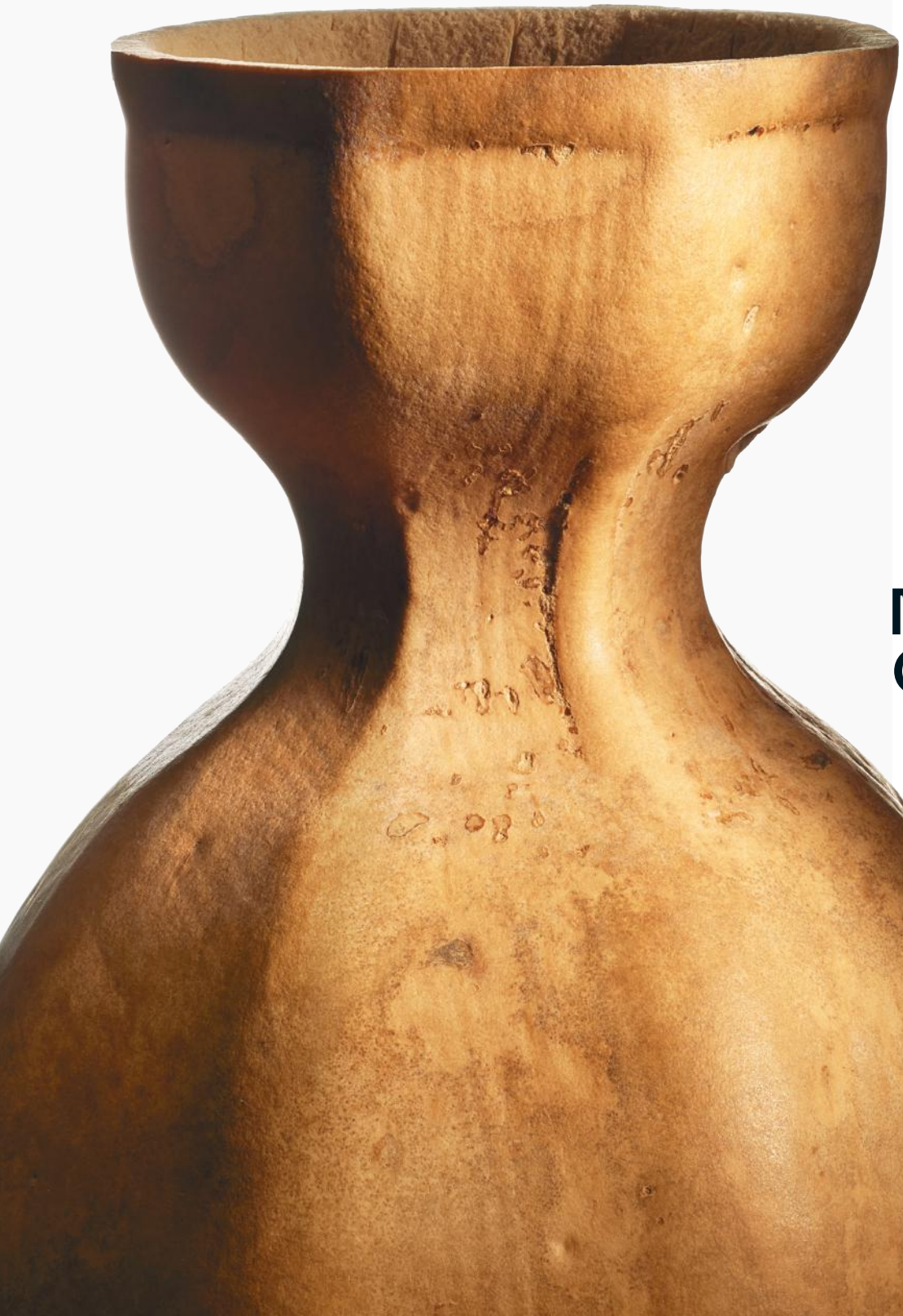
WHAT WILL THE WORLD OF TOMORROW BE MADE OF? WE ZERO IN ON THE PHYSICAL MATTER BEHIND DESIGN, HIGHLIGHTING SURPRISING, DELIGHTFUL, AND DOWNRIGHT STRANGE NEW MATERIALS AND PROCESSES WITH THE POTENTIAL TO SHAPE THE FUTURE.

