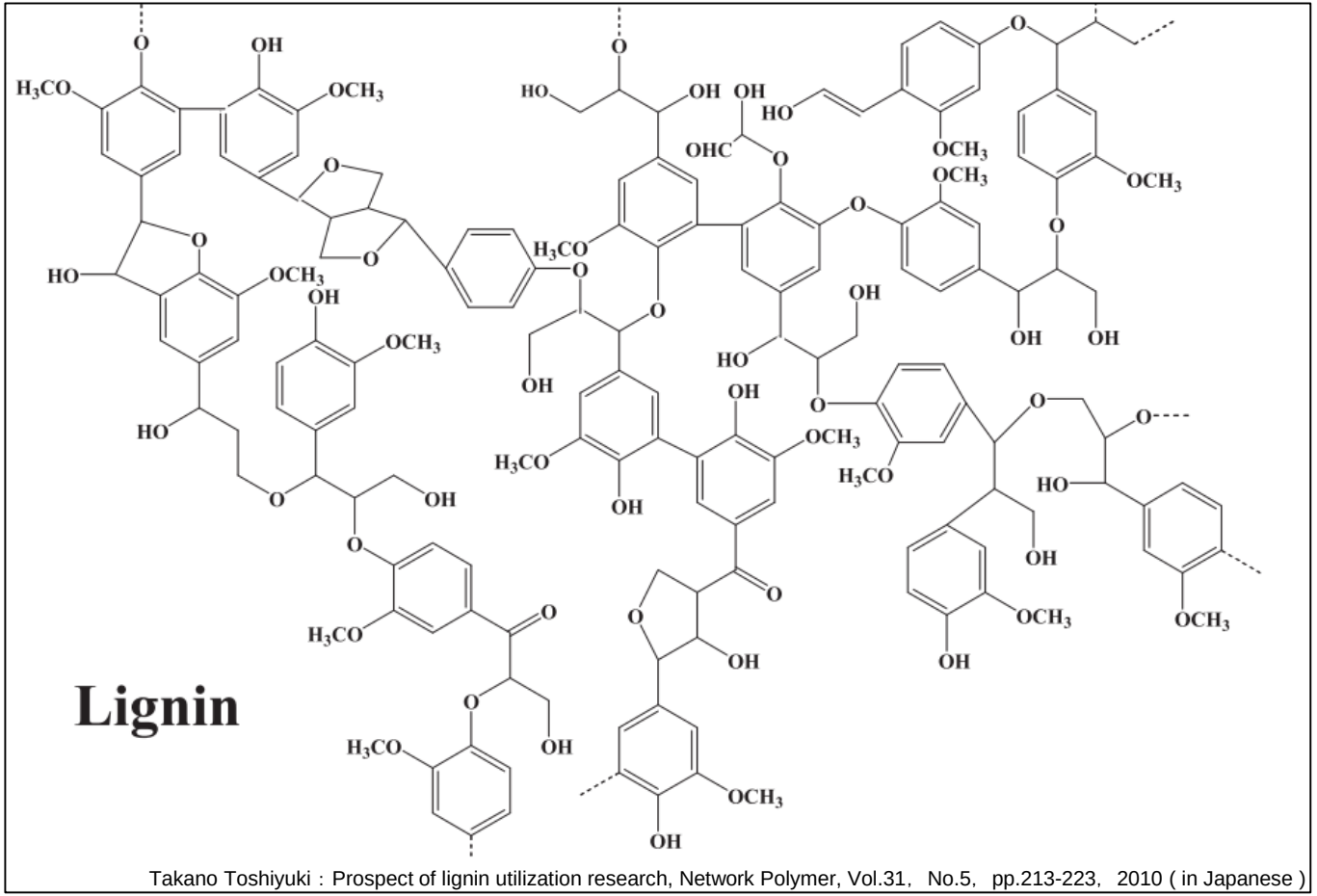
Extraction of lignin from wood and its application

Hyogo Prefectural Kakogawa Higashi High School
Science & Math Course　Science Research Group 6

Contents



Takano Toshiyuki：Prospect of lignin utilization research, Network Polymer, Vol.31, No.5, pp.213-223, 2010 (in Japanese)

Figure 1. Chemical structure of lignin

1. Motivation & Purpose

- To extract lignin from wood
- To investigate its properties
- To develop a new material with lignin

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2. Preliminary experiment

Purpose:

To extract lignin from wood

Method:

Extract lignin from cherry and cedar by using acetic acid.

＊Each piece：50g

Results:

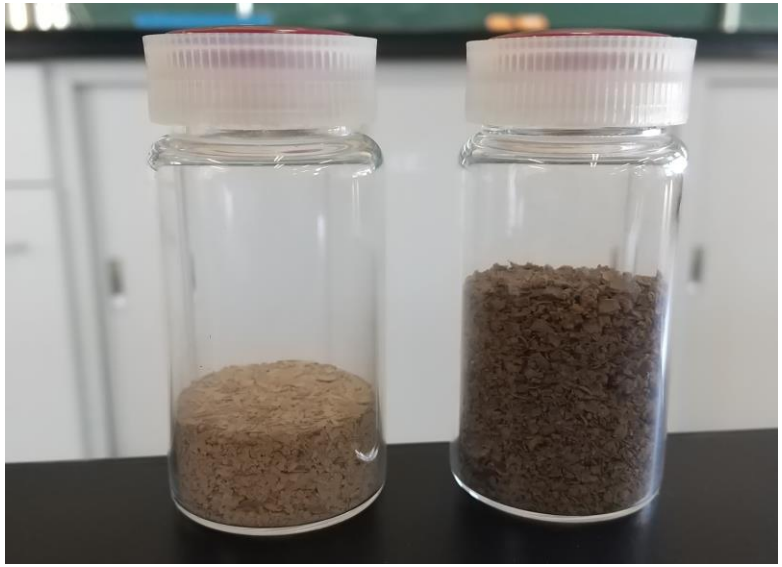


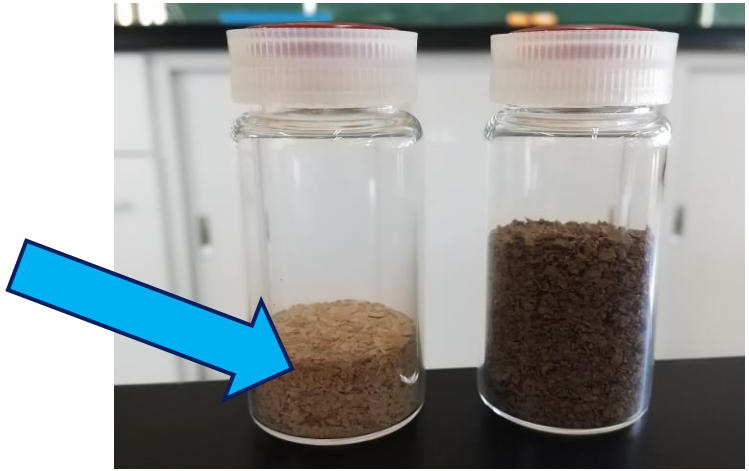
Figure 2　Extracts
（left：Cherry, right：Cedar）

	Amounts [g]	Lignin / Wood [%]
Cherry	2.4	4.2
Cedar	4.8	8.4

Table 1.　Amount of lignin extracted

Study:

Lignin from cherry is paler than lignin from cedar.



Essentially, lignin is said to be white.

→ Lignin from cherry can be considered to be purer.

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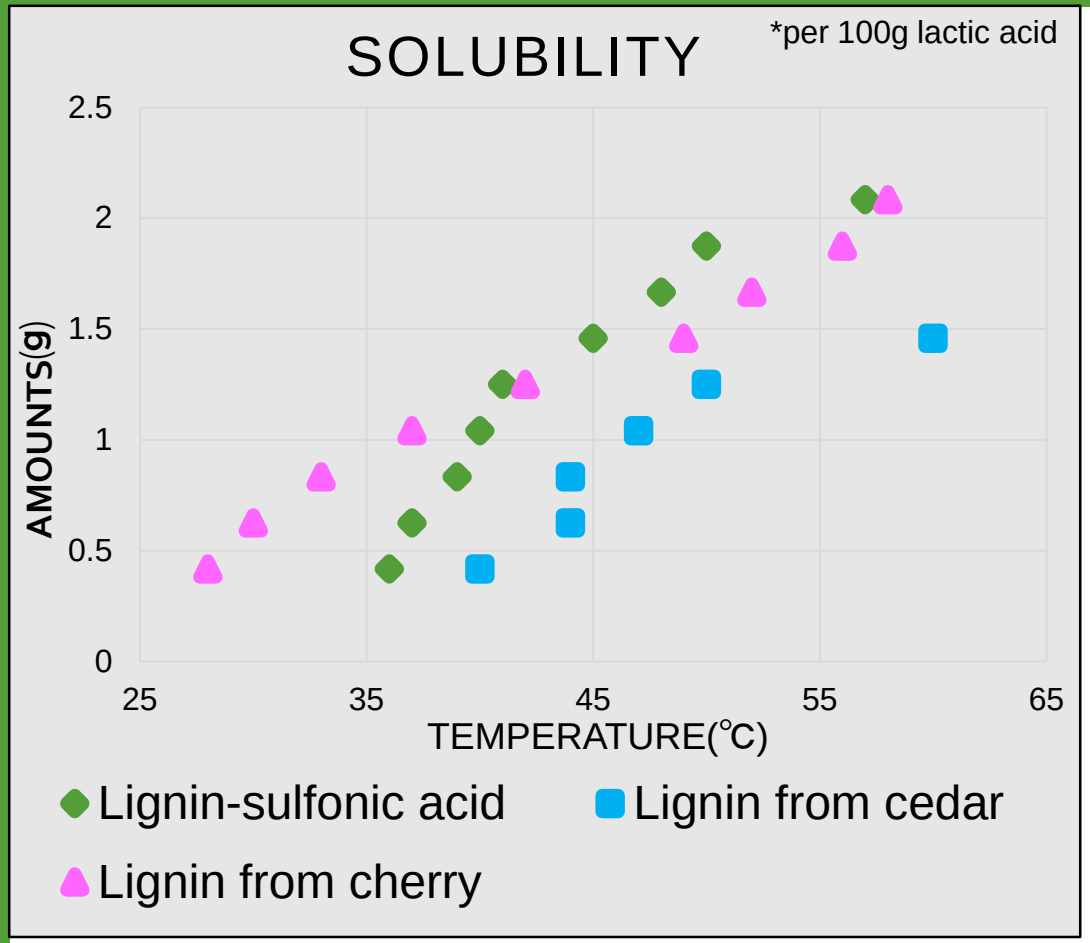
3. Experiment 1

Purpose:

To investigate the solubility of lignin

Hypothesis:

Lignin dissolves in acid or alcohol.



