

Turning trash into treasure

The weekly rubbish truck should not be the solution to our waste, says Veena Sahajwalla. There's cash in that trash.

By GREG BEARUP

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Veena Sahajwalla, dressed in a hard-hat and a blazing safety coat, is bouncing with excitement in her steel-capped boots. She's one of the world's leading experts in the field of recycling science, the toast of academia, but it's obvious there are few places she'd rather be than here, in the control room of an electric arc furnace at this Newcastle steel mill. She can't wait to step through the door and onto the floor where a raging torrent of heat is rendering steel into liquid.

"Greg," she says, leaning in to be heard above the cackle of the furnace. "It'll make me sound like a pyromaniac [but] I love all this high-temperature stuff. Everything to do with big, hot furnaces." She gives me a cheeky smile and a hint of Indian head wobble. "I love the whole hungry beast of a big metal furnace. It works for me." Then, beaming with awe and wonder, she steps through the door to be greeted by the hot breath of the beast.

Sahajwalla is a world leader when it comes to this molecular alchemy. Australian steel makers have commercialised her groundbreaking invention known as Green Steel — using the carbon in old car tyres to replace coking coal in steel production. Her technology has been patented and exported around the world, used in the -

production of more than 30 million tonnes of steel. Last year she was made a fellow of the esteemed Australian Academy of Science.

Today, here in Newcastle, she is taking her technology one step further. This furnace is using coke to provide the vital carbon in the scrap steel recycling process, but trials are underway that will see it transition from coke to rubbish — shredded plastics that, like coke, are packed full of carbon. The plastics will be funnelled into the middle of this furnace at more than 1500 degrees where there's no oxygen so it doesn't burn. The carbon in this junk becomes a vital element in the steel.

For more than a century they've been making steel on this site at Maud St, Waratah, a suburb of Newcastle; they currently produce train wheels and axles and grinding balls used in mining. During World War II the mill made 200,000-odd artillery shells and other munitions. If your grandpa fought in the war, chances are he was capped with a steel helmet made by the blokes at the old Commonwealth Steel Company — more than two million were shipped out through the gates at Maud Street to Allied soldiers.

What may surprise many is that this steel mill still exists — didn't we offshore all this already? It went through some lean years and several owners, and is now in the hands of a US company, Moly-Cop. And on the day we visit, there's a sense of great optimism among the workers. They've witnessed the alchemy of trash being transformed into valuable products. They've seen the future and it is in breathing new life into old rubbish.

The Newcastle steel workers were dubious when Sahajwalla first suggested replacing coke with plastic but they've discovered it's actually significantly more efficient and less toxic than the coke. Going green, they say, gives them a competitive advantage. They've taken on Sahajwalla's ideas with gusto and recently began experimenting with a process that transforms old photocopiers and their endless toner cartridges into bespoke carbons that can be used in batteries.

And now, in partnership with Sahajwalla and her team at the University of NSW's Sustainable Materials Research and Technology (SMaRT) centre, they are working on the Holy Grail, feeding their furnaces with car "flock": the glass, leather or vinyl seats, plastics, tyres and e-waste that's left over when the car has been stripped of its metals. Tens of thousands of tonnes of flock end up in landfill each year. Moly-Cop has begun trials, feeding it into its furnaces in a process called thermo-micronising to extract the valuable stuff.

Combinations of flock can produce an array of highly specialised materials including ceramics that can be used as computer circuitry and chips, as well as highly valuable carbons and graphites. The steel works is also planning to invest in a solar plant to drive its hungry furnaces. And so while Canberra fiddles as its energy policy smoulders, this company is taking the future into its own hands. “We’ve got to stop creating energy by burning crap,” one of the metallurgists says.

Ian Tooze, an engineer with Moly-Cop, tells me Sahajwalla has changed their thinking. “She’s brought the ideas and the science to the table and challenged us to think: ‘Well, what could be?’” He reckons that within five years they’ll have a commercially viable thermal-micronising plant on the Newcastle site, processing thousands of tonnes of flock. It will be a game-changer for the mill. “Mate, if we can make this micronising plant work we’ll put more people on, our business will grow, we’ll get new revenue streams and we’ll become more competitive by using some of those products in our steelmaking process.”

The possibilities for this 100-year-old mill, Tooze says, are now endless. “Why couldn’t you start a battery-making plant up here? Why couldn’t you start an electrode plant, because all the raw materials are here... I can see a world where we are creating all these regional jobs, feeding all this material back into the supply chain.”

Professor Sahajwalla’s got them thinking.

