

How plastics react with organic solvents

Keywords

- Solubility parameter : a value which expresses the solubility of a substance.

Solubility Parameters

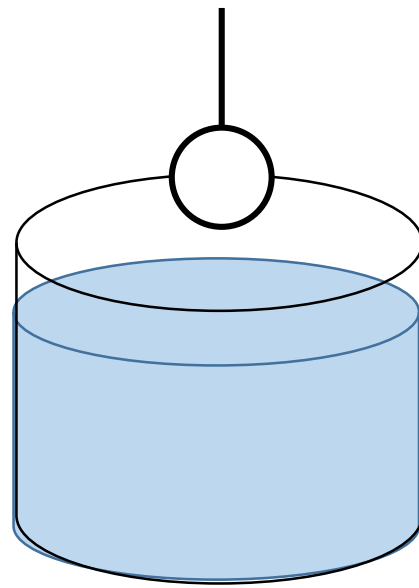
Polyethylene (PE)	16.6	acetone	20.1
Polypropylene (PP)	16.6	n-hexane	14.7
Polyvinyl Chloride (PVC)	19.6		

Keywords

- Organic solvents : liquids often used in industry.
ex. Acetone, Paint thinners

Keywords

- swelling

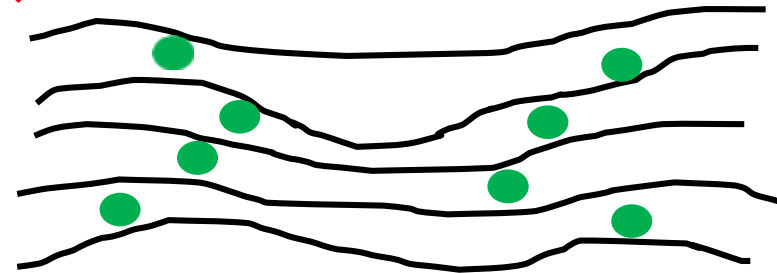
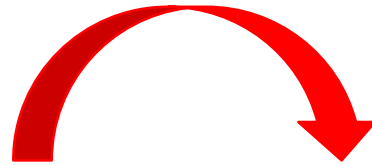


○ Plastics

● Organic solvents
~ Molecular chain



Solvents enter plastics



Volume increases



Motive

- Plastics : used in many ways

When plastics are immersed in organic solvents...

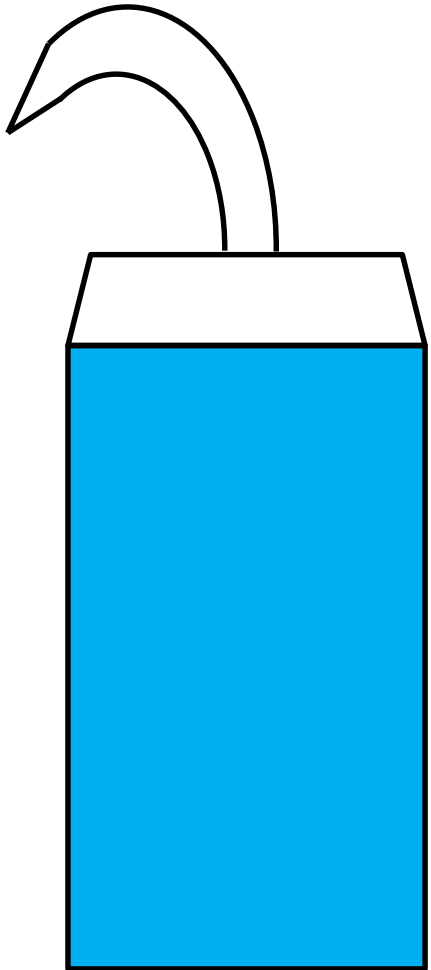


Dangerous!



swelling and **dissolution reactions** happen!

Motive



- Swelling

- ➔ Cracks

- ➔ Solvents would leak from the bottle!!

- Dissolution reaction

- ➔ Plastics dissolve in organic solvents

- ➔ Organic solvents would not work properly!!

Motive

To avoid these **dangerous** reactions...



- Investigate these reactions!
- &
- Make a plan to avoid danger!

