

BEAN PLASTIC POLLUTION

GOOD NEWS FROM INDIA

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Ministry of Environment, Forest and Climate Change

Government of India

Produced by the Ministry of Environment, Forest and Climate Change (MoEFCC),
Government of India, New Delhi-110003

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ISBN: 978-81-933131-4-5

Citation: Ministry of Environment, Forest and Climate Change, 2018. Beat Plastic Pollution: Good News from India. MoEFCC, New Delhi.

Pp. 70.

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डॉ. हर्ष वर्धन
Dr. Harsh Vardhan



भारत सरकार
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GOVERNMENT OF INDIA
MINISTER OF ENVIRONMENT, FOREST &
CLIMATE CHANGE



MESSAGE


Plastics have become a part of everyone's life and Indians are no exception. However, the per capita plastic consumption in India is much lower (11 kg per capita per annum) as compared to the global average (28 kg), and per capita consumption in developed countries such as USA (139 kg) and the European Union (65 kg). At the same time, the Indian plastics industry's growth rate is one of the highest in the world and, due to rapidly expanding incomes, the per capita consumption of plastic is likely to increase.

To address the challenge of plastic pollution many steps are being taken at different levels by this Government, with strong public engagement. The *Swachh Bharat Abhiyan* is one of the largest global initiative on waste management. Plastic waste management is a critical element of the *Swachh Bharat Abhiyan*. To enable effective implementation, the policy architecture at the national level has also been amended. In 2016, the Ministry of Environment, Forest and Climate Change amended the Plastic Waste Management Rules which make source segregation of waste mandatory. The policies suggest maximum resource recovery based on the principles of waste management hierarchy and circular economy. The Plastic Waste Management Rules also include provisions for implementation of Extended Producer Responsibility (EPR).

This book covers a holistic overview of the Indian plastic industry, existing challenges, the role of citizen groups and, most importantly, the role of the informal sector. The Indian lifestyle is based on a maximal recovery of resources before disposal. This lifestyle of repair and reuse forms the basis of waste to wealth (*kabad se jugad*) pathways contributing to a relatively high plastics recycling rate of almost sixty percent as compared to the global recycling rate of fourteen percent.

In spite of the challenges posed in managing waste, there are several success stories that are being spearheaded by conscious individuals and organisations. The case studies of managing plastic waste in a responsible manner included in this book can be inspirational to many countries and regions that are struggling with waste management. At the same time, these case studies can inspire actions within our own country. These light house examples showcase how our informal waste workers, especially women, are instrumental in addressing this huge challenge and how innovative ideas like 'Liter of Life' can make a positive change.

I congratulate the team in the Ministry working under the guidance of Shri C K Mishra, Secretary; Shri A K Jain, Additional Secretary; and Dr J R Bhatt, Scientist-G for bringing out this invaluable knowledge product in a timely manner. I urge all the readers to draw inspiration from these models of managing plastic waste in a responsible manner and contribute to *Swachh Bharat Abhiyan*.


(Dr Harsh Vardhan)



डॉ. महेश शर्मा
Dr. Mahesh Sharma

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GOVERNMENT OF INDIA



FOREWORD

On the occasion of the World Environment Day 2018, it is my great pleasure to dedicate this book on 'Good News from India' to the global community on this year's theme 'Beat Plastic Pollution'. As the host of the World Environment Day, we reaffirm our commitment, in partnership with the global community, to conserve our natural resources and protect Mother Earth.

The Indian Government is moving forward on the path of sustainable development. At this juncture it is important that we do not forget our traditional environment-friendly ethos. Plastic accounts for a tenth of all the waste we generate and about half the plastic we use is single-use and disposable. It has been observed that with rising prosperity, the use-and-throw practice of single-use plastic utilities and 'out of sight and out mind' attitude towards their disposal is emerging as a matter of serious concern.

I urge people around the world to adopt the Green Good Deeds inspired by traditional Indian lifestyles which are based on the foundations of minimal waste and maximum recovery. The case studies covered in the book highlight how simple habits like carrying your own cloth/jute bag for shopping, segregation of waste, and innovative solutions like road making from plastics can contribute in combating this challenge.

I urge global leaders, businesses and civil society to join hands and explore sustainable alternatives and urgently reduce the production and excessive use of single-use plastics polluting our air, soil and water bodies, damaging marine life and also threatening human health.

With this book, we make a humble contribution to tackling this grand challenge by highlighting local initiatives in different parts of the country. I am sure other countries have similar initiatives. Let's celebrate these initiatives and hope that some of them could be scaled up at the national and international levels, contributing to sustainable and environment friendly management of plastics in our environment.

(Dr Mahesh Sharma)



सी.के.मिश्रा
C.K.Mishra



सचिव
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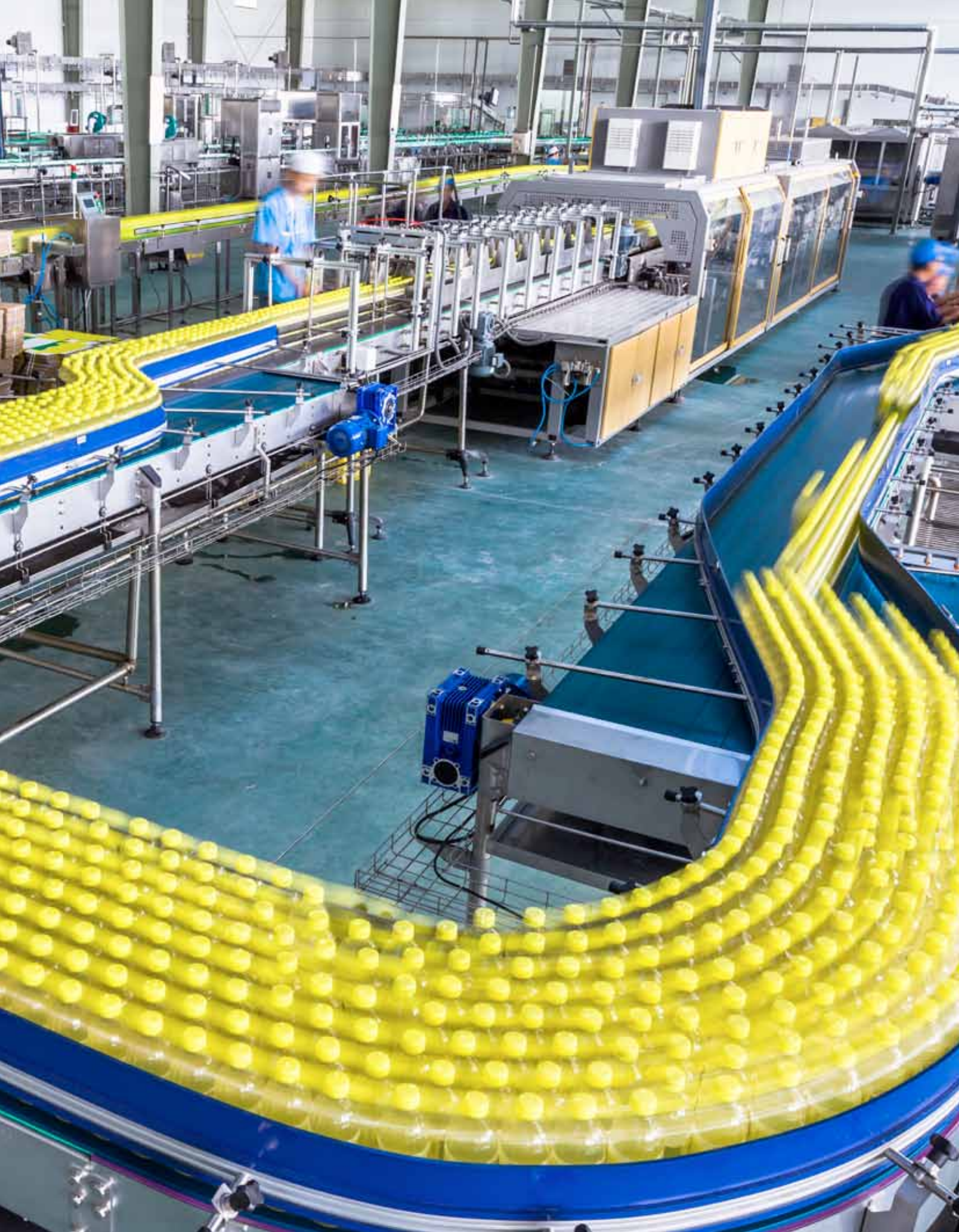
PREFACE

As one of the fastest growing economies in the world, India has a rapidly expanding consumer class. With increasing per capita incomes, there is a concomitant increase in the use of all kinds of materials, including plastics. The aftermath of this increased use of plastics is the waste that has the potential to affect our living environment. Plastic waste management is an emerging challenge for all countries alike.

This book presents several efforts by individuals and organisations across the country to tackle the challenge of plastic waste management. From cleaning our cities to making roads using plastics, to creating partnership models for effective solutions, the case studies present the pioneering efforts of extraordinary individuals and organisations. The case studies also demonstrate that no single institution or individual can solve the challenges of plastic waste management on their own. The case studies while highlighting the critical role of actors from the private sector, civil society, local government as well as the scientific community, demonstrate that scaling up of these solutions and endeavours would involve setting up partnerships and alliances.

I congratulate all those who were involved in this assignment, in particular, Shri A K Jain, Additional Secretary and Dr J R Bhatt, Scientist-G for identifying and conceptualising this book project and leading it to fruition. The support by GIZ was timely and well appreciated. The 'Good News from India' tells us that every individual is capable of contributing significantly to 'Beat Plastic Pollution'.

(C K Mishra)



PLASTICS IN INDIA

The growth rate of the Indian plastics industry is among the highest in the world

SINCE 1957, when India began making polystyrene, the country's plastics industry has steadily grown. And how.

It was a modest but promising beginning. The industry began gradually adding to the pool of polymers they were manufacturing: LDPE in 1959, PVC in 1961, HDPE in 1968 and Polypropylene in 1978. Over time, the fact that raw materials were available domestically became a core strength of the industry. The potential in the industry motivated entrepreneurs to acquire technical expertise, achieve quality standards and build capacities.

Consistent growth of the industry's plastics processing machinery sub-sector, coupled with growth in the petrochemical industry, facilitated the growth of plastics processors in the country. It also helped that plastics processors did not have to depend on raw material imports. Today in India there are about 22,000 plastics processing units and about 150 plastics processing machinery manufacturers.

