Chemical upcycling of polyolefin into upcycled waxes

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Introduction

Polyethylene (PE) is the most consumed plastic worldwide, accounting for approximately 30% of global annual plastic consumption.

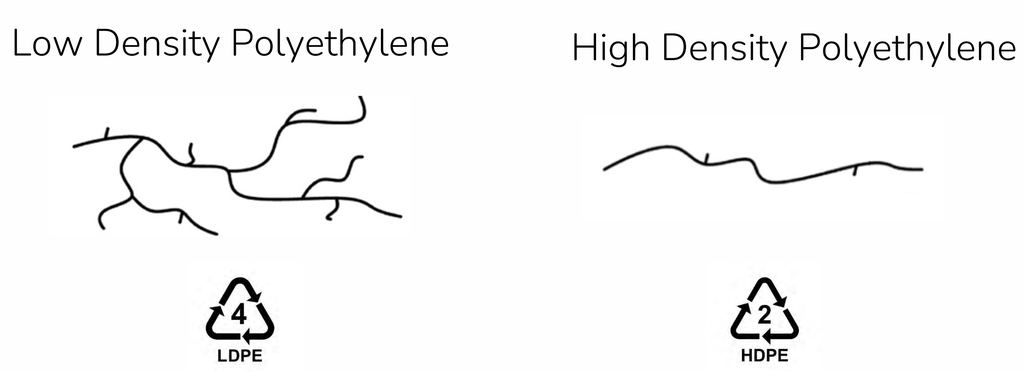

Figure 1. LDPE and HDPE structures.

The thermal degradation of polyethylene follows the free radical chain theory.

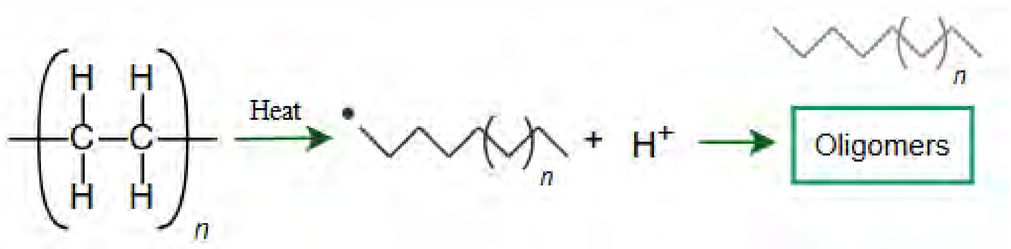

Figure 2. Thermal degradation of PE.

Polyethylene waxes have a wide range of applications, including use in the paint and varnish industry to enhance abrasion resistance, and as additives in plastics to serve as lubricants and improve flow during extrusion and molding processes.

Methodology

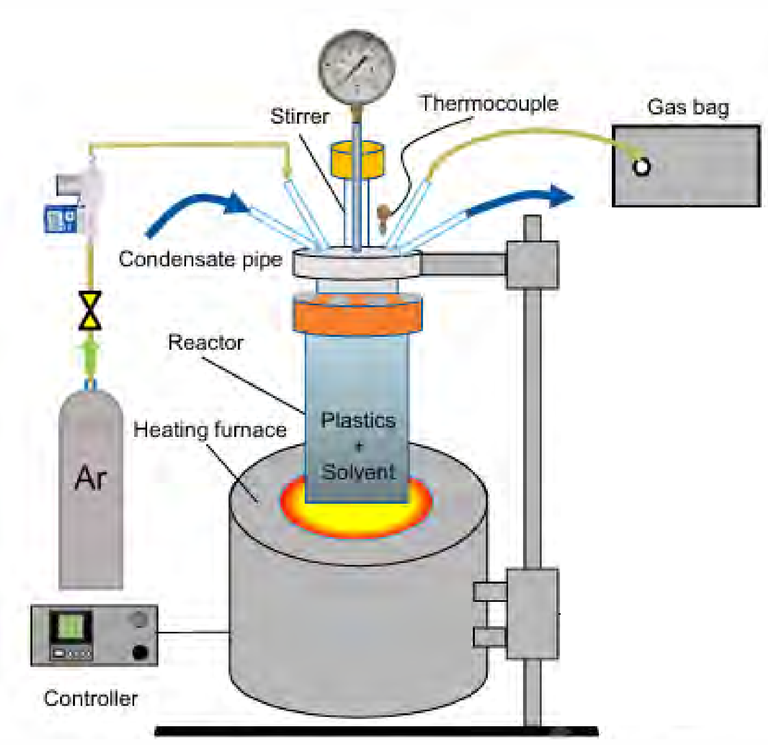

Figure 3. Scheme of the hydrothermal reactor. [1]

Wax production

Purification

Characterization:
FTIR, TGA, DSC, GC-MS

Results

Table 1. Summary of six experiments, including their respective temperatures, solvents, yields, and product characteristics.

