

# SOIL TEXTURE

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→ *Relative comparison of soil single particle*

→ *Relative comparison between sand, silt and clay*

*Sand*

*Silt*

*Clay*

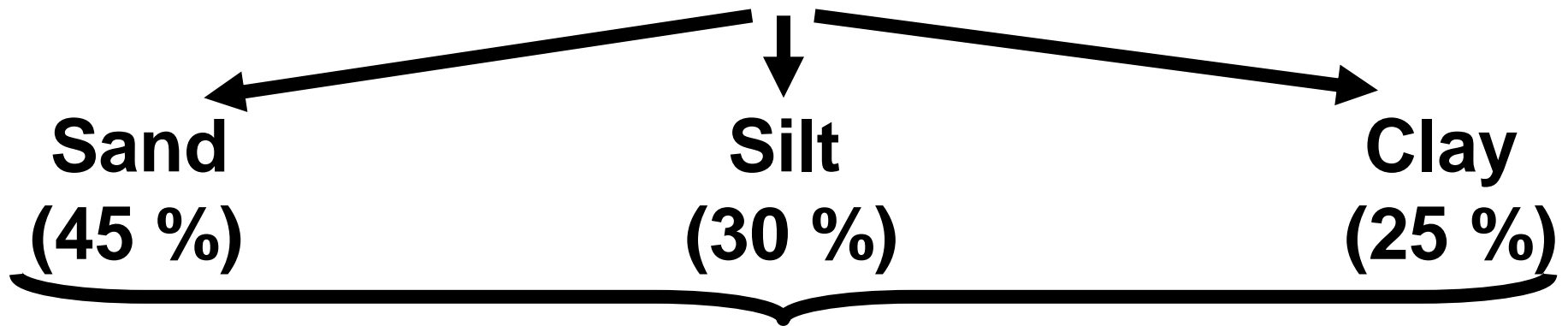
*Soil particle = Varied size components*

**Tekstur tanah sangat penting karena berkaitan dan berdampak pada:**

- *soil structure***
- *aeration***
- *water holding capacity***
- *water movement***
- *nutrient storage and soil chemistry***
- *etc***

