A GAS-FIRED TUMBLER FOR DRYING FORAGE SAMPLES

The common practice in measuring forage yields is to weigh the fresh herbage in the field and to remove a representative sample to determine the percentage dry matter. On visiting different experiment stations one readily observes a wide divergence in procedure for determining dry matter. Drying ovens are generally individually designed and it is difficult to get sound engineering advice on size, shape, heat requirements, air circulation, and other necessary specifications. Following an unfortunate fire in a custom-built wooden drier, an investigation of the type of tumbler used in commercial laundries for drying clothes was begun.

Tumblers are made by a number of manufacturers in the USA. They are heated by gas, electricity, oil, or steam. The optimum tumbling action, air movement, and heater capacities have been determined by the manufacturers through years of experience. Tumblers come in different sizes. The one purchased by this station and shown in figure 1 has a drum size of 57 by 30 inches, and occupies a floor space approximately 5 by 5 feet. It has a capacity of approximately 80 pounds of green forage. Heat is supplied by natural gas. The heater capacity is 127,000 B.T.U. per hour. Cost of gas varies widely, but at this location it would be around 19 cents per hour if the heat were on constantly. Since it is on intermittently, the actual cost is 9 to 15 cents per hour. The tumbling action and blower are run by a 1/2-horsepower electric motor. A 5-hour timer was substituted for the 1-hour timer which is regular equipment. The manufacturer's list price is $545.00, F.O.B. factory.

Figure 1—Gas-fired laundry tumbler.

The procedure used in 1958 for determining percentage dry matter in forage was as follows:

1. After weighing the green material in the field, approximately 1½ pounds was placed in an 18 by 24 inch muslin bag and wired shut. Bags were numbered so that separate tags were not required, and all had the same tare weight within 0.01 pound.

2. Within 0.01 pound on a Toledo scale, with the weight of the sack and wire allowed for on the tare beam.

3. Samples were tumbled at 220° F. for 3½ to 4 hours.

4. Samples were again weighed in the sack, to the nearest 0.01 pound.

It is essential that the bags be free of holes and tightly tied since the tumbling action is rather severe. Bags were tied with Bates loop-end wire ties which can be applied or removed very quickly with a twister. Numbering the bags involved some extra bookkeeping but eliminated the necessity of tags. It was found that tags on the outside often came off or were torn, while those on the inside became illegible if the forage was very wet.

As an experiment to reduce the tumbling action, the drum was slowed to half speed, using a jack shaft. Tumbling was too slow, however; the sacks became twisted to the point where scorching can occur.

Comparison of driers using different species: In order to compare the reliability of tumbler drying with a conventional room-type drier, several experiments were made, using various forage species. The conventional drier was a 3 by 8 by 12-foot cabinet with a 10-kilowatt electric heater and forced air circulation. Samples were distributed on wire shelves to allow free air movement. The operating temperature was 150° F.

Materials used for comparing the driers were alfalfa, red clover, orchardgrass, tall fescue, and rye. All were in the vegetative stage, and all except the rye were unchopped. Sixty fresh samples weighing 1.00 pound each were weighed and sacked. As the samples were weighed they were alternately assigned to the tumbler or to the cabinet drier. Length of drying time in the tumbler was 4 hours, and in the cabinet drier 48 hours.

Dried samples were weighed to the nearest 0.01 pound. Subsamples were drawn from several sacks and dried in a laboratory oven at 105° C. for 24 hours to determine residual moisture. Residual moisture averaged 1.5% in tumbled grasses compared with 4.2% for cabinet-dried grasses. For legumes the corresponding averages were 2.4% and 4.5%.

Notes