NATIONAL SCIENCE AND TECHNOLOGY FORUM

PROCEEDINGS OF SEMINAR ON PLASTICS – SUBSTITUTES VS RECYCLING

Date: 15 November 2019
Time: 10:30–13:00
Venue: Emperor's Palace Convention Centre, Lucretia Room, 64 Jones Road, Kempton Park, Gauteng

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WELCOME AND INTRODUCTION

Prof. Ali Dhansay (NSTF Chairman) opened the Discussion Forum and welcomed everyone. With respect to the outlook for the worldwide challenges related to plastics, he commented that somewhere between the complexities and the nuances, we need to find hope.

Ms Jansie Niehaus (NSTF Executive Director), welcomed everyone and introduced the topic for the Discussion Forum. She explained that the present event was an introduction to a topic that might be explored in more depth at a Discussion Forum in the second half of 2020.

PRESENTATIONS

Sustainable biobased biodegradable plastics: An alternative to non-biodegradable plastic products (Dr Sudhakar Muniyasamy, Advanced Polymer and Composite Research Group, Chemical Cluster, Council for Scientific and Industrial Research)

Plastics are contaminating the environment and causing huge pollution. There is thus a need to replace non-biodegradable plastic with sustainable biobased plastic. Biobased plastic will not fully replace petroleum-based plastic. The focus of the CSIR Advanced Polymer and Composite Research Group is to find substitutes for single-use plastics.

World plastic production has risen exponentially since the 1950s, from 1.5 million tons in 1950 to 335 million tons in 2016. Plastics have become part of everyday life. Due to the many desirable qualities of plastic – such as being lightweight, transparent, low cost and easy to process – it has replaced other materials that were used in the past. Most non-durable plastics (39.4%) are used in packaging; the building and construction sector account for 20.3%, the automotive sector for 8.2%, the electrical and electronics sector for 5.5% and agriculture for 4.2%. Other areas of short-term use include consumer and household appliances, furniture, sports equipment, health and safety.

The world faces a global plastics pollution crisis. Plastic takes more than 100 years to degrade and is harmful to many living organisms. Globally, more than eight million tons per year of single-use plastics are dumped in landfill sites or oceans. Plastics are cheap to produce, but very expensive to clean up in the environment. Future generations will suffer from the pollution caused by plastic. It is anticipated that by 2050, there will be more plastic than fish in the world's oceans.

Plastics in the ocean are a huge pollution problem. In Asian countries including China, Thailand and Indonesia, more than five million tons of plastic per annum are available to enter the ocean. Countries such as the USA, India, Brazil and South Africa account for between 0.25 and 1 million tons per annum of the plastic available to enter the ocean. The source of the plastic cannot be identified once it enters the ocean, and it becomes a global problem affecting the global population.

Ninety per cent of the waste generated in South Africa, including plastics, is still disposed of to landfill. This results in valuable finite resources in the form of fibre, polymer and metals to the value of more than R176 billion being lost to the South African economy. Land filling of all waste is generally the worst strategy from an environmental point of view.

Apart from disposal to landfills, there are several different management options available for plastic waste, including:

- Mechanical recycling of segregated plastics and mixed plastics.
- Energy recovering including pyrolysis or incineration, but burning plastics is accompanied by the release of hazardous substances to the atmosphere.
- Biological recycling via sewage, anaerobic digestion, aerobic composting and soil. In these processes, plastic would be used as a carbon source. Significant reductions of gaseous emissions can be accomplished through biogasification and composting of the biodegradable materials. Biodegradable plastics can be decomposed by the action of living organisms, usually microbes, and broken down into water, carbon dioxide and biomass.

However, it is not economically viable to recycle single-use thin-film plastic. There is therefore a global drive to reduce the use of single-use plastics. African countries such as Kenya, Côte d'Ivoire, Tanzania and others including India, Italy and France have outlawed the use of petroleum-based single-use and

short-term-use plastic items. The development of biodegradable plastics contributes towards a circular economy aimed at eliminating waste and promoting the continual use of resources. Certified verifiable biodegradable or compostable plastics offer responsible end-of-life options for plastic waste in harmony with the circular economy model. The end-of-life options for bioplastics included both mechanical recycling and organic recycling. Biodegradable plastics have a different chemical structure from petroleum-based plastics and have to be kept separate during recycling.

