Effect of HVFA binder on the production parameters and size of artificial aggregates made from Autoclaved Aerated Concrete (AAC) Powder

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1. Abstract

Autoclaved aerated concrete (AAC), one of the most popular building and construction materials which is approaching the end of its useful life. This is creating environmental and depository problems. Utilizing recycled AACP powder as a raw material for producing artificial aggregates can be a potential solution as an alternative to landfill deposition. The study investigates the effectiveness of utilizing high-volume fly ash mortar as a binder to produce cold-formed AAC aggregates. The initial assessment focuses on the use of different high-volume fly ash (HVFA) binder contents and their impact on the production parameters (viz., production efficiency, duration of pelletization, water-to-total solid ratio) and size of the aggregates. The results indicated that higher binder content influenced greater production efficiency, shorter duration of pelletization, and larger aggregate size.

2. Research Problem

- Aerated Autoclave Concrete (AAC) is a form of concrete that is primarily used as insulating material and partition blocks as an alternative to clay bricks.
- In China, 110 million m^3 of AAC was produced in 2015, which has increased to 177 million m^3 by 2018 (Shi *et al.*, 2019).
- AAC waste is generated during production as well as construction and demolition process. limited study in management of AAC waste fines.
- Use of AAC fines as a substitute raw material in the production of lightweight artificial aggregate has not been conducted previously.
- The study investigates the feasibility of utilizing AAC fines in producing lightweight artificial aggregate through pelletization.

3. Materials and Methods

Material Preparation (AACP and Binder) → Mixing and Production of AACP aggregates using disc pelletizer → Testing of aggregates

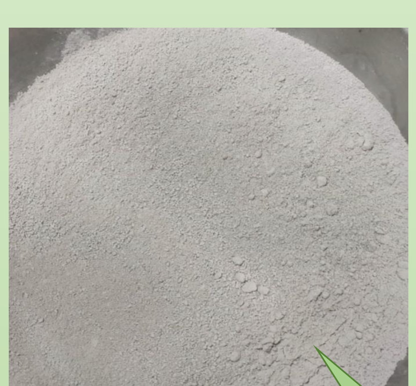
3.1 Preparation of AAC powder

AAC waste

Crushing of AAC Waste

AAC Powder Waste

Sieve through 600μm



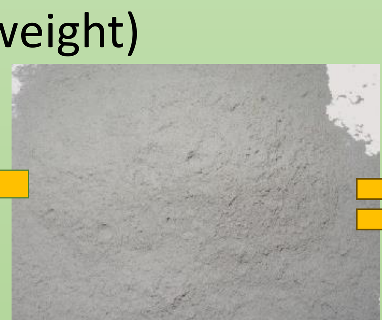
AAC powder passing through 600μm

3.2 Binders

(1:1 by weight)

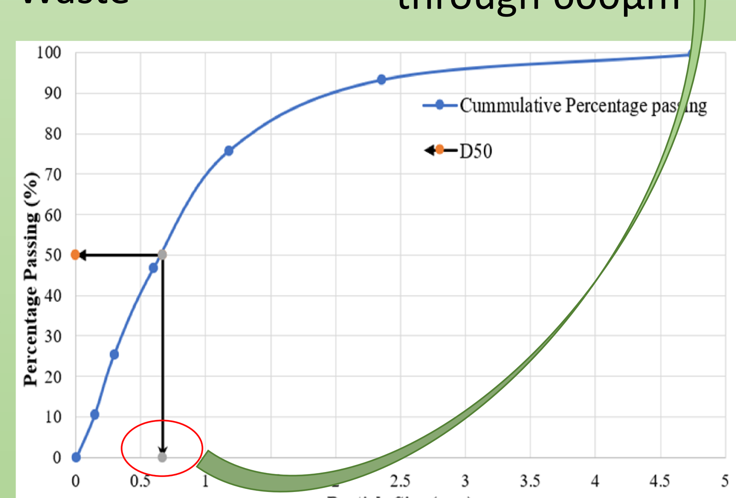
Cement (42.5 Mpa)

