MICROMETRICS (nauk o majhnih delcih)

d(μm)- velikost

0,5 – 10	**suspenzije, "fine" emulzije**
10 – 50	**"grobe" emulzije, flokulirani delci suspenzij**
50 – 100	**"fini" prašek (meja sejalne analize)**
150 – 1000	**grob prašek**
1000 – 3360	**povprečna velikost granul**

Pomembne lastnosti delcev:

1) oblika in površina posameznega delca

2) območje velikosti delcev in število ali teža ter tako celokupna površina

Premer delcev – primeren za okrogle delce; problem z nepravilnimi oblikami – ekvivalentni premer sfere

(d_s) – glede na površino **d_v – glede na volumen**

d_{st} – glede na Stokes-ov zakon sedimentacije

$$v = \frac{h}{t} = \frac{d^2(\rho_s - \rho_0)g}{18\eta_0}$$

d < 5 μm, Brownovo gibanje moti

ULTRACENTRIFUGA, KOLOIDNI DELCI (0,5 μm – 1 nm)

PORAZDELITEV VELIKOSTI DELCEV in POVPREČNA VELIKOST DELCEV

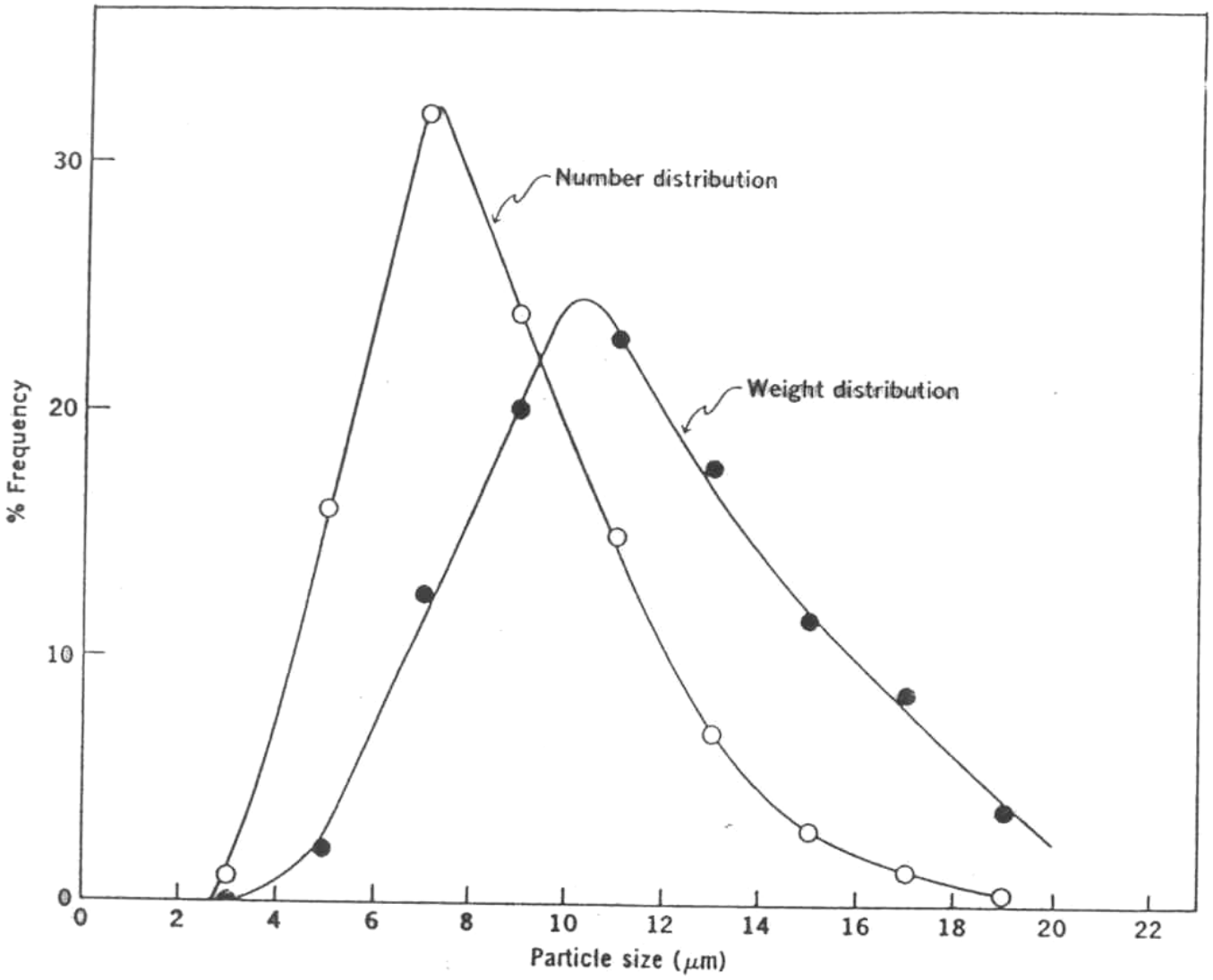
TABLE 18-4. *Conversion of Number Distribution to Weight Distribution (Log-Normal Distribution)*