The term 'biobased' refers to the carbon content of a product coming from renewable organic sources (such as plants and agricultural sources) rather than fossil sources (such as oil and coal). Products made from plant biomass thus have a value proposition that does not exist for products made from oil or coal. The drivers of bioplastics include:

- **Social effects**, including contributing to rural development for biomass sourcing, increasing sustainability and greening of chemical industry, improving workforce health and safety, and decreasing human toxicity.
- **Environmental effects**, including the absence of hazards in raw materials sourcing, decreased consumption of non-renewable resources, reduction in greenhouse emission during biobased polymer production, and biodegradation and recycling opportunities for biobased products.
- **Economic effects**, including the utilisation of wastes and by-product streams, contributing to rural development, the competiveness of raw materials compared to fossil fuels, job creation, savings in production and investment costs, possible green premium within the value chain from chemicals to biobased plastics, market entry with environmentally friendly products, new innovations and products with superior functionality, and saving waste charges.

In 2018, the global production capacity for bioplastics totalled 2.11 million tons, with production taking place mostly in Asia, followed by Europe, North America, South America and Australia. Africa has no production capacity for bioplastics, which means that there is considerable opportunity for developing a bioplastic industry on the continent.

In 2017, the world plastics production was approximately 335 million tons, with an annual growth rate of 3%. It is predicted that bioplastics will account for 4% of market share in 2019, and reach 40% by 2030. Packaging remains the largest field of application for bioplastics with almost 60% (1.2 million tons) of the total bioplastics market in 2018.

Biobased products are not automatically biodegradable. There have been many misleading claims in this regard. The plastic needs to be processed in a way that makes it biodegradable, and must be certified and verifiable as such.

Oxo-degradable additives were added to plastics with the intention of causing the plastic to break down in open environments. These additives consist of transition elements (cobalt, manganese, iron, zinc) that promote oxidation and chain cleavage of conventional plastics when these are exposed to heat, air and UV light. This chain degradation results in very small and hardly visible polymer particles (microplastic), which are not biodegrade and move through the food chain. Oxo-degradable additives hasten the degradation of conventional plastics, but are not a solution to plastic pollution. More than 200 countries have now banned the use of oxo-degradable additives.

Certification bodies, standards and logos have been established for biodegradable polymer products. South Africa, and indeed Africa as a whole, does not yet have any certification bodies. Challenges with respect for biobased or biodegradable polymers include low mechanical and thermal properties, not being suitable for conventional processing, low scale-up production, being between three and five times more expensive than conventional plastics, and the risk of contamination in plastics recycling when biopolymer is mixed with non-biodegradable plastics.

Plastic carrier bags have been identified as the most common plastic waste items in the marine environment (approximately 41% of the total). A case study in Italy demonstrates the success of bioplastics. Legislation introduced in Italy in 2011 to effectively impose both durable reusable bags and single-use biodegradable compostable carrier bags, and to ban light-weight traditional plastic bags has been successful. Biodegradable compostable carrier bags are certified by accredited certification bodies. In compliance with European Standard EN 13432, such carrier bags contain no heavy metals, are biodegradable in soil and marine environments within six months, and have no negative impact on the composting process. These regulations received 94% support in Italy. A large proportion of Italian

households have separate collection of organic and various streams of inorganic waste. The quality rate organic waste collected amounts to 95.73%, or five million tons, which represents a capture rate of 90 kg per person per year. The biodegradable compostable carrier bags have created new agro-industrial value chains in synergy with local agricultural production, new opportunities for an industry aimed at the transformation of traditional plastic, a boost for local growth areas, new investments in R&D and the creation of job opportunities. Italy has become a model for new regulations in the environmental field.

The R&D being performed on bioplastics by the CSIR Advanced Polymer and Composite Research Group is aligned with the South African Bio-Economy Strategy. The CSIR led biorefinery technologies in developing new value chains from lignocellulosic biomass. Agro-residues derived from agroindustries that contribute significantly to the South African GDP and are currently under stress include paper and pulp waste streams, sugarcane, maize, chicory, pineapple and other high-value agro-crop waste streams. The potential long-term impact will be the transformation of South African industry towards biobased products as a basis for the South African bioeconomy.

The CSIR has developed bioplastics for packaging, including biodegradable plastic bags and fruit crates. The advantages of CSIR bioplastic technology include good mechanical properties that are similar to conventional plastics; processing by conventional techniques (melt extrusion, blown film extrusion and injection moulding); being fully biodegradable in soil, compost and water as well as fully recyclable by mechanical means; making use of a non-toxic renewable resource base; and being suitable for packaging applications (films, bags and crates) and agricultural applications (mulch films and nursery pots). Other potential products include biodegradable cutlery and sanitary pads.

The CSIR has a Biodegradation Testing Facility for testing the environmental claims and certifications of bioproducts. CSIR bioplastic bags are fully biodegraded within 140 days in seawater conditions, and 90 days in soil conditions.

