Thomas Zemb

*lecture n°4:*

# *Basics of solid-liquid separation processes*

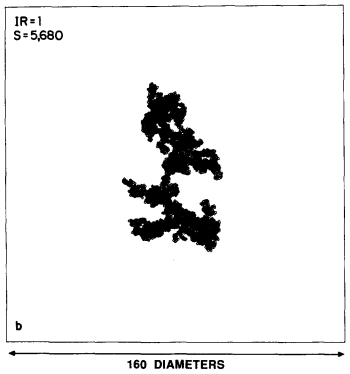
2014-2015

# An intrinsic multi-scale approach :

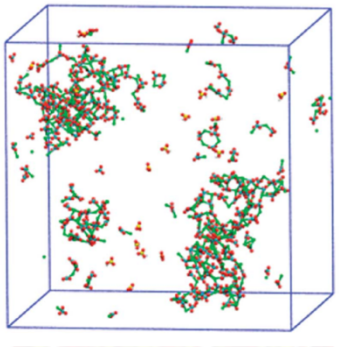
Usine

Extracteur
PAREX

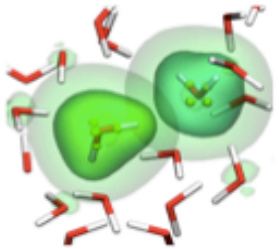
Mésoscopique
Thermo
cinétique




Supra-
moléculaire
et colloidal



Chimie des liaisons
Chimie quantique



# Content

- **The three scales of liquid-solid separation :**

- Nucleation and growth
- Coagulation and flocculation driving sedimentation
- Solid-liquid separation at engineering scale

