to their inert nature. Thus, the study presented here focuses on investigating the possibility of the use of marble dust as a potential partial cement substitute in mortar combined with fly ash. Therefore, a total eight number of mortar mixes were prepared. The replacement levels of marble cutting waste dust were 10%, 20%, 30% by volume & fly ash+marble cutting waste dust were 25% + (10, 20, 30)% of cement in the standard 1:3 mortar. Along with this, strength development, mechanical properties, physical properties, bonding strength, adhesion strength, and shrinkage characteristics were assessed at the curing periods of 7 and 28 days. The test outcomes revealed a positive impact on the workability properties as well as mechanical and drying shrinkage performance. The optimized combined use of marble waste dust and fly ash can serve to produce sustainable mortar. Moreover, the use of such non-biodegradable waste in infrastructural development would lower down the disposal burdens from the marble industry.

Introduction

The most important and widely used material after concrete in the field of construction is the mortar. The utilization of mortar as binder and finishing has been accounted for since antiquated occasions. At the outset, different types of mortars like Egypt mud mortar, gauged mortar, lime mortar, gypsum mortar, etc., were used to join the stones or mud bricks [1]. Nowadays, cement mortar is broadly famous because of its homogeneous nature and early strength acquiring characteristic over pozzolana lime or lime-based composite mortar.

India, a developing country that contains 1931 million tonnes of huge loads of marble assets actually left to use [2], has effectively been tormented with garbage removal issues related to handling and marble mining[3]. Because of the system utilized for cutting, shaping, and cleaning of the raw marble, it produces waste marble in slurry form, and the quantity is around 10% to 22% of the mined marble block [4]. The produced slurry waste from the cutting and polishing industry is aimlessly unloaded on empty grounds, waterway banks, or timberland regions and creates serious environmental and respiratory problems [5]. Such waste is also responsible for the contaminations in groundwater, jeopardized oceanic biodiversity, and cause eye, kidney, and skin infections in people [6], [7]. There is an estimated quantity of around 3 million tons of waste is being generated from the marble industry in India every year [8].