Such growth helped in promoting the use of plastics in different sectors of the economy as well as in the daily lives of people. As the world over, in India too, plastic products began to replace other materials — such as rubber, wood, brass, copper, glass, aluminium and steel in households, hospitals and offices. The industry's opportunities kept diversifying.

At the same time, there were hurdles. For instance, in the second quarter of 2015, the demand for major polymers (PVC, HDPE, LDPE and the like) dipped. That hurt the industry. For in India's plastics industry, more than 85-90 percent of the turnover comes from small-scale companies. And so when the market fluctuates, they are directly affected.





TUKARAM.KARVE/SHUTTERSTOCK.COM

Historically
the industry
has been
fragmented,
with no
consistency
in scale

It would also not be wrong to say that the industry's attempts to insert itself in the global plastics market has been difficult. In 2006, for instance, the value of world plastics export was US \$375 billion. And India's share was less than one percent, with exports of US \$3.187 billion. If, in earlier times, the industry faced roadblocks such as a conservative import-export policy regime, or a problem of quality control, then as the twenty-first century progressed, it was simply swept aside by the Asian juggernaut China. As China aggressively began to increase its market share — in polymer-making and processing, in successfully inviting the developed world to set up manufacturing facilities, and indeed in cornering the global trade in plastics waste and recycled waste — the slice of the global plastics market pie available to India became thinner.

There was competition too, from other Asian countries including Thailand, Malaysia, Taiwan and Hong Kong. As each country stepped up its efforts to make gains out of an increasingly globalised world, operating in the global plastics market became a complex, many-layered phenomenon.

Moreover, historically Indian industry has been quite fragmented, with no consistency in scale. On the one hand, there are corporate entities such as Finolex, able to produce 90,000 metric tonnes of pipes each year, and Plastibends India Ltd, renowned as a pioneer of masterbatch manufacture. On the other, there are several small-scale companies with varying degrees of efficiency and capacity. In this context, perhaps the biggest challenge the industry faced, and still faces, is the low per capita consumption of plastics in the country.

PER CAPITA PLASTICS CONSUMPTION 2014-15 (IN KG)

GLOBAL AVERAGE
28



SELF-RELIANCE

Despite all of these hiccups, the scenario for the industry has remained upbeat. From 2005 to 2015, the consumption of plastic polymers grew at a compound annual growth rate (CAGR) of 15 percent, from 4.7 million tonnes to 18.9 million tonnes. The industry's turnover increased from US \$1,900 million to US \$10,215 million.

In 2011-12, the plastics processing sub-sector turnover was INR 850 billion. Raw material produced was 5.3 million metric tonnes. In 2012-13, the industry experienced, to their joy, a strong off-take from the packaging, automotive and infrastructure sectors. In 2013-2014, the industry's plastics export was worth US \$7.19 billion, approximately 47 percent more than the previous financial year.

Indeed, Indian plastics exports grew at a CAGR of almost 20 percent, 2007-2008 onwards. In 2014-15, such export was worth almost US \$8 billion. India, by now was exporting plastics to Nepal, Nigeria, China, the US and the UAE, among many other countries.

According to the India Brand Equity Foundation (IBEF), in 2015-2016, export of plastic products from India stood at US \$7.64 billion. In this financial year, major importers of Indian plastic products were the US (US \$652.28 million), China (US \$480.8 million), the UAE (US \$368.16 million), the UK (US \$271.67 million), Germany (US \$256.2 million), Turkey (US \$246.86 million), Italy (US \$208.29 million), Iran (US \$194.5 million), Nepal (US \$141.2 million) and Bangladesh (US \$136.27 million).

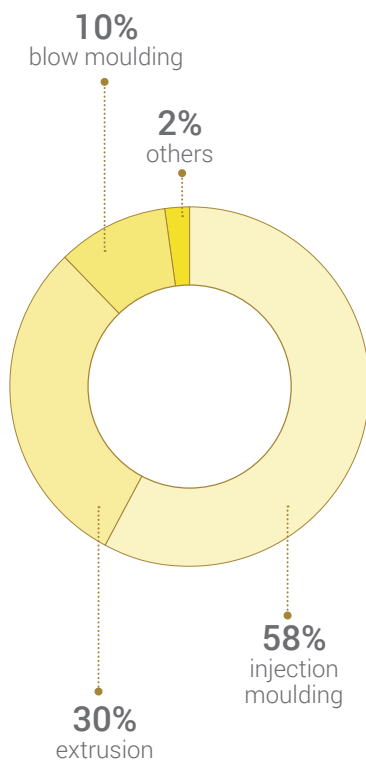
A 2011 review of the Indian plastics industry by the British Plastics Federation (BPF) stated that the growth rate of the industry is one of the highest in the world, with domestic plastics consumption growing at 16 percent, compared to 10 percent in China and around 2.5 percent per annum in the UK. With a growing middle class, estimated at 50 million, and a low per capita consumption of plastics (8 kg per head in 2011), this trend is likely to continue. Current per capita consumption of plastics in India, according to a report of the Federation of Indian Chambers of Commerce and Industry (FICCI) published in 2017, is 11 kg per annum, compared to countries such as the US (a whopping 139 kg per capita per annum), EU (65 kg) and China (38 kg). The Plastindia Foundation estimated that annual plastics consumption in India was likely to reach 16 kg per capita by 2015.

Reliance Industries, India's largest private sector conglomerate company, stated that India's polyolefins market was expected to grow by 12 percent to about 7.5 million metric tonnes in 2011, with double-digit growth in consumption of both polypropylene and polyethylene. Polypropylene, according to Reliance as quoted by BPF, would account for the largest growth at 18 percent (with consumption growing from 2.2 million metric tonnes to 2.6 million metric tonnes).

BPF estimated that 75-80 percent of polypropylene demand in India is met by Reliance Industries, with around 20 percent coming from four government-run companies: Indian Oil Corporation Ltd (IOCL), Haldia Petrochemicals, Bharat Petroleum Corporation Ltd (BPCL) and the Gas Authority of India Ltd (GAIL).



MAIN PLASTIC PROCESSING TECHNOLOGIES IN INDIA



Indeed, as domestic plastics demand and consumption in India continues to grow at about twice the rate of India's overall economy, polymer-making is a segment of the industry moving fastest, with an expected growth rate of 8-12 percent a year through 2020.

Today, the industry is upbeat, and from the market point-of-view the optimism is justified. The approximate size of the industry, according to *ibef.org*, is more than 2,000 exporters, 150 plastic processing machinery manufacturers and more than 30,000 processing units. Yet 85-90 percent of the sector remains small-scale. The really good news: domestic plastics consumption is expected to touch 20 million metric tonnes by 2020. And Union Petroleum and Natural Gas Minister Dharmendra Pradhan has said that India's annual per capita consumption was projected to double to 20 kg by 2022.

VARIETY

Data on the Indian plastics industry is often inconsistent - different industry bodies report different sets of figures, in different currencies and measures. There is much scope here to reduce this inconsistency.

What is certain, though, is the variety. A good indication is *indiaplasticdirectory.com*, a website that has created a directory of companies, firms, businesses and factories involved in the plastics life-cycle in India, in some way or the other.

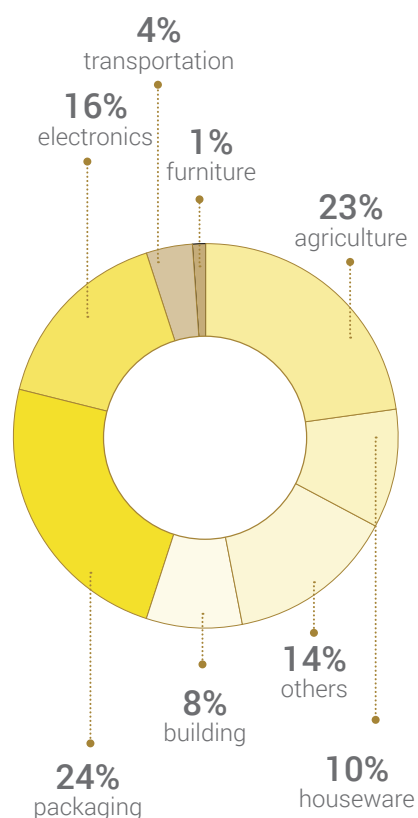
Entities making additives and chemicals: 414. Those making automobile plastic parts: 158. Bottles: 125. Bags, film and lay flat tubing: 977. Heaters and coolers: 110. Brushes and brooms: 109. Gift novelty items: 174. Nylon products: 92. Given the large presence of plastics processors, a large segment of the industry is devoted to the making of moulds and dies: 1,355.

Polyvinyl chloride (PVC) is easily India's predominant polymer. 714 entities manufacture PVC compounds. Merely compare the number that make PE or polyethylene (27), PP or polypropylene (31) and polyurethane (53).



SAURAV022/SHUTTERSTOCK.COM

PLASTICS CONSUMPTION BY APPLICATION



There are 259 plastics raw materials suppliers. And 267 plastics raw materials producers (e.g., raw material for engineering plastics products; colours, plastics granules, PP). Resins and allied products are the preferred niche of 145 entities.

Ten entities are invested in polycarbonate products. 133 make LLDPE, LDPE, HDPE products. 116 make injection-moulded containers. 55 entities produce disposable containers. Plastic pipes, hoses and pipe fittings: 631. Plastic buckets: 44. PET bottles: 78

At least two plastics-making ways are popular: 243 produce various injection-moulded articles. Blow-moulded articles, variously made: 65. Extrusion isn't in demand; only 17 entities use this process to make products.

The industry has obviously been shifting contours, as more and more uses of plastics have emerged. There is a healthy catering to sectors of the economy now comfortably travelling on the plastics bandwagon. 316 entities are dedicated to electronics and electrical products. Engineering plastics products: 102. Those making household articles: 221. Composites seem a marginal attraction: only 74 entities are making fibreglass products.

Industrial plastic products: 268. Medical and surgical equipment: 151. Packaging machinery: 219. If the list of entities the website provides, company by company, is to be believed, the most popular sector catered to is packaging materials: 660 entities are dedicated to making single-use plastics.

In India today, as per the website 1,242 entities are plastics importers and exporters. Those into plastics recycling and re-processing? A paltry 272 !

A VAST DIFFERENCE

There is a vast difference in the manner in which the plastics economy grew in the West, and the emergence and consolidation of such an economy in India (indeed, Asia). In the West, the proliferation in polymers and products occurred since the 1950s, in a time that, without irony, may be called 'innocent'. 'Innocent' because there was no, or little, awareness of the menace of post-use or after-use plastics waste.