Hypothesis

- Present method

➡ Plastics were immersed only once



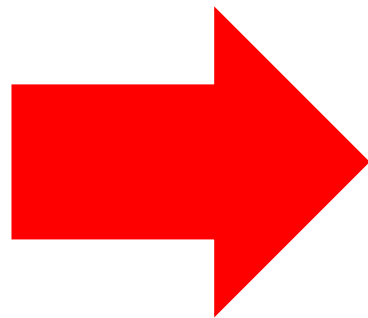
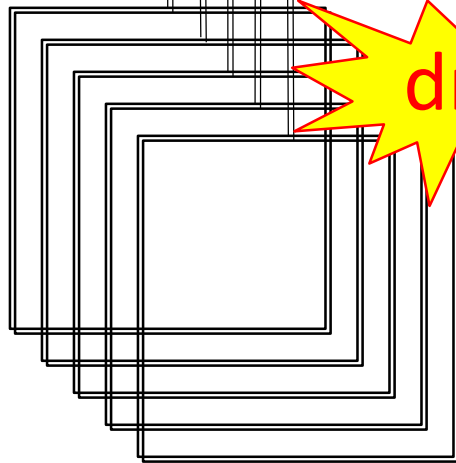
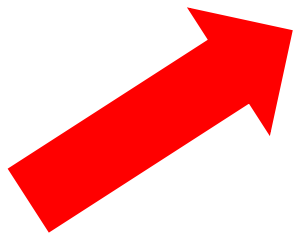
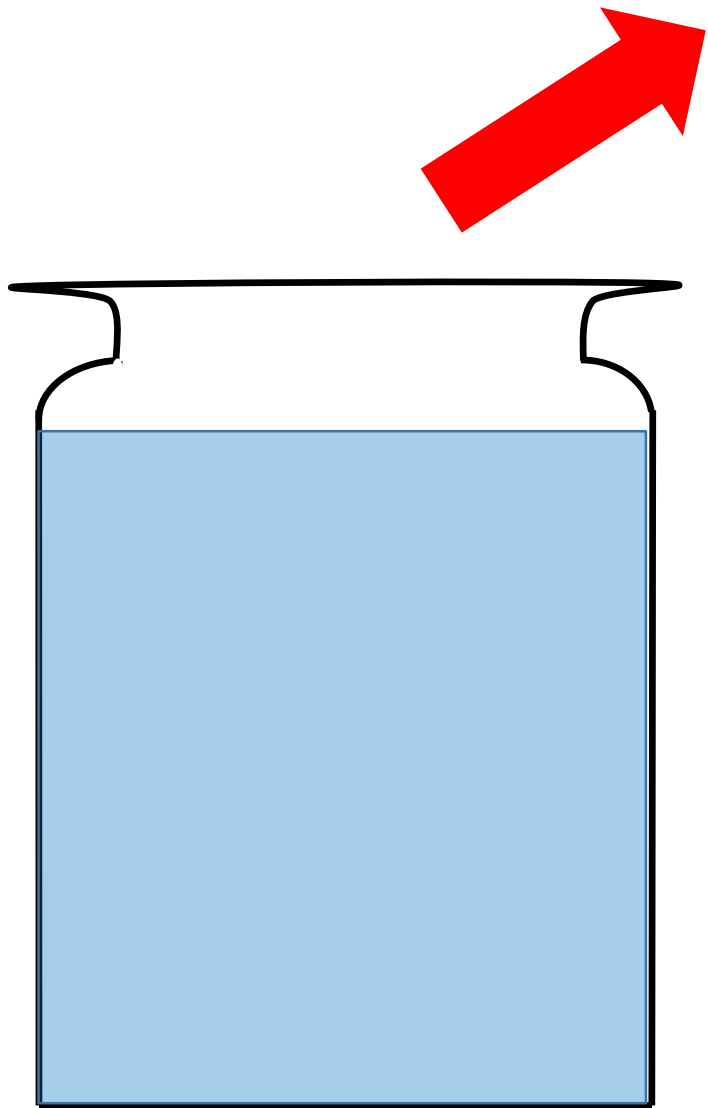
- When they are immersed many times...

Hypothesis

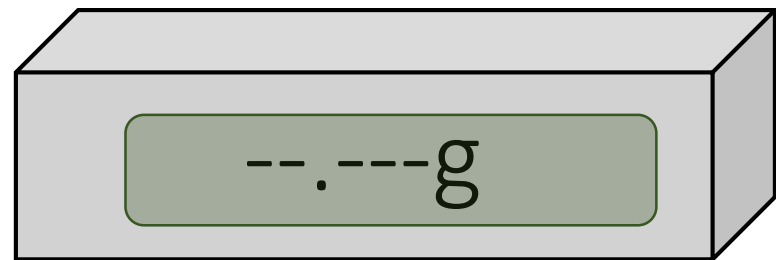
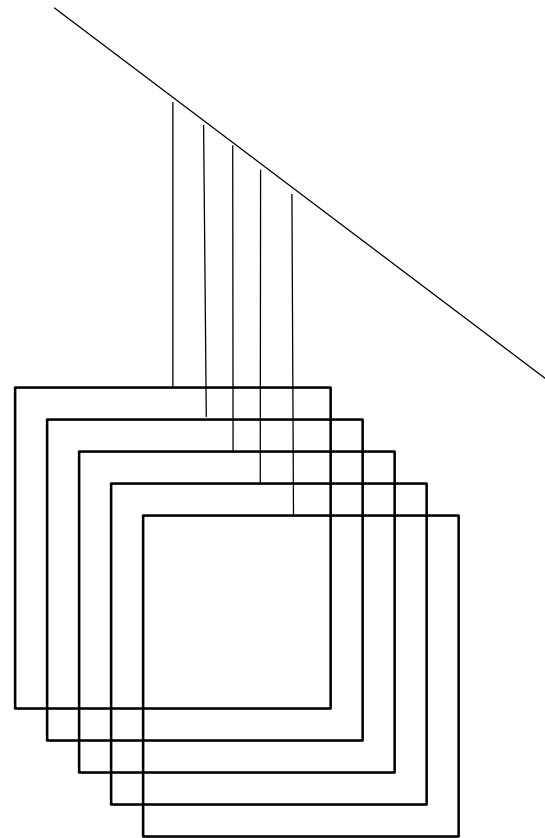
- Solubility parameter
- Structure of plastics
affect

