ASSESSING THE VIABILITY OF PHOTOVOLTAIC SILICON GLASS POWDER (PSGP) AS A SAND REPLACEMENT IN CONCRETE

Project Reference No.: *48S_BE_*2444

College : *Jain College Of Engineering And Technology, Dharwad*
Branch : *Civil Engineering*
Guide(s) : *Prof. G M Kotur*
Student(s) : *Ms. Nanditha S N*
Mr. Junaid Ahmed Z Pallan
Mr. Md Juned Imtiyaz Ahmed Shabdi
Ms. Annapurna Subhas Pawar

Keywords:

Photovoltaic Silicon Glass Powder (Psgp),Sieve Analysis , Workability ,Compression

Introduction:

The demand for concrete is rising due to rapid urbanization and infrastructure growth. This increases the consumption of natural river sand, a key component in concrete. Uncontrolled sand mining causes environmental damage like erosion and habitat loss. Simultaneously, disposal of solar panels is emerging as a major E-waste challenge. Photovoltaic (PV) panels contain high-purity silicon-based glass. Millions of these panels will reach end-of-life in the coming years. Their improper disposal leads to land pollution and health hazards. This project proposes using crushed PV glass as partial sand replacement in concrete as psgp. It offers a dual solution: reducing sand usage and managing solar panel waste. The approach supports sustainability and circular economy goals. Crushed PV glass which is psgp is a promising alternative to natural sand in concrete. It reduces dependence on natural aggregates and minimizes E-waste. Therefore, testing is essential to ensure structural safety and performance. Previous studies show potential benefits when glass is used correctly. This aligns with green construction and sustainable development strategies.

Objectives:

- Optimise the mix design of M25 Grade concrete for reference mix.

2. Optimise the mix design of M25 Grade concrete with PSGP mix for best performance.

3. Evaluate suitable mix proportion of PSGP for sand replacement of 20% 40% and 60%.

4. Conduct fineness modulus test on fine aggregates and PSGP.

5. Conduct Workability test on concrete for various mix proportion of PSGP in Concrete.

6. Conduct Compressive Strength test on concrete for various mix proportion of PSGP in Concrete.

7. Promote E-Waste Recycling in the Construction Industry.

Methodology:

1.Discarded photovoltaic solar panels were sourced from E-waste recycling centers.
2.Glass was separated from panels, cleaned, and stripped of coatings.

3.The glass was crushed and ground into Photovoltaic Silicon Glass Powder (PSGP) (<600 microns).

4.Sieve analysis ensured proper gradation of the PSGP.

5.Ordinary Portland Cement (OPC) conforming to IS standards was used.

6.Natural river sand served as fine aggregate in the control mix.

7.PSGP replaced sand at 0%, 20%, 40%, 60%, and by weight.

8.Coarse aggregates (10–20 mm) were used as per IS guidelines.

9. Mix design targeted M25 grade concrete using IS 10262:2019.

10.A constant water-cement ratio was maintained across all mixes.

11.Slump cone tests were conducted to check workability.

12.Concrete was mixed thoroughly to ensure uniformity.

13.Specimens (cubes) were cast using standard Molds.

14.Samples were demoulded after 24 hours and cured in water.

15.Compressive strength was tested at 7 and 28 days (IS 516).

16.Results were compared to the control mix to analyse performance.

