

Researchers turn plastic water bottles into prosthetic limbs

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Credit: CC0 Public Domain

Artificial limbs made out of plastic water bottles could save healthcare providers millions of pounds and help tackle pollution at the same time.

An expert at De Montfort University Leicester (DMU) has successfully manufactured the first-of-its-kind prosthetic limb socket made from recycled plastic bottles.

Dr. K Kandan, senior lecturer in Mechanical Engineering at DMU, found he could grind the plastic bottles down and use the granulated material to spin polyester yarns, which can then be heated up to form a solid yet lightweight material that can be molded into prosthetic limbs.

The cost of producing a prosthetic socket this way is just £10, compared to the current industry average of around £5,000 each.

Dr. Kandan, who is also associate director of the Institute of Engineering Sciences at DMU, said this breakthrough could address the gap between high-performance prosthesis that cost thousands of pounds and affordable prostheses that lack quality and durability—as well as helping to solve the problem of plastic pollution.

"Upcycling of recycled plastics and offering affordable prosthesis are two major global issues that we need to tackle," he said. "We wanted to develop a prosthetic limb that was cost effective yet comfortable and durable for amputee patients."

The project was funded by the Global Challenges Research Funding (GCRF), which supports cutting edge research to address challenges faced by developing countries. It was also backed by the Academy of Medical Sciences, the independent UK body that represents the diversity of medical science.

"There are so many people in developing countries who would really benefit from quality [artificial limbs](#) but unfortunately cannot afford them," said Dr. Kandan. "The aim of this project was to identify cheaper materials that we could use to help these people, and that's what we have

done."

Dr. Kandan worked with the Bhagwan Mahaveer Viklang Sahavata Samiti (BMVSS) in Jaipur, India—the world's largest organization for rehabilitating disabled people—as well as prosthetic experts from the Malaviya National Institute of Technology (also in Jaipur), the University of Salford, University of Southampton and University of Strathclyde.

"We manufactured the socket at DMU and then traveled to India to trial it with two patients—one who had his leg amputated above the knee, and one who had his leg amputated below the knee," explained Dr. Kandan.

"Both patients were really impressed—they said the prosthetic was lightweight and easy to walk with, and that it allowed air to flow to the rest of their leg, which is ideal for the hot climate in India."

Dr. Kandan is now looking to conduct a larger-scale study with more people from different countries, so that his design can be adapted to meet patients' individual circumstances.

"People have their limbs amputated for a number of reasons—from diabetes and infection to accidents and injuries," he said. "We want to further develop the design so that the [prosthetic limb](#) can be custom-made to meet each patient's needs."

It is estimated that more than 100 million people worldwide have had a limb amputated. Diabetes and traffic accidents are two of the biggest causes of lower-limb amputation—both of which are continuously on the rise.

Meanwhile, around one million [plastic water bottles](#) are bought every minute yet only 7 percent are recycled, with the rest leaking into landfill

or the ocean.

"There are some really scary statistics about how much plastic there is polluting our oceans and the planet," said Dr. Kandan. "One of the biggest problems is that the [plastic bottles](#) cannot be recycled and re-used for the same purpose, so it's up to us to find new uses for them.

"Our design has significant potential to promote the circular economy for plastic by using recycled [plastic](#) yarns to manufacture affordable prosthetic limbs—especially for amputees in developing countries."

More than a billion people worldwide are thought to live with a disability, with up to 190 million encountering significant difficulties in their day-to-day lives. It is estimated that 80 percent of disabled people live in low- and [middle-income countries](#) (LMICs), where there is significant demand for affordable prosthesis.

"Our work will help restore mobility to the millions of amputees in LMICs and will undoubtedly have a major positive impact on [public health](#) and welfare," added Dr. Kandan.

Provided by De Montfort University Leicester

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