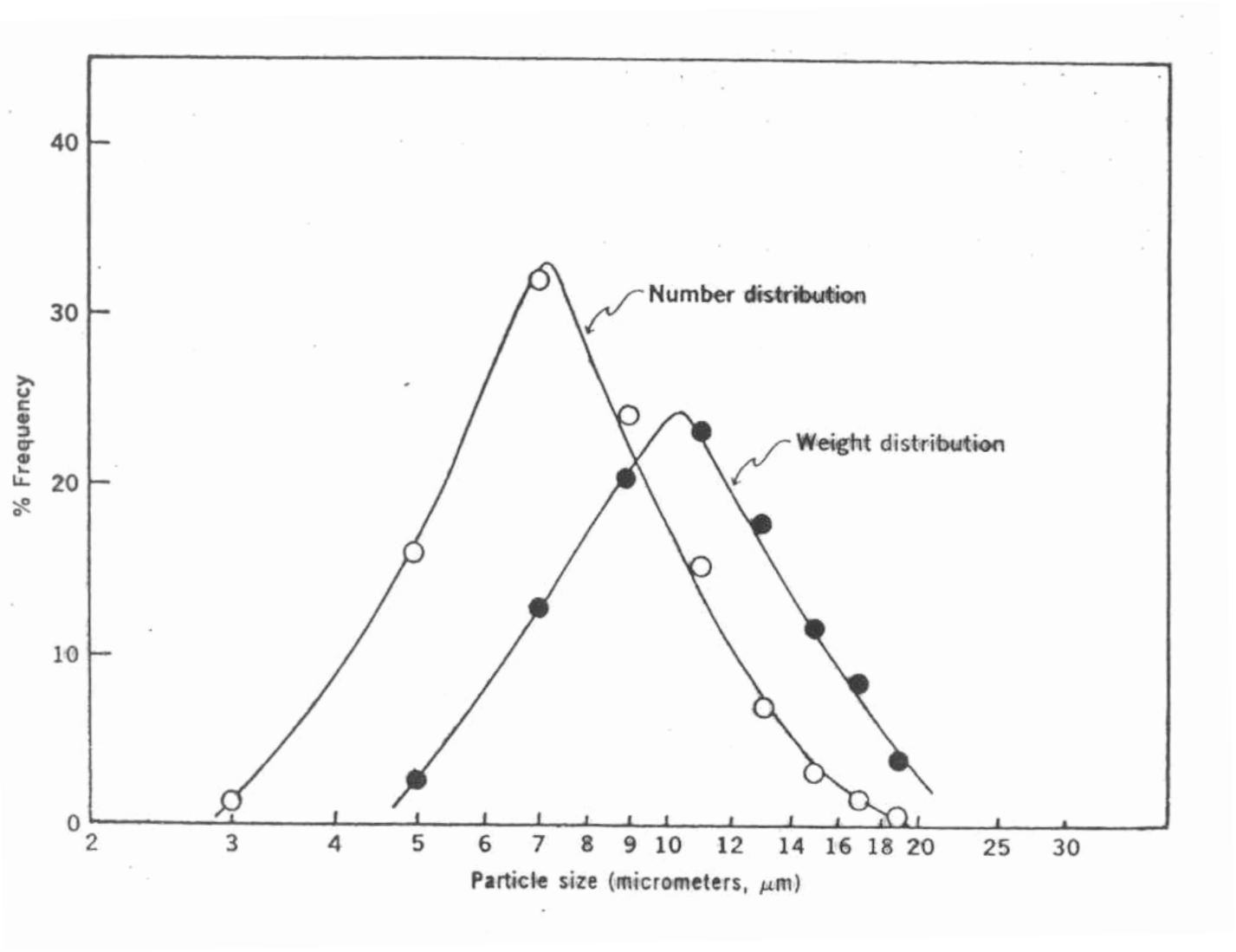
(1) Size Range in Micrometers	(2) Mean of Size Range (d) in Micrometers	(3) Number of Particles in Each Size Range (n)	(4) Percent n	(5) Cumulative Percent Frequency Undersize (Number)	(6) nd	(7) nd^2	(8) nd^3	(9) Percent nd^3 (Weight)	(10) Cumulative Percent Frequency Undersize (Weight)
2.0–4.0	3.0	2	1.0	1.0	6	18	54	0.03	0.03
4.0–6.0	5.0	32	16.0	17.0	160	800	4000	2.31	2.34
6.0–8.0	7.0	64	32.0	49.0	448	3136	21952	12.65	14.99
8.0–10.0	9.0	48	24.0	73.0	432	3888	34992	20.16	35.15
10.0–12.0	11.0	30	15.0	88.0	330	3630	39930	23.01	58.16
12.0–14.0	13.0	14	7.0	95.0	182	2366	30758	17.72	75.88
14.0–16.0	15.0	6	3.0	98.0	90	1350	20250	11.67	87.55
16.0–18.0	17.0	3	1.5	99.5	51	867	14739	8.49	96.04
18.0–20.0	19.0	1	0.5	100.0	19	361	6859	3.95	99.99
		$\Sigma n = 200$							

