Forest Waste to Clean Water:
Natural Leaf-Guar-Derived Solar Desalinator

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Supplementary Figures

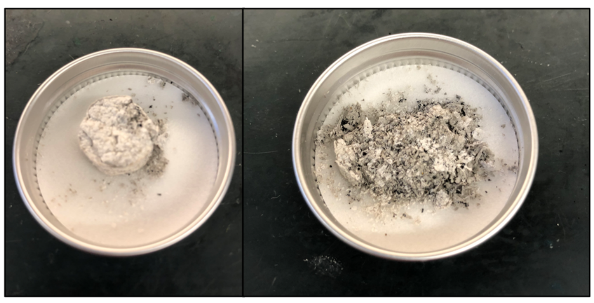

Figure S1 Carbonized filtered leaf without guar. Raw filtered leaf carbonized at 500°C for 1 hour (left) before and (right) after being picked up by hand. The structure has barely any stability and falls apart under the effect of even small forces.

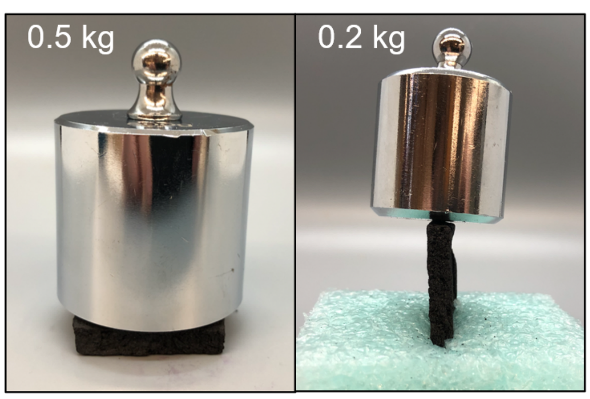

Figure S2 Desalinator under compressive loads on its top and side faces. The ability of the leaf-guar-derived desalinator to withstand sizeable loads in various orientations demonstrates its structural integrity.

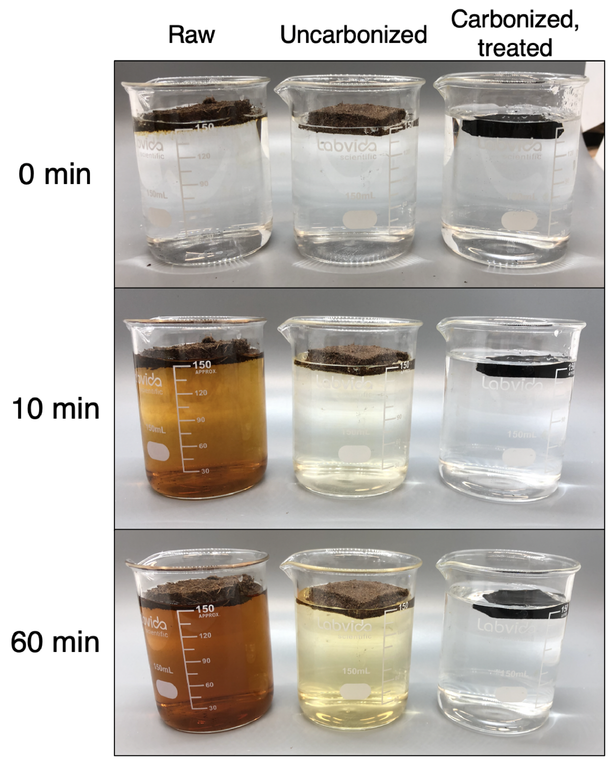

Figure S3 Sample stability in water. Qualitative stability of raw blended leaf sample, uncarbonized leaf-guar sample, and carbonized and treated leaf-guar sample in water.

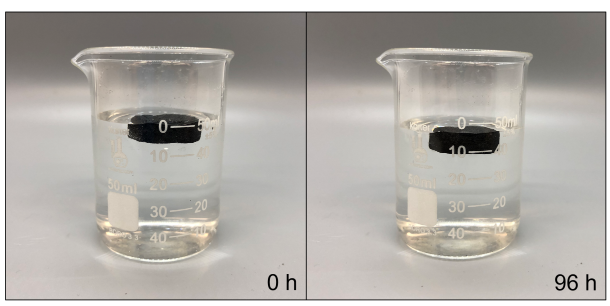

Figure S4 Treated sample long-term stability in water. Qualitative stability of carbonized and treated leaf-guar sample in water over a period of 96 hours. The lack of sample degradation over this period is easily seen by the lack of change in water color.