+



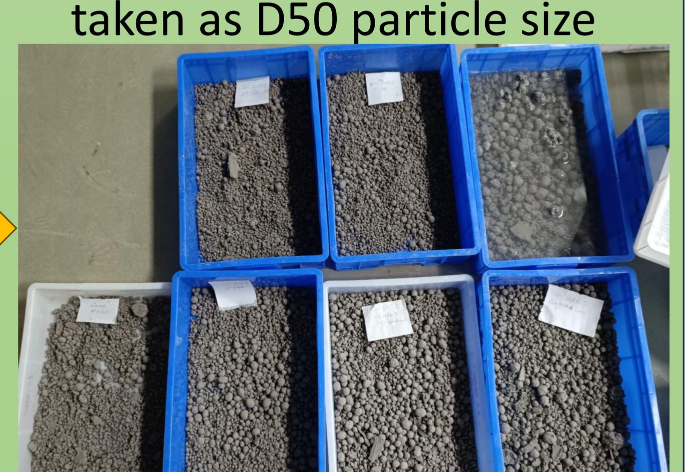
FlyAsh Type-II

= HVFA



Selection basis of AAC powder taken as D50 particle size

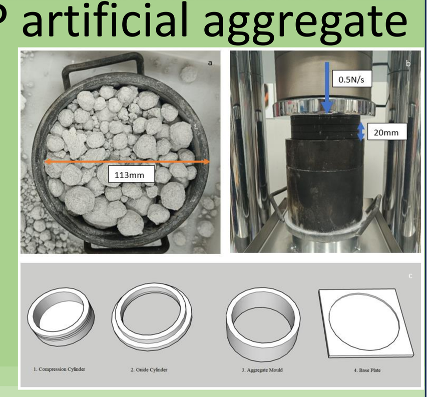
3.3 Production (Disc Pelletizer)



Fresh AACP artificial aggregate

3.4 Experiments

- Sieve analysis
- Loose bulk density, Apparent density, Specific gravity
- Water absorption
- Bulk Crushing Strength



4. Results

- **Production efficiency** of both the Cement and HVFA exhibited **improved performance** when the **binder content is higher than 30%.**
- **Duration of pelletization** and water to solid ratio decreased as the binder content increased
- Low binder content required up to 30 mins of pelletization time while at higher binder dosage the **pelletization time reduced up to 15 mins**
- Aggregate size ranged from **4.75mm to 40mm**
- Increase in binder content resulted in larger size aggregates so for **aggregate of size range 5-20mm, binder is required between 20-40%**

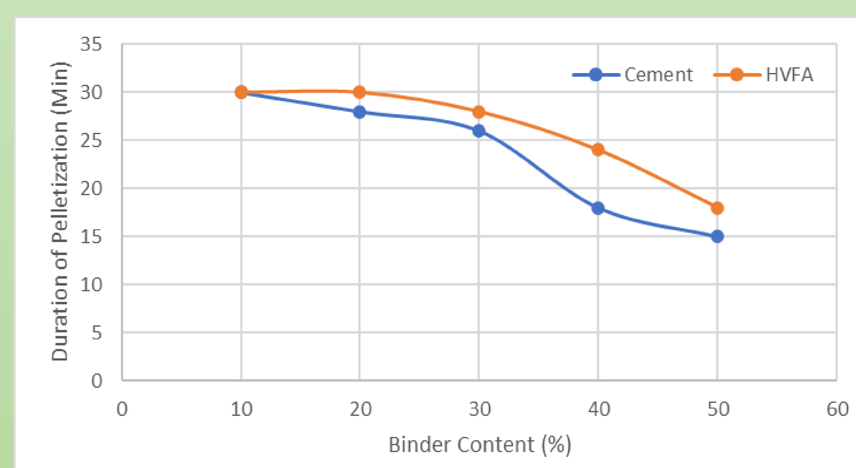


Fig 1: Duration of pelletization vs Binder Content

Table 1: Production efficiency of Aggregates with different binders

Binder Content (%)	Cement (%)	HVFA (%)
10	71.00	63.81
20	79.94	81.06
30	95.12	88.82
40	88.31	94.11
50	97.36	93.64

