TABLE 3. DRYING TIME AND CONDITIONS FOR REPRESENTATIVE MATERIALS[a]—Con.

MATERIAL	TEMPERATURE DEG F	PER CENT RELATIVE HUMIDITY	DRYING TIME
Tanin and other chemicals (spray dried)	250–300		Instantaneous
Terra Cotta (air drying in conditioned room)	150–200		12–96 Hrs
Tobacco leaves	85–130		12 Hrs
Tobacco stems	180–200		12 Hrs
Varnish refrigerator boxes	110	35	5–7 Hrs
Varnish steering wheels	110–140	25–35	Overnight
Veneer ¼ in. 3-ply	120–130	35–40	6–8 Hrs + 2 Hrs acclimation
13/16 in. 5-ply	120–130	35–40	16–18 Hrs + 4 Hrs acclimation
1¼ in. 5-ply	120–130	35–40	20–24 Hrs + 4 Hrs acclimation
Vitreous Enamel sheets before firing	170		
Wallboard pasted plywood	300		15–20 Min
Wallboard fiber insulating, roller type drier	300–385		2½–3 Hrs
Wallboard fiber insulating, truck type drier	300–385		24–48 Hrs
Walnuts	100		24 Hrs
Wheat, corn, oats, rice, barley	180		
Wire cloth Japan	200		20 Min
Wool	105		

[a]See references at end of chapter.

the common constituents of fuel are shown in Table 4. The heating values of oils are shown in Fig. 7. The sensible heat in Btu contained in the products of combustion of an average fuel oil and various gases is given in Fig. 8. The problem of securing complete combustion in a heater is important, in order to secure efficiency and the absence of soot formation, but unlike the ordinary power or heating boiler, excess air need not be maintained at a minimum in most cases. Excess air is generally admitted either in the heater or before the products go into the drier.

DESIGN

In all drying problems, data regarding temperatures, time, and humidity must be obtained by experiment or previous experience. Experiments are best performed at the temperatures, humidities, and velocities to be actually used in the full sized drier, and with full size samples.

The following nomenclature and explanation of terms will be used in the discussion of drying calculations:

H = humidity of air, pounds of water vapor per pound of dry air.
G = pounds of dry air supplied to the drier per unit of time.
S = pounds of stock dried per unit of time in a continuous drier.
S' = pounds of stock charged per batch to a discontinuous drier.
Θ = time.
Q = total heat supplied to the drier.

t = air temperature.
t' = stock temperature.
t'' = average stock temperature over short time interval, in a batch drier.
t_w = wet-bulb temperature.
s' = specific heat of the stock.
B = total radiation and conduction losses per unit time.
w = pounds of water per pound of dry stock.
r = heat of evaporation of water.
s = humid heat of air, *i.e.*, heat necessary to raise 1 lb of dry air + H lb of steam 1 F.

Subscript (1) designates conditions at the point where the material in question (air or stock) enters and (2) where it leaves the drier.

Air driers may be divided into two classes, those in which *all moisture* evaporated from the stock *leaves the drier as vapor* in the effluent air, and those in which *part or all* of the moisture *is condensed* from the air *in the drying equipment itself*. In any continuously operating drier of the first type the relation between moisture content of the stock and quantity of air required for the drying operation is given by the equation:

$$G\,(H_2 - H_1) = S(w_1 - w_2) \qquad (2)$$

TABLE 4. GAS COMBUSTION CONSTANTS[a]

GAS	CHEMICAL FORMULA	MOLECULAR WEIGHT	CU FT PER LB	HEAT OF COMBUSTION Btu per Lb		LBS PER LB OF COMBUSTIBLE					
						Required for Combustion			Flue Products		
				Gross	Net	O_2	N_2	Air	CO_2	H_2O	N_2
Carbon	C	12.000		14,140	14,140	2.667	8.873	11.540	3.667		8.873
Hydrogen	H_2	2.015	187.723	61,100	51,643	7.939	26.414	34.353		8.939	26.414
Oxygen	O_2	32.000	11.819								
Nitrogen	N_2	28.016	13.443								
Carbon Monoxide	CO	28.000	13.506	4,369	4,369	0.571	1.900	2.471	1.571		1.900
Carbon Dioxide	CO_2	44.000	8.548								
Methane	CH_4	16.031	23.565	23,912	21,533	3.992	13.282	17.274	2.745	2.248	13.282
Ethane	C_2H_6	30.046	12.455	22,215	20,312	3.728	12.404	16.132	2.929	1.799	12.404
Propane	C_3H_8	44.062	8.365	21,564	19,834	3.631	12.081	15.712	2.996	1.635	12.081
Sulphur Dioxide	SO_2	64.060	5.770								
Water Vapor	H_2O	18.015	21.017								
Air		28.900	13.063								

[a]All gas volumes corrected to 60 F and 30 in. mercury barometric pressure dry.