

[Home](#) > [Journal](#) > [Earth & Environmental Sciences](#) > [JEP](#)[Indexing](#) [View Papers](#) [Aims & Scope](#) [Editorial Board](#) [Guideline](#) [Article Processing Charges](#)[JEP](#) > Vol.3 No.6, June 2012

OPEN ACCESS

Influencing Factors and Process on *in Situ* Degradation of Poly (Butylene Succinate) Film by Strain *Bionectria ochroleuca* BFM-X1 in Soil

PDF (Size: 1494KB) PP. 523-532 DOI: 10.4236/jep.2012.36063

Author(s)

Xueli Mei, Chengming Tian, Qian Dong, Yingmei Liang

ABSTRACT

This is the first report on the PBS film degraded by any *Bionectria ochroleuca* fungal strain. The fungal strain BFM-X1 was isolated from an air environment on a vegetable field and was capable of degrading poly (butylene succinate) (PBS). The taxonomic identity of the strain BFM-X1 was confirmed to be *Bionectria ochroleuca* (showing a 99% similarity to *B. ochroleuca* in a BLAST search) through an ITS rRNA analysis. The bio-degradation of the PBS film by strain BFM-X1 was studied. Approximately 97.9% of the PBS film was degraded after strain BFM-X1 was inoculated at 28°C for 14 days. The degradation efficiency of BFM-X1 against PBS film under different soil environmental conditions was characterized. The results indicated that 62.78% of the PBS film loss was recorded in a 30-d experimental run in a sterile soil environment indoors. On adding strain BFM-X1 to a soil sample, the PBS degradation rate accelerated approximately fivefold. Furthermore, both temperature and humidity influenced the *in situ* degradation of the PBS by strain BFM-X1, and temperature may be the major regulating factor. The degradation was particularly effective in the warm season, with 90% of weight loss occurring in July and August. Scanning electron microscope observations showed surface changes to the film during the degradation process, which suggested that strain BFM-X1 preferentially degraded an amorphous part of the film from the surface. These results suggested that the strain *B. ochroleuca* BFM-X1 was a new resource for degrading PBS film and has high potential in the bioremediation of PBS-plastic-contaminated soil environment

KEYWORDS

Poly(Butylene Succinate) (PBS); *In Situ* Biodegradation; Strain *B. ochroleuca* BFM-X1; Temperature; Humidity

Cite this paper

X. Mei, C. Tian, Q. Dong and Y. Liang, "Influencing Factors and Process on *in Situ* Degradation of Poly (Butylene Succinate) Film by Strain *Bionectria ochroleuca* BFM-X1 in Soil," *Journal of Environmental Protection*, Vol. 3 No. 6, 2012, pp. 523-532. doi: 10.4236/jep.2012.36063.

References

- [1] T. Fujimaki, " Processability and Properties of Aliphatic Polyesters, ' BIONOLLE' , Synthesized by Polycondensation Reaction," *Polymer Degradation and Stability*, Vol. 59, No. 1-3, 1998, pp. 209-214. doi:10.1016/S0141-3910(97)00220-6
- [2] R. A. Gross and B. Kalra, " Biodegradable Polymers for the Environment," *Science*, Vol. 297, No. 5582, 2002, pp. 803-807. doi:10.1126/science.297.5582.803
- [3] H. S. Kim, H. J. Kim, J. W. Lee and I. G. Choi, " Biodegradability of Bio-Flour Filled Biodegradable Poly (Butylene Succinate) Bio-Composites in Natural and Compost Soil," *Polymer Degradation and Stability*, Vol. 91, No. 5, 2006, pp. 1117-1127. doi:10.1016/j.polymdegradstab.2005.07.002
- [4] M. Kunioka, F. Ninomiya and M. Funabashi, " Biodegradation of Poly(Butylene Succinate) Powder in a Controlled Compost at 58°C Evaluated by Naturally-Occurring Carbon 14 Amounts In Evolved CO₂ Based on the ISO 14855-2 Method," *International Journal of Molecular Sciences*, Vol. 10, No. 10, 2009, pp. 4267-4283. doi:10.3390/ijms10104267

- [Open Special Issues](#)
- [Published Special Issues](#)
- [Special Issues Guideline](#)

[JEP Subscription](#)[Most popular papers in JEP](#)[About JEP News](#)[Frequently Asked Questions](#)[Recommend to Peers](#)[Recommend to Library](#)[Contact Us](#)

Downloads: 301,517

Visits: 673,842

Sponsors, Associates, and Links >>

- [The International Conference on Pollution and Treatment Technology \(PTT 2013\)](#)

