

# INFLUENCE OF E-WASTE AND SILICA FUME ON THE STRENGTH CHARACTERISTICS OF M30 CONCRETE

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**Abstract-** The electronic industry is the world's largest and most rapidly growing manufacturing industry. Because e-waste has a negative impact on human health, it must be repurposed in some way to be environmentally benign. Huge loads of electronic gadgets are sent across seas consistently, yet after their utilization, they make a muddled waste matter including an assortment of unsafe weighty metals, acids, toxic mixtures, and non-biodegradable polymers. E-waste is collected, dismantled, separated, and exported for recycling by a number of commercial companies.

The compressive and tensile strengths of concrete specimens constructed from E-waste material will be tested in this study. The e-waste material is used to make coarse aggregates of 20mm in size. For a concrete mix of M30, multiple concrete mixes are made by replacing regular coarse aggregate with e-waste material in various percentages such as 0 percent, 20%, 40%, 60%, 80%, and 100%. Cement is replaced with Silica fume in percentages of 0% to 10% when coarse aggregate is replaced. The impact of replacing coarse aggregate with e-waste material and cement with Silica fume on concrete parameters such as compressive and tensile strength for hardened concrete at 28 and 90 days will be investigated. For each concrete mix, a certain number of examples are made.

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## 1. INTRODUCTION

Electronic trash is one of the most rapidly expanding dangers to the environment, which includes both animals and humans. In comparison to other squanders, such as metropolitan and modern squanders, these squanders are physically and artificially distinct. Over 1000 hazardous and nonhazardous chemicals are found in electronic trash, often known as E-squander. According to the United Nations Environment Program (UNEP), E-waste must be in excess of 50 million tonnes per year. Each year, India generates 8,00,000 tonnes of e-waste, which will need to increase in the future. E-waste contains heavy metals, nickel, chromium, cadmium, arsenic, and mercury, as well as the majority of the hazardous elements in the periodic table. These hazardous E- Waste were dumped in India due of their environmentally friendly techniques to reuse E- Waste from most developed countries. E-waste burning in recycling plants has no influence on environmental pollution or human health.

The goal of this research was to achieve the desired mechanical characteristics of concrete, such as compressive and splitting tensile, using E-waste as a coarse aggregate substitute. Ground granulated impact heater slag (GGBS) is added to the solid to reduce bonding and improve mechanical characteristics. The physical and chemical features of GGBS drew the attention of various researchers, who proposed that it be utilised as a partial substitute for cement and fine aggregates in concrete. The E-waste was gathered from a landfill in Ananthapur where electrical and electronic garbage was held for reuse. The E-waste was crushed into the necessary size using a pulveriser, such as 4.75 mm, 12.5 mm, and 20 mm.

### Objectives of the study

1. E waste (electronic waste) is a recent waste management for and it is the better way to reduce the industrial waste in various countries. In this study the E waste is utilized in concrete for determine the strength characteristics.

2. The major goal of this project is to explore the impact of E-waste materials as aggregates when combined (addition & partial replacement) with coarse aggregates to see how they affect various parameters of concrete grade M30.
3. Workability, compressive strength, and split tensile strength of M30 grade concrete utilising E-Waste and silica fume were evaluated and compared to conventional concrete.
4. For M30 (expansion and fractional substitution) instances with regulated mix concrete, to design attributes of thus improved cement.
5. To guarantee that E-waste and silica fume are used to their full potential.
6. The main goal is to generalise the qualities of concrete by using E-waste materials.

## 2. LITERATURE REVIEWS

**R.K. Mittal, Maheshwar Dwivedy, and others (2012)** In a worldwide market, multinational firms continue to rely on reverse supply chains that characterise reuse and recycling. The environmental and social advantages of reuse that might arise from systematic interventions in India's existing WEEE trade chain are critically examined in this paper. We show that reselling WEEE to other users as soon as possible can significantly extend their lives. By statistically analyzing the performance measures of alternative policy scenarios, the study employs a Markov chain model to investigate the underlying relationships that exist among the reverse supply chain partners.

**Sagar R. Raut, Roshani S. Dhapudkar, Monali G. Mandaokar, et al.,(2018)** Electronic trash (e-waste) creation, on the other hand, is a rising concern that is creating major environmental issues. E-waste generation is a major problem across the world. E-waste, such as non-metallic sections of PCB plates, can be recovered and utilized as a concrete ingredient. As a result, we may employ e-waste to attain desired concrete qualities. The coarse aggregate in this article is replaced by e-waste, and the research strongly suggests that e-waste might be utilized as a fine and coarse aggregate alternative. More utilization of this waste material reduces the demand for natural resources used in concrete, therefore it is critical that a coarse aggregate alternative be investigated.

