APPENDIX E

DEVELOPMENT OF MATHEMATICAL MODEL

Convective Mass Transfer

Rewriting equation (4.6) for individual species, with subscript A representing eurycomanone, B for benzoic acid and C for gallic acid reproducing the following equation.

$$\frac{dC_A}{dt} = k_L \cdot a(C_{Ae} - C_A) \quad \text{(E1)}$$

$$\frac{dC_B}{dt} = k_L \cdot a(C_{Be} - C_B) \quad \text{(E2)}$$

$$\frac{dC_C}{dt} = k_L \cdot a(C_{Ce} - C_C) \quad \text{(E3)}$$

Decomposition and Volatilization

Rewriting equation (4.7), (4.8) and (4.9) for each compounds yields equation (E4) to (E12) when subscript A, B, and C representing eurycomanone, benzoic acid and gallic acid.

$$\frac{dC_A}{dt} = -(k_{DA} + k_{vA})C_A \quad \text{(E4)}$$

$$\frac{dC_B}{dt} = -(k_{DB} + k_{vB})C_B \quad \text{(E5)}$$

$$\frac{dC_C}{dt} = -(k_{DC} + k_{vC})C_C \quad \text{(E6)}$$

$$k_{DA} = \alpha_A T + \gamma_A \quad \text{(E7)}$$

$$k_{DB} = \alpha_B T + \gamma_B \quad \text{(E8)}$$

$$k_{DC} = \alpha_C T + \gamma_C \quad \text{(E9)}$$

$$k_{vA} = \varphi_A T + \theta_A \quad \text{(E10)}$$

$$k_{vB} = \varphi_B T + \theta_B \quad \text{(E11)}$$

$$k_{vC} = \varphi_C T + \theta_C \quad \text{(E12)}$$

Complete Modelling Equations

Mass Balance

Finally, considering all the aspects discussed (convection, decomposition and volatilization), the overall mass balance for all the 3 components are rewritten as follows:

$$\frac{dC_A}{dt} = k_L \cdot a(C_{Ae} - C_A) - (k_{DA} + k_{vA})C_A \quad \text{(E13)}$$

$$\frac{dC_B}{dt} = k_L \cdot a(C_{Be} - C_B) - (k_{DB} + k_{vB})C_B \quad \text{(E14)}$$

$$\frac{dC_C}{dt} = k_L \cdot a(C_{Ce} - C_C) - (k_{DC} + k_{vC})C_C \quad \text{(E15)}$$