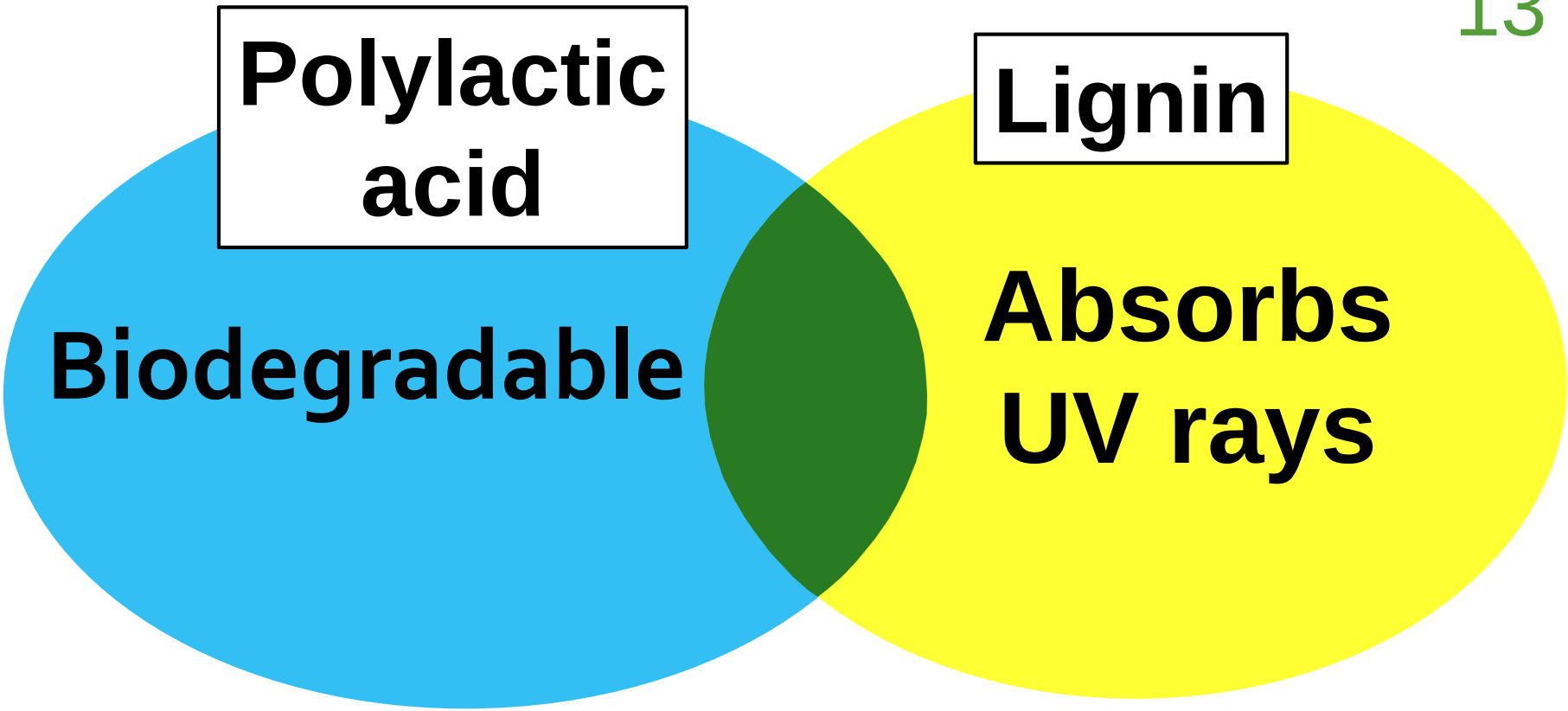
Graph 1. Solubility

- The higher the temperature, the higher the solubility.
- When the temperature is low, cherry lignin is more soluble than cedar lignin.

3. Experiment 2

Purpose:

To develop a new material using lignin-lactic acid solution


Polylactic acid
Biodegradable
Lignin
Absorbs UV rays

Method:

We heated 3 kinds of lactic acid solution (A, B, & C)* to 230 degrees Celsius for 2 hours with a hotplate and let them cool.

* Concentration of lignin

A : 0.40 wt.% B : 0.80 wt.% C : 1.6 wt.%

Results:

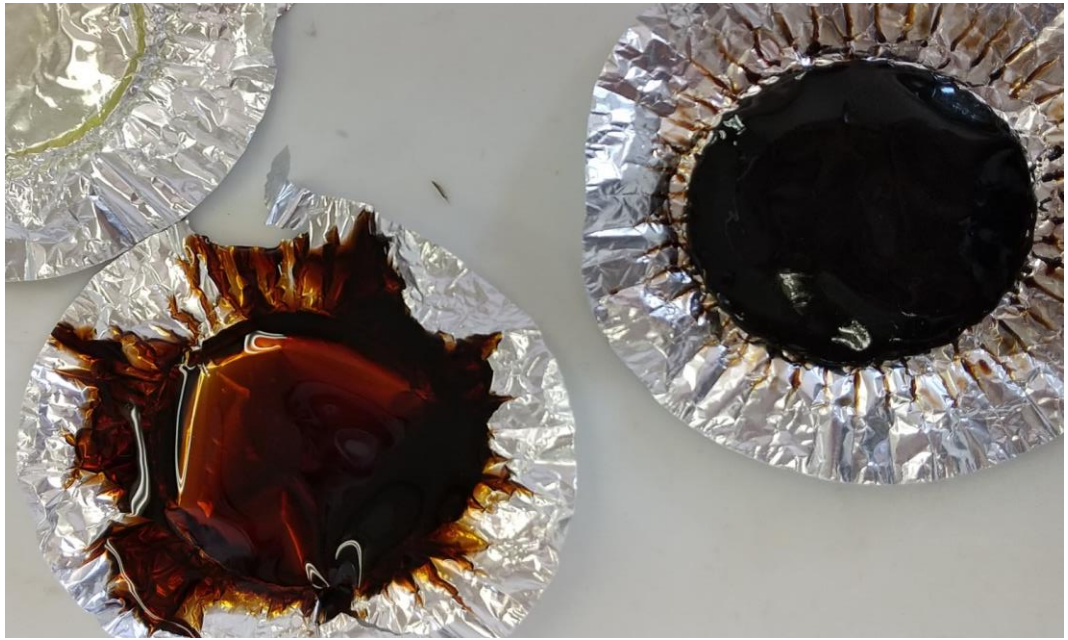


Figure 3. Products (left：A, right ：B)

Figure 4. Product (C)

Figure 4. Product (C)

Figure 5. Cross section (C)

Study:

How easy to set : A＞B＞C

We think that the more lignin we add to solutions, the harder they become.