Such a luxury is no longer affordable. Civil society has set up a clamour and even governments can't play ostrich: the litter is visibly there for anyone to see. According to *bir.org*, the world now uses about 20 times more plastics than it did 50 years ago. According to a 2017 research article in the journal *Science Advances*, of the 8.3 billion tonnes of plastics the world has produced, 6.3 billion tonnes ended up as waste.

Thus, there is at least one similarity between India and the rest of the world today: the realisation that post-use plastics simply cannot be ignored. This is the context in which the Indian plastics industry must make its way to the future: a growing number of people impatient to live in a post-plastics world. It is unprecedented, and a challenge that could become formidable.

There is another trait the plastics industry of the West, Asia and India share: a brief nod at recycling apart, a stubborn refusal to take responsibility for post-use plastics trash.



THE WASTE STREAM

Like other countries, India too is struggling to deal with plastics waste

As per a 2013 estimate of the Central Pollution Control Board (CPCB), Indians throw out 15,342 tonnes of plastic waste every day, of which about 60 percent is recycled, most of it in the informal sector. According to BPF, 47 percent of all waste produced is recycled. Either way, the recycling rate in India is considerably higher than the global average of 14 percent. Yet, there are over 6,100 tonnes of plastics being dumped in landfills or ending up polluting streams or groundwater resources every year. This is a problem: while some kinds of plastics do not decompose at all, others can take up to 450 years to completely break down.

CPCB surveyed 60 Indian cities and found that plastics account for eight percent of all solid waste, the figure going up to over 10 percent in nine cities. Delhi produces the maximum plastics waste in the country, followed by Kolkata and Ahmedabad. The biggest hurdle to plastic recycling and waste management is non-segregation of waste at source.

Answering a question raised on plastics waste in the Lok Sabha in 2017, Minister of State Mr. Mahesh Sharma used this study by CPCB to inform parliamentarians that these cities together produced 4059 tonnes/day. Surat produced a particularly high amount - 12.47 percent of its municipal solid waste is plastics, while only 3.1 percent of Chandigarh's solid waste is plastics.



PLASTIC WASTE PER DAY (IN TONNES)



Source: CPCB

It was also clarified that heavy metals, chloride and phthalates 'migrate from plastic waste into the surrounding medium'. The leachates can cause considerable pollution problems by contaminating the surrounding soil, ground or surface water.

In a written response to a question in Lok Sabha, former Union Minister of State for Environment, Forest and Climate Change the Late Mr Anil Dave said, "consumption pattern and consumer behaviour have changed and witnessed a manifold increase in PET bottles and plastic wrapping of products". "As per a report of a Task Force constituted by the erstwhile Planning Commission in 2014, 62 million tonnes of municipal solid waste were generated annually in urban areas", he said.

In the current scenario, waste is the default responsibility of the informal sector. Wastepickers. They collect unsegregated waste from households, schools, offices and shopping malls. They then segregate the waste and sell the recyclables to small waste-handlers. The non-recyclable or wet waste is taken to 'dhalaos'. Municipal trucks pick the waste up from the 'dhalaos' and dump it in landfills. At the landfill, the waste is further segregated by wastepickers who eke out a living by selling recyclables. In most cases, low grade polythene packets, packets of chips and the like do not get recycled.

INTERVENTION

India's tryst with solid waste management, including plastics, began in 2000. Many municipalities, Pune being one, responded with alacrity. So started a policy intent that, to be fair, can only be termed honest.

The Plastic Waste Management Rules, 2016 (henceforth, Rules) were notified by the Union Ministry of Environment Forest & Climate Change in March 2016. It is a Central legislation that aims to tackle the plastics waste menace. The Rules make source segregation of waste mandatory. The ambition is to follow a waste-to-wealth pathway via recovery, reuse and recycling.

In his answer to the Lok Sabha, Dave said that the Ministry had comprehensively revised the Plastic Waste (Management and Handling) Rules 2011, and notified the 2016 Rules.

'These rules prescribe two years' time to phase out manufacturing non-recyclable multi-layered plastic,' he said. 'The lack of awareness and absence of effective tools to collect back the discarded plastic products including the wrapping material has led to the indiscriminate littering and disposal of plastic waste,' Dave said.

The Rules are well-conceived. Section 4(b) explicitly states that only virgin plastic is to be used for products related to storing, carrying, dispensing or packaging food stuff which is ready to eat or drink. Section 9(3) requires the phasing out of non-recyclable multi-layered plastic by March 2018, while Section 17 requires manufacturers, producers and users of non-recyclable packaging to either pay municipalities for the cost of managing such waste, or arrange to take it back and manage its disposal themselves.

According to earlier rules related to municipality solid waste, waste generators are required to segregate waste into three streams: biodegradables, dry (plastics,



paper, metal, wood and similar materials) and domestic hazardous waste (diapers, napkins, mosquito repellents, cleaning agents, to name a few). All resident welfare and market associations and gated communities with an area of above 5,000 sq m will have to so segregate materials at source and hand over the recyclable waste either to authorised waste-pickers and recyclers or to the urban local body.

The Rules stipulate the minimum thickness for carry bags be raised from 40 microns to 50 microns and, in what would become a contentious clause, street vendors and retailers who provide plastic carry bags will have to pay a minimum monthly waste management fee of INR 4,000.

As per the Rules, brand owners who sell or market their products in packaging materials, which are non-biodegradable, should put in place a system to collect back the packaging waste generated.

The Rules also direct that non-recyclable waste of a calorific value of 1,500 K cal/kg or more should be utilised to generate energy either through refuse-derived fuel or as feedstock to prepare refuse-derived fuel. High calorific wastes are to be used for co-processing in cement or thermal power plants.

The Plastic Waste Management Rules, 2016 also aims to expand its jurisdiction to rural areas, because plastics has reached rural areas as well. Here, it confers the responsibility of managing plastics waste to Gram Panchayats. Another goal is to induce producer responsibility in the plastics waste management system and to encourage a collect back system of plastics waste by the producers/brand owners under the rubric of extended producer responsibility. Moreover, it recommends ways of gainfully using waste. A major area in this regard is to promote the use of plastics waste for road construction, as per Indian Road Congress guidelines. Plastic waste can also be utilised for energy recovery, for the waste-to-oil process.

These rules have been in effect for quite some time now. However, hardly any Indian city has actually taken advantage of the highly beneficial Section 17. Municipal corporations were given the power to ask all major snack-food brands to provide the city with equipment for shredding snack sachets into 2-4 mm tea-powder-like flakes and for transport of the shredded flakes to hot-mix plants. So far, no one has taken any concrete steps in this direction. And Section 4(b) has been completely ignored.

India is strong on laws related to plastics. But it remains a challenge to implement these laws



Source segregation remains the dirty prerogative of wastepickers, who work in the informal economy. Plastics packaging producers, and retailers' shops and malls have not bothered to put in place a system to take back packaging plastics waste from buyers. And resident and market associations prefer to remain blissfully unaware of the Rules: they do not segregate dry waste and hand it over to authorised waste collectors.

However, the levels of awareness are picking up and household level segregation has started happening due to it. In addition, the Rules have now been amended. The Plastic Waste Management (Amendment) Rules 2018 contain the following:

- Rule 15 (Explicit pricing of carrying bags) has been omitted in the amendment. Earlier every vendor who sold commodities in a carry bag was required to register with their respective urban local body and pay a minimum fee of INR 48,000 per annum (INR 4,000 per month). Other minor amendments include the addition of two more definitions: one on 'alternate use' and one on 'energy recovery'.
- Under Section 9(3), the term 'non-recyclable multilayered plastic if any' has been substituted by 'multi-layered plastic which is non-recyclable or non-energy recoverable or with no alternate use'. This stipulates plastics producers to prove that their products can be put to some other use, if not recycled. This kind of single-use plastics was supposed to be banned by March 2018.



SAYANTONI PALCHOU DHURI

Shouldn't
the onus of
managing
plastics be
a shared
societal
duty?

- Section 13(2) now requires all brand owners and producers to register or renew registration with the concerned State Pollution Control Board (SPCB) or Pollution Control Committee if operational only in one or two states or union territories. They have to do the same with the Central Pollution Control Board (CPCB), if the producers/brand owners are operating in more than two states or union territories. Earlier, only the producers had to register with CPCB or SPCB regardless of their extent of the area of operation. CPCB says that a centralised registration system will evolve from this.

For at least two years now, the government has tried to introduce, and convince all stakeholders, of the idea of extended producer responsibility. It is a policy decision. Progress on this front is steady and gaining momentum.

STATE OF BAN

Twenty-five Indian states/UTs now have some form of ban on polythene carry bags, but the implementation is often a challenge and the bags continue to be used.

In Karnataka and Punjab, a ban has been in place since 2016. The widespread availability of and demand for polythene bags persists.

In Arunachal Pradesh and Uttar Pradesh, there is limited awareness about permissible grades of polythene. In Uttarakhand, the use is gradually fading out, experts say, while in Rajasthan awareness campaigns seem to be paying off.

Jammu and Kashmir and Maharashtra became the latest states to ban the use of polythene carry bags respectively in January and March 2018.

These instances reflect that levels of awareness are on an ascending curve in different states, but at varying levels.

According to a 2017 article in the journal *Environmental Science & Technology*, of the world's ten rivers that carry 90 percent of the plastics the oceans receive, three are in India: the Indus, the Ganga and the Brahmaputra. However, this situation is a result of the material flow (legal and illegal) of plastics across national boundaries. Attributing this situation to domestic source is questionable as India's per capita consumption of plastics still remains less than half of that of global average.

THERE IS HOPE

All over the country, some city municipalities, civil society groups and individuals have risen to the occasion and have taken it upon themselves to reduce, in whatever way and to whatever extent, the burden of plastics on society. From Afroz Shah cleaning the Versova Beach mobilising citizen participation, to Aditya Mukarji replacing 50,000 plastic straws. Ukhrul in Manipur became a plastic free district, to Vengurla taluka banning plastic bags and using plastics to make roads. The start-up Banyan Nation has helped global brands to use more recycled plastics. 5 million Bharat Scouts and Guides (BSG) have pledged to give up their plastic woggles, a signature element of the BSG uniform, and replace it with more sustainable and eco-friendly options.

Let us now turn our attention to some beacons of hope.



A photograph of a red recycling cart on a street. A person's hand, wearing a red and white glove, is on the handle. The cart has a green recycling symbol and text in Marathi and English. The background shows a building and a utility pole.

