Biodegradable Biobased Polyesteramides for High-Quality Fibers

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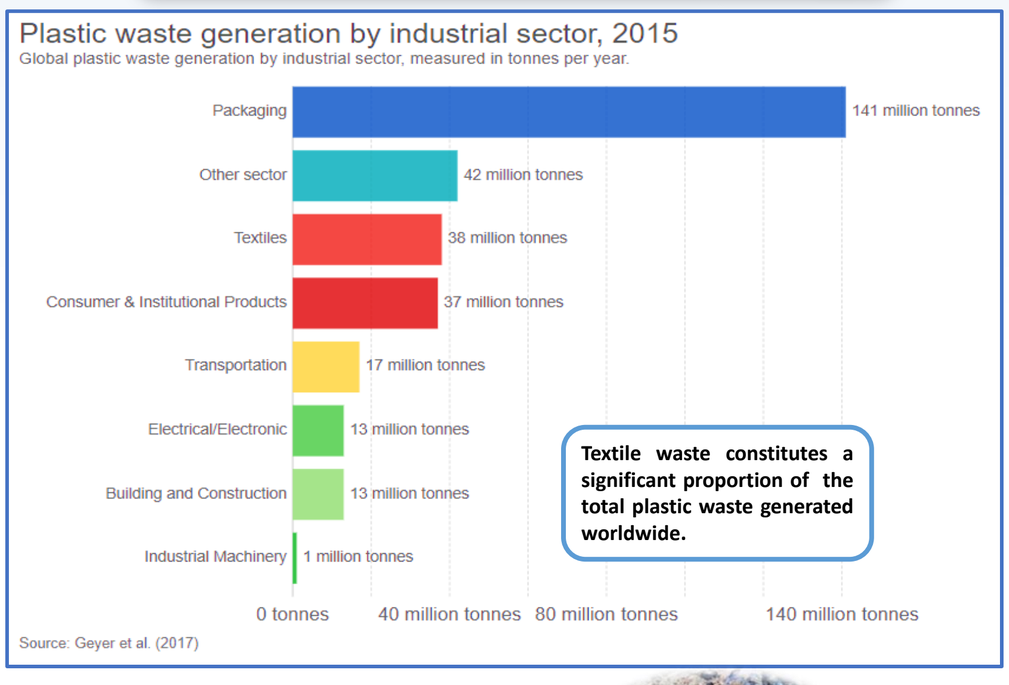
Motivation and Research Strategy

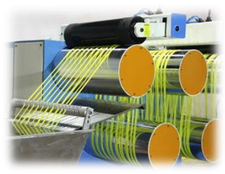


Textile waste constitutes a significant proportion of the total plastic waste generated worldwide.

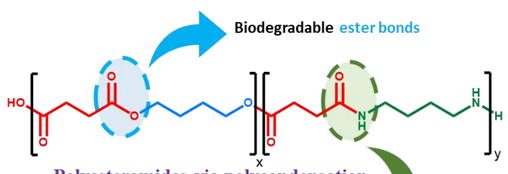
Environmental problems caused by the textile industry

Solution: Biobased biodegradable polymers with good mechanical and thermal properties.