The following conclusions are reached and recommendations are made:

- The trends in plastic production and consumption, and mounting environmental concerns caused by plastic waste, are in favour of an increasing acceptance and diffusion of biodegradable plastics.
- The improved utilisation of agricultural undervalued by-products in biomaterial formulations by green technology research, with a focus on renewable, recyclable and reusable materials, offers opportunities to create new biomaterials for use in packaging and other sectors.
- Renewable resources can be used as cost-effective feedstocks for the production of biodegradable plastics.
- Biodegradable plastics will replace conventional commodity plastics in those segments where recycling or feedstock recovery is difficult and heavily penalised from an economic standpoint.
- Biobased polymers from non-food agricultural lignocellulosic biomass have a potential role to play in the development of the bioeconomy due to their ability to address environmental concerns regarding plastic waste and economic challenges.

Discussion

Question: What are the legislative requirement with respect to the use of biodegradable plastics?
Response: In order to understand why governments are banning certain products, it is first necessary to understand which products are causing plastic pollution. Recent legislation passed in India, for example, banned thin-film plastics of a certain thickness range. Alternative products (e.g. paper-based products) were suggested to replace those that had been banned. The legislation is related to certain standards with respect to the time required for the degradation of plastic products.

Question: Which regulations of the EU or the US FDA govern the use of additives as performance enhancers in biobased plastics? For traditional petroleum-based products, the regulations are based on the CAS (Chemical Abstracts Service) Registry Numbers of their components.
Response: The FDA regulations for direct food contact products are different from those related to degradation properties. Different certification would be required for these two different purposes.

Question: The degradation products of biodegradable plastics are carbon dioxide and water. Is there a potential risk that the proposed solution of biodegradable plastics to replace petroleum-based single-

use plastics will cause further problems through increased emissions of carbon dioxide into the environment?
Response: The contribution of biodegradable plastics to carbon dioxide emissions is very small compared with the negative impact on the environment caused by petroleum-based plastics. The degradation of food waste also creates carbon dioxide. Austria and Italy have anaerobic digesters to collect biogas

Question: What are the key optimal requirements for the biodegradation process?
Response: The degradation process involves microorganisms and enzymes. The primary degradation and mineralisation processes vary between different environments.

Dr Nonhlanhla Kalebaila (WRC): What are the benchmarks for best practice with respect to the time period for biodegradation in different media (e.g. soil, sea water, fresh water)? Are EU standards applicable in a developing country where waste management processes are less than ideal?
Response: The CSIR is engaging with the South African Bureaus of Standards (SABS) with respect to developing standards suitable for the climatic and landfill conditions in this country. EU standards are suitable for conditions in Europe, which lacks sufficient land for landfills and is therefore developing industrial composting facilities with relevant standards. South Africa and other African countries have only limited industrial composting, so the focus should rather be on materials suitable for home and water composting.

Mr Kendy Madisha (BSTEP): Are there any efforts to link the development of biodegradable plastics to additive manufacturing where it could serve as a feedstock.
Response: The CSIR is working on possibilities for the development of high-end processing applications.

Mr Kendy Madisha (BSTEP): Why not ban plastics altogether, including biodegradable plastics? Even biodegradable plastics that take only three months or less to disintegrate will still have a negative impact, especially on the marine environment, and given burgeoning population growth? It may be more important to focus on behavioural and lifestyle changes with respect to the use of plastics.
Response: Bioplastics that degrade fully within six months are better than petroleum-based plastics that do not degrade in more than 100 years. A challenge for R&D is to develop better alternatives. The best models are controlled end-of-life systems for plastics, such as home composters, that stop the plastic from reaching landfills or the ocean.

Ms Mariana Purnell (Agricultural Business Chamber): With respect to the bioplastic production process, how much water is required and what are the waste products? The inputs required for biodegradable plastics are currently used as cattle feed. Using these products for producing bioplastics could lead to a shortage of cattle feed.
Response: There could be environmental benefits from recycling water used in upstream processing. The CSIR's area of expertise is downstream processing. The quantity of water required for the production of bioplastics is likely to be similar to water use by the existing plastics industry, as similar processes are involved.

Question: South Africa experiences challenges with respect to health waste. Could biowaste be used to address the issue of health waste?
Response: Any organic waste, including biowaste, could potentially be utilised for the production of biobased materials. Biowaste is a classified material, however, and the implications of the diseases associated with biowaste would have to be carefully considered.

Plastics Recycling in South Africa: Substitutes versus recycling – will it solve our litter problems? (Annabé Pretorius, Plastics SA)

The worldwide challenges experienced with respect to plastics are not simple. The question has been raised whether biodegradable plastics might not simply replace one problem with another. This is a valid concern, because the unintended consequences of anything that we do may be much bigger than expected. Social media have focused attention on plastic pollution and brought the problem close to us.