**Bhupendra Singh Shekhawat, Dr. Vanita Aggarwal, et al.,(2014)** Concrete is one of the most usually utilised constructing substances at the planet. However, the manufacture of portland cement, a important aspect of concrete, effects withinside the emission of a sizeable amount of CO<sub>2</sub>, a greenhouse gas; one tonne of portland cement clinker is anticipated to supply one tonne of CO<sub>2</sub> and different greenhouse gases (GHGs). Environmental demanding situations have a sizable have an effect on withinside the cement and urban industry's long-time period viability.

## 3. MATERIALS AND MIX DESIGN

### Cement

In this examine Ordinary Portland cement of 53 grade (ACC cement) has been procured and has been used. The diverse exams in this fabric is executed in laboratory.



**Fig1:** OPC 53 grade ACC cement

### Coarse aggregate

Coarse aggregates are particles having a diameter greater than 4.75mm but ranging from 9.5mm to 37.5mm on a regular basis.

In this study coarse aggregate of nominal sizes of 20mm, 12mm are used.



**Fig2:** Coarse aggregates

### **Fine aggregates**

Fine aggregate is comprised of sands gathered from either the land or the ocean. Regular sand or squashed stone are the most well-known fine aggregates, with most of particles going through a 4.75mm screen.



**Fig 3:** Fine aggregates

### **E-waste aggregates**

Electronic component parts, such as CPUs, may include potentially hazardous elements such as lead, cadmium, beryllium, or brominated fire retardants. Reusing and exchanging e-waste may pose a significant risk to the quality of experts and systems in developed countries, and extraordinary thought must be given to maintain a critical separation from hazardous presentation in reusing exercises and spilling of materials, such as generous metals from landfills and incinerator red hot garbage. E-waste was collected for this study at a disposal yard in Ananthapur, where electrical and electronic misuses were secured for reuse.



**Fig4:** E-Waste aggregates

### **Silica fume**

"Condensed silica fume or microsilica" is a "very fine non-crystalline silica generated in electric arc furnaces as a byproduct of the manufacturing of elemental silicon or silicon alloys." (Cement and concrete technology, ACI 116R-90). Silica fume, also known as microsilica, is produced when high-purity quartz is reduced to coal in the assembly of silicon and ferrosilicon composites using an electric heater.

### **Mix design of concrete**

This study is crucially based on the advancement of ordinary quality M30 grade of E Waste concrete of regular building improvements.

Final trial mix for M30 grade concrete is 1:1.86:2.89 at w/c of 0.50.

### **Mix Proportions**

Mix types with percentage relative proportions and blend proportions of constituent materials are appeared in Table below

Mix Type	Cement	Fine aggregates	Coarse aggregates	E Waste aggregates
Mix 1	394	732	1139	0
Mix 2	394	732	911	228
Mix 3	394	732	684	455
Mix 4	394	732	455	684
Mix 5	394	732	228	905
Mix 6	394	732	0	1139

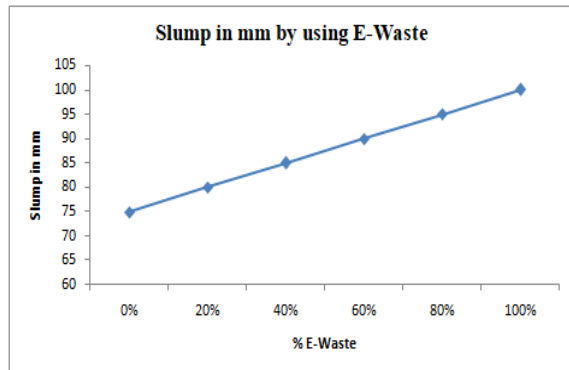
**Test to conducted on concrete**

1. Fresh concrete test
2. Slump cone test
3. Compaction factor test
4. Strength of concrete
5. Compressive strength
6. Split tensile strength

