APPENDIX A

Notation

The following symbol notation has been adopted in this text. Where applicable, the units most commonly used are shown. A symbol may sometimes be used to define more than one variable. In such cases, the reader should refer to the appropriate section of the text to determine the context in which the symbol is used.

a	$=$	thermal diffusivity, cm^2/h
A	$=$	area or area perpendicular to the direction of heat or mass transfer, cm^2 or ft^2
A	$=$	area of a discharge orifice
A	$=$	area required for drying, ha
a	$=$	number of free enzyme adsorption sites per unit volume
ASH_m	$=$	ash component of the feed mixture, fraction of TS
$ASH_m\%$	$=$	mixture ash content, % of TS
ASH_p	$=$	ash component of the product, fraction of TS
$ASH_p\%$	$=$	product ash content, % of TS
A_v	$=$	available surface area per unit volume
B	$=$	biodegradable fraction of the volatile solids
B	$=$	constant relating barrier height to puff height
c	$=$	pollutant concentration at coordinates x, y, and z, g/m^3 or ou
C	$=$	odor concentration
C	$=$	weight percentage of carbon, ash-free basis
C	$=$	orifice discharge coefficient
c_b	$=$	average odor concentration at the downwind edge of a large area odor source, ou or ED_{50}
C_i	$=$	concentration of gas in the liquid phase at the gas/liquid interface
c_k	$=$	concentration estimate for the reference sampling time, t_k
C_l	$=$	concentration of gas in the liquid phase
c_p	$=$	heat capacity per unit mass at constant pressure, cal/g-°C
c_s	$=$	concentration estimate for the desired sampling time, t_s
c_v	$=$	heat capacity per unit mass at constant volume, cal/g-°C

d = inside stack diameter, m

D = diameter of a circular or equivalent circular section

D_g = diffusion coefficient in the gas phase, cm^2/sec

D_l = diffusion coefficient in the liquid phase, cm^2/sec

D_r = decimal reduction factor, time required to achieve a 10-fold reduction in cell population, T_{90}

d_{si} = initial depth of the wet substrate, cm

d_w = depth of water to be evaporated, cm

e = absolute surface roughness in a pipe or manifold

e = number of free enzymes per unit volume or the reaction mixture

ΔE = change in internal energy within a system

E = energy ratio, ratio of heat released to weight of water

E = evaporation rate, cm/day

E_a = activation energy, cal/mol or kcal/mol

EAR = excess air ratio

E_d = inactivation energy, cal/mol or kcal/mol

f = free airspace, ratio of gas volume to total volume

f = Darcy-Weisbach friction factor

F = association factor for solvent, equal to 2.6 for water

F_a = configurational factor to account for the relative position and geometry of two heat radiating bodies

F_b = buoyancy flux, m^4/sec^3

f_b = free airspace within the interstices of a bulking agent before wet substrate addition

F_e = emissivity factor to account for nonblack-body radiation

f_h = fraction of compost material in the high temperature zone of a compost pile

f_l = fraction of compost material in the low temperature zone of compost pile

f_m = free airspace within the interstices of a mixture of composting materials

F_m = momentum flux, m^4/sec^2

f_s = free airspace within the interstices of a wet substrate, usually assumed to be zero

ΔG = Gibb's free energy change between two states of a system, kcal/mol or cal/mol

g = acceleration of gravity, 9.8 m/sec^2 or 32.2 ft/sec^2

G = mass flowrate of a gas

G_f = specific gravity of the fixed or ash fraction of the total solids

G_m = specific gravity of mixture solids

$\Delta G°$ = Gibb's free energy change measured under standard state conditions, kcal/mol or cal/mol

ΔG_R = reaction free energy change based on activities of the chemical constituents, cal/mol or kcal/mol

$\Delta G_R°$ = reaction free energy change under standard state conditions, cal/mole or kcal/mol