There have been suggestions to ban plastics altogether, especially plastic packaging, but consumers prefer fresh produce, especially meat products, to be hygienically wrapped in plastic. An argument could be made that bananas, for example, do not need to be packaged for retail sale because they are protected by their skins. However, 94% of the carbon footprint of bananas is due to processes before the produce reaches the shelves of consumer outlets. Final distribution accounts for only the last 6%. If bananas were not packaged for sale to consumers, there would be a risk of contamination and potential loss of most of the crop before it reaches the consumer. Packaging is not used primarily for aesthetic reasons but to serve the purpose of making fresh produce last longer on the shelf, and to be more hygienic and safer for consumers. We need packaging, but perhaps not as much as is currently used.

Plastic is an integral part of our lives in many areas, as the following examples show:

- **Promoting food production**: Plastic improves yield and reduces losses. In banana production, plastics are used to create a micro atmosphere around the tree to prevent chill damage to the fruit, reduce the flower-to-harvest interval, filter particular wavelengths by using blue plastic, and increase bunch weight.
- **Reducing food waste**: Plastic packaging of fresh produce makes it last longer, prevents and slows dehydration, and increases shelf life by ten days or more.
- **Enhancing food safety**: Plastic contributes to hygienic distribution, preventing UV burn marks, preventing discolouration by providing an oxygen barrier, improving shelf life, serving as a protective layer, offering a moisture barrier, making sealability possible, and reducing costs.
- **Improving fuel consumption**: The use of plastic components in motor vehicles to replace metal parts reduces vehicle mass by at least 10% and increases fuel efficiency by 6–8%. The Boeing 787 aircraft contains 50% plastic composites by weight and 80% by volume, with a 20% fuel saving.
- **Saving lives**: In modern motor cars, safety features are made of plastic, including the seat belt, airbag, and front and rear crumple zones. Bulletproof vests are made of plastic. Plastic has countless uses in the medical field.
- **Helping with disabilities**: 3D-printed hearing aids, as well as prosthetic limbs for both people and animals, are made from plastics.
- **Saving carbon**: Replacing the plastic bags used in the EU in one year with paper bags would require an additional 2.2 million trees.
- **Keeping us warm**: Plastics are used in thermal underwear, polar fleece and windbreakers.
- **Allowing us to have fun**: Plastic is used in manufacturing sports equipment.
- **Enhancing communication**: Plastic is used in cell phones and computers.
- Serving many purposes in the construction industry.

In South Africa, coal is predominantly used to create plastic. Plastic is a secondary product in fuel production. As long as we continue to use fossil fuels, we will continue to have a petrochemical industry. Sasol's main aim is to produce petrol, and ethylene is a by-product. If the ethylene was not used for plastics, it would have to be burnt into the atmosphere.

Of all the petrochemicals used worldwide, 4% goes into manufacturing plastics (this statistic is sometimes given as 6%, which includes textiles), compared with 70% for diesel and heating fuel, and 13% for motor fuel. Banning plastics would thus solve only 4% of the universal petrochemical problem, but would add to the percentage spent on motor fuel (because cars would be heavier and less fuel efficient without plastic) and heating (as plastics would not be available for use in high-technology thermal clothing).

Domestic consumption of plastics in South Africa amounted to 1.5 million tons in 2018, which represented only 0.44% of the international market for plastics and included 332,250 tons of recycled polymer. This represented an increase of 4.9% over the previous year, compared with a growth of 6% in the population over the same period. The consumption of plastics in South Africa is thus growing more slowly than the population growth. Recycling has increased by almost 60% over the last five years, and the consumption of virgin plastics has grown by 26%.

The main sources of the plastic pollution in the world's oceans has been investigated, and it was found that four major rivers in India, China and Indonesia carry most of the plastics to the sea. The Ganges River, for example, is a major waste management facility for India. Refuse removal trucks empty their load directly into the river.

Most of the polymers used in plastic production in South Africa are locally made. The research on biodegradable plastics being done by the CSIR could contribute to local biobased products. There is room in the country for another polymerisation plant. The major producers of polymers in South Africa are:

- Sasol, which produces PE-LD, PE-LLD, PVC and PP
- Safripol, which produces PP and PE-HD
- Hosaf, which produces PET
- Smaller producers, which produce PUR, UPM, PF, UF and MF (mostly for adhesives, binders and glues).

In the South African context, it is important not to lose site of the fact that there are no refuse removal services in the informal settlements where a large percentage of the population lives, and this is a significant source of plastic pollution, including the visible litter that gets washed down rivers and ends up on beaches during the rainy season.