**4. RESULTS AND ANALYSIS**

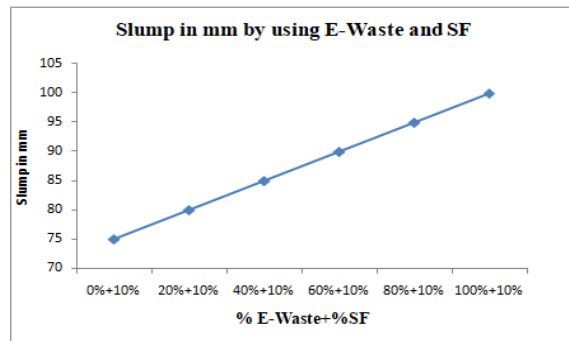
**Slump cone test**

**With E Waste**



**Chart 1:** comparison of slump values with E waste

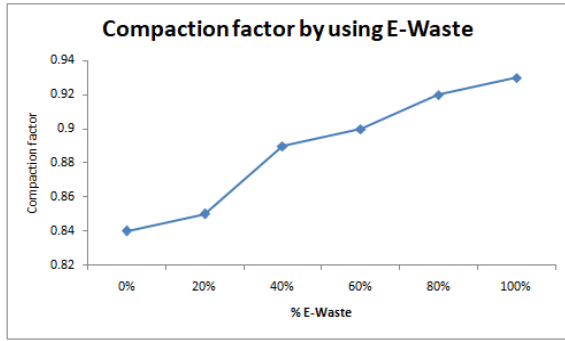
**With E Waste and Silica fume**



**Chart 2:** comparison of slump values with E waste and silica fume

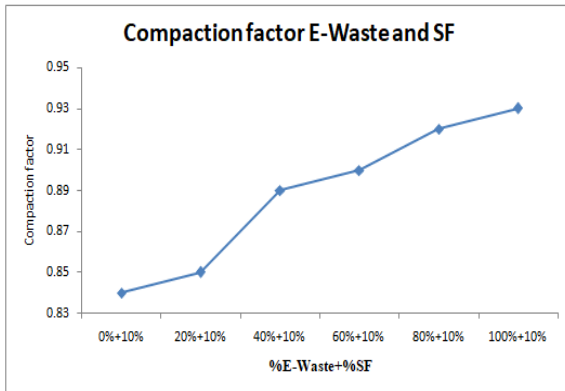
**Compaction factor**

**With E Waste**



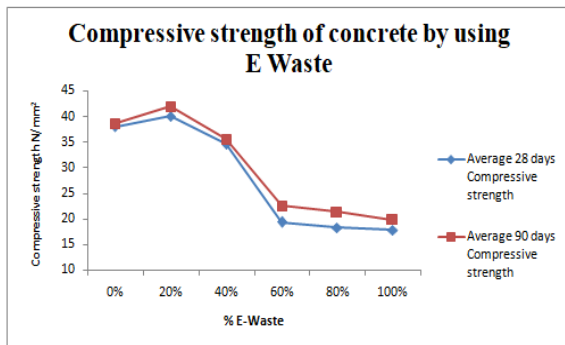
**Chart 3:** comparison of compaction factor with E waste

**With E Waste and Silica fume**



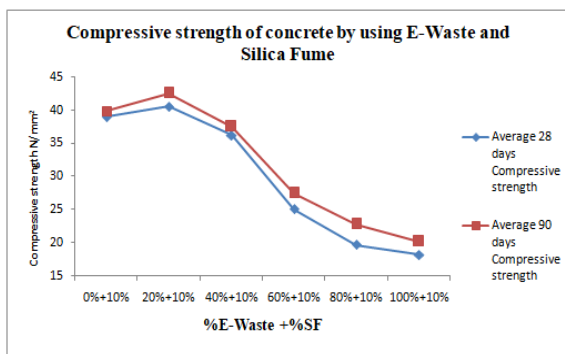
**Chart 4:** comparison of compaction factor with E waste and silica fume

**Compressive strength  
 With E Waste**



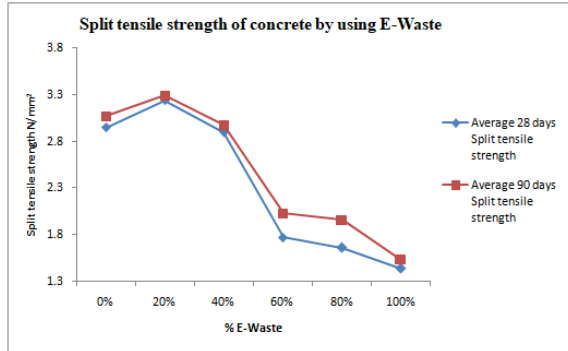
**Chart 5:** comparison of Compressive strength with E Waste

**With E Waste and Silica fume**



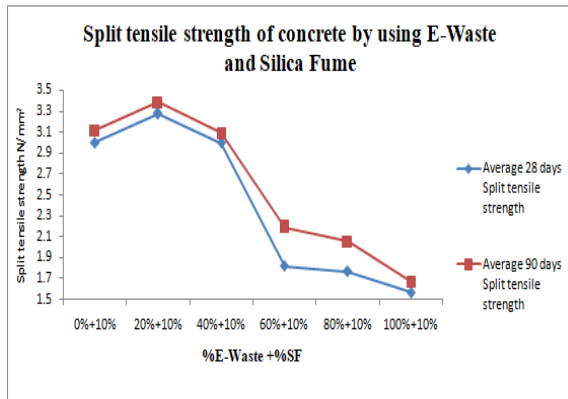
**Chart 6:** comparison of Compressive strength with E Waste and silica fume