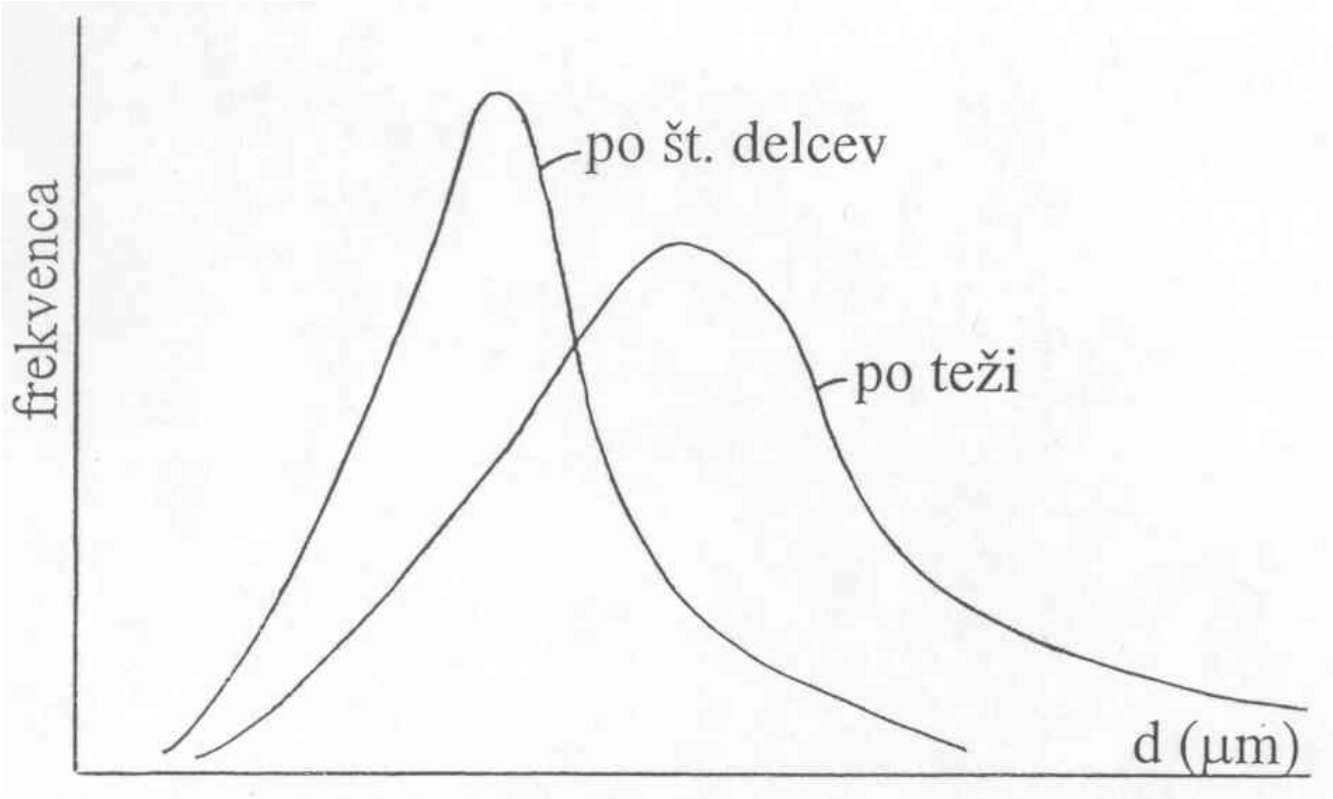
Σ = 173534

graf (št. delcev)

graf (teža)


Number distribution
Weight distribution
% Frequency
Particle size (μm)
0
10
20
30
0
2
4
6
8
10
12
14
16