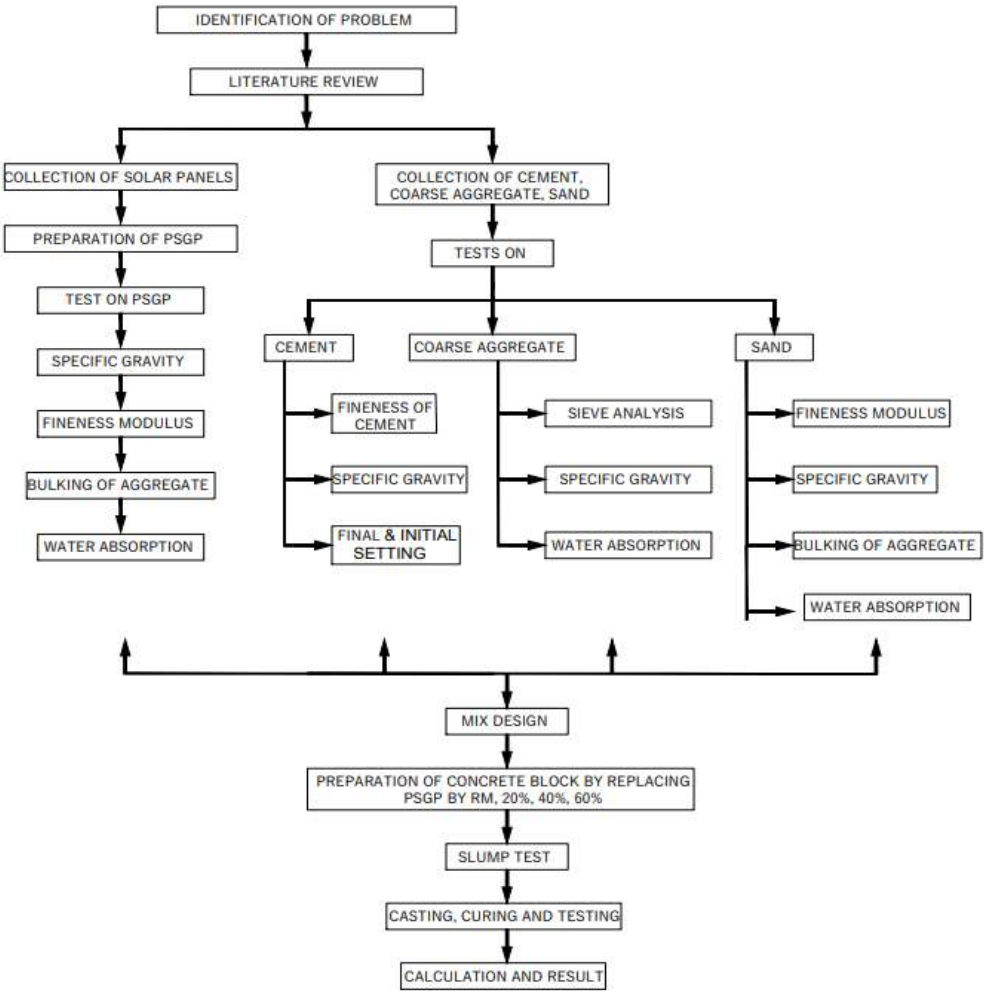


Fig- Methodology flowchart

Result and Conclusion**:**

Test on cement

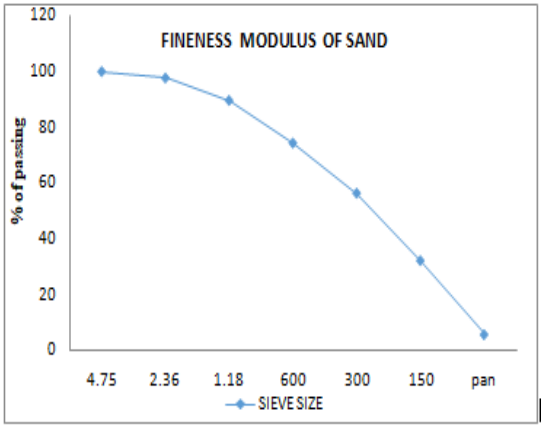
- Specific gravity of Cement: **3.18**
- Fineness of cement is **4.75 %**

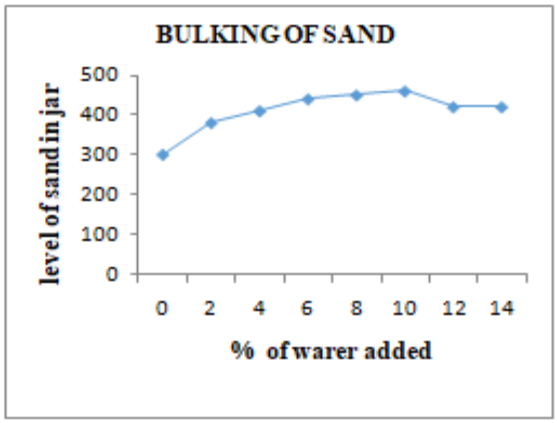
- Initial setting time of cement, **45** **minutes.**
- Final setting time of cement, **498** **minutes (8.3 hours).**