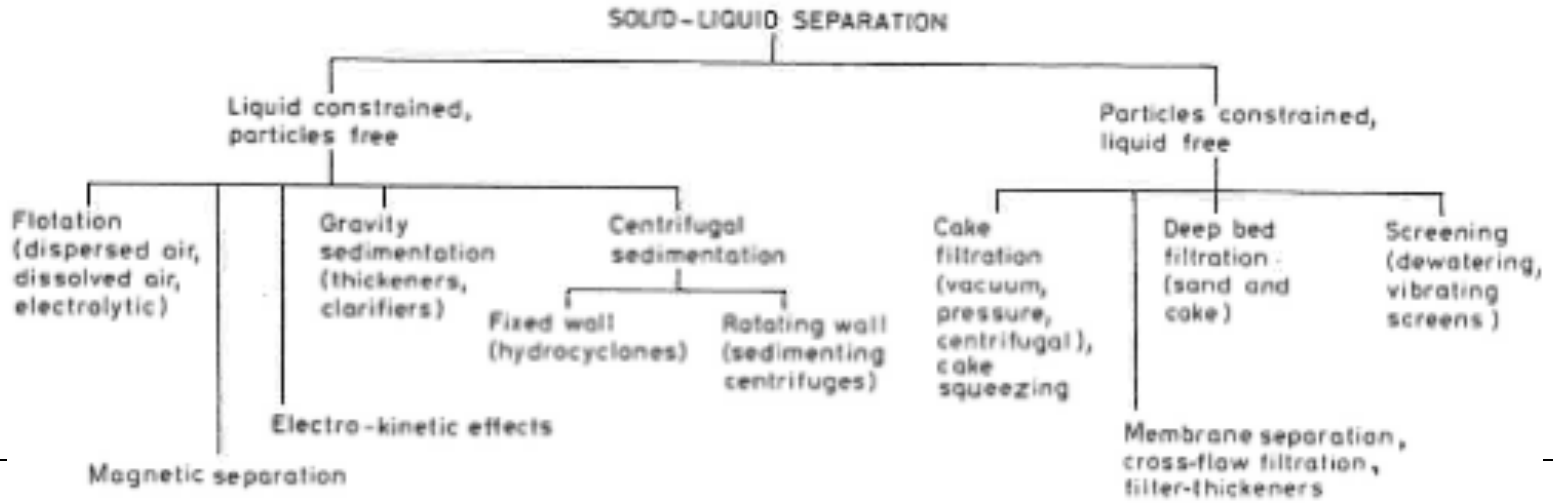



*Figure 1.2. Classification of solid–liquid separation processes*

# WHAT ARE INITIAL NUCLEI ?

