

PolarID: POLARization based IDentification of plastics for in-line sorting.

Publieke samenvatting / Public summary

Aanleiding

Plastic recycling is crucial for reaching EU climate goals, but current efforts are insufficient due to regulations, technical limitations, and market competition between recycled and virgin plastics. Poor recycling efficiency results from the high costs and limitations of effective processing technologies for identification, separation, and cleaning. To ensure purity and minimize contamination, many questionable plastics are rejected or incinerated as waste. Two major challenges must be addressed: (1) identifying and sorting plastic types and grades, and (2) cleaning contaminated streams. This project focuses on low-cost identification of small plastic packaging films and foils, which often end up in waste due to sorting difficulties. Technologies like NIR and shape or color identification exist but struggle with black and multilayer plastics. Additionally, the high cost of multiple identification tools hinders effective sorting. Automated quality control of sorted plastics is lacking, increasing uncertainty in purity. Reducing identification costs and implementing automated quality assessment is essential for improving plastic recycling efficiency.

Doelstelling

The major goal of the project is the development of a new optical tool that will be able to identify plastics films and foils on various locations in a plastic sorting line, using polarimetry as the plastic recognition mechanism. The major benefit of such a tool is the low cost technology that can be deployed on various point in the sorting process, because it

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Algemene informatie / General information

Penvoerder / Secretariat
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does not rely on (NIR, FTIR or UV-VIS) spectroscopy. The spectroscopic components in such devices make them in general more expensive, especially when move into the (near) infrared regime. The proposed approach uses lower cost visible cameras having specifically designed polarization filters. Each oriented plastic film to be identified intrinsically contains the optical information of the orientation and chemistry of the polymer chains that can be extracted by polarization measurements. Since similar polymers may behave similarly with respect to their optical response, an extensive Machine Learning framework is needed to convert the optical data into useful information. The results of new measurement technique will be benchmarked with State-of-the-art NIR detection and the more extensive MID Infrared spectroscopy.

Korte omschrijving

The PolarID project will design and build a new optical plastic identification tool based on polarized light. TNO will be the research partner designing and building the new tool. The raw data will be processed using Machine Learning algorithms that will be written and trained by TNO. Once built, the new PolarID tool will first be validated using reference films and foils supplied by the industrial partners LyondellBasell and BASF. A large database will be constructed for the training of the ML model. After successful lab tests, the sensing tool will be installed in two sorting lines: one post-industrial sorter at Broeckx Plastic Recycling, identifying polyolefin films and foils (including LDPE, LLDPE and BOPP); and one post-consumer sorter at PreZero identifying plastic films and products in household waste. Since the project is designing a sensing solution and not an actual sorting step, no full recycling activities are planned. LyondellBasell will assess the results of the new sensing tool leading to enhanced sorting from a recycler point of view, and TNO/BCS will perform a small set of extrusion experiments with sorted films that are to be expected from adapted sorting lines.

Resultaat

The developed optical plastic identification system

is designed for real-time in-line detection within plastic sorting processes. Leveraging the optical polarizability of polymer materials as a distinctive marker, this technology is particularly effective for recognizing oriented films and foils, including biaxially oriented polypropylene (BOPP), shrink wraps, and stretch foils. The proposed system is anticipated to offer a cost-efficient alternative to current state-of-the-art solutions, enabling large-scale deployment along sorting conveyor belts. Integration of this tool-potentially alongside near-infrared (NIR) spectroscopy-will facilitate enhanced identification of challenging materials while ensuring quality control at the output stage by continuously assessing all sorted plastics. Presently, quality control is conducted manually on limited batches, leading to variability in the composition and purity of the recycled streams. The implementation of this automated detection system will mitigate such inconsistencies, improving efficiency in plastic recycling.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.

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