Appendix

Notation

(Dimensions given in terms of mass, M, length, L, time, T, and temperature, θ)

a	Exponent
A	Area (L^2), amplitude (L)
A_a	Arithmetic mean of the cake area in a filtering centrifuge (L^2)
A_l	Logarithmic mean of the cake area in a filtering centrifuge (L^2)
A_m	Area of the filter medium in a filtering centrifuge (L^2)
b	Exponent, constant, height of the bowl of a tubular centrifuge (L), isotherm slope
b_1	Empirical constant
B	Intercept with the y-axis in a plot of a constant-pressure filtration run (T/L^3), permeability coefficient
B_0	Constant
B'	Intercept with the y-axis in a plot of a constant-rate filtration run (M/LT^2)
c	Exponent, capillary viscosity constant, velocity (L/T), velocity of light (L/T)
c_p	Specific heat ($L^2/T^2\theta$)
C	Volume fraction of solids in suspension, gas concentration (M/L^3)
C_f	Volume fraction of solids in the feed
C_p	Heat capacity at constant pressure ($L^2/T^2\theta$)
C_u	Volume fraction of solids in the underflow
C_v	Heat capacity at constant volume ($L^2/T^2\theta$)
C_D	Drag coefficient
d	Exponent, diameter of the rod supporting rollers in chain conveyors (L), radius of the product in roller mills (L), diameter of the neck of a hydrometer (L), exponent, depth of a layer (L)
d_c	Cell diameter (L)
D	Diameter (L), screen aperture (L), dose of microbial inactivation energy
D_c	Cyclone and hydrocyclone diameter (L)
D_f	Diameter of the feed in roller mills (L)
D_g	Gas diffusivity (L^2/T)

(continued)

E. Ortega-Rivas, *Non-thermal Food Engineering Operations*,
Food Engineering Series, DOI 10.1007/978-1-4614-2038-5,

D_i	Inlet diameter of a hydrocyclone (L)
D_o	Overflow pipe diameter of a hydrocyclone (L)
D_p	Diameter of the product in roller mills (L)
D_{pc}	Cut diameter (L)
D_r	Diameter of the roll in roller mills (L)
D_u	Underflow diameter of a hydrocyclone (L)
D_{UV}	Decimal reduction rate in UV treatment
D_0	Lethality constant
D_{10}	Decimal reduction time, decimal reduction dose
e	Exponent
E	Energy (ML^2/T^2), overall screen efficiency, Young's modulus (M/LT^2)
E_a	Activation energy (ML^2/T^2)
E_c	Electric field intensity threshold value (V^a/L)
E_d	Energy absorbed (ML^2/T^2)
E_i	Bond work index (ML^2/T^2)
E_O	Oversize screen efficiency
E_p	Partial efficiency
E_t	Total efficiency
Eu	Euler number
E_U	Undersize screen efficiency
E_0	Radiating light hitting the surface of a material
f	Frequency (dimensionless), frequency (1/T), fanning friction factor
f_a	Size fraction of one component of average weight w_a
$f(x)$	Frequency or occurrence related to size
$f_L(x)$	Size distribution function by length
$f_M(x)$	Size distribution function by mass (volume)
$f_N(x)$	Size distribution function by number
$f_S(x)$	Size distribution function by surface
F	Force (ML/T^2), mass flow rate of solids in the feed (M/T), cumulative percentage of the coarse fraction in the feed
F_f	Cumulative percentage of the fines fraction in the feed
F_A	Buoyancy force (ML/T^2)
$F(x)$	Cumulative frequency
F_D	Drag force (ML/T^2)
$F(x)$	Cumulative percentage oversize of feed solids
Fr	Froude number
g	Acceleration due to gravity (L/T^2)
G_c	Critical flux (M/L^2T)
$G(x)$	Grade efficiency
$G'(x)$	Reduced grade efficiency
h	Height (L), length of the hydrometer not submerged in the liquid (L), Planck's constant (L^2M/T)
H	Height or depth (L), relative humidity
I	Intensity of radiation at a given distance (L^2/T^2)
I_0	Intensity of radiation at the surface of an absorber (L^2/T^2)
J	Rate of diffusion (M/T)

