CSIR C³
collaborate.create.commercialise.

Formulated biodegradable polymer pellets.

FORMULATIONS FOR BIODEGRADABLE PLASTICS FOR A GREENER FUTURE

Biodegradable plastic formulations tailored for use in packaging, agriculture and medical device casing

Addressing a problem and responding to market demand

Conventional plastic: Pollution pest

The current patterns of production and consumption of conventional plastics are unsustainable. Conventional plastics are non-biodegradable, leading to visible pollution in soil, marine environments and the air when discarded, landfilled or burnt.

Products that are practically non-recyclable, such as plastic mulch films used in agriculture, often end up being disposed of in the environment or break down into microplastics, causing ecological issues with frequently underestimated consequences.

To address the pollution problem, there is a growing demand for biodegradable alternatives for specific product lines. These alternatives must meet performance requirements, making it essential to tailor the properties of biodegradable polymers.

The CSIR specialises in modification processes and a range of formulations designed to address specific needs. These include biodegradable mulch films suitable for crops with varying lifecycles and rigid formulations suitable for biomedical device casings.

The technology on offer

Biodegradable polymer plastic formulations

CSIR C³ offers a range of modification processes and biodegradable polymer plastics formulations for commercial uptake. These formulations

are tailored for flexible and rigid applications in packaging, agriculture and medical device casing. The formulations contain up to 40 wt% locally derived natural materials, undergo complete composting, converting into carbon dioxide, water and biomass without any release of toxic residues. They are well-suitable for instances where the end-of-life scenario supports biodegradation or composting, such as in the case of biodegradable mulch films.

Value proposition and competitive advantage

Biodegradable plastics at up to a third cheaper than commercial counterparts

While several commercial biodegradable polymers are two to four times more expensive than conventional polymers, the CSIR-developed biodegradable plastics have been formulated to achieve cost reductions by up to 30%. Unlike imported neat or formulated equivalents, our solution is customised to address specific needs.

In contrast to imported equivalents, the CSIR uses up to 40 wt% locally sourced material to unlock functionalities that would otherwise remain inaccessible. The approach allows for customised formulations, for instance, controlled biodegradability rates and biodegradable mulch films for short-, medium- and long-term crops.

Market opportunity

A growing sustainability awareness that could flourish with lower production cost

In South Africa, as with the rest of Africa, the biodegradable plastics market is currently almost non-existent but is expected to grow significantly. Currently, it is characterised by low-volume imports of finished products, formulated intermediates and virgin pellets for specific applications. Globally, bioplastics constitute just 1% of the annual production of polymers, with the capacity for bioplastics projected to rise significantly from an estimated 2.2 million tons in 2022 to an estimated 6.3 million tons in 2027, growing at a compound annual growth rate exceeding 20%.

The global market is valued at approximately USD4.8 billion. With market segments, biodegradable polymers are finding niche applications in agriculture, medical and packaging industries. Production capacity is expanding and companies are opting for mergers, acquisitions or geographic expansions to gain a competitive edge.

South Africa does not produce any major biopolymers. Therefore, forming downstream beneficiation partnerships such as joint ventures with industry leaders could yield mutual benefits. Elsewhere, drivers for the shift towards biodegradable plastics include favourable policies, consumer preferences for environmentally friendly products, uniform labelling and major brands adopting more sustainable practices. In South Africa, there is an increasing awareness of sustainability among a niche market segment, although scaling is hampered by high costs. Demand-side policy interventions could help drive biodegradable plastics consumption. Nevertheless, the current flexible and rigid packaging, as well as agriculture markets are valued at over R38 billion. It is estimated that approximately 5% of this market could transition to biodegradables in 10 years, amounting to a market size of approximately 54 290 tons.

Prototype CSIR biodegradable mulch film produced at industrial partner premises.

Business opportunity

Producing and selling formulated pellets to biodegradable plastic product manufacturers

Licensees of the technology will be able to manufacture, market and sell formulated and compounded pellets to converters. These converters, in turn, will produce final products such as composting bags, agricultural mulch films, diapers or plant clips for distribution to end-users. The compounding business's primary revenue stream will be derived from the sale of these biopolymer pellets, while CSIR C^3 will receive royalties based on these sales. To ensure a consistent supply of base biopolymers, such as polybutylene adipate-co-terephthalate, the business may want to partner, through a joint venture, with major producers.

Investment and return on investment

Invest to capitalise on the rise of biodegradable plastic

An estimated R40 million is required to establish a compounding business that will cater to the addressable market. This budget includes R10 million allocated for pre-commercialisation activities to de-risk the process. The payback period for this investment is five years, with a net present value of R54 million, calculated at an 18% discount rate, with an internal return rate of 30% over a 10-year analysis period.

Milestones and timelines

Pre-commercialisation activities are expected to take a year; the manufacturing facility will be set up during the second year and full-scale production will commence in the third year.

A team of experts in biodegradable plastics

The technical team is highly experienced in the formulation, processing and characterisation of biodegradable plastics. Apart from expert knowledge on biodegradable plastics, the core team has multi-disciplinary skills that facilitate the successful achievement of project goals.

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