

Review Paper on the Use of Eggshell Powder in the Construction Industry

Mr. Akshay Kadlak¹ Mr. Meghnandan Nale² Mr. Umesh Gatkal³

Mr. Nagesh Shinde⁴ Prof. Rachana Vaidya⁵

Student, B.E, Dept. of Civil Engineering, Alard College of Engineering and Management, Pune.^{1,2,3,4}

Professor, Dept. of Civil Engineering, Alard College of Engineering and Management, Pune.⁵

Abstract Worldwide, eggshell waste is a prevalent kind of food waste. Every day, houses, restaurants, food processing facilities, and poultry farms produce a large amount of eggshells. Eggshells can cause problems with cleaning and the environment if they are not disposed of appropriately. Calcium carbonate, which makes up the majority of eggshell powder, may be repurposed in a variety of sectors. This analysis examines the amount of eggshell waste produced, its potential uses, and its numerous applications in industries. It also discusses how recycling eggshell trash may save money and the environment. Eggshell powder reduces waste and promotes a more sustainable future by being used in concrete, cement alternatives, and other industrial goods.

Key Words: Eggshell, Environment, Concrete, Cement, Waste Reduction, Economical,

1. INTRODUCTION

Because of the growing population and industrial activity, waste management has emerged as a significant environmental concern in recent years.[5] Among the several kinds of garbage, eggshell waste is produced in large amounts by bakeries, poultry farms, families, and the food industry. Since calcium carbonate comprises up 94–97% of eggshells, they may be used again in a variety of industrial settings. Eggshell trash may be processed into eggshell powder (ESP) and utilized as a valuable resource rather than being dumped in landfills. Researchers have discovered that eggshell powder may be utilized in agriculture and other sectors, enhance soil qualities, and partially replace cement in concrete. [8]

1.1 3R Concept: A Framework for Waste Management

One key tactic for environmentally friendly trash management is the 3R principle (Reduce, Reuse, Recycle). This idea emphasizes reducing waste production and encouraging resource efficiency. [7] [2] [6]

a) Reduce

Effective waste management starts with cutting waste at the source. Environmental pollution may be greatly decreased by producing less garbage. [7]

b) Reuse

Reuse is the repurposing of resources without extensive processing. Eggshells may be recycled into a variety of products, including building materials, fertilizers, and additions for animal feed. diode (CCD). [2]

c) Recycle

Recycling is the process of turning waste resources into new, reusable items. Concrete, soil stabilization, water treatment, and other industrial processes can all benefit from the recycling of eggshells into eggshell powder. [6]

1.2 Eggshell Waste Generation

Because eggs are inexpensive and have a high nutritional value, their consumption has grown dramatically around the world. The production of eggshell trash has consequently grown. The shell makes up around 11% of the weight of the millions of eggs produced daily by the chicken industry. [3]

Eggshell waste is generated from several sources, including:

- Household kitchens
- Restaurants and hotels
- Bakeries and food processing industries
- Poultry farms
- Egg processing industries

Every year, thousands of tons of eggshell trash are created. This trash can lead to health and environmental issues if improperly managed. For sustainable waste management, it is crucial to identify efficient ways to repurpose eggshell waste. [11]

1.3 Eggshell Waste Utilization in India, Maharashtra, Pune

India is among the world's top producers of eggs. Over the last few decades, India's chicken sector has expanded quickly, which has resulted in a notable rise in the production of eggshell waste. [12]

One of the top states for raising chickens and producing eggs is Maharashtra. Large amounts of eggshell waste are produced by families, bakeries, restaurants, and the food industry in cities like Pune, Mumbai, and Nashik.

Even though a lot of eggshell trash is produced, very little of it gets recycled. The majority of eggshell trash is either combined

with municipal solid garbage or dumped in landfills. This emphasizes the need for improved waste management techniques and the creation of technology to efficiently use eggshell waste. [10]

Eggshell powder can assist lessen waste disposal issues and advance environmental sustainability when used in building materials, fertilizers, and other industrial items. [9]

2. USE OF EGGSHELL ACROSS VARIOUS INDUSTRIES

Because eggshells contain a lot of calcium carbonate, they offer several beneficial qualities. They may be transformed into eggshell powder (ESP), which has a variety of uses, after being properly cleaned, dried, and ground. [10]

Uses of Eggshells for Various Objectives

Eggshell use in Construction Industry [1]

- Replacing some of the cement in concrete
- Manufacturing environmentally friendly construction materials
- Strengthening concrete at ideal replacement levels

Improving agriculture using eggshell powder [6]

- Used as a natural fertilizer
- Improves soil calcium content
- Enhances plant growth

Animal Food [4]

- Used as a calcium supplement in poultry feed
- Helps strengthen eggshell formation in poultry

Dissociation using eggshell water treatment [8]

- Used as an adsorbent to remove heavy metals and impurities from water

Pharmaceutical Industry [13]

- Used as a calcium supplement in medicines and health products

Ceramic and Material Industry [5]

- Used in the production of ceramics and lime-based materials

3. BENEFITS OF USING EGGSHELL FOR THE ENVIRONMENT

Utilizing eggshell powder provides several environmental benefits.