# Tekstur geluhan (*Loam texture*)

*comparison of sand, silt and clay is balance*



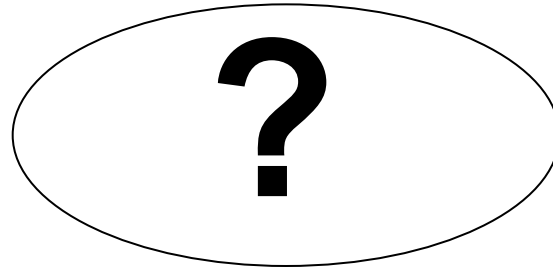
**Mudah mengolah**

**Penyerapan (perpindahan) air baik**

***Loam soil (physic)* belum tentu subur**

**→ Dasar subur fisik pada struktur tanah**

**→ Tanah remah**



## ***How to know and measure soil particle size***

### ***Batu (Stones and cobbles)***

**→ > 64 mm (diameter)**

### ***Kerikil (Gravel)***

**→ 2 mm – 64 mm**

### ***Pasir (Sand)***

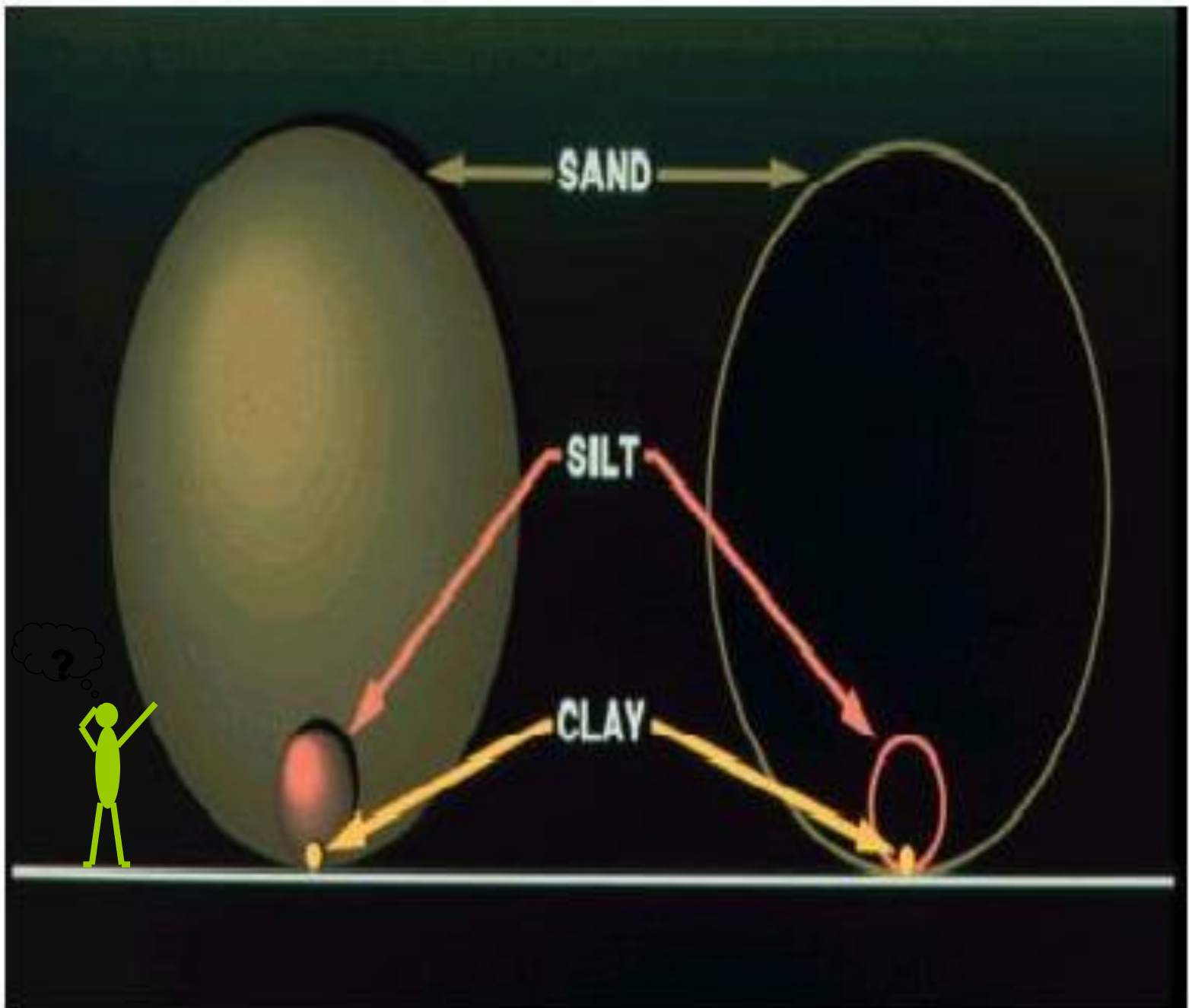
**→ .05 – 2 mm**

### ***Debu (Silt)***

**→ .002 – .05 mm**

### ***Lempung (Clay)***

**→ < .002 mm**



**Relative sizes of sand, silt, and clay.**

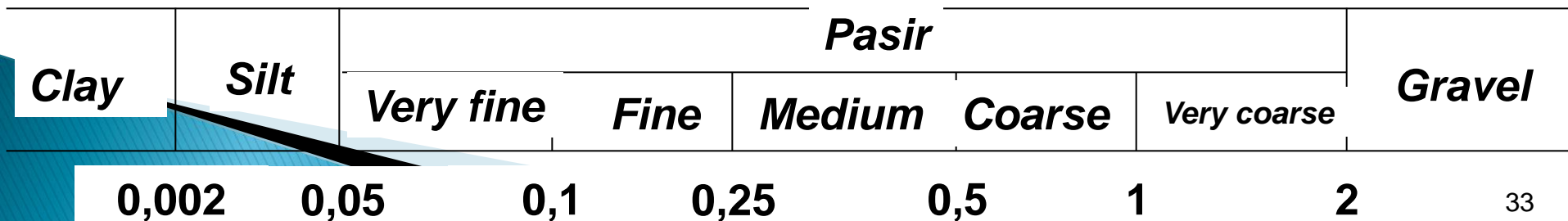
# *International System / Atterberg System*

<b>Particle</b>	<b>Size (mm)</b>
<b><i>Gravel</i></b>	<b><math>&gt; 2</math></b>
<b><i>Coarse sand</i></b>	<b><math>0,2 - 2</math></b>
<b><i>Fine sand</i></b>	<b><math>0,05 - 0,2</math></b>
<b><i>Silt</i></b>	<b><math>0,002 - 0,05</math></b>
<b><i>Clay</i></b>	<b><math>&lt; 0,002</math></b>