**Split Tensile strength of concrete  
 With E Waste**



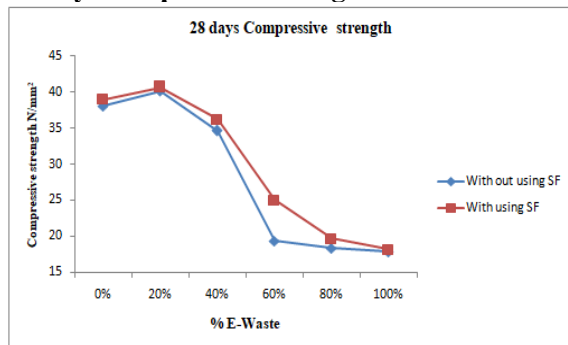
**Chart 7:** comparison of tensile strength with E Waste

**With E Waste and Silica fume**

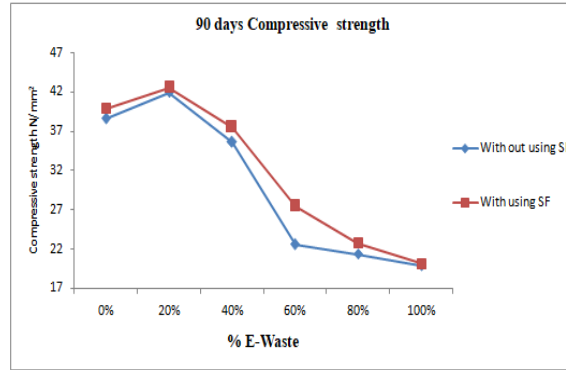


**Chart 8:** comparison of tensile strength with E Waste and silica fume

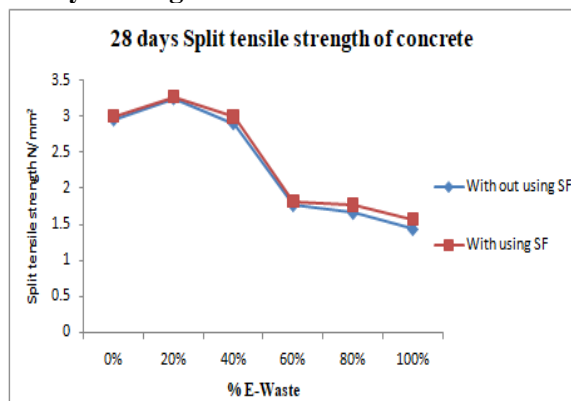
**Comparison of Compressive strength  
 28 Days compressive strength**



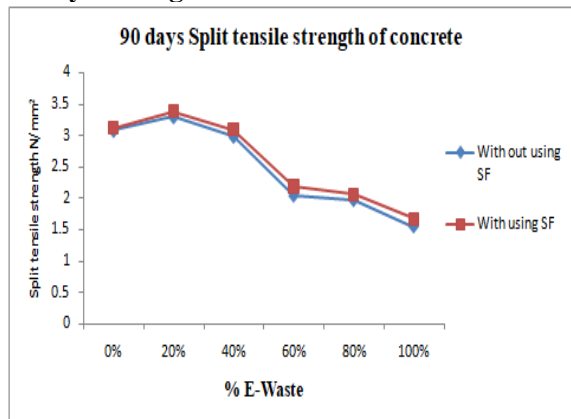
**Chart 9:** Comparison of 28 days compressive strength with and without silica fume  
 90 Days compressive strength



**Chart 10:** Comparison of 90 days compressive strength with and without silica fume  
**Comparison of split tensile strength  
28 days curing**



**Chart 11:** Comparison of 28 days tensile strength with and without silica fume  
**90 days curing**



**Chart 121:** Comparison of 90 days tensile strength with and without silica fume

## 5. CONCLUSIONS

1. The purpose of this research is to determine the most effective methods for repurposing E-Waste particles as coarse aggregate and Silica fume as cement.
2. It is also discovered that when coarse aggregate is substituted by 20% with E-waste at the age of 7 days, the compressive strength is at its peak. Beyond that, the compressive strength starts to deteriorate.
3. When 30% silica fume is applied in addition to varied proportions of E-waste replacement with coarse aggregate, the compressive strength will progressively decline.

4. At 20% E-Waste for 28 days and 90 days repairing, the optimum esteem (most extreme esteem) of split elasticity was observed. After 20 percent, the solid's split elasticity decreases.
5. The utilisation of E-Trash and Silica as a partial substitute for coarse aggregates and cement gives us a new way to turn waste into an usable substance.
6. The use of E-waste as a rough combination reduces the quantity of rubbish that have to be disposed of in landfills and decreases pollution.
7. The density of E-waste concrete is decrease than that of traditional concrete, decreasing the price of concrete and ensuing in a lighter concrete construction.
8. This experimental investigation clearly demonstrates that the right selection of E-waste elements, such as Silica Fume, may improve the concrete's strength.

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