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## The Crashworthiness Performance of the Energy-Absorbing Composite Structure—A Review

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### Abstract

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The improved energy absorption capacity of composite materials will upgrade people's safety in accidents. Several parameters affect energy absorption such as fibre type, matrix type, fibre architecture, specimen geometry, processing conditions, fibre volume fraction, and test speed. These parameters influence the composite material-specific energy absorption. The distinct characteristic properties of composites play an essential role in a variety of industries. Automotive applications have

attracted worldwide attention due to their rapid use and are expected to increase. This review focuses on understanding the effect of a particular parameter on the energy absorption capability of composites, an analysis of the energy absorption properties of polymer composites. The data from the various researchers are collected and categorised in the field of energy absorption of composites. Many testing methods and refraction types for composites are described.

## Keywords

**Crash assessment**      **Composite material**  
**Energy absorption**      **Polymer**      **Testing**

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## References

1. Tan H, He Z, Li E, Cheng A, Chen T, Tan X, Li Q, Xu B (2021) Struct Multidiscip Optim
2. Smith D, Graciano C, Martínez G (2021) Thin-Walled Struct. 160:107371
3. Hongyong J, Yiru R, Reinf J (2019) Plast Compos 39
4. Isaac CW, Ezekwem C (2021) Compos Struct 257:113081

- 
5. Isaac CW, Pawelczyk M, Wrona S (2020) Appl Sci 10:1543

---

  6. Alkateb M, Sapuan S, Leman Z, Ishak M, Jawaid M (2018) Def Technol 14:327

---

  7. San Ha N, Lu G (2020) Compos Part B Eng 181:107496

---

  8. Xie J, Waas AM (2015) J Appl Mech 82

---

  9. Tariq F, Uzair M, Shifa M (2021) J Sandw Struct Mater 10996362211036988

---

  10. Jefferson AJ, Arumugam V, Dhakal H (2018) Repair of polymer composites: methodology, techniques, and challenges. Woodhead Publishing

---

  11. Warrior N, Turner T, Robitaille F, Rudd C (2004) Compos Part Appl Sci Manuf 35:431

---

  12. Reyes G, Cantwell W (2000) Mater Struct Energy Absorpt London UK 33

---

  13. Ilami M, Bagheri H, Ahmed R, Skowronek EO, Marvi H (2021) Adv Mater 33:2003139

- 
14. Baillie C, Southam C, Buxton A, Pavan P (2000) Adv Compos Lett 9

---

  15. Baars J, Domenech T, Bleischwitz R, Melin HE, Heidrich O (2021) Nat Sustain 4:71

---

  16. Ismail I, Abdelrazek E, Ismail M, Emara A (2021) Int J Automot Mech Eng 18:8728

---

  17. Kender Š, Brezinová J, Sailer H (2020) Trans Motauto World 5:3

---

  18. Ahmad H, Markina AA, Porotnikov MV, Ahmad F, Conf IOP (2020) Ser Mater Sci Eng 971:032011

---

  19. Hussain NN, Regalla SP, Rao YVD, Dirgantara T, Gunawan L, Jusuf A (2021) Proc Inst Mech Eng Part J Mater Des Appl 235:114

---

  20. Summerscales J (2018) Mar Compos Des Perform. Elsevier/Woodhead imprint

---

  21. Liu H, Liu J, Ding Y, Zheng J, Kong X, Zhou J, Harper L, Blackman BR, Kinloch AJ, Dear JP (2020) J Mater Sci 55:15741

---

22. Costas M, Morin D, Langseth M, Romera L, Díaz J (2016) *Thin-Walled Struct* 99:45

---

23. Aktay L, Toksoy AK, Güden M (2006) *Mater Des* 27:556

---

24. Niknejad A, Assaee H, Elahi SA, Golriz A (2013) *Compos Struct* 100:479

---

25. Ochelski S, Gotowicki P (2009) *Compos Struct* 87:215

---

26. Elmarakbi A, Azoti W, Serry M (2017) *Appl Mater Today* 6:1

---

27. Zhu G, Yu Q, Zhao X, Wei L, Chen H (2020) *Compos Struct* 233:111631

---

28. Xin Z, Duan Y, Zhou J, Xiao H (2019) *Compos Struct* 209:150

---

29. Boria S, Scattina A, Belingardi G (2015) *Compos Struct* 130:18

---

30. Siromani D, Henderson G, Mikita D, Mirarchi K, Park R, Smolko J, Awerbuch J, Tan T-M (2014) *Compos Part Appl Sci Manuf* 64:25

---

31. Solaimurugan S, Velmurugan R (2015) *Int J Veh Struct Syst IJVSS* 7

---

32. Sun G, Zhang H, Lu G, Guo J, Cui J, Li Q (2017) *Mater Des* 118:175

---

33. Sun G, Li G, Hou S, Zhou S, Li W, Li Q (2010) *Mater Sci Eng A* 527:1911

---

34. Yang X, Ma J, Wen D, Yang J (2020) *Prog Aerosp Sci* 114:100618

---

35. Nian Y, Wan S, Zhou P, Wang X, Santiago R, Li M (2021) *Mater Des* 209:110011

---

36. Movahedi N, Murch GE, Belova IV, Fiedler T (2019) *Mater Des* 168:107652

---

37. Zhang D, Gao J, Tang D, Wu X, Shi J, Chen J, Peng Y, Zhang S, Wu Y (2021) *One Earth* 4:135

---

38. Murali PK, Kaboli M, Dahiya R, Kaboli IM (2021) *Adv Intell Syst*

---

39. Reyes JEA, Barbosa CJM, Nonato MEB, Olayres TN, Tamba ER. Springer, pp 317–324

---

40. Chai Z, Nie T, Becker J (2021) *Auton. Driv. Chang. Future* (Springer), pp 137–178

---

41. Porter JM, Case K, Freer M, Bonney MC (1993)

---

42. Sinmazçelik T, Avcu E, Bora MÖ, Çoban O (2011) *Mater Des* 32:3671

---

43. Pawar PM, Ganguli R (2011) *Structural health monitoring using genetic fuzzy systems*. Springer Science & Business Media

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