18
20
22

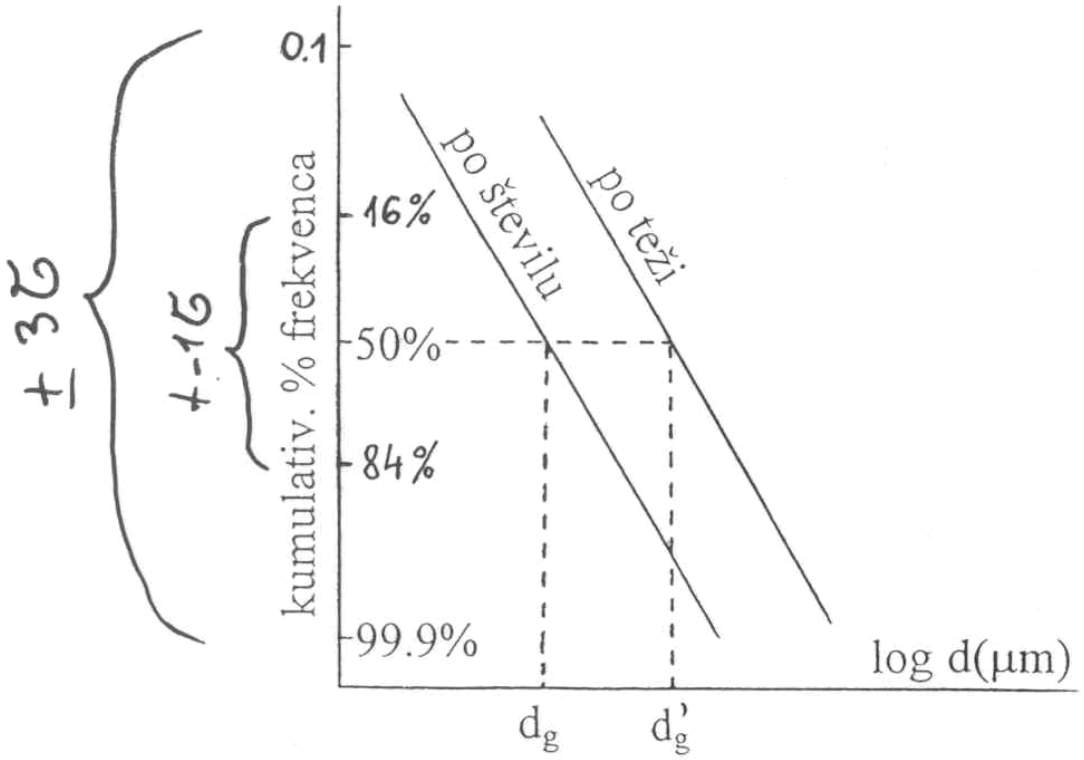

40
30
20
10
0
% Frequency
Number distribution
Weight distribution
2
3
4
5
6
7
8
9
10
12
14
16
18
20
25
30
Particle size (micrometers, μm)



