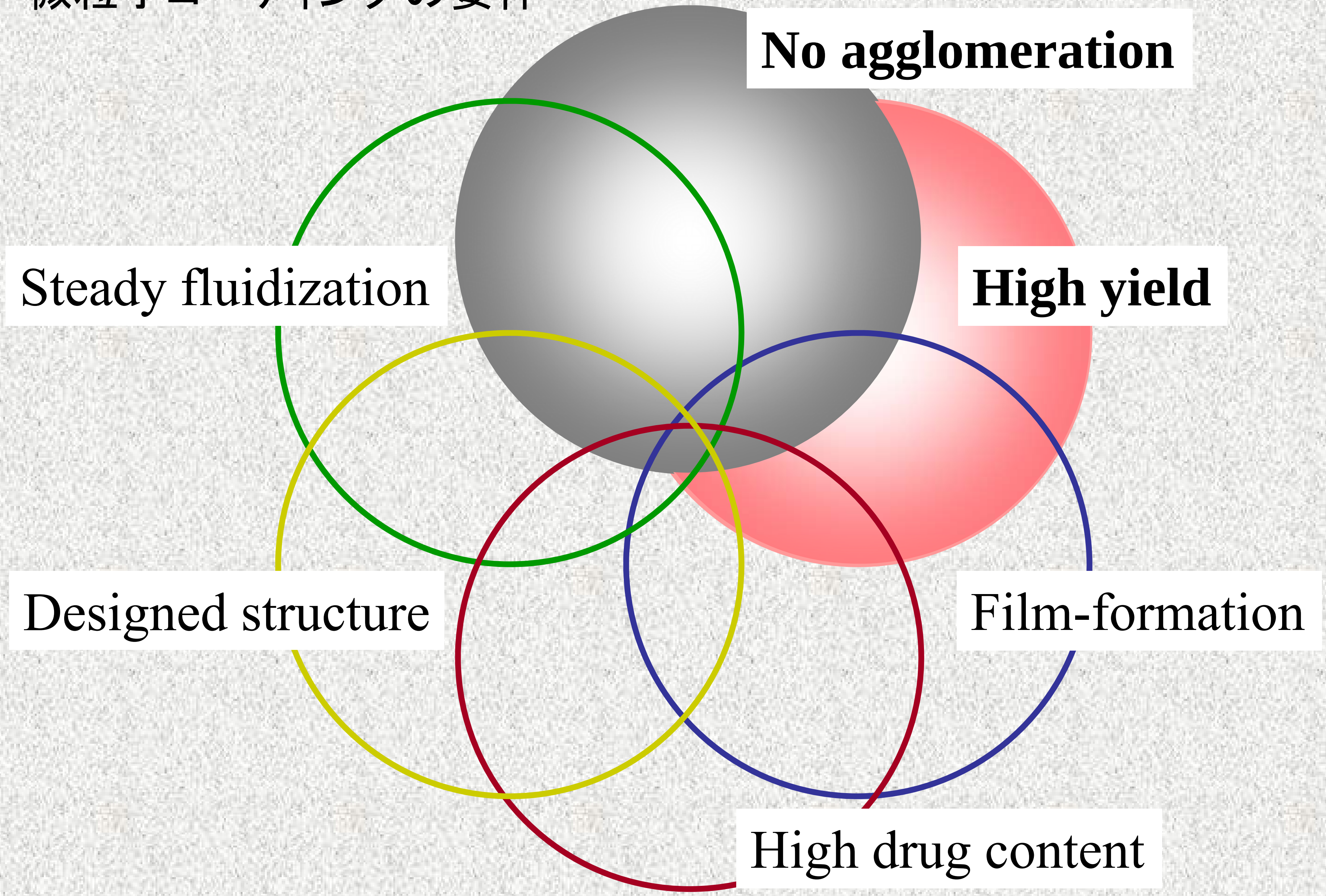
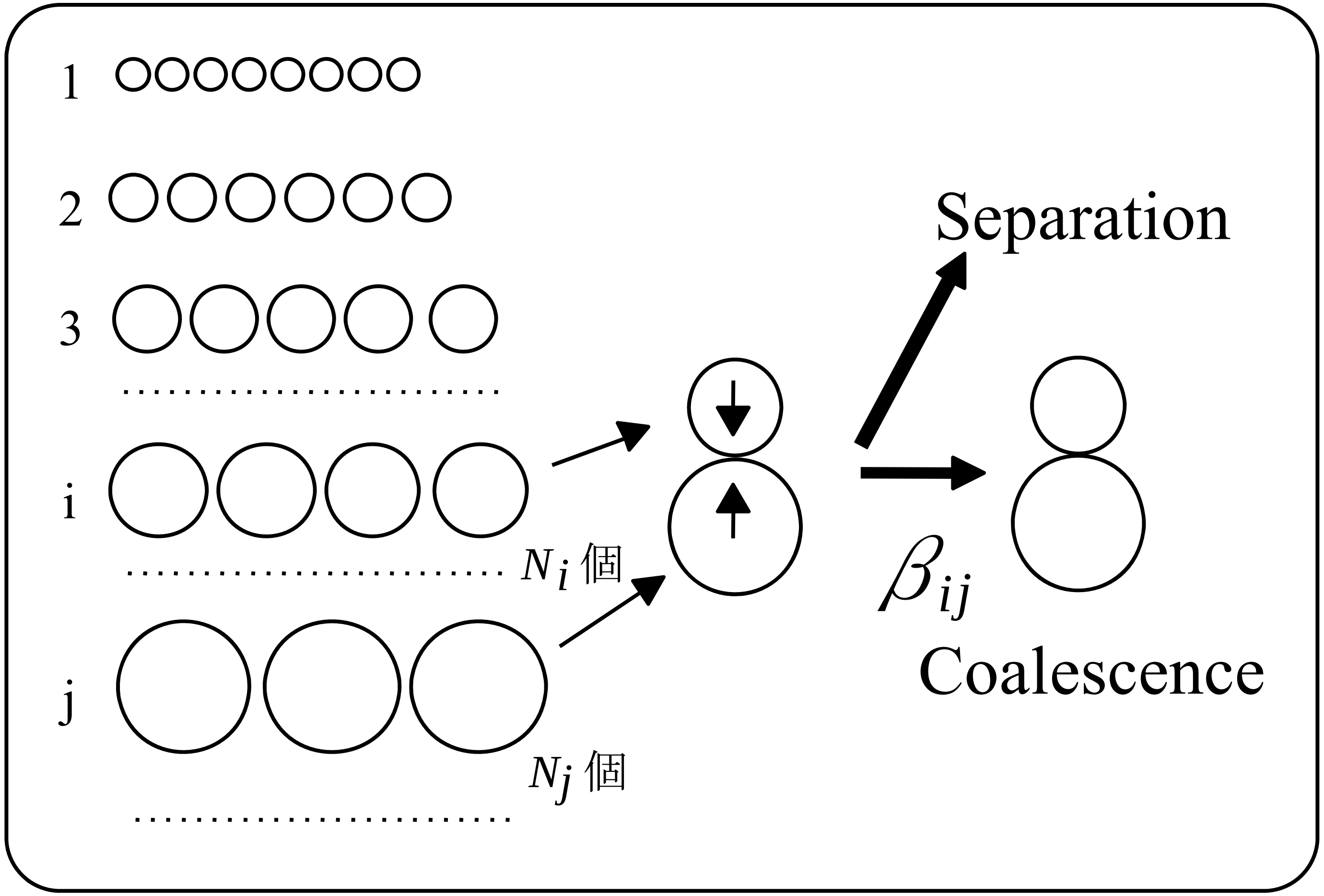
微粒子コーティングの要件



$$\frac{dN_i}{dt} = \frac{1}{N_T}\left(N_{i-1}\sum_{j=1}^{i-2} 2^{j-i+1}\beta_{i-1,j}N_j + \frac{1}{2}\beta_{i-1,i-1}N_{i-1}^2 - N_i\sum_{j=1}^{i-1}2^{j-i}\beta_{ij}N_j - N_i\sum_{j=1}^{\infty}\beta_{ij}N_j\right) \quad (1)$$