The plastic industry has a number of initiatives to combat plastic pollution, including:

- The aim of the South African Plastics Pact driven by WWF and the South African Plastics Recycling Organisation (Sapro) is to identify unnecessary plastics, set targets for 100% of packaging to be reusable, recyclable and compostable by 2025, and set targets for recycled content.
- Producer responsibility organisations (PROs), namely, the South African Vinyls Association, Polyco, Petco and Polystyrene Association of South Africa, encourage their producers to promote recycling.

There are several river catchment projects in South Africa that undertake waste management, education and awareness, litter prevention solutions and clean-up campaigns. Plastics SA has identified four particularly problematic catchments in the country where river catchment projects operate, namely the Black River in the Western Cape, the Zwartkops River in the Eastern Cape, the Umgeni River in KwaZulu-Natal and the Sabie River in Mpumalanga.

While recycling will help, it will not fully address the problem of plastic pollution. Consumers are confused about which types of plastics can be recycled. Statistics for South Africa show that 352,000 tons of plastic were recycled into new materials in 2018. Only 2.2% of collected tonnages were exported to be recycled elsewhere. Of all recyclable plastics waste, 46.3% was collected for recycling. More than one million tons are not yet recycled.

The breakdown of the plastic materials recycled in 2018 was:

- PE-LD/LLD (flexible plastic wrap packaging), 119,933 tons (34% of all plastic recycled in the country). This material is not recycled in Europe or many other developed countries because it does not lend itself to being sorted in automatic sorting plants. The high percentage of PE-LD/LLD recycled in South Africa is due to manual sorting by waste pickers.
- PET (plastic beverage bottles), 74,328 tons (21%)
- PE-HD (for example, milk bottles), 63,038 tons (18%). Eighty per cent of all plastic milk bottles in South Africa are recycled.
- PP (for example, chocolate wrappers, woven film), 61,901 tons (18%). The recycling of PP has grown significantly in the last year as new recyclers have entered the industry.

Seventy per cent of all recycling is post-consumer (e.g. from households), 15% post-industrial, 13% ex-factory and 2% toll and in-house. The 352,000 tons of plastics recycled annually in South Africa are equivalent to 19 million two-litre milk bottles every day, or the fuel equivalent of 200,000 cars travelling 30,000 km per year. The plastic tonnage from South Africa that is recycled locally and abroad has increased by 12.2% in the last year.

An international comparison between Europe and South Africa shows the following:

Europe	**South Africa**
Recycling is an environmental principle.	Recycling is a financial principle. Recycling is only undertaken if it makes money.
Accurate waste collection data are available, but the latest data available	Accurate recycling data are available (i.e. how much recycled material leaves the recycling plant). Data on collection are not available. The waste that reaches

for the quantities that were actually recycled are from 2016.	recycling plants comes from various sources, including waste pickers.
Separation of waste takes place at source.	Separation of waste is done by waste pickers.
Recycling is considered the right thing to do.	Recycling is incentivised by money.
The majority is recycled outside Europe, usually after being transported to India or China.	Only 2.2% is exported to be recycled elsewhere.
There are landfill restrictions.	Only 64% of South Africans have access to waste management.

The recycling value chain in South Africa starts with domestic waste, which is sorted on the pavement by waste pickers who collect recyclables, or the waste is removed by a municipal refuse removal truck and taken to a landfill where is it sorted by waste pickers. Small collectors buy recyclables from waste pickers. There are an estimated 53,000 waste pickers and primary collectors in South Africa. Waste picking or collecting is only viable for them if they are involved with all materials. An interesting statistic is that a waste picker must bend down 375 times to collect 1 kg of bottle caps, for which he can earn only R2.

Large collectors compact the recyclables, which are taken to recyclers or re-processors. The process for recycling plastic bags is that the bales are opened when they reach the recycler, and the material is conveyed into granulators using manual intervention. It passes through a continuous wash line, settling tanks and a drying process, which entails electricity costs. Residue and sludge go to the landfill, and the water is recycled through a water treatment plant. The plastic is formed into pellets. In 2018, the markets for recyclates were flexible packaging (19%), clothing and footwear (14%), agriculture (13%), building and construction (11%), rigid packaging (9%), furniture (8%), houseware (6%), exports (6%), mining and engineering (4%), electrical and electronics (3%) and other uses (4%). The high-end use of plastics needs to be further developed in South Africa.

Demand is the driver for recycling in South Africa. Brand owners demonstrate their commitment towards recycled content, but it has to be consistent and reliable. Traditional markets are saturated, and new end markets have to be created.