<b><i>Clay</i></b>	<b><i>Silt</i></b>	<b><i>Sand</i></b>		<b><i>Gravel</i></b>
		<b><i>Fine</i></b>	<b><i>Coarse</i></b>	
<b>0,002</b>	<b>0,05</b>	<b>0,2</b>	<b>2</b>	

# United State Department of Agriculture, Bureau of Soil System

<i>Particle</i>	<i>Size (mm)</i>
<i>Gravel</i>	<i>&gt; 2</i>
<i>Very coarse sand</i>	<i>1 – 2</i>
<i>Coarse sand</i>	<i>0,5 – 1</i>
<i>Medium sand</i>	<i>0,25 – 0,5</i>
<i>Fine sand</i>	<i>0,1 – 0,25</i>
<i>Very fine sand</i>	<i>0,05 – 0,1</i>
<i>Silt</i>	<i>0,002 – 0,05</i>
<i>Clay</i>	<i>&lt; 0,002</i>





# Partikel

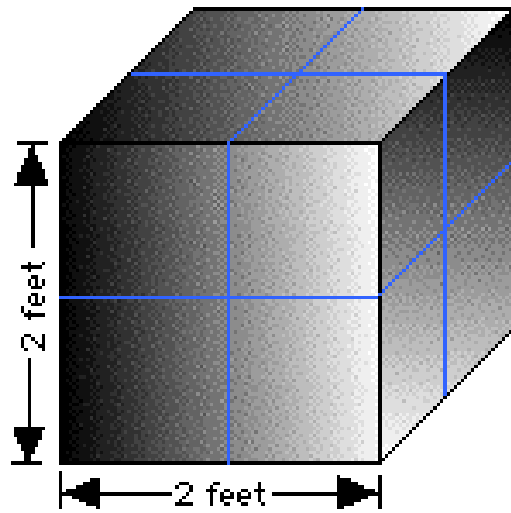
Ukuran

Jumlah

Permukaan spesifik

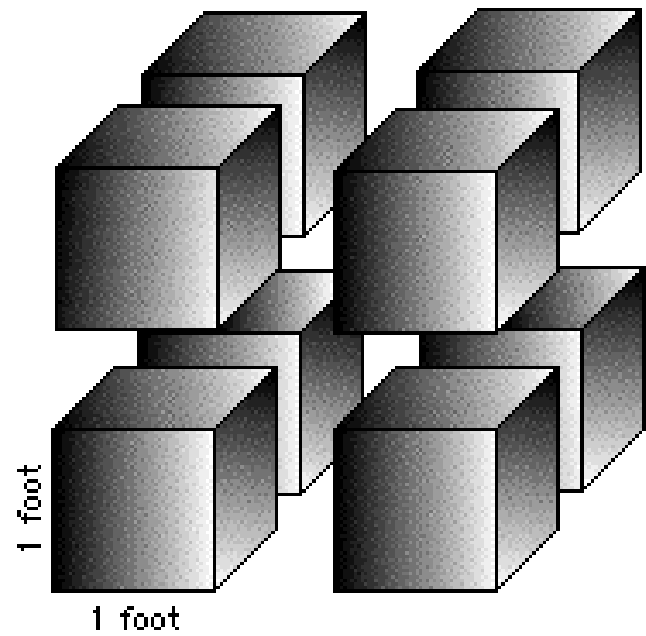


Size ( $\mu\text{m}$ )	Particle / gr	Spesific surface ( $\text{cm}^2/\text{g}$ )
2000 – 200	$5 \times 10^2$	20
200 – 20	$5 \times 10^5$	200
20 – 2	$5 \times 10^6$	2000
2 – 0.2	$5 \times 10^{11}$	20,000 – 20 $\text{m}^2$



$$\text{Volume} = 8 \text{ ft}^3$$

$$\text{Area} = 24 \text{ ft}^2$$



$$\text{Volume} = 8 \text{ ft}^3$$

$$\text{Area} = 48 \text{ ft}^2$$

# Fraksi maya

*(Pseudo / sham particle)*

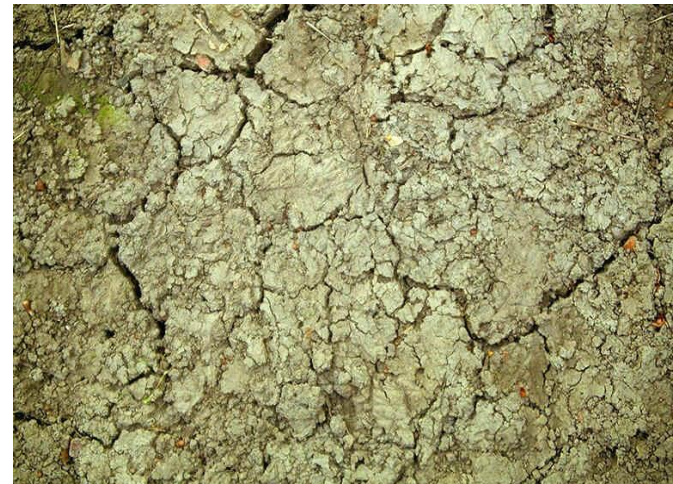
→ fraksi debu atau lempung yang membentuk ukuran partikel lebih besar