Population of particles（$v_{i+1}=2v_i$）

２　Ennisらのモデル

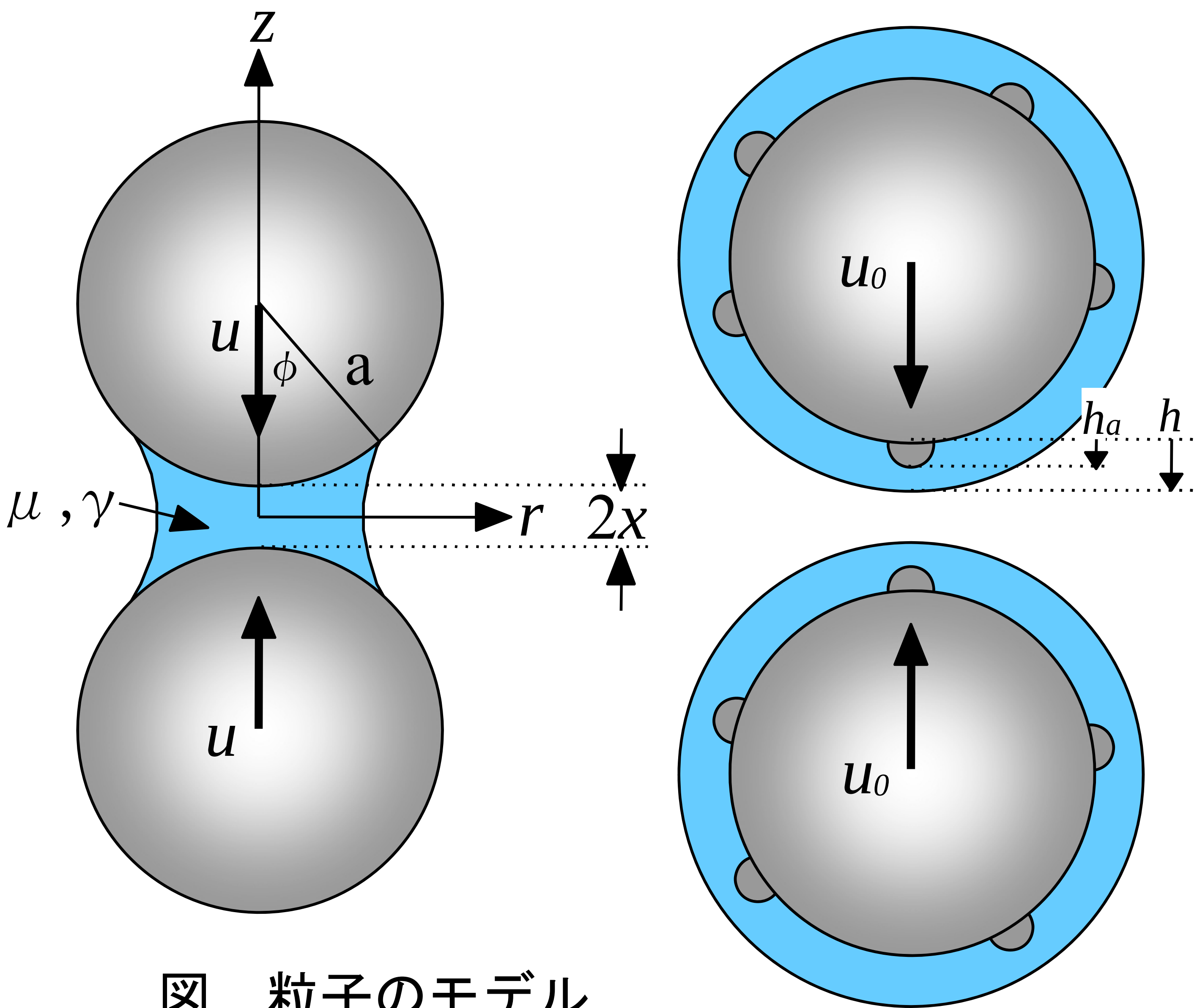
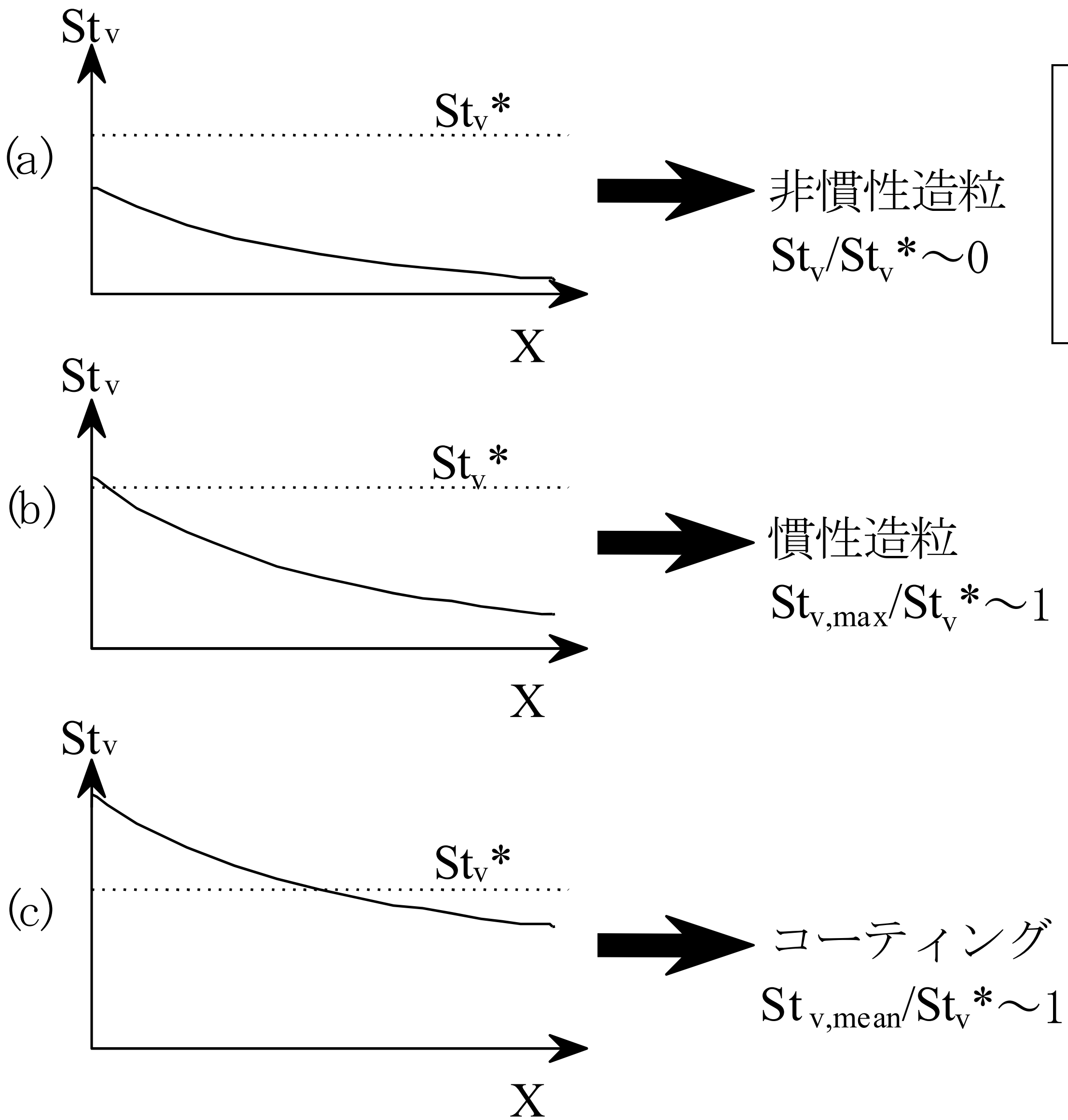


