Introduction

What Are Wood Plastics?
• A mixture of
  - Wood
  - Thermoplastic Resins
  - Other additives

Why Use Wood Plastics?
• Architectural Desires
• Have Good Strength
• No Toxic Preservatives

Current Applications:
• TRENX Decking
• Railing
• Interior Auto Parts
• Window Frames

Emerging Applications:
• Structural Building Components
• Bridge and Pier Members

Objectives

Develop a viable formulation and extrusion processing parameters using Nylon-12 as a matrix polymer for WPCs.
• Determine the influence of different lubricant packages and nylon-12 melt grades on composite properties
• Develop temperature processing schedules to extrude nylon-12 based WPCs
• Understand the role of moisture in the processibility
• Evaluate resulting mechanical performance of the composites

Experimental Methods

Materials
• 60 Mesh Pine Flour
• Nylon 12 - Melt Grades: L16G & L20G
• OPE 629A Lube

Torque Rheometer
Nylon and wood flour were mixed together and then placed into the rheometer which is set at a given temperature. The mixture was melted together and mixed with screws set at 50 rpm/s, which measured the torque to mix the material. Data obtained showed the processing temperatures and mixing time required for extrusion. The graphical analysis also determined the best lube type and percent use in the mixture.

Extruder
The 35mm extruder was used to form the Nylon-Wood composites. With 3 temperature barrel zones, and 2 dye temperature zones, many trial variations were run in order to consistently create a composite with optimum mechanical properties.

TGA
Both types of Nylon 12 (L16G & L20G) were heated from 35 C to 600 C at 10 C per minute in the TGA (Thermal Gravimetric Analysis) and the heat loss was graphed.

SEM
The Scanning Electron Microscope allowed pictures to be taken of the gold coated, glass cut Nylon Wood Composite samples.

Results and Discussions

After running different lubricants with the nylon in the torque rheometer, OPE 629A lube had the best results, and was therefore used for all extruding parameters. Due to the high melting temperature of Nylon and the degradation of the wood, determined from TGA testing, a temperature profile was selected for the extrusions. SEM photos provided visual indication that wood cells were collapsing which also suggested that higher temperature profiles were required. The mechanical testing results from trials 3 and 4 are shown below. Both profiles were almost identical, 60% pine flour, 37% Nylon, 3% OPE 629A lube, extruded with the same temperature profiles at 20 rpm. The only main difference between these trials was the moisture content found in the wood flour. Trial 3 had 3% moisture where Trial 4 had approximately 1%. This small difference in the wood’s moisture affected the final trial significantly, increasing both the Modulus of Rupture as well as the Modulus of Elasticity. L20’s density increased in Trial 4 and L16 was slightly less due to cooling effects. Higher densities typically correlate to higher mechanical properties.

Conclusions

Though the trials ran, it can be concluded that when using OPE 629A lubricant, Nylon 12 L20G composite has better mechanical properties than a Nylon 12 L16G composite. Any residual moisture can become trapped in the composite as a gas causing a reduction in the density which lowers the mechanical properties. As seen in the graphs above, in order to obtain higher strengths, it is necessary to use wood flour that contains minimal moisture.