INTELLIGENT SYSTEM FOR MONITORING THE CIRCULAR ECONOMY OF PLASTIC

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SUMMARY : When we refer to the circular economy, we associate it with production and consumption that aim to capitalize and recycle various materials and products in order to extend their life cycle.
Obtaining a final product through recycling involves going through specific stages of the circular economy, which also includes the recycling process.
Currently, the circular economy in polymer materials focuses on maximizing their use by reducing the amount of waste, recycling and regenerating existing materials, and developing new sustainable and environmentally friendly materials. This involves collaboration between all parties involved, from producers and consumers to environmental authorities and organizations, to create an efficient and sustainable system for the management of polymer materials.

KEY WORDS: system, intelligent, recycling, plastic.

1. Introduction

The history of the circular economy in polymer materials is a complex one and begins with the appearance of the first synthetic polymers in the 1900s. During the 20th century, the production of plastics developed exponentially, while their recycling remained a rare and expensive practice.

However, with the growing concern for environmental protection in the 1970s, the first circular economy initiatives in the polymer industry began to appear. In Europe, the first directive on packaging and packaging waste was launched in 1994, which required a certain rate of recycling and incineration with energy recovery.

The circular economy of plastic is an approach that involves the sustainable use of natural resources by reducing, reusing, recycling and regenerating products and materials. Regarding plastic, the circular economy involves transforming it from a material that is used only once into a valuable material that can be used again and again in the economy.

Today, the misuse of plastic is one of the biggest threats to the environment, with billions of tons ending up in oceans, rivers and land every year. Unfortunately, this situation is fueled by a linear economy where we produce, use, and throw away materials. But by shifting to a circular plastic economy, we can reduce environmental risks and encourage responsible use of resources.

The first step towards a circular plastic economy is to reduce the amount of plastic produced. This can be achieved by avoiding the use of non-essential plastics, such as plastic bags and single-use cups, but also by replacing them with sustainable and biodegradable alternatives.

If plastic is needed, the next step is to reuse it. This can be achieved by encouraging the use of reusable containers, to avoid single-use packaging.

If the plastic cannot be reused, the next step is to recycle it. If the plastic is properly recycled, it can be transformed into new products, which significantly reduces the amount of new materials to be produced and subsequently thrown away. In addition, recycling plastic can help reduce greenhouse gas emissions and environmental impact.

Finally, regenerating is another important step in the circular plastic economy. This involves turning plastic waste into fuel or energy through incineration or other methods. In addition, plastic can be used to produce new materials through bio-refining processes, which turn it into valuable molecules for other products, such as packaging materials or car fuels.

In conclusion, the circular economy of plastic is an important approach in the fight against pollution and climate change. By reducing, reusing, recycling and regenerating products and materials, we can reduce environmental risks, but also encourage the responsible use of resources.

2. Current status

The subject of the project theme is to design an intelligent system to facilitate the waste sorting and recycling process and integrate it into the circular economy.

Recycling processes must be cost and quality efficient, and material distribution is a factor that determines the efficiency/profitability of the entire system.

So, I developed an intelligent system consisting of a mechanical equipment, called a material distribution system, and an intelligent sorting equipment, consisting of a camera and an operational system with cobot-type equipment.

The mechanical material distribution equipment is designed with 2 rotating discs located above a conveyor belt, on which the waste will be spread evenly over its entire width. The disc system will be positioned between 2 lanes, namely the acceleration lane and the supply lane of the intelligent waste sorting equipment. From the first belt, the supply one, located above the rotating discs, the waste will fall onto them, which, driven by a motor, rotate continuously, at an optimal speed to spread the waste evenly on the next belt, called the acceleration belt.

The material dispensed by the distribution equipment is monitorized in an intelligent recycling process.

An artificial intelligence camera system constantly monitors material quality/distribution and an intelligent cobot-based sorting unit is mounted directly on the material distribution equipment acceleration belt and acts integrated with the signals received from the camera system.