Modern World

TEXT BY
Lindsay J. Warner

PHOTO BY | @SLINC
Stephen Lewis



Jun Aizaki of Crème studio makes cups and vases (like the one shown here) out of bottleneck gourds, which he encases in molds as they're growing to produce the desired shapes. For more details about how he does it, see page 26.

Material Obsessions



PHOTO BY | @SLINC
Stephen Lewis

KIRSTIE VAN NOORT & XANDRA VAN DER EIJK
Eindhoven & Utrecht, The Netherlands

Stardust Cube

"We see a future in which we collectively treat resources differently. What's in our backyards will become more important than what's in the ground."

Dutch designers Kirstie van Noort and Xandra van der Eijk looked to the skies—and beyond—for material inspiration for their speculative project "As Above, So Below," which used stardust collected from rooftops. The two gathered micrometeorites—metal and rock cast off from other planets and asteroids in pieces small enough to pierce the Earth's atmosphere—and fashioned them into a poetic cube. The duo also anticipate scientific uses for the extraterrestrial materials, whose molecular structures differ from even the same minerals dug from the ground. Just as important to them is a reconsideration of who stands to profit from natural resources. With some 60 tons of meteoritic material landing every day, they propose "crowd-mining" to increase the scope of stardust collected and its ownership. "Because it falls everywhere, all people have equal access to it," van der Eijk says.

PROCESS

1 **COLLECT AND DRY**
To make the cube, the designers gathered about 4 liters of wet dirt and debris from gutters, then dried it in a ceramics oven at a low temperature.

2 **FILTER OUT THE STARDUST**
First using a magnet, then a microscope, they filtered out and analyzed which pieces might be micrometeorites.

3 **MELT AND CAST**
The pieces were heated in a small ceramic flask, reaching melting point (about 2012°F) in roughly 10 minutes. They then poured the molten stardust into a mold and let it cool.

CRÈME
Brooklyn, New York

Gourd Cup

"The why stems from the fact that we're using all these plastic cups that are meant to last for thousands of years. We use it for one second, then throw it away. As a designer, you start asking yourself, is there a better solution?"

Humans have used the prolific, easy-to-cultivate bottle gourd as a drinking vessel for some 10,000 years, but it has one limitation: It grows in all sorts of cockamamie shapes. So when Jun Aizaki, principal of Crème architecture and design studio in New York, set out to explore the gourd as an alternative to the ubiquitous disposable coffee cup, he first had to find a way to create a more predictable result. In 2013, Aizaki planted bottle gourd seeds in his tiny backyard in Brooklyn—"it immediately became a gourd jungle," he says—and over the next five years refined a method of fitting 3D-printed molds over the fruits early in their growing cycle to encourage them to take the shape of a cup. After several months of air-drying, the gourds become a watertight stand-in for the disposable type, but can be used again and again or thrown away—better yet, composted—with other food garbage. Next up: figuring out how to decrease production time—or taking the process indoors, where it would be free from the constraints of the growing season.

PROCESS

1 **GROW THE GOURDS**
Aizaki plants bottle gourd seeds in the ground in spring. He lets them flower and produce fruit.

2 **MAKE THE MOLD**
He creates 3D-printed two-part molds in the shape of cups and vases and places them around the growing fruit. The gourds are allowed to grow until they fill the molds.

3 **LET IT DRY**
Aizaki frees each gourd from the mold and leaves it outside for several months until it is brittle and dry enough to hold liquid.



PHOTO BY | @SLINC
Stephen Lewis

KATHARINA HÖLZ
Frankfurt, Germany

Pomace Compound

"Studying product design, I was amazed by the 'cradle to cradle' principle, that there is no such thing as 'trash' in nature—everything is being used over and over again. I wanted to introduce that principle for pomace."

