FACILITIES, EQUIPMENT, AND OTHER

The Ingram School of Engineering and the Department of Engineering Technology, Texas State University-San Marcos has state-of-the art laboratories in the areas of 'Composites and Plastics', 'Microelectronics Manufacturing: Clean Room', 'Ceramics Engineering', 'Rapid Manufacturing', 'Human Machine Factor', 'CAD and CNC' , 'Foundry and Metal Casting', 'Robotics', 'Computer Integrated Manufacturing', and 'Material Testing'. The equipment in these labs can be viewed at link: http://www.engineering.txstate.edu/labs.html. The most used lab for this project will be 'Advanced Composites Lab'. Pages 1-3 of this document explains on safety majors in handling nanoparticles; page 4-5 lists rules and policies in 'Advanced Composites Lab'.

Safety Training on Mechanical Tooling and Hazardous Materials

All faculty, staff, and students using these labs have to undergo safety training provided by 'Mr. Ray Cook, Chief Technician, The Ingram School of Engineering' and 'Ms. Elsie Romano, Industrial Hygiene, Environmental Health Safety & Risk Management (EHS & RM)' in the areas of 'Mechanical tooling', 'Hazardous Communication', 'Hazardous Waste Disposal', and 'Respiratory Protection'. All students need to pass quizzes in these areas before they start using facilities. All labs involving hazards materials and safety concerns are inspected monthly by EHS & RM. Deficiencies are reported to lab manager and head of the department. In case these deficiencies are not addressed on time, then use of particular equipment or entire lab is not allowed.

Handling of Dry Nanoparticles: 'Composites and Plastics Lab- CPL'
http://composites.engineering.txstate.edu/resources/nano-handling.html

The 'Advanced Composites Lab' is maintained by Dr. Jitendra Tate. This lab uses different types of industrial nanoparticles such as nanoclays and Hollysoite Nanotubes (HNT); and engineered nanoparticles such as multiwall carbon nanotubes (MWCNT). These dry nanoparticles are dispersed with liquid thermoset resins using different mixing techniques such as high shear mixer, sonication, centrifugal mixer, and low-shear mechanical mixer. These nanomodified resins are further used in composite manufacturing processes such as vacuum infusion and compression molding.

Half-mask Respirators and 'Pulmonary Function Test (PFT)'

Experimenters have to use half-mask respirators while handling dry nanoparticles. The appropriate filters need to be used. The log of 'use of filter' is maintained. The filters are not used more than its specified life (usually 8 hours). There is special training organized by EHS & RM on use of 'Respirators'. All faculty, staff, and students using 'Respirators' have to take 'Pulmonary Function Test (PFT)' at the Department of Respirator Care with Dr. Greg Marshall. Unqualified people are not allowed to use the respirators and in turn are not allowed to experiment with dry nanoparticles.

Special care is taken while handling and storing dry nanoparticles. Handling dry nanoparticles in open atmosphere is not allowed. Two methods have been developed to handle dry nanoclays and dry carbon nanotubes.

Specialized Glove Box for Nanoclays

Dry nanoclays are stored and handled in a specialized glove box. The experimenter has to mix dry nanoparticles in the liquid polymer resin or solvent inside the glove box (refer figure 1) and then only should transfer to other equipments such as high shear mixer or, centrifugal mixer. The high shear mixer is kept under a fume hood at all times (refer figure 3). There is definite protocol to be followed based on material system.

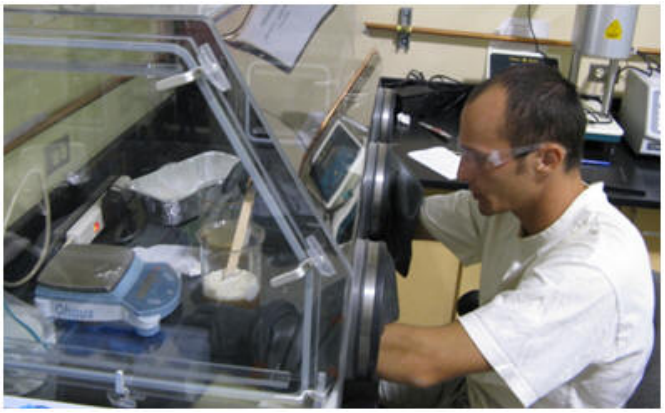

Figure 1. Specialized Glove Box to Handle Dry Nanoclays

Specialized Nanoparticle Containment Room for Carbon Nanotubes and Related materials

Handling of dry carbon nanotubes imposes certain health hazards. We do not allow the use of carbon nanotubes in the glove box. These classes of materials should be isolated from other lab part. Therefore, we ordered a portable clean room referred to as the 'Nanoparticle Containment Room'. This room is designed and manufactured (as per our requirements) by Liberty Industries, Inc. Berlin, CT 06023. This room has been installed in one small room within the lab. Please, refer Figure 2.

