

LEMELSON-MIT



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\$15,000 “Use it!” Lemelson-MIT Student Prize Graduate Winner

Takataka Plastics: Machines for plastic waste recycling in Uganda

The Challenge: Single-use plastics are recognized as a massive environmental and public health threat worldwide. Wealthier and more industrialized countries engage in widespread recycling efforts to address the devastating effects of single-use plastics, but many developing nations struggle in their efforts. A particular problem is polyethylene terephthalate (PET), the most common plastic for single-use food packaging including water and soda bottles. The chemical properties of PET plastic make it difficult to recycle without large, industrial machinery. PET becomes brittle when melted and snaps or crumbles, making it difficult to repurpose for further use. Many developing countries lack the infrastructure and technology to recycle PET plastic, and it is often infeasible to ship the PET plastic elsewhere for recycling. Low-income countries see 93% of waste burned or dumped in roads, open land, or waterways, whereas only 2% of waste in high-income countries is improperly disposed of in this manner.¹

Uganda produces 600 metric tonnes of plastic waste – the equivalent weight of 331 cars – every day, much of it from water and soda bottles.² The capital city of Kampala once exported PET abroad to be recycled, but recent political and trade changes now severely limit that option. Smaller cities such as Gulu did not have the means to export plastic for recycling when it was possible to do so, nor the ability to transport PET to Kampala, six hours away.

Gulu and other cities like it in the developing world that lack centralized, large-scale recycling need decentralized, local solutions to plastic waste. Plastic bottles are burned, discarded as litter in

¹ Kaza, Silpa, L. Yao, P. Bhada-Tata and F. Van Woerden, *What a Waste 2.0: A Global Snapshot of Solid Waste Management to 2050*, Washington, D.C.: World Bank, 2018.

² Care International, *Invitation to Innovation Challenge on: Plastic Waste Recycling and Local Manufacturing of Products Made from the Recycled Plastic in Ugandan Refugee Settlement*, Geneva: Care, 2019.

the streets, or thrown into landfills in the absence of a local recycling option. Paige calls these cities “waste sinks” because plastic is stuck there. The bottles create toxic fumes when burned, releasing carcinogens and greenhouse gases into the atmosphere. When littered, they accumulate rainwater and attract mosquitos, increasing the danger of malaria. The result is a massive environmental and public health hazard.

The challenges of plastic waste disposal are deeply intertwined with the economic and political instability in many countries in the developing world. The traumas of war and social and political upheaval within Uganda have left many young people without jobs or stable homes. Often referred to as “street youth,” these individuals are left alone, unsupported, and without employment prospects.

The Solution: Paige created a technical, socially-focused approach to simultaneously address problems of plastic waste disposal and the untapped human potential of street-connected youth. She developed manually-operated machines that make durable products from PET. The machines can be locally made using parts that are commonly available in medium-size towns or cities in developing countries and are intended to be operated by local youth.

PET plastic trash is collected, shredded, washed, dried in the sun, and fed into the machines. The plastic is melted and the chemical structure of the PET is altered just enough to make it strong and prevent the brittleness and breakage that normally inhibit PET repurposing. Molten plastic is molded into usable products like wall tiles that are sold to contractors, builders, hardware stores, and homeowners. The PET recycled plastic wall tiles passed flammability testing and are cheaper and more durable than ceramic tiles currently on the market.

Paige’s recycling process is 5 ½ times more environmentally friendly than the current practice of PET open burning, as it saves resources and does not release noxious fumes. The simple injection machine design is easy to operate and maintain, and it is 85% less costly than other machines that could be imported.



Examples of tiles made from PET with Paige’s machines.

Photo Credit: New World Photography in Gulu

Commercialization: Paige founded [Takataka Plastics](#) with her Ugandan colleague, Peter Okwoko, a community organizer and former university lecturer focused on social and environmental efforts. Their Gulu-based company created these locally-made, manually-powered recycling systems to transform plastic waste into useful products. Takataka (which means “waste” in Swahili) employs street-connected youth to operate the machines, thereby creating a sustainable economic and employment loop. The youth are provided with steady wages above the average rate in Uganda, as well as free meals, trauma counseling, and support. Takataka currently employs 16 staff members and plans to double in size by the end of 2021.

Takataka partners with local government and community initiatives to provide outreach and education to transform Gulu residents’ view of their plastic waste from unsightly garbage to a resource that can be used to produce goods and generate income. By the end of 2021, Takataka hopes to be recycling nine tonnes of PET plastic in Gulu every month.

Takataka currently produces wall tiles for kitchens and washrooms and plans to broaden its product line to other construction materials. In Uganda, building materials is a \$3.2 billion market increasing 8.6% annually.³ The Takataka model for plastic recycling and local employment is scalable across the developing world because the machines are locally fabricated, low cost, durable, and easy to maintain. If fully implemented in these markets, Takataka would serve 3.6 billion consumers, create 700,000 jobs for vulnerable youth, and remove 2 billion kilograms (over 4.4 billion pounds) of plastic waste from the environment every year.

Takataka’s technology and socially-oriented business model can pivot quickly to other products. When COVID-19 hit East Africa, Takataka shifted from producing wall tiles to face shields, providing over 10,000 reusable face shields to 27 districts across Uganda. The Takataka approach can similarly be applied to a range of other products, including high-demand housing materials such as pavers, plastic lumber, and floor tiles.

To see other inventions made by Paige, visit her profile on the Lemelson-MIT website, here: <https://lemelson.mit.edu/award-winners/paige-balcom>.

³ Fitch Solutions, "Industry Forecast (Infrastructure Report Uganda Construction Forecast - Uganda - Q1 2021)," Fitch Solutions, Inc., London, 2020.
Macrotrends, "Uganda Inflation Rate 1994-2021," Macrotrends LLC, 2021. [Online]. Available: <https://www.macrotrends.net/countries/UGA/uganda/inflation-rate-cpi#:~:text=Uganda%20Inflation%20Rate%20-%20Historical%20Data%20%20,%20%200.04%25%20%2022%20more%20rows%20>. [Accessed 18 April 2021].