Katharina Hölz comes from Moselle, a German region known for its Riesling wines. "And where there is much wine, there is much pomace," she says, referring to the pulpy residue—stems, seeds, and skins—left over and discarded as waste after the grapes have been pressed. Germany alone generates more than 200,000 tons of pomace each year. The Frankfurt-based designer saw that waste as something she could develop into her own biodegradable material and began experimenting with various mixtures of ground pomace and wax before producing a compound she could turn into objects. She calls the material Tresta, after *trester,* the German word for pomace. A bottle-inspired lamp and wine cooler were her first creations, but she is also testing variations to use for packaging, sound-absorbing wall tiles, and 3D printing. While Hölz sources hers from a friend's winepress, pomace is easy to come by: "Vineyard owners are glad to get rid of it," she says.

PROCESS

1 **SOURCE AND DRY**
Hölz obtains her pomace from a friend who makes wine. She dries it outside in winter, avoiding the need for drying machines.

2 **GRIND AND MIX**
The pomace is ground into a powder and mixed with warm wax—finding a workable mixture took Hölz a number of tries.

3 **CAST THE ITEM**
The warm mixture is poured into a mold and allowed to cool until hardened. So far Hölz has used only white pomace, given the Moselle region's focus on Riesling wines.

GRANBY WORKSHOP
Liverpool, England

Smoked Ceramics

"It's important to us to develop new materials, since they can change our perception of, and relationship to, everyday objects and the world around us. They can let us see something mundane in a completely new light."

First used to clad a bar at the Ace Hotel in London, Granby Workshop's smoked ceramic tiles are made from liquid earthenware clay that's fired in an electric kiln, then "smoked" in a backyard barbecue. "Instead of glazing, we utilize this really basic process," says Lewis Jones, cofounder of the Liverpool workshop. "It's just a normal Weber barbecue filled with sawdust and newspaper—the ceramic absorbs the smoke from the fire to get this very exciting and unusual result." The effect of the smoking is different every time, depending on what's added to the coals: Banana skins and pine needles are just two of the ingredients used to create the mottled look. "We're always trying to introduce the unexpected into the making process," says Jones. In addition to the tiles, Granby produces smoked ceramic door handles, trivets, and cord pulls.

PROCESS

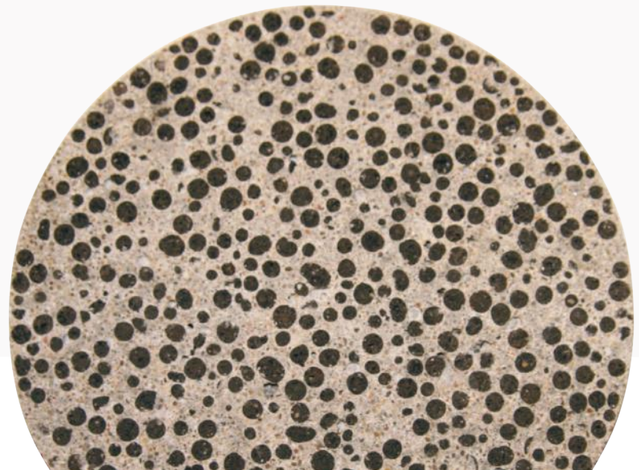
1 **FIRE THE CLAY**
Granby Workshop slip-casts or press-molds pieces of white earthenware clay into tiles, allows them to dry on a shelf for a few days, then fires them in an electric kiln at 2200°F until hard.

2 **PREPARE THE GRILL**
They fill a Weber barbecue with sawdust and newspaper, add unconventional ingredients such as banana skins and pine needles, and light the grill.

3 **SMOKE THE TILES**
The ceramic tiles are placed in the fire for 12 hours, then removed from the ashes and cleaned, waxed, and polished.



PHOTOS: COURTESY GRANBY WORKSHOP; COURTESY HENK JONKERS



HENK JONKERS, PH.D
Delft, The Netherlands

Self-Healing Concrete

"I hope this will allow us to design in a way that results in materials savings and lowers the environmental impact of concrete construction."

Years of research into the behavior of bacteria have led a microbiologist to a discovery with huge implications for the world of architecture and design. Along with colleagues at the Delft University of Technology in the Netherlands, Henk Jonkers has found a way to create a concrete that heals itself. Water seeping through cracks in concrete can result in leaks and corrosion of steel reinforcements. But with Jonkers's healing agent—bacteria and nutrients mixed into the concrete—water activates a chain reaction, converting the mixture into waterproof limestone and sealing the cracks. "When you work with self-healing concrete, you can design like nature does, using slender, more delicate materials," Jonkers says. "There's no need to over-design, as you need fewer reinforcements and less concrete if your material can heal itself."

