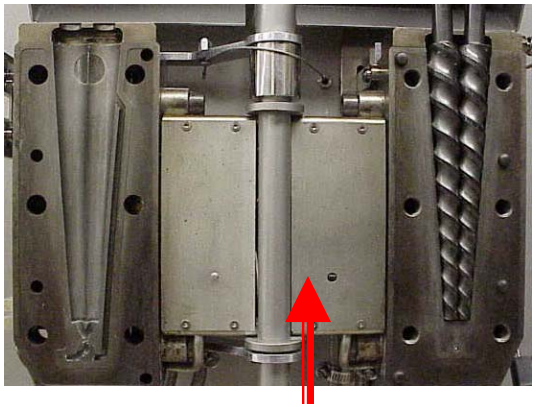
*Title:*Acquisition of Micro-Compounding Molding Systems for Polymers and Bio-based Materials Research & Education

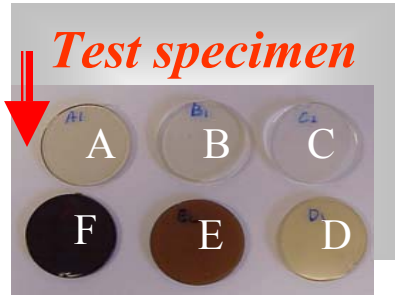
Lawrence T. Drzal and Amar K. Mohanty, Michigan State University

(NSF- DMR -2002 Award #: 0216865)



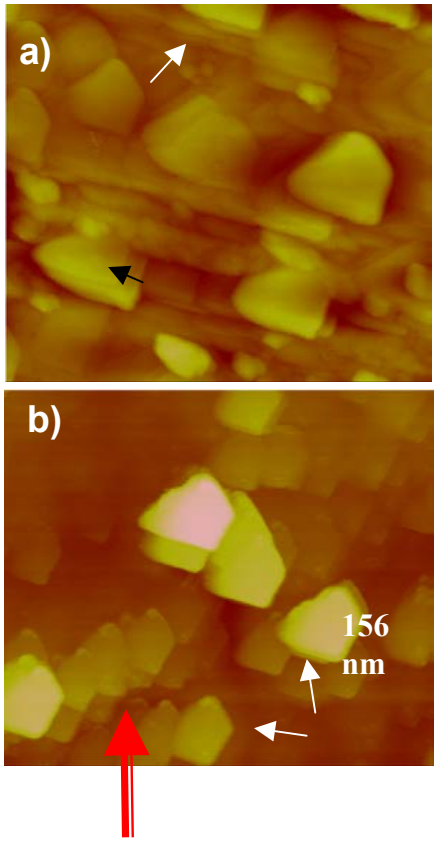
DSM mini-extruder-open

Injection molder



The acquisition of this DSM 15 Micro Extruder and Injection Molder by Michigan State University provided hands-on laboratory experiences and opportunities for graduate, undergraduate, and high school students as well as post-doctoral researchers working in the area of polymer blending, polymer composites and nanocomposites.

Example: NSF-NER Project - "Cellulose Ester(CA) /Clay Nanocomposites Processing and Characterization."



Plasticized Cellulose Ester / compatibilizer /organoclay hybrid: a) AFM without compatibizer b) AFM with compatibilizer

AFM characterization was conducted using a Nanoscope IV atomic force microscope from Digital Instruments (Santa Barbara, CA) equipped with an E scanner. Samples were mounted onto a stainless steel disk using a sticky tab (Latham, NY). The microscope was allowed to thermally equilibrate for thirty minutes before imaging. Scanning rates less than 1 Hz were used. Room temperature was maintained at 22 $\pm$ 1 ºC. Images were recorded in tapping mode using etched silicon probes (Digital Instruments). The parameters, especially the set point and the gains, were adjusted to obtain the best image resolution. For every sample, images were collected at different locations to obtain reproducible and reliable images. Most images are presented without further treatment unless specified. The sample surfaces were prepared by cross, plane, sectioning with a diamond knife at room temperature. The sample surface was polished with 4000# grit paper until a smooth surface was obtained. Figure a)and b) show AFM height images of the nanocomposites without compatibilizer (Figure a) and with 5 wt.-% compatibilizer (Figure b), respectively. An advantage of AFM imaging is the relatively high phase contrast between the soft matrix and the hard silicate particles of the nanocomposites. The images show that the plasticized CA/organoclay/compatibilizer hybrid has better exfoliation nanocomposites than the counterparts without compatibilizer. The intercalated structure of clay is dominant in Figure a) as labeled by the arrows. Completely exfoliated clay can be seen clearly in Figure b)(showed by arrows), coexisting with the intercalated clay particles.

*Title:*Acquisition of Micro-Compounding Molding Systems for Polymers and Bio-based Materials Research & Education

Lawrence T. Drzal and Amar K. Mohanty, Michigan State University

(NSF- DMR -2002 Award #: 0216865)

Research & Education:This equipment has been a key factor in the expansion of polymeric and composite materials research and education at Michigan State University.

Twenty(20) researchers(undergraduate/ graduate students, high school students, visiting scholar and postdocs), from the Chemical Engineering and Materials Science, Composite Materials Structures Center and The School of Packaging Departments have operated this instrument with 6 NSF, 2 USDA, and 3 company projects

Findings: The major research findings from this instrumentation project include: (i) investigation of fundamental phenomena in newly developed biobased materials and polymers, (ii) optimization of processing parameters at the micro-scale to establish structure, property, and performance relations and (iii) expansion of the integration of research and education in a research-intensive environment.

Graduate student Yash Parulekar explains the operation of the DSM microcompounding and molding machine to high school students, Selena Purvis and Courtney Butts (Summer 2004 Multicultural Apprentice program/MAP, Michigan State University)