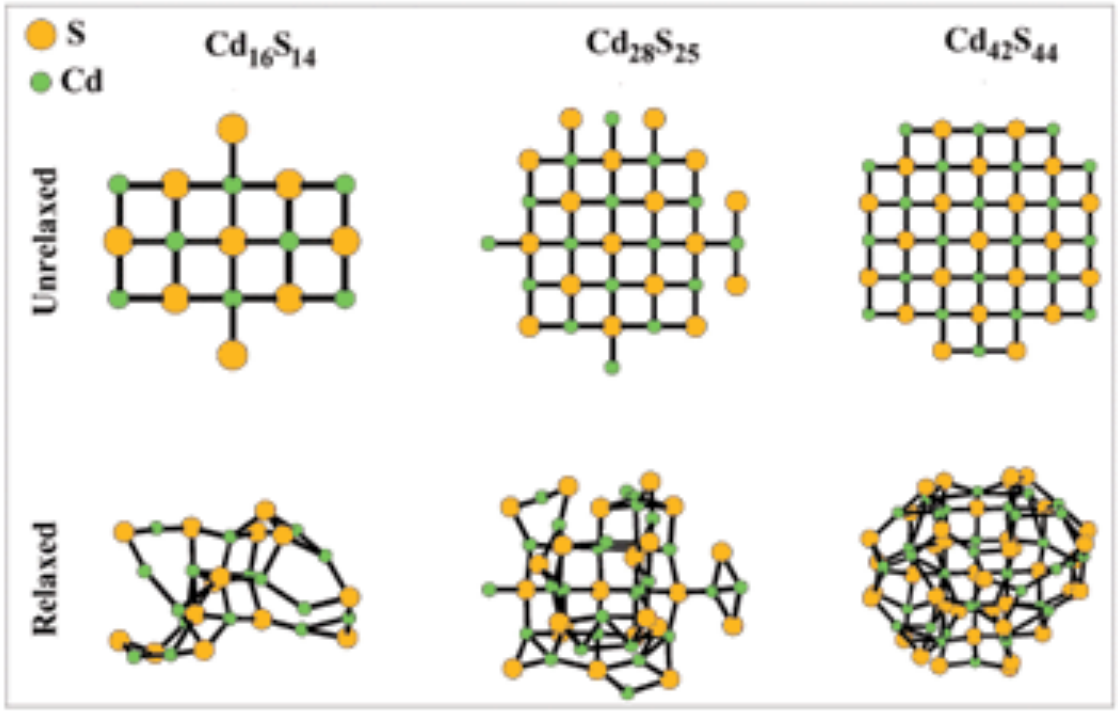
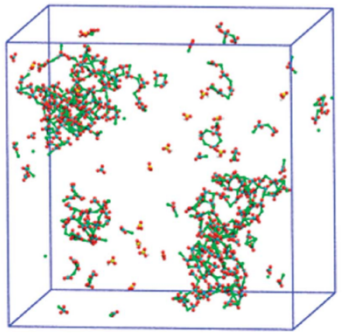
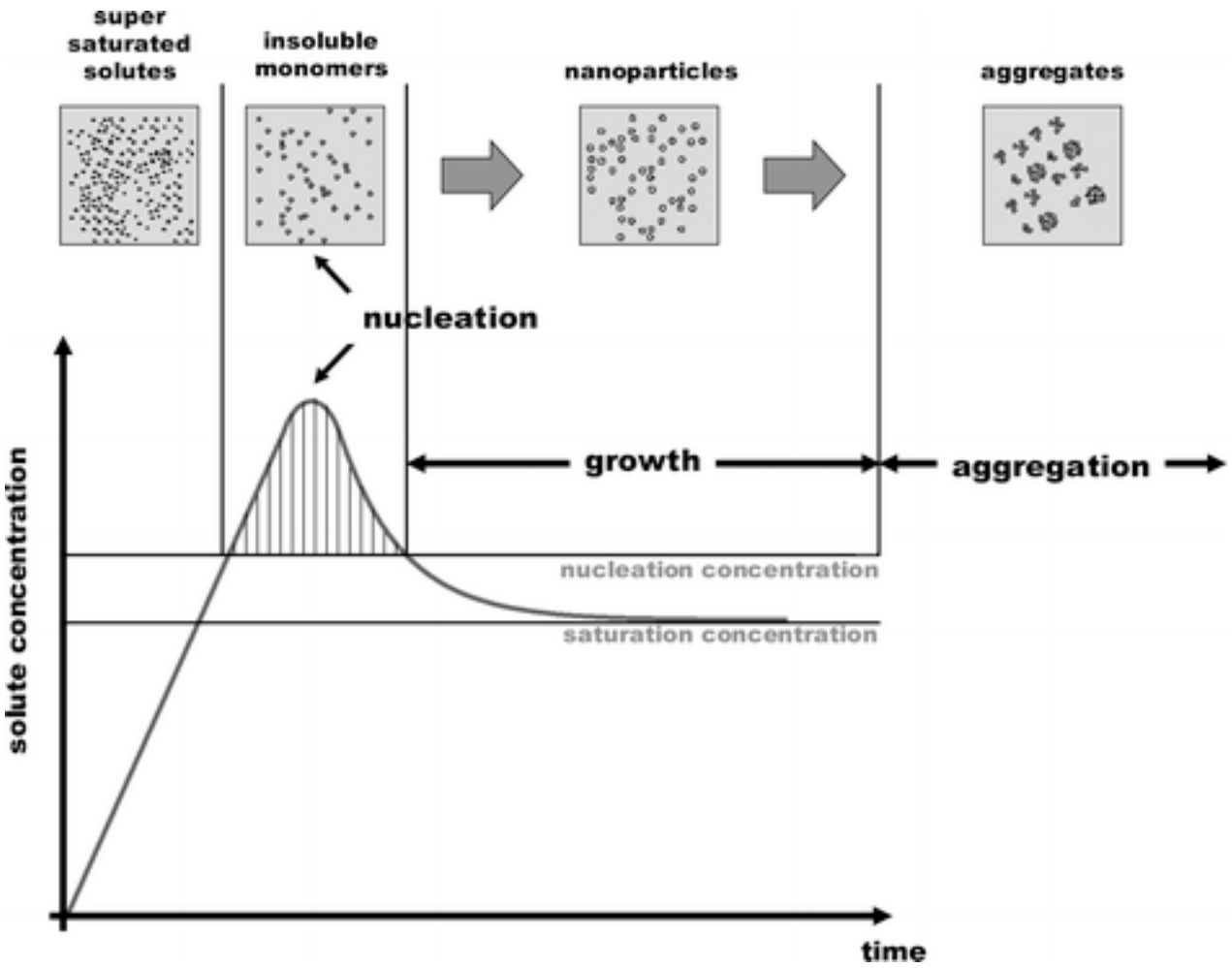