GOOD NEWS FROM INDIA

मी पुनर्वापराचे काम करते



I'M YOUR RECYCLER



A LUMINOUS IDEA

Picture a slum. Typically, tiny dwellings stacked back-to-back, together like goods containers, connected by a network of the narrowest of alleys. No electricity, unless a brave soul decides to hook a wire into the mains of an electricity pole outside the slum. In the day, the houses remain dark, for there is no place for sunlight to filter in. At night darkness descends, making it difficult, well-nigh impossible, to wander out or find one's way home. In all, a distressing condition.

But now, in slums in India and many other poor parts of the world, an innovation that uses discarded PET bottles is literally lighting up the lives of people. All thanks to Liter of Light.

Liter of Light is a global open source movement present in over 27 countries with over 53 chapters. The organisation's mission is to reach out to areas where people either do not have access to electricity or simply cannot afford it. They light up such communities with do-it-yourself, sustainable solar-lighting made from discarded plastic bottles and locally sourced parts.

Enter 31-year-old Tripti Aggarwal. In 2013, she started the India chapter of Liter of Light in Bengaluru, where she works full-time and stays. 'Though I was socially inclined,' says Aggarwal, 'I had no plans of starting something of my own like this. Especially when I am doing a full time job. But something made me take this up and when I see the happiness in the eyes of people, it is all worth it.'

HOW?

How does a PET bottle light up a house? The procedure is unbelievably simple. First, cut a small hole in the roof of a house. Take a well-cleaned discarded and transparent plastic bottle. Fill it with clear water, adding two capfuls of bleach to protect the water so it doesn't turn green (with algae). Close the cap and seal it with a sealant. Fit the bottle into the hole such that it pokes out of the roof. Fix and seal the fitted-in bottle such that it remains fixed and the roof doesn't leak. For example,

Every Liter of Light project is crowd funded

polyester resin can be used as a sealant. Even when it rains, the roof never leaks—not one drop.

During the day, as sunlight reaches the water bottle, the light is refracted and spreads in the entire room. Eureka: the bulb bottle is here! The bottle bulb concept is the brainchild of Alfredo Moser, who first used it in Brazil in 2002. Using the technology as a social enterprise, the bulb bottle was first launched in the Philippines by Illac Diaz under the MyShelter Foundation in April 2011. 'It's a divine light,' believes Moser. 'God gave the sun to everyone, and light is for everyone. Whoever wants it saves money. You can't get an electric shock from it, and it doesn't cost a penny.'

Tripti Aggarwal agrees. 'The USP of these "bulbs" is that they are low cost, made from waste and locally sourced material and can be easily made and maintained by the community,' she says. The idea is best suited for small, congested slums with narrow alleys.

ONE STEP FURTHER

Indeed, the Bengaluru Liter of Light chapter has gone a step further. And more than 25 families living in a slum in Chikkaballapur district will soon be able to step out of their homes fearlessly after sundown, thanks to the work Aggarwal, co-founder Pankaj Dikshit and a band of 20 enthusiastic volunteers are putting in.





The chapter has adopted Kundwara slum in the district and plans to install streetlights made from waste mineral water bottles, solar panels and locally available inexpensive parts there. Here's why they took the step.

The organisation had been working in the space of providing light in slums for years. Their idea worked very well during the day. However, even as bulb bottles began to dot the roofs of dwellings in Kundwara, the volunteers realised that the method was effective only during the day. People continued to remain in darkness after sunset.

As Pankaj Dikshit puts it: 'We were doing our bit in slums. However, light matters the most during the nights. We wanted to light up the places at night. We started working on the project and initially thought of a solar panel that could be connected to this set up. But that would be a much bigger project and would cost a lot more. This is when we thought of using the same concept to create streetlights.'

The streetlight consists of solar cell panels and an LED covered with a PET bottle. There are PVC pipes used as poles on which these are fit. The cost per streetlight is INR 5,000 and the team plans to install at least 25 such streetlights in the area.

The organisation chose Kundwara slum as the volunteers felt the area was in grave need of streetlights to create a safe and fearless environment. The slum has around 25 families staying in 70 makeshift houses – without electricity. As Tripti Aggarwal says, 'The bigger concern is the scare of snakes and scorpions in the area. There have been at least four to five deaths in the area because of snake bites. Imagine what life is like for this community after sunset. You cannot work, children cannot play or study and going out to the bathroom can be fatal because of snakes. Women and children do not move out of the house after 5pm as there is no light.'

Every Liter of Light project is done using crowd-funding and volunteer help. The estimated cost of this project is INR 300,000 lakh and there are 20 volunteers working on the project. More than 30 Bengalureans have already contributed INR 70,000 to the project. The group has begun work and as more donations come in, more and more streetlights will be put up.





THE GURUGRAM INITIATIVE

ON OCTOBER 2, 2014 India's Prime Minister Narendra Modi launched a nationwide 'cleanliness' initiative called the Swachh Bharat Abhiyan (SBA), or Clean India Mission. His stentorian call to eliminate open defecation and clean up cities, towns and villages – and meet Sustainable Development Goal 6, about providing clean water and sanitation to all – reverberated through the country. And in 2017 Gurugram, one of the most modern and fastest-growing urban conurbations adjacent to Delhi, felt the vibrations.

Enter a waste management programme well-named Alag Karo-Har Din Teen Bin (Segregate-in Three Bins Every Day).

Former captain of the Indian cricket team Saurav Ganguly, appointed by Modi as an SBA ambassador, flagged off the project. At the inauguration, he said: 'As citizens, it is our responsibility to contribute to the maintenance and conservation of the environment. I strongly believe that each one of us can make a significant contribution in making India clean through our holistic approach'.

Also present at the inauguration was Narheri Banger, Additional Commissioner, Municipal Corporation Gurugram (MCG). He said: 'As developing nations surge forward on the path of development, they are also plagued by the problem of manifold increase in the quantum of waste generated. Gurugram generates 1,000 tonnes of Municipal Solid Waste per day. If source segregation is practiced and collection and processing infrastructure is improved, it is possible to reduce the amount of waste being dumped by 85-90 percent.'

Alag Karo is a unique multi-stakeholder initiative, involving government, the private sector and civil society. The objective is to establish and sustain segregation at source and develop capacities of the waste collectors (formal and informal) to

Alag Karo is a multi stakeholder initiative: municipal corporation, companies and civil society

ensure high recycling rates in Gurugram. The programme aims at reaching out to 9,000 households in Gurugram, 50 commercial establishments, 50 schools and 500 waste pickers in order to spread awareness about three-way source segregation – dry waste, wet waste and reject waste.

The project's policy umbrella is the Solid Waste Management Rules, 2016. The project's pivot is NGO Saahas. Saahas is implementing Alag Karo, working in close coordination with MCG under the latter's 'Open Waste Free' initiative. Funding is provided by the German Federal Ministry of Economic Cooperation and Development through the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Coca-Cola India and Tetra Pak India.

SINCE INCEPTION

Currently, Alag Karo is working with more than 11,000 households, shops and offices. The project is implementing waste segregation for more than 10 tonnes of waste generated per day. A core approach is to reach out to residents (in gated communities as well as plotted properties) via in situ training programmes related to segregation. The Saahas website says it has reached 25,000 citizens, diverted 15,000 tonnes of waste from landfills, avoided 19,000 tonnes of greenhouse gas emissions and created 200 livelihoods.

All waste management begins in office, in a mall or at home. The waste is source-segregated into biodegradable waste, non-biodegradable waste and domestic hazardous waste (sanitary waste and inerts). Once the waste is collected, biodegradable waste is sent to in situ composting site, if available. Non-biodegradable waste is collected by waste pickers, who further segregate the waste into different streams and sell it to the waste aggregators for recycling. Non-recyclables are sent to landfills. Sanitary waste and inerts are collected by waste pickers separately and sent to a disposal site.





There are two systems of collection: one for high-rise condominiums, and for plotted properties. For the former, segregated waste is collected from households in collection trolleys having 3 bins, or 2 bins and a bag. Segregated waste is then stored in the garbage rooms. Waste pickers come and collect the waste and take it to a secondary sorting site, where dry waste is sent for recycling. Domestic hazardous waste is sent to a dumping site.

For plotted properties, waste is collected directly by wastepickers from households. The wastepicker takes the segregated waste to a secondary sorting site, where dry waste is sent for recycling and domestic hazardous waste is sent to the dumping site.

In both cases, biodegradable waste is sent to the composting site.

The success of the project depends, ultimately, on people's attitudes to waste

ROADBLOCK

The biggest roadblock is wet waste disposal.

While most gated communities, even individual plotted properties, are ready to segregate at source, residents are most concerned about wet waste. Since land is at a premium, people don't want to allocate space for on-site wet waste processing (composting). Some gated communities have in situ composting. But they are too few. And there are not many community composting sites where plotted properties exist.

In such a scenario, the wastepicker collects wet waste separately and sends it to the dumping site. In this way, biodegradable waste that is easily compostable actually lands up in a landfill. This has been an issue with the project.

Nevertheless, what matters more is that the initiative, once taken, should not falter. It is a fledgling project, and old projects take time to transform. What the project is attempting is salutary: turning waste to wealth.



A PATH FOR PLASTICS USE

PLASTICS HAVE OVERTAKEN our lives. However hard we try not to use it, it manages to sneak in. This is because of the very nature of this substance. It is light, durable, easy to produce, unbreakable, odourless and chemical resistant. Plastic does not decompose. This is the strength of its widespread use as well as the root of the waste disposal problem we face today. Plastic is clogging drains, causing floods, choking animals and in fields it blocks vegetation and prevents rainwater absorption. Plastics can be recycled only three or four times. When it is melted, it releases highly toxic fumes.

Enter Professor Rajagopalan Vasudevan.

Rajagopalan Vasudevan, by all accounts, is a humble man. But walk with him to his office in Thiagarajar College of Engineering, Madurai, and you will notice students and colleagues respectfully deferring to him. The reason is not difficult to fathom: the 72-year old college Dean and Head of the Chemistry Department is known, in India and the world over, as 'The Plastic Man'.

Hailing from rural Tamil Nadu, Vasudevan grew up in a modest household. After finishing school in Kumbakonam, a town in Thanjavur district, he pursued his bachelor's degree at Madras University in Chennai and went on to do his higher studies there. He studied chemistry against the wish of his family of lawyers. Thank god for that. For Vasudevan's innovation provides a huge fillip to plastics waste reuse.

By the turn of the century, a lot of noise was being made to reduce the use of plastic and control the waste it was generating. It was during this time when, one evening, Professor Vasudevan saw a doctor on a TV programme saying that plastics 'dissolved' in waterbodies and caused pollution.

