



AIR-INK FROM POLLUTION TO ARTIST SUPPLY

STORY BY
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ANIRUDH SHARMA WAS TRAVELLING TO HIS HOME country of India during his studies at MIT when the idea hit him. He noticed that his clothes were being stained black from smog and the exhaust of passing cars. The air pollution, he realized, was acting almost like ink. Very much like ink, as it turns out: vehicle exhaust consists mostly of unburned carbon, the same material used as a pigment in black ink.

It got Anirudh thinking: Could this pollution be harnessed to create something useful? Could it be captured, and turned into ink? The answer, thanks to Anirudh's ingenuity, is yes. Four years on, artists can now draw and paint with Air-Ink, a deep-black ink harvested directly from air pollution.

Anirudh, a computer engineer and self-described “chronic inventor,” has long been driven to find solutions to social problems. While still an undergrad, he invented a shoe insole for the visually impaired, using GPS navigation and directional vibrations to help guide the wearer. It was just an experiment, but demand led him to start a company to sell the product, which he called Le Chal (“take me there” in Hindi).

After Le Chal, he went to study at the MIT Media Lab—taking a master's in augmented and virtual reality—eager to get more involved in innovative technologies. His focus, however, remained on India, and in applying what he learned at MIT to the local problems in his home country. It was at this point that his interest in air pollution was piqued.

Anirudh hails from Delhi, a city that has made headlines recently for the poor state of its air quality. India boasts 33 of the 100 most polluted cities in the world, according to the World Health Organization (WHO), with Delhi claiming top spot.



"I really like the idea behind the ink, in that instead of extracting from raw materials, they instead use airborne soot from traffic. The ink works very well, has high opacity and adheres well to surfaces. I suppose I'm pretty happy with it!"

— CATHERINE GROSSRIEDER
(CATH LOVE)

||| cathlove.com

The problem is the particulate matter in vehicle exhaust and industry emissions, in particular those that are just 2.5 microns in diameter (referred to as PM 2.5). These tiny particles get lodged in the lungs and can cause long-term health problems. They can also be deadly. The WHO estimates that air pollution causes seven million deaths a year, mostly in the developing world.

Knowing this, Anirudh got to work. Back at MIT, he experimented with capturing soot from a candle, mixing it with vegetable oil and vodka to create an ink. It may not have been efficient, but it worked: he was able to fill an HP C6602 inkjet cartridge and print with it.

Next he gathered a team and began working on a more serious prototype. After three years of research and prototyping, they had developed a device they called the Kaalink, designed to filter out and collect the soot from vehicle exhaust. They also developed a process for turning this pollution into Air-Ink. Anirudh and his partners, Nitesh Kadyan and Nikhil Kaushik, now sell Air-Ink and the Kaalink through their startup, Graviky Labs.

The name Kaalink is a play on *kaali*, the Hindi word for "black." Kaali is also the name of a fierce Hindu goddess who fights against evil—an apt name for a device taking on such a persistent and devastating problem.

The Kaalink itself is a cylindrical metal unit that fits onto a vehicle's exhaust pipe, in order to capture the pollution coming out in the exhaust—catching it before it can get into the air. As the exhaust passes through it, the Kaalink emits an electrostatic charge to filter out the

particulates, storing it as soot. Once the unit is full (typically after a couple of weeks), the Graviky team collects the soot and takes it to a lab. (The Kaalink, meanwhile, is reusable, and continues to collect soot for the next round.)

At the lab, the process is fairly simple: the team puts the soot through a cleaning and purification process to remove the heavy metals, dust and carcinogens. The resulting pure carbon powder is ground extra-fine, then mixed with solvents to create black ink.

The Kaalink comes in several different sizes, designed to fit onto cars and trucks, as well as onto the diesel generators commonly used to power homes in India. The technology can also be scaled to fit such things as ship exhausts and factory chimneys.

The Kaalink is impressively effective: it can filter out around 85% to 95% of vehicle emissions, including the deadly PM 2.5. The device can typically collect enough carbon in 45 minutes to produce 30 mL (or 1 fluid ounce) of ink—enough to fill one Air-Ink marker pen. Put another way, one Air-Ink pen represents 45 minutes of vehicle emissions that were prevented from polluting the air.



Graviky Labs co-founders Anirudh Sharma (at left), Nikhil Kaushik and Nitesh Kadyan.



"I have used Air-Ink in several projects and the product proves to be something much better than a marketing campaign. The colour is a solid black with very little translucency, making it perfect for all surfaces. The texture of the ink is thicker than regular ink in the market, which means it's good when working on porous surfaces. It's quick drying yet extremely durable."