G_s = specific gravity of the total solids

G_v = specific gravity of the volatile fraction of the total solids

ΔH = height of rise of a plume above the discharge stack, m

ΔH = enthalpy change between two states of a system, cal/mol or kcal/mol

H = effective plume height, m

H = weight percentage of hydrogen, ash-free basis

H	$=$	building height, m
h	$=$	point source stack height, m
H_a	$=$	higher heat value of the amendment, cal/g or Btu/lb of organics oxidized
H_b	$=$	puff height downwind of a barrier, m
h_b	$=$	barrier height, m
H_b	$=$	building height, m
H_e	$=$	system energy demand estimated as cal/g of water evaporated, or Btu/lb of water evaporated
ΔH_{fg}	$=$	enthalpy change from liquid to vapor at temperature T, cal/g or kcal/kg
H_{gep}	$=$	"good engineering practice" stack height, m
h_l	$=$	headloss in height of fluid
h_m	$=$	average puff height over an odor emission area, m
ΔH°	$=$	enthalpy change measured under standard state conditions, cal/mol or kcal/mol
ΔH_R	$=$	reaction enthalpy change based on activities of the chemical constituents, cal/mol or kcal/mol
ΔH_R°	$=$	reaction enthalpy change under standard state conditions, cal/mol or kcal/mol
H_R	$=$	height of the downwind recirculation cavity, m
HRT	$=$	single-pass mean residence time of the mixed materials including recycle
H_s	$=$	higher heat value of the substrate, cal/g or Btu/lb of organics oxidized
I	$=$	intensity of an odor sensation, usually expressed as equivalent concentration of 1-butanol
j	$=$	height exponent for flow through a compost material
k	$=$	thermal conductivity, cal/(h-cm^2-°C/cm) or Btu/(h-ft^2-°F/ft)
k	$=$	reaction rate constant, time^{-1}
k	$=$	maximum rate of solid substrate hydrolysis that occurs at high microbial concentration
K	$=$	coefficient related to permeability of a porous media
K	$=$	a coefficient in Steven's Law
k_a	$=$	fraction of amendment volatile solids degradable under composting conditions
k_b	$=$	fraction of bulking agent volatile solids degradable under composting conditions
k_d	$=$	rate constant, time^{-1} or g BVS/g BVS-day
k_d	$=$	thermal inactivation or death coefficient, time^{-1}
k_e	$=$	endogenous respiration coefficient, mass of microbes respired/mass of microbes-time
K_{eq}	$=$	equilibrium constant
k_m	$=$	maximum utilization coefficient, maximum rate of substrate utilization at high substrate concentration, mass substrate/mass microbes-day
k_m	$=$	fraction of mixture volatile solids degradable under composting conditions
k_s	$=$	average surface odor emission rate, SOER, m^3/min-m^2
k_s	$=$	fraction of substrate volatile solids degradable under composting conditions
K_s	$=$	half-velocity coefficient, also referred to as the Michaelis-Menten coefficient, mass/volume
K_x	$=$	half-velocity coefficient equal to the microbial concentration where ds/dt = k/2
L	$=$	length of area odor emission source, m

