DIRECT MEASUREMENT OF SURFACE LITTER MOISTURE CONTENT

Introduction

With the introduction of the new Fire Behaviour Tables, it is now possible to predict the surface litter moisture contents of a number of major fuel types found in our forests. In order to test the accuracy of these moisture estimates it is necessary to obtain a field measurement of the average fuel moisture content of the fuel type under consideration. Such tests would be done on a regular weekly basis in a forest area representative of the majority of the type present in that Division or district.

Another use for direct moisture reading occurs when a prescribed burn is contemplated and where some doubts exist about the fuel moisture prediction for that area. Direct moisture readings will help establish the extremes of moisture levels found in each fuel type in the burn area under consideration. This can be achieved by sampling fuels in the exposed, drier aspects and on the shaded moister situations.

Direct reading of surface litter moisture contents is possible with the use of either

(i) the Marconi Moisture Meter

or (ii) the Speedy Moisture Meter.

The Marconi meter which measures the electrical resistance across a ground-up fuel sample has been found to be easier to use and slightly more reliable than the Speedy Meter. The latter is basically a pressure cylinder which measures the gas (acetylene) released on the reaction of added calcium carbide with the moisture in a measured weight of fuel. The range of moisture contents that can be measured with the Marconi is 7 to 30 percent (oven-dry weight basis) whereas the Speedy has a greater range of 7 to 50 percent (O.D.W.). The moisture contents at which hardwood and pine litter will ignite and burn is less than 25 percent and 35 percent respectively. For this reason it is recommended that the Marconi Meter be used for hardwood moisture sampling, and the Speedy Meter be used for pine fuels.

Sampling

(1) Location

Where the aim is to conduct weekly checks on the moisture content predictions, it is necessary to conduct such tests in a forest area representative of the selected forest type found in the Division. Such a stand should have an approximate 50 percent canopy cover, stand on level topography, and carry fuels of about 5 years old. The sampling area selected should be more than 50 metres away from forest roads, major openings, ridges or gullies. This is so that the fuels sampled are not excessively drier or wetter than in the average situation.

(2) Sampling Procedure

The fuel sampling collection is as follows:

Collect a small handful of dead non-decomposed leaf (or needle) litter off the surface (top 5 to 10 mm) at each of five positions about 10 metres apart. Gather the fuel in mottled

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sun/shade situations away from the base of trees. Collect enough fuel to fill a 1 litre container. Do not include bark, twigs, capsules, soil etc. Make sure hands are dry and clean of grease.

(3) Fuel Preparation

The collected fuel sample must be ground to a fine particle size in preparation for reading in either the Marconi or Speedy Meters, Fuels are ground in a Spong No. 10 mincer. It is important to obtain the final mince in the shortest possible time as the finely ground sample will lose moisture under hot conditions and thus give misleading results. For this reason also, the grinding and meter reading operations must be conducted in the shade. The minced fuel should be collected on a flat, clean surface. From this sample, obtain 3 subsamples for measurement in the moisture meter.

MARCONI Moisture Meter.

The Marconi meter is simply an ohm meter which measures the electrical resistance offered by a small sample of material (e.g. grain, leaves). The resistance is directly influenced by the amount of moisture present within the fuel; the higher the moisture content the lower the resistance and vice versa. As temperature also affects the resistivity it is allowed for in the moisture readings. The Marconi is used in the following manner.

1. Preparation

Set up the instrument on a flat surface in the shade. Position the clamp and connect up the red and black leads to their respective sockets in the compartment of the meter. Leave the instrument switched off.

Take a temperature reading in the shade and set the [illegible] slide at the correct temperature. Attend to these details before the sample is ground.

2. Fit the black plastic [illegible] on the electrode base making sure to avoid touching the upper surface as this may moisten the insulating surface between the electrode rings.

3. Fill Cell. Pour the freshly ground litter subsample into the cell and tamp lightly with dry finger until cell is a little over half full. Insert the plunger cylinder on top of sample and place entire unit on the base of the clamp.

4. Screw down clamp until the top of the compression plate of the clamp is flush with the rim of its housing. Further compression can lead to damage of the clamp.