— KRISTOPHER HO
(KRISTOPHER H)

||| kristopherh.com

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In its first year, Graviky distributed 75 units. From these they captured around 100 kg (220 pounds) of carbon, enough to make 1,000 litres (264 gallons) of ink—all the while cleaning nearly two trillion litres of air.

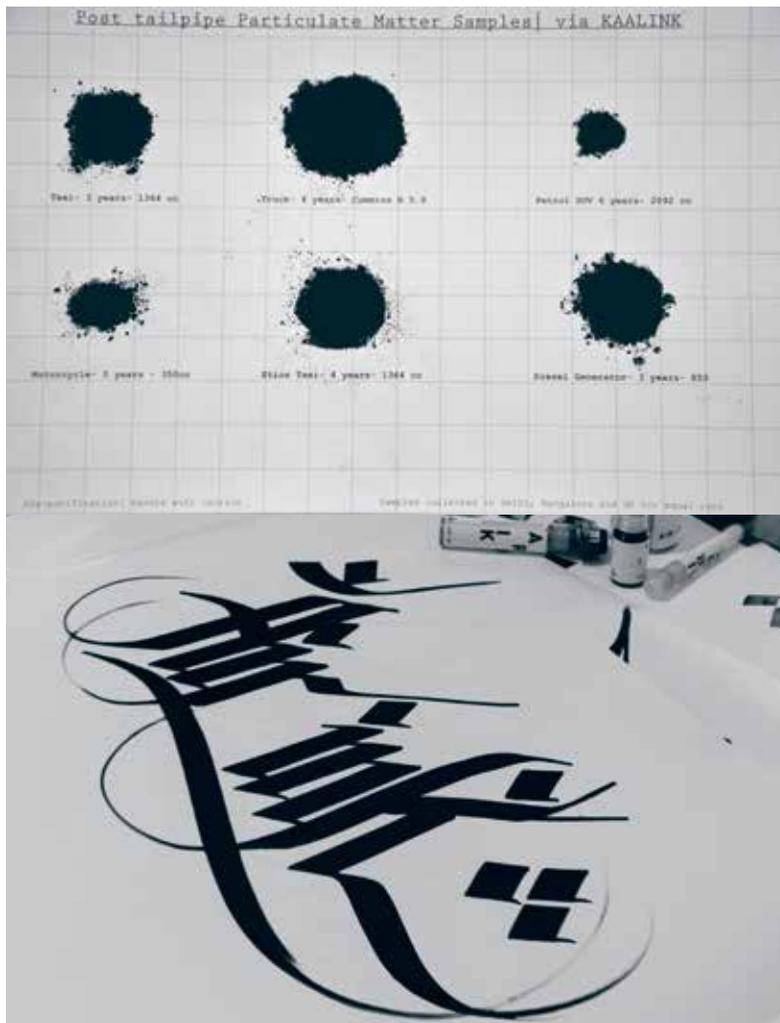
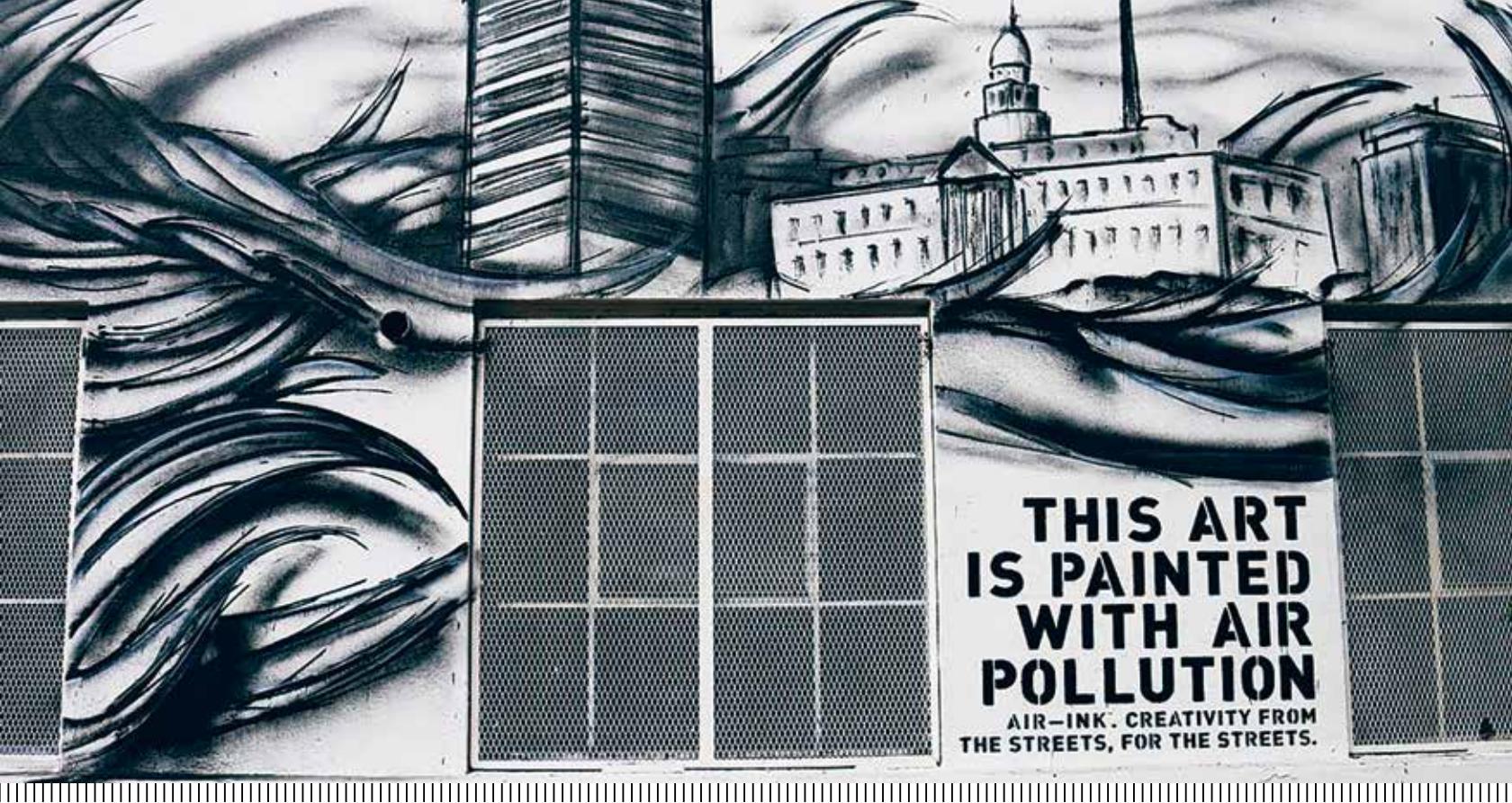
In February 2017, Graviky launched a Kickstarter crowdfunding campaign for Air-Ink in order to raise money to begin full production. They surpassed their goal of \$10,000 US in 10 days, ultimately raising nearly three times their goal.