normalna distribucija: 68 % ~ x ± σ

95,5 % ~ x ± 2σ in 99,7 % ~ x ± 3σ

logaritem d – “log-normal distribution”



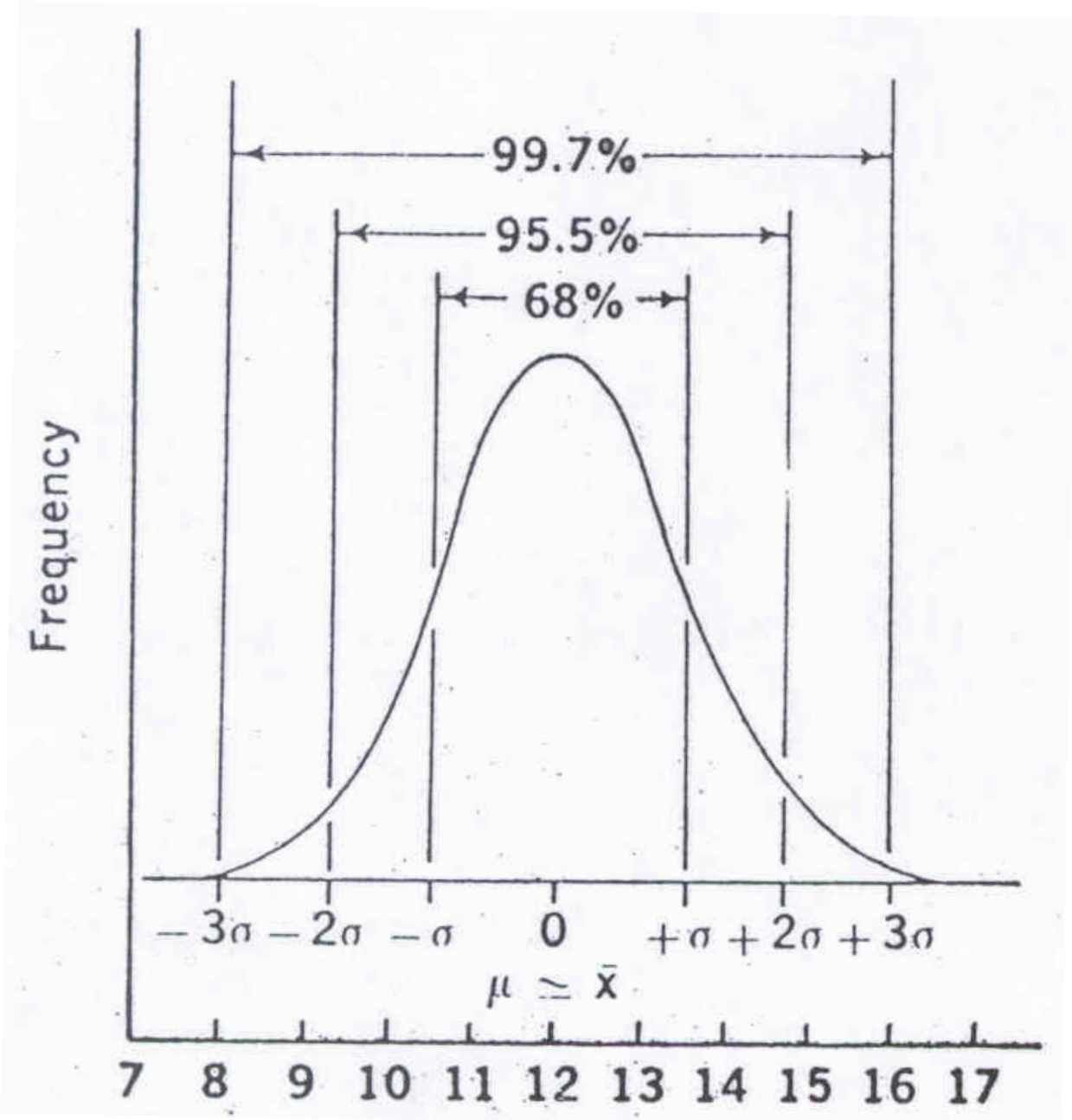
d_g – geometrijski povprečni premer

“ PROBABILITY SCALE”