PROCESS

1 **DETERMINE THE USE**
The self-healing agent contains long-living bacteria and nutrients that aid spore growth. It's mixed with concrete but can also be made into a repair mortar or spray.

2 **USE THE CONCRETE**
Build as desired. The bacteria remain dormant until moisture enters their environment, setting off a chain reaction.

3 **HEAL DAMAGE**
Water seeping through a crack leads bacterial spores to germinate, ultimately producing a durable and waterproof limestone seal.

PHOTO BY | @SLINC
Stephen Lewis

SPINNOVA
Jyväskylä, Finland

Wood-Pulp Fiber

"We can also use agricultural waste—like wheat and straw—and are in the process of turning synthetic waste into fiber."

Janne Poranen and his business partner, Juha Salmela, were physicists specializing in fluid dynamics and working in the pulp and paper industry when Salmela was inspired by a talk on spider silk to see if he could create something similar to the arachnid's sturdy web using wood pulp. With spiders as the model, the Finnish pair devised a system that uses a patented nozzle to rotate and "spin" wood pulp and other types of biowaste into a strong, elastic cellulose fiber. When dried, it can be turned into a highly adaptable natural filament and used for insulation, filling, textiles, and even hygienic wipes. The bio-based Spinnova process requires zero harmful chemicals and produces no waste. "What's unique is that we don't use dissolving chemicals," says Poranen. "The only by-product is evaporated water, which we recycle back to the start."



PROCESS

1 **REFINE THE PULP**
A mechanical refining machine aligns the pulp fibers between metal plates to create microfibers. Water is added to create a liquid solution.

2 **PUMP, OR 'SPIN,' THE MICROFIBERS**
The solution is pumped through tiny vessels onto a flat surface in a fashion similar to the process of a spider spinning silk. As the "spun" microfibers dry, the excess water is recycled.

3 **ROLL OR CUT THE FIBER**
The dry cellulose fiber can be rolled up as a continuous filament or cut into staple fibers for spinning, knitting, or weaving, depending on the end use.

PODCAST

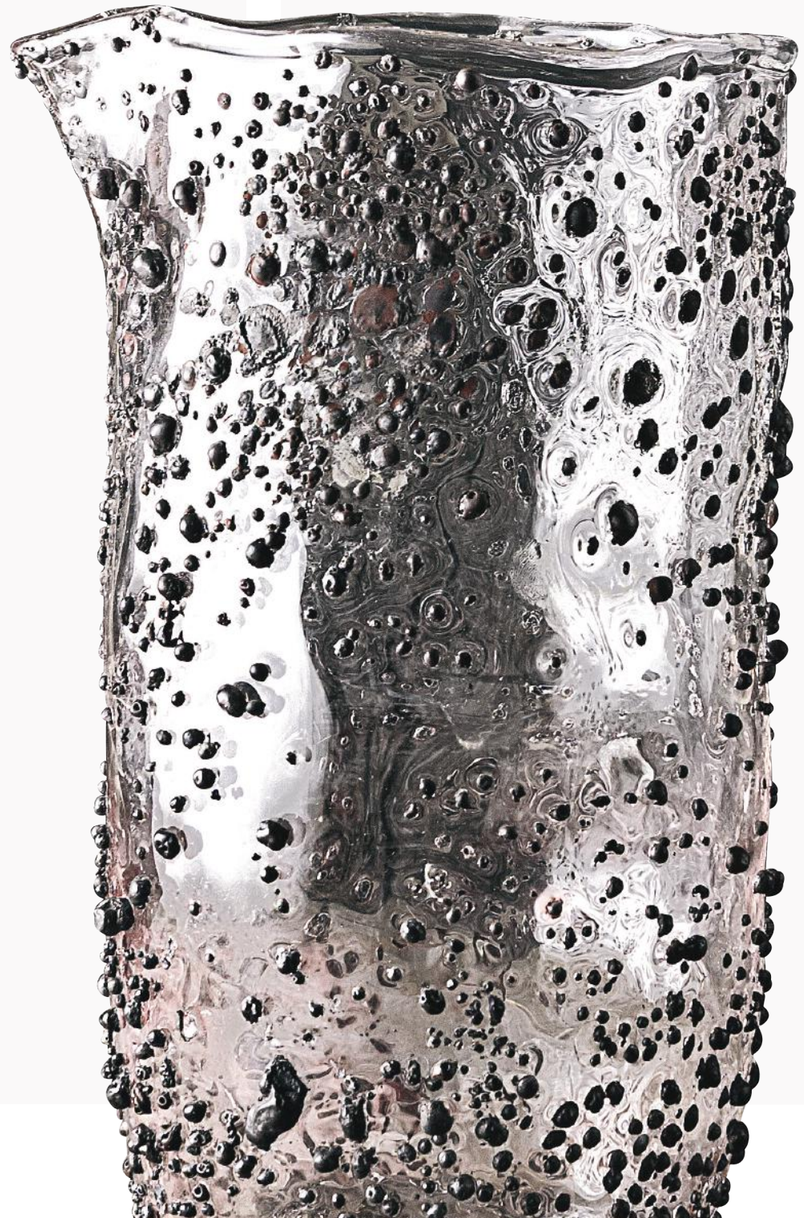
Learn more about Spinnova in a bonus episode of Raw Materials 3 Ways at dwell.com/podcast

