

SECTION 4

SHORT TERM AND SIMULATED WEATHERING

4.1 LABORATORY AND FIELD METHODS

4.1.1 Summary

Physical and chemical changes inevitably occur in the changed environment of disturbed materials. The methods presented here provide a basis for estimating rate and degree of change.

A mild slaking test identifies materials that will disintegrate quickly when left exposed at the surface of a minesoil. These materials will provide fines in minesoil profiles.

The Physical Weathering Potential (P.W.P.) method disintegrates earth and rock fragments unless they are strongly cemented. Materials surviving this test should persist in loose rock flumes or valley fills. Fines measured by this method will form under intense weathering at the surface but will not necessarily form when rocks are covered in minesoils.

The modified Sieve Analysis after Intermediate Disaggregation (SAID) method disaggregates rock fragments less violently than P.W.P. but more than Standardized Slaking. Modified SAID provides an estimate of rock particles that soil scientists commonly consider coarse fragments rather than soil fines.

Field Weathering Plots evaluate rock stability or breakdown under exposed outdoor conditions in a particular climate. This method standardizes what happens on the surface of minesoils and helps to calibrate laboratory measurements of disintegration. It can be interpreted directly into recommended placement of disturbed materials and aids the study of variables that cause rock stability.

Stimulated Weathering Cells provide standard laboratory conditions for measuring rate and degree of change under favorable conditions for special reactions. The major focus has been sulfate and acid formation from pyritic forms of sulfur. The same approach applies to other chemical or physical changes.

4.1.2 Standardized Slaking

4.1.2.1 Principle--

An air-dry fragment of soil or rock when quickly submerged in water is subjected to forces that will break it apart if the individual grains are not firmly cemented together. The disruptive forces are caused by the release of air trapped in the pores of the fragment. As the water moves into the pore system, the air is compressed by surface tension causing pressures that may become great enough to break the fragment into small pieces.

4.1.2.2 Comments--

This method uses a mild treatment to get an index of physical weathering. It is simple, semiquantitative, and can be done in the field as well as the laboratory.

Many samples break into smaller pieces, but the pieces sometimes slump into a pile and do not fall through the 6.35 mm sieve. Physical overlap and surface tension may hold the small pieces of sample together on top of the sieve. To overcome this problem the standard liquid limit device has been tried and calibrated. It shakes the pieces apart and allows them to fall through the sieve.

4.1.2.3 Chemicals--

Distilled or tap water

4.1.2.4 Materials--

1. 250 ml beakers.
2. Hardware cloth, 6.35 mm (0.25 in) openings.
3. Paper clips.
4. Standard liquid limit device (Sowers, 1965, Fig. 1-1, p. 395) adjusted to drop a distance of 1 cm.

4.1.2.5 Procedure (Modified and updated from Smith et al., 1976)--

1. Select one or more rock fragments weighing approximately 15.0 g.
2. Cut hardware cloth to fit inside of beaker.
3. Suspend the hardware cloth in the beaker by large paper clips hooked over the rim.
4. Fill beaker with enough water (distilled or tap) to cover sieve and fragment to be tested.

5. Place fragment on sieve and let sample stand undisturbed for 30 minutes.
6. Place beaker in cup of standard liquid limit device and turn crank 20 times at a rate of one revolution per second. NOTE: After every five revolutions, straighten beaker without changing the rate if necessary to keep the beaker upright.
7. Visually estimate the percentage of material which has fallen through the sieve, using a scale of 0 through 10 to represent 0 to 100 percent.

4.1.3 Physical Weathering Potential

4.1.3.1 Principle--

The procedure was developed by combining features of methods by Bouyoucos (1951), Tyner (1940), Day (1956), and Kilmer and Alexander (1949). Rocks are artificially weathered by treatment with a dispersing agent while shaking on a reciprocating shaker for 16 hours. The particle size distribution of material passing a 2 mm sieve is determined by mechanical analysis. In this procedure, materials are subjected to vigorous treatment to get a measure of particle sizes.

4.1.3.2 Comments--

The particle size distribution can be determined by either the hydrometer or pipet method. If the pipet method is used, be sure to read method 3.4.2 carefully before starting.

Temperature is quite important to the sedimentation procedure. Although correction factors are given, the procedure is best carried out in a constant temperature room or by placing the cylinders in a constant temperature bath. Care must be taken not to touch materials retained on the sieves with anything but a gentle stream of water during the washing process.