• Waste Reduction

The quantity of solid waste may be decreased by recycling and reusing eggshell trash rather than disposing of it in landfills. [1]

• Reduction of Environmental Pollution

When eggshell trash is disposed of improperly, it can attract bugs and produce a stink. Eggshell powder recycling aids in avoiding these environmental problems. [5]

• Reduction in Cement Consumption

Large volumes of carbon dioxide are released into the atmosphere throughout the cement making process. Cement use and carbon emissions can be decreased by partially substituting eggshell powder for cement. [6]

• Sustainable Construction

Using recycled resources, like eggshell powder, encourages sustainable growth and environmentally beneficial building techniques. [12]

• Conservation of Natural Resources

Utilizing waste materials for industrial use lessens the need to extract raw materials and contributes to the conservation of natural resources. [14]

4. METHODS OF USING EGGSHELL POWDER (ESP)

Through a variety of processing and application techniques, eggshell powder (ESP) may be used in a number of sectors. Eggshells may be ground into a fine powder and added to a variety of industrial products since their primary component is calcium carbonate. Depending on the necessary application, researchers have created a variety of efficient ways to employ ESP. [6]

4.1 Use of Eggshell Powder as a Partial Replacement of Cement

In the construction sector, eggshell powder is frequently used to partially replace cement in the manufacturing of concrete. This approach involves substituting a small amount of cement (usually 5% to 15% by weight) with eggshell powder in the concrete mix. Better particle packing inside the concrete matrix is facilitated by the tiny particles of ESP, which serve as a filler. This technique lowers the amount of cement used, building expenses, and carbon emissions related to the production of cement. [1]

4.2 Use of Eggshell in Soil Stabilization

The engineering qualities of soil can also be enhanced with eggshell powder. This technique increases the strength, stability, and bearing capability of weak or expanding soil by mixing it with ESP. Eggshell powder's calcium compounds interact with soil particles to strengthen soil bonding. When improving the soil is necessary for foundation work and road building, this technique is helpful. [2]

4.3 Use of Eggshell in Agricultural Fertilizer

Agriculture is another significant application for eggshell powder. ESP can be used as a natural fertilizer or soil conditioner because of its high calcium concentration. It enhances the pH of the soil, raises the calcium content, and encourages the growth of healthy plants. [11]

4.4 Use of Eggshell in Water Treatment

In water treatment procedures, eggshell powder can be utilized as an adsorbent substance. Using adsorption and chemical reactions, ESP is added to polluted water to aid in the removal of heavy metals and other contaminants. This method provides an economical and environmentally friendly approach for water purification. [13]

4.5 Use of Eggshell in Industrial Materials

Additionally, eggshell powder is utilized in the manufacturing of calcium-based industrial goods, ceramics, and biomaterials. Eggshells may be used as a raw material in a number of manufacturing processes since they contain calcium carbonate. Researchers are looking at using ESP to create composite goods and environmentally friendly building materials. [12]

5. CONCLUSION

Waste eggshells are a precious resource with a lot of potential for reuse in several industrial applications. Effective waste management techniques are now required because to the growing amount of eggshell waste produced by homes, food businesses, and chicken farms. A sustainable way to recycle eggshell trash is to turn it into eggshell powder. This review research demonstrates the usefulness of eggshell powder in a variety of areas, including environmental engineering, agriculture, and construction. Eggshell powder may be used in the construction industry to partially substitute cement while making concrete, which lowers carbon emissions and cement use. Eggshell powder can also serve as an adsorbent in water treatment procedures and increase soil fertility in agricultural settings. Examining ESP-based composites for high-performance building materials (such as green concrete and eco-friendly bricks). Using eggshell powder encourages sustainable and cost-effective manufacturing practices in addition to lowering environmental pollution. Therefore, further investigation and education are required to promote the widespread application of eggshell powder in many sectors.

6. REFERENCES

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BIOGRAPHIES



Akshay Dinesh Kadlak
B.E Civil project done on Review
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