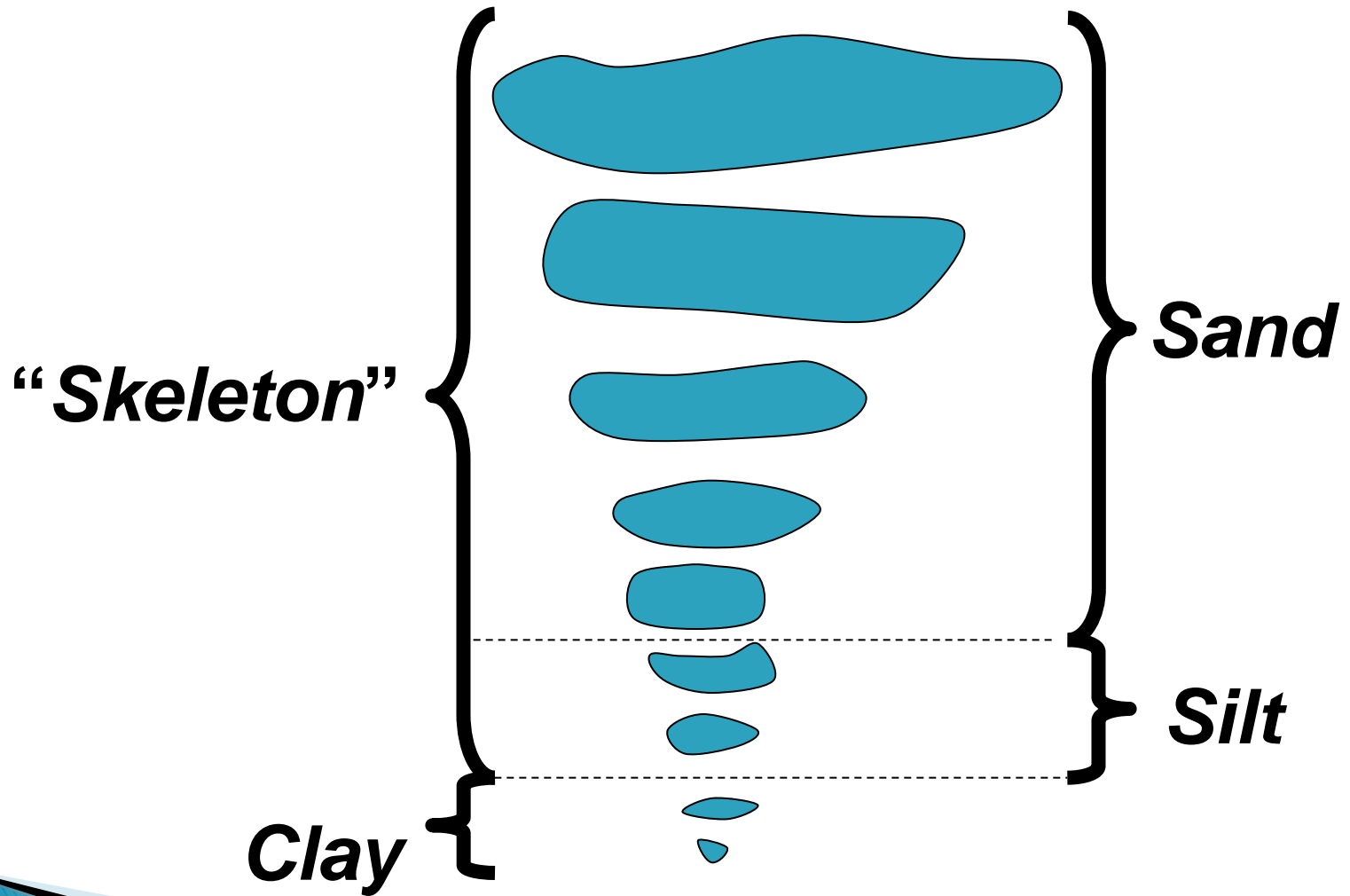
Etc.