If the temperature corrected hydrometer reading for a particular size fraction equals the temperature corrected reading for the dispersing agent, that particle size is recorded as a "trace."

4.1.3.3 Chemicals--

Dispersing agent: Instant Calgon (see 3.2.2) or dissolve 35.7 g glassy sodium metaphosphate ($\text{Na}(\text{PO}_3)_6$) (Fisher Scientific No. S-333 or equivalent) and 7.94 g sodium carbonate (Na_2CO_3) in distilled water and dilute to one liter. The Na_2CO_3 is used as an alkaline buffer to prevent the hydrolysis of the metaphosphate back to the orthophosphate which occurs in acidic solutions.

4.1.3.4 Materials--

1. Bottles, French square, 1 liter (32 oz) with caps.

2. Shaker, horizontal reciprocating type, 6.3 cm (2.5 in) stroke, 120 strokes per minute.
3. Standard soil hydrometer (ASTM 152H, with Bouyoucos scale in grams per liter).
4. Glass sedimentation cylinders with markings at 1130 and 1205 ml levels (Bouyoucos cylinders).
5. Balance, can be read to 0.1 g.
6. Drying oven.
7. Weighing pans.
8. Thermometer, 0-100°F.
9. Plunger (see 3.4.3.4).
10. Sieve, 2 mm (10 mesh) openings, 13 cm (5 in) diameter.
11. Sieve, 6.35 mm (0.25 in) openings, 13 cm (5 in) diameter.
12. Powder funnel, large diameter to hold 2 mm sieve.

4.1.3.5 Procedure--

1. Dry intact rock fragments, between 13 and 38 mm in diameter, overnight in an oven set at 50°C.
2. The rock fragments are weighed (\pm 0.1 g) on a tared pan. Record as oven-dry weight (A). NOTE: Place no more than a 100.0 g sample of sandstone (no more than a 50.0 g sample of other rock types) in a one liter shaker bottle.
3. Add 125 ml of dispersing agent and 400 ml of distilled water to the bottle.
4. Cap bottle snugly and place horizontally on a reciprocating shaker for 16 hours at 120 strokes per minute.
5. Remove bottle and allow to cool to room temperature.
6. Put a wide-mouth powder funnel in a sedimentation cylinder and insert the 6.35 mm sieve on top of the 2 mm sieve in the funnel.
7. Transfer sample to sedimentation cylinder by pouring suspension through sieves. NOTE: Wash all sediment from bottle by holding bottle at a 45° angle with mouth of bottle over center of sieve. Direct a jet of distilled water upward into bottle, sweeping all particles out by the force of the water stream.

8. Carefully and thoroughly wash particles retained on sieves with a gentle stream of distilled water. CAUTION: Do not touch particles with anything but a stream of water. Do not exceed two-thirds the cylinder volume during washing.
9. Carefully remove sieves from funnel. Transfer material retained on each sieve to a separate tared weighing pan. NOTE: To make this transfer without losing material is important. The means of making the transfer can be with a jet of water, tapping material gently off sieves, picking material off by hand, etc.
10. Put weighing pan and material in oven at 105°C overnight. Weigh (± 0.1 g) material and record weight of greater than 6.35 mm material (B) and weight of 6.35 to 2 mm material (C).
11. Set cylinder in a place free from vibrations.
12. Place hydrometer in suspension.
13. Fill cylinder to upper mark (1205 ml) with distilled water for a sample between 50.0 and 100.0 g. Fill to lower mark (1130 ml) for 50.0 g sample.
14. Remove hydrometer. Take plunger in one hand holding cylinder with the other. Strongly move plunger up and down being careful not to spill contents of cylinder.
15. After all sediment is off the cylinder bottom, carefully remove plunger. Record time.
16. Record hydrometer reading at meniscus top at the end of 40 seconds. NOTE: About 10 seconds before taking reading, carefully insert hydrometer and steady by hand.
17. Remove hydrometer from suspension. CAUTION: Do not leave hydrometer in suspension longer than 20 seconds as particles will settle out on its shoulders.
18. Record suspension temperature. For each °F above calibrated temperature of the hydrometer, add 0.2 g to the reading. For each °F below calibrated temperature, subtract 0.2 g.
19. Record corrected hydrometer reading (D).
20. With the plunger, restir suspension. Take a reading at the end of 2 hours. Correct hydrometer reading (see step 18) and record corrected hydrometer reading (E).
21. Make 3 blanks by placing 125 ml of dispersing agent in 3 sedimentation cylinders.

