LIST OF SYMBOLS

Nomenclatures

A	Area [m^2]
C	Cost [$]
c_p	Specific heat capacity [$J.kg^{-1}.K^{-1}$]
d	Diameter [m]
D	Width of the tape [m]
Ex	Exergy [W]
f	Friction factor [-]
G	Mass velocity [$kg.m^{-2}.s^{-1}$]
h,	Heat transfer coefficient [$W.m^{-2.}K^{-1}$]
I	Irreversibility [W]
k	Thermal conductivity [$W.K^{-1}.m^{-1}$]
L	Length [m]
m	Mass flow rate [$kg.s^{-1}$]
N	Number of tubes
Nu	Nusselt number [-]
P	Pitch of the coil [mm]
p	Pressure drop [Pa]
Pe	Peclet number [-]
Pr	Prandtl number [-]
q	Heat transfer rate [W]
R	Thermal resistance [$K.W^{-1}$]
Re	Reynolds number [-]

S	Entropy [W K^{-1}]
T	Temperature [K]
U	Overall heat transfer coefficient [W.m^{-2}K^{-1}]
u	Velocity [m.s^{-1}]
W	Pumping power [W]

Greek symbols

α	Convective heat transfer coefficient [W.m^{-2}.K^{-1}]
Δ	Temperature difference [K]
ε	Effectiveness
Φ	Particle volume concentration [-]
μ	Dynamic viscosity [Pa.s]
ρ	Density [kg.m^{-3}]

Subscripts

bf	Base fluid
c	Cold fluid (water)
f	Friction
gen	Generation
h,hot	Hot fluid
ht	Heat transfer
i,o	Inner/outer
in,out	Inlet and outlet
it,ot	Inner tube and outer tube
m	Mean
nf	Nanofluid

np,p	Nanoparticle
op	Operating
s	Steam

Abbreviations

AlN	Aluminum nitride
Al_2O_3	Alumina nanoparticle
Ag	Silver
C-type	Convergence type
C-D type	Convergence-Divergence type
CMC	Carboxymethyl cellulose
CNT	Carbon nanotube
CTAB	Cetyl trimethyl ammonium bromide
Cu	Copper
CuO	Copper oxide nanoparticle
D-type	Divergence type
DI	De-ionized
DR	Depth ratio
DTHX	Double tube heat exchanger
EDX	Energy-dispersive X-ray
EG	Ethylene glycol
EES	Engineering equation solver
Fe_3O_4	Iron(II, III) oxide nanoparticles
GNP	Graphene Nanoplatelets
IEP	Isoelectric point
LMTD	Logarithmic mean temperature difference
MgO	Magnesia
MWCNT	Multi-walled carbon nanotubes
PCM	Phase change materials
PG	Propylene glycol
SDS	Sodium dodecyl sulfate
SEM	Scanning Electron Microscope

SiO_2	Silica nanoparticle
STHX	Shell and tube heat exchanger
TEM	Transmission electron microscopy
TiO_2	Titania nanoparticle
TGA	Thermogravimetric Analyzer
TR	Twist ratio
MgO	Magnesia
MWCNT	Multi-walled carbon nanotubes
PBP	Payback period
PCM	Phase change materials
SDS	Sodium dodecyl sulfate
VSM	Vibrating Sample Magnetometer
WR	Width ratio
X	Uncertainty (%)
XRD	X-ray diffraction
ZnO	Zinc oxide