*“Pseudosand/Shamsand”*  
(Pasir maya)

→ Fraksi debu yang membentuk fraksi pasir



# Primary Particle *Particle Single Circle*



**“*Skeleton*” membentuk agregat karena:**

- ***Organic matter***
- ***Clay* → fraksi tunggal primer**
- ***Sesquioksida (Al and Fe oksida / hydroxida)***
- ***Alofan (Oksida Si amorf / koloid)***

# Soil Texture

1. ***Argile lourde*** (lempung berat)  
 **$> 60 \% \text{ clay}$**
2. ***Argile*** (lempungan)  
 **$\geq 40 \% \text{ clay}, < 45 \% \text{ sand}, \text{ dan } < 40 \% \text{ silt}$**
3. ***Argile limoneuse*** (lempung debuan)  
 **$\geq 40 \% \text{ clay}$  dan  **$\geq 40 \% \text{ silt}$****
4. ***Argile sableuse*** (lempung pasiran)  
 **$\geq 35 \% \text{ clay}$  dan  **$\geq 45 \% \text{ sand}$****
5. ***Loam limono-argileux*** (geluh lempung debuan)  
 **$27 - 40 \% \text{ clay}$  dan  **$< 20 \% \text{ sand}$****
6. ***Loam argileux*** (geluh lempungan)  
 **$27 - 40 \% \text{ clay}$  dan  **$20 - 45 \% \text{ sand}$****

7. ***Loam sablo-argileux*** (geluh lempung pasiran)  
20 – 35 % *clay*, < 28 % *silt*, dan  $\geq$  45 % *sand*
8. ***Limon*** (debuan)  
 $\geq$  80 % *silt* dan < 12 % *clay*
9. ***Loam lomoneux*** (geluh debuan)  
 $\geq$  50 % *silt* dan 12 – 27 % *clay*, atau 50 – 80 % *silt* dan < 12 % *clay*
10. ***Loam*** (geluhan)  
7 – 27 % *clay*, 28 – 50 % *silt*, dan < 52 % *sand*
11. ***Loam sableux*** (geluh pasiran)  
 $\leq$  20 % *clay*, persentase *silt* 2 x pesentase *clay* > 30, dan  $\geq$  52 % *sand*; atau < 7 % *clay*, < 50 % *silt*, dan 43 – 52 % *sand*

- ***Loam sableux grossier (geluh pasir kasar)***  
***≥ 25 % coarse and very coarse and < 50 %  
another sand***
- ***Loam sableux (geluh pasir)***  
***≥ 30 % coarse, medium and very coarse, but  
< 25 % very coarse, and < 30 % fine and very  
fine***
- ***Loam sableux fin (geluh pasir halus)***  
***≥ 30 % fine and < 30 % very fine or 15 – 30 %  
medium, coarse and very coarse***
- ***Loam sableux très fin (geluh pasir sangat  
halus)***  
***≥ 30 % very fine or > 40 % fine and very fine,  
that half of very fine, and < 15 % medium,  
coarse and very coarse***



## **12. Sable loameux (pasir geluhan)**

***top limit 85 – 90 % sand, and percentage of silt 1,5 x percentage of clay not less 15 bottom limit not less 70 – 85 % sand, and percentage of silt 2 x percentage clay not more 30***

- Sable grossier loameux (pasir kasar geluhan)**  
***≥ 25 % coarse and very coarse and < 50 % other sand***
- Sable laomeux (pasir geluhan)**  
***≥ 25 % medium, coarse and very coarse and < 50 % fine and very fine***
- Sable fin loameux (pasir halus geluhan)**  
***≥ 50 % fine or < 25 % medium, coarse and very coarse and < 50 % very fine***
- Sable très fin loameux (pasir sangat halus geluhan)**  
***≥ 50% very fine***

### **13. Sable (pasiran)**

**$\geq 85$  % sand; percentage of silt 1,5 x  
percentage of clay not more 15**

- **Sable grossier (pasiran kasar)**

**$\geq 25$  % coarse and very coarse, and  $< 50$  %  
other sand**

- **Sable (pasiran)**

**$\geq 25$  % medium, coarse and very coarse, and  
 $< 50$  % fine and very fine**

- **Sable fin (pasiran halus)**

**$\geq 50$  % fine or  $< 25$  % medium, coarse and  
very coarse, and  $< 50$  % very fine**

- **Sable très fin (pasiran sangat halus)**

**$\geq 50$  % very fine**

# STOKES LAW

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**Kecepatan partikel (fraksi) yang mengendap melalui media cair tergantung pada faktor ketetapan dan diameter fraksi**