How these reactions proceed

Method



× 4



Results & Analysis

(i) First mass

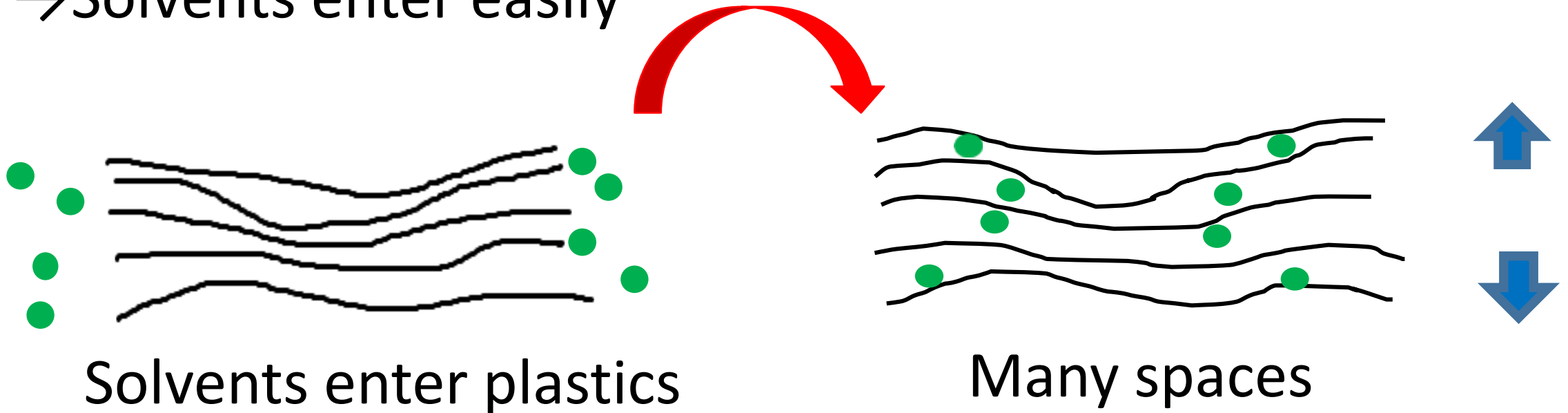
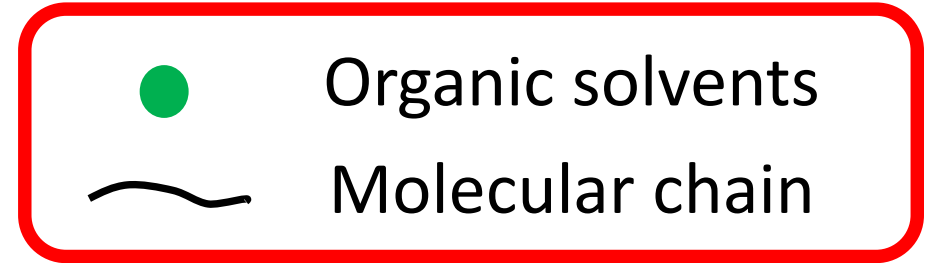