22. Fill cylinder two-thirds full with distilled water. Insert hydrometer and fill cylinder to the lower mark (1130 ml) with distilled water.

23. Take hydrometer reading and temperature of suspension. Correct hydrometer reading using step 18 and record corrected hydrometer readings of the blanks (F_1 , F_2 , and F_3).

4.1.3.6 Calculations--

1. Legend:

A = Oven-dry wt. of rock fragments (excluding weighing pan).

B = Oven-dry wt. of material retained on 6.35 mm sieve (excluding weighing pan).

C = Oven-dry wt. of material retained on 2 mm sieve (excluding weighing pan).

D = Temperature corrected 40 second hydrometer reading.

E = Temperature corrected 2 hour hydrometer reading.

F_1 = Temperature corrected reading of first blank.

F_2 = Temperature corrected reading of second blank.

F_3 = Temperature corrected reading of third blank.

G = Dispersing agent correction factor.

2. $G = (F_1 + F_2 + F_3)/3$.

3. % material greater than 6.35 mm in diameter = $(B/A) \times 100$.

4. % material between 2 and 6.35 mm in diameter = $(C/A) \times 100$.

5. Weight corrected 2 hour reading = $E - G$.

6. Weight corrected 40 second reading = $D - G$.

7. % clay = $(\text{Weight corrected 2 hour reading}/A) \times 100$.

8. % silt = $[(\text{Weight corrected 40 second reading} - \text{weight corrected 2 hour reading})/A] \times 100$.

9. % sand = $100 - (\% \text{ material greater than 6.35 mm} + \% \text{ material between 2 and 6.35 mm} + \% \text{ clay} + \% \text{ silt})$.

4.1.4 Modified SAID

4.1.4.1 Principle--

This method uses a combination of slaking and a minimum of vigorous shaking to decompose a rock fragment. The suspension is passed through a nest of sieves and washed with water. The amount of material retained on each sieve is then calculated as a percent of the total sample.

4.1.4.2 Comments--

The term SAID was coined and defined by Soil Survey Staff (1970). The translation is: Sieve Analysis after Intermediate Disaggregation. Our modified SAID retains the original idea of the method but changes details to satisfy objectives of this manual.

The procedure is designed particularly for normal shales, mudstones, and other materials which tend to break-down easily. It provides a laboratory measurement needed to help predict field behavior and for correlation with other methods. It is intermediate in intensity between Slaking (4.1.2) and Physical Weathering Potential (4.1.3).

4.1.4.3 Chemicals--

1. Dispersing agent: Sodium metaphosphate ($\text{Na}(\text{PO}_3)_6$) available from Fisher Scientific Company No. S-333 or Instant Calgon available from Calgon Corporation, Pittsburgh, Pennsylvania).
2. Water, tap.

4.1.4.4 Materials--

1. Sieve, 6.35 mm (0.25 in) openings, U.S. Standard, 20.3 cm (8 in) diameter.
2. Sieve, 2 mm (10 mesh) openings, U.S. Standard, 20.3 cm (8 in) diameter.
3. Sieve, 0.1 mm (140 mesh) openings, U.S. Standard, 20.3 cm (8 in) diameter.
4. Balance, can be read 0.01 g.
5. Flasks, Erlenmeyer, 2 liter capacity with rubber stoppers.
6. Aluminum cake tins, 23 cm (9 in) diameter.

4.1.4.5 Procedure--

1. Rock fragments between 13 and 20 mm in diameter are air dried.
2. Take a representative sample of approximately 50 g. Weigh in tared pan and record weight (A).

3. Place sample in a 2 liter Erlenmeyer flask.
4. Add 1 liter of tap water and 1 heaping teaspoon (about 5 g) of dispersing agent.
5. Gently swirl, stopper, and let stand overnight.
6. Again swirl gently to free soil from bottom of flask.
7. Rotate end for end vigorously 10 times.
8. Pass through a nest of 3 sieves with 6.35 mm, 2.0 mm and 0.1 mm openings.
9. Wash the samples left on the sieves with a gentle stream of tap water and allow time for air drying.
10. Vigorously shake the air-dry separates from side to side on sieves for 1 minute.
11. Weigh material retained on 6.35 mm sieve in tared pan and record weight (B).
12. Weigh material retained on 2 mm sieve in tared pan and record weight (C).
13. Weigh material retained on 0.1 mm sieve in tared pan and record weight (D).

