Environmental health and Safety (EH&S)
2809 Daley Drive
Ames, IA 50011-3660
Phone: (515)-294-5359
Fax: (515)-294-9357
www.ehs.iastate.edu

Standard Operating Procedure

Procedure: Separating different sized particles for intend applications.

Department: Bioeconomy Institute

Building/ Room Number: Biomass Preparation Room

Supervisor: Jacqulyn Baughman

Procedure Overview: Sieving is used to separate sample particles by size, either to isolate a particular size fraction for use or as a particle size distribution analysis. Sieves are essentially metal (or other material) screens with varying hole sizes to allow smaller particles to pass through. They are stacked with the largest-hole screens on the top and the finest on the bottom, with a solid pan underneath to collect particles that pass all the screens. Sizing is based on the width of the square screen openings, in inches, mm, or microns. One common alternative sizing system goes by number, referring to the number of openings per square inch; as the screen gets smaller, and the sieve number increases.

Hazard Control Measures:

- Safety glasses
- Dust mast/respirator
- Proper attire (no shorts, open-toed shoes, etc.)
- Lab coat and gloves are strongly recommended as samples often are very dirty.

Waste Disposal Procedures: Biomass can be placed in the non-hazardous waste garbage.

Decontamination Procedures: None

Spill Containment and clean up procedures: Biomass can be swept up or wiped with a wet cloth and disposed of in the garbage.

Using substances requiring special procedures: No

Written By: Catie Brewer **Date:** 5-25-2011

Revised By: Zach Bartlett **Date:** 10-3-2011

Approved By: **Date:**

Detailed procedures, operation instructions, maintenance, and emergency contact information list is attached.

Separating different sized particles for intend applications.

Equipment Description:

The Ro-TAP Model B Shaker is designed to allow analysts to obtain particle size distributions of various materials in a standardized way by delivering consistent vertical and horizontal force on a sieve stack. The sieves, usually 6 plus the bottom pan, are placed on the movable plate with stack supports to keep the sieves together and on the plate. Two legs of the plate are rotated by the motor, effectively shaking the sieve stack horizontally. On top of the sieve stack is a heavy lid with a cork in the center. A heavy metal bar is connected to the motor and, as the stack is shaken side to side, is moved up and down so that one ends "taps" on the cork. This creates the vertical force on the stack. Samples are normally shaken for a uniform amount of time, controlled by a time dial on the side of the instrument.

The main hazards involved in using this equipment are dust released during the shaking and sample handling, loud noise from the motor and mechanical tapping, and a pinch/crush risk while the shaker is running.

Pre-Run Checklist:

- Ro-TAP shaker is plugged in.
- If weighing will be done, appropriate balance is on and calibrated (Ohaus Voyager 200g by fast pyrolysis unit).
- Appropriate sieves have been selected and obtained from by the shaker or the upstairs cabinet.
- Selected sieves are clean. If not, use dry brush or gentle tapping on sieve frame (not screen) to remove particles.
- Sufficient sample is available if doing analysis. To be reliable, there is an acceptable range of mass loading values depending on the sieves used. For chars, this is ~50-100 g. See ASTM 6913 for more information and recommended masses.
- Heavy lid with cork is available near the shaker.

Potential Hazards:

- Noise: while the shaker is running, the noise level in the immediate vicinity is listed by the operator's manual as 80dB. For this reason, it is recommended that ear plugs be worn near the instrument or that the operator move to another part of the pilot plant floor while the shaker is running.
- Dust/particulate matter: most of the finer samples particles remain in the sieve stack during the shaking process as long as the heavy lid is on. These particles can (and often do) still become airborne during shaking or when performing samples transfer/weighing. Therefore, dust mask/respirators should be worn by all operators and others working in the immediate vicinity of the shaker or samples at all times. Do not run the shaker without a lid on the top sieve! If significant dust is produced, a venting system should also be used (such as "Fred").
- Pinch/crush risk: since the shaker involves mechanical moving parts, especially the heavy metal tapping bar, adjustments should not be made to the machine or the sieve stack during shaking. If a sieve starts to slip, for example, turn off the shaking by setting the time dial to zero, then make necessary adjustments to avoid pinching/crushing fingers.
- Combustion: some samples are combustible (i.e. char, biomass), especially as fine particulate matter. Therefore, keep flame and heat sources away from the shaker or wherever the samples are handled or stored.
- Electrical: as with all electrically-powered instruments, make sure the electrical cord is in good condition and plugged into a grounded, three-prong outlet.

