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Recycling Neolast: A Sustainable Spandex Alternative Claire Sklar, Peter Lim, Aryan Anand, Laurice Djepeno

spandex without the environmental harm.



Solution: Alkaline Hydrolysis Based Recovery of Neolast Soft Segments **FTIR Data Analysis Design Challenge** Polyester : hard In collaboration with Celanese, Under Armour has developed a high-performing elastic Neolast : alternating soft covered Neolast Soft Segments vs Theoretical Neolast Soft Segments (Neolast - Polyester): FTIR Spectra terephtnalate (TPA) olyois & hard terephthalate alternative to spandex: Neolast. With a green, solvent-free manufacturing process, Neolast linked by ester bonds (TPA) linked by ester bonds shows promise in addressing the textile industry's challenge of achieving the stretch of melt extrusion Stretchy textiles also cause environmental harm in their disposal: -250 they are difficult to shred and recycle, so they accumulate in landfills. -500 -Recovering and recycling Neolast from composite textiles would Recovered Neolast Soft Segmer minimize textile waste, further contributing to Under Armour's sustainability goals. Polyester Fibers (yarn) Fig. 5: FTIR Analysis of Recovered Neolast Neolast Fibers (yarn) Theoretical Neolast Soft Segments spectrum was generated by subtracting the pure polyester Under Armour needs a process to separate Neolast from polyester in spectrum from the pure Neolast spectrum and normalizing. composite textiles to recycle the fibers. weaving / knitting (a) Overlay of transmittance spectrum for theoretical and recovered Neolast soft segments recycle back (b) PCA (Principal Component Analysis) for theoretical and recovered Neolast soft segments, an **Defining NEOLASTTM** recycle back Into Neolast into polyester overlap is observed within 99.5% confidence ellipses composite textile: (a) Polyester (PET) Polyester (80%) **Environmental Analysis** Neolast (20%) Fig. 6: Energy Usage and CO2 Emissions of Virgin PET and Recovered PET **Under Armour Textile Manufacturing** (b) Neolast **Our Recycling Process** 2.0 1. Prepare solution with ionic liquid, water, and sodium hydroxide. 2. Add textile & neat (80°C), I hour. rigid (crystalline) segment soft (amorphous) segment 3. Allow textile to degrade 1.0 Fig. 2: (a) Polyester chemical structure, rigid polyethylene IN SOLUTION FOR I WEEK at room temperature. terephthalate linked by ester bonds (b) Neolast chemical structure, 0.5 Fig. 1: Optical Microscope Image degraded TPA IN thermoplastic, alternating polybutylene terephthalate (rigid) and of Composite Textile (20%) Solution long chain polyol (soft) segments linked by ester bonds Virgin PET Neolast, 80% Polyester) Virgin PET Recovered PET What is FTIR? hydrolysis also has the additional benefit of recovering Neolast. Furthermore, alkaline hydrolysis is **Theory of Alkaline Hydrolysis** separation independent, meaning textile made of PET and Neolast does not need to be pre-separated purify, reuse precipitate Wash, NITH HCI rigid terephthalate soft polyol (unlike most other recycling processes for PET). dry Scalability degraded textile Shredded Neolast-**Polyester Textile** with N recycled back recycied back into leftover \sim INTO POIYESTER (or Neolast!) JIDIJ6 aggregated on segments. SOlution the surface Pure Materials: FTIR Spectra ETERET **Role of Ionic Liquids** TPA precipitated m out of solution \bowtie Ionic liquids Stirred consist entirely **Stainless Steel Industrial Shredder Rotary Drum Compressed** ionic liquid SWIFI textile in Water, recover Tank **Jacketed Reactor** Air Dryer Filter PET of ions and are in water, with Agitator Nacuum liquid at room then dry/filter Filtration temperature! 50 \bigcirc reaction coordinate ث Pure Polyester Fiber Pure Neolast Fiber Neolast Polyester Textile With a sufficient carbon chain length, ionic THE H ÚÐ ×~ neutralize 3000 2500 2000 1500 1000 5000 4500 3500 4000 liquids can become cationic surfactants – they STER States and a Wavenumber (cm⁻¹) Into H₂O and **Knitting Machine Polymer Extrusion Spinning Machine** lower the surface tension of water to catalyse the Naci, discard **Line Melt Reactor** recovered TPA reaction. They are also more sustainable (less recovered N degraded soft polyols polyester mesh





FTIR passes infrared radiation through the chemical bonds within a molecule to measure their vibration, allowing us to characterize the molecule's chemical **structure**. Strong peaks represent unique aspects – for example, the peak at 1700 cm⁻¹ represents ester bonds and the peak at 2900 cm⁻¹ indicates the Neolast soft





volatile) than the traditionally used methanol.

Fig. 3: FTIR spectra of pure polyester fiber, pure Neolast fiber, and composite Neolast polyester textile

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In addition to having nearly equal energy cost and reduced CO2 emissions, recovered PET via alkaline

