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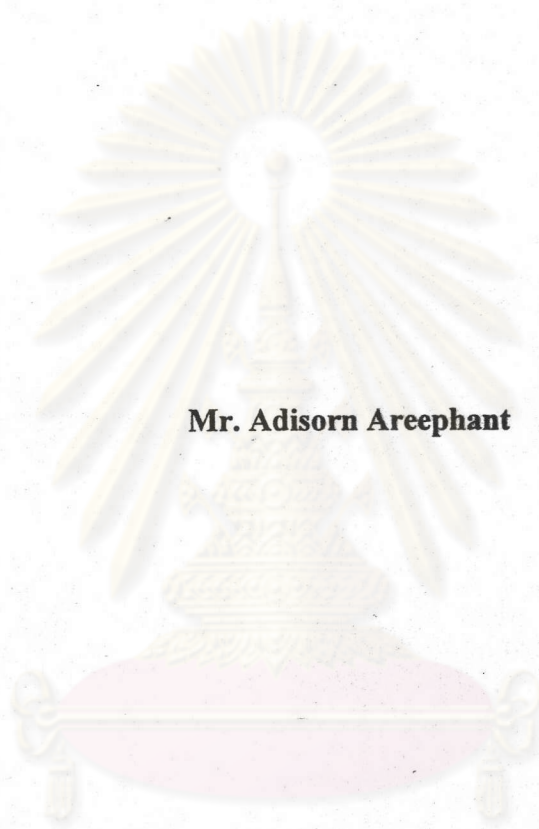
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**PARAMETER ESTIMATION OF A SIMPLIFIED MODEL
FOR PREDICTING AEROSOL COLLECTION EFFICIENCY
ON A DUST-LOADED FIBER**



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for the Degree of Master of Engineering**

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พิมพ์ต้นฉบับบทคัดย่อวิทยานิพนธ์ภายในกรอบสี่เหลี่ยมนี้เพียงแผ่นเดียว

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การเติบโตของเดนไดรต์บนเส้นใยเดี่ยวในไส้กรองอากาศ เป็นสาเหตุของการเพิ่มขึ้นอย่างรวดเร็วของประสิทธิภาพการจับอนุภาค พร้อมกับ การเพิ่มขึ้นอย่างรวดเร็วของความดันลด ตามเวลาการกรอง แบบจำลองเชิงคณิตศาสตร์ของการเติบโตของเดนไดรต์ซึ่ง ดร.วิวัฒน์ และคณะได้พัฒนาขึ้น บนพื้นฐานของคูลประชากร ถูกดัดแปลงสำหรับการจับอนุภาคโดยการแพร่และการกระทบจากแรงเฉื่อย ค่าตัวแปรเสริมที่เหมาะสมของแบบจำลองดังกล่าวนี้ สามารถประมาณ โดยการเปรียบเทียบกับผลการจำลองเชิงสโตแคสติก การประมาณค่าอาศัยวิธีซิมเพล็กซ์แบบไม่เป็นเส้นตรง เพื่อหาตำแหน่งที่ให้ค่าต่ำสุดของฟังก์ชันเป้าหมาย ซึ่งเป็นผลต่างกำลังสองของการกระจายตัวของเดนไดรต์ระหว่างแบบจำลองนี้กับแบบจำลองเชิงสโตแคสติกครั้งก่อน การกระจายตัวของเดนไดรต์ที่ทำนายได้โดยแบบจำลองนี้ สอดคล้องได้ดีกับของแบบจำลองเชิงสโตแคสติก ที่ค่าพารามิเตอร์น้อยๆ ของการสกັดกัน แต่สอดคล้องกันปานกลางที่ค่าพารามิเตอร์ค่อนข้างมากของการสกັดกัน ชุดค่าตัวแปรเสริมที่เหมาะสม และค่าอัตราการเพิ่มของประสิทธิภาพการจับอนุภาค จะขึ้นกับสภาวะการกรอง นั่นคือ ค่าพารามิเตอร์ของการสกັดกัน และค่าตัวเลขเพศเลขสำหรับการแพร่ หรือค่าพารามิเตอร์ของการสกັดกัน และค่าตัวเลขสโตคส์สำหรับการกระทบจากแรงเฉื่อย อนึ่งแบบจำลองนี้ยังใช้หน่วยความจำคอมพิวเตอร์ และเวลาการคำนวณน้อยกว่าแบบจำลองเชิงสโตแคสติก