Biomass

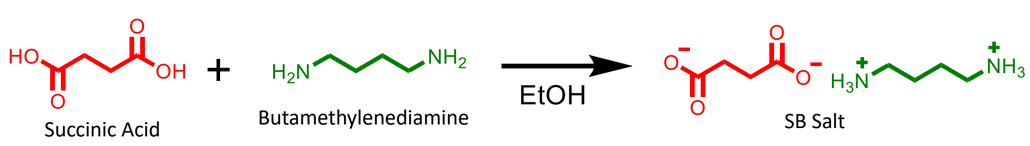


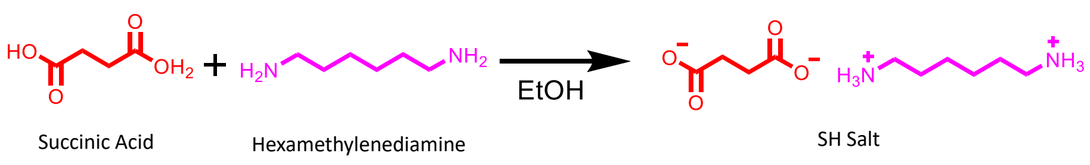
Application as high-quality fibers



Synthesis of PEAs

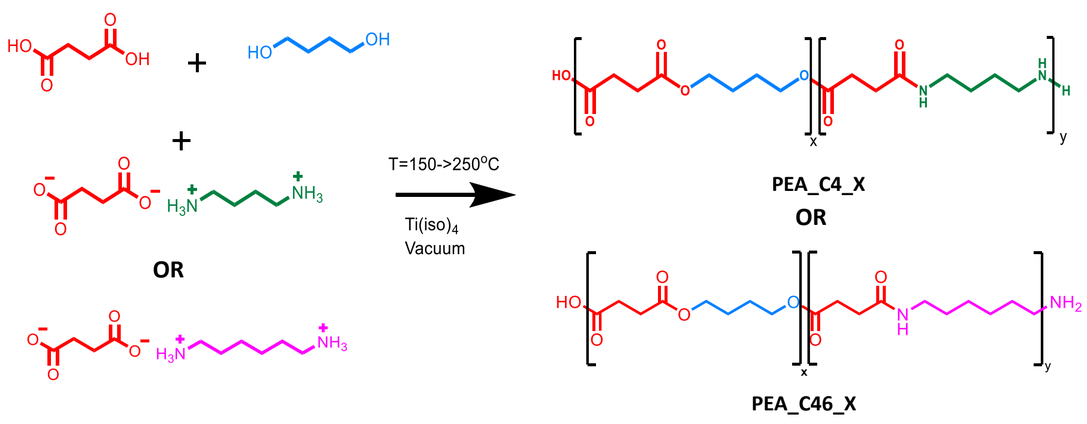
Preparation of Amide-Ester Salts



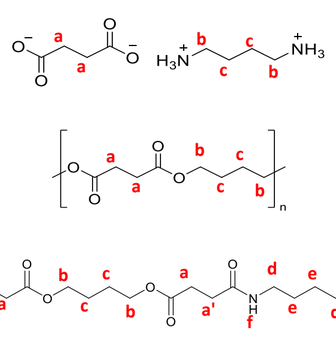


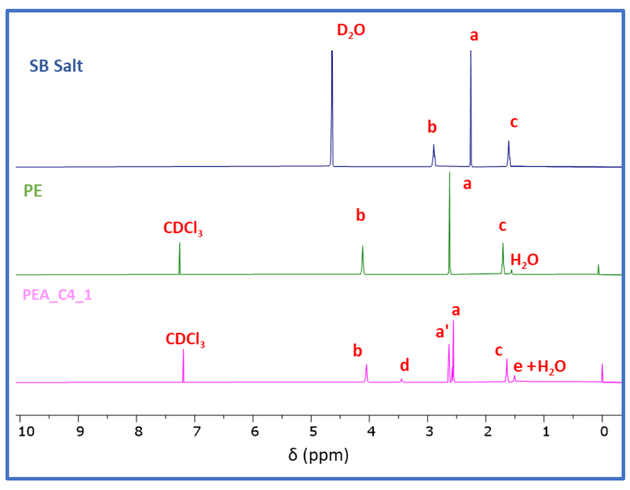
Polyesteramide Synthesis

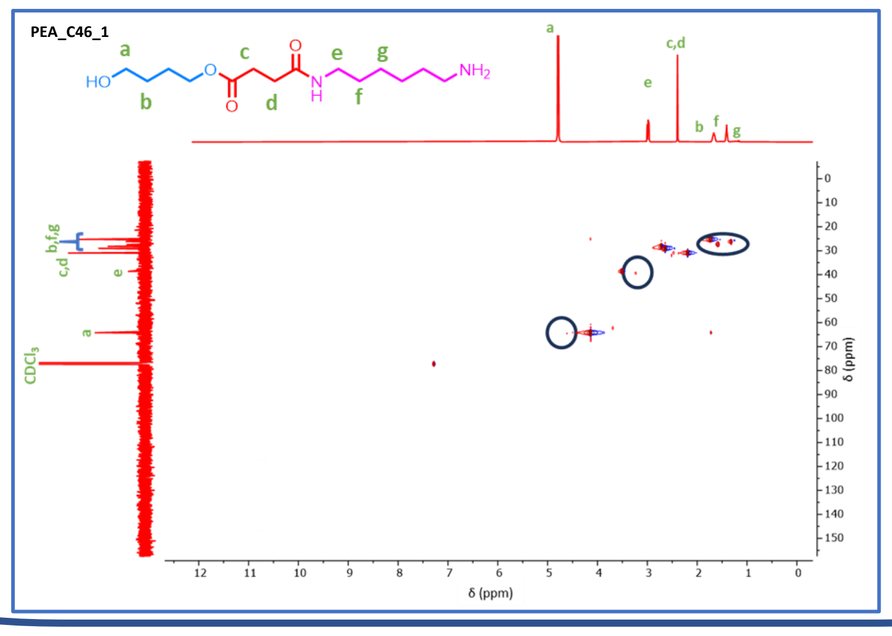
- **Solid-state melt polycondensation** was utilized to synthesize the polyesteramides (PEAs).
- PEAs with **Amide/ Ester** ratio (X) in the range of **0.0 to 1.0** are synthesized.