(continued)

k	Constant, coordination number
k_p	Constant for a family of geometrically similar hydrocyclones
k_1	Constant
k_2	Constant
K	Constant, correlation constant of the power law, slope of the line in a plot of a constant-pressure filtration run (T/L^6)
K_c	Constant depending on the filter medium in air filtration
K_1	Cake resistance factor in air filtration
K'	Fluid consistency index (MT^n/L^2), slope of the line in a plot of a constant-rate filtration run (M/L^4T^2)
K''	Constant in constant-rate filtration
L	Length (L)
m	Mass (M), weight of a hydrometer (M), constant, moisture content
m_e	Moisture content of an isotherm based on a straight-line approximation
m_f	Weight of a pycnometer filled with a sample (M)
m_i	Initial moisture content
m_l	Weight of a pycnometer filled with liquid (M)
m_s	Weight of a pycnometer filled with a solid (M)
m_{sl}	Weight of a pycnometer filled with liquid and a solid (M)
m_{LC}	Weight of a container partially filled with liquid (M)
m_{LCS}	Weight of a container with liquid and a submerged solid (M)
m_0	Weight of an empty pycnometer (M)
M	Mesh size, mass flow rate of solids in suspension (M/T), molar concentration
M_c	Mass flow rate of separated solids (M/T), the mass of the solid cake in the bowl of a filtering centrifuge (M)
M_f	Mass flow rate of unseparated solids (M/T)
M_s	Weight of a specimen (M)
M_1	Mixing index
M_2	Mixing index
M_3	Mixing index
N	Rotation speed (1/T), sample size, initial microbial load
N_c	Critical rotation speed (1/T)
N_t	Microbial load after treatment time t
n	Exponent, shear index, number of particles in a sample, slope
n_p	Constant for a family of geometrically similar hydrocyclones
n'	Flow behavior index
O	Mass flow rate of solids in the overflow (M/T)
p	Proportion by weight of the component within a total sample weight w, agglomerating pressure (M/LT^2)
P	Pressure (M/LT^2), power (ML^2/T^3)
P_R	Pressure at reference pressure conditions (M/LT^2)
P_0	Vapor pressure of pure water at a given temperature (M/LT^2)
q	Proportion by weight of a component within a total sample weight w
Q	Volumetric flow rate (L^3/T)
r	Radius of a particle in roller mills, radius of a feed particle in roller mills (L), radius of a ball in tumbling mills (L), radius (L)

(continued)

R	Radius (L), radius of the roll in roller mills (L), radius of the drum in tumbling mills (L), radius of rotation (L), universal gas constant
Re	Reynolds number
$\mathrm{Re_p}$	Particle Reynolds number
Re^*	Reynolds number for power-law fluids
R_f	Underflow-to-throughput ratio
R_i	Neutral zone in a centrifuge (L)
R_m	Resistance of the filter medium (1/L)
R_x	Outer radii of a stack of discs in a disc-bowl centrifuge (L)
R_y	Inner radii of a stack of discs in a disc-bowl centrifuge (L)
R_A	Weir radius for the denser phase in a centrifuge (L)
R_B	Weir radius for the less dense phase in a centrifuge (L)
s	Standard deviation of the analyses of the average value of the fraction of a specific powder, specific surface of a solid (L^2), empirical constant, compressibility coefficient
s_p	Surface area of a particle (L^2)
s_r	Estimate of the standard deviation of the fraction of a specific powder under complete randomization
s_0	Estimate of the standard deviation of the fraction of a specific powder under complete segregation
S	Surface (L^2), number of discs in the stack in a disc-bowl centrifuge
SG	Specific gravity
Stk_{50}	Stokes number
Stk'_{50}	Stokes number including the reduced cut size
Stk^*_{50}	Stokes number for power-law fluids
$Stk^*_{50}(r)$	Stokes number for power-law fluids including the reduced cut size
t	Time (T)
t_c	Treatment time threshold value in pulsed electric field technology (T)
T	Temperature (θ), tensile stress ($\mathrm{M/LT}^2$)
TMP	Transmembrane pressure ($\mathrm{M/LT}^2$)
u	Linear velocity in the vertical direction (L/T), fluid–particle relative velocity (L/T), settling velocity at concentration C (L/T)
u_g	Terminal settling velocity under gravity (L/T)
u_t	Terminal settling velocity of particles (L/T), channel velocity calculated from the cross section (L/T)
U	Mass flow rate of solids in the underflow (M/T), volumetric flow rate of the underflow (L^3/T)
v	Linear velocity in the horizontal direction (L/T)
v_g	Terminal settling velocity under gravity (L/T)
v_r	Radial settling velocity (L/T)
v_t	Terminal settling velocity (L/T)
v_tan	Tangential velocity (L/T)
V	Volume (L^3), compacted volume of solids at a given pressure (L^3), linear velocity (L/T)
V_f	Gas superficial velocity through the filter medium in air filtration (L/T)
V_p	Volume of a particle (L^3)
V_K	Volume of a test body (L^3)
V_R	Relation of volumes (V/V_s)