図　粒子のモデル

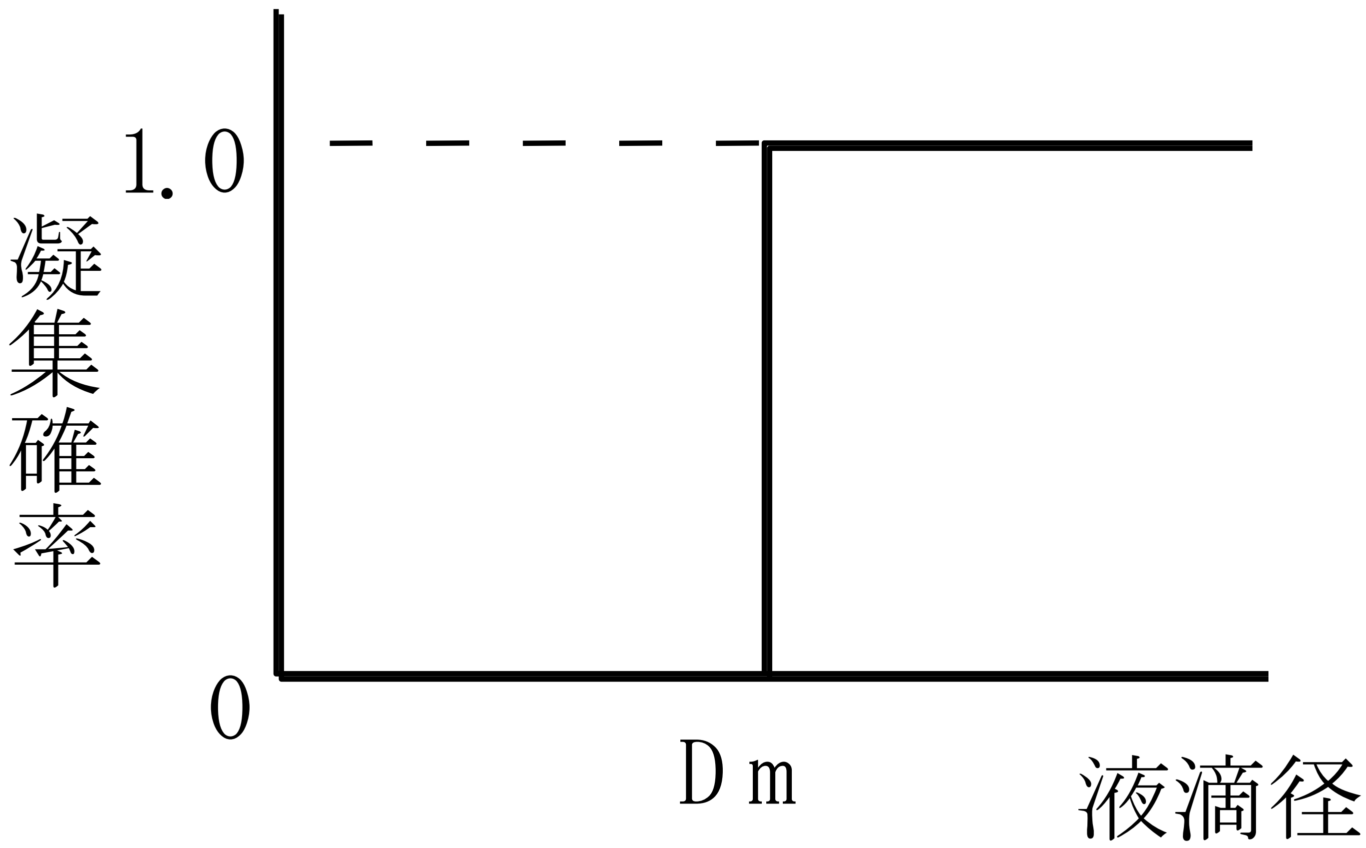
4）Classification of coalescence phenomena



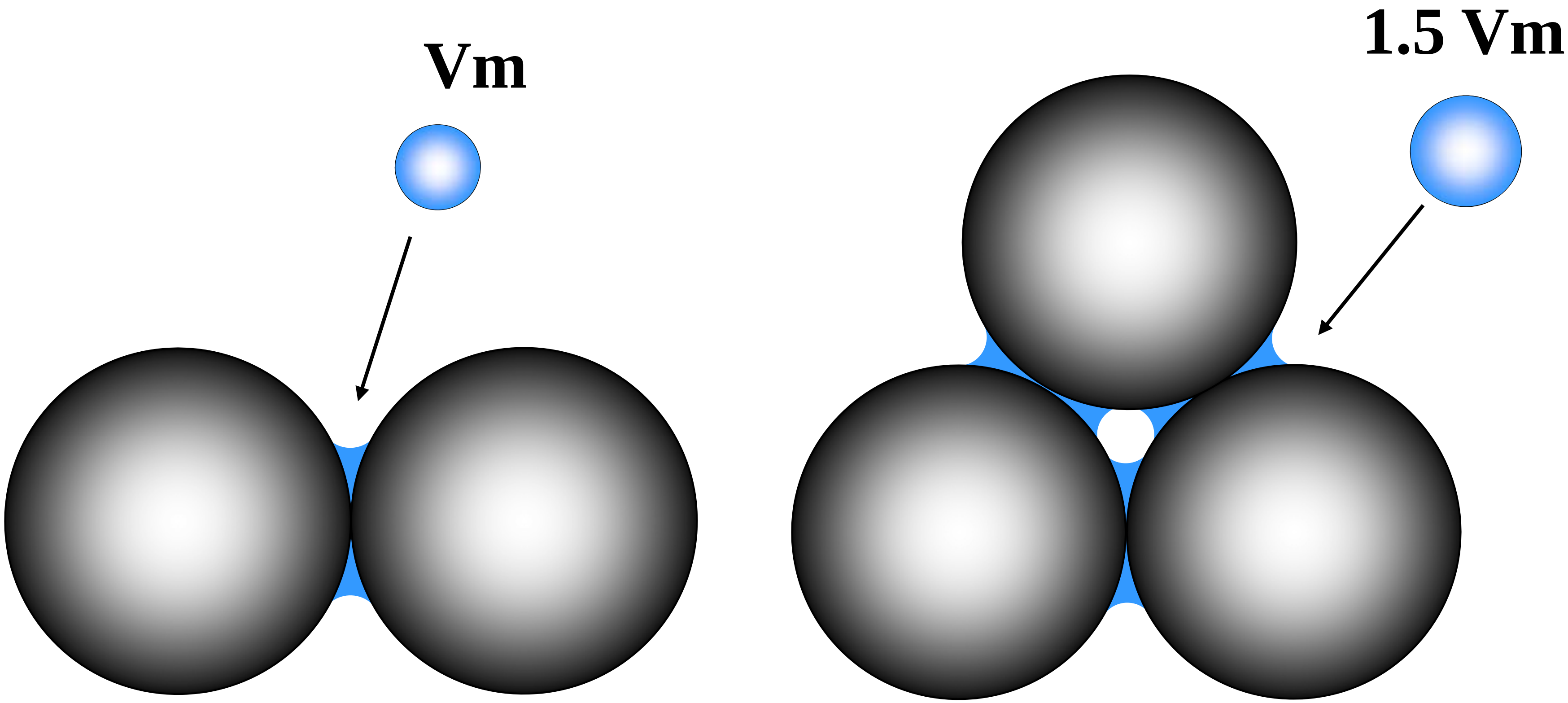
$$St_v = \frac{2mu_0}{3\pi\mu a^2} = \frac{8\rho u_0 a}{9\mu}$$