Causes

swelling

- (1) • PE × n-hexane
- PP × n-hexane

→ Solubility parameters similar
→ Solvents enter easily

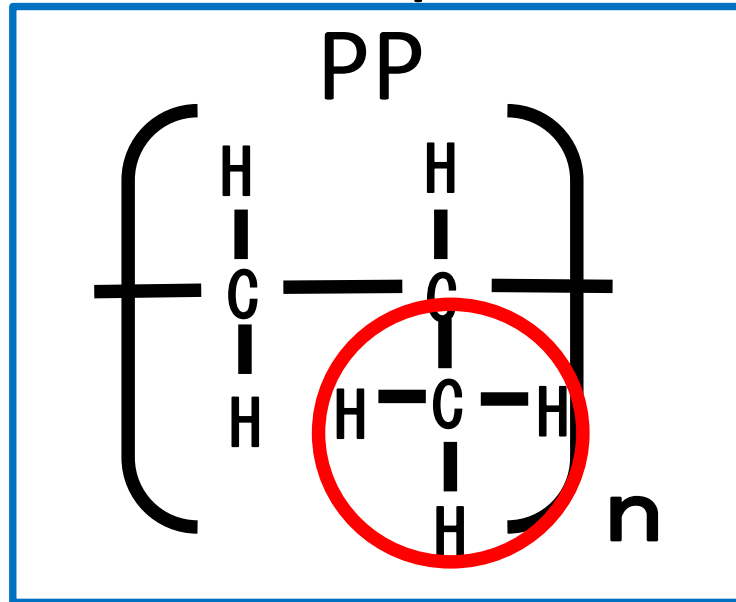


Causes

(2) • PP × n-hexane

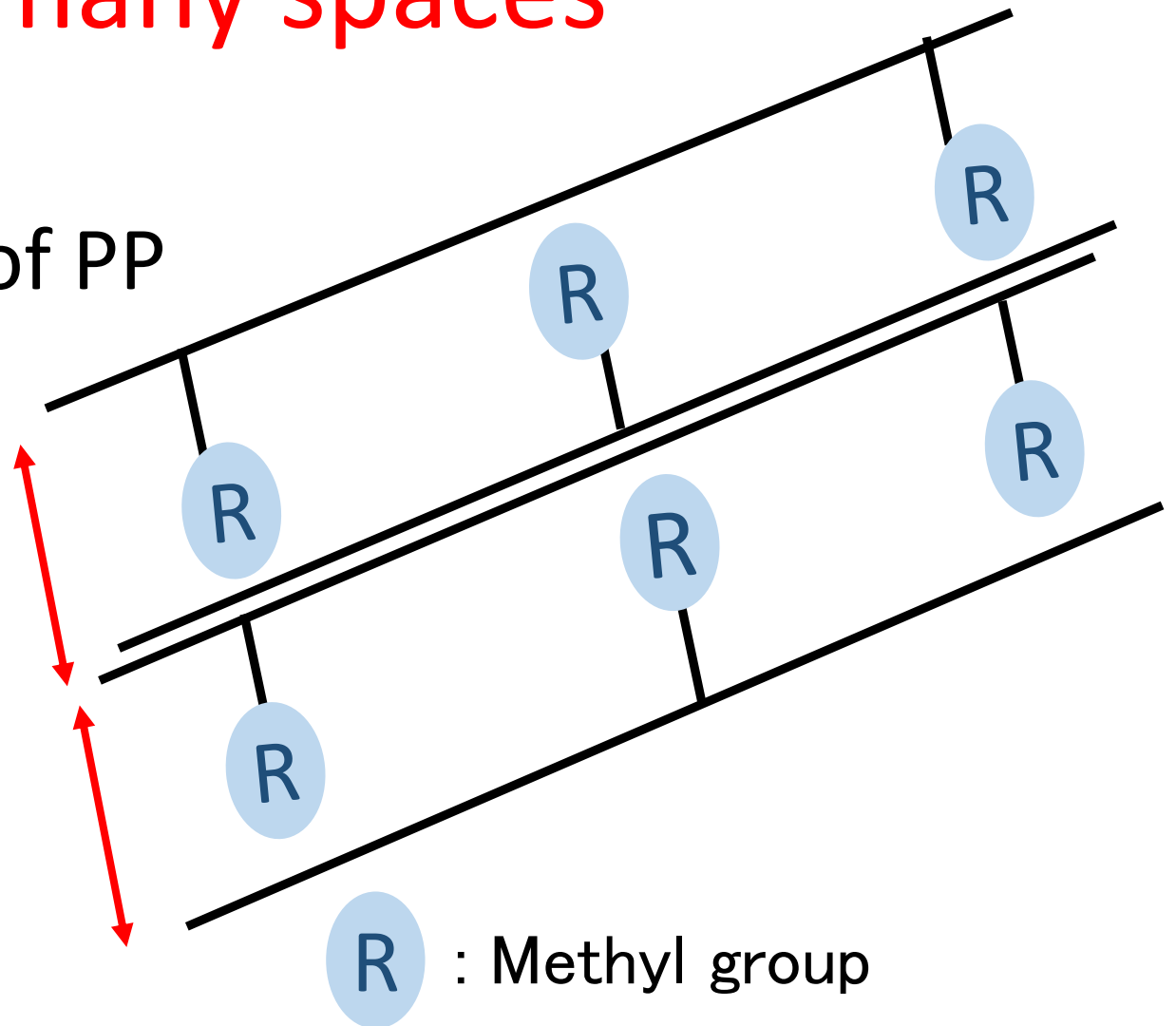
• PP × acetone

→ depend on structure of PP



Methyl group

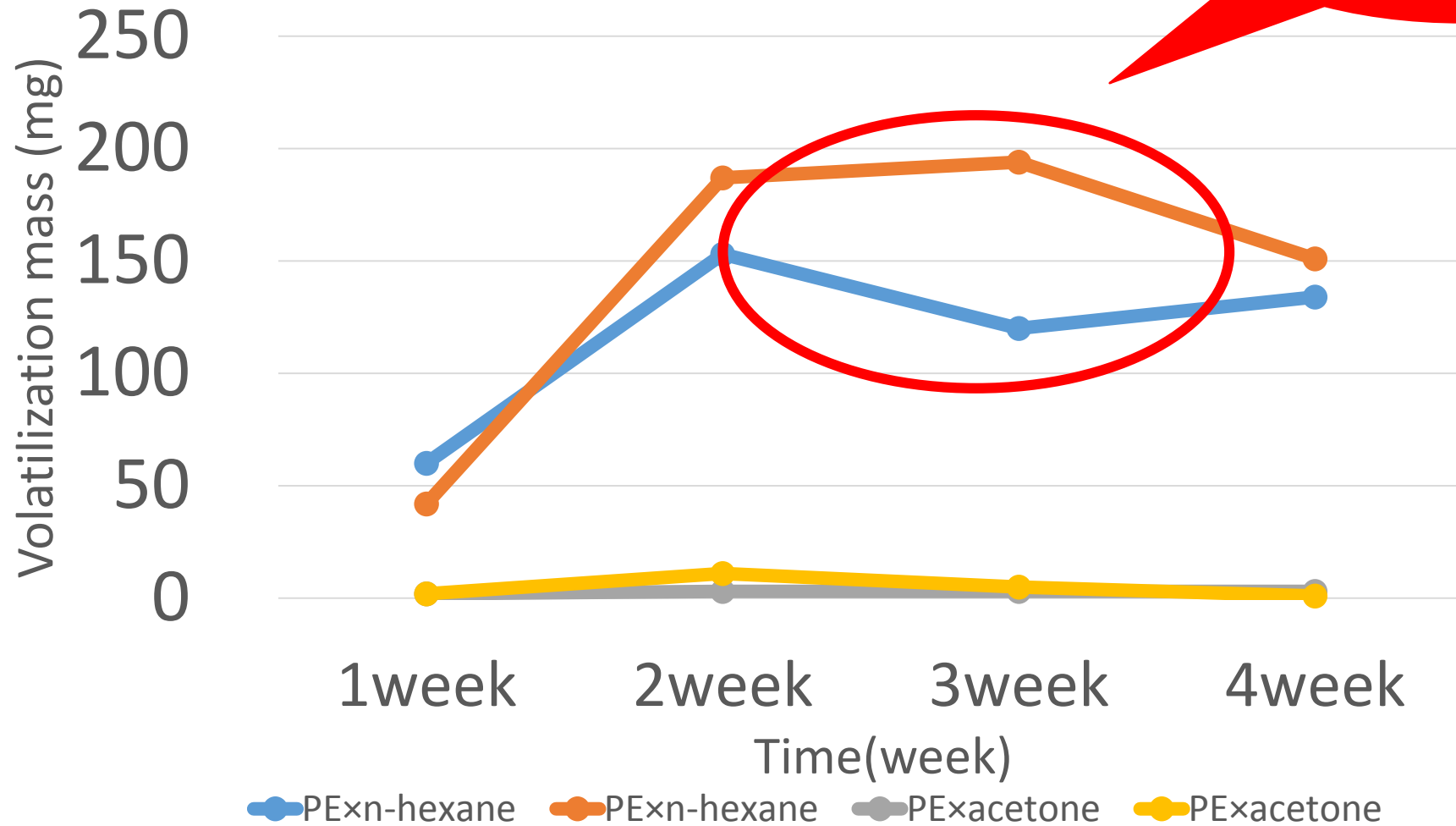
many spaces



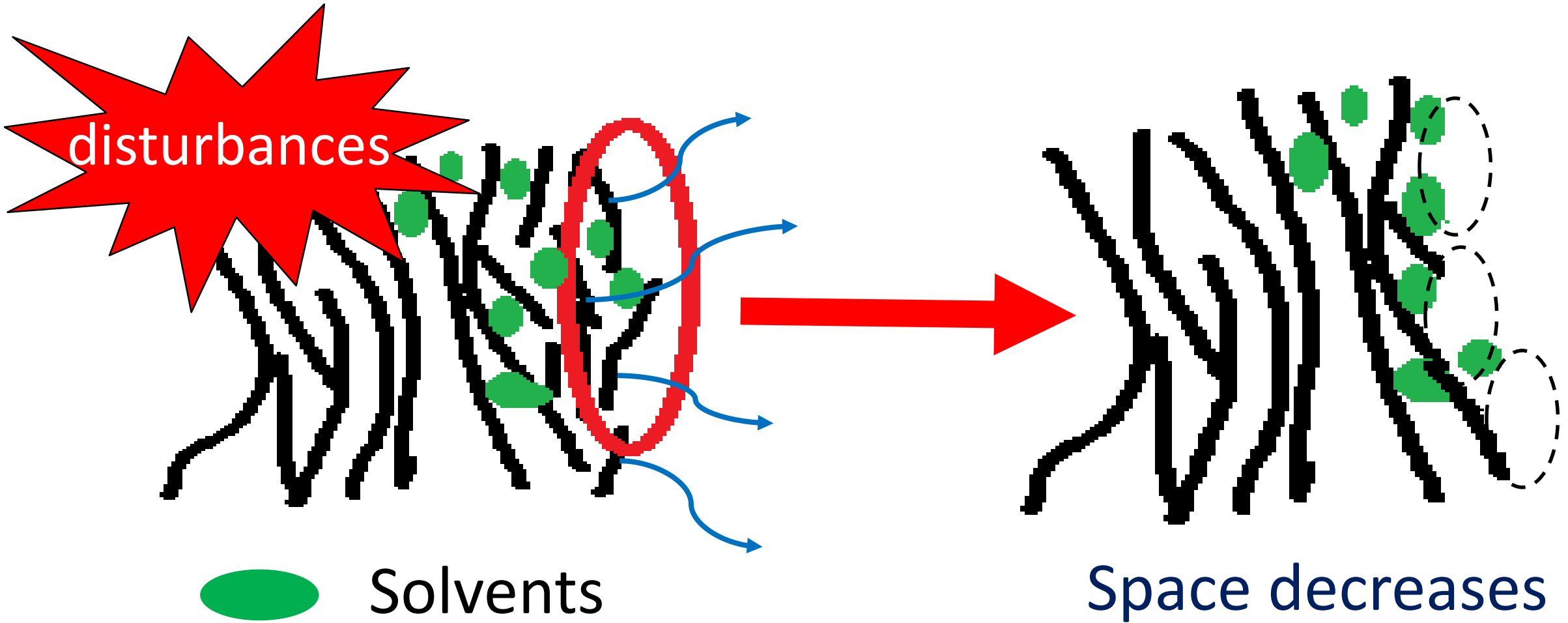
R : Methyl group

Results & Analysis