A further experiment

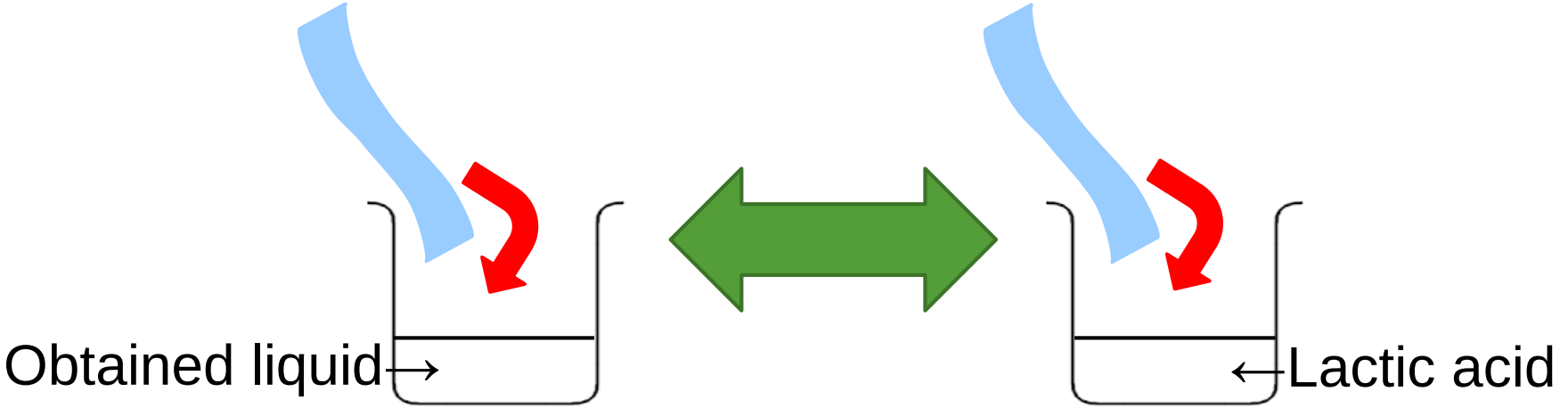
Purpose:

To investigate how lactic acid changed into a solid

Method:

We dipped cobalt chloride paper into liquid which we obtained by heating the solution* and lactic acid, and compared the change.

∗ the solution : lactic acid which lignin-sulfonic acid was dissolved in



Results:

The paper dipped in obtained liquid turned red while the paper dipped in lactic acid did not change.

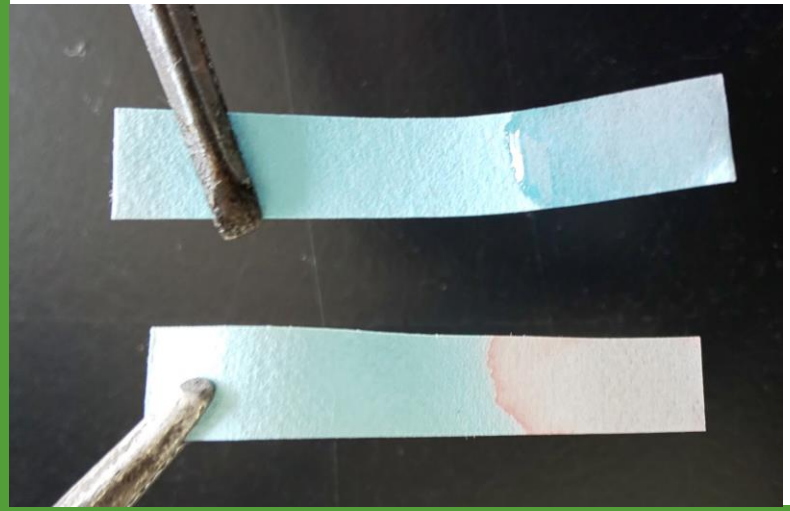
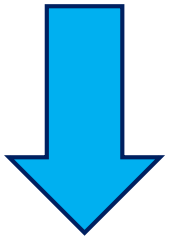


Figure 6. Results of experiment 3

{ upper : lactic acid
{ lower : obtained liquid

Study:

Obtained liquid contained more water than lactic acid.



There must have been **dehydration** in experiment 2.

3. Experiment 3

Purpose:

To examine the properties of the product materials

Inspection 1

Method:

Examine whether the product transmits electricity using a dry battery and an electronic music box.

Inspection 2

Method:

Heat the product.