4.1.4.6 Calculations--

1. Legend:

A = Air-dry wt. of sample (excluding weighing pan).

B = Air-dry wt. of material retained on 6.35 mm sieve (excluding weighing pan).

C = Air-dry wt. of material retained on 2 mm sieve (excluding weighing pan).

D = Air-dry wt. of material retained on 0.1 mm sieve (excluding weighing pan).

2. % material greater than 6.35 mm = $(B/A) \times 100$.
3. % material between 2 and 6.35 mm = $(C/A) \times 100$.
4. % material between 0.1 and 2 mm = $(D/A) \times 100$.
5. % material less than 6.35 mm = $100 - (\text{calculation no. 2})$.
6. % material less than 0.1 mm = $100 - (\text{calculation no. 2} + \text{no. 3} + \text{no. 4})$.

4.1.5 Simulated Weathering Cells

4.1.5.1 Principle --

Processes of chemical weathering that take place during acid generation are: solution, oxidation, hydration, and hydrolysis, with oxidation usually emphasized. Carrucio (1967) stated that the oxidation of pyrite was affected by four factors: oxygen, temperature, mode of iron disulfide, and bacteria. He refined laboratory cells to provide standard conditions for measuring acid generation rates of selected materials. Other variables influencing rates include exposed surface area, catalytic agents, pH, ferric iron, and mineral species other than iron disulfide. The cells described here provide simple control over air, temperature, moisture, and microbes. Conditions created are relatively favorable to formation of sulfates and related compounds. Different materials can be compared and rated. Special treatments (i.e. lime rates) can be imposed to help answer theoretical and practical questions.

The end products have to be removed or the rate of oxidation will decrease. Decomposition products form coatings on particles and effectively close off the exposed surfaces. The decomposition products are removed by leaching the sample with distilled water at the end of each treatment cycle. Measurements are then made on the leachate.

4.1.5.2 Comments--

Empirical comparisons of materials and treatments afforded by this method may be interpreted directly into likely field behavior or may serve to reinforce or calibrate other laboratory measurements of field experiences. Analyses identified will give a good indication of major reactions occurring in samples. Additional analyses will satisfy specific objectives related to plant nutrients or toxic elements.

For each cell, the graduated cylinder, beaker, and centrifuge tubes into which the water extract is poured should be labeled the same as the cell. It is better to take a little time labelling everything clearly and distinctly, than to save time and get two or three samples intermixed.

4.1.5.3 Chemicals--

1. Distilled water (H_2O).
2. Sodium hydroxide (NaOH), 1 N stock solution : Dissolve 40.0 g NaOH (electrolytic pellets) in carbon dioxide-free, distilled water (see 3.2.3.3 No. 1) and dilute to 1 liter. Protect from the atmosphere using an ascarite guard tube.
3. Sodium hydroxide (NaOH), 0.01 N : Pipet 10 ml of 1 N NaOH into a 1 liter volumetric flask and dilute to volume with carbon dioxide-free, distilled water (see 3.2.3.3 No. 1). Protect from the atmosphere using an ascarite guard tube.

4.1.5.4 Materials--

1. Plastic shoe box. The plastic shoe box is used to make a leaching chamber. The chamber is constructed by drilling a 6.35 mm (0.25 in) hole in the center of one of the short sides of the box. Reverse box and drill a 6.35 mm (0.25 in) hole at the base of the other short side in the right hand corner. Plexiglass tubing is inserted and bonded with a nonwater-soluble glue to the box. Be sure that the plexiglass tubing bonded to the box is 2.5 cm (1 in) long with equal lengths on both the inside and outside of box. The hole in the center is used for the entrance of dry and moistened air. While the hole in the corner is used as an exit. The lid should be sealed using a non-hardening putty weatherstripping.

2. Wide-mouth jar, screw lid. (Mason type) - The jar is used as a humidifier. Two 6.35 mm (0.25 in) holes are drilled in the lid and copper tubing, 2.5 cm (1 in) long, is inserted and soldered in place. From the bottom of the lid flexible plastic tubing is attached to one piece of copper tubing and to an aerating stone, which rests on the bottom of the bottle. The copper tubing, which is attached to the aerating stone inside the bottle, is attached to an external air source. To the other copper tubing insert, attach flexible plastic tubing to the inlet tube of the leaching chamber.