An autonomous and artificial intelligence system found in the specialty market is represented by the INSPEKTO product, easy to configure in just 6 steps, described in **figure 1**.

https://inspekto.com/

Figure 1 – Steps to configure the camera system with artificial intelligence

The integrated waste selection system (mechanical - artificial intelligence - operational mathematical model - collaborative robot) is designed on a didactic scale and presented in **figure 2**.

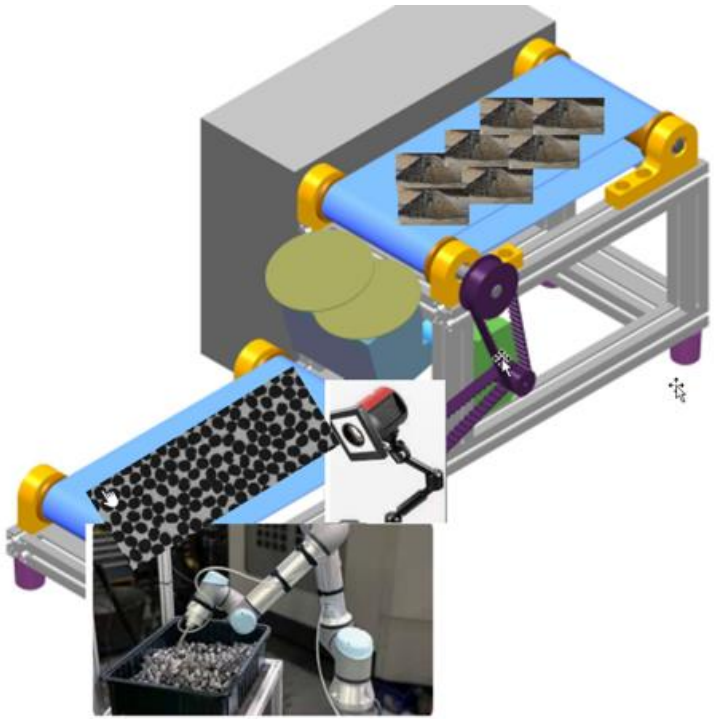

Figure 2 – Intelligent waste sorting system

The previously mentioned systems, an integral part of a standard recycling process, from the flow of the circular economy, as provided in **figure 3**, will generate the reconditioning/recovery of waste in 2 types of materials.

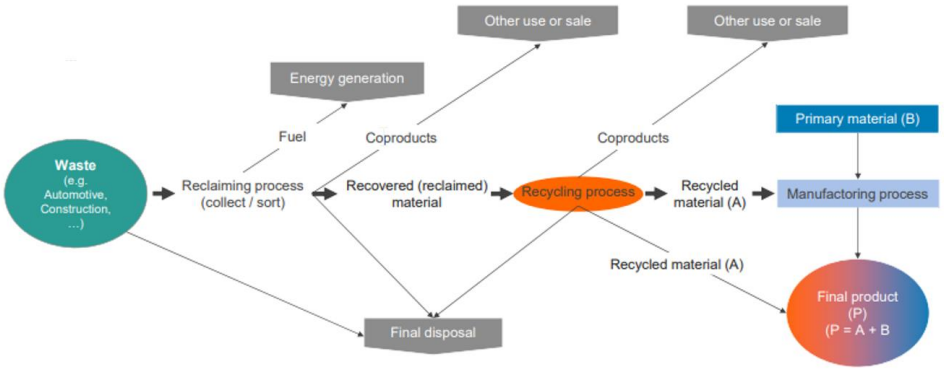

Figure 3 – The flow of the circular economy

The intelligent sorting unit, through a mathematical program, sends the materials further to the category of which it is identified as belonging, corresponding to the flow described in **figure 3**.

The result is the identification of the recycled material resulting from the recycling process and its classification according to two categories:

a. To other use or sale (Coproducts)
b. Towards a production process (recycle material A), where by using it in a special recipe with a raw material (B – primary material) the final product P will be obtained.
Where, P = A + B.

3. Conclusions

The software that should manage the flow of the circular economy described in **figure 3** will have 3 points of analysis, control and decisions:

- Selecting material as good to use as it is.
- Selecting the material as a coproduct and directing it to the niche market to sell as it is.
- Involvement of the material in the production process, where it will be processed to obtain a final product that is good for use.

4. Bibliography

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