**Nomenclature**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>(a)</td>
<td>Absorption Coefficient</td>
</tr>
<tr>
<td>(a_{e,i})</td>
<td>The weighting factor depends on temperature</td>
</tr>
<tr>
<td>(\overline{a}_p)</td>
<td>Average of the momentum equation coefficients for the cells on either side of the face</td>
</tr>
<tr>
<td>(A')</td>
<td>Pre-exponential Factor in Arrhenius Formula</td>
</tr>
<tr>
<td>(A)</td>
<td>Surface Area</td>
</tr>
<tr>
<td>(b)</td>
<td>Temperature Exponent in Arrhenius Formula</td>
</tr>
<tr>
<td>(b_{e,j,j})</td>
<td>The emissivity gas temperature polynomial coefficients</td>
</tr>
<tr>
<td>(c_i)</td>
<td>Concentration of Species (i)</td>
</tr>
<tr>
<td>(C_p)</td>
<td>Specific Heat Capacity at Constant Pressure</td>
</tr>
<tr>
<td>(C_{1e}, C_{2e})</td>
<td>Constants of Standard (k-\varepsilon) Model</td>
</tr>
<tr>
<td>(C_i)</td>
<td>Vapor Concentration</td>
</tr>
<tr>
<td>(C_D)</td>
<td>Drag Coefficient</td>
</tr>
<tr>
<td>(C_{RF})</td>
<td>Char reactivity factor</td>
</tr>
<tr>
<td>(CV)</td>
<td>Control volume</td>
</tr>
<tr>
<td>(d_p)</td>
<td>Particle Diameter</td>
</tr>
<tr>
<td>(\Delta G_{f}^0(T))</td>
<td>Gibbs function</td>
</tr>
<tr>
<td>(D)</td>
<td>Diffusivity</td>
</tr>
<tr>
<td>(D_{i,m})</td>
<td>Mass Diffusion Coefficient</td>
</tr>
<tr>
<td>(D_f)</td>
<td>transport due to the diffusion through the face (f)</td>
</tr>
<tr>
<td>(D_{r,i})</td>
<td>Coefficient of thermal diffusion</td>
</tr>
<tr>
<td>(E)</td>
<td>Total Energy</td>
</tr>
<tr>
<td>(E_p)</td>
<td>Equivalent Particle Emission</td>
</tr>
</tbody>
</table>
E_a  Activation energy
f_{pn}  Scattering Factor of Particle n
F  Lorentzian Broadening Factor
\vec{F}  Force Vector
\vec{F}_D  Drag Force
\phi_f  A first-order upwind scheme indicating that the face value f
\vec{g}  Gravitational Acceleration
G  Incident Radiation
G_k  Production of Turbulent Kinetic Energy
\Gamma_\phi  The diffusion coefficient
h  Species Enthalpy
\bar{h}_1  Sensible enthalpy change
h  Convective Heat Transfer Coefficient
h_j(T_{ref})  Enthalpy of formation species j at reference temperature
h_{lg}  Latent Heat of Evaporation
H  Total Enthalpy
H_{lat,ref}  Latent Heat at Reference Condition
H_v  Net heat (lower heating values) of combustion of reactants
\Delta H_j^0  Enthalpy change of reaction at standard conditions
I  Radiation Intensity
\vec{J}_i  Diffusion Flux
J_f  The mass flow is rate through the face f
k  Turbulent Kinetic Energy
-\vec{k}_{eq}A\vec{\nabla}T  Axial heat transports
K_{eq}  Equilibrium constant
\[ k_{\text{eff}} \] effective thermal conductivity

\[ K_{eq} \] Equilibrium constant for reaction \( j \)

\( k_f, k_r \) Rate Constant for Forward / Reverse Reactions

\( k_{\infty} \) Thermal Conductivity of Continuous Phase

\( k_{\infty} \) high pressure limit

\( k_0 \) low pressure limit

\( L_e \) Lewis Number

\( \text{LHV} \) Lower Heating Value

\( m \) Mass

\( m' \) Mass Flow Rate

\( \dot{m}_{\text{char}} \) Inflow and outflow rates in each control volume

\( M_{w,i} \) Molecular Weight of Species \( i \)

\( n_{i,f}, n_{i,r} \) Reaction Orders of Forward / Reverse Reactions

\( n_{k,l} \) Molar flow rate of species \( k \)

\( N \) Number of Chemical Species

\( N_u \) Nusselt Number

\( \nabla \left( \rho \overline{v^2} \right) \) Fluctuation in turbulent flows

\( p \) Pressure

\( P_e \) The Peclet number

\( \sigma_k \) Prandtl Number

\( \sigma_\varepsilon \) Scattering coefficients

\( q_r \) substituted into the energy equation to account for heat sources (or sinks) due to radiation

\( Q_{\text{rad}} \) Radiative Heat Flux

\( \dot{Q}_{\text{loss}} \) Heat loss rate from \( I^{th} \) CV to the surrounding

\( \dot{Q}_{\text{reac}} \) Endothermic heat absorption rate
\( Q_{CH_4} \) Annual methane generation in the year of the calculation