'This set me thinking,' says the professor. 'Since plastic is a product of petroleum this theory of the doctor had to be false. There was a lot of serious talk about banning plastics all over the country and finding solutions to the waste plastics strewn all over. I decided to take up the challenge to experiment with waste plastics and see if I could find a solution.'

And that's exactly what he did. Laboratory results of mixing waste plastic with heated bitumen and coating the mixture over stone proved positive. In 2002, he

Plastic improves the quality of flexible pavements and has reduced wear and tear to a large extent

implemented the use of plastic waste on a road constructed inside the premises of his college. 'To date, this stretch of road is still going strong,' he says. In 2006, the Thiagarajar College of Engineering received the patent for this technology.

The plastic waste items that can be used for road construction are plastic carrybags, plastic cups, plastic packaging for potato chips, biscuits, chocolates and so on. Essentially, single-use plastics.

SIMPLE PROCESS

The plastic waste material is first shredded to a particular size using a shredding machine. The aggregate mix is heated at 165°C and transferred to the mixing chamber, and the bitumen is heated to 160°C to result in good binding. It is important to monitor the temperature during heating.

The shredded plastic waste is then added to the aggregate. It gets coated uniformly over the aggregate within 30 to 60 seconds, giving an oily look. The plastic waste coated aggregate is mixed with hot bitumen and the resulting mix is used for road construction. The road laying temperature is between 110°C to 120°C. The roller used has a capacity of 8 tonnes.

'The advantages of using waste plastics for road construction are many. The process is easy and does not need any new machinery. For every kilo of stone, 50 gm of bitumen is used and one-tenth of this is plastic waste; this reduces the amount of bitumen being used. Plastic increases the aggregate impact value and improves the quality of flexible pavements. Wear and tear of the roads has decreased to a large extent,' explains the professor.

Such road construction is also extremely eco-friendly, with no toxic gases released. It is a boost too, for ragpickers.

Plastic waste helps increase the strength of the road, reducing road fatigue. These roads have better resistance towards rain water and cold weather. Since a large amount of plastic waste is required for a small stretch of road, the amount of waste plastic strewn around will definitely reduce.

PLASTONE: ANOTHER INNOVATION

Prof R Vasudevan's inclination to keep experimenting led to another innovation. He decided to try and make a stone block with plastic coating. In 2012, 'plastone' was born.

A plastone block is made from a mixture of waste plastic and stone. It has been found to withstand more pressure and it resists water percolation. In the professor's Department of Chemistry plastone blocks have been made using granite and ceramic waste, along with plastic waste.

Each plastone block consumes 300 plastic carry bags and six PET bottles. Plastone can be used for flooring, especially outdoors. It can be a cheap and strong substitute for cement blocks, which have a tendency to wither away in constant rain. It can be an effective liner for waterbodies, especially canals, preventing water seepage. It can also be used to raise compound walls. A mere coat of emulsion is all that is required to make it colourful and attractive.



COURTESY: RAJAGOPALAN VASUDEVAN



RECOGNITION

Prof. Vasudevan was rewarded with projects by AICTE, New Delhi. The Central Pollution Control Board, also signed an MoU with him on Preparation of Status Report on Reuse of Plastics Waste in Road Construction and another MoU on Performance Studies on Built Plastic Tar Roads. The Department of Science and Technology, Government of India, also awarded three project worth INR 12 million for finding the solution of waste plastics, e-waste and other waste materials.

Indeed, this idea has been adopted by many towns and cities across the country. These include Kovilpatti, Kothamangalam, Madurai, Salem, Wellington, Chennai, Puducherry, Hindpur (Andhra Pradesh), Kolkata, Shimla, Thiruvananthapuram, Vadakara, Calicut, Jamshedpur and Kochi.

In Tamil Nadu alone, more than 1,200 km of plastic roads have been built covering more than 29 districts under the District Rural Development Agency. Today, more than 12 states are successfully implementing his idea. The idea received ultimate recognition when, in November, 2015, a government order made it mandatory for all road developers in the country to use waste plastic, along with bituminous mixes, for road construction.

He was awarded with Tech Icon of India, awarded by India Today Group, and handed over by Prime Minister Narendra Modi on October 2, 2015. He featured in 'Nominee in Amazing Indians', conducted by Times Now Group. He was given the Tapman Award by the Tamil Nadu Plastics Manufacturers Association. The king of Mewar, Udaipur appreciated his service to society and the environment with the Maharana Udai Singh Award –2017. The Kalam innovation centre awarded him the Dr Abdul Kalam Innovation Governance Award on January 20, 2018. And, a few days later, he was conferred India's highest civilian award, the Padma Shri.

Moreover the college, and the professor in particular, have been receiving many queries from various countries in Europe and the Americas regarding this technology.

But, says the professor, 'Swacch Bharat is our first priority. We will first help India dispose of its waste material by spreading the message about the use of plastic waste in road construction and usage of plastone. Once we have made headway in almost every part of our country, we will share this technology with other countries.'

Making headway is now eminently possible. But the thing to notice, in all this, is how humble a man the professor is. Who else would give away a patented technology for government to use, for free?

Each
plastone
block
consumes
300 plastic
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six PET
bottles



TARGET: SINGLE USE PLASTICS

THE NORTH-EASTERN INDIAN state of Sikkim is on a mission to create a Green Revolution of its own kind. One that has nothing to do with rice and wheat, but everything to do with single-use plastics. In this respect, as *unenvironment.org* approvingly notes, 'Despite being small and isolated, and with its people leading their lives in extremely tough mountainous terrain, Sikkim has emerged as one of India's environmental leaders'.

There is reason for such praise. In 2016, the home department of the state government came out with two notifications. One banned the use of plastic (PET) bottles in all government departments and programmes. The other banned the use of foam (Styrofoam) food containers all over the state.

As a May 25, 2016 press release of the PTI informs, the government said there had been rampant use of packaged drinking water during departmental meetings and functions, creating a huge pile of garbage that added to the burden of landfills. 'Therefore, in order to reduce creation of garbage in the form of used drinking water plastic bottles it is notified that the packaged drinking water bottles may not be used during any government meetings or functions', said the order signed by then Chief Secretary Alok K Shrivastava.

The state government also found a lot of disposable foam containers were being rampantly used, not only in the bazaar areas but also in rural pockets. So,



In 1996, Yuksam became the first village in Sikkim to ban the use of plastics

a notification banned the use and sale of disposable items such as cups, plates, spoons, containers and similar items made from polystyrene foam. According to PTI, ruling Sikkim Democratic Front leader and MP Prem Das Rai said the decision was taken in a cabinet meeting chaired by Chief Minister Pawan Chamling.

IT BEGAN IN 1998

Sikkim's tryst with plastics began in 1998, when Sikkim became the first Indian state to ban disposable plastic bags. In this context, the role of village Yuksom was noteworthy. Nestled beside the magnificent Khangchendzonga National Park, by 1997 the villagers were so fed up of the visible deterioration of the protected area—that contains 14 types of natural forests and hiking trails and became a focal point of tourism and trekking boom that followed the relaxation of permit regulations for foreigners and Indian nationals in 1994—that they decided enough was enough.

Local community members came together to form the Khangchendzonga Conservation Committee (KCC). The organisation comprises of community members and stakeholders in tourism enterprises working to conserve natural and cultural resources, coordinated by the Sikkim Forest Department. Among the key issues KCC identified for immediate action was garbage management within the national park, especially single-use plastics.

Annually, KCC's monitoring programs helps in collecting around 800 kg of waste from the trekking trails and the forests. KCC now operates a functional Waste Segregation Centre and has worked with the Forest Department to create a system by which trekking operators have to declare non bio-degradable waste products being carried through, make a checklist and upon return account for these products. Defaulters are fined a hefty sum of INR 5,000 if they fail to account for waste not brought back.

Waste material like noodle packets, tetra packs and other plastics are recycled to make fashionable handbags, pillows, notebooks and so on that tourists can buy when they visit the KCC office. Yuksam was the first village in Sikkim to ban the use of plastics (especially, bags and bottles) in 1996. Two years later, the state government announced a state-wide ban on plastic bags.

The state-wide ban on plastic bags started on June 4, 1998. States the legislation: 'You shall not deliver any goods or materials purchased or otherwise to any person, firm, shop, company or any other agency or organisation in plastic wrappers or plastic bags'. Initially, in big towns, continuous checks took place and strict fines of up to INR 20,000 were imposed on offenders. This created a level of fear, making the ban effective.

Current research by Mumbai-based NGO eCoexist, as reported in a March 25, 2018 article in the Pune edition of The Hindustan Times, indicates that within India, the ban on plastic bags has worked in places like Sikkim. The NGO's study found that 66 percent of shops around Sikkim used paper bags or newspapers and around 34 percent used plastic bags (which included non-woven bags). Although the use of plastics was still quite common, the research stated, significantly more people





were using paper than in most Indian states. eCoexist had one concern, though. In both Gangtok and Soreng, researchers found, polypropylene non-woven bags were popular. This was concerning, the article reported, because they were falsely advertised as eco-friendly when they, too, were made from plastics and could damage the environment. People needed to be made aware of these facts, so they could make better, informed decisions regarding their choice of their bags. The NGO wants the Sikkim government to recognise this fact and include non-woven bags in the ban.

ALL SAID AND DONE

The Sikkim government's actions are context-logical. It has a huge tourism industry, but through its actions, it has tried to plug and control the excesses tourists on a happy holiday are bound to perform. It comprises communities that have cultural mores often ignored and swamped by, among other things, plastics waste; the state's actions are a response to community dismay. It is a mountainous state and, therefore, does not have land to covert to landfills as easily as, say, a Gangetic Basin state might have.

All said and done, it cannot be contested that Sikkim's actions vis-à-vis single-use plastics remain the most enlightened in this country. Lots of states have banned plastic bags, but not many have looked at implementation strictly enough. The Sikkim government has evolved with the times. The 2016 notifications, for instance, are not only a response to an external intrusion (the tourist; the hotel; the have-a-ball milieu). They are also a response of a culture that is confronting throwaway habits. No state in India can afford, any longer, rampant single-use plastics use. Sikkim was the first to understand that.

Sikkim's actions vis-à-vis single-use plastics remain the most enlightened in India



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हरित पुणे !

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WIN-WIN ALL THE WAY

HERE IS A FEBRILE friendship that has the whole country agog: the working together of the Municipal Corporation of Pune (MCP) and a city-based ragpickers union called the Kagaz Kach Patra Kashtakari Panchayat (KKPKP).