The Ingram School of Engineering has spent about $6000 on the glove box and $15,000 on the 'Nanoparticle Containment Room'. The following are the highlights of nanoparticle containment room.

- This is 8' x 10' hard-wall ready-made clean room
- This room maintains negative pressure and there is dedicated exhaust to this room (with blower on the roof).
- The filters used are ULPA (Ultra-Low Penetration Air) Filters rated 99.999% efficient with particles 0.12 microns (120 nm) in diameter. Traditional HEPA filters are good up to 0.3 microns (300 nm) with rated efficiency of 99.98%.
- Researchers who would like to use this room have to wear half-mask respirator, lab suit, and other personal protected equipments (PPE).
- All these people will have to pass 'Pulmonary Function Test' and undergo 'Respirator Training.'

Figure 3. High Shear Mixer Kept Under Fume Hood

Figure 2. Nanoparticle Containment Room

Activities in the Lab:

Composites Manufacturing

- Advanced polymeric composites using vacuum assisted resin transfer molding (VARTM) and compression molding
    - Polymer Nanocomposites
    - Bio-based composites
    - Sandwich composites
    - Hybrid composites

Plastics Manufacturing

- Injection molding
- Compression molding
- Extrusion
- Calendaring (manufacturing of prepreg materials)
- Dispersion of nanoparticles in liquid thermoset resins using sonication, high shear mixer, planetary centrifugal mixer, and low shear mechanical mixer

Characterization

- Mechanical testing- tension/compression/shear/bending; interlaminar shear; fracture, drop impact, Izod impact, and axial fatigue tests
- ThermoMechanical Analyzer (TMA): creep, coefficient of thermal expansion, and glass transition temperature
- Optical microscopy
-Thermal imaging

General Rules and Policies of the Composites and Plastics Lab (CPL)

Lab rules will be followed very strictly. You may be prohibited to use the lab, if you handle chemicals and/or nano-particles carelessly.

1. Before you start working in the lab you must have:
    a. Read 'Hazardous Communication' presentation and have passed the Quiz on TRACS.
    b. Read 'Respiratory Protection' presentation and have passed the Quiz on TRACS.
    c. Read 'Hazardous Waste Disposal' presentation and have passed the Quiz on TRACS.
    d. Schedule a PFT (Pulmonary Function Test) with the Respiratory Care Department and have passed it.
    e. Schedule to be Fit-Tested on Respirator with Environmental Health, Safety and Risk Management (EHS & RM) and have passed it.
2. Log book: There is a common log book. Everyone needs to sign-in and sign-out when using any of the instruments in the lab. Please book your dates a week before you like to use specific instrument/s.
3. Please read MSDS of chemicals that you will be using and follow instructions related to handling and storing.
4. Please perform experiments under the supervision of designated lab coordinator/s. Students are NOT allowed to work independently.
5. Please identify locations of all chemicals in the lab, MSDS folder, emergency phone numbers, eye wash and drench shower, first-aid, aprons, gloves, safety glasses, chemical storage areas, chemical disposal bins and emergency exits.
6.
7. Please wear full length pants in the lab at all times. No tank tops, spaghetti straps or bare midsection.
8. Please wear closed toed shoes in the lab at all times. No flip-flops, sandals, or chappals.
9. No food or drink is allowed in the lab.
10. You must wear appropriate Personal Protective Equipment (PPE) while working in the lab, especially when handling liquid chemicals. PPE: Lab coat, Gloves, aprons, safety glasses, face shields, nose masks, respirator are provided.
11. You MUST wear half-mask respirator when handling nanoparticles and when handling **polyurethane** resin.
12. Please maintain a clean work environment. Be considerate and leave your work area in a neat and clean condition.
13. If you create any mess (such as resin spill or fabric cutting) it is your responsibility to clean your mess immediately.
14. After using tools,gages, chemicals or other items, return them to their designated storage location immediately.
15. All small containers (having cured or uncured resin) must be placed under fume hood and MUST be labeled with a marker to indicate their content. These containers are called secondary containers.
16. Wash basin in the lab is ONLY for washing hands. Do NOT wash/clean glassware or plastics ware in wash basin.
17. If you break any equipment please report it immediately.
18. Do not leave any equipment running and unattended. You should be around.
19. Please shut off machines, mixers, vacuum pump once you are done.
20. If you are heating/curing any material overnight or for long hours, you MUST place a note on the oven indicating the material inside , when it was kept and when it should be removed.
21. Follow protocols for off cured, uncured resin, rags, VARTM bagging material, etc. Do not throw everything in garbage container. Place is designated satellite waste containers.
22. All nanoparticle contaminant waste such as wipes, rags, beakers, napkins, respirator cartridges etc. MUST be put in Zip-lock bag and kept in Nanoparticle Containment Room.
23. When in doubt, consult Ray Cook, Jason Wagner, Shane Arabie, Dr. Tate, or EHS&RM personnel. All important phone numbers are placed near MSDS folder.
24. Contact information in the Ingram School of Engineering:
    - Dr. Jitendra S. Tate, jt31@txstate.edu, office: 512-245-4875, cell: 336-509-0109, home: 512-722-6211.
    - Mr. Ray Cook, rc31@txstate.edu, office: 512-245-2050.
    - Ingram School of Engineering, office: 512-245-1826 or, 512-245-3058.

