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Elvira Rakova

Investigation on the improvement of the cost-efficiency of compressed air systems

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Investigation on the improvement of the cost-efficiency of compressed air systems

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To my father

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Nomenclature

α	W/(m^2·°C)	Heat transfer coefficient
A	m^2	Surface
b	-	Critical pressure ratio
C	Nl/(min·bar)	Pneumatic conductance
c	-	Spring constant
c_1	-	Friction coefficient
c_2	-	Load coefficient
c_a	m/s	Sound speed
c_p	J/(kg·K)	Isobar heat capacity
c_V	J/(kg·K)	Isochoric heat capacity
D	m	Piston diameter
d	m	Piston rod diameter
E_{el}	J	Electrical energy
E_{ex}	J	Exergy
E_{dp}	J	Damping energy
E_{fr}	J	Friction energy
E_{im}	J	Impact energy
$E_{pn,in}$	J	Exergy in the meter-in side of cylinder
$E_{pn,out}$	J	Exergy in the meter-out side of cylinder
E_Q	J	Exergy of the heat
E_{task}	J	Task energy
e_{ex}	J/kg	Specific exergy

$e_{ex,v}$	J/kg	Specific exergy of the volume
F_C	N	Coulumb force
F_{fr}	N	Friction force
F_n	N	Normal force
F_s	N	Stribeck force
F_{load}	N	Load force
g	m/s^2	Gravity acceleration
H	J	Enthalpy
h	kJ/kg	Specific enthalpy
I	A	Electric current
J	kg·m^2	Moment of inertia
k	-	Isentropic constant, 1.4
k_p	-	Pressure depended friction coefficient
k_v	-	Velocity depended coefficient
L	m	Tube length
M	kg/mol	Molar mass
M_e	N/m	Torque
m	kg	Mass
$\dot{m}$	kg/s	Mass flow rate
μ	kg/(m·s)	Viscosity
μ_f	-	Friction coefficient
n	-	Polytropic exponent
P	W	Power
P_{mech}	W	Mechanical power
p	Pa	Pressure
p_{supply}	Pa	Supply pressure
Q	J	Heat
q	J/kg	Heat transfer per unit mass

R	J/(K·mol)	Universal gas constant
R_0	J/(K·kg)	Specific gas constant for air
R_s	m	Lever length
S	J/K	Entropy
s	J/(K·kg)	Specific entropy
T	K	Temperature
t	s	Time
U	J	Inner energy
u	J/kg	Specific inner energy
V	m^3	Volume
$\dot{V}$	m^3/s	Volume flow rate
V_{cyl}	m^3	Cylinder volume
V_{tube}	m^3	Tube volume
v_f	m/s	Flow velocity
v_S	m/s	Stribeck velocity
$\dot{w}$	1/s	Angular velocity
W_t	J	Technical work
W_Q	J	Heat transfer work
W_{shaft}	J	Shaft work
x	m	Cylinder stroke
x_0	m	Initial coordinate
$\dot{x}$	m/s	Mean piston velocity
$\ddot{x}$	m/s^2	Piston acceleration
z	m	Height coordinate
η	-	Efficiency
λ	-	Darcy coefficient
ρ	kg/m^3	Density

Subscripts

0	Surrounding
A	Meter-in cylinder chamber
B	Meter-out cylinder chamber
dp	Damping
t	Tube

Superscripts

˙ (over dot)	Quantity per unit time