Only 64% of South Africans have access to waste management. In other words, 36% of the population of 55 million South Africans do not have access to waste management (i.e. a bin in which refuse can be disposed, and a collection service to take the refuse to a landfill). Twelve per cent of people living in metropolitan areas do not have access to waste management, and in Gauteng the proportion of people without access to waste management is 19%. Waste that is not disposed of through a waste management service is disposed of by littering or illegal dumping, and often ends up in rivers, on beaches or in oceans. There would have to be an incentive such as fines to stop people from littering. In Singapore, people can be jailed for littering.

Many people believe that biodegradable plastics will be a green solution to all the problems of plastic pollution, and that litter will simply disappear or dissolve. However, it is important to ensure that the solution does not simply replace one problem with another one. Woolworths makes a Green Bottle, 30% of which is plant based, made from Brazilian sugar cane which is a renewable raw-material source. It would be possible to make the bottle 100% plant based, but if there were not an outlet for the ethylene that is a by-product of the Sasol petrochemical industry, the ethylene would have to be flared off into the atmosphere. Valpré's PET plantbottle is 30% biobased, with the ethanol component coming from plant material, but the bottle is not biodegradable.

The challenges related to biodegradable packaging include false claims about whether the material will degrade in landfills, oceans and river, whether it will impact on the circular economy, whether it will impact on recycling waste streams, and whether it is the solution to the litter problem. Consumers need information on how to dispose of plastics that are compostable.

Italy places huge emphasis on bioplastics. In Northern Italy, data are recorded on how much waste is collected from each household according to weight. Taxes related to collection are based on how much a household puts out for collection in relation to the number of people in the household. Households in

Milan have seven bins, with separate bins to dispose of kitchen waste, garden waste, plastics, paper and board, general waste, cans and glass, and other materials). These bins are different colours and are put out on different days of the week. Most people live in blocks of flats, and the block will have a waste manager. The municipalities provide the bins and pay for the trucks that collect the kitchen waste (which is collected daily). Italy has well-developed and heavily subsidised composting plants. The plants are subsidised per ton of waste that they take in, and farmers are subsidised to buy from composting plants. Without subsidies, this model would not be viable.

The question is what else can be done. Some of the answers to this question are to:

- Create more markets for recyclate, thereby contributing to demand, which is the driver of recycling in South Africa. South Africa has a competition for Best Recycled Products, which results in considerable innovation with respect to materials that were previously not thought capable of recycling. For example, contaminated polystyrene trays in which meat was sold are used to manufacture insulated concrete blocks. The technology is not new, but in the past virgin polymer was used
- Grow recycling rates
- Separate waste at source
- Increase the recycling standards
- Reduce the cost of recycling. Despite the many non-value-adding steps in the recycling value chain in South Africa, it is still profitable.

Plastics SA has an initiative driven by the Consumer Goods Council to end plastics waste in the environment. The initiative has several working groups addressing Infrastructure for Waste Collection, Innovation and Technology, Bioplastics, and Education and Awareness. However, the initiatives will not reduce plastic litter to zero or result in no plastics in the waste stream. Consumers, government and industry need to work together:

- Consumers can contribute to reducing plastic waste by buying local products, not buying unnecessary things, wasting less, recycling at home, assisting others (e.g. inviting domestic workers who do not have waste management services to dispose of their waste at your home), and telling the story (e.g. www. Millionplusrecyclers.co.za, an initiative to challenge one million people to pick up one piece of trash every day).
- Government needs to implement waste management services, develop waste streams and separate at source, clamp down on illegal dumping, and enforce by-laws for public spaces.
- Industry needs to take responsibility, create more markets for recyclate, design for recyclability, invest in alternative recycling (e.g. plastic timber, paving bricks and roof tiles; using plastic in road construction; and turning waste to energy).

Since plastic is the material of choice for numerous applications, we need to combine various solutions to address visible litter.

Discussion

Prof. Olof Vorster (TUT): The talk did not mention the three Rs – reduce, recycle, reuse. There does not seem to be anyone in South Africa looking at lifecycle assessment.
Response: The University of Cape Town has an initiative to look at lifecycle assessment, but it is still in the early stages.

Debbie Schultz: What was the source of the statistics cited in the presentation?
Response: Statistics on local consumption of plastics come from Plastic SA, which collects data from local polymer producers and import figures. Statistics on recycling also come from Plastic SA and are updated annually and published. Statistics on waste come from Statistics SA. Plastics Europe provides statistics for the EU.

Dr Liesl Burger (NMISA): Why is there no waste removal in townships?
Response: Several factors play a role. One of the issues is logistics, as there is no space for trucks to move through informal settlements. There are no services in informal settlements, and other necessities of life such as water are a higher priority. The explosion of population is another significant factor.

Question: Are there any initiatives by government or industry to incentivise people to pick up waste in townships for recycling?

