





Utilization of waste materials from marble processing industry for sustainable pavement design

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Abstract

Marble is used extensively in construction industry. During mining and quarrying operations of marble, humungous amount of waste is generated. This gives rise to environmental concerns in the areas surrounding the quarry due to unorganised waste disposal system. Marble waste in form of marble dust, slurry and marble blocks/fragments are dumped randomly contaminating land as well as water bodies near these quarries. This study aims to gainfully utilize marble waste in form of rock fragments as replacement of natural aggregate in pavement layer. Marble stones in the range of 10mm size were identified and were used to replace the corresponding sized coarse aggregates in DBM grade II layer of flexible pavement. Marshall stability parameters were checked and found to be in range establishing that marble waste as an aggregate could be used successfully in pavement design process.

Introduction

India is one of the major producers of marble across the world. Rajasthan is considered as the richest state in the country with regards to marble deposits both in quality and quantity. About 85% of marble produced in India comes from Rajasthan state [1]. There are about 4000 marble mines and around 1100 processing plants in the state.

During the time of cutting, this industry produces huge amounts of waste in form of slurry, dust and irregularly sized stones (locally known as *Khandas*). Due to absence of a proper disposal mechanism; these rock fragments are carelessly dumped in open areas around the quarries. This leads to environmental degradation of natural land and water bodies in the vicinity. About 30% of the stone is wasted as rock fragments during operation and hauling operations [2]. Aggregates constitute about 90% of the volume of hot mix asphalt (HMA). A significant effect on performance of bituminous pavements is brought about by the quality and type of aggregates [3], [4]. Owing to the high percentage of aggregates in pavement construction, utilizing suitable waste materials as aggregate comes up as a viable solution to the issues of environmental and economic concerns [5], [6]. Researchers have worked on various nanotechnologies based methods to develop more sustainable pavement construction practices [7], [8].

Waste materials that could be incorporated in flexible pavement design could be categorised into the following categories: industrial waste, municipal waste, and mining waste [9]. Marble aggregate produced as mining waste could be gainfully utilized in the construction of asphaltic pavements, replacing the need for virgin aggregates and simultaneously solving the waste disposal problem of the marble quarries [10].