(ii) volatilization mass



New hypothesis



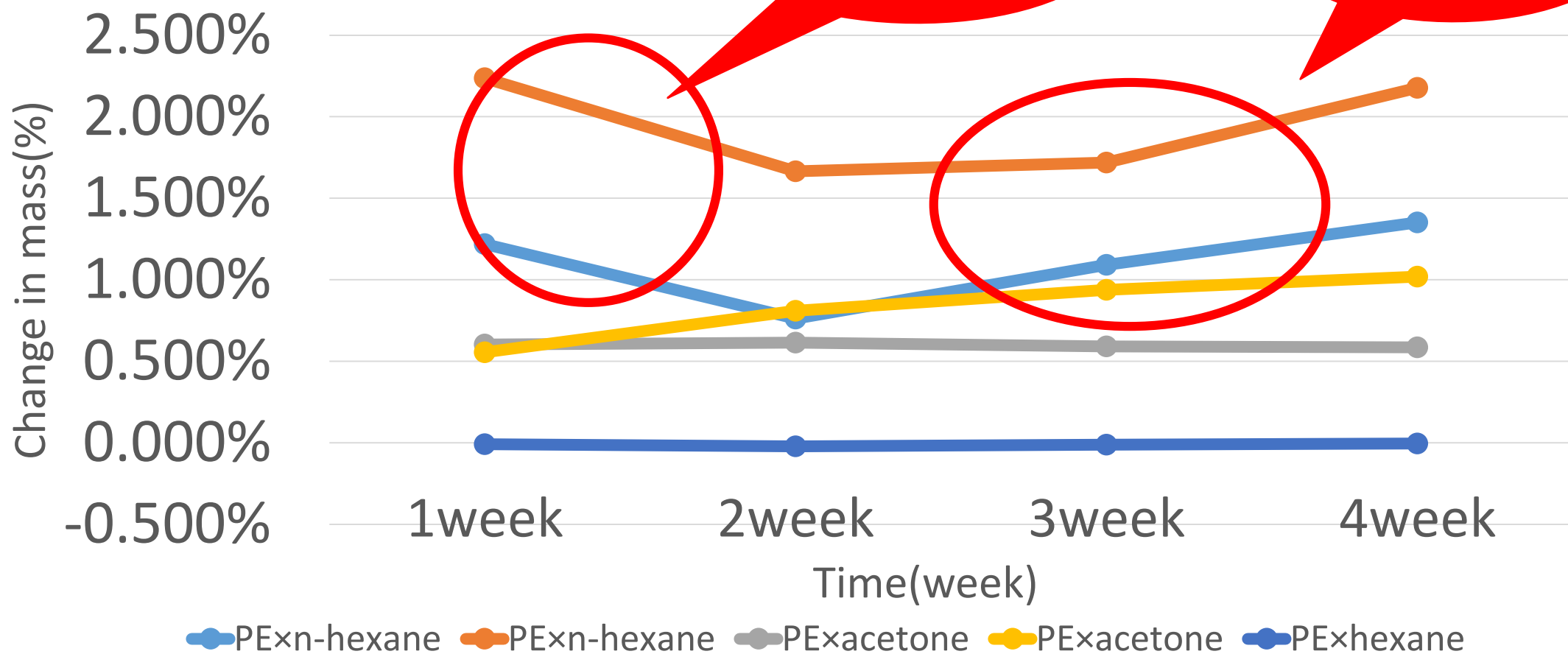
How to calculate percent change in mass

Percent change in mass (%)

$$= \frac{(\text{Last mass}) - (\text{First mass})}{(\text{First mass})} \times 100$$


Result & Analysis

(iii) Change in mass



Causes of the change

✓ increase : **swelling** (cf.(i))

(1) ▪ PE × n-hexane
▪ PP × n-hexane  Solubility parameters similar
→ Solvents enter plastics easily

(2) ▪ PP × n-hexane
▪ PP × acetone  Depends on structure of PP

Causes of the change

✓ decrease : dissolution reactions

- PE × n-hexane
- PP × n-hexane



Solubility parameters similar
→ Easy to blend

Conclusion

① confirmed things

- When solubility parameters are similar
→ dissolution reactions happen

② findings

- When solubility parameters are similar and structures of plastics have many open spaces
→ swelling proceeds easily