(continued)

V_s	Volume of solid material (L^3)
V_0	Sliding velocity at a reference location defined by Eq. 3.16 (L/T), initial volume (L^3), mean gas velocity (L/T)
V'	Activation volume constant
w	Weight of a sample (M), mass of solids deposited on the medium per unit volume of filtrate (M/L^3)
w_a	Average weight of a sample (M)
W_s	Weight of dry solids in a package (M)
WVP	Water vapor permeance (T/L)
WVTR	Water vapor transmission rate (M/L^2T)
x	Particle size
x_c	Cut point (L)
x_i	Every measured value of the fraction of one powder
x_p	Diameter of a particle (L)
x_{sv}	Equivalent surface diameter of a particle (L)
x_{50}	Cut size (L)
x'_{50}	Reduced cut size (L)
X	Fraction, distance (L)
X_F	Mass fraction of coarse particles in the feed
X_O	Mass fraction of coarse particles in the overflow
X_U	Mass fraction of coarse particles in the underflow
$Z(P)$	Pressure increase required to accomplish a one log reduction cycle in D_{10}
Greek letters	
α	Half the angle of nip in roller mills, angle to the vertical in tumbling mills, surface tension of liquid (M/LT^2), specific cake resistance (L/M)
α_0	Empirical constant in Eq. 7.71
α'_0	Empirical constant in Eq. 7.71
β	Empirical constant in Eq. 7.72
γ	Viscosity coefficient for power-law fluids (M/LT^{2-n})
$\dot{\gamma}$	Shear rate (1/T)
δ	Membrane thickness (L)
ΔP	Pressure drop (M/LT^2)
Δm	Apparent increase in weight (M)
ΔG	Apparent weight force (ML/T^2)
ΔP_c	Pressure drop through the powder layer in air filtration (M/LT^2)
ΔP_f	Pressure drop across the filter medium of an air filter (M/LT^2)
$-\Delta P$	Total pressure drop across the filter (M/LT^2)
$-\Delta P_c$	Pressure drop across the cake (M/LT^2)
$-\Delta P_m$	Pressure drop across the medium (M/LT^2)
ΔV^+	Activation volume (L^3)
ε	Porosity or voidage, strain
ε_A	Axial strain
ε_L	Lateral strain
η	Apparent viscosity (M/LT)
θ	Angle between the particle and the screen aperture, hydrocyclone cone angle
λ	Wavelength (L)
μ	Liquid absolute viscosity (M/LT), Poisson's ratio, friction coefficient

(continued)

μ_g	Gas viscosity (M/LT)
μ_o	Viscosity of a pure solvent (M/LT)
μ'	Friction coefficient in roller mills
ν	Kinematic viscosity (L^2/T)
π	Osmotic pressure (M/LT^2)
ρ	Liquid density (M/L^3), frequency
ρ_b	Bulk density (M/L^3)
ρ_g	Gas density (M/L^3)
ρ_s	Solids density (M/L^3)
ρ_A	Density of the denser phase in a centrifuge (M/L^3)
ρ_B	Density of the less phase in a centrifuge (M/L^3)
σ	Interfacial tension (M/T^2), stress (M/LT^2)
σ_t	Strength of agglomerates (M/LT^2)
Σ	Operator, meaning "algebraic sum of," characteristic geometrical features of a centrifuge equivalent to the area of a gravity settling tank with settling characteristics similar to those of a centrifuge
τ	Shear stress (M/LT^2)
τ_0	Intercept with the *y*-axis in plot of shear stress versus shear rate
ϕ	Volume fraction of spheres in suspension
Φ	Sphericity
ω	Angular velocity (1/T)
Ω	Conical half angle of the discs in a disc-bowl centrifuge

[a]Volt

Index