Inspection 3

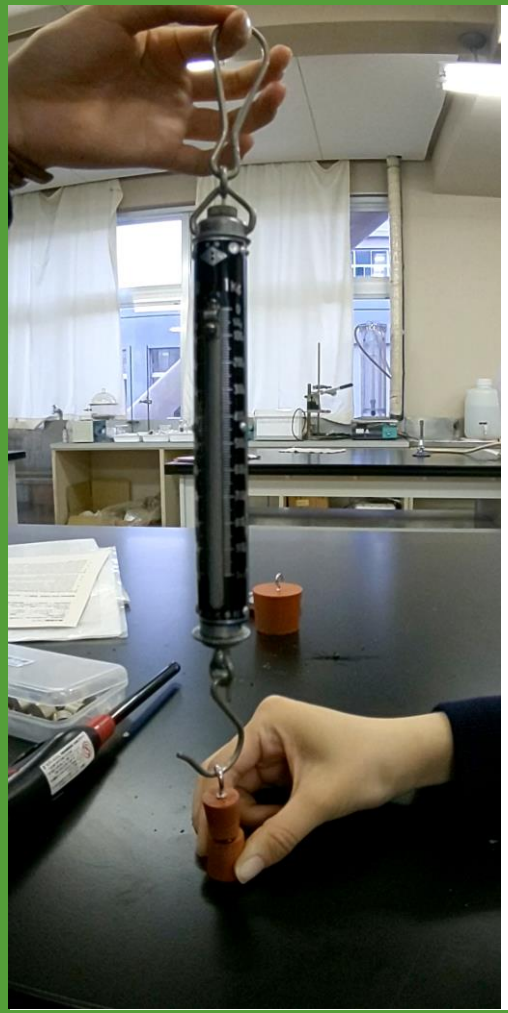
Method:

Cool down the product.

Inspection 4

Method:

Ignite a part of the product.



Inspection 5

Method:

1. Heat the product and melt it.

2. Put it between two rubber stoppers.

3. Fix one and pull the other with a spring balance.

∗ The area of contact was about one square centimeter.

Properties of the product:

①Non-conductive
②Becomes soft at around 100℃
③Becomes fragile
④Stretches when heated
⑤Has ability to glue

Study:

The products have properties similar to thermoplastic resin.

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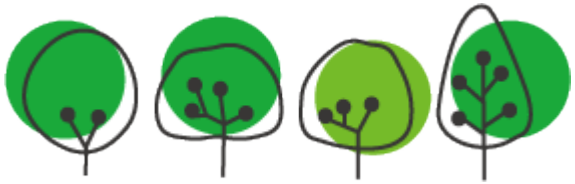
4. Conclusion

- Lignin dissolved in lactic acid.

- The solution solidified when it was heated and then cooled.



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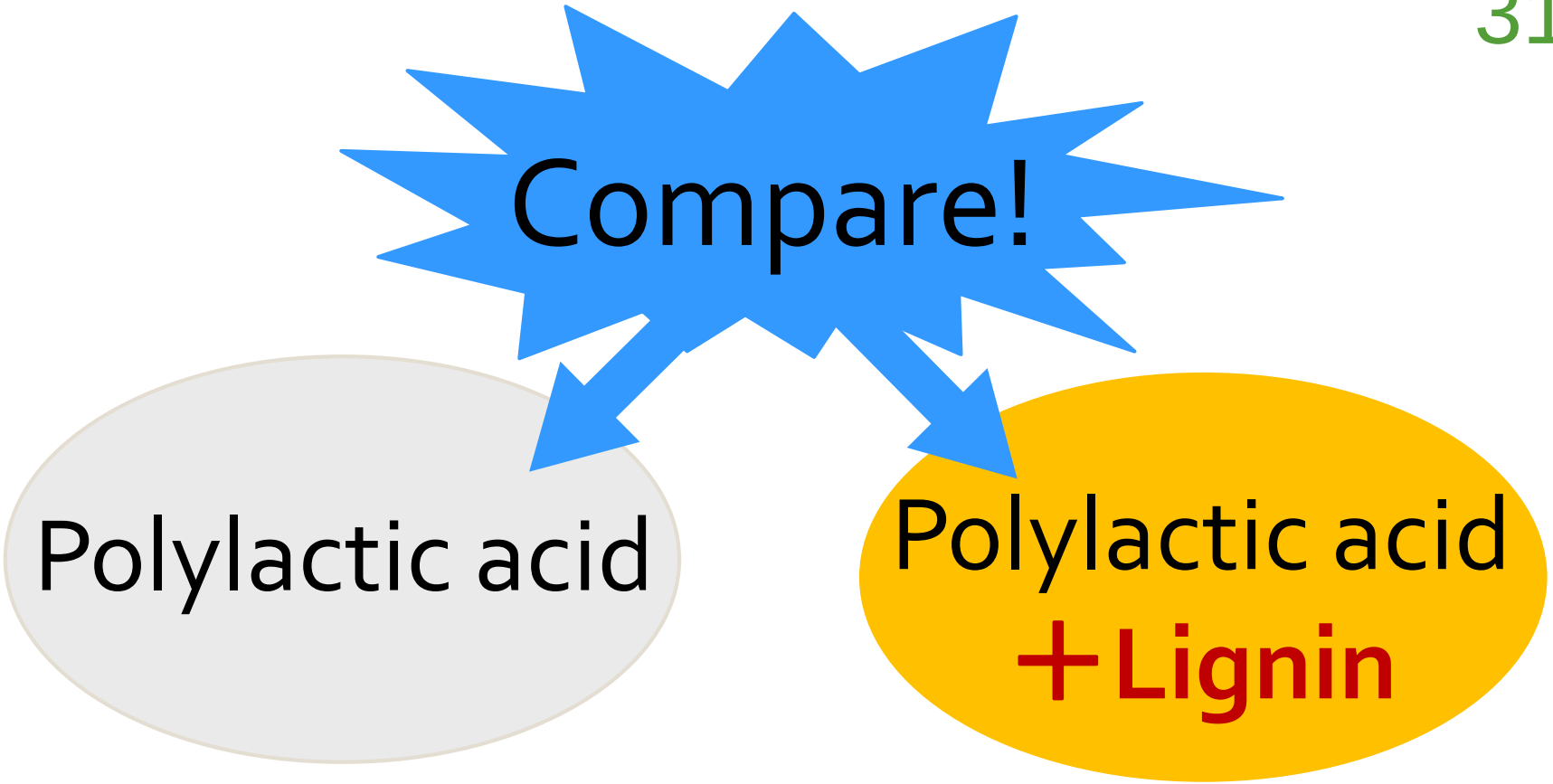
5. Future prospects

- Advance the survey of lignin and material produced from lactic acid
- Consider how to use the products


Compare!
Polylactic acid
Polylactic acid
+Lignin

6. Acknowledgements

- NIPPON PAPER INDUSTRIES CO., LTD.
- Kamatani shigyo Co., Ltd.