L	=	characteristic dimension of a building for plume downwash calculations
L	=	length of the flow path or length of a pipe section
L	=	length of a building in the alongwind direction
M	=	solvent molecular weight
m	=	mass, kg-mol or lb-mol
M_{bs}	=	volumetric mixing ratio, ratio of volume of bulking agent to volume of substrate
M_{mb}	=	volume ratio of mixed materials to bulking agent
n	=	velocity exponent for flow through compost material
n	=	number of substrates
n	=	viable cell population
n	=	an exponent in Steven's Law
N	=	number of pile turnings
n	=	porosity, ratio of void volume to total volume
n_f	=	final viable cell population
n_o	=	initial viable cell population
n_t	=	viable cell population after time, t
O	=	weight percentage of oxygen, ash-free basis
P	=	pressure or absolute pressure
p	=	pressure
P	=	precipitation rate, cm/day
p_a	=	absolute pressure or atmospheric pressure, mbar
P_c	=	percent of inorganic conditioning chemicals in sludge cake
P_g	=	partial pressure of gas in the gas phase
P_i	=	partial pressure of gas in the gas phase at the gas/liquid interface
$P_0(t)$	=	extinction probability, probability that all organisms are inactivated
p_s	=	static pressure
p_t	=	total pressure
p_t	=	power law constant for correcting concentrations to different time averaged periods
P_v	=	percent volatile solids in sludge cake
p_v	=	velocity pressure
p_w	=	wind profile exponent
q	=	heat flow into (+) or out of (−) a system
q	=	volumetric flowrate of recycle material
Q	=	heat of combustion or fuel value, Btu/lb or cal/g
Q	=	volumetric flowrate of material, excluding recycle
Q_{air}	=	air flowrate moving across an area odor source, m^3/min
Q_f	=	stack gas volumetric flowrate, m^3/sec
Q_o	=	odor emission rate, m^3/min
q_p	=	heat flow in a constant pressure system, cal or kcal
q_v	=	heat flow in a constant volume system, cal or kcal
R	=	radius of a spherical particle
R	=	degree of reduction of an organic compound
R	=	universal gas constant
R_d	=	dry weight recycle ratio, ratio of dry weight of compost product recycled to dry weight of substrate
R_w	=	wet weight recycle ratio, ratio of wet weight of compost product recycled to wet weight of substrate

ΔS	$=$	entropy change between two states of a system
S	$=$	weight percentage of sulfur, ash-free basis
S	$=$	concentration of the rate limiting substrate, mass/volume
S	$=$	mass emission rate of pollutant, g/sec or ou/sec
S_a	$=$	fractional solids content of amendment
S_b	$=$	fractional solids content of bulking agent
S_{bm}	$=$	fractional solids content of bulking agent in the substrate/bulking agent mixture after moisture absorption
S_m	$=$	fractional solids content of a composting mixture
S_{bm}^m	$=$	minimum fractional solids content of bulking agent achievable by absorption of moisture from substrate to bulking agent
S_{sm}^m	$=$	maximum fractional solids content of the substrate achievable by absorption of moisture from the substrate to bulking agent
S_p	$=$	fractional solids content of compost product
S_r	$=$	fractional solids content of recycled material
SRT	$=$	mean residence time of the feed solids, excluding recycle
S_s	$=$	fractional solids content of the composting substrate
S_{sf}	$=$	final solids content of the dried substrate, fraction
S_{si}	$=$	initial solids content of the wet substrate, fraction
S_{sm}	$=$	fractional solids content of substrate in a substrate/bulking agent mixture after moisture absorption
t	$=$	time
T	$=$	temperature
ΔT	$=$	temperature change
t_{90}	$=$	time required to achieve a 10-fold reduction in cell population
T_a	$=$	air temperature, °K
t_a	$=$	time required for air drying, days
T_a	$=$	absolute temperature, °K or °R
T_c	$=$	temperature, °C
t_k	$=$	reference sampling time
T_k	$=$	temperature, °K
T_s	$=$	stack gas temperature, °K
t_s	$=$	sampling time corresponding to the desired time averaged concentration
u	$=$	mean wind velocity effecting plume transport, m/sec
U	$=$	overall heat transfer coefficient which includes effects of both conductive and convective heat transfer, cal/(h-cm²-°C)
u_o	$=$	observed wind speed at the measuring height z_0, m/sec
u_z	$=$	wind speed at elevation z, m/sec
V	$=$	velocity of flow
V	$=$	volume of reactor, m³
V	$=$	volume of a thermodynamic system
v	$=$	rate of product formation in an enzyme catalyzed reaction
V_a	$=$	volatile solids content of amendment, fraction of dry solids
V_b	$=$	volatile solids content of bulking agent, fraction of dry solids
v_g	$=$	volume of gas phase
V_m	$=$	volatile solids content of mixture, fraction of dry solids
V_o	$=$	solute molar volume at normal boiling point, 25.6 cm³/g-mol for oxygen
V_p	$=$	volatile solids content of compost product, fraction of dry solids
V_r	$=$	volatile solids content of recycle, fraction of dry solids