FIG. 2: Representation of (a) unrelaxed and (b) relaxed cubic CdS nanoparticles.

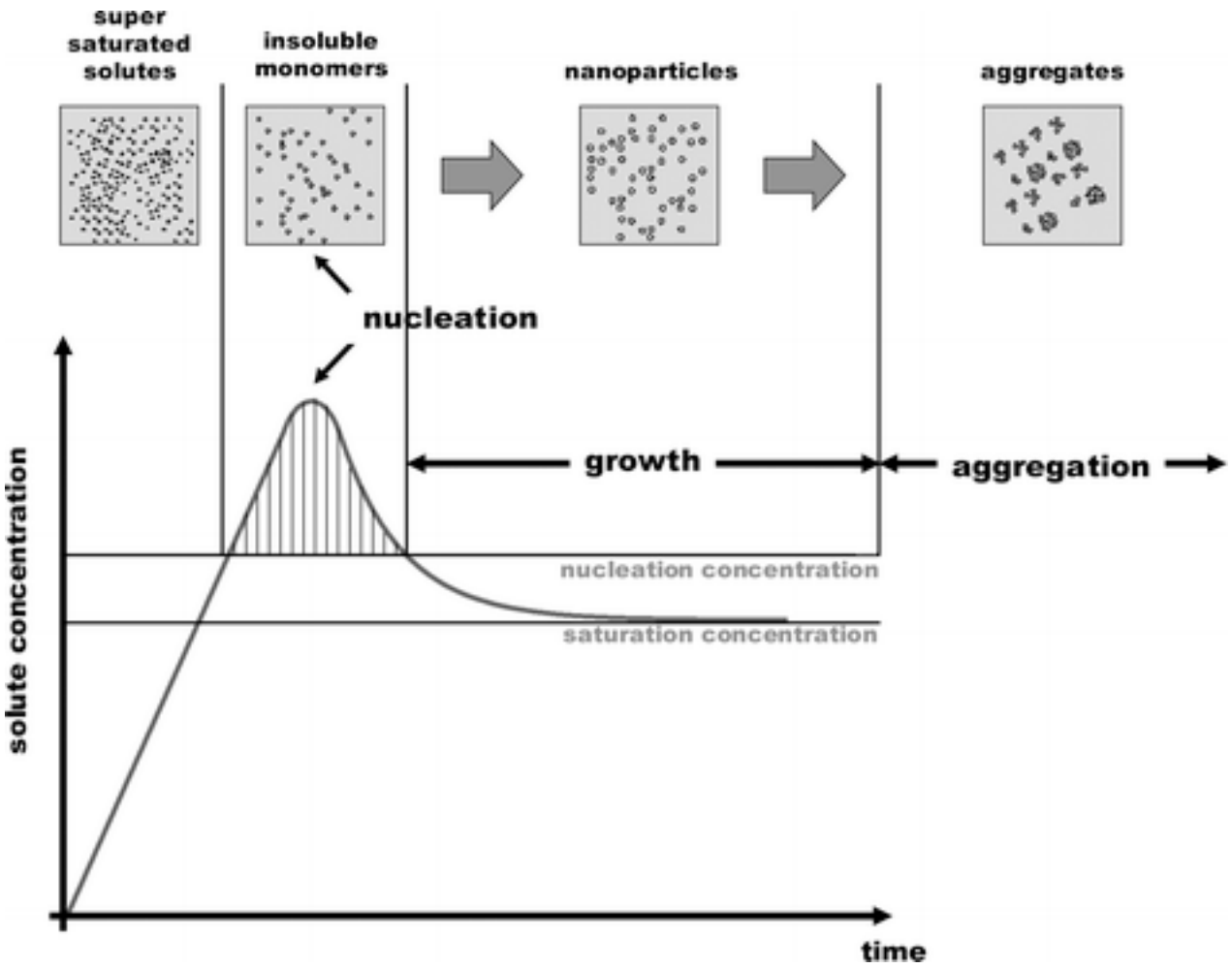


*Overbeck, Kruyt, Verwey … Philips/Eindhoven*
*D. Gebauer, H. Cöelfen, P. Baglioni*