**Gaya yang bekerja pada partikel adalah percepatan gravitasi, gaya mengapung dan gaya gesek**

**→ Partikel terbesar mengendap terlebih dahulu dalam larutan**

$$v = \frac{2(d_p - d) g r^2}{9 \eta}$$

**v** : *velocity*

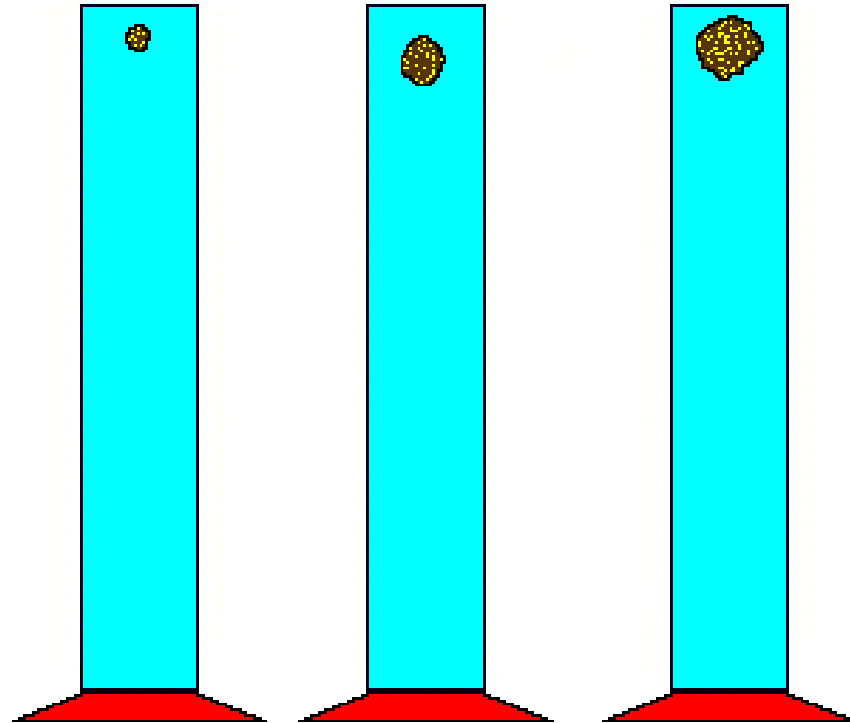
**d<sub>p</sub>** : *density of particle*