v_s	$=$	volume of solids
v_s	$=$	exit velocity of stack gas, m/sec
V_s	$=$	volatile solids content of substrate, fraction of dry solids
VS_m	$=$	volatile solids component of the feed mixture, fraction of TS
$VS_m\%$	$=$	mixture volatile solids content, % of TS
VS_p	$=$	volatile solids component of the product, fraction of TS
$VS_p\%$	$=$	product volatile solids content, % of TS
v_t	$=$	total volume of solids, water and gas in a composting matrix
v_w	$=$	volume of water phase
VX_y	$=$	virtual point source distance for horizontal dispersion
VX_z	$=$	virtual point source distance for vertical dispersion
w	$=$	specific humidity, mass of water vapor per mass of dry gas
w	$=$	work done on (–) or by (+) a system
W	$=$	water to degradable organic ratio, weight of water to weight of degradable organic in a composting mixture
W	$=$	weight of water to be evaporated daily
W	$=$	width of an area odor source, m
W_1	$=$	weight of reactor outfeed
W_2	$=$	weight of reactor outfeed less the weight of recycle
w_{O2}	$=$	rate of oxygen consumption, mg O_2/g VS-h
W_s	$=$	weight of dry solids
W_w	$=$	weight of water
x	$=$	downwind distance measured from the source to the receptor, m
X	$=$	concentration of microbes, mass/volume
X	$=$	lignin content, percent of volatile solids
X_a	$=$	total wet weight of amendment added to mixture per day
X_b	$=$	total wet weight of bulking agent added to mixture per day
X_m	$=$	total wet weight of mixed material entering the compost process per day
X_p	$=$	total wet weight of compost produced per day
X_r	$=$	total wet weight of compost recycled per day
X_s	$=$	total wet weight of substrate added to mixture per day
X_w	$=$	weight of water added to the composting mixture per day
y	$=$	lateral distance from the centerline of a plume to the receptor, m
Y	$=$	expansion factor for compressible flow
Y_m	$=$	growth yield coefficient, mass of microbes/(mass of substrate)
z	$=$	height of the receptor, m
z	$=$	particle thickness
z_o	$=$	anemometer height, usually 10 meters
δ	$=$	gas specific weight upstream of an orifice
δ_b	$=$	unit bulk weight of bulking agent, wet weight per volume, g/cm^3
δ_g	$=$	thickness of laminar gas film as used in the two-film model of gas transfer
δ_l	$=$	thickness of laminar liquid film as used in the two-film model of gas transfer
δ_m	$=$	unit bulk weight of the mixed material to be composted, wet weight per volume, g/cm^3
δ_s	$=$	bulk weight of substrate, g/cm^3
$\delta_s(dry)$	$=$	unit dry weight, dry weight per unit volume, g/cm^3
δ_{si}	$=$	initial bulk weight of the substrate, g/cm^3
δ_w	$=$	bulk weight of water, g/cm^3

θ	=	detention time, days
θ	=	temperature coefficient for a chemical or biochemical reaction
u	=	net specific growth rate, g cells grown/g cells-day
u_m	=	maximum net specific growth rate, g cells grown/g cells-day
ρ	=	mass density, g/cm^3
σ	=	Stefan-Boltzmann constant, 4.87×10^{-8} kcal/(h-m^2-°K^4)
σ_y	=	standard deviation of plume concentration in the horizontal direction, m
σ_{ye}	=	effective horizontal dispersion coefficient
σ_z	=	standard deviation of plume concentration in the vertical direction, m
σ_{ze}	=	effective vertical dispersion coefficient