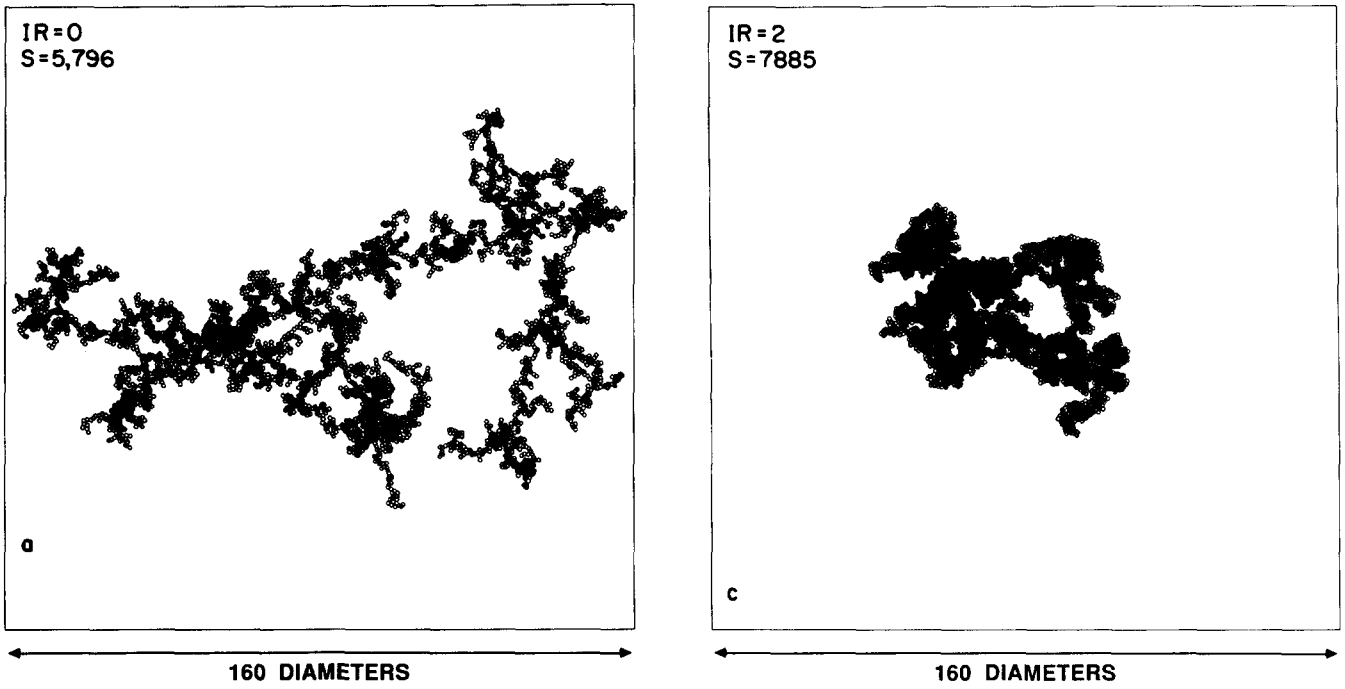
# Nucleation and growth



# Nucleation and growth



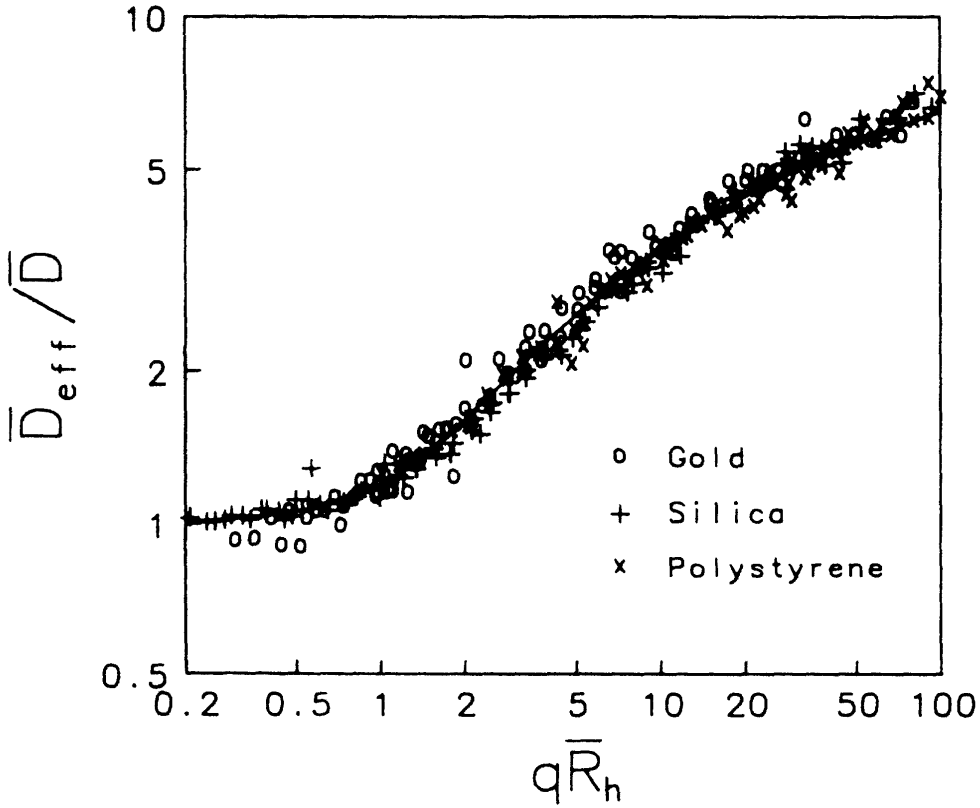
# (BALLISTIC), DLA, RLA… WITH REORGANISATION