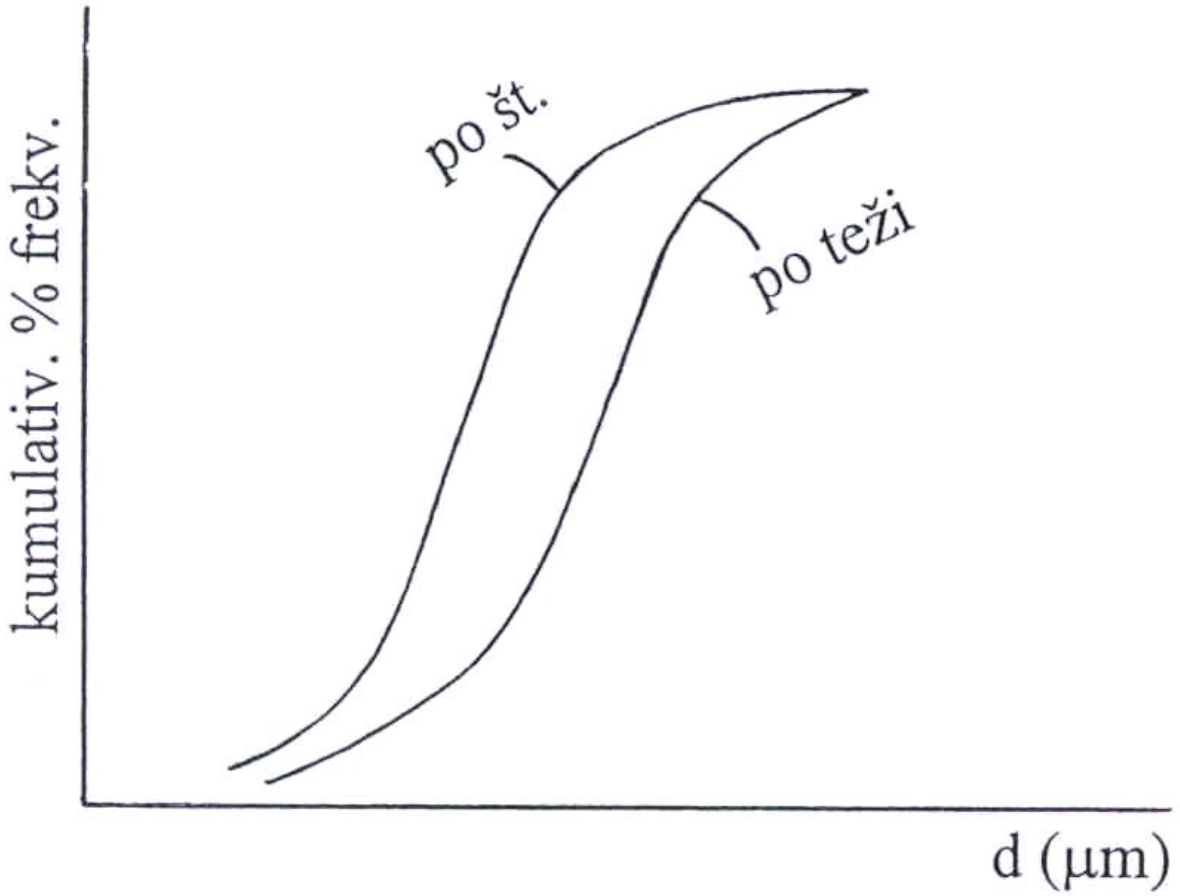
± σ → 68 %

± 2σ → 95,5 %

± 3σ → 99,7 %

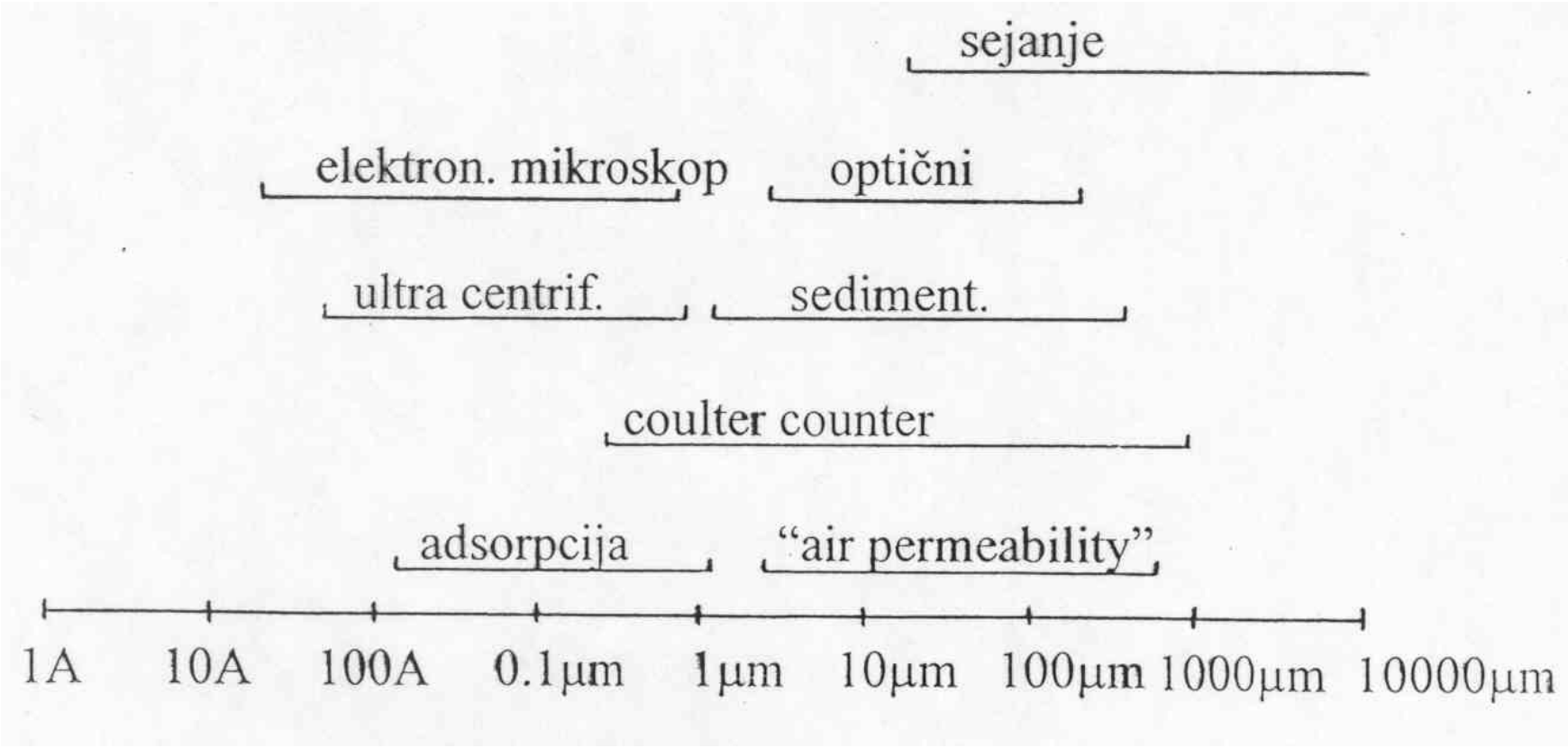

99.7%
95.5%
68%
Frequency
−3σ −2σ −σ 0 +σ +2σ +3σ
μ ≃ x̄
7 8 9 10 11 12 13 14 15 16 17