**d** : *density of liquid*

**g** : *gravity acceleration*

**r** : *radius of particle*

**η** : *viscosity of liquid*

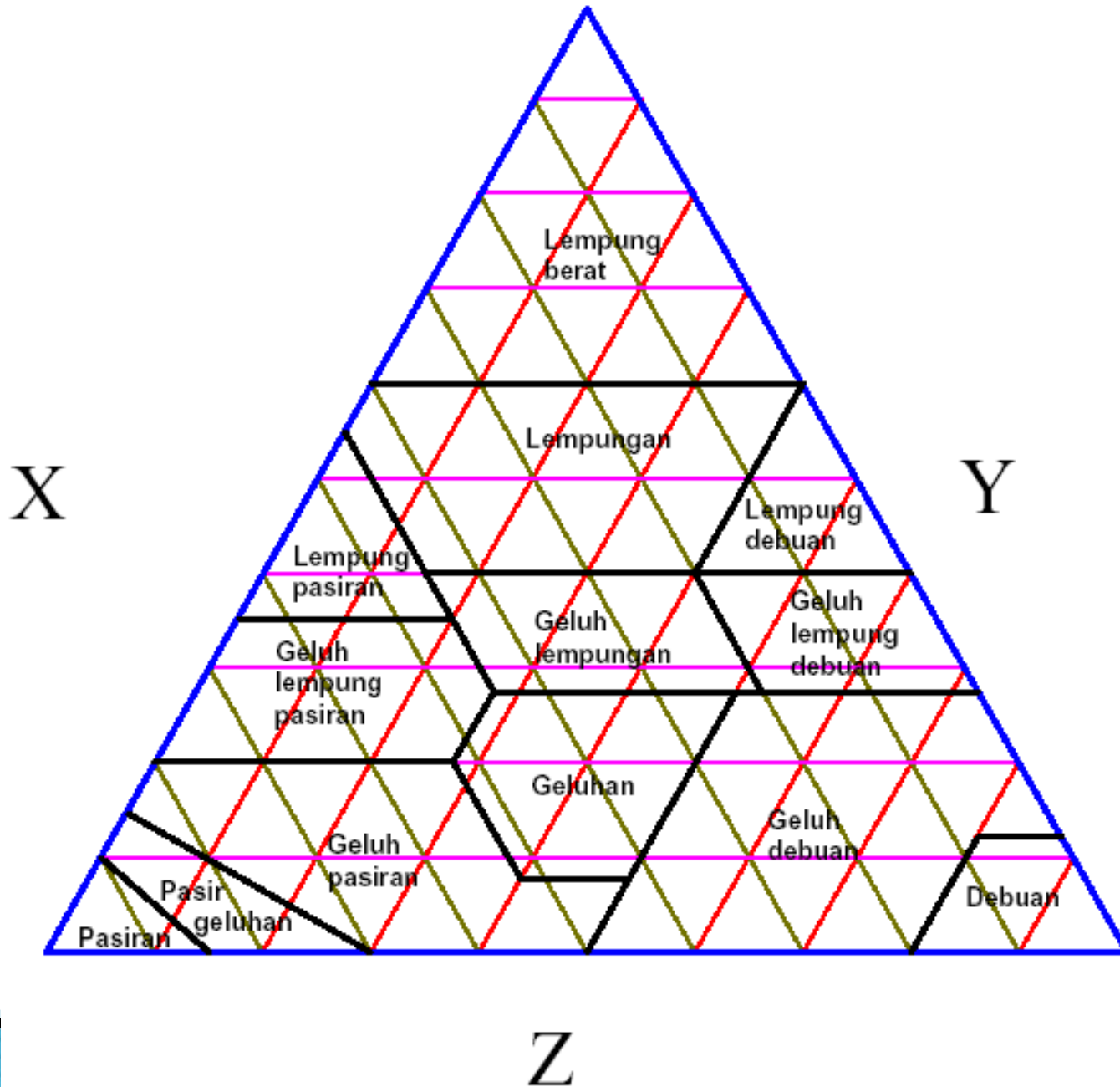


## **Cara pengukuran (analisis):**

- 1. Analisis mekanik**
- 2. Metode perasaan**

## **Analisis laboratorium:**

- 1. Metode Hydrometer**
- 2. Metode Pemipetan**



# SOIL TEXTURE ANALYSE



# Laboratorium Analyse:

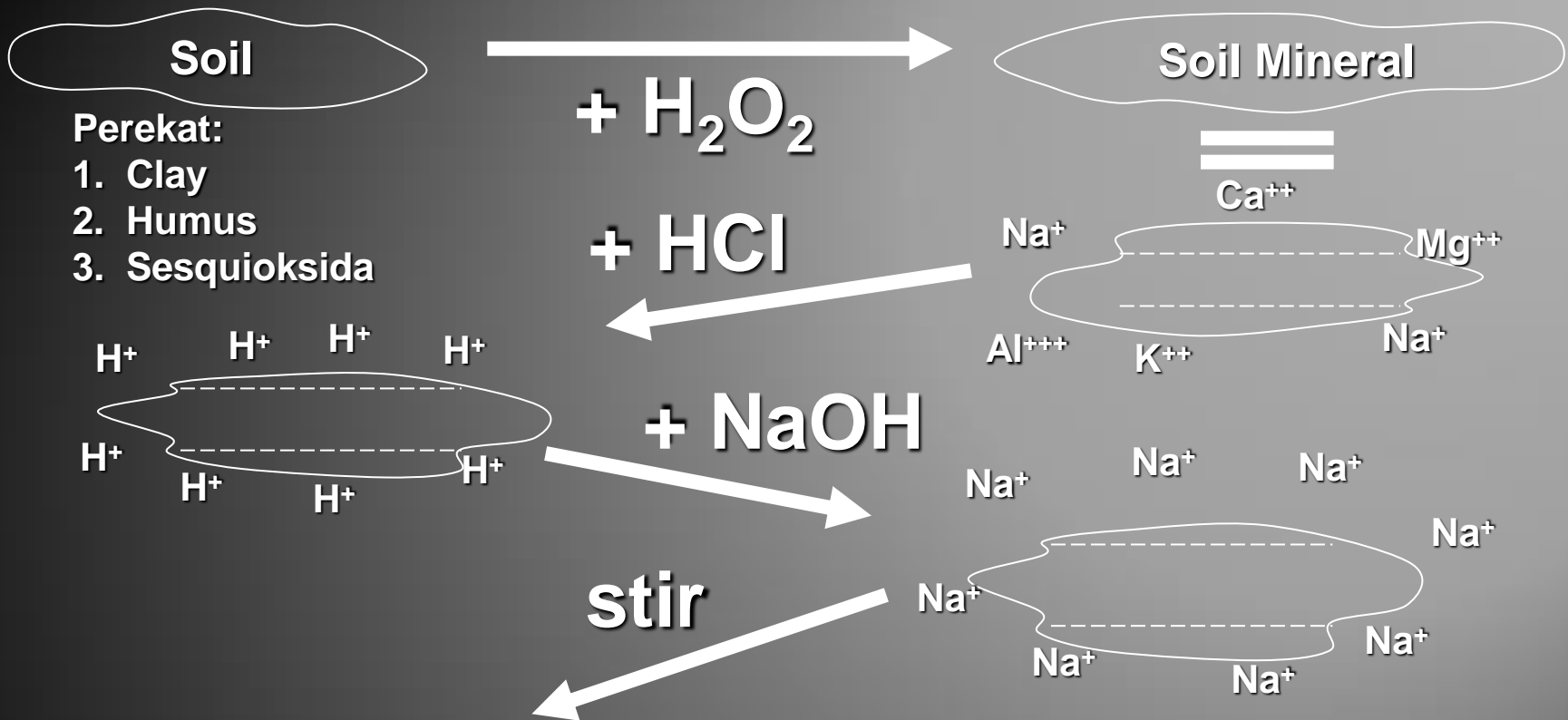
## 1. Metode Pemipetan

→ analisis granuler

## 2. Metode Hydrometer

→ Bouyoucos

# Analisis Granuler



**Pemipetan 1 :  $x = \text{silt} + \text{clay}$**

**Pemipetan 2 :  $y = \text{lempung}$**

**$\rightarrow \text{silt} = x - y$**

**$\rightarrow \text{sand} = 100 - x$**

**(%)**

**1. *Added* H<sub>2</sub>O<sub>2</sub> 30%**

**→ Penghilangan bahan organik**

**Reaksi kimia:**



**2. *Added* HCl**

**→ Penghilangan kapur**

**Reaksi kimia:**



**3. *Added* NaOH**

**→ Pendispersian tanah menjadi fraksi**

# Hydrometer Method

- Calgon
- Soil Mixer
- Hydrometer
- Erlemenyer/*settling cylinder*

50 grams  
of soil

Calgon

Soil Mixer  
(Malt blender)

Hydrometer



- 1. Penambahan calgon pada 50 g tanah**
- 2. Pencampuran/pengadukan larutan hingga tanah/agregat menjadi terurai**