*Macroscopic :FLOCCULATION, COAGULATION, COMPACTION/ »RIPENING »*

P. Meakin, R. Jullien: J. Chem. Phys 89, 246-258

# UNIVERSAL TRACES FRACTAL 1.5




Lin, Lindsay, Weitz, Ball, Klein, Meakin, Phys Rev A (1990), 41, 2005-2020

# SOLID-LIQUID SEPARATION : methods

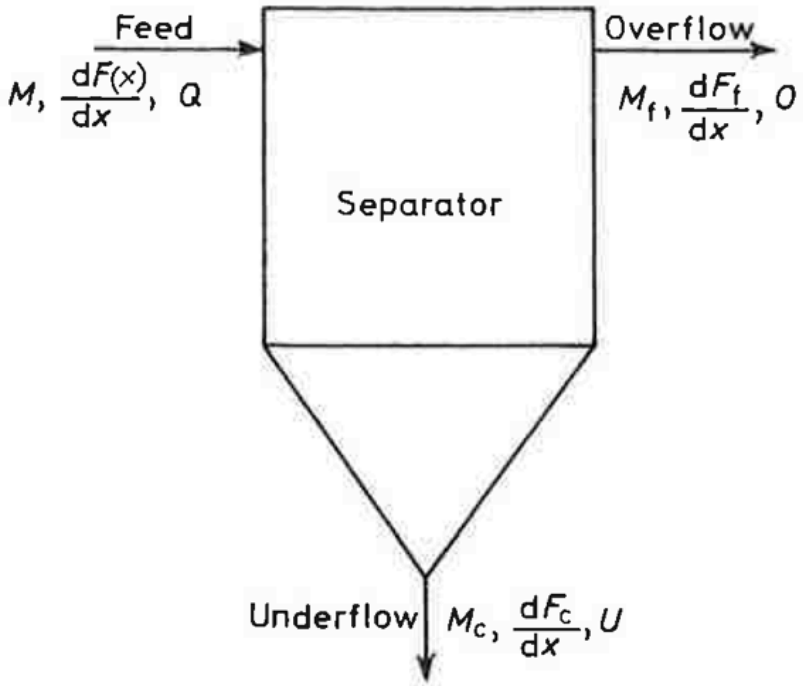



*Figure 3.1. Schematic diagram of a separator*

$$M = M_c + M_t$$

$$M\frac{dp}{dx} = M_c.\frac{dp_c}{dx} + M_t.\frac{dp_t}{dx}$$

L. Svarosky : « solid-liquid separation » Butterworth – 4th ed. 2001

# MODELLING : « SIZE » DISTRIBUTION COUNTS !



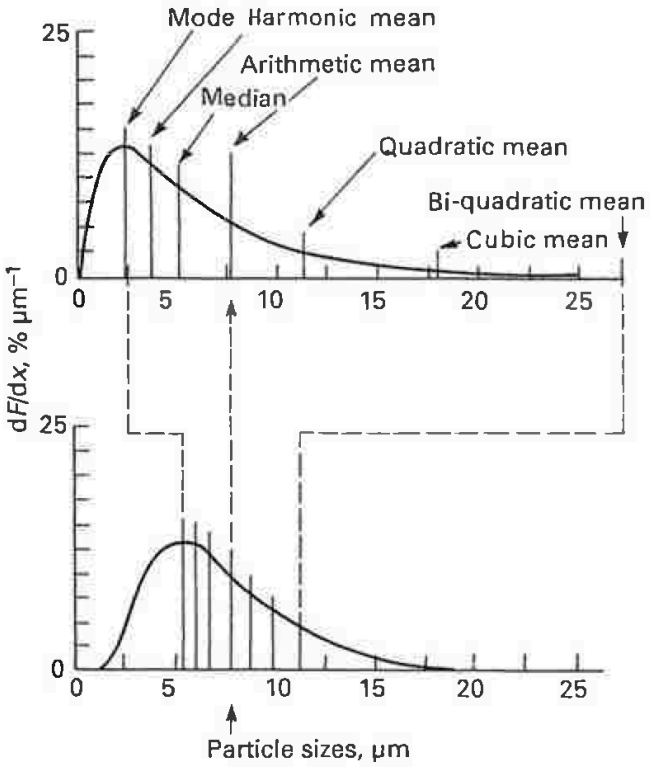