Special Instruction for Research Students

- Ask undergraduate students to write experimental procedure before they begin. Send me copy of procedure.
- Reading Haz Com, Haz Waste, and Respirator presentation is not sufficient. You need to strictly follow yourself and make students follow it.
- Before you file MSDS read **storage and handling and labeling** instructions carefully. [Remember that, NOT all resins and catalysts are labeled **RED]**.
- You must write receiving date and date when you opened the container on major and secondary containers.
- File MSDS in the folder immediately.
- File packing slip in appropriate folder immediately.
- File "Analysis Report" in Technical Data Sheet folder immediately.
- Do not remove any setup of your fellow research student without contacting him.

Below is a list of general regulations for the successful operation in the Nanoparticle Containment (NC) Room. Anyone working in this room must follow these guidelines.

1. All personal items such as keys, watches, and rings should be stored outside the nanoroom.
2. Valuable personal Items such as wallets may be permitted in the nanoroom provided they are NEVER removed from beneath the nanoroom garments.
3. NO eating, drinking, or gum chewing allowed inside the nanoroom.
4. Only approved room paper shall be allowed in the nanoroom.
5. Ball point pens shall be the only writing tool used.
6. Use of paper or fabric towels is prohibited. Use cleaning towels within the nanoroom.
7. Only approved gloves, pliers, tweezers should be used to handle product.
8. All tools, containers and fixtures used in the cleaning process should be cleaned to the same degree as the nanoroom surfaces.
9. NO tool should be allowed to rest on the surface of a bench or table. It should be place on a nanoroom wiper.
10. Only nanoroom approved wipers are allowed to be used.
11. NO ONE who is physically ill, especially with respiratory or stomach disorders, may enter nanoroom.
12. All nanoparticle contaminant waste such as wipes, rags, beakers, napkins, respirator cartridges etc. MUST be put in Zip-lock bag and kept in nanoroom.

Personal Actions Prohibited in NC Room:

1. Fast motions such as running, walking fast or horseplay.
2. Sitting or leaning on equipment or work surfaces.
3. Writing on equipment or garments.
4. Removal of items from beneath the nanoroom garments.
5. Wearing the nanoroom garment outside the nanoroom.
6. Wearing torn or soiled garments.

By signing below, I certify that I have carefully read rules and policies of the Composites and Plastics Lab. I have attended or, read 'Hazardous communication', 'Hazardous waste disposal', 'Respiratory Protection' presentations and have taken quizzes on it. I also have undergone safety training provided by Mr. Ray Cook or, his staff. Further, my signature indicates that I will abide by, and be responsive to, all rules and policies of the Composites and Plastics Lab.

Name (Print): _____ Signature: _____Date:_____