INGE SLUIJS
London, England

Plasma Glass

"Plasma rock is still kind of a scientific material, but it's interesting to show from a designer's perspective what the possibilities are. And to show that it's possible to transform landfills into something new and beautiful."

Dutch designer Inge Sluijs is "fascinated by waste"—where it ends up and what can be made from it—so when she saw an online example of a lustrous, ink-black "plasma rock" created from landfill junk, she followed up. She found the scientists responsible at KU Leuven university in Belgium and began sourcing the material from them. Plasma rock is made by superheating waste until it turns to a gas, then blasting that gas with plasma, which results in a rock-like piece of slag. The non-hazardous material can be ground into powder and used as concrete, but the grounds also contain bits of shiny stone, which Sluijs incorporates into handblown borosilicate glass vases. "Normally you can't mix anything with glass—it has to have the same melting point and cool at the same time—but plasma rock meets these requirements," she says.



PROCESS

1 **SOURCE THE PLASMA ROCK**
Sluijs receives ground-up plasma-rock slag—the end product of superheating and plasma-blasting landfill trash—from scientists at the KU Leuven university in Belgium.

2 **PICK THE STONES AND COMBINE**
Sluijs selects 3mm shiny pieces of rock, puts them on a metal tray, then heats borosilicate glass tubes and rolls them in the tray of rocks.

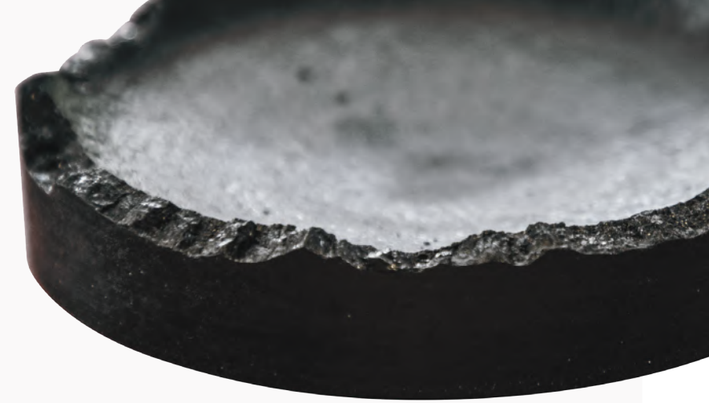
3 **REHEAT AND CREATE VASE**
Because the rock has the same melting point and cooling time as the borosilicate glass, Sluijs is able to heat the two together for glassblowing.

BASSE STITTGEN
Amsterdam,
The Netherlands

Blood Objects

"With these objects, I'm trying to bring attention to an invisible waste stream produced by the slaughterhouse industry. Physicalizing this waste creates awareness without accusation."