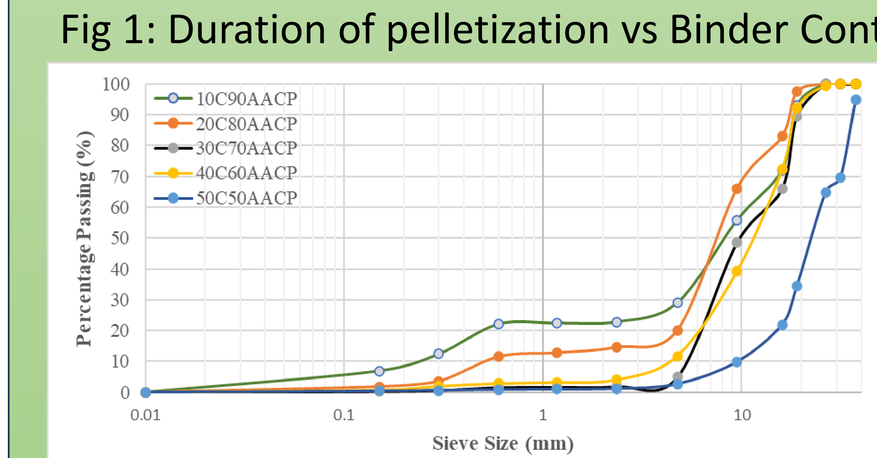


Fig 2: Particle size distribution of cement based AACP aggregates

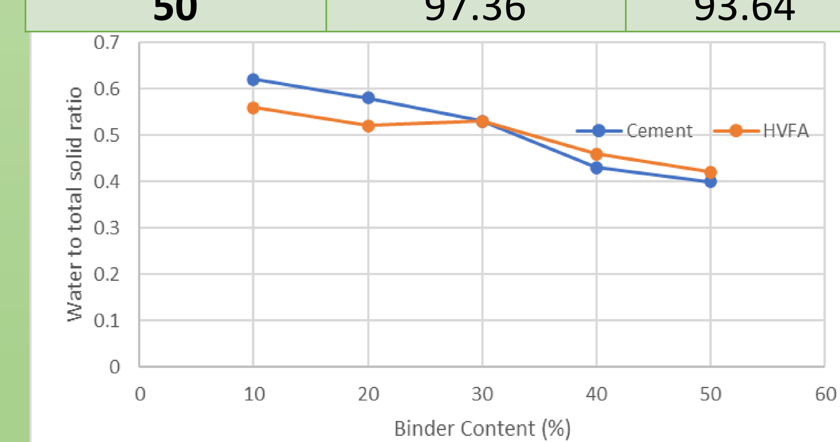


Fig 4: Water to total solid vs Binder Content

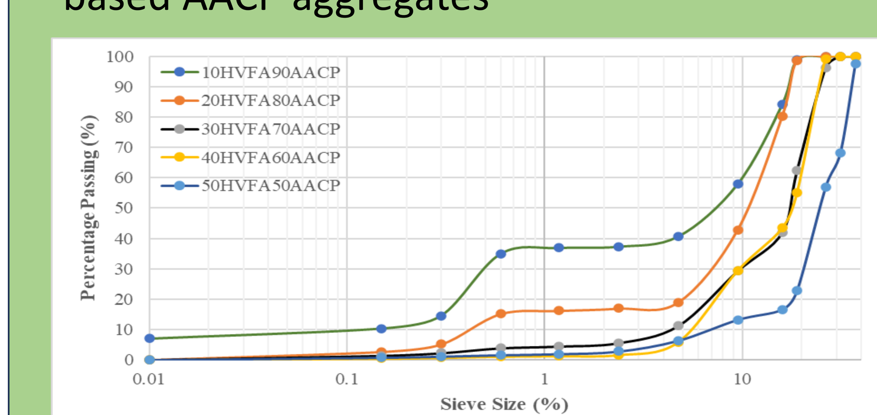


Fig 3: Particle size distribution of HVFA based AACP aggregates

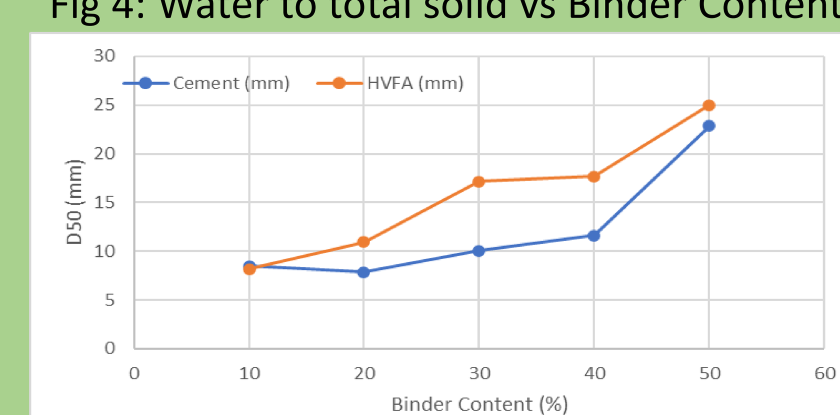


Fig 5: D50 Particle Size of Cement and HVFA aggregate vs Binder content

5. Key Findings

1. Pelletization of Autoclaved Aerated Concrete is **feasible** for the production of lightweight artificial aggregate.
2. Use of HVFA (1:1 of Cement: Fly Ash) binder as an alternative to traditional cement resulted in comparable size and production parameters. So, traditional **cement binder can be replaced with HVFA binder** for artificial aggregate production
3. From the production efficiency of the aggregates, it is observed that the AACP aggregates with 10-20% binder are insufficient for overall pelletization of the particles, resulting in very low production efficiency. Therefore, **an optimum binder content between 20-50% is recommended.**
4. Also from the particle size distribution analysis, the **optimum binder content is between 20-40%**

6. References

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