New science behind biodegradable algae-based flip-flops

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Commerical-quality biodegradable flip-flops. Credit: Stephen Mayfield, UC San Diego.

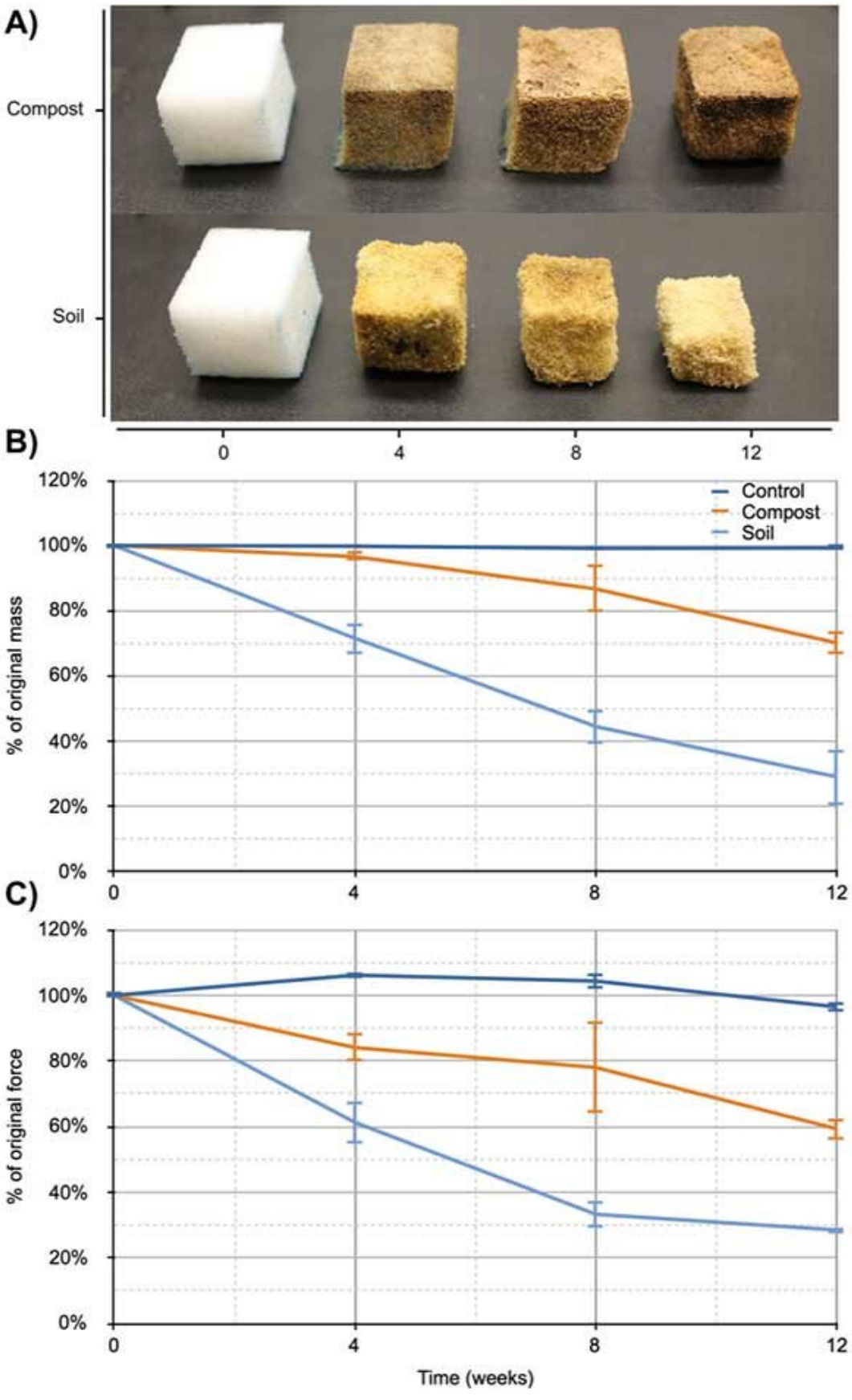
As the world's most popular shoe, flip-flops account for a troubling percentage of plastic waste that ends up in landfills, on seashores and in

our oceans. Scientists at the University of California San Diego have spent years working to resolve this problem, and now they have taken a step farther toward accomplishing this mission.

Sticking with their chemistry, the team of researchers formulated polyurethane foams, made from algae oil, to meet commercial specifications for midsole shoes and the foot-bed of flip-flops. The results of their study are published in *Bioresource Technology Reports* and describe the team's successful development of these sustainable, consumer-ready and biodegradable materials.

The research was a collaboration between UC San Diego and startup company Algenesis Materials—a materials science and technology company. The project was co-led by graduate student Natasha Gunawan from the labs of professors Michael Burkart (Division of Physical Sciences) and Stephen Mayfield (Division of Biological Sciences), and by Marissa Tessman from Algenesis. It is the latest in a series of recent research publications that collectively, according to Burkart, offer a complete solution to the plastics problem—at least for polyurethanes.

"The paper shows that we have commercial-quality foams that biodegrade in the natural environment," said Mayfield. "After hundreds of formulations, we finally achieved one that met commercial specifications. These foams are 52 percent biocontent—eventually we'll get to 100 percent."


A)
Compost
Soil
0
4
8
12
B)
120%
100%
80%
60%
40%
20%
0%
% of original mass
Control
Compost
Soil
0
4
8
12
C)
120%
100%
80%
60%
40%
20%
0%
% of original force
0
4
8
12
Time (weeks)

Biodegradation of PU cubes over 12 weeks. Degradation was analyzed through A) Change in appearance, B) Cube mass and C) Maximum force at 50% compression force deflection (CFD). Error bars indicate sample standard deviations of the triplicate measurements. For compost and soil mass loss, p