- 3. Pemindahan ke *settling cylinder***
- 4. Pengadukan larutan dan mendiamkan sekitar 40 detik dan mengukur menggunakan hydrometer**
- 5. Setelah sekitar 2 atau 6 – 8 jam (tergantung suhu), diukur kembali**

# Metode lapangan

**Remas tanah (hancurkan agregat)  
Basahi tanah (jika kering) hingga menjadi  
pasta**

**Bentuk bola**

***If you can  
→ Next step***

***If you can't  
→ sandy***

# Bentuk menjadi pita

*If you can't*  
→ *Loamy sand*

*If you can*  
→ *Next step*



**Jika pita terbentuk sepanjang  $< 2,5$  cm  
(sebelum sepanjang itu sudah patah)**

**Dominan kasar**

***Sandy loam***

**Dominan halus dan  
licin**

***Silty loam***

**Terasa seimbang**

***Loamy***



**Jika pita terbentuk sepanjang 2,5 – 5 cm**

**Dominan kasar**

***Sandy clay loam***

**Dominan halus dan  
licin**

***Clay loam***

**Terasa seimbang**

***Loam clay***

**Jika pita terbentuk sepanjang  $> 5$  cm**

**Dominan coarse**

**Sandy clay**

**Dominan halus dan  
licin**

**Silty clay**

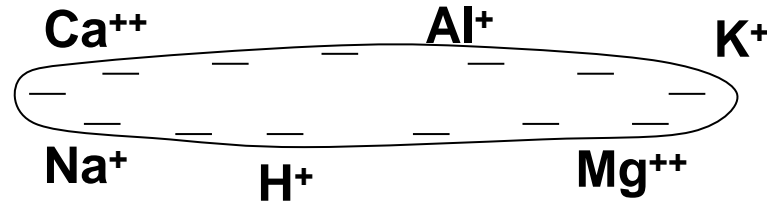
**Terasa seimbang**

**Clay**

# Butiran Padatan Mineral

## Lempung / Clay AKTIF

Kimia dan Fisika



Mengembang

Kimia

Fisika



Basah (lembab)

Lempung (Clay)