5. Zero Maching. To zero machine, switch left hand knob to ZERO, making sure that the 'tens' dial is not set to 0. Adjust the red zero knob until the pointer rests exactly at the centre mark.

6. Read Machine. Switch to READ and rotate first the 'tens' dial and then the 'units' dial until pointer is brought back to the centre mark. Note the combined reading shown by the dials.

Note: If 'units' dial is on negative (-) part, move the 'tens' dial anticlockwise (unless it is already 0) and rebalance. The negative part of the dial should never be used if a positive reading is possible. If the final reading is negative (e.g. -4) then this indicates a moisture content

of less than 9 per cent. Estimates can be made for such low moisture contents by extrapolation, to the left of the fixed black scale. Switch off machine after each use.

7. Convert Reading to Litter Moisture Content. After aligning the sliding scale to the correct temperature transfer the dial reading from the fixed black scale to the Litter moisture content, e.g. at 25°C, a dial reading of 30 gives a fuel moisture of 17.5 per cent.

8. The final moisture content is the average of the three sample measurements. Make sure that the 3 readings are done within 3 to 5 minutes to reduce evaporation loss to a minimum.

Maintenance and Storage of Marconi

Make sure that all cell surfaces are clean after each use and that all leads are intact and packed with care. It is recommended that the instrument be housed in a foam-padded wooden box and that it be kept in the cab of the vehicle, out of strong direct sunlight during transport.

The performance of the Marconi Meter may be impaired by lengthy exposure to a damp atmosphere. Therefore it should be stored under cool and dry conditions when not in use. The batteries must be removed for storage.

All instruments are to be checked each 12 months for accuracy by the Protection Branch.

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SPEEDY MOISTURE METER

The SPEEDY meter is basically a pressure cylinder to which is added a measured amount of ground-up fuel and calcium carbide. The carbide reacts with the moisture from the fuel releasing acetylene gas. The gas pressure is recorded directly on a dial gauge as the actual moisture content of the sample.

Use of the Speedy

(1) Clean equipment. Ensure all carbide residues are cleaned from the cap and cylinder with the brushes supplied. This will prevent premature reactions leading to false readings.

(2) Weight material. Make sure the weighing pan is free swinging and clean, and that the beam balance is centrally placed at the pivot so that it does not become stuck against the sides. Add the ground-up fuel until the marks on the beam and body of the balance are in line.

The balance will weigh out either a full (6 gm) or half (3 gm) measure of fuel. If the sample appears to be fairly dry (< 20 per cent moisture content) a full measure is required. However, if the sample is obviously moist (> 20 per cent M.C) then only half measures are used and the Speedy reading recorded is then doubled.

To obtain half measures, place the 3 gm hook weight on the pan end of the beam balance and proceed to add the fuel to the pan until the marks on the beam and body of the balance are in line.

(3) Add Absorbent (calcium carbide). Add 2 measures of absorbent to the 'cap' of the Speedy.

(4) Add Fuel. The weighed ground-up fuel should be placed in the Speedy cylinder and the instrument sealed in a horizontal position so as to prevent premature mixing of the absorbent fuel

(5) Mixing. After firmly tightening the stirrup screw to hold the cap flush against the body of the cylinder, turn the Speedy to a vertical position with the gauge downwards. Shake the Speedy violently for 5 seconds, then invert it and tap the cylinder to ensure that all the contents fall into the cap. Keep the Speedy in this position for one minute.

Repeat this procedure for a second and third mix. After mixing has been completed, feel the cap to see if it is cool. If not, continue to shake up and down until it has cooled.

After cooling, hold the Speedy horizontally at eye level until the indicator needle comes to rest. Now take the gauge reading. Double the reading only if half a measure of fuel was used.

(6) Completion. After reading the moisture value, release the pressure slowly away from yourself. Empty the contents and clean out the Speedy cylinder and cap with brush provided.

NOTE: If the pressure rapidly builds up and appears likely to exceed the maximum value on the dial, then immediately release the pressure to avoid damaging the instrument. Halve the quantity of fuel and proceed as in (2)

Speedy Moisture Content Corrections

There are two corrections to be made to the basic Speedy reading.

(1) The first correction is made for different fuel types. For instance, a eucalypt fuel and a pine fuel may have the same moisture content, but because of their different moisture holding capacities, even when finely minced, the Speedy will give different readings.