The money is helping them not only scale up production, but expand their line of inks. Currently, Air-Ink is available as a felt-tip marker, designed for calligraphy and lettering, and as silkscreen ink (markers come in 2, 15, 30 and 50 mm sizes). Graviky also plans to produce oil-based paints, fabric paints and outdoor paints.

Much of Air-Ink's appeal, of course, is as a socially conscious, eco-friendly product. Not only does the ink come directly from recycled pollution, it also provides an alternative to standard commercial ink production, which requires the burning of fossil fuels to create "carbon black," the pigment commonly used in black inks.

But it seems they have also managed to produce a superb product: Air-Ink is thicker than standard inks, making it a unique ink to draw with, and one less likely to bleed. It is also an intense, deep black that has impressed the artists who have used it.

Regardless of the reasons, the appeal is catching on, and gaining attention. Air-Ink's first major boost came with a partnership with Tiger Beer in 2016, in which the beer company teamed up with Graviky for a promotional campaign in Hong Kong. Nine Hong Kong-based street artists (Kristopher H, Sinic, Xeme, Bao Ho, Calvin Ho,



Roes, Caratoes, Lei Lei and Cath Love) were given samples of Air-Ink and invited to create public art pieces throughout the city. Tiger fitted their transport trucks with the Kaalink, supplying the necessary ink.

Hong Kong was just the first stop. The following year, Tiger took the campaign to seven other cities: London, Berlin, Chicago, New York, Sydney, Singapore and Amsterdam. The first stop was London, where 19 artists created billboards and murals with Air-Ink to draw attention to the problem of air pollution. The ink was also used to petition the government to set up trials on London's transportation system.

Now, with Air-Ink finally available for purchase, Anirudh and the rest of the Graviky team are focused on scaling up the project. They are targeting mass transportation systems, including commercial fleets and public transit, such as buses and taxis. The Kaalink remains available to individuals, but the Graviky team knows that for the technology to have a substantial effect, they need to get corporations and city- and state-level governments on board.

Air-Ink, meanwhile has become a powerful tool for expressing a desire for change. The idea has been to provide a way of tackling a serious social and environmental problem, while also inspiring other creative solutions. But Anirudh and the Graviky team are equally inspired by the merging of science, technology and art, and the creative possibilities that they have seen can come from getting Air-Ink into the hands of artists. 📍

||| graviky.com