CHAPTER – 5

CONCLUSIONS AND FUTURE SCOPE

5.1 Conclusions

In the universe, nothing is completely waste; whether it is above or below the earth surface. For saving the energy, economy and environment, the potential to reduce, reuse, recycle and reclaim of wastes becomes a global environmental concern. There should be an urgent need to take proper attempt to convert the WASTE into WEALTH, otherwise the nature possibly will convert the WEALTH into WASTE. Thus there is an urgent need to conduct extensive research and development work for optimizing the usage of current technology and exploring novel applications for a sustainable waste management with social and economic benefits. Stabilization of any waste is a process in which an additive/reagent is employed to reduce the toxic nature by changing its toxic constituents into a more stable form to diminish the contaminant migration rate, thus reduce the level of toxicity. In this study, hazardous jarosite waste is treated with different percentage of GGBS and lime, on that stabilized jarosite is suitable to be used in various applications in eco-friendly manner. Based upon this study the following conclusions are drawn:

1. The unconfined compressive strength and split tensile strength both were increases significantly with an increase in GGBS and lime content along with curing period respectively.
2. The unconfined compressive strength (UCS) ≈ 11 Mpa and split tensile strength ≈ 680 kPa were observed at 90 days curing with 30% GGBS and 10% lime content.

3. Satisfactory durability characteristic of stabilized jarosite (Freeze-Thaw) was observed with very small loss in strength and weight i.e. UCS strength loss ≈ 14.20% and weight loss ≈ 6.20% at 28 days curing with 30% GGBS and 10% lime content.
4. SEM and XRD results also demonstrate the development of particles agglomeration upon addition of GGBS and lime leading to increase in strengths (compressive and tensile) and development of a durable product.
5. Before and after the durability study, the stabilized jarosite has acceptable TCLP characteristic. The, heavy metals and toxic elements present in the hazardous jarosite got immobilized and observed within the permissible limits as suggested by the USEPA.
6. Relationships between UCS (q_u) or split tensile strength (q_t) with various GGBS content (G), lime content (L) and curing period (t) have been proposed, which will help the engineer or user to choose the optimum amount of GGBS and lime against targeted compressive or tensile strength of jarosite-GGBS-lime blends.
7. A unique scalar ratio, q_t/q_u (independent of lime content, GGBS and curing period) has been formulated that will enhance the possibility to concentrate on any one strength, tensile or compressive, and estimate the other one.
8. Jarosite stabilized with 30% GGBS and 10% lime has satisfactory strength to be used in sub base or subgrade, and base course for both types of pavement.
9. A solidified, durable, immobilized, economical brick has been developed which fulfills the requirement of minimum compressive strength (> 3.5 MPa) and water absorption limits (< 20%) as per Indian Standards for unfired bricks (IS 12894-2002).

Thus, the present investigation contributes in the making of stabilized jarosite material (cement free), which is sufficiently durable, stronger, immobilized (heavy and toxic metals), and cheaper from the conventional material. This is also cheaper than the existing knowhow in literature (jarofix). Furthermore, this novel stabilized material is practically viable, i.e. can be used in various applications of civil engineering.

5.2 Limitation of Present Study and Scope for Future Work

In the current study of jarosite waste, it is observed that the safe management of hazardous zinc residual waste with incorporation of other wastes additives to prevent the environmental pollution is feasible.

However, the present study is limited to laboratory only and it will be prime need to cross check these laboratory parameters with field conditions.

The extensive generation of jarosite waste in the process of industrial production of zinc is a universal problem. From current research scenario on jarosite, it is observed that the seriousness in bulk consumption and utilization of jarosite waste is still insufficient. The solidification/stabilization (S/S) of jarosite is an auspicious method in which the addition of a binding agent encapsulates and diminishes the mobility of heavy and toxic waste elements. The long term binding of such toxic elements reduces the permeability and contamination leaching rate, thus potentially allows the safe land disposal of waste. The scope of present study for future work is summarized as follow:

- Further research on the utilization of various waste materials along with jarosite and their viability in perspective of long-term durability, strength and environmental impact of stabilized/solidified jarosite composite.

- In depth studies for comprehensive evaluation of physical, chemical and biological effects of stabilized jarosite waste on the environment and its valuable bulk utilization.