R Universal Gas Constant

Re Reynolds Number

\( R_i \) Production of \( i^{th} \) species due to chemical reaction

\( Re_{ij} \) Reynolds Stresses

\( R_{tk} \) Net production rate of species \( k \) in the control volume

S Source Term

\( S_j \) Other source term

\( S_{ij} \) Mean Rate-of-Strain Tensor

\( S_{ct} \) Turbulent Schmidt Number

Sh Sherwood Number

\( S_{\phi} \) The source of \( \phi \) per unit volume

\( S_m \) the mass added to the continuous phase from the dispersed second phase

\( \Delta S_j^0 \) Entropy change of reaction at standard conditions

t Time

t\(_{\text{cross}}\) Particle Eddy Crossing Time

T Temperature

Tbp Boiling Temperature

Tvap Evaporation Temperature

Tw Gasifier Wall Temperature

\( \bar{\tau} \) Stress tensor

\( u_i \) Velocity Magnitude

\( u = \bar{u} + u'(t) \) Instantaneous gas velocity

\( u_p \) Particle Velocity

v Overall Velocity Vector

\( v'_i \) The stoichiometric coefficients for reactants
The stoichiometric coefficients for products

Volume

Volume of $i^{th}$ control volume

Direction

Equilibrium mole fractions

Mole Fraction of Species $i$

Mass Fraction of Species $j$

Mass Fraction of Element $i$

Bell-Evans-Polanyi Factor

Delta Function

Emissivity of Particle $n$

The gravitational body force

Turbulent Dissipation Rate

Normally Distributed Random Number

Kolmogorov Length Scale

Radiation Temperature

Air-Fuel Ratio

Thermal Conductivity

Effective Thermal Conductivity

Turbulent Thermal Conductivity

Dynamic Viscosity

Turbulent Viscosity

Kinematic Viscosity

Length Fraction of Fine Structures

Density

Density of the Oxidizer Stream
\( \sigma \)  Stefan-Boltzmann Constant
\( \sigma_p \)  Equivalent Particle Scattering Coefficient
\( \sigma_s \)  Scattering Coefficient
\( \tau \)  Time Scale
\( \tau^* \)  Time Scale of Fine Structures
\( \chi \)  Scalar Dissipation Rate
\( \omega_k \)  Angular Velocity
\( \Delta t \)  Time Step
\( \phi \)  Phase Function
\( \Omega' \)  Solid Angle
\( \Omega_{ij} \)  Mean Rate-of-Rotation Tensor
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<th>Description</th>
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<tr>
<td>AMG</td>
<td>Algebraic multi grid</td>
</tr>
<tr>
<td>BHTGS</td>
<td>Battelle high throughput gasification system</td>
</tr>
<tr>
<td>CAA</td>
<td>Clean Air Act</td>
</tr>
<tr>
<td>CFB</td>
<td>Circulating fluidized bed</td>
</tr>
<tr>
<td>CFD</td>
<td>Computational fluid dynamics</td>
</tr>
<tr>
<td>CGE</td>
<td>Cold gas efficiency</td>
</tr>
<tr>
<td>CPCB</td>
<td>Central pollution control board</td>
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<tr>
<td>CRF</td>
<td>Char reactivity factor</td>
</tr>
<tr>
<td>C$_{RF}$</td>
<td>Char reactivity factor</td>
</tr>
<tr>
<td>CV</td>
<td>Control volume</td>
</tr>
<tr>
<td>DPM</td>
<td>Discrete phase model</td>
</tr>
<tr>
<td>DRW</td>
<td>Discrete random walk</td>
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<tr>
<td>EDS</td>
<td>Energy dispersive X-ray spectrometry</td>
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<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
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<tr>
<td>EDC</td>
<td>Eddy dissipation concept</td>
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<tr>
<td>EPI</td>
<td>Energy Products of Idaho</td>
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<td>GHGs</td>
<td>Green house gases</td>
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<tr>
<td>HTR</td>
<td>High temperature recycling</td>
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<td>HAPs</td>
<td>Hazardous air pollutants</td>
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<tr>
<td>IGCC</td>
<td>Integrated gasification combined cycle</td>
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<tr>
<td>IMD</td>
<td>India Meteorological Department</td>
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<tr>
<td>IPCC</td>
<td>Intergovernmental panel on climate change</td>
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<td>ISAT</td>
<td>In-situ adaptive tabulation</td>
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<td>LCI</td>
<td>Life-cycle inventory</td>
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<td>LFG</td>
<td>Landfill Gas</td>
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<tr>
<td>MCD</td>
<td>Municipality Corporation Delhi</td>
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<tr>
<td>MEET</td>
<td>Multi-staged enthalpy extraction technology</td>
</tr>
<tr>
<td>Mg</td>
<td>Mega gram</td>
</tr>
<tr>
<td>MT</td>
<td>Metric ton</td>
</tr>
<tr>
<td>MTCI</td>
<td>Manufacturing and technology conversion international, Inc</td>
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<tr>
<td>Abbreviation</td>
<td>Full Form</td>
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<tr>
<td>--------------</td>
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</tr>
<tr>
<td>MSW</td>
<td>Munispality solid waste</td>
</tr>
<tr>
<td>NDMC</td>
<td>New Delhi Municipality Corporation</td>
</tr>
<tr>
<td>NEERI</td>
<td>National environmental engineering research institute Nagpur India</td>
</tr>
<tr>
<td>NMOCs</td>
<td>Non-methane organic compounds</td>
</tr>
<tr>
<td>PPMV</td>
<td>Parts per million by volume</td>
</tr>
<tr>
<td>PTFV</td>
<td>Potential tar formation volume</td>
</tr>
<tr>
<td>RCBC</td>
<td>Rotary cascading bed combustor</td>
</tr>
<tr>
<td>RDF</td>
<td>Refuse derived fuel</td>
</tr>
<tr>
<td>TGA</td>
<td>Thermo gravimetric analysis</td>
</tr>
<tr>
<td>WSGGM</td>
<td>Weighted sum of gray gases model</td>
</tr>
<tr>
<td>WTE</td>
<td>Waste to energy</td>
</tr>
<tr>
<td>VOCs</td>
<td>Volatile organic compounds</td>
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