REFERENCES

Commercial Drying Apparatus, by L. P. Dwyer (A.S.H.V.E. TRANSACTIONS, Vol. 22, 1916, p. 479).

Artificial Drying with Special Reference to the Use of Gas, by G. C. Shadwell (A.S.H.V.E. TRANSACTIONS, Vol. 23, 1917, p. 231).

Drying by Evaporation, by F. R. Still (A.S.H.V.E. TRANSACTIONS, Vol. 23, 1917, p. 255).

High Temperature Drying, by Burt S. Harrison (A.S.H.V.E. TRANSACTIONS, Vol. 24, 1918, p. 7).

The Temperature of Evaporation, by W. H. Carrier (A.S.H.V.E. TRANSACTIONS, Vol. 24, 1918, p. 25).

Commercial Dehydration, by J. E. Whitley (A.S.H.V.E. TRANSACTIONS, Vol. 26, 1920, p. 551).

Drying as an Air Conditioning Problem, by A. W. Lissauer (A.S.H.V.E. TRANSACTIONS, Vol. 27, 1921, p. 251).

A Chronological Survey of Drying and Driers, by J. E. Bolling (A.S.H.V.E. JOURNAL SECTION, October, 1921, p. 715).

Calculations for Drying Design, by Grosvenor (*Transactions, American Institute Chemical Engineering*, 1908, p. 184).

The Rate of Drying Solid Materials, by J. Lewis (*Industrial Engineering Chemistry*, 1921, p. 427).

Adiabatic Drying of Hygroscopic Solids, by A. M. McCready, and W. L. McCabe (*Transactions, American Institute Chemical Engineers*, 1933).

Lignite Drier, by Lavine & Sutherland (*Chemical and Metallurgical Engineering*, July, 1929).

Enameling Oven Economy, by B. S. Harrison (*Fuels & Furnaces*, February, 1931).

Powdered Yeast Prepared by Spray Drying, by A. W. Farrell (*Food Industry*, December, 1931).

Factors that Influence Drier Performance, by A. Weisselberg (*Chemical and Metallurgical Engineering*, August, 1932).

Principles of Drying Lumber and Humidity Diagram, by H. D. Tiemann (*Forest Service Bulletin* 104, 1912).

Symposium on Drying. Articles by W. K. Lewis, W. H. Carrier, A. E. Stacey and R. S. Fleming, R. G. Metz, G. B. Ridley, C. O. Lavett, D. J. Van Marle (*Journal Industrial Engineering Chemistry*, May, 1921).

The Drying of Solids, by T. K. Sherwood (*Bulletin Massachusetts Institute Technology*, Nos. 237, 247 and 258).

Air Conditioning and Engineering, American Blower Co.

Combustion (*American Gas Association*, 3rd edition, 1932).

Die Trockentechnik, by M. Hirsch (Julius Springer, Berlin, 1932).

Drying (*Kent's, Mechanical Engineers Handbook*, 10th edition, 1923; 11th edition, 1936).

Drying, by W. H. Carrier (*Marks', Mechanical Engineers Handbook*, 3rd edition, 1930).

Drying, by Perry (*Chemical Engineers Handbook*, 1934).

Drying by Means of Air and Steam, by E. Hausbrand (D. Van Nostrand & Co., 1901).

Drying in Industrial Plants, by J. O. Ross.

Elements of Chemical Engineering, by Badger and McCabe (McGraw Hill Co., 1931).

Fan Engineering, Buffalo Forge Co.

Fuels and Their Combustion, by Haslam and Russell (McGraw Hill Co., 1926).

Heat Transmission, by W. H. McAdams (McGraw Hill Co., 1933).

Modern Drying Machinery, by H. B. Grenshaw, London, 1926.

Principles of Chemical Engineering, by Walker, Lewis, McAdams (Chapters on Evaporation, Humidity and Drying, 2nd edition, (McGraw Hill Co.).

The Kiln Drying of Lumber, by A. Koehler and R. Thelen, New York, 1926.

The Kiln Drying of Lumber, by H. D. Tiemann (Lippincott, 1920).

PROBLEMS IN PRACTICE

1 ● What makes a commercial adiabatic drier differ from a theoretical one?

The word *adiabatic* means no heat lost to the outside and that the sensible heat lost by the air is equal to the latent heat of the water evaporated. In an actual drier, the solid containing the water, and the water itself must be heated to the temperature of evaporation, before evaporation can begin. Radiation losses from the drier enclosure is the other factor causing deviation from the theoretical adiabatic process.

2 ● What is a zone drier?

This term refers to a continuous drier where the drying medium is divided into two or more sections, in order to have better control of the temperature and humidity gradients through the drier, and often different velocities.

3 ● If a material enters a drier containing 70 per cent water and 30 per cent solids, and leaves the drier with 10 per cent water and 90 per cent solids, (a) What is the evaporation per pound of dried product? (b) What is the evaporation per pound of bone dry material?

a. $\frac{90}{30} - 1 = 2$ lb water per pound dried product.

b. Water entering $= \frac{70}{30} = 233$ per cent on bone dry basis.

Water leaving $= \frac{10}{90} = 11$ per cent on bone dry basis.

Water evaporated 222 per cent on bone dry basis.

Evaporation $= 2.22$ lb water per pound bone dry material.

4 ● What items must be included in a calculation of the drier heat requirements?

a. Heating water to be evaporated from the entering temperature to the temperature of evaporation.

b. Evaporating water to be removed.

c. Superheating evaporated water from the temperature of evaporation to the exit temperature of the air.

d. Heating material from entering to leaving temperatures.

e. Heating residual water from the entering to the leaving temperatures.

f. Heating conveyor or other supporting materials.

g. Radiation losses through the enclosure.

h. Sensible heat in the exit air.

5 ● The following conditions prevail in a drier; 250 lb water evaporated per hour. Air enters heater at 80 F dry-bulb and 65 F wet-bulb. Air exhausted from drier at 130 F dry-bulb and 100 F wet-bulb. Stock enters drier at 70 F. Heat required for warming stock and radiation losses are not considered. Fan is located ahead of heater. Find conditions of air entering and leaving drier, volume handled by fan, and temperature of air entering drier to supply the necessary heat, using Humidity Chart in Fig. 4.

Entering Air: Humidity, $H = 0.01$ lb water vapor per pound dry air.
Dew-point $= 57$ F.
Per Cent Humidity, $\% H = 46$.