ABSTRACT

Road connectivity is an important element for economic development of any nation. Construction of road is cost intensive. Of this, stone aggregate, a major component, consumes about 60% of the material cost. Hence, it is most important to economize in construction with proper selection of materials, optimum input of technology and adoption of appropriate design methodology by conducting extensive research. Considering the vast impact on economy and environment, demand and supply, the availability of waste materials has to be explored for use as alternative material.

In this study, the Granulated Copper Slag (GCS), a waste from copper industry, has been studied as an alternative material by identifying its environmental and technical characteristics. The specification for Copper Slag Dust Base (CSDB) has been evolved with an objective of high volume utilization of GCS.

The chemical properties and physical properties of GCS have been studied to check the suitability of the same as an aggregate in bituminous base construction. The chemical analysis, including the leaching properties of GCS has been conducted in order to ascertain its environmental suitability. From
the leaching study, it has been observed that the elements leached out from GCS are within the regulatory limits given by the Environmental Protection Agency (EPA) and permitted levels of trade effluents by the Central Pollution Control Board (CPCB). The physical properties conform to the American Society for Testing and Materials (ASTM) and Ministry of Road Transport and Highways (MORTH) specification requirements for fine aggregates in bituminous works.

In the process of arriving at specification for CSDB as bituminous base, an attempt has been made to match as much as desirable properties of mix with optimum utilization. The mix properties and their design requirements are used as constraints for the optimization process. The test values of mix properties from the experimental mix design have been used for arriving at objective functions of mix properties. The Multi-Objective Three Dimensional Non-linear Optimization Program Technique (MONLOP) has been used to derive the specification for CSDB.

From the study, it is observed that the GCS can be used as an aggregate alternative for bituminous works by considering the environmental and engineering properties. By optimizing the GCS utilization in the mix without compromising the design requirements of specifications for Fine Aggregate Bituminous Base (FABB) courses, the CSDB yields desirable
Marshall Properties and, hence, this can be used as a base course in the bituminous pavement construction.

It is observed that by using MONLOP process, the optimization of three inputs like binder, aggregate and their mix properties is possible. By this method, the mixture composition may not be given as a single prescription. Instead, depending upon the availability of mixture constituents, the composition may be adjusted, without compromising any design requirement.