3. Aerating stone.

4. Pipet, 20 ml volumetric.

5. Flexible plastic tubing (Tygon or equivalent).

6. Compressed air source.

7. Sieve, 2 mm (10 mesh) openings.

8. Graduated cylinders, 100 ml capacity, plastic or glass.

9. Microburet, 10 ml capacity, graduations in 0.02 ml (Kimax 17110F or equivalent).

10. Meniscus magnifier for above buret.

11. pH meter (Corning Model 12 or Equivalent), with combination electrode.

12. Wheatstone bridge, (see 3.2.18.4, no. 1).

13. HACH water test kit (Model DR-EL or equivalent).

14. Conductivity cell, pipet type, with cell constant of 1.0 reciprocal centimeter.

15. Beaker, 250 ml.

4.1.5.5 Procedure--

1. Crush sample to pass a 2 mm sieve. NOTE: Subsampling and grinding are done according to method 3.1.2; however, after the material has been crushed to 6.35 mm (0.25 in) size, the material is split into equal halves. One-half is used for this weathering experiment. The other half is subsampled and ground according to method 3.1.2 for chemical analyses.
2. Place 200 g of less than 2 mm material in the specially designed cell and spread evenly across the bottom. The sample is then thoroughly moistened with distilled water. NOTE: At this time the cell and sample can be inoculated with bacteria to catalyze the oxidation reaction.
3. The lid is sealed tightly to the bottom of the cell and the air line is attached to the air source. The experiment runs in a 7 day cycle. For the first three days, dry air is passed over the sample. Then for the next three days, moistened air is passed over the sample by filling the wide-mouth jar about half full with water and allowing air from the aerating stone to pass through the water.
4. On the last day of the cycle, 200 ml of distilled water is added to each cell. The sample is allowed to soak for one hour.
5. After soaking, the cell is drained through the plexiglass tubing at the front of the cell into a beaker. NOTE: If the water extract is turbid, spin the water extract down in a centrifuge. Pour off the supernatant liquid into a graduated cylinder and set aside. With a small amount of distilled water, resuspend the fine material in the bottom of the centrifuge tube and pour back into its proper cell.
6. The cycle of dry air and moist air passing over the sample in the cell is started over.
7. The water extract from each cell is measured in a graduated cylinder and the volume recorded (A).
8. Measure the electrical conductivity (see 3.2.18.5) of the water extract.
9. A 25 ml aliquot of the water extract will be taken and used to measure sulfate concentration using a HACH DR-EL kit. Record instrument reading of sulfate concentration (B).
10. Measure the pH (see 3.2.2.5) of the water extract. NOTE: When the pH of water extract is 7.0 or higher, titratable acidity is zero and steps 11 through 13 are omitted.
11. The remaining water extract is transferred to a beaker and heated to boiling to drive off any dissolved CO₂.
12. After the water extract has boiled for one minute the beaker is transferred to a desiccator, which contains no dessicant, and allowed to

come to room temperature. NOTE: An ascarite tube is placed inside the desiccator to remove any CO₂ in the air.

13. After cooling, the water extract is titrated to pH 7.0 with 0.01 N NaOH. Record volume of titrant used (C).

4.1.5.6 Calculations--

1. Legend:

A = Volume of water extract.

B = Sulfate concentration (ppm).

C = Volume of titrant used.

TS = Total sulfates (mg/100 g).

TA = Titratable acidity (ppm).

DF = Dilution factor.

2. Electrical conductivity. This measurement will be recorded for each water extract and will be plotted on a graph versus time.

3. pH. This measurement will be made on each water extract and will be plotted on a graph versus time.

4. $TS = [B \times DF \times (A/25)]/200$, where DF = 25/volume of extract used. This measurement will be made on each water extract. It will be plotted on a graph versus time. Also, it will be plotted as accumulative sulfates released versus time.

5. $TA = [(C \times 0.01 \text{ N}) \times (A/(A - 25))] \times 5$. Titratable acidity will be plotted on a graph versus time. On another graph, accumulative titratable acidity versus time will be plotted.

4.1.6 Field Weathering Plots

4.1.6.1 Principle--

A group of standard plots under uniform outdoor conditions constitutes a weathering yard for that particular climate. The purpose of a weathering yard is to provide a standard near-natural means of comparing and rating the stability of rock or earth fragments selected to represent materials of special interest. Standard exposure affords comparison between paired samples and calibration of breakdown against descriptive properties, laboratory measurements, and weather events. Periodic descriptions, photographs, and weights record sample changes over time. Special tests involve surface placement versus shallow burial, flat versus upright orientation of bedded samples, contact with acid versus alkaline substrate, and other variables. This yard provides ratings that can help operators and

regulatory people decide which rocks to choose for selective placement for a particular purpose.