Ločitev med porazdelitvijo po št. delcev oziroma po teži



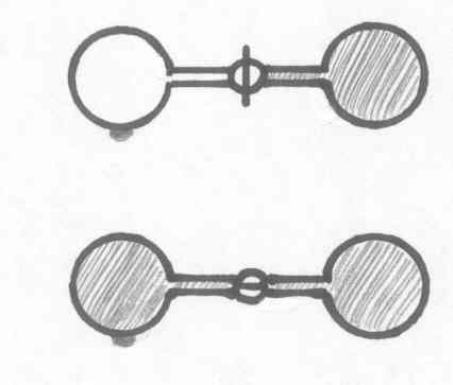
$$\frac{4\pi r^3}{3} \cdot \rho = m$$

METODE ZA DOLOČANJE VELIKOSTI DELCEV



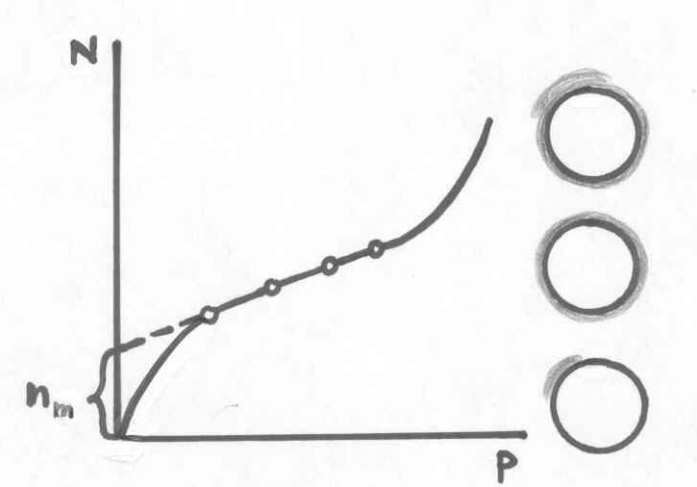
BET (Brunauer, Emmett, Teller)

adsorpcija N_2, “monolayer”, nizke T



$$N = \frac{\Delta P \cdot V \cdot 6 \cdot 10^{23}}{R \cdot T}$$

adsprpcijska izoterma (5 tipov)



$P_{N2\ molekule} = 16 \cdot 10^{-16}\ cm^2$ (površina, ki jo molekula “pokriva”)

GOSTOTE

1) prava (true, real density): $\sigma = m/V$
2) apparent, bulk density, nasipna gostota (navidezna, volumska)
3) tapped density (zbita gostota)
4) granule density (granularna gostota)
5) relativna gostota

DOLOČANJE

Ad 1) He piknometer, metoda topil
Ad 2) potrebno definirati pogoje
Ad 3) za določanje kompresibilnosti (stisljivosti) granulata, stresanje (udarci)
Ad 4) živo srebro prodre v medprostore, "večje" pore, ne pa v "intraparticle Spaces"
Ad 5) relativno (npr. H_2O); piknometer

POROZNOST

v ("prazni volumen") = $V_b - V_p$
bulk real

$$\varepsilon = \frac{V_b - V_p}{V_b} = 1 - \frac{V_p}{V_b}$$

$$\varepsilon_{\text{int raparticle}} = \frac{V_g - V_p}{V_g} = 1 - \frac{V_p}{V_g} = 1 - \frac{\text{teža/pravaρ}}{\text{teža/granul.ρ}} = 1 - \frac{\rho_g}{\rho}$$

$$\varepsilon_{\text{int erspace}} = \frac{V_b - V_g}{V_b} = 1 - \frac{V_g}{V_b} = 1 - \frac{\rho_{bulk}}{\rho_{gran.}}$$

$$\varepsilon_{total} = \frac{V_b - V_p}{V_b} = 1 - \frac{V_p}{V_b} = 1 - \frac{\rho_{bulk}}{\rho}$$

- "bulkiness" – voluminoznost
- pretok
- kompresibilnost