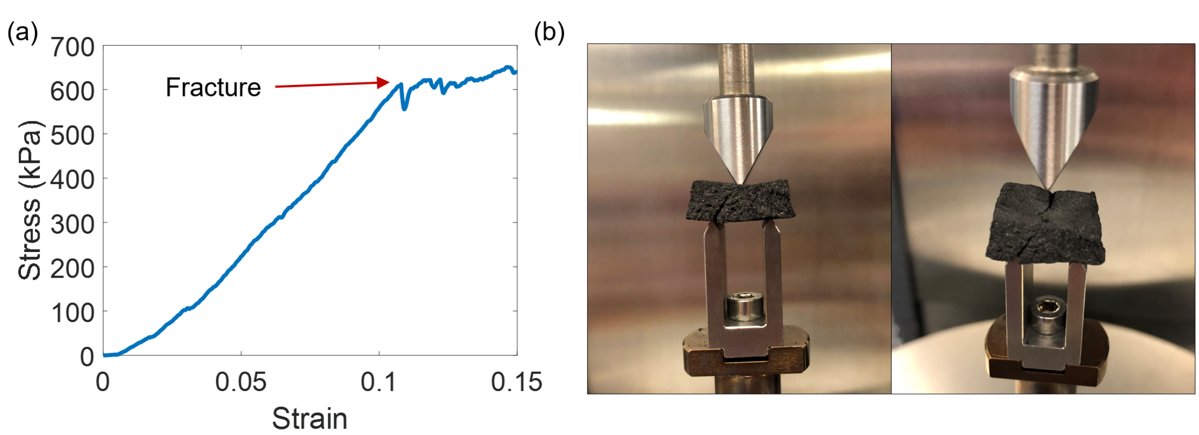

Figure S5 Mechanical stability of sample. (a) Stress-strain curve for carbonized and treated desalinator in response to three-point bending, showing a fracture strength of over 600 kPa. (b) Experimental setup for mechanical stability measurements, shown after sample fracture was reached.

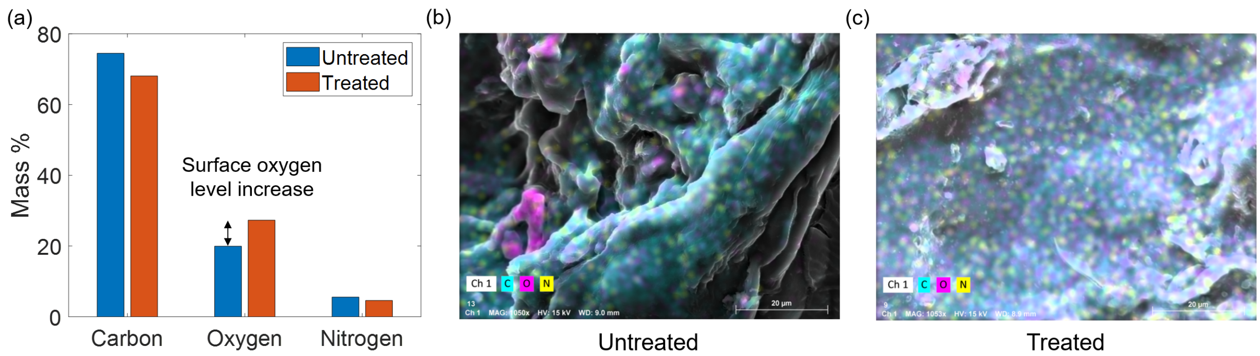

Figure S6 Energy dispersive spectrometry (EDS) characterization before and after chemical treatment. (a) Mass percentages of carbon, oxygen, and nitrogen on the surface of the untreated and treated samples. (b) Untreated and (c) treated sample SEM images with colored overlay representing concentrations of different elements. While the untreated sample shows small, intense pockets of oxygen, the treated sample shows a much more even distribution of oxygen throughout its entire surface.