4.1.6.2 Comments--

Care must be exercised to insure that representative samples of a rock are selected for exposure in the weathering yard. To facilitate observations and hamper sample manipulation by rodents, vegetative growth in the plot rows is controlled with periodic sprayings of herbicide.

Plastic fence should be periodically checked to insure their security, especially during periods of freezing and thawing of the ground. If the fence is not securely in the ground, the sand cushion may be lost. A sand cushion was chosen because rodents tended to remove cushions of nylon or cloth. A coarse (0.84 - 0.50 mm), pure silica sand is used to facilitate the separation of the weathered particles from the cushion. Due to its inert nature, pure silica will not markedly change size nor affect the sample weathering.

A grid system was utilized to facilitate sample location and number. The even numbered rows contain 25 plots each, designated "A" through "Y". The odd numbered rows allow passage through the weathering yard and contain no plots. Each plot is 2 X 2 m with space for four subplots designated "a" through "d" in a clockwise direction from the upper left corner. The weathering yard should be located away from possible flood or other damage and in an open area where samples will not be sheltered from sun or rain actions. Duplicate samples should be evaluated.

4.1.6.3 Chemicals--

1. Herbicide (Paraquat or equivalent).
2. Hydrochloric acid (HCl), 1 part acid to 3 parts water : Dilute 250 ml of concentrated HCl to 1 liter with distilled water.

4.1.6.4 Materials--

1. Plastic yard trimming fence, 15 cm (6 in) high, cut in 60 cm (24 in) lengths. A circle is formed from each length, overlapping the ends by about 5 cm (2 in) and stapling together with 6 staples.
2. Pure silica sand, 0.84 to 0.50 mm diameter (Ottawa flint shot, Berkeley Springs 2Z sand, or equivalent). The sand is sieved through a nested 20 mesh (0.84 mm openings) sieve and a 35 mesh (0.50 mm openings) sieve with a 2 minute hand shaking time. Sand retained on the 35 mesh sieve is used on the weathering plots.
3. Sieve, 0.84 mm (20 mesh) openings, 20.3 cm (8 in) diameter.
4. Sieve, 0.50 mm (35 mesh) openings, 20.3 cm (8 in) diameter.
5. Balance, can be read to 0.01 g.

6. Tile spade.
7. Metric ruler.
8. Munsell color book (available from Munsell Color Division, Kollmorgen Corporation, Baltimore, Maryland 21218).
9. Knife.
10. Weather station (optional). Required if accurate weathering conditions are required.

4.1.6.5 Procedure--

1. Select a 5 to 10 cm representative rock sample.
2. Weigh sample to the nearest 0.01 g.
3. Obtain a Munsell color of the matrix, streak, and any noticeable spots or films (see 2.1.3).
4. Determine rock type (see 2.1.2) and record hardness (see 2.1.4).
5. Check for presence of calcareous material (see 2.1.5), and other rock features (see 2.1.6 and 2.1.7).
6. Dig a round hole with the tile spade 15 cm (6 in) in diameter and 5 cm (2 in) deep.
7. Place prepared plastic fence in hole, placing soil around both the inside and the outside to hold it in place. Leave the inside depth 4 cm (1.5 in) below ground level.
8. Place 4 cm (1.5 in) of prepared pure silica sand inside the plastic fence.
9. Place rock sample on the sand.
10. Describe samples periodically in the field using the following criteria:
 - a. Is it breaking down? If so, describe.
 - b. If cracks are developing, are they regular or irregular?
 - c. Have there been any color changes?
 - d. Are there any other unusual qualities of the sample?
11. A daily record of high and low temperature and rainfall should be maintained.

12. Carefully take intact samples into laboratory periodically for weighing.

13. After samples have been broken down, remove them from the field, weigh and do a hydrometer mechanical analysis (see 3.4.4) on the less than 2 mm fractions.

14. At the end of a study remove the remaining resistant rocks, describe, weigh, and report their percent weight loss.

4.1.6.6 Calculations--

% weight loss = [(Initial wt. - Terminal wt.)/Initial wt.] X 100.