U.S. Department
of Transportation

**Pipeline and Hazardous
Materials Safety
Administration**

1200 New Jersey Avenue, SE
Washington, DC 20590

November 7, 2023

Robert Ten Eyck
Director, Technical Services
TEN-E Packaging Services, Inc.
1666 County Road 74
Newport, MN 55055

Reference No. 23-0064

Dear Mr. Ten Eyck:

This letter is in response to your June 14, 2023, letter and subsequent email conversation requesting clarification of the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180) applicable to the use of plastic resin produced through pyrolysis for the construction of plastic United Nations (UN) performance-oriented packagings. Specifically, you describe a "chemical recycling process"—*i.e.*, pyrolysis—which uses heat in the absence of oxygen to break down used/waste plastic to its chemical building blocks in the form of liquid, oil feedstocks (*i.e.*, raw materials), which can then be converted back to plastic resin. You provide information from a producer of the plastic resin stating that it is equivalent in chemical and polymer structure to newly produced resin (known as "virgin resin"). Finally, you note this process is distinct from the other widely-used reclaiming method—"mechanical recycling process"—where used/waste plastic is ground, melted, and then re-pelletized for use. You ask whether plastic UN performance-oriented packagings manufactured from pyrolyzed raw materials used to make plastic resin must be approved in accordance with § 178.509(b)(1), which states, "[n]o used material other than production residues or regrind from the same manufacturing process may be used unless approved by the Associate Administrator."

The answer is no. It is the opinion of this Office that the raw materials (*i.e.*, feedstocks) produced by pyrolysis of used/waste plastic is not "used material" for purposes of § 178.509(b)(1) and therefore, not subject to the approval provision. The Research and Special Programs Administration (RSPA) added the approval provision to authorize the use of used material of known origin and characteristics for the manufacture of UN specification plastic drums and jerricans.[1] The revision was added to encourage greater use of recycled plastics yet only under an approval provision because of uncertainties in quality of material and limited experience with use of used plastic materials. Mechanical recycling was and remains the primary method of recycling used plastics, but it involves melting and reforming of polymers used for plastic that causes degradation of quality and introduces impurities. The chemical recycling process of

[1] See final rule HM-215C (March 5, 1999; 64 FR 10742, 10750).

pyrolysis differs because it breaks the plastic down to its chemical building blocks—equivalent to newly extracted fossil feedstocks—that (re)enter the plastic production chain early on in the process to form polymers.

Therefore, plastic resin produced through pyrolysis would not be considered "used material" within the scope of the § 178.509(b)(1) approval requirement and may be used to construct plastic UN performance-oriented packagings without prior approval from the Associate Administrator. To this end, it remains the responsibility of both manufacturer and shipper to ensure packaging is manufactured from suitable plastic material and otherwise adheres to conditions of § 178.509.

I hope this information is helpful. Please contact us if we can be of further assistance.

Sincerely,

Dirk Der Kinderen
Chief, Standards Development Branch
Standards and Rulemaking Division

Patrick

23-0064

From: Nickels, Matthew (PHMSA)
To: Hazmat Interps
Subject: TEN-E Packaging Services, Inc. -- Interpretation Request
Date: Tuesday, July 18, 2023 10:40:26 AM
Attachments: image001.png
Chemical Recyling Interpretation 23-MN50026.docx
GAO Report.pdf

Hey Alice and Jessie, please assign new interp request asap – attached. And please have the interp drafter contact Bob asap to discuss the 'additional information' he wants to provide.

Thanks!

From: Robert Teneyck <Robert.Teneyck@ten-e.com>
Sent: Monday, July 17, 2023 8:59:06 PM
To: Kelley, Shane (PHMSA) <shane.kelley@dot.gov>
Subject: FW: Interpretation Request

CAUTION: This email originated from outside of the Department of Transportation (DOT). Do not click on links or open attachments unless you recognize the sender and know the content is safe.

Hi Shane,
Can you tell me who in your group is looking at this interpretation request as I have some additional information that I would like to forward to them?
Thanks much.
Bob T.

From: Robert Teneyck
Sent: Wednesday, June 14, 2023 12:48 PM
To: Shane Kelley (shane.kelley@dot.gov) <shane.kelley@dot.gov>
Subject: Interpretation Request

Hi Shane,
Let me know if you have any questions concerning this interpretation request.
Regards,
Bob T.

Robert Ten Eyck
robert.teneyck@ten-e.com
Office: 651-459-0671
Fax: 651-459-1430

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TEN-E
TEN-E Packaging Services, Inc.