$$St_v^* = \left(1+\frac{1}{e}\right)\ln\left(\frac{h}{h_a}\right)$$

図．造粒過程の分類



２個の一次粒子の凝集確率



３個の一次粒子を凝集させるのに必要な液滴

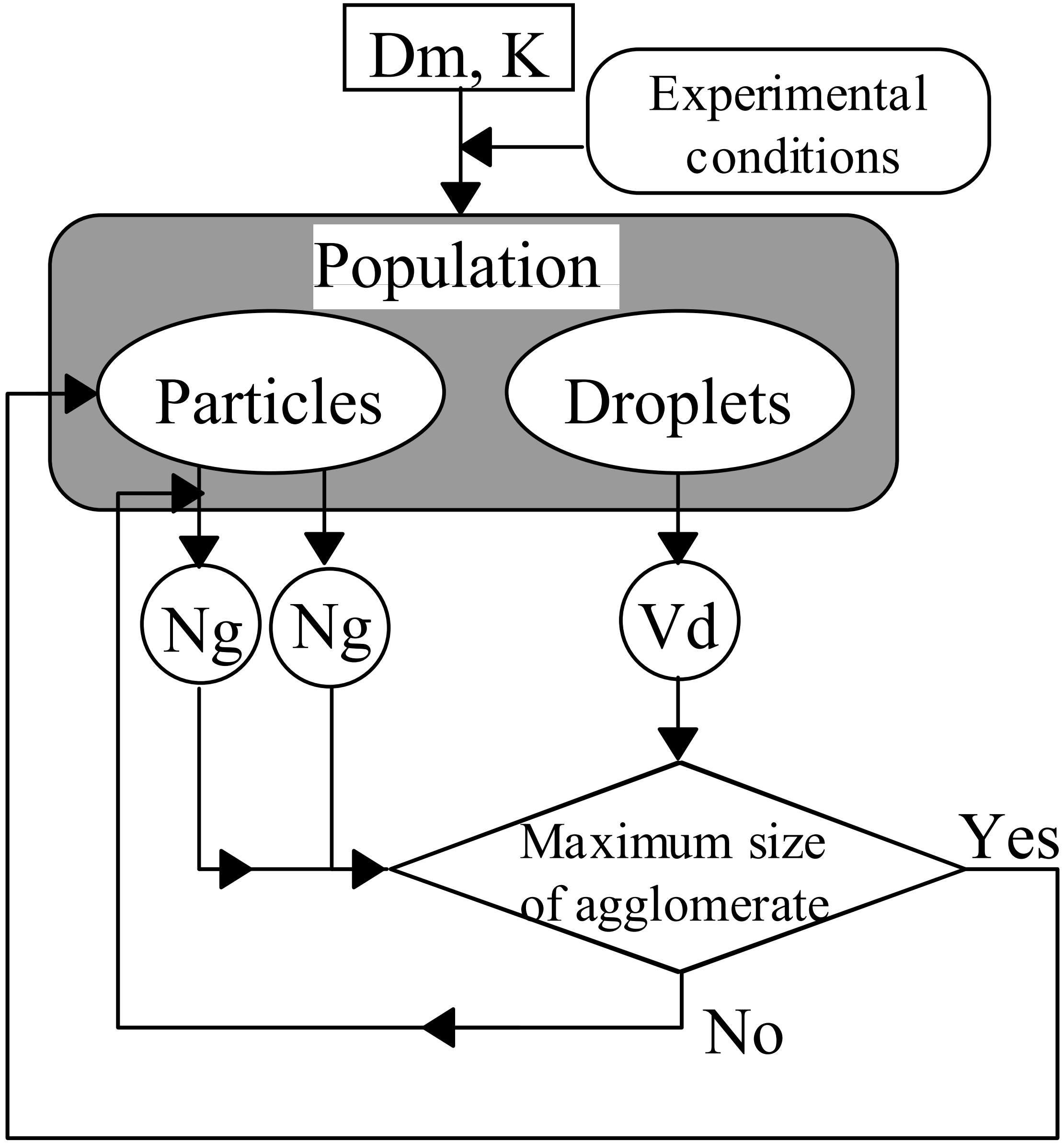
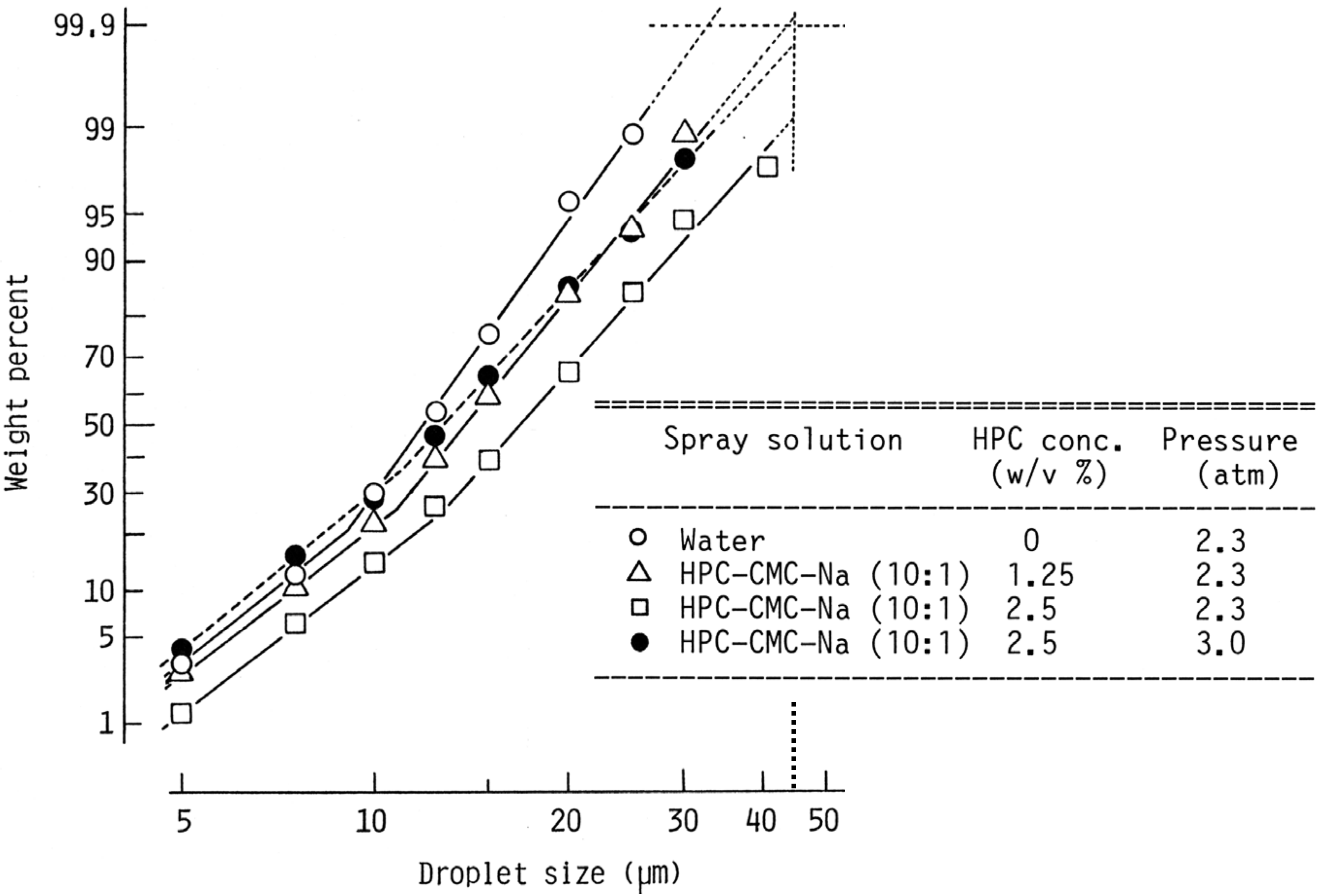


図　シミュレーションの流れ図

Generation of Agglomerates in Coating Process

			Core fraction (μm)			
			32-44	44-53	53-63	63-75
Formulation:	Cores (g)		25			
	Spray solution	HPC (g)	10			
		CMC-Na (g)	1			
		Water	added			
		Total (ml)	400			
Operating conditions:						
	Inlet air temp. (°C)		80			
	Outlet air temp. (°C)		26-31			
	Inlet air flow rate (m^3/min)		0.35	0.50	0.70	0.70
	Spray rate (ml/min)		3.7	3.9	4.0	4.0
	Spray pressure (kg/cm^2)		2.2			
Product:	Yield (%)		72	87	87	86
	Mean diameter (μm)		80	71	71	81
Agglomeration:						
	Core size (μm)		44.0	56.2	67.2	79.9
	Dm (μm)		37.1	41.9	45.7	49.0
	Fraction of agglomerates (%)		95.6	75.1	58.7	51.8
	Fraction of droplet generating agglomerates (%w/w)		2.73	1.31	0.74	0.46

A spouted bed coater with a draft tube (Grow Max 140, Fuji Paudal)