The jet-black objects in Basse Stittgen's "Blood Related" series are beautifully sparse and smooth to the touch, inviting you to run a finger along their curves. They're also made entirely from cow's blood. The Dutch designer was casting about for a material he could create from scratch when he came across an 1850s patent for a substance made from sawdust and ox blood. He found a way to make a hard, plastic-like product from cow's blood alone, even using it to make a record of a cow's heartbeat. "Blood is the only material that expresses both life and death at the same time," he says. Stittgen takes it upon himself to collect the blood from the slaughterhouse. "It's important for me as a consumer—and producer—of animal products to see where it comes from," he says. "A lot of people like to eat meat, but they don't like to think about how it gets produced."



PROCESS

1 **COLLECT THE COW BLOOD**
Stittgen goes to a local slaughterhouse to collect blood as a cow is being killed. He freezes a portion of the blood for later use.

2 **STIR AND DRY**
Stirring continuously, Stittgen dries the blood in a large flat pan over a hot plate. The liquid slowly evaporates, leaving behind a powder.

3 **MOLD AND HEAT**
The powder is put in two-part molds and placed in a heat press at 400°F under five tons of pressure. The blood's albumin binds it into a solid object.

PHOEBE QUARE
London, England

Mussel Plaster

"It was important to me to create a material and a collection that is derived from waste but does not resemble that visually."

When self-described "materialologist" Phoebe Quare went to tiny Bere Island off the coast of County Cork, Ireland, in 2015, she found one pub, one school, 165 people, and mountains of discarded mussel shells. "They aren't like oysters—they're not reused, they just sit there empty," she says. She discovered that applying heat made them turn a beautiful porcelain white and become brittle enough to crush into powder. "The material has a chalky character, so I made some handcrafted chalks—something the islanders could be proud of and think, yes, that belongs to us," Quare says. She then added a natural binder and created three island-inspired lanterns, including a signal lamp like the ones the military used when they had bases—and provided jobs—there. But that was then. "I asked the kids what they'd do when they grew up, and they all said they'd leave," Quare recalls. So as she explores more designs for the plaster, she's in talks with the Irish government about establishing the infrastructure needed for the islanders to make money from it themselves.

PROCESS

1 **HEAT THE SHELLS**
Quare employs various heating processes until the shells are brittle and can be ground into a fine powder.

2 **CREATE THE PLASTER**
She makes a liquid plaster by adding a proprietary binder—Quare says it dissipates in the drying process, leaving the finished material 100 percent mussel shell.

3 **CAST AND DRY**
After being poured into a mold, the plaster dries for three to four weeks, depending on the item's thickness and intended use.

PHOTOS: COURTESY INGE SLUIJS; COURTESY BASSE STITTGEN; COURTESY PHOEBE QUARE



PHOTO BY | @SLINC
Stephen Lewis

PROCESS

1 **FIT THE KAALINK**
The Kaalink device is installed on a diesel generator to capture particulate matter emitted during combustion.

2 **ANALYZE AND RECYCLE THE SOOT**
The lab determines each capture's carbon content and other characteristics; different diesel grades have more or less oxygen, for example, affecting particle size. The soot is recycled as a high-grade black ink.

3 **TURN INK INTO MARKERS**
A German engineering company creates artists' markers with the ink; they come in various sizes and are refillable.

▲

ANIRUDH SHARMA
Bengaluru, India

Pollution Ink

"The fact that particulate pollution has the ability to make things dirty and tainted is exactly what made me go after its 'inking' property."

In Anirudh Sharma's native India, one in eight people dies from air pollution–related causes. In many cities, Sharma says, an underground mafia quietly—and illegally—disposes of particulate waste created by factory emissions by dumping it in rivers or landfills. So he decided to find a way to both turn the pollution into a resource and get it out of the air in the first place. Graviky Labs, the MIT Media Lab spin-off Sharma founded, created the Kaalink device to capture particulate emissions from all types of combustion. Its use has switched from mostly car tailpipes to diesel generators—people don't drive away with the device as often now, he notes. The lab recycles the soot into a nontoxic, carbon-free black ink that is used for artist-grade markers known as Air-Ink. "There's no need to burn fossil fuels to make black ink when we can capture pollution and recycle it instead," says Sharma.