June 14, 2023

Shane Kelley
Standards and Rulemaking PHH-10
Pipeline and Hazardous Materials Safety Administration
U.S. Department of Transportation
1200 New Jersey Avenue, SE, East Building, Room E23-447
Washington, DC 20590

Dear Shane:

We are working with a client who manufactures UN specification 1H1 and 3H1 containers and they want to incorporate plastic resins that are reclaimed from used plastic by what is referred to as “chemical recycling” wherein the used material is converted by pyrolysis to oil and then converted back to resin. This reclaiming process is distinctly different from the “mechanical recycling” widely used today where the used resin is ground, melted and then re-pelletized. We are seeking a formal interpretation as to whether the manufacture of UN specification drums with resins from chemical recycling require an approval from the Associate Administrator under §178.509(b)(1) of Title 49 CFR.

We are enclosing an article by the Government Accountability Office (GAO) that describes the chemical recycling process.

Please let us know if you need any further information to respond to this interpretation request.

Sincerely,

Robert J. Ten Eyck
Director, Technical Services
TEN-E Packaging Services, Inc.

Attachment

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GAO | Science, Technology Assessment, and Analytics

SCIENCE & TECH SPOTLIGHT:

ADVANCED PLASTIC RECYCLING

Accessible Version

SEPTEMBER 2021

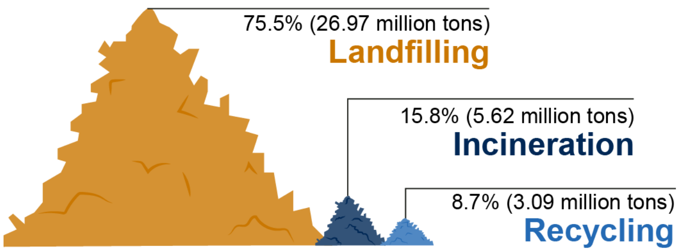
WHY THIS MATTERS

Plastic waste in the U.S. has grown tenfold from 1970 to 2018, while recycling rates have remained low. Mounting plastic waste in landfills and oceans can contaminate ecosystems and adversely affect human health and wildlife. Chemical recycling technologies have the potential to improve plastic recycling, but several challenges remain.

/// THE TECHNOLOGY

What is it? Plastics are found in many everyday items—including food packaging, water bottles, bags, and appliances. They are largely made from fossil fuel-based chemicals combined with various additives—such as stabilizers or flame retardants—to achieve a desired result (e.g., strength, rigidity, color, heat resistance).

The majority of plastic waste in the U.S. ends up in landfills, with a relatively small portion incinerated and an even smaller portion recycled. The accumulating plastic waste in landfills generally does not biodegrade or break down.



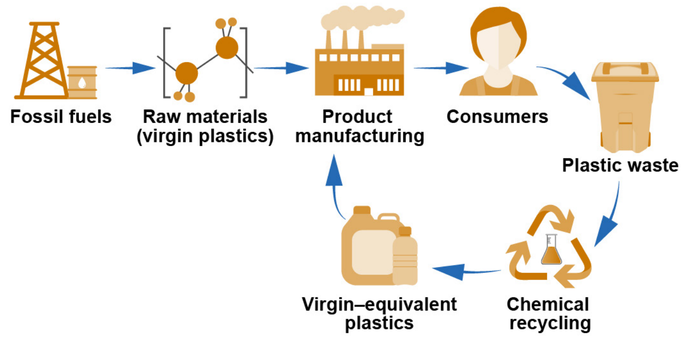
Source: GAO analysis of 2018 U.S. Environmental Protection Agency (EPA) data. | GAO-21-105317

Figure 1. Methods of plastic waste disposal in the U.S.

Plastic recycling technologies reprocess or remanufacture plastic waste for reuse. Currently, the dominant technology for plastic recycling is mechanical recycling, which uses physical processes—such as sorting, grinding, washing, separating, drying, and re-granulating—to recover plastics that can be substituted for virgin, or new, plastics. However, mechanical recycling technology is expensive, labor intensive, and generally results in lower quality plastics than virgin plastics. Consequently, industry is considering advanced recycling technologies—namely, chemical recycling—as an alternative or complement to mechanical recycling. Chemical recycling technologies use heat, chemical reactions, or both, to recycle used plastic into virgin-equivalent plastic, fuel, or other chemicals.

In addition, recent advances in sorting technology—one of the physical processes common to both chemical and mechanical recycling technologies—may also increase the efficiency of chemical recycling and lead to increased plastic recycling. For example, artificial intelligence technologies have the potential to increase automated sorting efficiency. Similarly, another advanced technology efficiently sorts materials by identifying their molecular vibrations.

How does it work? Chemical recycling can promote a closed-loop system, known as a circular economy, wherein plastics are reused rather than discarded in landfills or incinerated. There are three general categories of chemical recycling technologies: conversion, decomposition, and purification.



Source: GAO illustration based on review of literature. | GAO-21-105317

Figure 2. Closed-loop chemical recycling

Conversion focuses on converting polymers—long-chain hydrocarbon molecules built from smaller repeating units called monomers—in mixed or sorted plastics into smaller molecules. This can occur through a variety of techniques, including pyrolysis and gasification.