スプレー条件を変化させた場合の液滴径分布の変化

Table I. Effect of Additives on Properties of HPC Microcapsules

Additives[a]	None	PEG	NaCl	SAC	AS	PS80	BC	HPMC	CMC-Na	PG	PVA	Talc	ALG	MC
Yield of product (%)	83	83	83	84	81	86	86	84	88	84	88	86	85	85
Mass median diameter (μm)[b]	88	67	67	73	75	78	79	83	83	85	87	91	95	110
Fraction larger than														
75 μm (%)[c]	69	18	18	43	50	56	58	61	62	66	69	74	76	87
106 μm (%)	28	0.2	0.7	5	9	14	16	19	16	23	21	27	36	54
Yield of HPC (%)	94	94	99	97	89	92	93	91	96	83	95	–	88	94
Relative viscosity	6.7	6.7	6.9	6.9	7.0	5.5	4.9	7.2	14.6	7.0	7.3	–	45.6	17.3
Moisture absorption (%)	3.3	3.6	6.4	4.1	3.3	3.2	3.3	3.3	3.8	3.2	3.3	–	3.8	3.5
Tablet hardness (kg)	6.8	0.8	6.2	4.4	4.2	3.0	5.4	4.8	6.2	6.6	6.2	6.3	5.1	3.8
Droplet:														
Mass median diameter (μm)	17.1	16.4	17.3	17.4	17.9	16.2	16.6	16.8	17.0	17.4	19.6	–	21.2	25.5
$D_{84.1\%}$ (μm)	25.8	25.2	27.5	25.5	27.0	24.5	25.8	24.8	25.5	26.9	28.4	–	42.0	48.7
Simulation:														
D_m (μm)	45.6	50.9	56.3	45.0	48.0	45.2	47.7	44.0	44.7	48.3	46.6	–	68.2	71.0
K	1.50	0.32	0.45	0.75	0.93	1.30	1.23	1.42	0.91	1.32	1.26	–	0.64	0.80
Fraction of agglomerates	0.74	0.28	0.26	0.54	0.56	0.60	0.60	0.65	0.70	0.68	0.73	–	0.83	0.91
Maximum of N_g	29	7	9	12	17	27	27	22	21	27	19	–	37	42
Droplet larger than D_m (%)	0.87	0.43	0.55	0.63	0.81	0.67	0.82	0.68	0.86	0.95	0.97	–	4.38	5.65

a) PEG: polyethyleneglycol 6000; NaCl: sodium chloride; SAC: saccharose; AS: Aerosol OT; PS80: polysorbate 80; BC: benzethonium chloride; HPMC: hydroxypropyl methyl cellulose; CMC-Na: sodium carboxymethyl cellulose; PG: propylene glycol; PVA:polyvinyl alcohol; ALG: sodium alginate; MC: methyl cellulose.

b) Theoretical (D_c): 69.9 μm; particle density: 1.407 g/cm^3.

c) The smallest limit of agglomerates was observed to be 75 μm on microscopy of each sieved fraction.