Test on fine aggregate

- Specific gravity of fine aggregate: **2.86**
- The water absorption of the fine aggregate is found to be **0.61%**
- Fineness modulus of fine aggregate is **2.44**
- Bulking density of sand **53.3%**

- **Graph: FINENESS MODULUS OF SAND** **Graph: BULKING OF SAND**

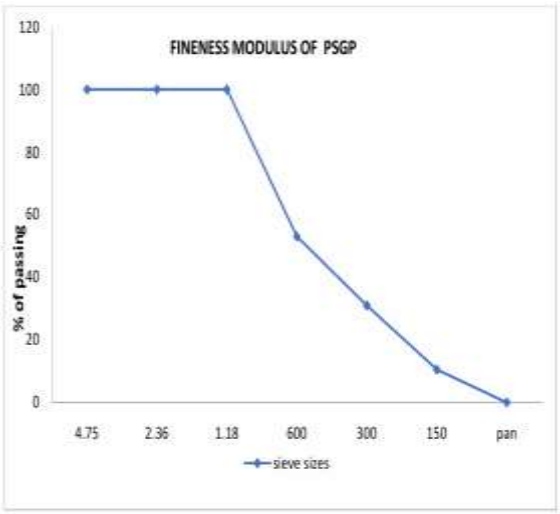


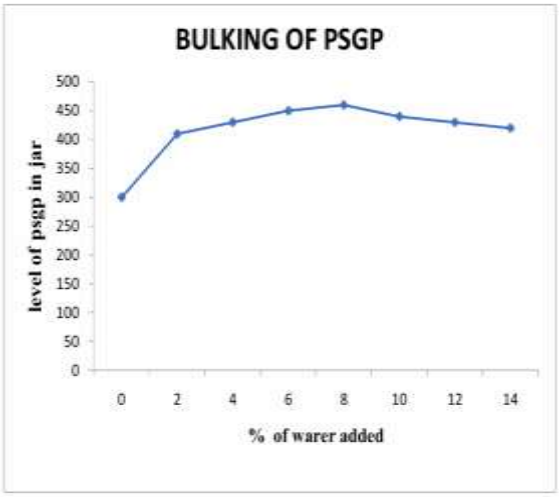


Tests on coarse aggregate

- Specific gravity of coarse aggregate is **2.77**
- Water absorption of coarse aggregate is **0.47%**
- Gradation of coarse aggregate is **6.13**
- **Tests on psgp**
- Specific Gravity of PSGP **2.38**
- The average water absorption of the PSGP is found to be **0.6%**
- Fineness modulus PSGP is **3.05**
- Bulking density of PSGP **53.3%**