In 2000, for the first time, India passed solid waste management rules. At the municipal level, the new law and rules required segregation of waste, door-to-door waste collection, and waste processing instead of dumping. The PMC duly swung into action. There was also a push towards reducing containers on the street and making the city 'container-free'.

Perceiving a gap between rules, rhetoric and practice, members of the KKPKP formed SWaCH, a wholly-owned workers' cooperative. SWaCH means Solid Waste Collection and Handling, in Marathi the SWaCH Seva Sahakari Sanstha Maryadit. It launched a pilot programme in collaboration with the PMC. From 2005 through 2008, waste pickers were integrated in door-to-door waste collection (DTDC) work. The SWaCH DTDC model was based on recovery of user fees from service users and provision of infrastructure and management support from the municipality. In 2008, the PMC signed a five-year Memorandum of Understanding with SWaCH to decentralise DTDC services and allowed SWaCH to carry out this work.

The work began. A point soon came when SWaCH was providing DTDC services to 3,78,419 households across 15 PMC wards.

SWACH HAS THE ANSWERS

How many waste workers are involved in the project?

Currently over 3,000 members of SWaCH cover different areas in Pune.

How many households do you work with?

Over 600,000 properties are covered by SWaCH DTDC services.

How much waste is collected?

Between 950 to 1,000 tonnes a day.

The system's core outcome is making the informal economy formal

How much is recycled?

Of the 250 tonnes of dry waste, SWaCH waste pickers recycle over 90 percent.

What happens to the wet waste?

Societies either have it composted on site or the PMC composts it.

What are the kinds of waste that are recycled?

Plastic, paper, metal, e-waste etc. Wastepickers fine-segregate waste once it is collected.

How is this system different from those used in other cities?

It's a decentralised system which employs waste pickers and formalises the informal economy. It provides sustainable livelihoods. It empowers women by providing them steady incomes. It is non-mechanised, giving it better access to difficult-to-reach areas such as slums. It saves tax payers and the municipality large amounts of money in labour and logistical costs.

How much do the wastepickers earn?

An average of around INR 6,000-7,000 a month. But the earnings vary with season, time of year, price of scrap, and demand and supply of recyclables.

What is the end goal of the project?

To become a successful, self-sustainable social enterprise of waste pickers aiming to improve their lives.

THE PUNE MODEL

A report by German scholars Judith Wolf and Fabian Schroth on 'Tracing back the choice: Implementation of primary collection of municipal solid waste in two Indian cities' compared two Indian cities – Varanasi and Pune – in terms of their waste management regime. The report states the Pune model is more sustainable than the Varanasi model of solid waste management. The two scholars examined the implementation of primary collection models as per the Management of Solid Waste Rules 2000, a policy of the Central government on municipal solid waste management (MSWM) that triggered the activities of the municipal corporations of the two cities.

In the study, they analysed the case of Varanasi, where a private company was employed for an integrated MSWM and Pune, where a social enterprise was employed for the door-to-door collection (DTDC). They consider the Pune model as more sustainable because it integrates the waste pickers and socially marginalised people. Their findings show that in Pune, local conditions were extremely supportive.

Speaking about the two models of public-private-partnership (PPP) in MSWM, the report said that the first (Varanasi) was the employment of a private company, whereas the second (Pune) was the employment of a social enterprise. The primary objective of a private company is to generate profit. A social enterprise follows a double or triple-bottom line approach. Whereas, the primary stakeholders of a private company are usually their stockholders or proprietors, the stakeholders of a social enterprise usually involve the marginalised sectors of society, who may or may not own the enterprise.





The report further stated that looking at the statewide development of MSWM in India, Varanasi could be understood as a mainstream case. In most of the cities, privatisation of MSWM has already been done or will be done. In Pune, the model used for the DTDC was very special. Not many similar models can be found in India.

OTHERS FADE IN COMPARISON

'Mumbai,' writes journalist Sadaf Modak in a February 3, 2016 article in The Indian Express, 'may have a few things to learn from its "smart" neighbour Pune. The city which trumped Mumbai in the bid to become a Smart City, has a model based on institutionalising the informal sector of waste pickers into the waste management system which Mumbai could replicate'.

Laxmi Narayan, general secretary of KKKPKP, explains why the Pune model was so designed: 'By integrating the informal sector into waste management, segregation is done as close to the source of the waste as possible. It contributes to reducing the cost of solid waste management significantly. The waste which eventually reaches the landfill is also reduced, therefore increasing the life of the landfill.'

In Mumbai, the emphasis has been on centralised waste to energy plants which, Narayan argues, has contributed dismally to energy production. Currently, only Kanjurmarg has a waste to energy plant outsourced to a contractor. In Mulund and Deonar, only solid waste management is done. Narayan adds that in Pune also, the SWaCH model is not the only one in place, for a central waste to energy plant is also functioning. 'After much battles, the wastepickers have been given identity cards and medical insurance by the municipal corporation,' Narayan points out.

In 2016, the PMC renewed its contract with SWaCH. The city heaved a collective sigh of relief. Since then, there has been no looking askance. Everyday the wastepickers fan out, earning a decent livelihood and keeping the city clean.

The Pune
model
works
because it is
sustainable



16

एक ही जमाने का हमारे
आप ही कामकाज कर ही सकेगा

एक ही जमाने का हमारे
आप ही कामकाज कर ही सकेगा

LIC

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Catering

RAGPICKERS & THE RAILWAYS

300: THAT'S THE number of trains that start from, terminate in or transit the four railway stations of Delhi, especially NDLS, the New Delhi railway station everyday. There, at 10 in the morning, Roshan Kumar is negotiating one of the busiest hours of his daily work on platform No.16. The New Delhi-Dibrugarh Rajdhani Express has just chugged in and Roshan's job is to ensure that sufficient number of wastepickers enter the train to pick the leftover food, papers, bottles, plastic packets, plates, glasses and all else considered waste.

Roshan is a Safai Sainik. One of 70 that work in shifts at NDLS. They are part of a project to ensure the station reaches zero-waste status. The Chintan Environmental Research and Action Group, an environmental organisation that works on urban waste management and rights of wastepickers, runs the programme in collaboration with the Indian Railways and the Safai Sena — a 22,000-strong collective of wastepickers in Delhi.

On the eve of the Commonwealth Games in 2010, the Northern Railways provided training to Roshan and a dozen others on waste segregation and recycling plastic bottles. When some months later, it floated tenders to let out the work of clearing waste from dustbins at all the four major railway stations of Delhi, and also to pick waste from Rajdhani and Shatabdi trains that reach the city every day, Safai Sena was chosen to do the job. 'We got the contract in November 2011,' says Jai Prakash Chaudhary, secretary of Safai Sena, a unit mobilised by Chintan in 2009.

WHAT THE BOYS DO

The project segregates garbage into organic and inorganic waste. The boys recycle what can be recycled and ensure that used mineral water bottles are crushed rather than allowed to go back into circulation. Wearing gloves and surgical masks, Safai Sainiks segregate trash, which includes cardboard, bottles, papers and even glass, into separate piles. Wet waste is piled on one side, dry garbage on another.

Three times a day and night, a team of eight boys go through the steel dustbins installed at every platform. Afternoons are when they collect the maximum garbage, late nights are lean periods. When a train rolls to a stop at a platform, another team

80 percent
of the
waste the
Safai Sena
collects
becomes
compost or
is recycled

of 10 boys wait patiently, trash bags in hand, and with a cart ready to take away the garbage left behind by passengers. This usually includes water bottles, newspapers, plastic bags, wet waste, just about anything people dump in trains.

The project clears at least three-four tonnes of garbage from the station every day, including at least 5,000 empty mineral water bottles. The collected waste is then taken to a materials recovery shed on the station premises. 'The waste gets segregated at the shed,' says Roshan.

The material recovery project has a compost unit on the premises where the wet waste is processed. Hard plastic is segregated from soft plastic. The PET bottles are separated and machine-crushed to make granules. Paper waste is set aside in sacks. Juice and chips packets, plastics, match box, etc. are taken out of the wet waste. 'The leftover is taken to the Okhla landfill,' informs Roshan. Silver foil, tea glasses, newspapers, cardboard, each type of garbage is segregated into separate trash bags and, along with the PET bottle shreds, sent onwards to recycling factories in Muzaffarnagar and Ghaziabad. 'Once they (the PET bottles) become granules, they are put in sacks and taken to Bhogpura in Ghaziabad. They are washed there and sold to company suppliers; Vijay Rai, the unit supervisor, says they work every day of the month. 'Trains come everyday, so do we.'

'Most people work here only, says Chaudhury. 'Since no Rajdhani or Shatabdi train goes to the Old Delhi railway station, we clean only the bins there and





segregate the waste. Same with the Hazrat Nizamuddin station. A few bottles come here from Anand Vihar station for recycling, though! The workers, aged 20-50 years, are mostly from UP, Bihar and West Bengal. For a monthly salary of INR 8,500 they lug in every day about three tonnes of waste from the bins across the New Delhi station alone. 'They bring in two tonnes of waste just from the 15 Rajdhani and Shatabdi trains that reach the New Delhi station daily,' Chaudhury says.

NO HARASSMENT

Roshan recalls facing harassment at the platforms initially. Now, Chintan provides the pickers with equipment, ID cards, a uniform and is also looking at health insurance. Of the waste that is collected by the Safai Sena members, roughly 80 percent finds its way to either the compost or recycling plants. The 20 percent that cannot be recycled is deposited in the trash mound that is collected from the tracks.

THE PET BOTTLE CHALLENGE

PET bottles pose one of the biggest challenges for the project, not in terms of recycling or collection, but because of the stiff opposition the project team of 115 has faced from the other waste pickers at the station, because bottles make for good money. "Sometimes, even Indian railways officers used to harass us, because they were involved in selling the bottles," Roshan remembers. Things are better now, but for the unauthorised ragpickers. 'We have been requesting the police to stop them from entering trains so that we can ensure that nothing goes wrong,' says Roshan. Itinerant rag-pickers pick whatever can be sold from the waste produced by other trains.

The waste from the tracks is picked by railway janitors and dumped within the stations. At the New Delhi railway station, they drop them at a dump yard next to the Safai Sena shed. 'We pick from it what can be recycled, rest they take to the landfills,' informs Roshan. On platform No 16, he points at a dustbin dressed in a garbage bag. 'We have our expenses, each bag costs INR 3. There are about 250-300 bins in this station itself.'

The project is one of the two from the city that was awarded the Deutsche Bank Urban Age Award 2014.





GERA

REVERSE LOGISTICS

KABADIWALLA CONNECT (KC) integrates the informal solid waste management sector into a supply chain that helps municipalities, brand owners and waste management companies in the recovery of post-consumer waste. Call it reverse logistics.