*Figure 2. A1.1. Two different size distributions with the same arthmetic mean*

$$x_{st} = \sqrt{\frac{18.\eta V_s}{g.\Delta\rho}}$$

DISTRIBUTION AND RIGHT AVERAGE IMPORTANT

# SOLID-LIQUID SEPARATION : real implementations

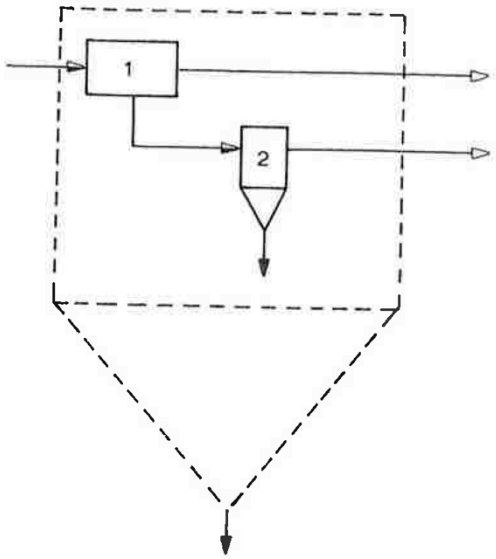



Figure 3.16. A concentrator with a separator in series

$$G(x) = \frac{G_1(x)G_2(x)}{1 - G_1(x) + G_1(x)G_2(x)}$$

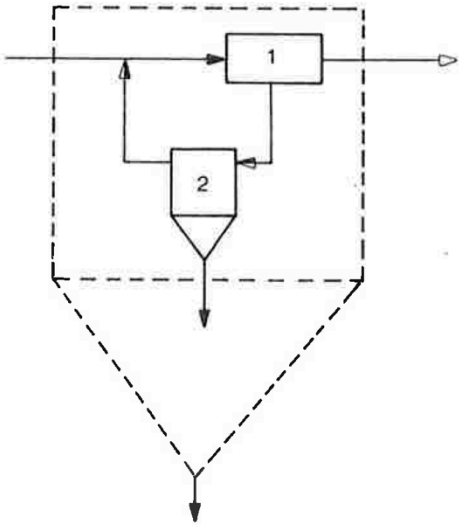



Figure 3.17. A concentrator with a separator in series, with feedback

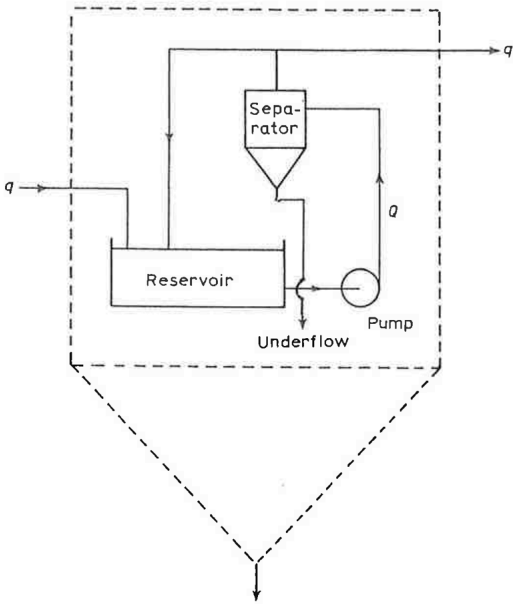