Material Prep and Handling

1. Samples should be suitably stored. For char and feedstock, this means analysis samples in closed glass jars and larger bulk samples in Ziploc bags in secondary containment, preferably metal.
2. When collecting a sample for sieving, make sure that the bulk material is well mixed and that the sample is as representative as possible.
3. Samples should be air-dry and cool. They can be oven-dried, as long as this is noted in sample pretreatment information.

Equipment Operation

(Procedure assumes particle size distribution analysis for char, fluidized bed material or feedstock which requires weighing)

1. Assemble sieves into stacks of six sieves, a bottom pan and a top lid. If more than 6 sieves are required, create two or more stacks; the larger sieving will happen first, before transferring the pan contents to the top of the finer sieve stack and repeating the shaking. If less than 6 sieves are required, make up the difference with larger sieves that will pass all of the material.
    a. For example, char analysis requires 12 sieves, arranged in the following two stacks (from the top):

    Lid → 500, 300, 250, 180, 150, 125 µm → bottom pan

    Lid → 160, 90, 75, 63, 53, 45 µm → bottom pan
2. Use a weigh boat or spare bottom pan to weigh out sample and record initial sample mass.
3. Record the empty weight of each sieve and the bottom pan.
4. Pour sample onto top sieve and cover the whole stack with the lid.
5. Place stack on shaker plate.
6. Place heavy metal lid with cork on top of lid and set heavy metal tapper bar so that it rests on the cork.
7. Use wire tie around shaker plate supports to wrap around bottom pan. This keeps the bottom pan (and stack) from sliding over the plate lip during shaking.
8. Set the time dial to 10 min (or other appropriate time between 5-30 minutes). Shaking will begin as soon as dial is set. Shaker will stop when the time runs down or when the time dial is turned back to zero.
9. Once shaking is finished, remove stack from the shaker.
10. Record the "full" weight of each sieve and the bottom pan. Once a sieve has been weighed, empty the sample back into a sample jar and brush out/tap the sieve clean. (Sieves should be reweighed before being reloaded with the next sample since any particulate matter stuck in the screen can affect the empty weight.
11. If a second stack will be used, repeat steps 3-10 with the finer stack using the contents of the "big" stack bottom pan as the sample.
12. Calculate mass difference retained in each sieve and percentage of total sample. For a particle size distribution, the mass retained in a sieve will have a particle size between that sieve and the next larger one.
    a. For example, if 100 g was sieved using the char method and the 150 µm sieve contained 5 grams of char after shaking, then 5% of the sample has a particle size between 150 and 180 µm.

Clean up

1. After the last sample has been sieved, make sure that all of the sieves are clean. If brushing/tapping does not effectively remove particulate, air or running water can be run through the screens. If water is used, shake off excess water, gently wipe out sieve with paper towel and allow it to dry.

2. Return sieves to where they were found, either near the shaker or to the upstairs cabinet; keep sieves organized by size.
3. Clean of balance with wet paper towel. Use brush or Shop-vac to clean up scale area of dust.
4. Unplug shaker. Use Shop-vac (or brush) to clean up any dust. Wipe down vacuumed surfaces of shaker with damp cloth as needed.
5. Return samples to appropriate storage locations; this can include returning the sample to the bulk material.

Emergency Contacts

Jacqulyn Baughman
Lab Supervisor
Office: (515) 29**4-7660** Cell: (414) 460-5776

Catie Brewer
Graduate Research Assistant
Cell: (206) 290-1234

Marjorie Rover
Lab Manager
Office: (515) 294-2984 Cell: (319) 230-1163 Home: (515) 292-3671

Ryan Smith
BEI Program Coordinator
Office: (515) 294-6244 Cell: (515) 203-1640 Home: (719) 660-2262

Dr. Robert Brown
BEI/CSET Director
Office: (515) 294-7934 Cell: (515) 520-1337 Home (515) 460-3434

Approved Trainers:
Adrian Ramirez, Zach Bartlett,

Training Sign-Off

Trainee	Date	Trainer