Psychrometry for Postharvest Management

Introduction

Rice is a hygroscopic material. In drying and storage of rice the final moisture content (MC) of the grains depends on the temperature and relative humidity (RH) of the air that surrounds the grains. The determination of the RH therefore is an important aspect of postharvest management. Using the psychrometric principle the RH can be determined in a simple and accurate way.

Why is Relative Humidity Important

The final grain MC resulting from exposing grain to air is called ***equilibrium moisture content*** or ***EMC***. The table on the right shows the EMC of paddy for different air temperatures and RH. If grain is exposed to high RH, in particular in the rainy season when the RH may reach 95-100%, grain MC will raise leading to quality deterioration.

The optimum grain MC depends on the desired storage duration.

MC, %	Purpose
<9	Storage for more than one year
9-13	8-12 months storage
14	Optimum milling yields
14-18	2-3 weeks of storage
>18	Rapid deterioration

EMC of Paddy at different Temperatures and RH

RH, %	Temperature, °C						
	22	24	28	32	36	40	44
50	11.2	10.9	10.7	10.5	10.2	10.0	9.9
55	11.7	11.5	11.2	11.0	10.8	10.6	10.4
60	12.3	12.0	11.8	11.6	11.4	11.2	11.0
65	12.7	12.6	12.4	12.2	12.0	11.8	11.6
70	13.5	13.3	13.1	12.8	12.6	12.5	12.3
75	14.3	14.0	13.8	13.6	13.4	13.2	13.0
77	14.6	14.3	14.1	13.9	13.7	13.5	13.4
79	14.9	14.7	14.5	14.3	14.1	13.9	13.7
81	15.3	15.1	14.9	14.6	14.5	14.3	14.1
83	15.7	15.7	15.3	15.1	14.9	14.7	14.5
85	16.1	15.9	15.7	15.5	15.3	15.1	15.0
87	16.6	16.4	16.2	16.0	15.8	15.6	15.5
89	17.2	17.0	16.8	16.6	16.4	16.2	16.1
91	17.9	17.7	17.5	17.3	17.1	16.9	16.7

How to Determine the RH of the Ambient Air

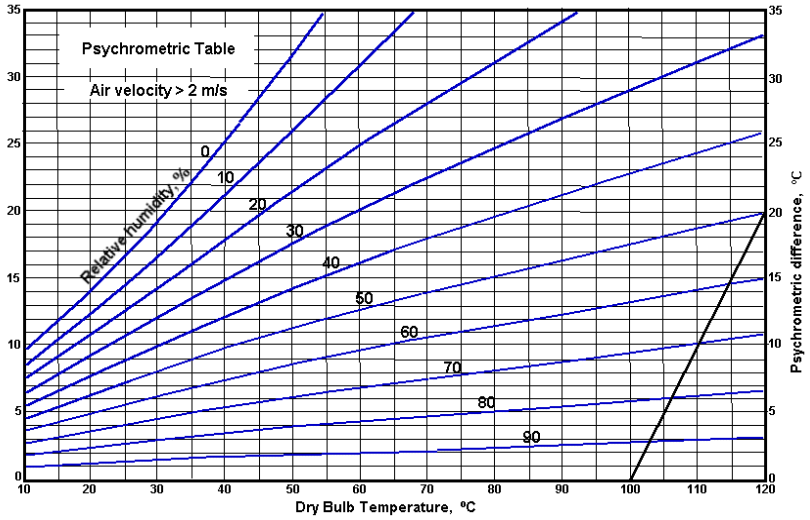
A psychrometer contains two thermometers to measure the dry bulb temperature and the wet bulb temperature. The psychrometric table is used for determination of the RH using the dry bulb temperature and the temperature difference between dry bulb and wet bulb temperature (psychrometric difference).

The ***dry bulb temperature*** is the temperature of the air indicated by a thermometer with dry sensing bulb.

The ***wet bulb temperature*** reflects the cooling effect of the evaporating water. It can be determined by passing air over a thermometer that has been wrapped with a small amount of moist cloth. The cooling effect of the evaporating water causes a temperature drop.

The simplest way to measure wet bulb temperature is to cover the sensing bulb of a thermometer with a wet wick and move the thermometer through the air with at least 2m/s velocity.

To determine RH find the dry bulb temperature on the x-axis of the chart (right), move upwards to the horizontal line of the calculated psychrometric difference and interpolate the corresponding RH using the Relative Humidity lines.



Recommendations

When using a psychrometer make sure that

- The wet bulb remains (dripping) wet.
- The water used to keeps the wick wet has the same temperature as the ambient air.
- A constant air flow of >2m/s is provided to cool the wet bulb.
- Radiation, e.g. from sunlight, to the sensing bulbs is minimized.
- In dusty environments the wick is cleaned regularly.

For more information:

Contact Agricultural Engineering Unit, IRRI

Agricultural Engineering Unit
IRRI, DAPO Box 7777, Metro Manila, Philippines
Tel.: (63-2) 580-5600
Fax.: (63-2) 580-5699
Email: M.Gummert@cgiar.org
J.Rickman@cgiar.org