

# SOIL STABILIZATION BY USING FLY ASH AND E-WASTE

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## **ABSTRACT:**

*Due to increase in population growth and the reduction of available land in India, more and more construction of the buildings and the infrastructure works have to be carried out on weak or soft soils. In India, the one of the soft soil is the Clay Soil, which covers an area of approximately 20% of the available land area. It is considered as unsuitable soil for construction purpose due to its swell and shrinkage properties upon wetting and drying. Such soils shows immense swelling while it comes in touch with water; however, it shrinks with decrease of Water content material and develops cracks on drying. Soil stabilization is the process to alter the properties of a present soil to improve the required engineering properties.*

*This paper presents the results of the soil stabilization of Clay Soil using e-waste and Fly Ash with varying dosages of e-waste i.e. 3%, 5% and 9% and with 20% of Fly Ash. The performance the Stabilized soil was evaluated the use of the familiar soil tests namely; Atterberg's limit, specific gravity, compaction test, unconfined compressive test, California bearing ratio (CBR). After performing Take a look at there was an improvement in angle of friction ( $\Phi$ ). While the proportion of e waste multiplied it became also located that there may be a growth in the Bearing capacity of the clay soil as bearing capacity is depending on  $C$  and  $\Phi$ .*

**Keywords:**

*E-waste, Clay Soil, Soil stabilization, bearing capacity, Fly Ash, Swell-shrinkage properties, Unconfined compressive strength and Plasticity index ratio*

## **1. INTRODUCTION:**

The Clay Soil swells and shrinks excessively with the change of water content. Such soils cause serious damage and distortion to structures, particularly for the Light homes and pavements built on such soils. Soil stabilization may increase the volume of soil which will improves the engineering properties of soils.

The present information and communication revolution has led to many problems includes the generation of hazardous wastes from electric and electronic products thus increasing the quantity of e waste day by day. One of the available disposal techniques is recycling. If it is not recycled then it has to be land filled in a nearby disposal facility. In view of above, we have considered the use of e-waste with addition of Fly Ash for improving the stability of the clay soils.

The motive of this examine is to represent normal fly ash from nearby thermal power

station and e-wastes and evaluate their Effectiveness in lowering swell. The purpose of this Paper is to assess the effect of adding the e-waste of various percentages plus 20% of fly ash on the geotechnical behaviour of the Clay Soil like the grain size distribution.

### **MATERIALS USED FOR STUDY:**

The materials used for the study include the Clay Soil and e-waste, which are discarded digital equipment consisting of unused mobile phones, computer and household appliances. The one of the common industrial waste is Fly Ash, which was obtained from nearby Thermal Power Station. When fly ash is delivered to Clay Soil, it reduces its plasticity index and decrease in the swell Ability and a growth inside the shear electricity of Clay Soil.

### **2. METHODOLOGY:**

Laboratory tests on Clay Soil with and without e-waste and Fly Ash were conducted. To evaluate the improvement in clay soil properties, soil tests namely; Atterberg's Limit, Specific Gravity, Compaction Test, Unconfined Compressive Test, California Bearing Ratio (CBR) were carried out.

### **3. LITERATURE STUDY:**

**Sivapullaiah (1996):** The effect of fly ash is associated with particle Length distribution, loose lime content and Pozzolanic reactivity of it. The effect of the Coarseness of fly ash particles is to lower. The interest and plasticity index of the soil.

**Temimi (1998):** Inclusion of fly ash within the clay fabric improves the mechanical homes of the Clay, just like the compressibility and the Consolidation.

**Puppala (2001):** The fly ash remedy method may be used to stabilize expansive soils, and fibers can be used to growth the electricity and reduce the Shrinkage potentials of expansive soils and Fibers alone will no longer offer comprehensive Stabilization. Both techniques confirmed a Growth in unconfined compression electricity of the soils. Each stabilizers have been Recycled waste merchandise and therefore their use in soil stabilization will reduce landfilling expenses.

**Prabakar (2004):** The fly ash improves the shear energy, Concord and bearing ability. So, this Aggregate may be used as the base materials for the roads, back filling and and so forth.

