Description of data files generated from a study involving weathering-induced fragmentation and release of nanosilica from low-density-polyethylene (LDPE) - nanosilica composites.

**Data File #: 1**

Filename:

Irradiance with cutoffs.xlsx

Description:

This datafile contains Irradiance data used in the weathering studies presented here. The data are recorded in units of W cm-2 nm-1. The spectral irradiance of the filtered light was measured using an Optronics OL 756 spectroradiometer calibrated using an OL 756-150 Dual Calibration Source. Three sets of data are presented, each with the ultraviolet light from an Altas XLS+ or a Solarlight LS1000 solar simulator partly blocked by a “cutoff” light filter. The filters are identified by the wavelength where the filter blocks 50% of the UV light. For example, the 305 nm transmits 50% at 305 nm; light >305 nm is transmitted and light <305 nm is blocked by the filter.

Keywords:

 Atlas, UV filters, block, wavelength, solar simulator

**Data Files #: 2**

Filenames (two data files):

FTIR spectral changes.jpg; Wavelength effects on FTIT carbonyl increase. docx

Description:

Chemical degradation of the LDPE/nanosilica composites was measured using Fourier transform infrared spectroscopy (FTIR) in transmission mode. FTIR spectra were measured using a Thermo-Nicolet model 6700 spectrometer at 128 scans with 4 cm-1 resolution for analysis of the films. The film thickness ranged from ~ 0.50 to ~ 0.55 mm; width was about 6 mm. The FTIR spectra of each film provided absorbance data in the spectral region of 450-4000 cm-1. FTIR changes observed with the 305 nm, 355 nm, and 385 nm filters in place are provided.

Keywords:

 Infrared, spectroscopy, transmission, chemical degradation

**Data File #: 3**

Filename:

AFM changes.docx

Description:

Atomic Force Microscopy (AFM)images of the weathered LDPE-nanosilica samples and dark controls were acquired using a Veeco Multimode AFM with Nanoscope V controller and J-Scanner. Images were produced in “tapping mode” with TESP cantilevers with an image size of 30 um, speed of 0.3 Hz, and a resolution of 512 × 512 pixels. All images were taken near the center of each crystal imaged. AFM surface topography images compared LDPE-nanosilica with or without pro-oxidant and their dark control. AFM compared the roughness of the film surface.

Keywords:

AFM, surface, topography, tapping mode

**Data File #: 4**

Filenames (two data files):

Mechanical property changes.docx; rate constants mechanical change.docx

Description:

The ASTM D1777 test method was used to measure the thickness of the film material (Ames thickness; 28.7 mm presser foot diameter; 4.14 kPa). The ASTM D882 test method was used to measure tensile properties of thin plastic sheeting (MTS Q-Test/5; 50 mm gauge; 25 mm/min). The laboratory condition for testing was 71 ⁰F and 63% relative humidity. To measure mechanical properties of these films, dumb-bell-shaped tensile test specimens (central portions 5 - 0.5 mm thick, 22 mm gauge length) were cut in a Wallace cutting press and conditioned at 25 ⁰C and 55-60% relative humidity for 48 h. The values of Young’s modulus, yield stress, and elongation at break and tensile strength at the breakpoint were determined. At least four specimens were tested for each sample and the average values are reported.

Keywords:

 Mechanical, tensile properties, Young’s modulus, yield stress, elongation at break

**Data File #: 5**

Filename:

Weighting function.jpg

Description:

FTIR and mechanical data were used to determine rate constants for photo-fragmentation of the LDPE-nanosilica composites. The results showed that sunlight-induced weathering is wavelength-dependent and could be described by weighting functions that decreased exponentially with increasing wavelength. The weighting function derived from the data obtained in this study is shown in this figure. The figure compares the weighting function with the midday solar spectral irradiance for July 2018 at latitude 40°N on a cloudless day. Also the figure shows the “weighted irradiance” for the fragmentation. This cross-product of the irradiance and the weighting function has a peak at 330 nm. The peak represents the UV wavelength where sunlight is moist effective at fragmenting the plastic matrix of the composite.

Keywords:

 Fragmentation, weathering, weighting function, weighted irradiance