In 1947, when the British partitioned and abandoned India, Sahajwalla’s parents were swept up in the brutality. They were children from Hindu families living in what is now Pakistan’s Sindh province. The two families fled for their lives, leaving behind property and possessions as hundreds of thousands were slaughtered in pogroms on both sides of the British-drawn border. “My mother and her brother were only very little at the time,” Sahajwalla says. “There was absolute chaos and they were separated from their parents... the stories from that time, and things they witnessed, were just horrific.”

The author William Dalrymple says Partition is as central to modern Indian identity “as the Holocaust is to identity among Jews”. Sahajwalla says this was the case in her family and it drove them all to high achievement: “We grew up with a sense that we’d made it out alive and that we’d better not screw this up.”

Her folks ended up in the Indian megacity of Mumbai; her father was a civil engineer and her mother still works as a paediatrician, running clinics for the city’s

poor. Sahajwalla sees herself as an alloy of the two, an engineer who wants to save the world. As a kid she was fascinated with how things fitted together and loved visiting her father's building sites and working out how the buildings were constructed. She wanted to be an engineer but there was great pressure to follow her mother into medicine. "It was not as if they didn't believe I could do it, they were trying to protect me — 'How can a girl in India do that type of job?'"

She prevailed and made it into the ivy league of South Asia to study at one of the Indian Institute of Technology campuses. One of only 10 girls in a cohort of 250, she topped her year and, after a few stints working and studying in the US, she and her husband Rama, also an engineer, moved in the early 1990s to Melbourne where she took up a post with the CSIRO, before moving to UNSW, where she's been ever since. "We just loved Australia the moment we arrived," she says.

In 1995 she gave birth to twin daughters, Tara and Mira, who both work in the finance industry. "She's pretty amazing," Mira says of her mum. "She survives on minimal sleep. I think she's in Beijing at the moment, and then she's going somewhere else overseas. Mum's a hardcore multi-tasker."

Sahajwalla is in huge demand as a speaker here and abroad, and it seems she can't say no. One day she'll be addressing the prestigious Falling Walls Conference in Berlin, then a few days later she'll pop up in Melbourne's Yarra Valley to talk at a waste management conference; the day after that she'll be behind a lectern at Burwood Girls High School in Sydney, inspiring the students to pursue careers in science. Her office sent me a copy of her itinerary for last year — conferences, speaking engagements, meetings with manufacturers and ministers, media interviews... it runs for 12 solid pages; you need a nap once you've read it.

The former deputy vice-chancellor of UNSW, chemistry professor Les Field, says it is difficult to overstate the contribution Sahajwalla has made to science "and to Australia more generally". He says her idea of using plastics and rubber in steel - production is "revolutionary" and, because she's been able to communicate with industry so successfully, her idea has gone from the lab to a commercial reality in a very short space of time.

"She has been an absolute role model and a great champion for women in engineering and women in STEM," Field says. "She is an incredible flag bearer. Engineering and recycling is normally considered a relatively dirty, male-dominated environment... I can't stress how important her role in this has been." And, he adds, she's a wonderfully generous person. "She relates to workers on the shop floor as

easily as she does the world's leading scientists. She's a stunning individual, a truly remarkable individual."

Field says our society has not yet come to terms with the urgent need to re-use our resources. This is, he says, one of the great environmental challenges. "We have not grasped it and we have not engaged with that issue anywhere near as much as we should have. We're tinkering around the edges, lurching from crisis to crisis with these mountains of recyclable materials."

Australia's solution to waste, so far, has been to bury it or export it to China. However, many of our landfill sites are full and early last year China placed a ban on the importation of a range of Australian rubbish. Local councils are now facing what they deem a "recycling crisis".

But one woman's truckload of rubbish is Sahajwalla's truckload of treasured elements. "What I love about Veena," says the broadcaster James O'Loughlin, who featured her as an expert panellist on his ABC show *The New Inventors*, "is that she motivates people to do the right thing by the environment, not necessarily because it is the right thing to do, but because it is cheaper and more efficient. She points out the opportunities."

I meet Sahajwalla at her office at UNSW to talk about some of those opportunities. It's the afternoon and she's running late; her secretary asks if I would like some samosas. "Veena will be starving, she'll need to eat," she explains. Sahajwalla sweeps into the room, a bundle of enthusiasm and charm. She is coy about her age; when I ask she replies: "I've managed to keep it a good secret so I won't tell you." (Mira is not so discreet. "I'm 23 and she's 30 years older than me so I guess her secret's out now.")

Sahajwalla nibbles on her samosa and explains that when she was growing up in Mumbai, nothing was wasted. Someone would turn up to collect bottles, someone else would collect paper, others old pots and pans and clothing. These people made a living out of junk. Like them, we've got to start seeing rubbish as an opportunity, she says. Enormous effort went into finding these resources, then mining, then processing and shipping them, so why would you throw them away?