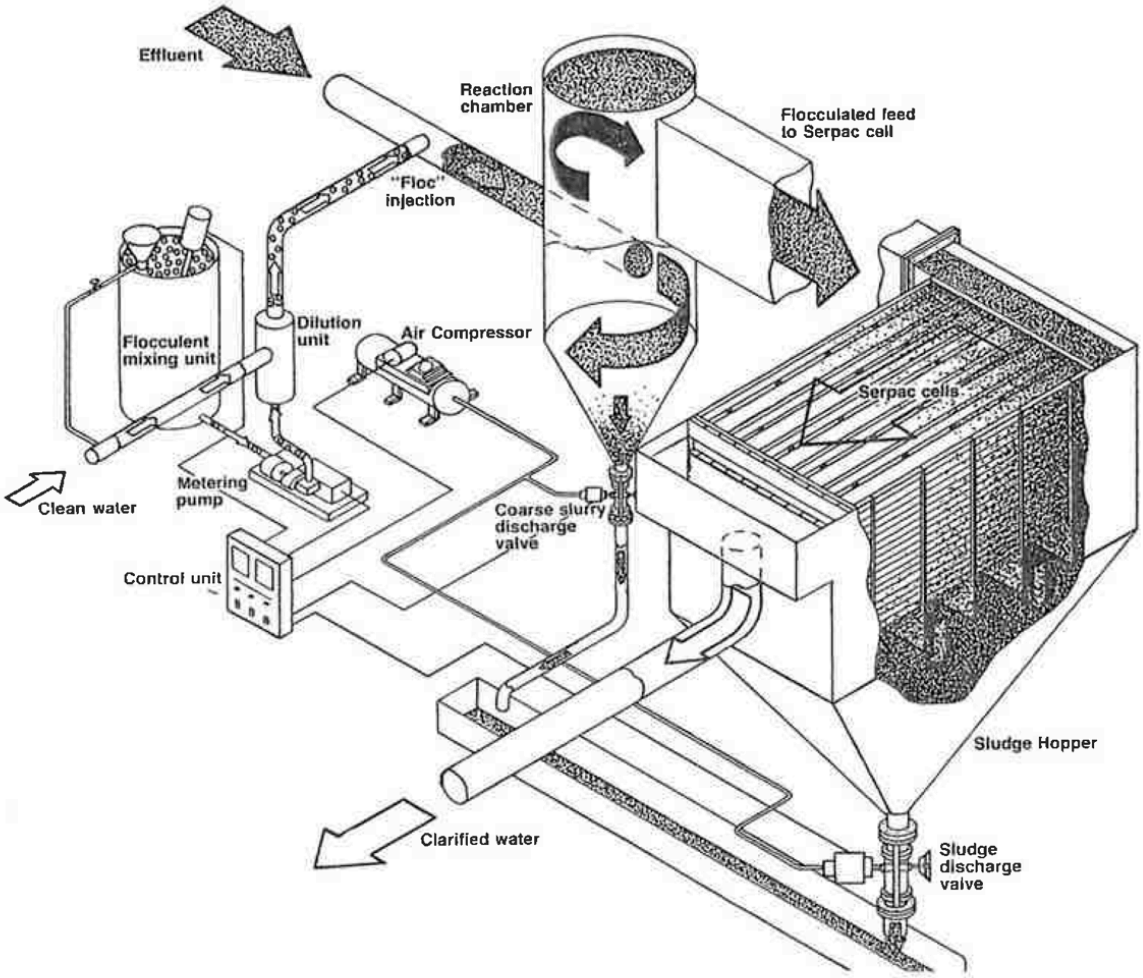



Figure 3.18. A multiple pass system

L. Svarosky : « solid-liquid separation » Butterworth – 4th ed. 2001

# ITERATIVE PROCEDURES : PLANT MAP

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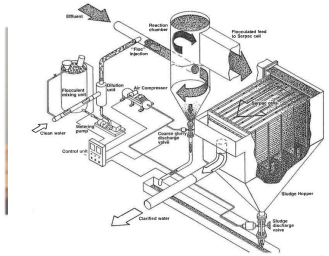
# An intrinsic multi-scale approach :



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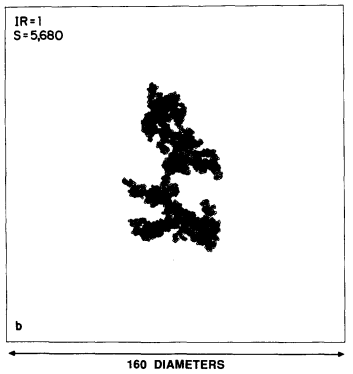


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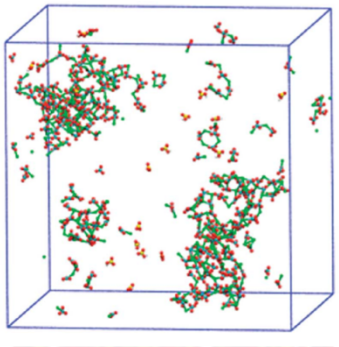

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