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NASEM study seeks opportunities for more recycled plastics in infrastructure projects

STEVE TOLOKEN
Assistant Managing Editor

U.S. National Academies of Sciences, Engineering, and Medicine

A new study from the National Academies of Sciences, Engineering, and Medicine on the use of recycled plastics in infrastructure projects points to pipes as a key user of recycled material.

A new federal government report finds major potential to use recycled plastic in infrastructure items like pipe but also highlights significant economic and environmental challenges to growth in other building applications.

A detailed July 18 report from the National Academies of Sciences, Engineering and Medicine said drainage pipe is currently the only infrastructure market that uses significant amounts of recycled plastics.

Other applications that attract major interest — such as filler in asphalt roads — continue to have lingering questions over performance, recyclability or microplastic leakage, it said.

The 374-page report, mandated by Congress and prepared for the Environmental Protection Agency and the U.S. Department of Transportation, is one of the most comprehensive looks at recycled plastics use in infrastructure in the United States.

The head of the NASEM committee, Carnegie Mellon University professor David Dzombak, said the report points out opportunities and challenges.

"There are real possibilities here, there are actual examples of recycled plastic being used in infrastructure at scale with the water drainage pipe," he said in an interview. "However, for most of these applications, it's hard to say because there's not enough information to make infrastructure owners and the public feel comfortable about using a product that has recycled plastic in it."

Dzombak said key messages to policymakers include information that the demand for recycled plastics exceeds supply in infrastructure markets, and the need for industry to have high-quality recycled feedstocks.

The report makes recommendations to EPA and USDOT on how they can standardize and expand plastic waste collection and recycling, and it said they should explore new applications in infrastructure markets.

NASEM also highlights some challenges for markets that get major attention, like using recycled plastic as fillers in asphalt.

While calling pavement fillers "one of the greatest opportunities for using recycled plastic in infrastructure," NASEM also noted lingering questions around long-term performance, technical formulation and environmental impacts, such as how recycled plastic could impact the recyclability of asphalt and whether it would increase microplastic leakage into the environment as roads wear down.

"Asphalt … is a very highly recycled material," he said. "There have been problems in the past with additives to asphalt mixes that have screwed up the ability to recycle the asphalt, so they're very, very sensitive to not adding anything that's going to degrade the ability to recycle."

The report noted that studies evaluating the potential release of microplastics from asphalt are limited, but it pointed to 2022 research that found asphalt with recycled plastic cracks more and releases more microplastics at temperatures under 40° F.

It noted ongoing research with several state departments of transportation on those questions.

The report also pointed to information gaps in trying to assess how much potential there is for infrastructure applications to have a big impact on recycled plastic markets or drive demand that could help clean up plastic waste.

It calculated, for example, that using plastic waste in 12 percent of asphalt pavement made with dry process dosages could divert 2.4 percent of U.S. polyethylene waste.

"That would make a contribution but it's not game changing," Dzombak said.

NAS called on USDOT and EPA to do more detailed studies of recycled plastics in infrastructure, saying that it's hard to assess if the potential is anything more than "modest."

"The potential for infrastructure applications of recycled plastics to divert plastic waste from landfills and leakage in the United States cannot be determined with confidence due to the information gaps that remain for some candidate applications," NASEM said. "However, even highly optimistic scenarios of successful infrastructure applications suggest the contribution could be modest."

It noted other potential markets, like highway sound barriers, composite utility poles, railroad ties and bike paths, but so far, success has been limited.

"Opportunities for using recycled plastic waste in infrastructure have been explored and evaluated for decades but with limited success in furthering deployment in the United States," the report said.

Dzombak

Focus on PET, PE, PP

The NASEM report said policymakers should focus on four grades of recycled plastics — PET, high density PE, low density PE and polypropylene — as having the most potential, saying they "have properties that make them conducive to use in infrastructure, such as suitable melting point and service temperature ranges, chemical resistance, and strength."

It did not list vinyl, which is widely used in construction, with the report at one point noting concerns over generating chlorine gases and dioxins in asphalt production and in recycling.

"There's concerns about recycling PVC from a number of respects and air emissions are right up there," Dzombak said. "That really holds it back as a recycled material."

The report noted that the committee toured a plastic pipe making plant for Advanced Drainage Systems Inc., to look at how it uses recycled plastic.

Dzombak said it was apparent how closely the drainage pipe industry works with its supply chain.

"These water drainage pipe manufacturers and their supply chains, they do take some plastic from post-consumer plastic waste from selected municipal recycling facilities, but they partner with them, they work closely with them, they monitor what's being sent to them and if it's not acceptable quality, they literally send it back," Dzombak said.

He said the report looked at both post-industrial and post-consumer supply chains for recycled plastics and pointed to cleaner supplies coming from post-industrial sources.

"We tried to make clear that there's really a lot of demand for post-industrial material, and there's a reason why there's demand, because of the quality," he said.

The report noted contamination in post-consumer collection systems holding back material quality, and at several points called out single-stream curbside recycling collection programs as impediments to better quality material.

"Examples of policies and practices that are less supportive and potentially detrimental to increasing the supply of high-quality recycled plastics are local programs that favor single-stream recycling that is convenient to customers but also leads to contamination of plastics waste due to lack of source separation," the report said.

The NASEM committee made extensive policy recommendations to federal and state governments, including for more recycling programs, extended producer responsibility and federal research into new products and material designs.

It recommended USDOT start a multi-year research program on performance and environmental questions around plastic in asphalt pavement, and it said the EPA should do more research on the environmental, human health, economic, and performance implications of recycled plastic.

The NASEM also dedicated its report to plastics recycling technical expert David Cornell, who was a member of the committee preparing the report until he died in October at age 76.

Cornell was a longtime employee and consultant to Eastman Chemical Co., the Association of Plastic Recyclers and the National Association for PET Container Resources.

NASEM said he brought tremendous experience in plastics manufacturing and recycling to the report.

The committee said it waived conflict of interest limits for Cornell, stemming from his industry work, because it could not find a similarly experienced person without a similar conflict.