Structural Analysis



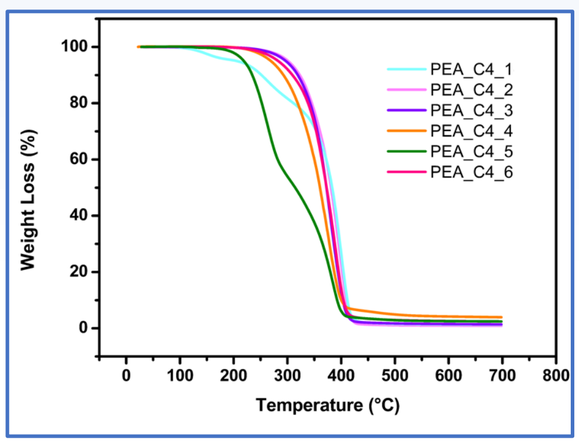




Thermal Analysis & Degradation Studies

PEA_C4_X

PEA	Amide/Ester Ratio	T_m (°C)	T_g (°C)	T_c (°C)	$T_{d5\%}$ (°C)	T_{dmax}(°C)
PEA_1	0	115	-35.0	76.9	205	394
PEA_2	0.1	112	-24.0	65.7	301	395
PEA_3	0.2	107	-22.9	58.4	297	374
PEA_4	0.3	112	-32.3	74.9	222	386
PEA_5	0.4	113	-24.4	84.2	219	383
PEA_6	0.5	113	-25.9	93.9	283	388



- Effect of
  - reaction time (7 – 16 h)
  - amide/ester ratio (0.5 – 1.0)
  - catalyst amount (600 ppm – 1500 ppm)

on thermal properties investigated for PEA_C46 series.

