

Press Release

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Recycled HDPE for Safe Hazardous Materials Containers

The Fraunhofer Institute for Structural Durability and System Reliability LBF and the German Federal Institute for Materials Research and Testing (BAM) have launched the “MultiCycCon” research project. They are investigating how repeated recycling affects the environmental stress cracking resistance of high-density polyethylene (PE-HD) used in safety-critical transport and hazardous materials containers. To this end, they will simulate real-world usage and recycling cycles in the laboratory and develop a rapid method for incoming inspection of PE-HD recycle materials. The goal is to enable manufacturers, processors, and recyclers to specifically evaluate material quality in the future and use recycled materials more safely and economically.

Starting in 2030, mandatory minimum recycled content requirements will also apply to hazardous materials packaging. However, it is still unclear how multiple recycling cycles affect the stress crack resistance of HDPE, which is critical for container safety. Existing verification methods do not explicitly account for this property in recycled materials and require time-consuming type testing for batches of up to 25 metric tons.

Researchers Focus on Aging and Multiple Processing

Fraunhofer LBF contributes its expertise in the reliable evaluation of materials and components. In the “MultiCycCon” project, three HDPE materials undergo up to ten extrusion steps; additional samples are aged through thermo-oxidative processes or UV radiation and then reprocessed. In this way, the researchers simulate real-world usage and recycling stresses in the laboratory and establish a robust foundation for safe material decisions.

After defined process steps, Fraunhofer LBF analyzes mechanical properties, molecular weight distribution, melt behavior, and chemical changes; BAM examines crystallinity, oxidation stability, and stress crack resistance. Full-notch creep tests and fracture surface analyses reveal how cracks form and grow. Several practical recyclates are included in the tests. Comparison with artificially aged samples is intended to clarify whether—and at what point—material degradation and multiple processing limit safe reuse.

Faster incoming inspection increases safety and cost-effectiveness

The project results help recycle manufacturers, processors, and producers of transport and hazardous-materials containers to identify unsuitable batches early on, avoid

production defects and time-consuming verification processes, and use recyclates more safely and more cost-effectively. At the same time, they promote closed-loop material cycles, conserve resources, and ensure the high level of protection provided by hazardous materials containers. The findings are also expected to be transferable to other PE-HD applications.

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The project, which has just been launched, is funded as part of the Industrial Collective Research project (IGF). Grant number 01IF25124N. The IGF project provides small and medium-sized enterprises with access to practical, pre-competitive research results.

Keywords: HDPE recyclates, stress crack resistance, hazardous materials packaging

More information: www.lbf.fraunhofer.de/multicyccon-en

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Recycled PE-HD in practical testing: Material samples and recycled flakes are being tested for their suitability for safe hazardous materials containers. (Illustrative image: Fraunhofer LBF, AI-generated by Copilot)

The Fraunhofer Institute for Structural Durability and System Reliability LBF in Darmstadt has stood for safe and reliable solutions since 1938 – and has been a part of the Fraunhofer-Gesellschaft since 1962. In 2026, the institute is focusing its orientation and combining classic engineering expertise with digital twins and AI methods to bring reliable, recyclable products to market more quickly. The focus is on the interactions at the interfaces between materials, components, and systems (MCS). With around 300 employees, Fraunhofer LBF supports companies throughout the entire development process – from material selection and component evaluation to system integration, validation, and operational monitoring. Clients come from the mobility sector (aviation, agriculture, shipbuilding, and vehicle construction), mechanical and plant engineering, security and defense, and the chemical industry, among others. www.lbf.fraunhofer.de

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