Essentially, KC connects waste generators with the informal sector, to kabadiwallas—or, the level one aggregators. Then, KC helps large waste processors work directly with aggregators in the informal waste sector via different types of technology.

For example, right now a large waste management company can only buy from a large trader, someone who collects 800 to 1000 tonnes each day. Through KC's technology, one can work with people who sell 500 to 600 kg even. KC has multiple tools and essentially integrates technology on both sides of the supply chain by connecting waste generators to the informal sector and then helping the informal sector sell directly to large waste processors for the best price. Efficiency, all around.

The technology allows the kabadiwallas to become drop off sites for any kind of waste. Since KC connects waste generators to their local kabadiwallas they can even pick up small quantities of recyclables. So the local kabadiwalla picks up the waste and gets more business and he along with six or seven other kabadiwallas get together and sell to KC directly. So, for example, one of the biggest issues for a waste processor right now is that he needs to get 10 tonnes of waste at one point so he can only work with one guy. However the app can have ten kabadiwallas who can report when they are ready to sell and it can be done collaboratively so that the volume requirements are met.

KC started as a research project. Three years ago, it won a grant from the World Economic Forum, which was used to study the informal sector. The team realised the informal waste management sector was a very interesting supply chain. You have wastepickers who sell to level one aggregators or kabadiwallas who, in turn, sell to level two aggregators. So, they actually form a pretty interesting supply chain. KC started mapping all of these different actors, trying to understand how volumes work and how materials flow. Through that the team identified the role of the kabadiwallas.

It is very difficult for an e-company to go to a house and collect 200 gm of trash

Right now KC is more of a technology provider. Most of the applications are around plastics but technically the technology can be used to procure any kind of material that has a recyclable potential.

So our innovation is really in the reverse logistics of bringing the costs down and in the aggregation and transport of materials. It's a suite of apps focussing on the kabadiwalla, the generator and logistics such as the driver. There's also an IVR platform to help with education and information. So it's a suite of tools that helps in the recovery and recycling of post-consumer materials.

Most of the developing world has an informal waste ecosystem and from a supply chain perspective this is a lot cheaper and more efficient since it is decentralised. One of the issues in formal collection is that there's one point outside the city and they have to go to pick up the recyclables. So the centralised model doesn't really work whereas this kind of private ecosystem or local decentralised system actually is very efficient. India does very well in recovering PET because there's a very strong demand.

For municipalities it is essentially about the cost: it's a huge sink hole in their budget. There are essentially three kinds of waste generators. Large generators such as big institutions and factories, where all the waste is already optimised because there's enough volume on site, so most processors go to them. The problem is that a bulk of recyclable waste generated in the city is from small and medium waste generators like small businesses, apartment buildings and individual households. And so to do a point of pick up is very hard, it's a huge operating budget. Thus, generally the model the municipality follows is a pay per tonne model: every tonne they take to the landfill, they get paid for. The issue with plastics is that it's a high volume low weight waste, and that's why there is a lot of illegal dumping.





There is also an issue of cost and efficiency in the centralised model which doesn't really work. It's in that gap that you see the informal sector thriving. There is already an informal relationship between the municipal corporation and the kabadiwallas because they realise that without these people they will have to handle volumes of waste they can't. In the research KC did in Chennai, it was found that almost 33 percent of post-consumer waste is already recycled by the kabadiwalla. If they were not there, there would be 33 percent more waste in the landfill.

Over the last couple of years KC has been focussing only on the business-to-business aspect. They procure now from about 90 kabadiwallas monthly. They also have a free app that allows households to connect with their local kabadiwallas. They have about 12,000 households that have used our services but haven't been focussing on that element at all, since they monetise on their business-to-business. It is only now through conversations that they are going into the consumer to business aspect: the generator to the kabadiwalla.

KC have a programme called KC Recover which is about operational efficiency. They also have KC Transform, which is about creating more value for the informal sector. They are working on a material centre that they can sell to a kabadiwalla where he can use a machine to point at a piece of plastic and it'll determine the kind of plastic it is. One of the issues with plastics is that it is very hard to understand what material it is by just looking at it, so a lot of plastics gets misclassified.

They are deploying smart bins which will ping the local kabadiwalla when it is full so he can go and pick up that recyclable material. They are also working on a plastic recovery facility that's optimised to procure from the informal sector. An intersection of hardware and software, especially around material recognition, is very important next steps for KC.

The main issue for them is that the recycling industry is very opaque and so finding a price point is very hard. KC entered the plastic recovery facility completely blind. But it's only with that knowledge that they got to a point where they are getting companies interested in them. Going forward, the important thing for KC is to form key relationships with big companies and municipalities and brands focussed on a circular economy.

The recycling industry is very opaque and finding a price point is very hard



GHOST NETS

GHOST NETS ARE FISHING nets fisherfolk leave, or lose, in the sea. And Robert Panipilla, Chief Convenor of NGO Friends of Marine Life (FML), knows all about them.

Let us call him a citizen scientist. He started off FML in 2000 out of personal concern for marine ecosystems in South India, and with a meagre team began researching on seabed ecosystems through oral traditions. In time, FML got registered as an NGO. In time, Panipilla realised he had to learn scuba diving if he had to understand what was going on beneath the surface of a mostly calm sea. 'When I began my quest for knowing as to what's happening underneath the ocean, I swam with my naked eyes. But it was very difficult and time-consuming to do any substantial research. So I got support from a scuba diver. Then, I learned scuba diving and trained six other fishermen like me,' Panipilla explains.

Now, academic as well as marine researchers, scuba divers—professional as well as those among fisherfolk communities who wanted to learn, and have learnt, the vocation—volunteers and villagers along the coasts of the Arabian Sea and the Bay of Bengal are part of a network dedicated to doing what they can to understand and reclaim seabeds around South India.

So far, FML's seabed studies have covered the Gulf of Mannar, Kanayakumari district in Tamil Nadu and Thiruvananthapuram and Quilon districts in Kerala. Around 2,000 sq km of sea area, near-inshore as well as up to a depth of 43 m. FML has now 50 members and most of them are from coastal communities.





DR. MP REMESAN

A ghost net can wreak havoc on the ocean floor

ALL NYLON NOWADAYS

Four types of ghost nets infest the bottom of the seas off the coastlines of South India, FML has found. The first are from large fishing vessels that stray into territorial waters and deploy large nets. At times, these nets get caught in underwater reefs, forcing the vessel to abandon them before leaving territorial waters. The second type are smaller nets cast by fisherfolk, that are cut off by a passing vessel. These, too, drift down to the ocean floor and get attached there. The third type are those that get caught in violent currents and swivel down to the ocean floor, where they get stuck. The fourth type are nets abandoned at sea after three or four uses.

A ghost net can wreak havoc on the ocean floor. Fish can be lacerated; marine animals, trapped, can suffocate and die of starvation. Such nets pose a major threat to the natural habitat and breeding ground of underwater fish. Many underwater reefs identified with flourishing fish stock have either been destroyed or are threatened by the stifling cover such nets cast. It is estimated that at least 10 percent of the reduced fish catch globally is due to ghost nets.

A ghost net can wreak havoc on the ocean floor for around 600 years. Once made of cotton, today all types are made of plastics. Nylon.

DIVE IN, BRING OUT

'Every two-three days, synthetic (kangoos) nets used by country fishermen have to be replaced,' informs Panipilla. 'On an average 2,500 kg of these nets are abandoned



DR. ANULEKSHMI CHELLAPPAN



At Valiathura and Kovalam, FML collected as much as 75 kg of waste in an hour of underwater swimming

in Thiruvananthapuram every month and most of this goes to the sea.' According to the Deccan Chronicle, FML claims to have also documented the presence of ghost nets at Shanmugham, Vettucaud and Anchuthengu.

After Cyclone Ockhi (November 29-December 6, 2017) caused damage and destruction in the south Kerala coast, Panipilla and his teams got on with their work with gusto.

Much debris had flown into the coastal seabed. FML members and volunteers removed marine debris and cleaned the ocean floor near Valiyathura and Kovalam beaches near Thiruvananthapuram. At Valiathura and Kovalam, they collected as much as 75 kg of waste in an hour of underwater swimming. Mostly, plastic debris. At Vizhinjam, FML divers and volunteers along with Scuba Kochi collected two large nets weighing as much as 400 kg. Explains Panipalli, 'The cyclone caused over a hundred boats to capsize, [adding up] ghost nets sprawling thousands of kilometres into the ocean'.

A resident of Valiyathura, Panipalli has been studying and training others to study the changes in the marine environment due to climate change since the past 12 years. 'We started observing the impact of climate change since the 2004 Asian Tsunami,' he says.

'The nature and character of the sea is not the same as it was 12 years ago. It has become unreliable and unpredictable. The water is not as transparent and clear as it was a decade ago. The surface of the sea water now looks disturbed, as if stirred up with all sorts of dust and other particles, and also plastic debris of various kinds'.



சென்னை மாநகராட்சி
சுரங்கப்பள்ளி கழிவுகூட்டு
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THE SEVENTH RESOURCE

ONE FINE DAY, IN 2007. Three trucks from Hindustan Unilever (HUL), laden with shampoos, powders and creams arrive at the gates of ACC's Kymore cement plant, near Jabalpur, Madhya Pradesh. The plant head is foxed: why has he been sent cosmetics? Perhaps an employee welfare initiative? Awestruck by the sudden bounty he called up headquarters, only to be told that the stuff—all past their expiry date—was to be burned in the kilns of the cement plant to generate energy.

It was then a small trial. And the technical staff had no inkling about the immense potential of waste to replace coal in cement kilns. In the next four years, HUL hauled 13,700 tonnes of its waste products to ACC's Kymore plant for 'co-processing', a term commonplace in the cement sector across the globe and now in India, too.

MORE TRIALS

The ACC-HUL initiative had the enthusiastic backing of S P Gautam, then chairperson of the Central Pollution Control Board (CPCB). Wheels must have turned, for the Kymore plant became the site of yet another trial, a very specific one: using plastics waste in co-processing.

In March 2008, a trial run was conducted with 1.5 percent plastics waste as supplementary fuel to coal. Plastics co-processed during the trial burn were: ABS (acrylonitrile-butadiene-styrene), PBT (poly butylene terephthalate), PET, PP (Polypropylene), HDPE (high density polyethylene), and PS (polystyrene). The trial was successful. There were no abnormal emissions of dioxins or furans. There was no impact on the quality of cement.