- Pyrolysis, sometimes called "plastics to fuel," turns plastic waste into a synthetic crude oil that can be refined into diesel fuel, gasoline, heating oil, or waxes. This process involves heating the plastic waste to high temperatures (300-900°C) in the absence of oxygen. Different forms of pyrolysis use different temperatures, pressures, and processing times.
- Gasification also heats plastic waste to high temperatures (500-1300°C) in a low-oxygen environment to convert plastic waste to synthesis gas, or "syngas." Syngas—a fuel mixture containing mainly hydrogen and carbon monoxide—can be combusted for electric power generation or converted into other fuels or chemicals, such as ethanol and methanol.

Decomposition breaks down polymers in sorted plastics into monomers to produce new plastics. This decomposition can be done with heat or chemicals. Chemical decomposition uses solvents to break the polymers into monomers. Some decomposition technologies use enzymes to break down polymers at temperatures as low as room temperature, resulting in less energy consumption.

Purification uses solvents to separate polymers from additives or contaminants. Unlike other types of chemical recycling, purification does not break or modify the polymer. Purification may be used with mixed or sorted plastics.

How mature is it? While technologies such as pyrolysis and gasification are mature, their use in plastic recycling is relatively new, due in part to the low cost of virgin plastic material and the challenges associated with recycling contaminated or complex plastic products. Conversion is currently the most mature of the chemical recycling technologies, with several companies using pyrolysis, and at least one company using gasification on a commercial scale. Several companies are also developing, or are in the initial phases of piloting, thermal and chemical decomposition. Purification is the least mature chemical recycling technology, although research into it is ongoing. Advanced sorting technologies vary in maturity, with molecular vibrations for material identification already in use, and artificial intelligence sorting still under development.

/// OPPORTUNITIES

- **Resource conservation.** Chemical recycling can produce raw materials of virgin quality, thereby decreasing demand for fossil fuels and other natural resources.
- **Reduced landfill use.** A significant amount of plastic waste ends up in landfills. New technologies could reduce the need for landfills, which may reduce the release of harmful chemicals into the environment.
- **New markets.** Developing advanced recycling technologies could promote domestic business and employment. Chemical recycling creates a market for plastic waste and a new way to reuse some plastics.

/// CHALLENGES

- **Adoption hurdles.** Companies looking to use chemical recycling may face several hurdles, including process and technology challenges, high startup and operating costs, underdeveloped domestic markets for recycled products, and limited incentives for recycling innovation and investment.
- **Suitability.** Chemical recycling may not be suitable for all types of plastic, particularly when polymer chains are irreversibly bonded together.
- **Competition.** Virgin plastics are typically cheaper to produce than recycled plastics, in part due to transportation costs and limited recycling infrastructure, making it hard for recycling processes to compete.

/// POLICY CONTEXT AND QUESTIONS

With the volume of plastic waste expected to grow over time, some key questions for policymaker consideration include:

- What steps could the federal government, states, and other stakeholders take to further incentivize chemical recycling rather than disposal? What are the potential benefits and challenges of these approaches?
- What steps could policymakers take to support a transition toward a circular economy, including innovation and investment in manufacturing and recycling capacity?
- What might policymakers do to promote advanced recycling technologies while also reducing the hazards associated with existing plastic production and recycling methods?

/// SELECTED GAO WORK

- Recycling: Building on Existing Federal Efforts Could Help Address Cross-Cutting Challenges, GAO-21-87.
- Science & Tech Spotlight: Consumer Electronics Recycling, GAO-20-712SP.
- Marine Debris: Interagency Committee Members Are Taking Action, but Additional Steps Could Enhance the Federal Response, GAO-19-653.

/// SELECTED REFERENCES

Brems, A., Dewil, R., Baeyens, J., and R. Zhang. “Gasification of plastic waste as waste-to-energy or waste-to-syngas recovery route.” *Natural Science*, vol. 5, (2013): pp. 695–704.

Hopewell, J., Dvorak, R., and E. Kosior. “Plastics recycling: challenges and opportunities.” *Phil. Trans. R. Soc. B*, vol. 364, (2009): pp. 2115-2126.

Solis, M., and S. Silveira. “Technologies for chemical recycling of household plastics – A technical review and TRL assessment.” *Waste Management*, vol. 105, (2020): pp. 128–138.

GAO SUPPORT:

GAO meets congressional information needs in several ways, including by providing oversight, insight, and foresight on science and technology issues. GAO staff are available to brief on completed bodies of work or specific reports and answer follow-up questions. GAO also provides targeted assistance on specific science and technology topics to support congressional oversight activities and provide advice on legislative proposals.

For more information, contact: Karen L. Howard at (202) 512-6888 or howardk@gao.gov.

Staff Acknowledgments: Sushil Sharma (Assistant Director), Nirmal Chaudhary (Analyst-in-Charge), Angelica Aboulhosn, Xiang Bi, Lena Keesecker, Anika McMillon, and Kristen Pinnock.