**Phani Kumar & Sharma (2004):** With addition of Plasticity hydraulic conductivity and swelling residences decreased and the dry unit weight, strength and undrained cohesion (*cu*) of aggregate elevated with a growth in fly ash content material

**Parsons & Kneebone (2005):** Fly ash contributed to soil power and And stiffness even as plasticity and swell capacity were reduced. Also, use of fly ash on my own for Stabilization may not be sufficient to improve Soil homes to desired tiers

**Kate (2005):** Swelling traits which includes unfastened swell Index, maximum swell and swelling strain Decreased with increase in percent of fly Ash. While, the addition of lime

will increase those values extensively. Moreover, Curing process triggered a super increase in power of fly ash combinations.

**Edil (2006):** Addition of fly ash extensively, expanded the cbr and resilient modulus of the Inorganic soils. Fly ash have to be stiffen over Time to increase the resistance of the Pavement.

**Senol (2006):** The fly ash increases unconfined Compressive energy, and the cbr values and may update with smooth subgrade of Highways.

**Zha (2008):** The plasticity index, pastime, loose swell, Swell ability, swelling pressure, and axial Shrinkage percentage decreased with a boom in fly ash or fly ash-lime content. With the Growth of the curing time for the handled Soil, the swell capacity and swelling pressure Reduced further. With a boom in fly ash and lime-fly ash content material, the most suitable water Content material and the maximum dry unit weight Decreased.

**Phanikumar & Sharma (2007):** Settlement and swell ability of structures Constructed in this stabilized clays with fly ash Decreased and consolidation passed off in shorter time. Moreover, maximum dry Unit weight elevated and superior moisture Content material decreased with increasing fly ash Content material.

**Lin (2013):** Stabilization with elegance c fly ash lessen the Plasticity index, clay size fraction, percent of Swell, swell strain, and volumetric water Contents of the soil water function Curves, and growth the unconfined Compressive energy.

**Sridharan (2013):** The liquid limits, compaction characteristics And swelling ability of expansive clay Soil-fly ash combinations are appreciably Advanced. Furthermore, compressibility Traits of the expansive soil are advanced with the addition of fly ash.

**Prasad & Sharma (2014):** The swelling of the clay reduced after Stabilization with fly ash. The driest Density of clay-sand-fly ash blend reduced with the addition of fly ash and optimum moisture content material extended. Widespread Development passed off in compaction Procedure and california bearing ratio of Composite containing clay, sand and fly ash.

**Sridharan (2013):** The liquid limits, compaction traits And swelling capability of expansive clay Soil-fly ash combinations are significantly Advanced. Moreover, compressibility Characteristics of the expansive soil are Progressed with the addition of fly ash.

**Jalal Uddin (2012):** Via progressive changes in product style under prolonged manufacturer duty (erp), use of environmentally friendly Substitutes for risky materials, those affects can be mitigated. A prison framework Need to be there for enforcing epr, rohs for reaching this aim. Manufacturers & Suppliers need to set desires for decreasing electronic waste.

**Vijay N. Bhoi (2014):** Most of the waste is inherently risky. It's going to degrade to provide leachate that can contaminate water, and make lowland gas, that is explosive. Additionally, due to the risks associated with lowland sites, there are currently extraordinarily strict needs at the improvement, operation and hospital therapy of such websites. Makers, retailers, customers, and disposers should share obligation for decreasing

the environmental impacts of merchandise.

**Kuehr and Williams (2003):** Said that a growing marketplace for reused computers in developing countries is permitting people to very own desktops and get admission to technology at more low-priced fees. Moreover, reuse also reduces the environmental impacts of technological artifacts by means of increasing their existence spans and thereby reducing the demand for brand new equipment.

**Yamini Gupt & Samraj Sahay (2015):** Counseled that financial duty of the producers and separate gathering and recycling corporations make a contribution appreciably to the achievement of the prolonged manufacturer responsibility-based totally environmental policies. Regulatory provisions, take back obligation and economic go with the flow pop out to be the 3 maximum vital components of the extended manufacturer obligation. Presence of informal zone had a negative effect on the regulatory provisions.

**Samarkoon M.B. (2014):** In his look at states that mistaken dealing with of e-waste can purpose damage to the environment and human health due to its poisonous additives. Even though the modern emphasis is on end-of-life management of e-waste sports, which include reuse, servicing, remanufacturing, recycling and disposal, upstream reduction of e-waste generation thru inexperienced layout.