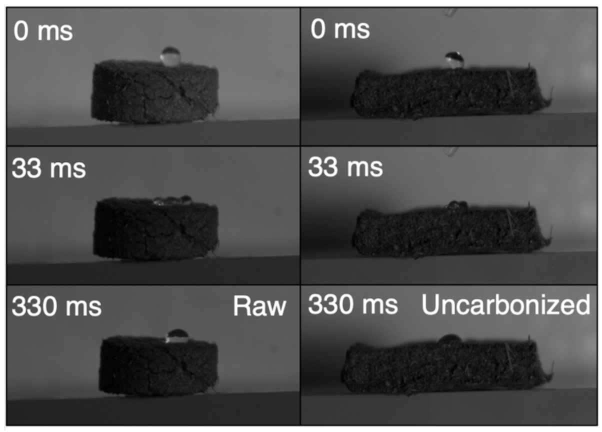

Figure S7 High-speed camera images for raw and uncarbonized samples. High-speed camera images of raw and uncarbonized samples showing lack of water absorption ability.

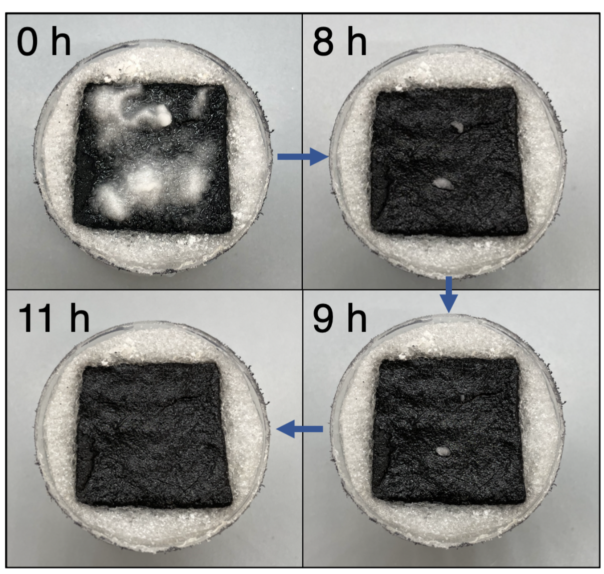

Figure S8 Salt rejection in excess of 8 hours. Salt rejection experiment results from 8 hours, when barely any salt remains, to 11 hours, when no salt remains.

Outdoor Desalination Experiment

The leaf desalinator was tested outdoors on the rooftop of Snell Engineering Center at Northeastern University, Boston, MA, USA on September 3, 2021. Two identical evaporation chambers are made from polycarbonate (PC) boards with a thickness of 0.8 mm and an overall transmittance of 83% in the solar wavelength region. The outer chamber measures 110 mm $\times$ 70 mm $\times$ 100 mm. Inside this sealed chamber is a smaller water-tight section in the center of its base measuring 70 mm $\times$ 35 mm $\times$ 20 mm, with an open top. This region holds the saltwater to be evaporated. In one of the two chambers, two leaf-guar desalinators are placed in this center region to float on top of the salt water. The size of this center region is tailored to the size of these desalinators, such that they completely