(2) Secondly, the readings indicated on the Speedy are moisture contents calculated as a percentage of the "wet weight" or total weight of fuel and moisture combined. However, it is important to standardize these readings by expressing them as a percentage of the oven dry weight of the fuel.

Both these corrections are given in the Table in the Appendix.

It is essential to keep the Speedy clean and well maintained. After a reasonable period of use the top rubber seal may deteriorate and need replacement. A spare rubber is usually supplied and should be used if leakages are suspected. Otherwise, incorrect readings will result.

Also care must be taken that the Calcium carbide is not left exposed or moistened as it will soon deteriorate. It should always be remembered that this substance is a source of highly inflammable acetylene gas and may form an explosive mixture with air.

APPENDIX

Speedy Reading Correction for Fuel Type and Ovendry Weight

Speedy Reading %	Moisture Reading as Oven Dry Wt. Pine	Eucalypt	Speedy Reading %	Moisture Reading as Oven Dry Weight Pine	Eucalypt
			8.0	17.5	14.0
			8.2	17.8	14.2
			8.4	18.2	14.4
			8.6	18.5	14.6
			8.8	18.7	14.8
2.0	4.9	2.2	9.0	18.9	15.0
2.2	5.7	2.8	9.2	19.2	15.3
2.4	6.5	3.4	9.4	19.5	15.5
2.6	7.3	4.1	9.6	19.8	15.7
2.8	7.9	4.8	9.8	20.0	15.9
3.0	8.6	5.4	10.0	20.2	16.2
3.2	9.2	6.0	10.2	20.5	16.5
3.4	9.7	6.5	10.4	20.8	16.7
3.6	10.2	7.0	10.6	21.0	16.9
3.8	10.7	7.5	10.8	21.3	17.1
4.0	11.2	7.9	11.0	21.7	17.4
4.2	11.6	8.3	11.2	22.0	17.7
4.4	12.1	8.8	11.4	22.3	18.0
4.6	12.5	9.1	11.6	22.6	18.2
4.8	12.9	9.5	11.8	22.9	18.4
5.0	13.2	9.9	12.0	23.2	18.7
5.2	13.6	10.2	12.2	23.5	19.0
5.4	13.9	10.5	12.4	23.8	19.2
5.6	14.3	10.9	12.6	24.1	19.5
5.8	14.6	11.2	12.8	24.3	19.8
6.0	14.9	11.5	13.0	24.6	20.0
6.2	15.2	11.8	13.2	24.9	20.4
6.4	15.5	12.0	13.4	25.2	20.8
6.6	15.8	12.3	13.6	25.5	21.2
6.8	16.0	12.6	13.8	25.8	21.6
7.0	16.3	12.8	14.0	26.1	22.0
7.2	16.6	13.1	14.2	26.4	22.4
7.4	16.8	13.3	14.4	26.7	22.7
7.6	17.1	13.5	14.6	27.0	23.1
7.8	17.3	13.8	14.8	27.3	23.5

APPENDIX (cntnd)

Speedy Reading Corrections for Fuel Type and Ovendry Weight

Speedy Reading %	Moisture Content Reading as % of Ovendry Weight	
	Pine	Eucalypt
15.0	27.6	23.9
15.5	28.4	24.8
16.0	29.1	25.8
16.5	29.8	26.7
17.0	30.6	27.6
17.5	31.4	28.6
18.0	32.1	29.5
18.5	32.8	30.5
19.0	33.6	31.4
19.5	34.3	32.4
20.0	35.1	33.3
The following reading obtained by using only ½ measure of fuel		
21.0	36.6	35.2
22.0	38.1	37.1
23.0	39.6	39.0
24.0	41.0	40.8
25.0	42.5	42.6
26.0	44.0	44.4
27.0	45.5	46.2
28.0	47.0	48.0
29.0	48.5	49.8
30.0	50.0	51.6
31.0	51.5	53.4
32.0	53.0	55.0
33.0	54.5	56.5
34.0	56.0	58.0
35.0	57.5	59.5
36.0	59.0	61.0
37.0	60.5	62.5
38.0	62.0	64.0
39.0	63.5	65.5
40.0	65.0	67.0