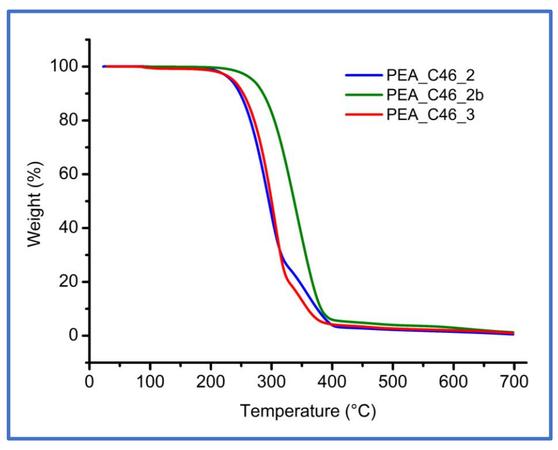
PEA_C46_X

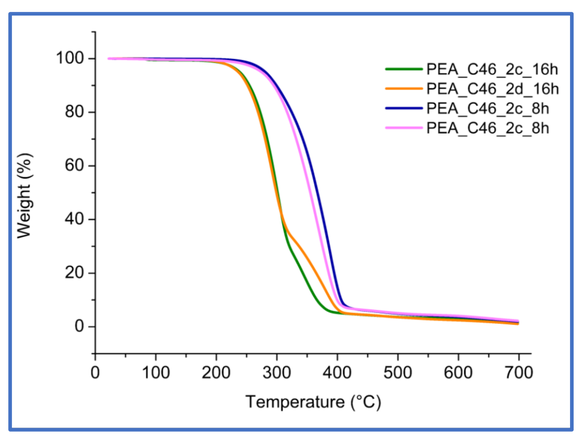
Effect of Catalyst Amount & Amide/Ester ratio (0.7-1.0)

PEA	T_g	T_m	T_c
PEA_C46_2	-25.7 °C	111.6 °C	55.0 °C
PEA_C46_2b	-17.2 °C	100.0 °C	55.7 °C
PEA_C46_3	-16.9 °C	116.6 °C	57.5 °C

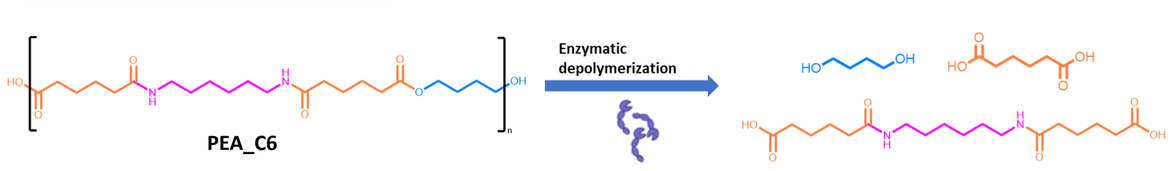
Effect of Reaction Time (Amide/Ester:0.7)

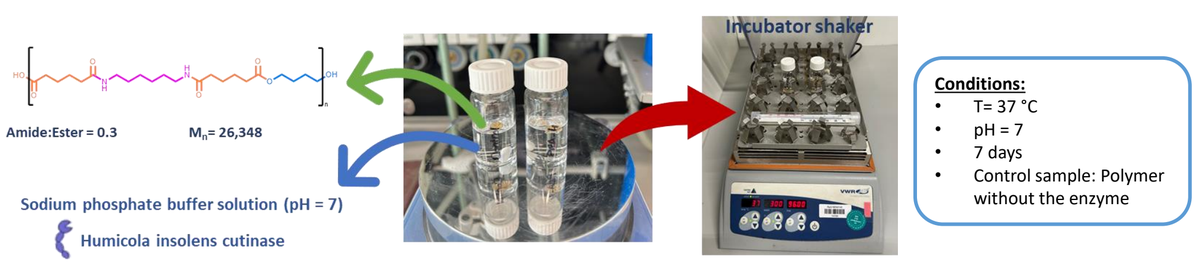
PEA	T_g	T_{m1}	T_{m2}	T_c
PEA_C46_2c_8h	-15.7 °C	101 °C	—	60.7 °C
PEA_C46_2c_16h	-19.1 °C	94 °C	113 °C	—
PEA_C46_2d_8h	-21.1 °C	109 °C	—	84.1 °C
PEA_C46_2d_16h	-21.3 °C	93 °C	113 °C	—