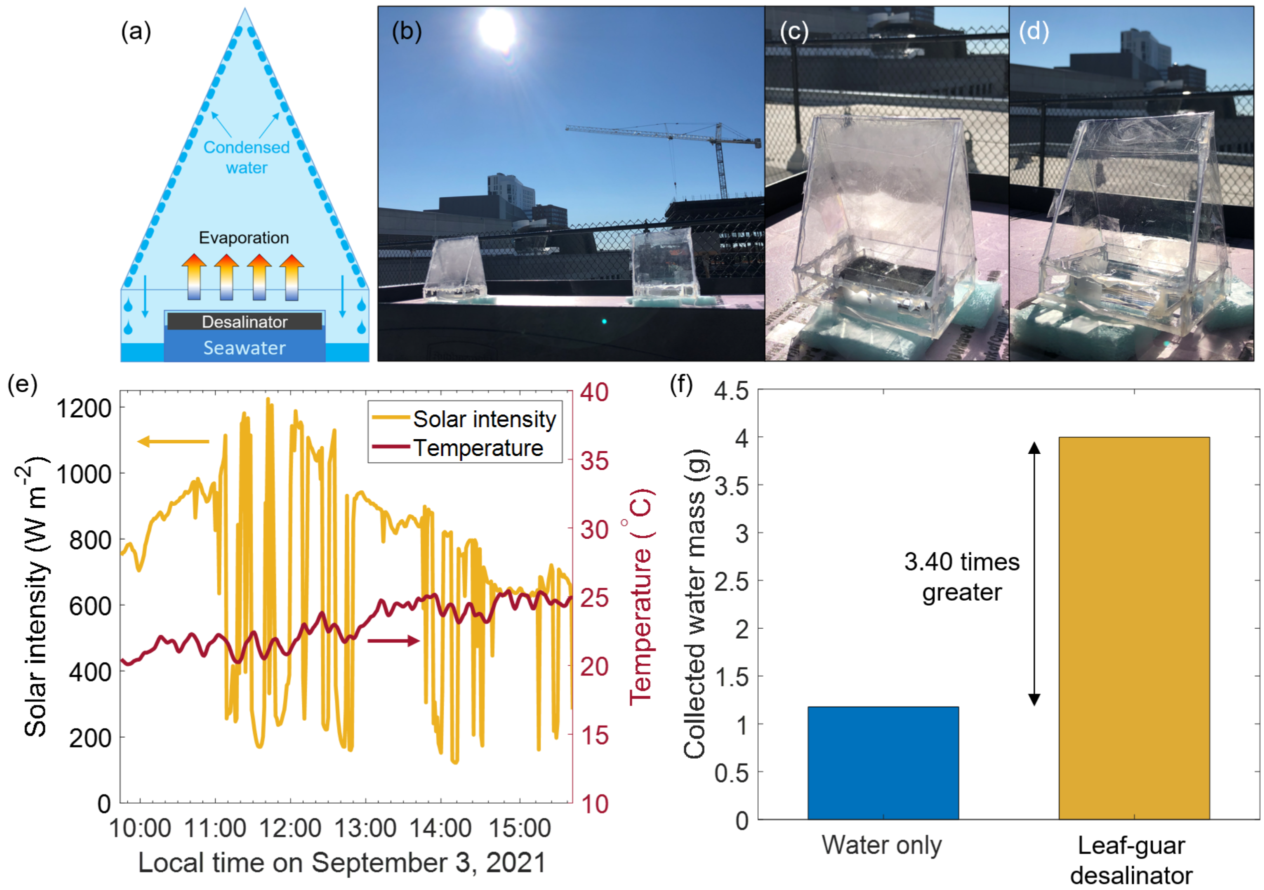

Figure S9 Outdoor experiment (a) Schematic of evaporation chamber with leaf desalinator. Seawater is contained in a water-tight section with an open top. The desalinator floats on top to aid evaporation. Evaporated water condenses on the inner walls of the chamber, where it drips down to the base. From here, it can easily be collected using a syringe. The chamber with the desalinator is compared with an identical water-only chamber, which does not include a desalinator on top of the seawater. (b) Image of desalinator and water-only chambers on the rooftop of Snell Engineering Center, Northeastern University, Boston, MA, USA during the outdoor test. Close-up images of (c) desalinator and (d) water-only chambers during the outdoor test. (e) Solar intensity and temperature over the outdoor testing period. While the solar intensity rises and falls due to fluctuating cloud cover, the average solar intensity over the test period is over 700 W m^{-2}. (f) Collected water mass from the two evaporation chambers. The mass of water collected from the desalinator chamber is approximately 3.40 times that of the chamber with only water.

cover the water surface. Both chambers are placed on top of a layer of polystyrene (PS) foam to provide insulation from the utility cart.

As the salt water evaporates, it condenses on the inside of the PC walls and drips down into the collection area. The experiment is performed for 6 h, from 9:45 to 15:45 local time. The solar intensity and temperature are recorded over the experimental period using a weather station. The average solar intensity is approximately 710 W m^{-2}, though varying levels of cloud cover cause the solar intensity to fluctuate with respect to time. After the experiment, all condensed water is collected with a syringe. The masses of the water collected from each chamber are compared to illustrate how the leaf-guar desalinator enhances evaporation.