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Exposure to sustainable mineral fibers as a reinforcement in polymer composites

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The extreme growth in the utilization of synthetic fossil-based fibers has led to the development of environmental pollutants that cause the greenhouse effect. Even though the researchers are trying to reinforce plant-based fibers in an eco-friendly concern, they still have many issues in meeting the requirements for engineering product developments [1]. The best way to compromise both environmental friendliness and engineering performance is the utilization of natural mineral fibers. These mineral fibers are naturally available on the earth and can also be obtained in the modified form of minerals. A few examples of mineral fibers are basalt, wollastonite, asbestos, and fibrous brucite. The other mineral fibers namely rock and slag wool are obtained through molten slag or rock utilizing steam or blowing methods [2]. The characteristics of obtained fibers are mainly dependent on the architecture and operation parameters of spinning equipment, melting conditions, and their inherent composition. These fibers are potential candidates in various industrial domains because of their excellent chemical stability, mechanical, thermal, sound absorption, and water-repellent properties. Basalt mineral fibers are the greatest substitutes for carbon, glass, or other synthetic fibers in the composites industry because of their remarkable mechanical and thermal properties. Conventionally, the production of mineral fibers is economically cheaper and environmentally safe in comparison to the glass fibers production [3].

The literature [3] has thorough information about mineral-reinforced composites. The creation of eco-friendly system and the stabilization of ecological problems are made possible by the potential of mineral fillers, such as basalt fiber powder, to decrease the polymer content of polymer goods while maintaining their original properties [4]. The heat transmission among polymer molecules is restricted by the basalt mineral reinforcement in a variety of thermosets and thermoplastic polymers, which also protects the material from thermal degradation. This is the reason for the mineral composite's improved thermal stability. The reduced mobility and

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flowability of the matrix have been considerably influenced by the increased rigidity of the basalt particles, which made a significant contribution to the viscoelastic behavior of the various thermoset and thermoplastic composites [5]. Under the artificial accelerated weathering, the significant loss of properties in various composites was significantly inhibited by basalt reinforcement. It has proven that the basalt is potentially capable to resist the UV rays, moisture absorption, and dry temperature conditions [6]. When it comes to the tribology performance, the basalt has significantly proven its ability to reduce the coefficient of friction and wear loss with polylactic acid [7], polypropylene and high density polyethylene [8] polymers.

Basalt fiber incorporated composites are more affordable and exhibit better chemical stability than glass and carbon fiber composites. These fiber's remarkable mechanical durability, superior temperature resistance, sufficient chemical rigidity, low energy consumption, and environmentally friendly production method easily meet the needs for possible applications. The application area includes automotive, civil engineering, aerospace, power, and petroleum industries. Basalt fibers and organic binders make a great match when it comes to the cryogenic storing and transporting of biological samples for medical studies [3]. Based on all of these facts, it can be inferred that mineral fiber's remarkable technological and environmentally benign qualities make it a useful reinforcing material for the current and the future. Since the mineral fibers have not been explored fully, the upcoming researchers have a chance to utilize the potentiality of these fibers for composite developments concerning both engineering and non-engineering sectors.

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