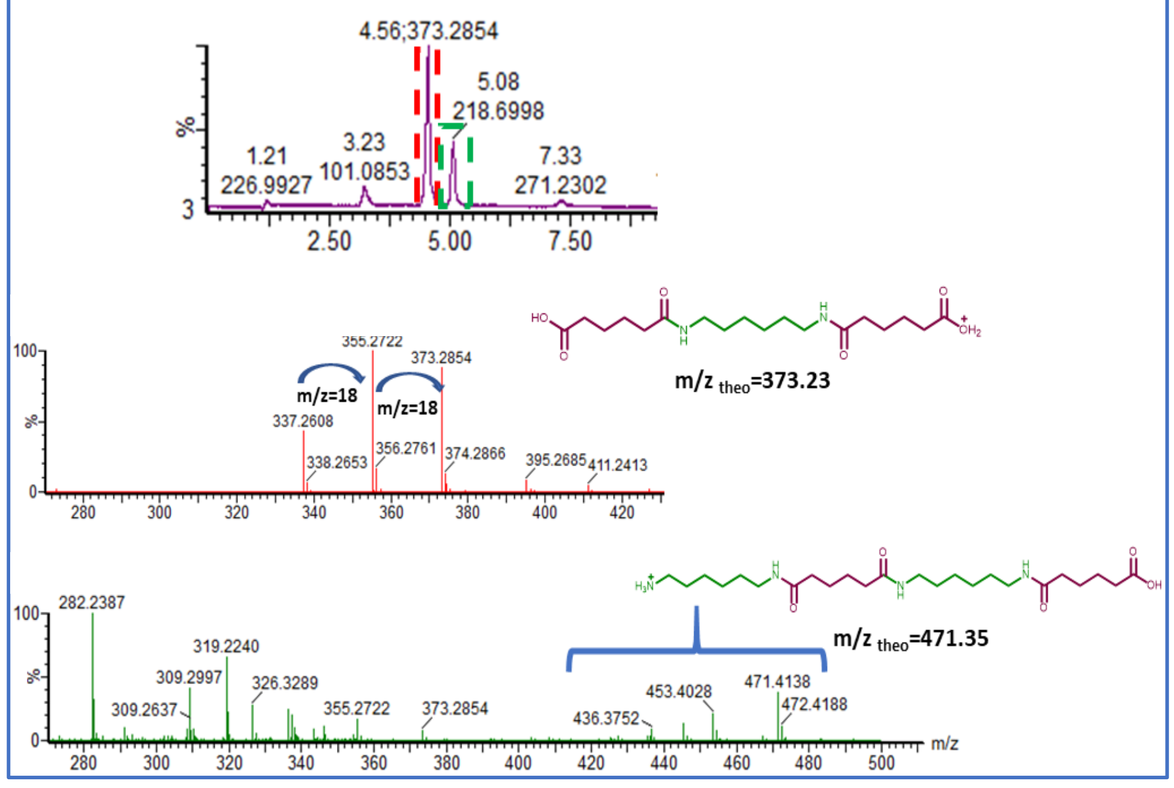
Enzymatic Degradation Studies





Conditions:
- T= 37 °C
- pH = 7
- 7 days
- Control sample: Polymer without the enzyme

Polymer solution after degradation



Conclusion & Outlook

- PEAs with a range of amide/ester ratio were synthesized.
- Structural & thermal analysis of PEA_C4s suggest **cyclization of diamines as side reaction.**
- **Alternative PEAs** to PEA_C4 series are synthesized using 6C diamines, **effect of various parameters on thermal properties** are tested to optimize the reaction conditions for PEA_C46 series.
- Synthesis of the PEA series and remaining characterizations (e.g. **GPC analysis**) are to be completed.
- **Enzymatic degradation** studies of the remaining PEAs will be completed and will be followed by standard **biodegradability tests**.
- Resulting PEAs can find **applications in textile industry as high quality yarns.**

References

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