流動コーティング法による細粒剤製造における

団粒発生に及ぼすスプレーミストサイズの影響

武田薬品工業 ㈱ ○田中 哲也, 且元 仁 , 盛本 修司

菊田 潤一, 堀井 紀史, 平井 真一郎

粉体工学会1995年度春期研究発表会講演論文集, pp.34-37

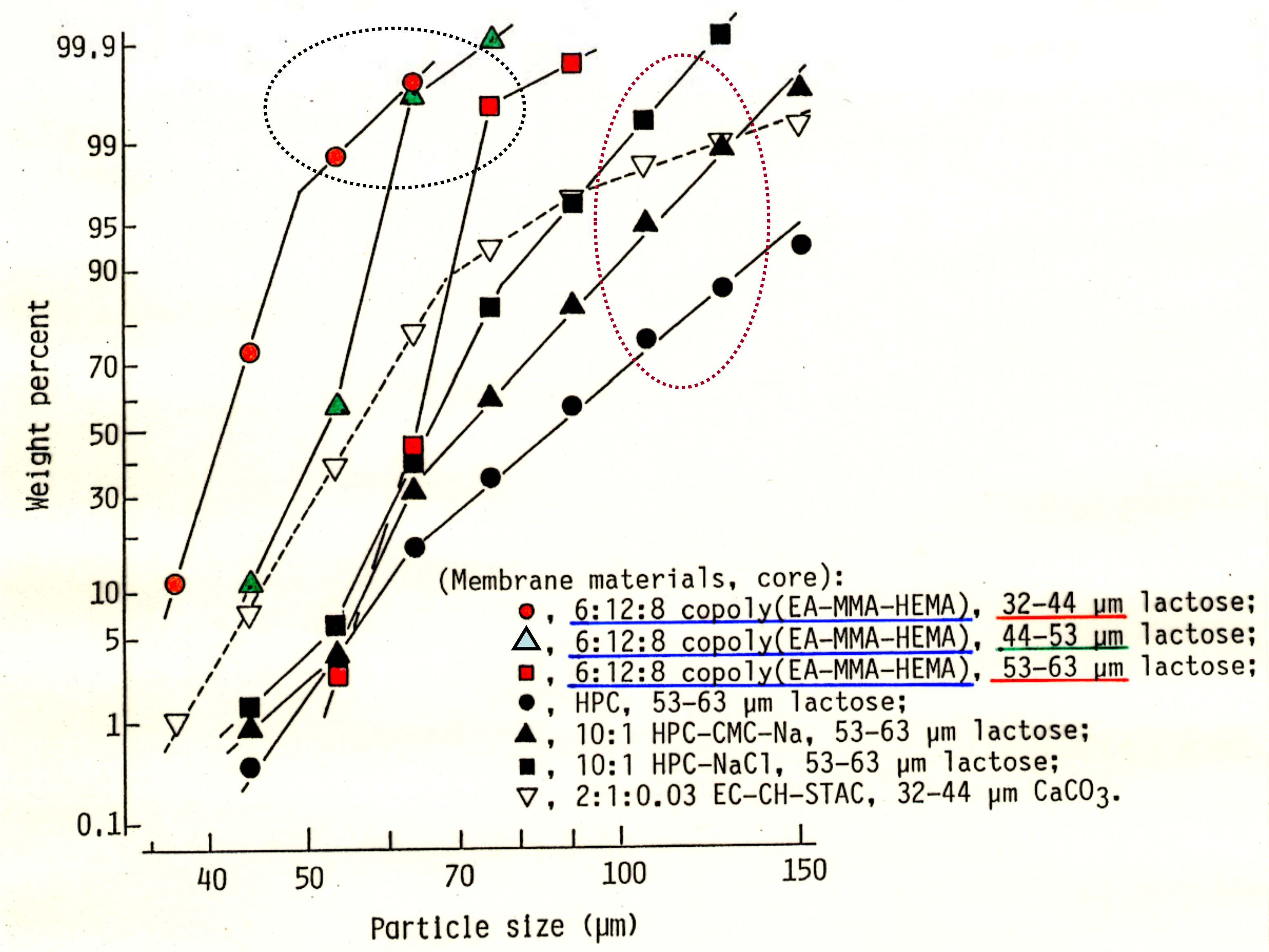
転動流動層を用いた微粒子ﾚｲｱﾘﾝｸﾞによる細粒製剤化

—新製剤技術（粒子設計、高能力、他）による製品化—

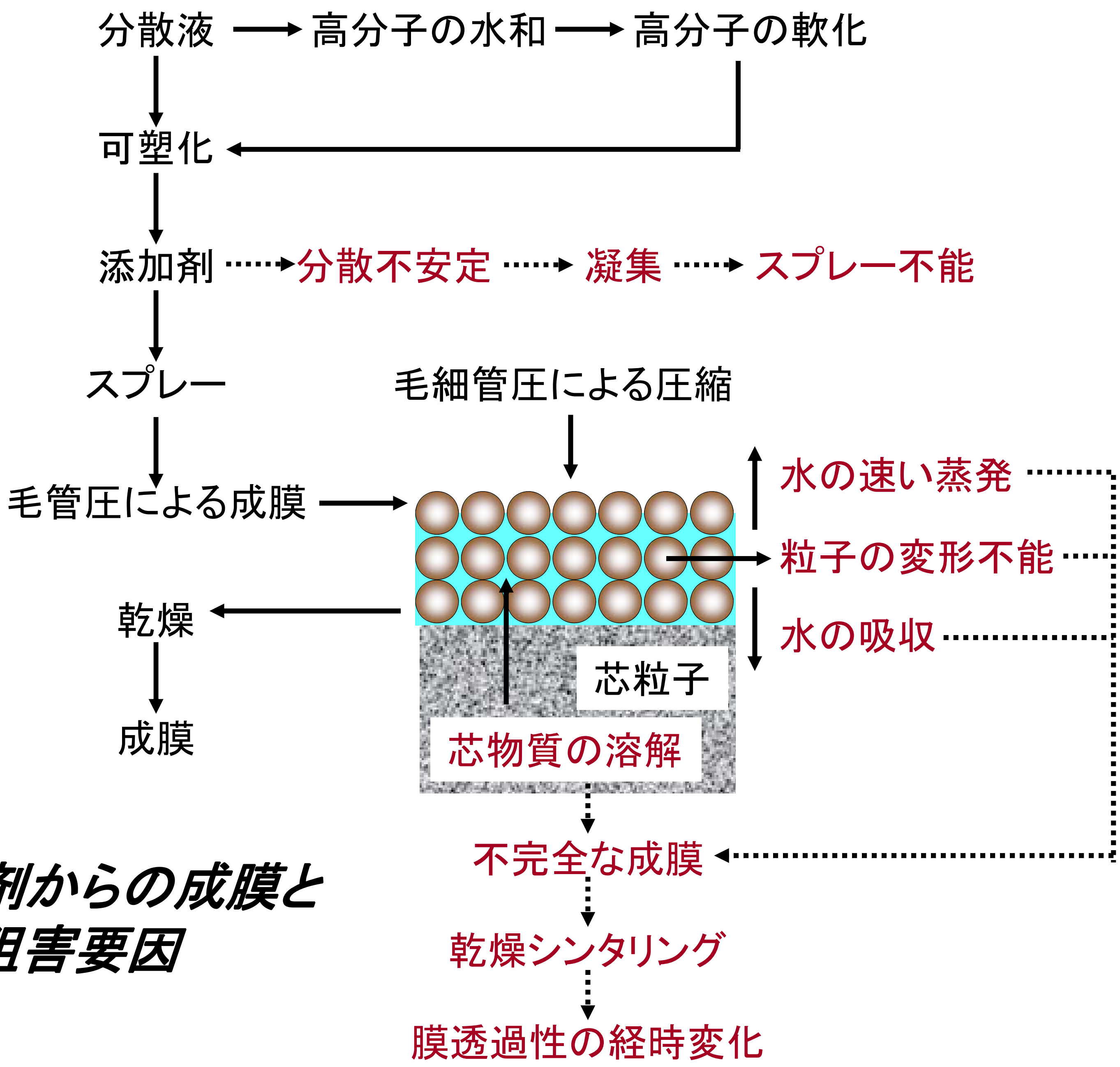
武田薬品工業（株）製剤研究所 ○盛本修司、田中哲也、且元仁、深田公司、田畑哲朗

（株）パウレック 坂本浩

粉体工学会第15回製剤と粒子設計シンポジウム講演要旨集, 1998, pp. 168-173

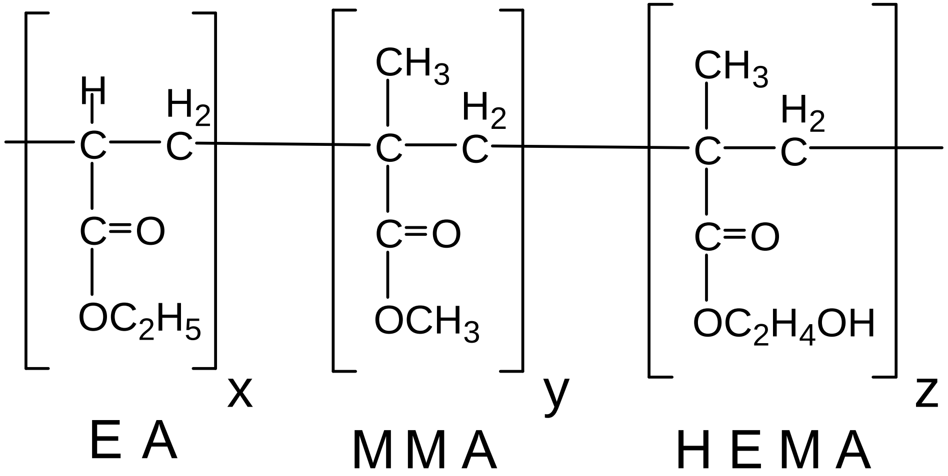


図．コーティング微粒子の粒度分布の例



分散剤からの成膜とその阻害要因

Synthesis of poly(EA/MMA/HEMA)



- Aqueous colloidal dispersions of poly(EA/MMA/HEMA were synthesized by an emulsion polymerization technique.
- Monomer mixture was emulsified in 14 mM sodium lauryl sulfate aqueous solution and subsequently polymerized for 6-7 h at 80℃ by adding an thermo-initiator, ammonium peroxodisulfate, while being stirred in N_2 atmosphere.
- The resultant colloidal poly(EA/MMA/HEMA) was dialyzed using a cellulose acetate tubing in purified water for 5 days.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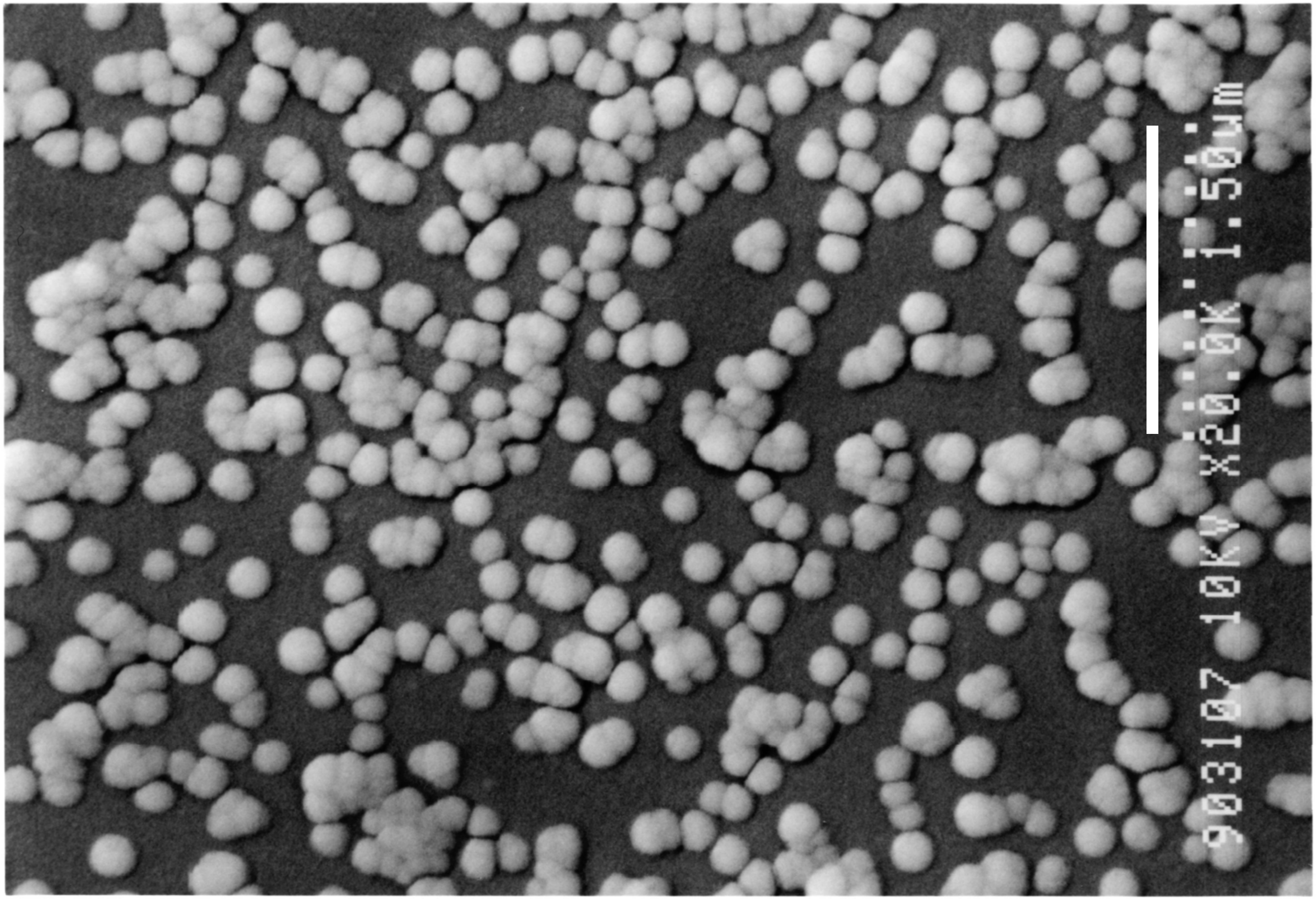


