Abstract—Concrete is one of the most vital and common materials used in the construction field. The current area of research in the concrete was introducing waste foundry sand (WFS) and waste ceramic tiles in the ordinary concrete. Waste foundry sand is the byproduct of metal casting industries which causes environmental problems because of its improper disposal. Construction industries require huge amount of ceramic tiles and other ceramic for architectural appearance, the productions of which are drastically increased, due to this waste is also produced during handling and usage of ceramic tiles. An experimental investigation was carried out on concrete containing waste foundry sand (WFS) in the range of 0%, 10%, 20%, 30%, and 40% and waste ceramic tiles (WCT) in the range of 0%, 10%, 20%, 30%, and 40% by weight for M-25 grade concrete. Concrete was produced, tested and compared with conventional concrete in plastic state as well as in harden state for workability, compressive strength & split tensile strength. These tests were carried out on standard cube, cylinder for 7 and 28 days to determine the properties of concrete.

Key words: Industrial Waste, Waste Foundry Sand (WFS), Waste Ceramic Tiles (WCT), Ecofriendly, Compressive Strength, Split Tensile Strength, Workability

I. INTRODUCTION

In the present research, experimental investigations can be carried out on concrete to investigate the effect of waste foundry sand (WFS) and waste ceramic tiles (WCT) as partial replacement of fine aggregate and coarse aggregate respectively on mechanical properties of concrete such as strength, workability, durability, etc of ordinary concrete.

A. Waste Foundry Sand (WFS)

Foundry sand is high quality silica sand with uniform physical characteristics. It is produced from ferrous and nonferrous metal casting industries, where sand has been used for centuries as a molding material because of its thermal conductivity. Indian foundries produce approximately 1.71 million tons of waste foundry sand each year (Metal World, 2006). In the casting process, heat and mechanical abrasion eventually render the sand and thus unsuitable for use in casting molds, and a portion of the sand is continuously removed and replaced with new one. This sand is treated as waste from casting industry and because of high silica content it cannot be disposed easily. Waste foundry sand is made up of mostly natural sand material. Its properties are similar to the properties of natural or manufactured sand, the fineness modulus of waste foundry sand is 3.027. Thus it can normally be used as a replacement of sand. The considerable disposal expense has made the current practice of WFS disposal in landfills less favorable. Besides the financial burden to the foundries, land-filling WFS also make them liable for future environmental costs, remediation problems and regulation restrictions. This issue is increasingly addressed by alternate options of reusing WFS beneficially. Beneficial reuses of WFS in variety of applications related to infrastructure engineering and rehabilitation works.

B. Waste Ceramic Tiles (WCT)

India ranks in the top 3 list of countries in terms of tiles production in the world. This huge amount of ceramic tiles are not recycled but is often used as pavement material or landfill. Ceramic tile aggregates are hard having considerable value of specific gravity, rough surface on one side and smooth on other side, having less thickness and are lighter in weight than normal stone aggregates. Using ceramic tile aggregate in concrete not only it will be cost effective, but also provide considerable strength to the concrete. Construction industries require huge amount of ceramic tiles and other ceramic for architectural appearance, the productions of which are drastically increased, due to this waste is also produced during handling and usage of ceramic tiles. As 30 to 40% of the total production from manufacturing units is solid waste. So, we selected these waste tiles as a replacement material to the basic natural aggregate. Tiles are a mixture of clays that are pressed into shape and fired at high temperatures which gives the hardness. Ceramic products are made from natural materials which contain a high proportion of clay minerals. These, through a process of dehydration followed by controlled firing at temperatures of between 700°C and 1000°C, acquire the characteristic properties of “fired clay”. Ceramic waste may come from two sources. The first source is the ceramics industry, and this waste is classified as non-hazardous industrial waste (NIHW). The second source of ceramic waste is associated with construction and demolition activity, and constitutes a significant fraction of construction and demolition waste (CDW). Reuse of this kind of waste has many advantages, not least of which are the economic advantages, including job creation in companies specializing in the selection and recycling of this kind of material. It goes without saying that reuse is better than recycling.
II. METHODOLOGY

Mix design is a process of selecting suitable ingredients for concrete and determining their proportions which would produce, as economically as possible, a concrete that satisfies the job requirements. In pursuit of the goal of obtaining concrete with desired performance characteristics, the selection of component materials is the first step, the next step is a process called mix design by which one arrives at the right combination of the ingredients. The mix proportion was modified by replacing fine aggregate by waste foundry sand (WFS) and coarse aggregate by waste ceramic tiles (WCT) in the range of 0%, 10%, 20%, 30% and 40% both. Mix design was carried out manually conforming to IS 10262:2009.

III. EXPERIMENTAL INVESTIGATION

Keeping in mind the gap in the research area, the objective of this study was to determine the strength of concrete containing waste foundry sand (WFS) as partial replacement of fine aggregate and waste ceramic tiles (WCT) as partial replacement of coarse aggregate. For this purpose different test on harden concrete were conducted at the age of 7 and 28 days like compressive strength on 150mm X 150mm X 150mm size cube and splitting tensile strength on 150 mm X 300 mm size cylinder. As per IS 516 Total 60 number of specimen were tested. Results are tabulated as below:

A. Compressive Strength

Compressive strength tests were performed on cube samples of size 150mm X 150mm X 150mm using compression testing machine. Three samples per batch were tested with the average strength values reported in table 2.

B. Splitting Tensile Strength

Splitting tensile strength tests were performed on flexural testing machine using cylindrical samples of size 150 mm X 300 mm. Three samples per batch were tested with the average strength values reported in table 3.

C. Workability

Workability is the most important parameter regarding flow of concrete. As coarse aggregates are replaced by waste ceramic tiles, as coarse aggregate absorb water because of pours surface waste ceramic tiles gives a advantage here due to its one polished surface and hence absorb less water content as compare to coarse aggregates therefore provide more workable concrete.

IV. CONCLUSION AND FUTURE WORK

A. Conclusion

Depending upon above results and methodology adopted following conclusion were made regarding properties of concrete incorporating waste foundry sand and waste ceramic tile.
- It is found that compressive strength of concrete mix increases with increase in percentage of waste foundry sand and waste ceramic tiles as compare to regular concrete. It was maximum for 20% replacement after that it reduces.
- It is also found that split tensile strength increases with increase in percentage of waste foundry sand and waste ceramic tiles up to 20% replacement after that it reduces.
- Workability of concrete mix increases with increase in percentage of waste foundry sand and waste ceramic tiles as compare to regular concrete.
- As waste foundry sand is waste from metal industries and waste ceramic tiles is waste from construction industries therefore both waste can be effectively use in concrete mix hence an eco-friendly construction material.
- By using this waste in concrete, problems regarding to safely disposal is reduced.

B. Future Scope

The compressive strength of concrete with replacements of the WFS and WCT can be differently checked for with different proportions to gin the maximum strength of the concrete.

REFERENCES