Response: Industry has a 'Weigh and Pay' initiative to send mobile balers and scales into townships. The community is informed that the facility will be available at a particular place and time. People bring their waste, which is weighed and they are paid accordingly on their credit card So far, there are six such schemes, and another 25 are planned. The initiative is gradually growing, but not fast enough. Implementing such an initiative is a slow process, which requires permission, and personnel have to be found to manage the trucks.

Ms Kara Nolte (Economic Food): One of the challenges that the food industry is currently facing is the difficulties of recycling flexible packaging. It seems that the plastic industry has been slow in developing densities of flexible food packaging suitable for recycling. Is the plastic industry committed to solving this problem and finding alternatives?
Response: Producer responsibility organisations (PROs), especially Polyco in the South African context, invite industry to put forward recycling solutions. An exciting development is that of Infinite Industries in Boksburg, whose first prototype is already available. The method uses compression rather than melting and extrusion to produce planks for ceiling boards and school desks. In the trials to date, the recycled material has been toothpaste tubes (where the high aluminium content poses challenges) and chip packets (where oil poses challenges).

Similar technology is being developed by Lavaplastic in Durban, which is also producing recycled products using a compression method. Unilever, the biggest user of no. 7 plastics (i.e. any new plastics, which could include bioplastics), is also driving recycling solutions. Manufacturers should avoid classifying no. 7 plastics as 'Other' on packaging and rather stipulate the chemical components in order to facilitate recycling. Commercial recycling plants for plastics are still not widely available throughout South Africa.

Mr Kendy Madisha (BSTEP): Perhaps much could be done to strengthen recycling initiatives, as fossil fuels will ultimately be depleted. A combination of recycling and bioproducts could perhaps sustain the plastics industry into the future.
Response: There is certainly room for bioplastics and biodegradables. The products that are never likely to be recycled in South Africa (e.g. feminine hygiene products, and nappies for both babies and adults) need to be identified as potential candidates for biobased biodegradable products.

Question: There is an initiative in Mpumalanga to extract gas by burning plastic. Could this serve as a business model for establishing a facility that functions commercially on similar principles?
Response: Pyrolysis is not new. There are several small-scale plants in South Africa, including a farmer in Tzaneen district who uses chicken waste from an abattoir as well as plastic waste. Some of the material is recycled into black pipes and the rest is used in a pyrolysis plant. However, diesel is still too cheap to compete with on price.

The Clariter factory in East London is based on Polish pyrolysis technology, and the end product is solvents and waxes (e.g. as used for lip balms and shoe polish). The main challenge is to get a consistent supply of incoming feedstock at the right price, which constitutes a bottleneck to pyrolysis in the local economy.

Question: The Fourth Industrial Revolution, especially 3D printing, will contribute to the consumption of recycled plastics. South Africa needs to position itself with respect to 3D printing to create a market for recycled plastics.
Comment: 3D printing (which is also known as additive manufacturing) is already being done. 3D printing makes it possible to repurpose waste plastic in a certain shape or form. However, the products of additive manufacturing are likely to become recycling problems in the future. Sixty per cent of waste electrical and electronic equipment comprises high-value plastics, but the flame-retardant additives that they contain (especially the older models) make them difficult to recycle. It is best to repurpose these plastics into things that are unlikely to cause any further contamination, and additive manufacturing is the ideal solution to recycle plastics for that purpose (e.g. to manufacture vases and garden ornaments). Big area additive manufacturing (BAAM) is already being done in South Africa.

Dr Nonhlanhla Kalebaila (WRC): What is the position of industry on primary micro plastics that are added to toothpastes and hand creams, for example.
Response: The major brand owners of these products in South Africa (Procter & Gamble, Colgate Palmolive, Unilever) stopped using micro polyethylene beads altogether in their products almost five

years ago. The scrubbing beads used in facial creams, for example, are now more likely to be made from cellulose (e.g. macadamia nuts), but there is still polyethylene in the environment from legacy products.

Microfibre plastics from clothing fabrics are shed each time the clothes are washed. Consumers could install a simple filter (e.g. coffee filter) on the outlet pipe of their washing machine to catch these micro fibres and prevent them from entering the environment.

Better awareness campaigns are needed to inform consumers about which products are made from recycled materials.

CLOSURE

Ms Niehaus thanked the speakers and participants and commented on the need to raise awareness among consumers of the complexities surrounding the use of plastics, including knowledge of the different types of plastic.