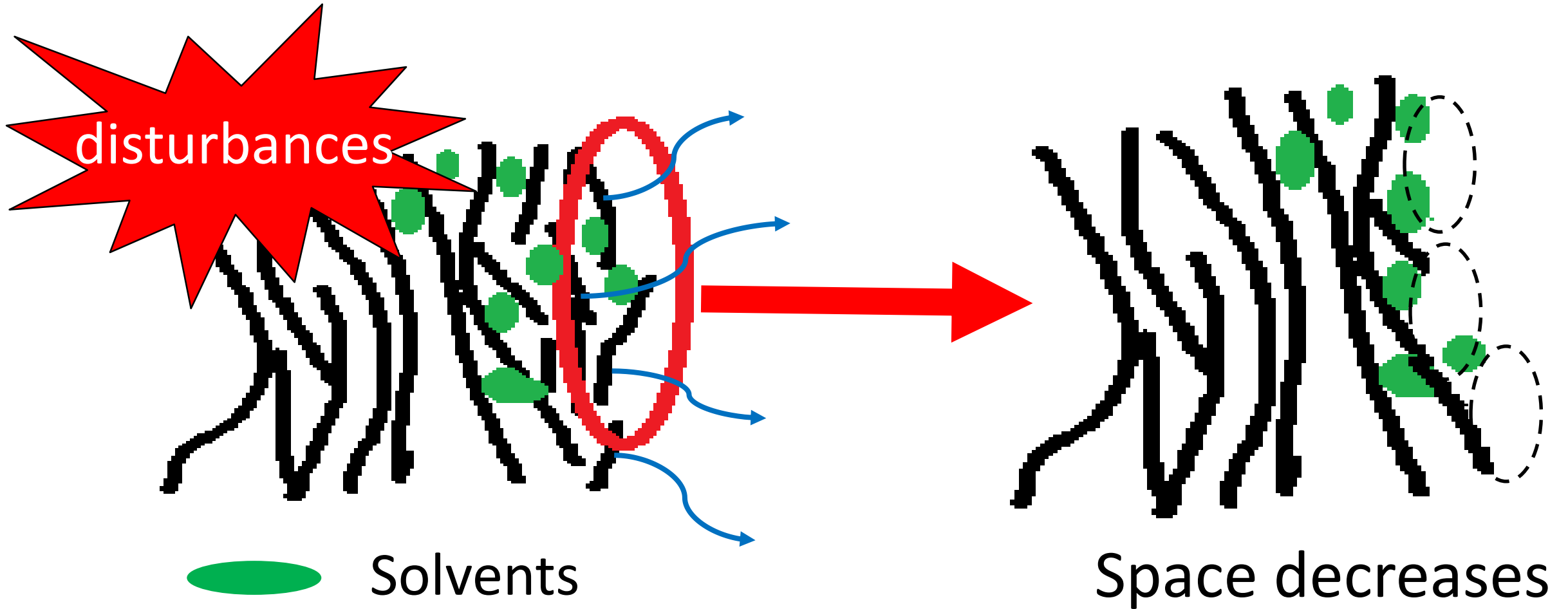
Conclusion

To avoid industrial accidents,...

- Choose plastics and organic solvents whose solubility parameters are **not similar**
- Use plastics which have **few open spaces** within their structure

Conclusion

③ Formed a new hypothesis



Future issues

- ✓ Further tests of our hypothesis
- ✓ Reveal how plastics react more clearly

Gratitude

We would like to express our gratitude to

- Takiron, Inc
- Miura Seisakusho, Inc

for providing us with material support.