The successful trial run at ACC Kymore revealed that the problem of plastics waste disposal now had a potential solution. Co-processing plastics wastes in cement kilns could go a long way in solving the disposal problem of plastics waste in the country. It was now possible to consider plastics waste as an Alternative Fuel and Raw material (AFR). Because, as the trial proved, during the usage of plastics waste in a cement kiln as an AFR, the material and energy value present in the waste was fully utilised in

Processing various plastics waste in cement kilns could go a long way in solving the problem

the cement kiln, as a perfect replacement to the fossil raw materials and fossil fuels conventionally utilised in the kiln.

The trial was rigorous. It included chemical and thermal parameters of raw materials, clinker product, plastic wastes and coal and emission monitoring during and after feeding of plastics waste in the cement kiln as AFR.

As a November 2012 paper written by a team that included R K Shrivastava of the Madhya Pradesh Pollution Control Board (MPPCB) puts it, co-processing of plastics and polythene waste has the following environmental benefits:

- High flame temperature of 2,000°C, material temperatures up to 1,450°C and residence time of four to five seconds in oxygen rich atmosphere ensures complete destruction of waste and harmful pollutants;
- Complete scrubbing of exhaust gas due to countercurrent flow of raw material, resulting in trapping of heavy metals, sulphur and other pollutants (such as dioxins and furans) within clinker;
- The waste generated does not require subsequent processing. Cement kiln operates under negative pressure or draft, thus preventing the generation of fugitive emissions;
- With the large mass of clinker processed inside the cement kiln, there is a presence of a huge thermal inertia, thereby eliminating the possibility of rapid swings in temperature;
- Inclusion of ashes and residual metals from the wastes within the clinker crystal structure;
- Kiln lines equipped with ESP/ bag filters ensures negligible particulate emission;
- Destruction and removal efficiency of greater than 99.9 percent.

Based on their evaluation, MPPCB forwarded its findings to CPCB along with recommendations. CPCB, after reviewing the trial report, approved the results of the trial and declared co-processing of plastics waste in cement kilns as a successful method for environmentally sound plastics waste management.

Gujarat Pollution Control Board (GPCB) was another early promoter of using plastics waste in cement industry. The problem started with unscientific and unsafe disposal of plastic lamination of paper in paper recycling industry. GPCB did the research and came up with strong regulation asking cement manufacturers in Gujarat to use waste plastics in the kiln. There was a smart approach of providing incentive on one hand, while being strict in monitoring the performance of the cement industry.



PHOTOGRAPH COURTESY: GPCB



GPCB even sent officials to get trained abroad from successful co-processing initiatives so that they became master trainers for cement industry in Gujarat. Starting the initiative in 2011-12, by now, cement industry in Gujarat has used 0.4 million tonnes of waste plastics, says Hardik Shah, formerly Member Secretary of GPCB.

In May 2017 CPCB came out with guidelines on co-processing plastics waste. The annexure to the guideline lists 54 cement companies practicing co-processing. Based on this suggestion, several state pollution control boards have provided consent to various cement plants and plastics waste generators to implement co-processing of plastics waste. Various cement plants are currently managing plastics waste as AFRs in their kilns.

WHY AFR IS GOOD

Vikram Cement Works (VCW)—a unit of UltraTech, a flagship unit of the cement business of the Aditya Birla Group Company located at Khor, a village in Neemuch, Madhya Pradesh—has been using alternative fuel in its cement kiln since 2007 and has conducted several trials to find out the impact of gases on environment and product quality. After successful trial runs, VCW started using plastics and polythene in the cement kiln from September 2008, under MPPCB guidance. The plant uses waste polythene bags, pouches (including laminated gutka pouches), waste polythene and plastics waste as a co-fuel in the cement kiln. The waste is collected by the network of the company and is gathered from the cities like Indore, Ujjain, Nagda and Pithampur. Success.

Madukkarai is a town in near Coimbatore in Tamil Nadu, with a population of about 40,000. ACC Limited has a clinker and cement manufacturing facility near this town. In 2012, the Panchayat of Madukkarai town considered it relevant to improve waste management in their town and move towards a zero landfill ideal. ACC, with experience in managing waste, proposed to collaborate with them. The town municipality segregates waste and non-recyclable plastics, among other materials, are sent across to the cement plant. Today, Madukkarai has achieved the status of being a zero landfill town. Success.

The need for AFR, or alternate fuel and raw material, arises due to the paucity of natural resources. How much coal can be unearthed? How much fossil fuel? Co-processing is a real answer, because it means somebody's waste becomes somebody else's raw material.

Today,
Madukkarai
has
achieved
the status of
being a zero
landfill town



WORKS OF WASTE ART

IN SEPTEMBER 2017 CSIR, or the Council of Scientific and Industrial Research, India, organised a Swachhta Abhiyaan-related exhibition. When Union Minister of Science and Technology Harsh Vardhan visited the exhibition, he came upon a bathroom. It was a demonstrative bathroom, with mosaic tiles that looked like works of art. They were works of art, except that they were mosaic tiles made entirely out of plastics waste. The minister was appreciative. 'Plastic waste is such a big problem for our country, we have made so many rules and regulations for it, you see that in animals, especially in cows, there is so much plastic found in their stomach, that causes them a lot of distress,' he said. 'With the same plastic we are making tiles used to make toilets.'

At the exhibition, the minister also informed that the Department of Science and Technology (DST) was considering promoting the use of the tiles in Prime Minister Narendra Modi-led government's toilet construction campaign. Harsh Vardhan said it would serve the twin purposes of plastics waste management and better sanitation in the nation.

At a time when not only India, but the entire world is searching for ways to handle post-use plastics, especially single-use plastics, here is an innovation that is a perfect example of turning waste into wealth.

The project is a CSIR brainwave. More specifically, it is the brainchild of a team of scientists led by Dr S K Dhawan, of the New Delhi-based National Physical Laboratory (NPL), a CSIR affiliate. Dr Dhawan and his three-member team—Mr. Brijesh Sharma, Ms. Ridham Dhawan and Dr. D.K. Aswal—have come up with a unique technology that can turn plastic waste into not only bathroom tiles, but also floor and pavement tiles and tiles that can be used on roofs of dwellings. NPL has also developed a suitable chemical composition that is incorporated in the waste plastic matrix before moulding into a tile.

Here is an innovation that is a perfect example of turning waste into wealth

WHY DO IT?

The CSIR-NPL initiative is very clear about its aims. Developing a technology to use plastics waste is an imperative. Developing products for societal use is an equally important goal.

Above all, the CSIR-NPL scientists developed such a technology because:

- Disposal of plastics waste is a major problem;
- Plastics are non-biodegradable and thrown-away plastics mainly consist of low density polyethylene plastic bags, bottles and the like; essentially, single-use plastics;
- Burning these waste plastic bags causes environmental pollution;
- According to the disposal policy of the Government of India, plastics waste has to go to a landfill site. In the landfill, such plastics material can take a 1,000 years to completely degrade. Also, plastics in different states of degradation release toxic material that leaches into the ground and pollutes groundwater;
- Plastics material should not be burnt. A multitude of toxic gases are released when plastics material is burnt. These include carbon monoxide, phosgene, nitrogen oxide and dioxin, to name a few;
- In addition, burning 1 kg of plastics material releases 3 kg of carbon dioxide, a gas that contributes to global warming.

A TESTED TECHNOLOGY

A number of tests were carried out before the CSIR-NPL were convinced their products could be of societal use. In various laboratories, tests were carried out to check a) tensile strength; b) flammability; c) thermal stability; d) glass transition temperature; e) permeability; f) environmental stability; and g) resistance against strong acids and strong bases. Most of these tests were carried out at the National Test House, Ghaziabad.





THE TILES ARE VERSATILE

In order to convert plastics waste into tiles, plastics waste—plastic bags, bottles, milk packets, the kinds of things that could otherwise find their way to a landfill — is collected and segregated and then shredded into small pieces. This shredded material is then treated chemically. It is mixed with fillers and then moulded into tiles of the desired dimensions. These tiles can also be used for making different structures and applications like separation panels, interlocking tiles and in showcase frames.

The NPL researchers have tied up with local ragpickers' associations to acquire plastics waste. Shayna Ecounified India Pvt Ltd, a New Delhi-based company which has rights to the technology now, is taking the help of NGOs to supply them with plastics waste. Another company that has been given the rights is Addin Infra Pvt. Ltd., Rajkot. The rights have been given on a non-exclusive basis.

One of the challenges is segregating the plastics waste from other kinds of waste. For the tile-making process, the plastics waste is further segregated into low density plastics, mostly used to make bags; high density plastics, used in bottles; and polypropylene, used in packaging material. These are then shredded into millions of pieces. Mixers are added to generate pellets that are then heated and cast into moulds. The tiles can also be used for pavements, jogger paths or for constructing structures.

About 600 plastic bags are used in the manufacture of one tile. Currently NPL has an order for 5 lakh tiles from CSIR itself. The plastic tiles cost INR 50-60 per sq ft.

Thus, the technology offers a simple and novel process of production of tiles from waste plastics bags and bottles. Recycling of waste plastics bags and bottles into decorative coloured tiles creates a durable material from waste. Thus, this technology not only provides a sustainable living for the people who are collecting them from garbage dumps but also converts waste into a useful product and saves the environment.

In addition, this technology provides a solution for the solid waste management problem that is be-devilling the country today and promotes a waste-to-usable technology programme, a much-needed impetus to India's recycling industry.

The technology offers a simple and novel process of production of tiles from waste

The discovery of plastics, barely a hundred and fifty years ago, opened new vistas for creating novel goods and even substituting precious natural resources with cheaper synthetic products. To an extent, plastics even helped in conservation of nature's bounties like timber and metal.

However, the cult of use-and-throw found a willing partner in plastics. The plastics in our life are now proving a bane for our environment. Single-use plastics are turning the ingenious human-made asset into a liability for the planet. While in the west, discarded plastic goods are exported to be dumped elsewhere, closer home, our land and water are covered with used plastic bottles, trays, bags and containers. A health conscious citizen may ensure food, water and beverage free of microbe and chemical contamination, but she will fail to eliminate microplastics.

It is not far away when fishing lines thrown in the water will recover more plastics than fish.

The society needs innovators and exemplary initiatives to tackle this menace. The challenge is before us. Options are open.





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Concept and Design

DamageControl

J R Bhatt and Ashish Chaturvedi have been responsible for ideating this book and its overall review and editing

Printed at

Perfect Impact Design & Printing, New Delhi
Printed on FSC certified paper

ISBN: 978-81-933131-4-5



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