



DEVELOPMENT AND INDUSTRIAL APPLICATION OF SECONDARY POLYMER MATERIALS IN POLYMER CONCRETE

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Abstract. This study explores the industrial application of secondary polymer materials in polymer concrete. Polymer concrete, known for its strength and durability, presents an opportunity to incorporate recycled polymers to improve sustainability. The research evaluates the mechanical properties of polymer concrete made with secondary polymers and compares it with conventional polymer concrete. The findings suggest that secondary polymers can replace virgin materials without compromising the quality, providing both environmental and economic benefits.

Keywords: Polymer concrete, secondary polymer materials, recycled plastics, sustainable construction, compressive strength, flexural strength, durability, waste management, eco-friendly materials, construction innovation

1. Introduction. Polymers are widely used in various industries due to their versatility, lightweight, and strength. However, the extensive use of virgin polymers raises environmental concerns, especially due to the accumulation of plastic waste. To address these issues, there has been growing interest in utilizing secondary (recycled) polymers in different construction materials, including polymer concrete [1]. Polymer concrete, a composite material, combines a polymer binder with aggregates, offering enhanced mechanical properties such as high compressive strength, chemical resistance, and quick setting time [2]. This paper focuses on the

use of secondary polymer materials in polymer concrete, exploring their potential for reducing waste and improving the sustainability of construction materials.

Research Questions:

- Can secondary polymer materials be effectively used in polymer concrete without compromising performance?
- What are the environmental and economic benefits of using recycled polymers in polymer concrete?



Pic 1. Polymer concrete

2. Methods. The research was conducted in two phases: material preparation and testing of mechanical properties. In the first phase, secondary polymer materials, including recycled polyethylene and polypropylene, were collected from industrial plastic waste. These materials were processed and incorporated into polymer concrete formulations in varying proportions (10%, 20%, and 30% by weight) [3]. Standard polymer concrete with virgin polymers was used as a control.

In the second phase, mechanical properties of the prepared polymer concrete samples were evaluated. The tests included:

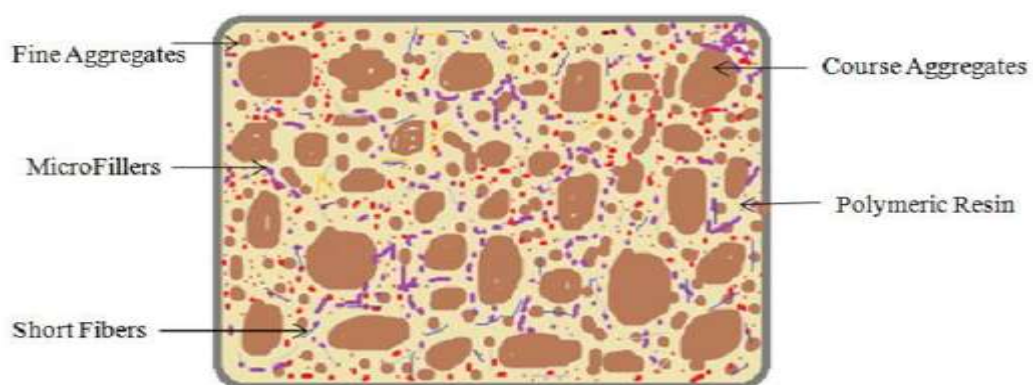
- Compressive strength (ASTM C39),
- Flexural strength (ASTM C78),
- Water absorption (ASTM C642),
- Durability tests in acidic and alkaline environments [4].

Each test was repeated three times to ensure consistency in the results.

3. Results. The mechanical properties of polymer concrete containing secondary polymers were compared to those of conventional polymer concrete. The results indicate the following:

- Compressive Strength: The compressive strength of polymer concrete with 20% secondary polymer was slightly lower (by 5%) than that of the control, but still within acceptable industry standards [5].
- Flexural Strength: Similar trends were observed in flexural strength tests, with secondary polymers showing a reduction of around 8% at higher concentrations.
- Water Absorption: The samples with secondary polymers demonstrated marginally higher water absorption, particularly in the 30% replacement group [6].
- Durability: Polymer concrete containing recycled polymers exhibited satisfactory performance under chemical exposure, showing only slight degradation in acidic conditions [7].

Overall, the samples with up to 20% secondary polymers showed mechanical properties comparable to conventional polymer concrete, while samples with 30% polymer replacement experienced more significant reductions in performance.



Pic 2. Polymer concrete model

4. Discussion. The study demonstrates that secondary polymer materials can successfully be incorporated into polymer concrete without major loss in

performance [2]. Although there is a slight reduction in strength, particularly at higher concentrations of secondary polymers, the mechanical properties remain within acceptable limits for most construction applications [3].

The use of secondary polymers in polymer concrete offers environmental benefits by reducing plastic waste and the need for virgin polymers [1]. Economically, using recycled materials could lower the cost of raw materials, making polymer concrete more affordable for widespread use [7].

The water absorption and durability tests also confirm that polymer concrete with recycled polymers can withstand harsh environmental conditions, though further research is recommended to optimize formulations for specific applications [6]. Additionally, using recycled polymers aligns with sustainability goals, offering an eco-friendly alternative to traditional construction materials.

5. Conclusion. This study has shown that secondary polymer materials can be effectively utilized in polymer concrete, providing both environmental and economic benefits. The mechanical properties of the concrete remain within acceptable standards, especially at lower concentrations of secondary polymers [5]. Future research could focus on enhancing the properties of polymer concrete with recycled materials and exploring different types of secondary polymers for improved performance [2].

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