ศูนย์วิทยทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย

ภาควิชา วิศวกรรมเคมี
สาขาวิชา วิศวกรรมเคมี
ปีการศึกษา 2538

ลายมือชื่อนิสิต
ลายมือชื่ออาจารย์ที่ปรึกษา
ลายมือชื่ออาจารย์ที่ปรึกษาร่วม

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KEY WORD: PARAMETER ESTIMATION/ AEROSOL COLLECTION/ DUST-LOADED FIBER/ DIFFUSION/ INERTIA

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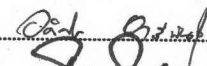
The growth of dendrite on a fiber in an air filter causes the particle collection efficiency along with the pressure drop to increase rapidly with filtration time. The deterministic dendritic growth model which Dr. Wiwut et al. developed on the basis of population balance was modified for particle deposition via convective diffusion and via inertial impaction. The optimal parametric values of the model could be estimated by comparison with the stochastic simulation results. The non-linear simplex method was used to estimate the set of values that minimized the objective function, which is the squared difference of the dendrite distribution between the present model and the previous stochastic model. The dendrite distribution predicted by the model agreed well with that of the stochastic model at a small interception parameter R but fairly well at a large R . The set of optimal parameters and the collection efficiency raising factor depended on the filtration conditions namely, R and Pe for convective diffusion, or R and St for inertial impaction. By the way, the present model also required much less computer memory and consumed much less computational time than the stochastic model.

ศูนย์วิทยุทรัพยากร
จุฬาลงกรณ์มหาวิทยาลัย


ภาควิชา.....วิศวกรรมเคมี.....

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ลายมือชื่ออาจารย์ที่ปรึกษา.....

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NOMENCLATURE

- $A(t)$ = fluctuating term (m/s)
 C_m = Cunningham's correction factor (-)
 d_f = fiber diameter (m)
 d_p = particle diameter (m)
 D_{BM} = diffusion coefficient $(= \frac{C_m kT}{3\pi\mu D_p})$ (m²/s)
 e_N = coefficient of effective capture area of a single dendrite of size N (-)
 e'_N = coefficient of effective shadow area of a dendrite of size N (-)
 E = particle collection efficiency of filter (-)
 Gr = gravitation settling parameter $(= \frac{U_\infty}{V_g})$ (-)
 h = thickness of filter (m)
 H = half height of generation plane (-)
 i = unit vector (-)
 K = hydrodynamic factor (-)
 K = position vector (m)
 L = Sample size (-)
 m = dust load in a unit filter volume (kg/m³)
 M = maximum dendrite size of interest (-)
 n = number of fibers (-)
 n = number concentration of aerosol particles (-/m³)
 n = standard normal random vector = (n_x, n_y, n_z)
 N = total number of sampling points (-)
 N_{gen} = number of incoming particles per unit dimensionless fiber length up to time t (-)
 Pe = Peclet number $(= \frac{D_f U_\infty}{D_{BM}})$ (-)
 P_N = number of dendrites of size N per unit dimensionless fiber length (-)

- R = interception parameter (d_f/d_p) (-)
 R_c = dimensionless radius of Kuwabara's cell (-)
 R_f = radius of fiber (m)
 R_p = radius of particle (m)
 S' = total area directly and indirectly (shadowed) by the dendrites (-)
 S_N = effective capture area of an incoming particle by dendrite of size N (-)
 St = Stoke number ($= \frac{C_m U_\infty \rho_p d_p^2}{9\mu d_f}$) (-)
 t = time (s)
 Δt = time step (s)
 u = fluid velocity (-)
 U_x = fluid velocity in x-direction (-)
 U_y = fluid velocity in y-direction (-)
 U_z = fluid velocity in z-direction (-)
 U_∞ = approach velocity of air (m/s)
 v = particle velocity (-)
 V_g = settling velocity (m/s)
 x = x-coordinate (m)
 X = dimensionless x-coordinate (-)
 y = y-coordinate (m)
 Y = dimensionless y-coordinate (-)
 z = z-coordinate (m)
 Z = dimensionless z-coordinate (-)

Greek symbols

- α = packing density of filter (-)
 β = mobility of particle (-)
 η = particle collection efficiency (-)
 η_0 = single fiber collection efficiency (clean surface) (-)
 λ = collection efficiency raising factor (kg/m^3)

ω	= weighting factor in equation (7) (-)
μ	= viscosity of air (Pa.s)
ρ_p	= particle density (kg/m^3)
σ	= scale length (-)
ψ	= stream function (-)

Subscripts

R	= interception
D	= diffusion
f	= fiber
G	= gravitaion
i	= i^{th} step
I	= inertia
o	= initial
p	= particle
sto	= stochastic simulation
i	= size of dendrites
x	= x-direction
y	= y-direction
z	= z-direction

Superscripts

j	= sampling point
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