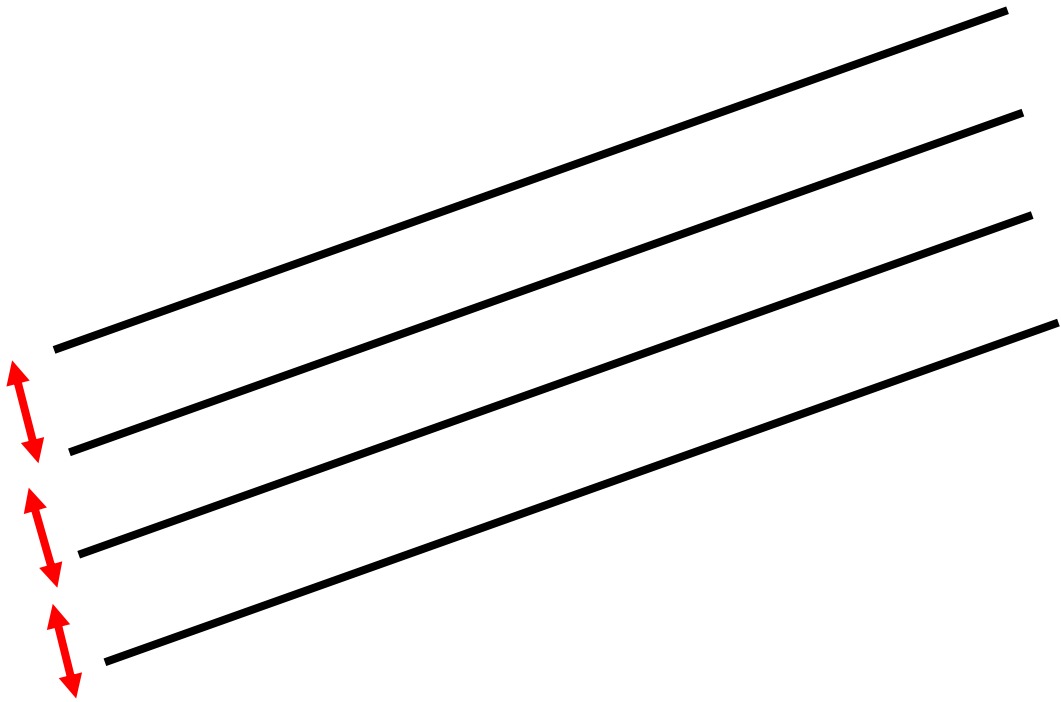
References

- Testing method and evaluation result of each dynamic characteristic of the plastic material 〈4〉.

Thank you for listening.

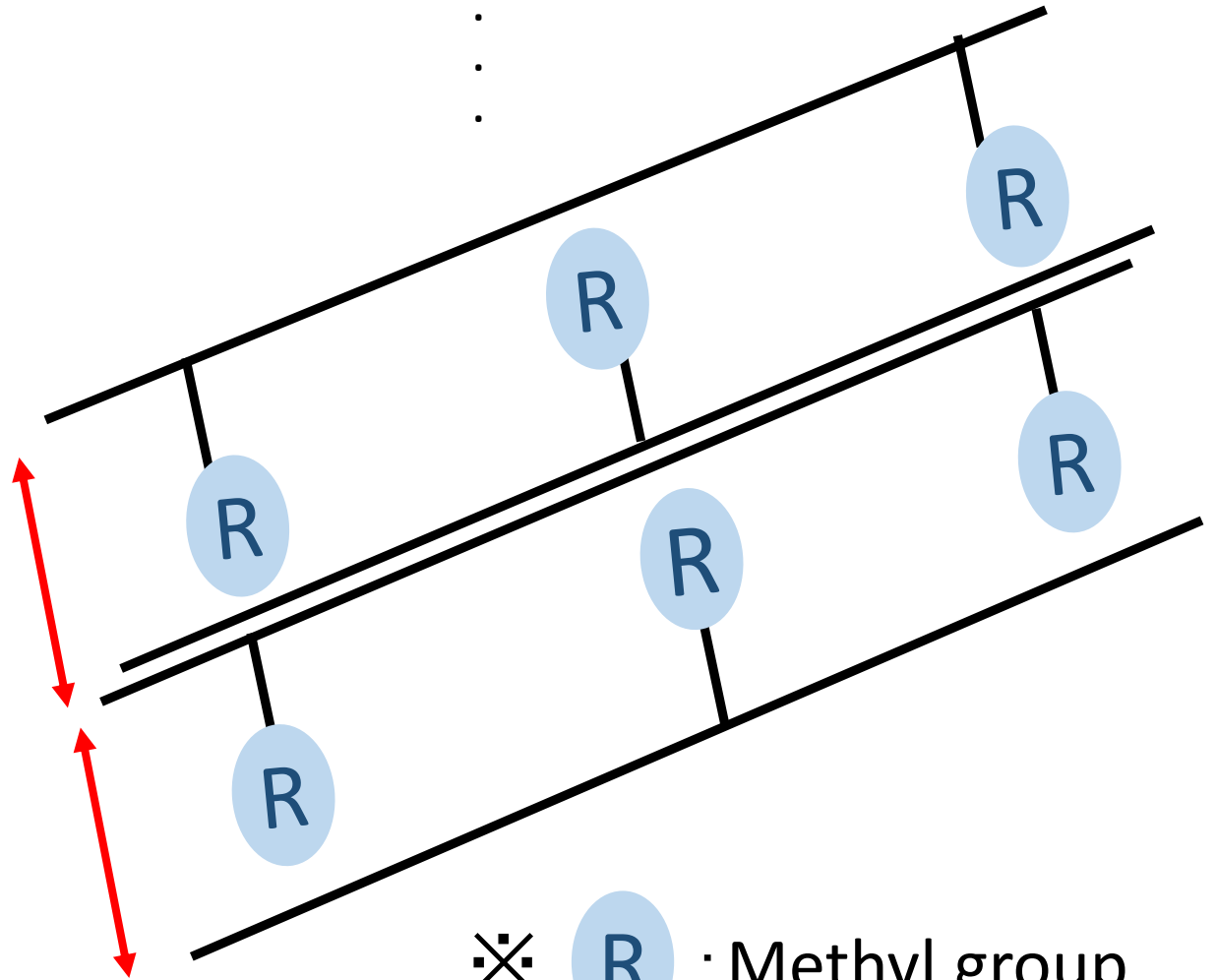
Cf. PE

⋮



PP

⋮



⊗ R : Methyl group