- [5] J. J. Ge, " Biodegradable Macromolecule Materials & Application," Chemical Industry Press, Beijing, 2002.
- [6] N. Hayase, H. Yano, E. Kudoh, C. Tsutsumi, K. Ushio, Y. Miyahara, S. Tanaka and K. Nakagawa, " Isolation and Characterization of Poly(Butylene Succinate-Co-Butylene Adipate)-Degrading Microorganism," Journal of Bioscience and Bioengineering, Vol. 97, No. 2, 2004, pp. 131-133.
- [7] N. Ishii, Y. Inoue, T. Tagaya, H. Mitomo, D. Nagai and K. Kasuya, " Isolation and Characterization of Poly(Butylene Succinate)-Degrading Fungi," Polymer Degradation and Stability, Vol. 93, No. 5, 2008, pp. 883-888. doi:10.1016/j.polymdegradstab.2008.02.005
- [8] J. H. Zhao, X. Q. Wang, J. Zeng and Q. Yan, " Study on the Biodegradation of Poly(Butylene Succinate) under Compost Conditions," Journal of Functional Polymers, Vol. 17, No. 4, 2004, pp. 666-170.
- [9] H. Pranamuda, Y. Tokiwa and H. Tanaka, " Microbial Degradation of an Aliphatic Polyester with a High Melting Point, Poly(Tetramethylene Succinate)," Applied and Environmental Microbiology, Vol. 61, No. 5, 1995, pp. 1828-1832.
- [10] H. Li, J. hang, A. Cao and J. Wang, " In Vitro Evaluation of Biodegradable Poly(Butylene Succinate) as a Novel Biomaterial," Macromolecular Bioscience, Vol. 5, No. 5, 2005, pp. 433-440. doi:10.1002/mabi.200400183
- [11] H. S. Yang, J. S. Yoon and M. N. Kim, " Effect of Storage of a Mature Compost on Its Potential for Biodegradation of Plastics," Polymer Degradation and Stability, Vol. 84, No. 3, 2004, pp. 411-417. doi:10.1016/j.polymdegradstab.2004.01.014
- [12] J. H. Zhao, X. Q. Wang, J. Zeng, G. Yang, F. H. Shi and Q. Yan, " Biodegradation of Poly(Butylene Succinate) in Compost," Journal of Applied Polymer Science, Vol. 97, No. 6, 2005, pp. 2273-2278. doi:10.1002/app.22009
- [13] T. Hirotsu, T. Tsujisaka, T. Masuda and K. Nakayama, " Plasma Surface Treatments and Biodegradation of Poly (Butylene Succinate) Sheets," Journal of Applied Polymer Science, Vol. 78, No. 5, 2000, pp. 1121-1129. doi:10.1002/1097-4628(20001031)78:5<1121::AID-APP210>3.0.CO;2-H
- [14] X. L. Mei, Y. M. Liang, C. M. Tian, Q. Dong and Q. Sun, " Study on Screening and Degradation Characteristics of High Efficient Degrading Fungi for Poly(Butylenes Succinate)," Microbiology China, Vol. 38, No. 3, 2011, pp. 348-354.
- [15] D. M. Horowitz and J. K. M. Sanders, " Amorphous, Biomimetic Granules of Polyhydroxybutyrate: Preparation, Characterization, and Biological Implications," Journal of the American Chemical Society, Vol. 116, No. 7, 1994, pp. 2695-2702. doi:10.1021/ja00086a001
- [16] M. Gardes and T. D. Bruns, " ITS Primers with Enhanced Specificity for Basidiomycetes-Application to the Identification of Mycorrhizae and Rusts," Molecular Ecology, Vol. 2, No. 2, 1993, pp. 113-118. doi:10.1111/j.1365-294X.1993.tb00005.x
- [17] T. J. White, T. Bruns, S. Lee and J. Taylor, " Amplification and Direct Sequencing of Fungal Ribosomal RNA Genes for Phylogenetics," In: M. A. Innis, D. H. Gelfand, J. J. Sninsky and T. J. White, Eds., PCR Protocols a Guide to Methods and Applications, Academic Press, San Diego, 1990.
- [18] Q. Sun, Y. M. Liang, C. M. Tian and C. A. Zhang, " Screening and Characterization of Poly(Butylenes Succinate)-Degrading Fungi," Journal of Beijing Forestry University, Vol. 32, No. 6, 2010, pp. 130-134.
- [19] M. Abe, K. Kobayashi, N. Honma and K. Nakasaki, " Microbial Degradation of Poly(Butylene Succinate) by Fusarium Solani in Soil Environments," Polymer Degradation and Stability, Vol. 95, No. 2, 2010, pp. 138-143. doi:10.1016/j.polymdegradstab.2009.11.042
- [20] K. Kasuya, K. Takagi, S. Ishiwatari, Y. Yoshida and Y. Doi, " Biodegradabilities of Various Aliphatic Polyesters in Natural Waters," Polymer Degradation and Stability, Vol. 59, No. 1-3, 1998, pp. 327-332. doi:10.1016/S0141-3910(97)00155-9
- [21] A. S?derg?rd, J. F. Selin and J. H. N?sman, " Hydrolytic Degradation of Peroxide Modified Poly(L-Lactide)," Polymer Degradation and Stability, Vol. 51, No. 3, 1996, pp. 351-359. doi:10.1016/0141-3910(95)00271-5
- [22] G. L. Siparsky, K. J. Voorhees, J. R. Dorgan and K. Schilling, " Water Transport on Poly(lactic Acid (PLA), PLA/ Polycaprolactone Copolymers, and PLA/Polyethylene Glycol Blends," Journal of Polymers and

the Environment, Vol. 5, No. 3, 1997, pp. 125-136.

- [23] M. It?vaara, S. Karjoomaa and J. F. Selin, " Biodegradation of Polylactide in Aerobic and Anaerobic Thermophilic Conditions," Chemosphere, Vol. 46, No. 6, 2002, pp. 879-885. doi:10.1016/S0045-