APPENDIX 1: LIST OF ATTENDEES

Name	Organisation
Ms Nombulelo Manyana	3S Media
Dr Siyabulela C Ntutela	AfricaBio
Ms Mpho Mamabolo	AfricaBio
Ms Mariana Purnell	Agricultural Business Chamber
Dr Thulasizwe Mkhabela	Agricultural Research Council
Mr Bongane Mabaso	African School of Innovation and Technology Management (ASITM)
Ms Renate Venier	Academy of Science of South Africa (ASSAf)
Mr Moraka Morudu	Bokamoso Science and Technology Education Centre
Mr Preddy Mothopeng	Black IT Forum
Mr Kendy Madisha	Black Science, Technology and Engineering Professionals (BSTEP)
Ms Deidre Penfold	Chemical and Allied Industries Association (CAIA)
Dr Mlu Ganto	Chemical & Allied Industries Association (CAIA)
Mr Pat Moncur	CET
Dr Leonie Maré	Council for Geoscience
Dr Lee-Ann Noach-Pienaar	Council for Scientific and Industrial Research (CSIR)
Dr Sudhakar Muniyasamy	CSIR
Avashnee Chetty	CSIR
Mr Rajan Naidoo	RV Packaging
Mr Mathala Mokwele	Department of Agriculture, Forestry and Fisheries (DAFF)
Ms Khathutshelo Mphumbude	DAFF
Mr Jabulane Zondo	Department of Higher Education and Training
Dr Mahlori Mashimbye	Department of Science and Innovation (DSI)
Dr Koni Rashamuse	DSI
Ms Mamolatelo Kgare	Department of Trade and Industry
Ms Kara Nolte	Economic Food
Ms Rose Kransdorff	Economic Food
Prof. Christopher Weldon	Economic Society of South Africa (ESSA)
Mr Ivan Muzondo	Geo-Information Society of South Africa (GISSA)
Prof. Gillian Drennan	Geological Society of South Africa (GSSA)
Mr Sabelo B Nkosi	International Association for Impact Assessment South Africa (IAIASA)
Mr Tony Parry	Institute of Information Technology Professionals South Africa (IITPSA)
Mrs Fiona Singh	Local government
Dr Ndabenhle Sosibo	Mintek
Ms Rebaone Mokate	South African Nuclear Energy Corporation (Necsa)
Miss Avuyile Gaga	Nampak Rigids
Mr Maanda Mudau	National Health Laboratory Service (NHLS)
Dr Liesl Burger	National Metrology Institute of South Africa (NMISA)
Dr Clive Oliphant	NMISA
Prof. Nnenesi Kgabi	North-West University (NWU)
Prof. Frans Waanders	NWU
Mr Julius Olubodun	ORT SA

Name	Organisation
Ms Annabé Pretorius	Plastic SA
Mr Fannie Matumba	PROTEC
Mr Stephen Jugmohan	Sasol
Prof. Helder Marques	South African Chemical Institute (SACI)
Dr Michael Booth	SACI
Prof. Helen Drummond	SACI
Dr Gerda Botha	South African Council for Natural Scientific Professions (SACNASP)
Mrs Zai Khan	SA FM
Mr Steven Kaplan	South African Institution of Civil Engineering (SAICE)
Dr David Lokhat	South African Institution of Chemical Engineers (SAIChE)
Dr Janine Victor	South African National Biodiversity Institute (SANBI)
Mr Muimeleli Mutangwa	SynNovation Solutions
Prof. Olof Vorster	Tshwane University of Technology (TUT)
Mr Legohu George Molepo	UNESCO
Dr Wynand van Staden	University of South Africa (Unisa)
Prof. Kevin Mearns	Unisa
Mrs Erica Sao Joao	University of Johannesburg
Prof. Rachael Jesika Singh	University of Limpopo
Prof. Kerstin Kruger	University of Pretoria
Dr Ella Linganiso	University of the Witwatersrand
Mr Martin Matlebyane	US Embassy
Mr Hendrik Wodewyk	Vaal University of Technology
Dr Nonhlanhla Kalebaila	Water Research Commission (WRC)

APPENDIX 2: LIST OF ACRONYMS

3D	Three-dimensional
BSTEP	Black Science, Technology and Engineering Professionals
CSIR	Council for Scientific and Industrial Research
EU	European Union
FDA	Food and Drug Administration
GDP	Gross domestic product
MF	Melamine-formaldehyde
NSTF	National Science and Technology Forum
PE-HD	High-density polyethylene
PE-LD	Low-density polyethylene
PE-LLD	Linear low density polyethylene
PET	Polyethylene terephthalate
PF	Phenol-formaldehyde
PP	Polypropylene
PUR	Polyurethane
PVC	Polyvinyl chloride
TUT	Tshwane University of Technology
UF	Urea-formaldehyde
UPM	UPM Biocomposites
US/ USA	United Stated of America
UV	Ultraviolet
WRC	Water Research Commission
WWF	World Wide Fund for Nature