- **Graph: FINENESS MODULUS OF PSGP** **Graph: BULKING OF PSGP**

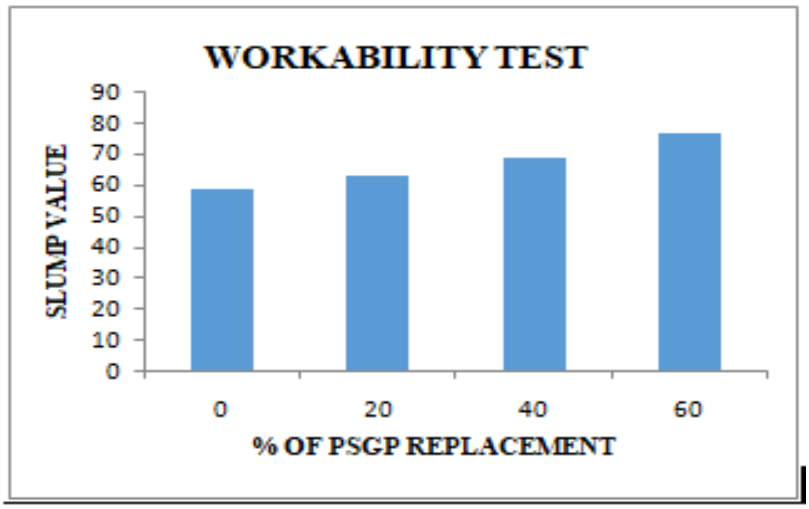




➢ **Observation for workability test**

SL NO	% OF PSGP REPLACEMENT	WORKABILITY IN MM
1	0	59
2	20	63
3	40	69
4	60	77

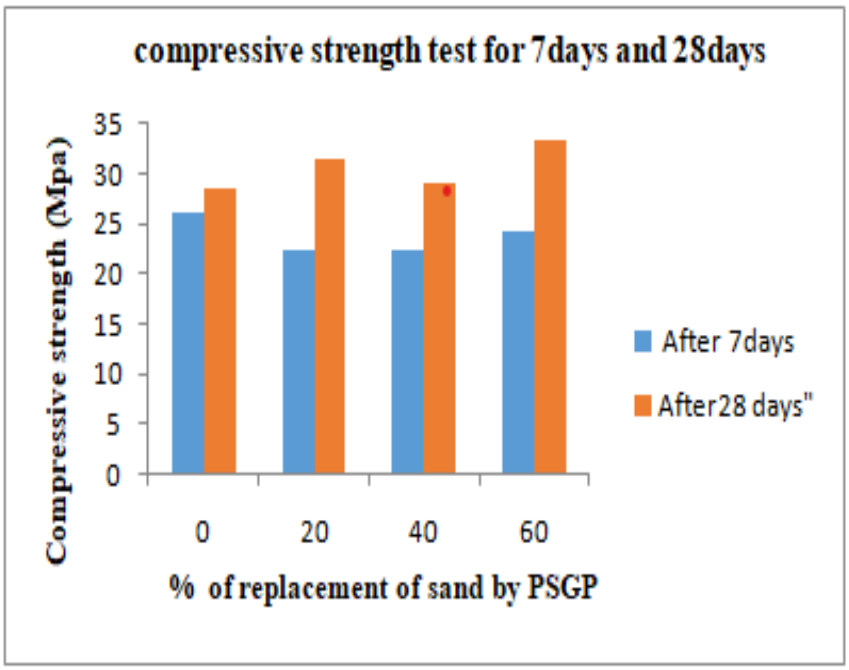
➢ **Graph on workability test:**



➢ **Observation for compressive test**

Concrete Mix	7 Days Compressive Strength (MPa)	28 Days Compressive Strength (MPa)
Normal Concrete (0% PSGP)	26.17	28.40
20% PSGP Replacement	22.31	31.55
40% PSGP Replacement	22.22	28.97
60% PSGP Replacement	24.08	33.33

➢ **Graph for compressive test:**



➢ **In this graph we observe that the optimum compressive strength is more for PSGP replacement concrete mix when compared with conventional concrete.**

CONCLUSION,

1. The M25 concrete mix having various sand replacement level up to 60% exhibited satisfactory results.

2. The optimum use of PSGP up to 60% replacement was found good for the M25 mix.
3. The optimum workability increased by 8% for every 20% replacement of sand by PSGP. The optimum compressive strength was **28.40 N/mm^2** for conventional concrete mix at 28 days.
4. The optimum compressive strength was **33.33 N/mm^2** for 60% replacement of the fine aggregate by PSGP at 28 days.
5. The optimum compressive strength here increases by **15.98%** in PSGP replacement concrete mix, when compared with the conventional concrete mix .
6. The use of PSGP can result in cost savings, particularly in areas with high sand scarcity and disposal costs for E-waste.
7. Reduction in natural sand usage, mitigating the negative impacts of sand mining.
8. Recycling of solar panel waste helps manage the growing issue of electronic waste (E-waste), contributing to sustainability.

Future Scope:

The future scope of this project includes:

1) Depletion of a natural sand resources.

2) Management of electronic waste generated by end-of-life solar panels.

3) This project promotes and has a potential for eco-friendly construction practice by reducing reliance on natural sand and recycling electronic waste (E-waste) simultaneously.

4) It tackles dual problems like resource scarcity and waste management.

5) Demonstrates economic viability for scaling up PSGP-based concrete production in construction.