広川典夫氏撮影

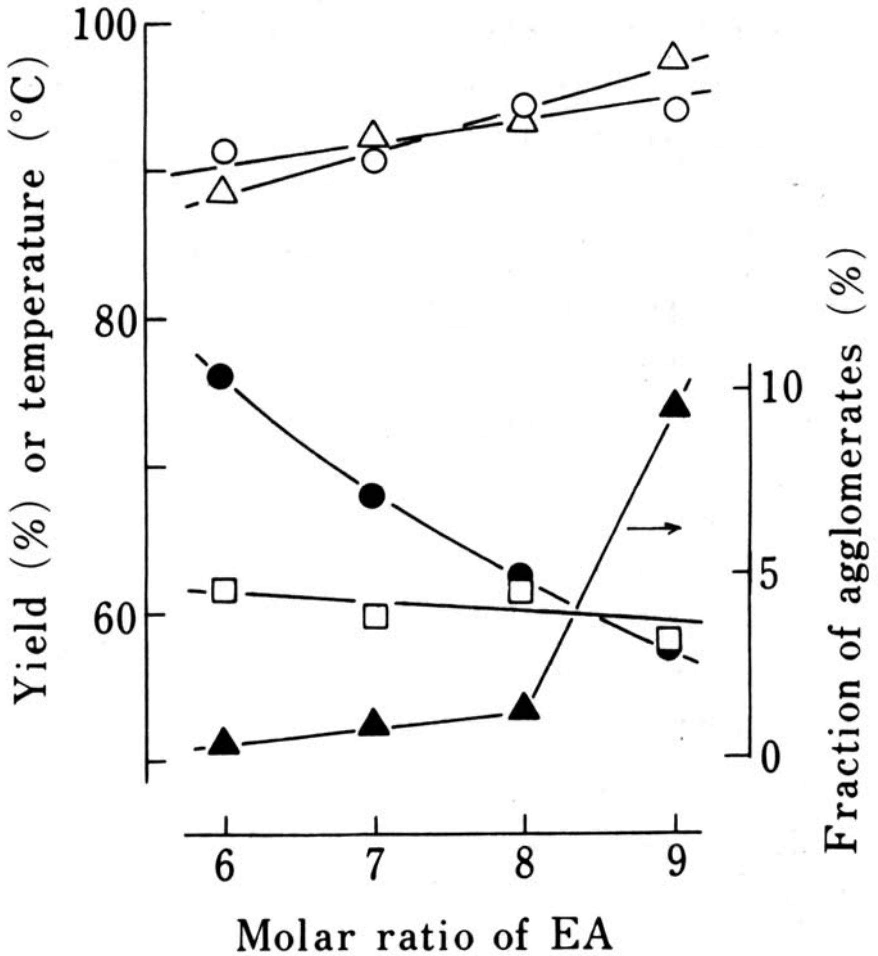
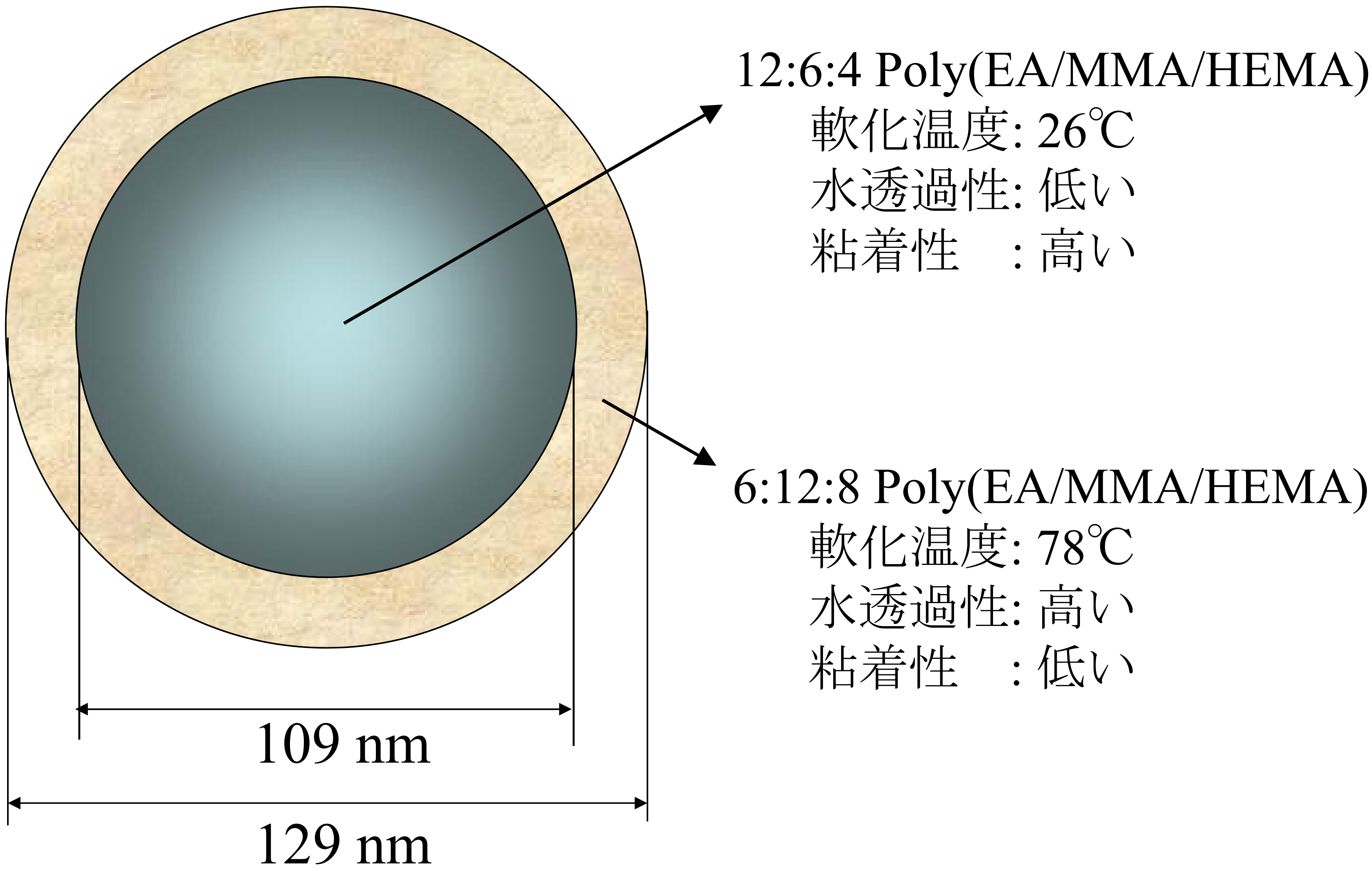


Fig. 4. Effect of Molar Ratio of EA–MMA on Agglomeration and Coating Efficiency with Latices of Copoly(EA–MMA–HEMA)