7. References

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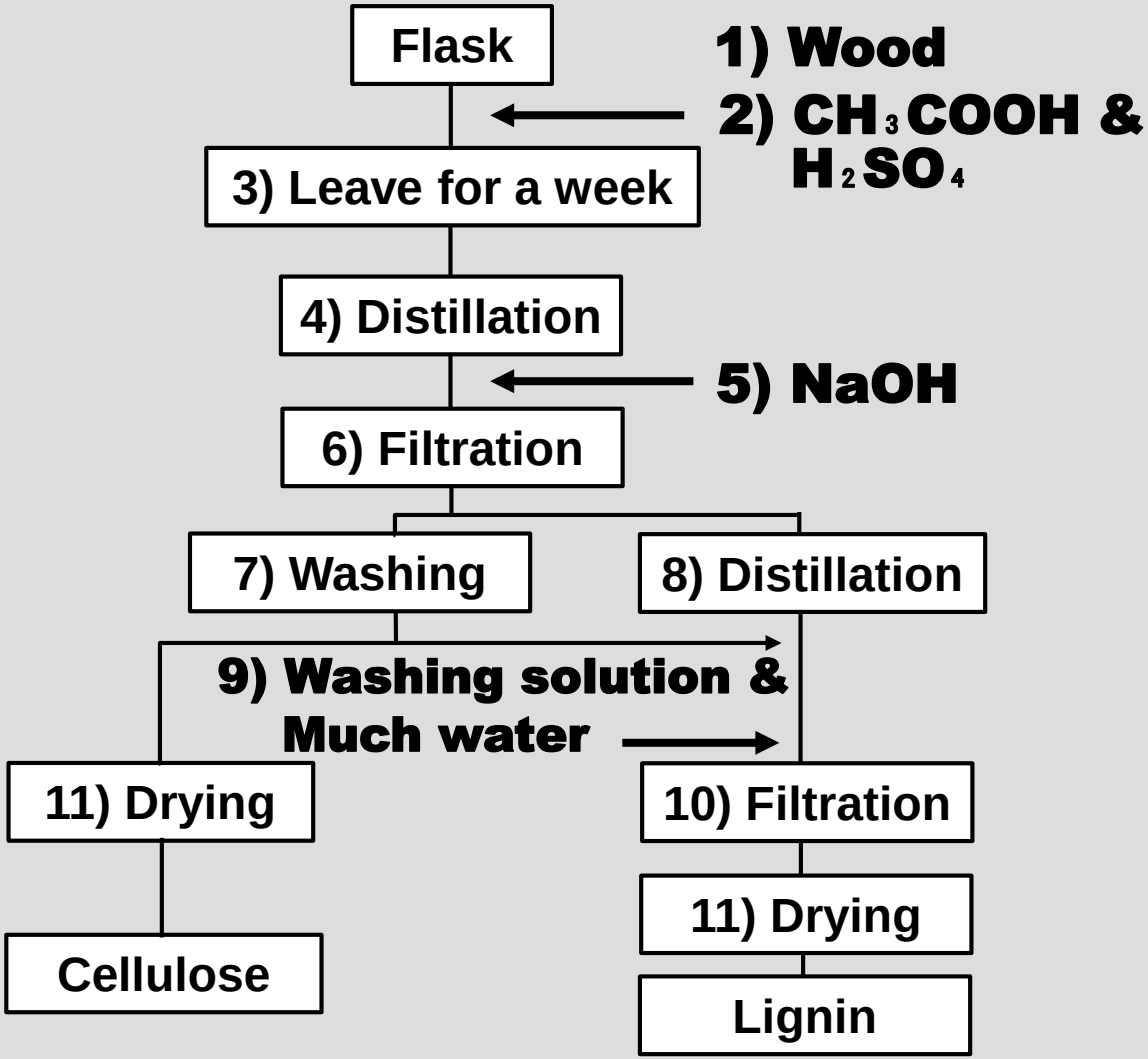
- Takano Toshiyuki : Prospect of lignin utilization research, Network Polymer, Vol.31, No.5, pp.213-223, 2010 (in Japanese)

Thank you for listening!

Q & A



How to extract lignin

Distillation

Filtration

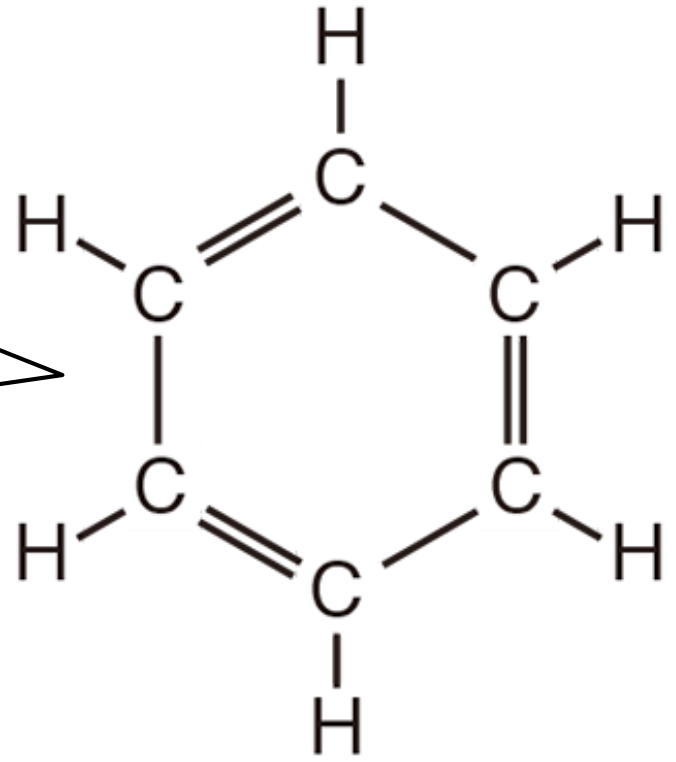
Results:

Liquid	Solubility	Liquid	Solubility
Acetic acid CH_3COOH	○	Isopropyl alcohol $(CH_3)_2CHOH$	×
0.10M-NaOHaq	○	Glycerin $CH_2(OH)CH(OH)CH_2OH$	×
Lactic acid $C_3H_6O_3$	○	Diethyl ether $C_4H_{10}O(CH_3CH_2)_2O$	×
Acetone CH_3COCH_3	△	Acetic anhydride $(CH_3CO)_2O$	×
Ethylene glycol $HOCH_2CH_2OH$	△	1-Butanol $CH_3CH_2CH_2CH_2OH$	×

○ : well-dissolved　△ : little-dissolved　× : non-dissolved

Solubility of lignin

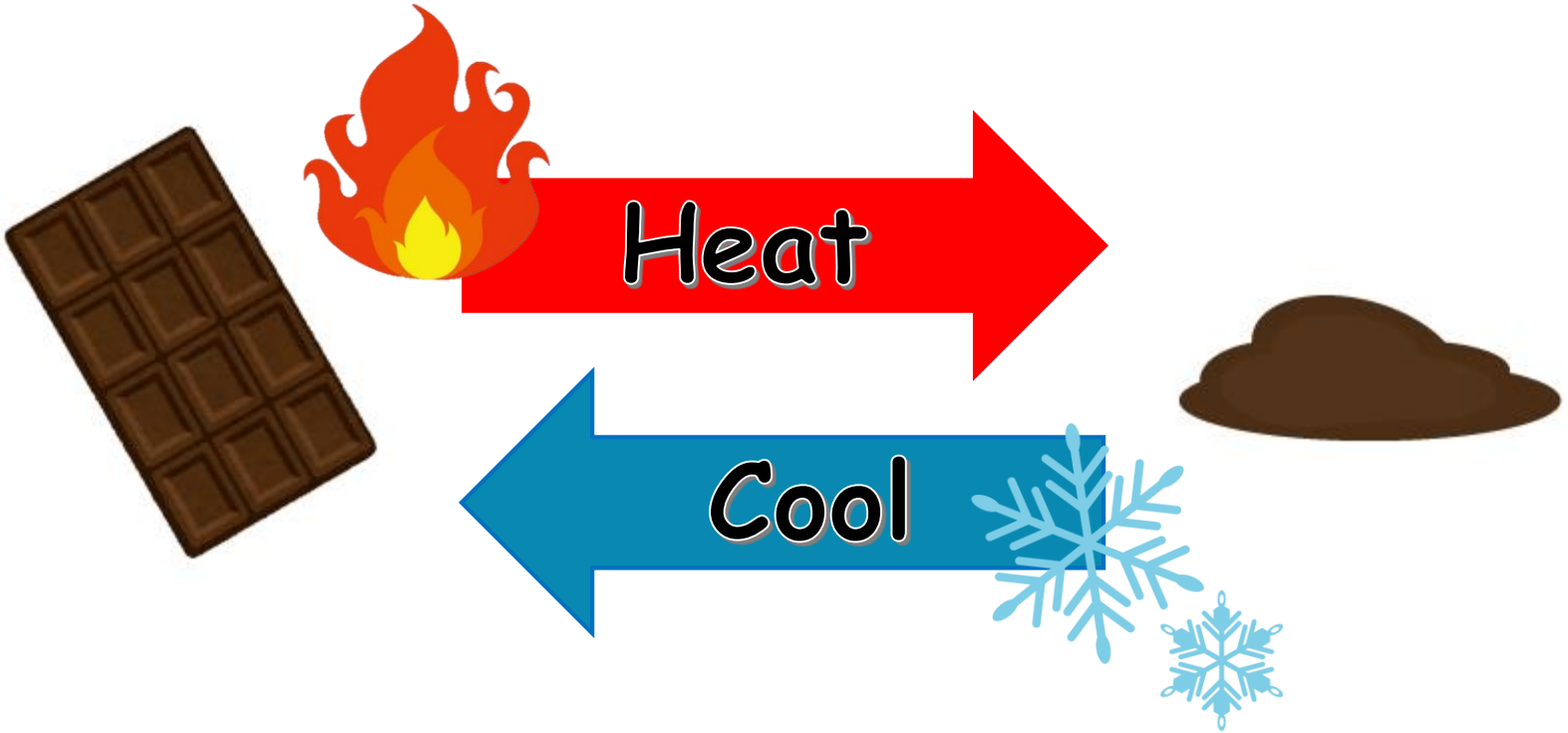
Absorbs UV rays

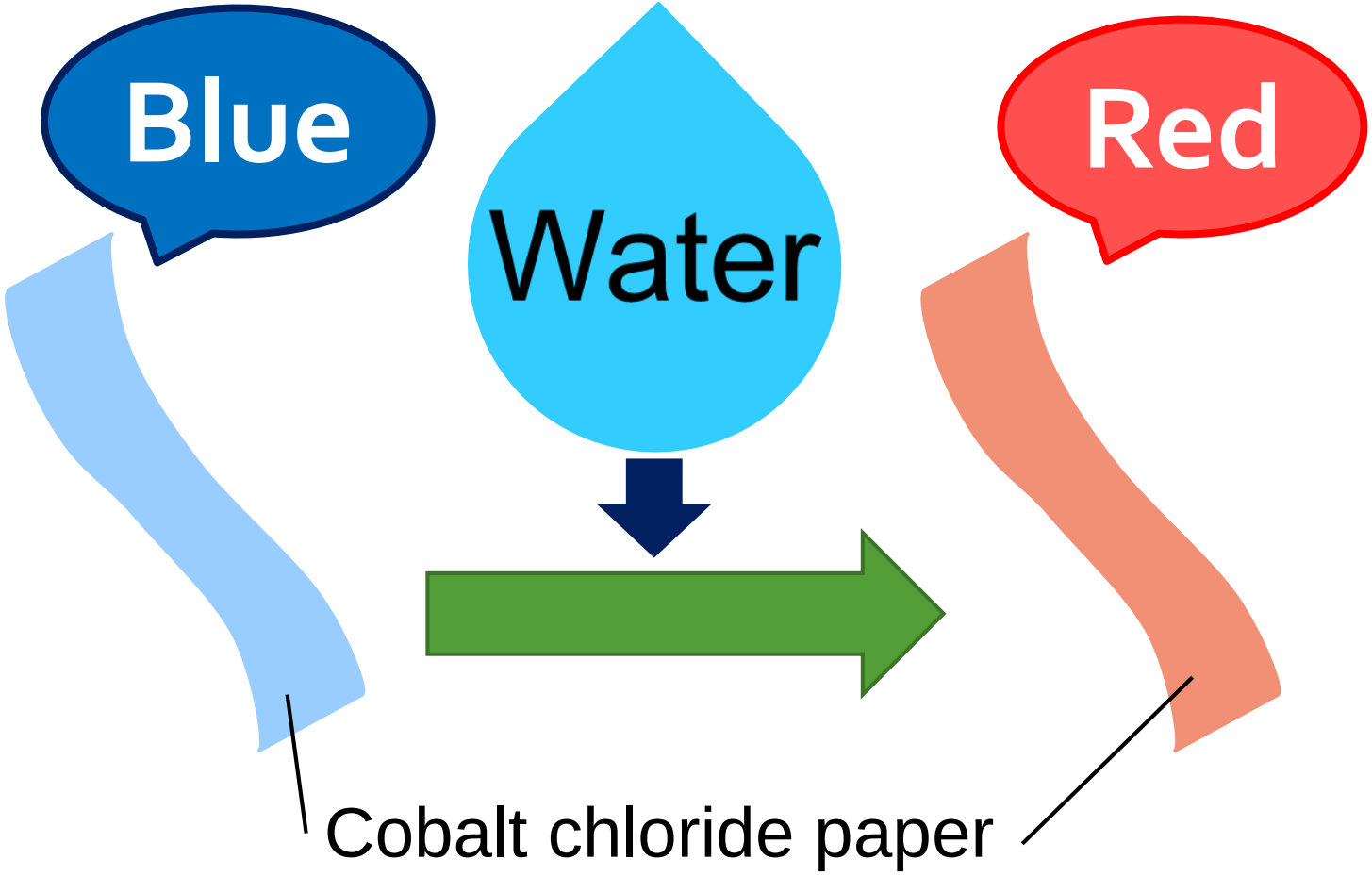


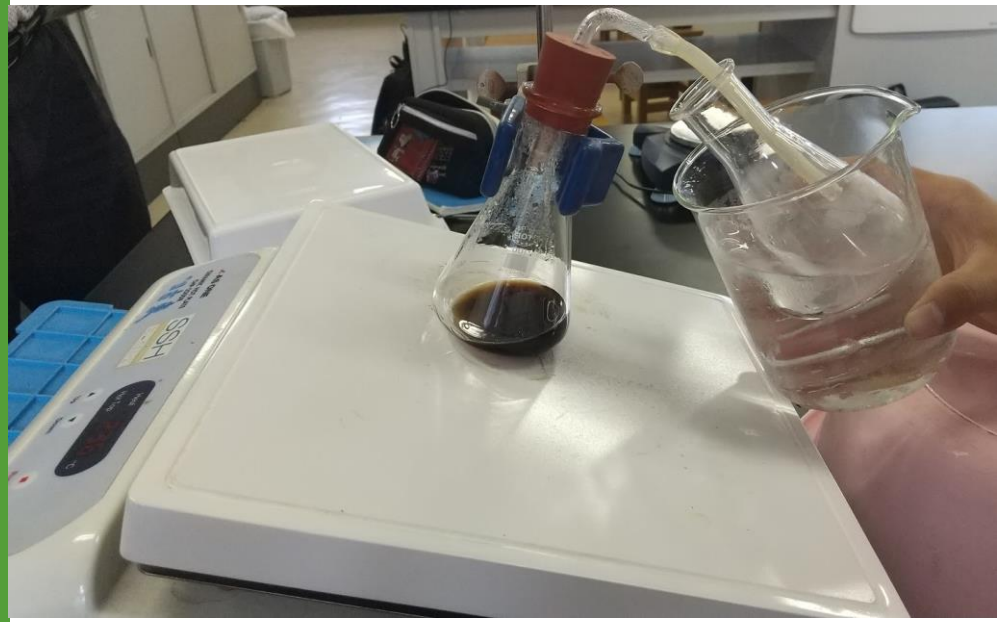
Benzene ring

Thermoplastic resin

…Like chocolate !




Blue
Water
Red
Cobalt chloride paper



Heating

Obtained liquid