"All of this waste contains valuable elements," she says. "We've got to start looking at this from that perspective — what are the elements we can use? We should be saying to the world, please put all your hard drives, all your circuit boards, all those lovely plastics into shipping containers and send it all over to us. We will store it

and we will find a use for it at some time. Or we'll come to you. We'll come to you with our micro-factories, with our IP, and we'll process it right there for you. And you pay us and then we'll sell you cobalt and then you can pay us more for that as well."

She's a capitalist who wants to save the world. "Yes, don't hold that against me," she jokes. "You've got to think like a capitalist. I keep saying, you know as a scientist and as an engineer, you've got to be able to think of long-term solutions and the impact that your work is going to create. You've got to be looking to put a long-term dollar value on it." It's got to be good for the health of the planet, she says, but it also needs to be economically viable "otherwise it doesn't work".

She segues into telling me about one of the projects she is working on, turning mountains of old clothing into building panels. "Just because a garment is no longer wearable doesn't mean that the material is no longer useful," she says. "You haven't actually lost its basic elements. Whether it's a fibre in a textile product or it is a compound, whether it's a molecule, fundamentally those basic building blocks are still there. So why not take those fibres and literally reform and restructure it into a whole new product?"

Last year her SMaRT centre opened the world's first e-waste micro-factory to process old computers, phones, televisions — all the electronic junk that ends up in landfill. The waste is sorted and dismantled by robots and then mined for its precious elements. Circuit boards are stripped of metals such as copper and tin, while glass and plastic are converted into industrial-grade ceramics and plastic filaments that are used in 3D printing.

The e-waste plant is the first in a series of micro-factories under development. There are plans to develop factories that can turn a range of consumer waste, such as glass, plastic and timber, into commercially viable products. The idea is to set these small factories up alongside regional waste disposal dumps to process the waste at its source. The eventual aim is to finetune these micro-factories and have Australian companies export the technology around the world.

All of this takes money, of course. Sahajwalla says governments and the public need to view money spent on research and development in this field in the same way they view the investment in medical research and public health. "It's a weird comparison," she says, "but if you think about research into health, right, it is important because it's not just about people's lives but there is an economic underpinning to the argument. If we're all healthier and we all proactively do the

right thing from a health point of view, it has better outcomes for the individual, better outcomes for their families and ultimately the economy.” Developing these recycling methods is expensive but over time the costs come down and the benefits to society are immense. “We may not have all the answers today but we may well tomorrow,” she says.

This is not just airy-fairy academic theory. Sahajwalla is working with industry to make these concepts work, with real outcomes and real jobs. “You only meet a handful of truly exceptional people throughout your life,” says Dresden Optics co-founder Bruce Jeffreys. “Veena’s one of ’em.” A few years ago, Jeffreys had an idea for producing high-quality spectacles and sunglasses out of recycled plastics — drink bottle lids, the plastic plugs from beer kegs and the like. “Veena and her team worked closely with us to get the formula right to produce a plastic from waste that had the performance characteristics of a virgin polymer,” he says.

Dresden has set up a small factory in Sydney producing high-quality prescription glasses and sunglasses that retail for \$49. It now has 10 stores in Australia and has opened stores in Canada and New Zealand. Jeffreys, who also co-founded the car share network GoGet, says Sahajwalla was invaluable in helping Dresden get to this point. “She’s an incredible communicator and a doer at the same time. It’s a killer combination.”

Michael Sharpe of the Advanced Manufacturing Growth Centre in Sydney has taken Sahajwalla on numerous tours to regional centres such as Dubbo, Bathurst, Albury and Taree. She’s visited flour mills, boat builders, kitchen cabinet manufacturers, bakers and waste recyclers. “It’s often the case that universities and industry speak different languages,” Sharpe says. “Veena is one of the world’s leading researchers but she can break that down into simple language.” She understands that these people are trying to make money and that her concepts for recycling have to share that aim.

Sahajwalla tells me she is excited about the future but says governments, industry and individuals need to make recycling a greater priority. We have to start picking the low-hanging fruit.

“We need better systems in place for the sorting of recycling,” she says. “We need places in every suburb where people know they can drop off all their old computer parts and remote controls. They need to be able to take all their food packaging back to where they bought it.”

Consumers need to put pressure on producers, manufacturers and supermarkets to cut down on packaging and to make products that can be more easily recycled.

“The producers and the supermarkets, all these guys need to get on board,” she says.

“We need to create a circular economy... and we shouldn’t just expect the consumers to do all the hard yards.” The weekly rubbish truck should not be simply seen as a solution to our waste, she insists. It’s an opportunity. There’s cash in those truckloads of trash.

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Greg Bearup is a feature writer at The Weekend Australian Magazine and was previously The Australian's South Asia Correspondent. He has been a journalist for more than thirty years having worked at The Armidale... [Read more](#)

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