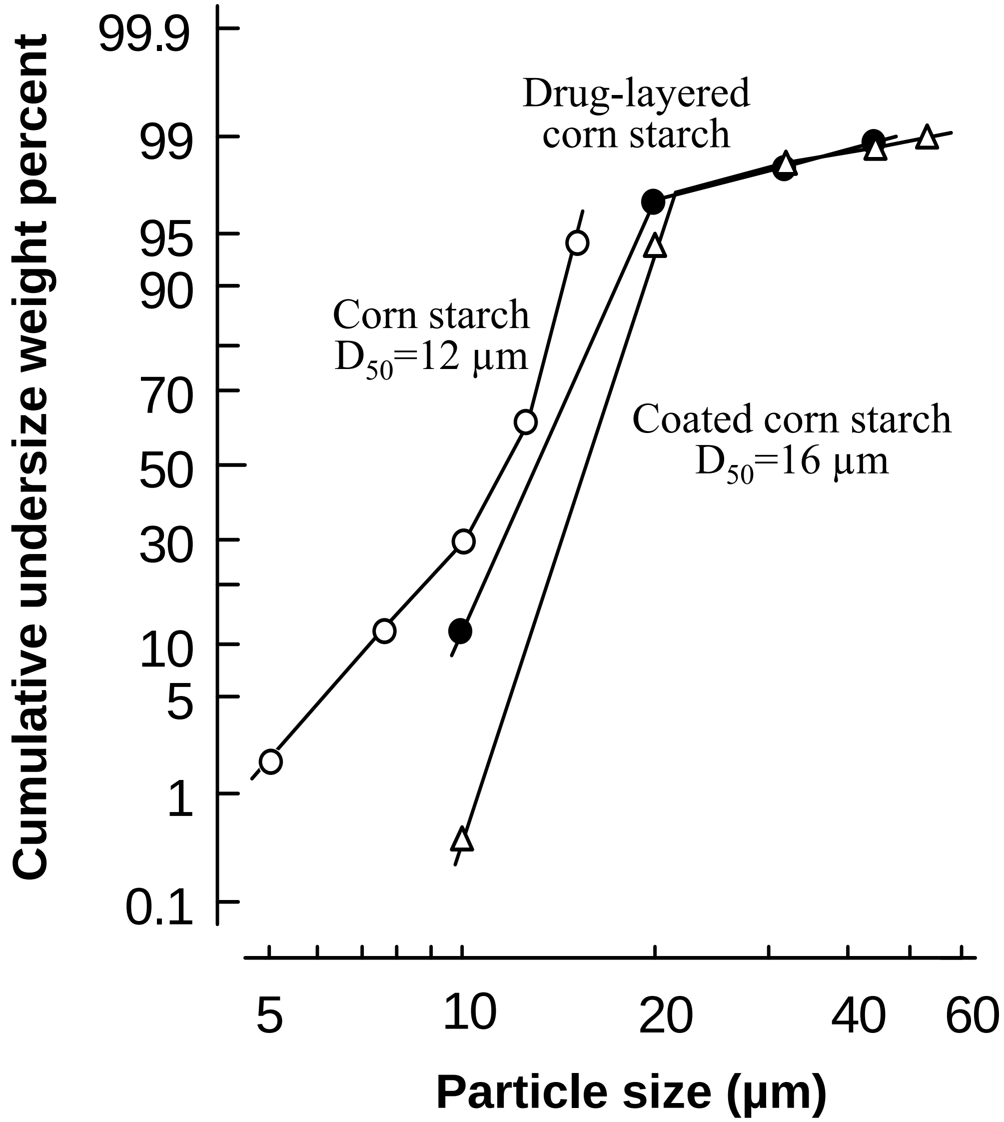
Fraction of agglomerates: ▲. Yield: ○, product; △, polymer; □, pigment. Softening temperature: ●. Molar ratio of EA–MMA–HEMA ($X:Y:Z$): $Z=8$, $X+Y=18$. Core: 25 g lactose of 53—63 μm. Spray dispersion, spray rate and operating conditions of NQ-GM are the same as those for 6:12:8 EA–MMA–HEMA in Table I.



図．微粒子コーティング用コアーシェルラテックス粒子の例

Table. Operating Conditions in the Coating of Corn Starch

Core	Corn starch (12 μm)	300	g
	Carbazochrome sodium sulfonate	15	g
Spray solution	6:4 core-shell latex	150	g (DLS)
	Water	added	
	Total	750	ml
Operating conditions of NQ-GM			
	Inlet air temperature	65	°C
	Outlet air temperature	30	°C
	Inlet air flow rate	0.04	m^3/min
	Spary-liquid flow rate	2.9	mL/min
	Spray pressure	4.5	kg/cm^2
Yield		92	%
Mass median diameter of products		16	μm



Cumulative Undersize Distributions of Corn Starch Coated with 6:4 Core-Shell Typed Composite NPs

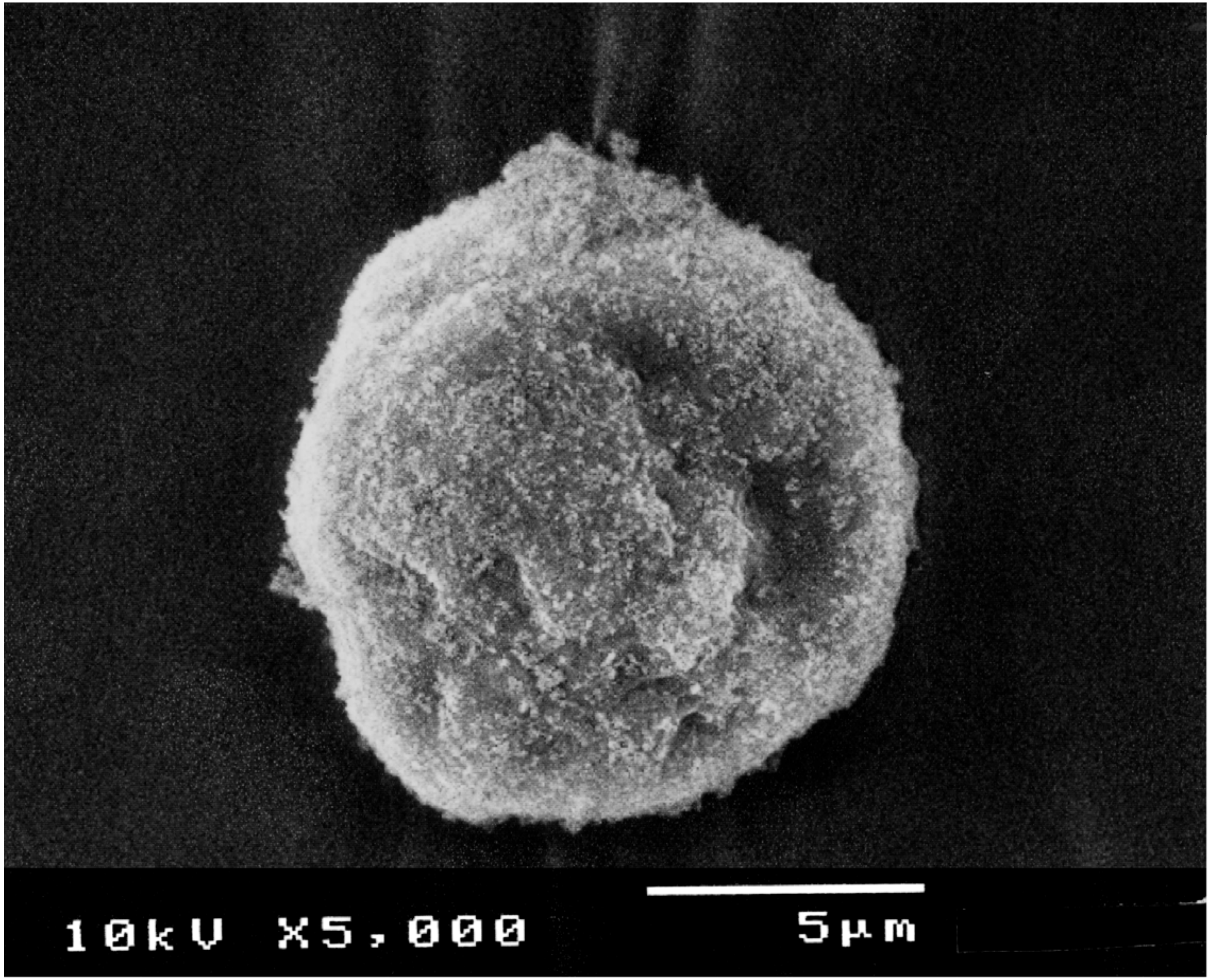


Fig. Corn Starch Coated with Copoly(EA-MMA-HEMA) Latex