

Use of Granulated Blast Furnace Slag in Road Construction

10 million tons of blast furnace slag is produced in India annually as a by-product of Iron and Steel Industry. Blast furnace slag is composed of silicates and alumino silicates of lime and other bases. It is a latent hydraulic product which can be activated with anyone- lime, alkalies or Portland cement

Studies were carried out on Lime-GBFS mix as alternate binder to cement, and for its use in mortar, soil stabilization as well as in concrete. Lime - granulated blast furnace slag (GBFS) binder in 1 : 2 ratio, with and without 7.5 percent gypsum fulfils the IS requirements for soundness as required for OPC. With 7.5 percent gypsum final setting time of lime granulated blast furnace slag binder is reduced from 338 minutes to 270 minutes as compared to lime – GBFS mix without gypsum. The compressive strength of lime – GBFS sand mortar is improved by 77.0 percent and 40 percent at 28 and 180 days by the addition of 7.5 percent gypsum by weight of lime-GBFS binder.

Lime – GBFS soil stabilized mixes (10-25 percent replacement of soil with lime-GBFS mix) gave CBR values in the range of 48-92 percent and the unconfined compressive strength 15-40 kg/cm² in comparison to plain soil which gave CBR value of 7 percent and unconfined strength 3 kg/cm² at 28 days. Addition of 7.5 percent gypsum to Lime –GBFS (by weight of binder) soil stabilized mixes further improved CBR and the unconfined compressive strength and the values obtained were in the range of 112-266 percent and 29-58 percent respectively.

Laboratory and semi-field studies carried out on various lime-GBFS concrete mixes showed that:

- (i) lean lime-GBFS concrete mix 1:5:18.5:39.3 (lime:GBFS:sand:coarse agg. i.e. 1:1.96, binder : aggregate ratio) with 7.5 percent gypsum can be used as base course material as it gave high flexural and compressive strength as compared to lime-flysh and lean cement concrete mixes which are used as base course materials and exhibits better load dispersion characteristics as compared to conventional base course material WBM. Moreover equivalency factor of lime-GBFS concrete mix was 1.7 against 1.5 for WBM suggesting lesser thickness of lime-GBFS concrete as base course material.
- (ii) Moderate lime-GBFS concrete mix 1:5:14.4::21.6(lime:GBFS:sand:coarse agg. i.e. 1:6 binder : aggregate ratio) with 7.5 percent gypsum gave flexural strength 39 kg/cm² at 28 days with further increase upto 48 kg/cm² at 365 days which is equivalent to flexural strength of M-30 grade concrete and therefore it can be used for paving foot paths, low traffic volume roads and precast blocks for shoulders and Creteways construction. Moderate lime – GBFS concrete with an overlay of asphaltic concrete or plain cement concrete can be used for construction of composite pavement for high traffic density corridors as the ultimate failure load for 10 cm thick slab was conforming to prevailing legal design axle load of 10.2 tones (IRC:58-2002) It has high abrasion value 0.38 against 0.24 for PCC suggesting its use in composite pavements instead of using as surface course course .

The significant advantages envisaged in the manufacture of lime – granulated blast furnace slag binder are:

- Lower energy requirement – only dry grinding of material is needed
- Significant lower capital requirements as compared to cement plant

In view of the above findings, lime – GBFS binder with 7.5 percent gypsum can be used for making mortars, stabilization of soils and making concrete mixes for use in road bases and composite pavements. This provides a great potential for profitable use of this waste material and produces alternate binder to cement.

Economics: Within 30 km area of steel plants lime: GBFS concrete 1:6 mix can be 30 percent economical than conventional concrete and 1:9.5 mix marginally cheaper than WBM base course.

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