Experiment	Temperature (°C)	Solvent	Yield (%)	Product
1	400	-	40	Black liquid
2	350	-	87	Yellow-*ish*, hard wax
3	300	Glycerol (1:5)	87	Yellow liquid, and hard solid
4	350	Water (0.5 mL)	96.5	White, brittle solid
5	350	Water (1 mL)	97.7	White, brittle solid
6	375	Water (1 mL)	87	Yellow, liquid wax

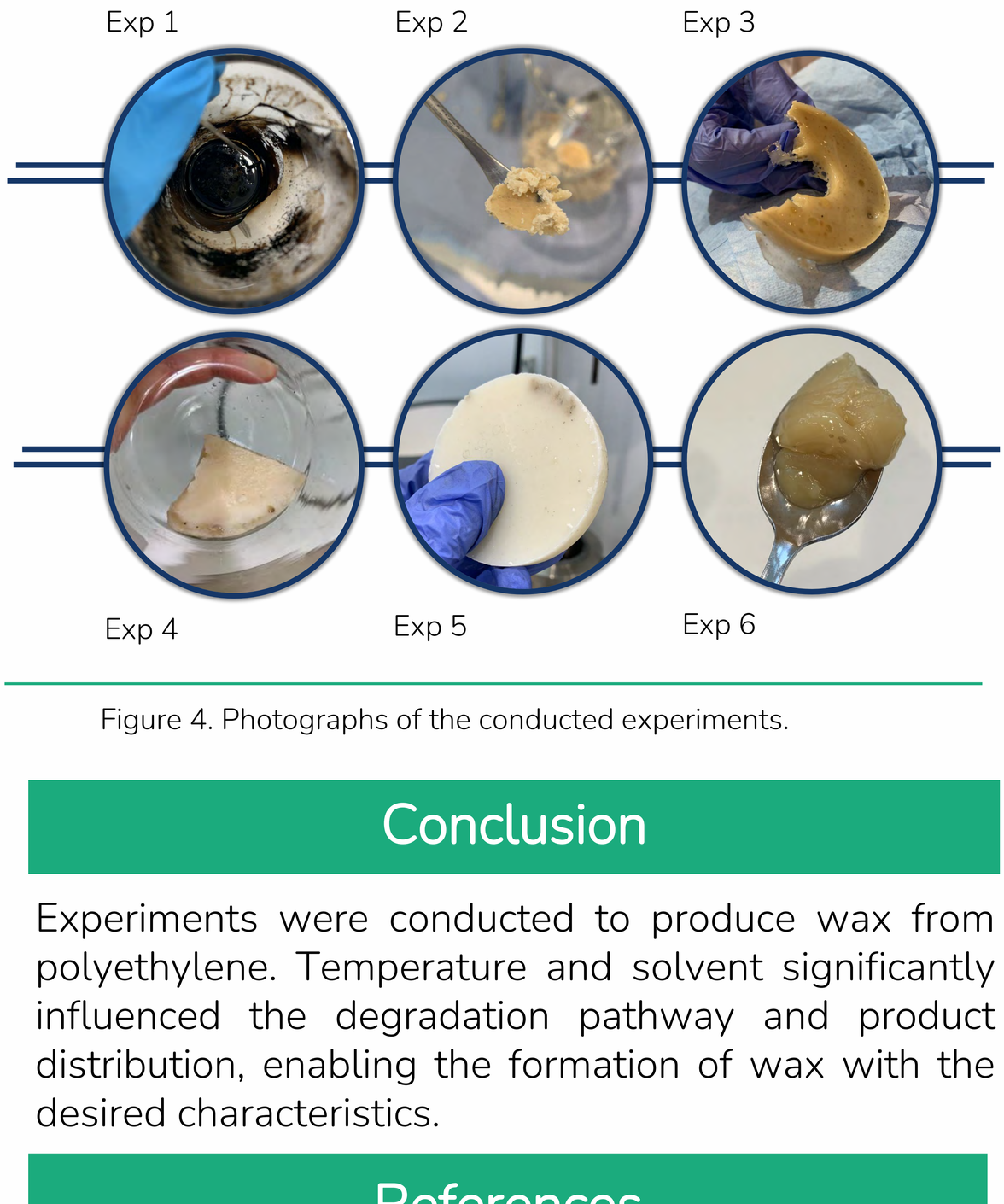

Figure 4. Photographs of the conducted experiments.

Conclusion

Experiments were conducted to produce wax from polyethylene. Temperature and solvent significantly influenced the degradation pathway and product distribution, enabling the formation of wax with the desired characteristics.

References

1.Karaki, A.; *et. al.* A review on material extrusion (MEX) of polyethylene - Challenges, opportunities, and future prospects. Polymer 307 (2024) 127333. https://doi.org/10.1016/j.polymer.2024.127333.

Acknowledgment

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