**Shubham Gupta (2014):** Studied that in growing countries like india, china, Indonesia, brazil, industrial agencies have a tendency to recognition more on monetary elements rather Than environmental policies of e- waste recycling. So, for the worthwhile restoration of Reusable materials and sustainable surroundings, the green recycling of this waste has been Rendered critical, and is considered as a task for nowadays's society.

**Sikdar & Vaniya (2014):** Of their studies stated that authorities need to introduce some Topics related to disposal of e-waste substances and its recycling and unfavourable outcomes of e-waste on health of human body in environmental education as a compulsory concern from decrease to Better grades. The researcher found out lately that the education machine on my own is a powerful Medium to ensure environmental protection. It should attain maximum elements of the population at a Younger age, and greater e-waste pleasant behavior should be practiced on every day basis.

**Ramzy Kahhat (2008):** stated in his article that some states are adopting e-waste Regulations, but to date the u.S. Does now not have a federal law that addresses the whole E-waste scenario, which include residential and non-residential sectors.This will create a greater efficient countrywide e-waste management Device. On this situation, the e-market for back deposit machine will be the mechanism for Residential customers to cast off their devices in a manner that motivates series, recycle And reuse of e-waste.

**Peeranart Kiddee (2013):** E-waste can be controlled with the aid of developing ecodesign devices, properly collecting e-waste, get better and recycle material by safe methods, Put off e-waste by way of appropriate techniques, forbid the transfer of used electronic devices to Developing countries, and raise awareness of the impact of e-waste. No single device is adequate but together they can supplement every other to resolve this issue. A national scheme along with Epr is a good policy in solving the growing e- waste issues.

**Norazli Othman (2015):** The amount of digital wastes may be managed if there may be a

sustainable incorporated method in dealing with the digital waste. Sustainable Included method ought to bear in mind digital wastes management from the manufacturing until its disposal factor. Implementation of new law and act must also be taken into consideration by way of the authority as to increase human capital in handling digital waste. The combination of Human capital with a sustainable technique for handling digital waste will result in Efficiency in managing digital wastes within the future.

**Hassan Taghipour (2012):** Counseled that a policy should be framed extending manufacturer Responsibility (epr) programme in aggregate with a schooling programme at distinctive ranges of society. A method consisting of a mandated product take back is proposed for implementing epr in iran. Meanwhile, the fitness ministry and the environmental safety Organisation ought to strictly supervise e- waste series, garage, and recycling and/or disposal, and the alternate and enterprise ministries need to have extra manage over the import and production of digital items.

**Ramzy Kahhat (2008):** Stated in his article that a few states are adopting e-waste Guidelines, however up to now the u.S. Does no longer have a federal law that addresses the entire E-waste situation, consisting of residential and non-residential sectors. Federal stage regulations and Guidelines gift the first-class way to deal with the e-waste state of affairs as they will overcome the shortage of regulations in maximum states and could standardize guidelines and Guidelines in the United States of America. This may create an extra green national e-waste control Device. In this situation, the e-market for back deposit device could be the mechanism for Residential customers to cast off their gadgets in a way that motivates collection, recycle And reuse of e-waste.

**Sukeshini Jadhav (2013):** Found that proper e waste control will assist efficient Sourcing and series proper upto extraction and disposal of material, ensuring that e-waste will change into lucrative merchandise and business possibility. The producers ought to take Responsibility for adopting the rule for production sound surroundings product and Sustainability management need to be started from the product manufacturing degree that could facilitate the recycling and reuse.

**Binegde (2015):** Studied that the restore stores of electronic items of the have a look at vicinity contributed an important function in extending the life span of electronic goods and therefore reduce the wide variety of thrown away e-items. The study indicated that the excessive repair fee of the Digital items and availability of relatively less expensive new electronic items with more Capabilities draws the customers toward the throw away tradition, main to accumulation of Obsolete electronic objects. Strengthening of formal recycling of e-waste could be very critical for Attaining sustainable development.

#### 4. CONCLUSIONS:

It is proposed to carry out the familiar soil tests; Atterberg's Limit, Specific Gravity, Compaction Test, Unconfined Compressive Test, California Bearing Ratio (CBR) in order to evaluate the improvement in clay soil properties by using e-waste and Fly ash as the stabilizer. We shall study the tests results to understand and discuss the mechanisms and geotechnical properties of clay soils stabilized with e-waste and fly ash.

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