Biodegradability of commercial polymers for skimmed rubber coagulation

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Outlines

- **Analytical chemistry and environment research unit (ACERU)**

1. Introduction:

Why study biodegradability of rubber coagulation polymer?

2. Materials & methods: How we did it?

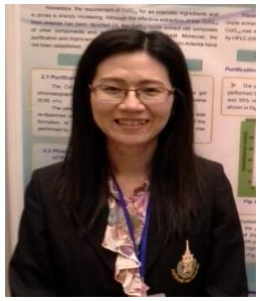
3. Results and discussion:

Are these polymer better than sulfuric acid in rubber coagulation?

4. Conclusions: Method for factory to assess polymer before onsite applications

ACE Research Unit

- **Analytical Chemistry and Environment Research Unit (ACERU)**
- **Prince of Songkla University**
  - **Pattani and Hat Yai campuses**
- **Invented new analytical methods and waste management technologies including ISO methods.**
- **Our alliances**
  - **ISA, France; CSIRO, Australia**
  - **Latex Industry; Science Park, PSU; Instrument center**



Dr.Thitima R.

Asst.Prof.Dr.Chonlatee C.

ACE Research Unit

- **Example of our ACERU products**

TMTD&ZnO test kits

- Mg test kit
- WIPO2011 139245
- ISO 17403: 2014

MALAYSIA

CERTIFICATE OF GRANT OF A PATENT

In accordance with Section 31 (2) of the Patents Act 1983 a patent for an invention having grant number MY-148291-A has been granted to 1) THE THAILAND RESEARCH FUND, 2) PRINCE OF SONGKLA UNIVERSITY, in respect of an invention having the following particulars :

TITLE : TEST KIT AND METHOD FOR QUANTITATIVE DETERMINATION OF THIURAM COMPOUNDS IN A SAMPLE

FILING DATE : 24 MARCH 2010

PRIORITY DATE : 11 NOVEMBER 2009

NAME OF INVENTOR : CHEEWASEDTHAM, WILAIRAT

PATENT OWNER : 1) THE THAILAND RESEARCH FUND
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BANGKOK 10400
THAILAND

2) PRINCE OF SONGKLA UNIVERSITY
15 KANJANAVANICH ROAD, HATYAI
SONGKHLA 90110
THAILAND

DATE OF GRANT : 29 MARCH 2013

Dated this 29 day of MARCH 2013

(SHAMSIAH BINTI KAMARUDDIN)
for Registrar of Patents
MALAYSIA

ACE Research Unit

- Our outstanding rewards and productivity
  - 2016: The number 1 inventor of PSU whose technology have been most licensed (2005-2015)
  - 2015: Newton fund, Leader in Innovation Fellowship
  - 2005: Outstanding research of Thailand Research Fund

1. Introduction

- During our new methods for Zn, Mg, etc. determination method have been announcing to latex industry
- Problem of new rubber coagulant polymer has been raised up from the user
- Concentrated H_2SO_4 → Skimmed rubber coagulation
- Coagulant polymer
- Activated sludge process in wastewater treatment was failed
- Polymer toxic to bacteria and protozoa?

1. Introduction

- **Our ACERU has promised to developed a new method for latex industry for biodegradability (Toxicity) assessment of rubber coagulatant polymer**
- **SIMPLE**
- **Fast**
- **Cheap**

1. Introduction

- **It is complicated if determine several toxic functional groups or compounds**
- **New polymer types have been continuously produced**
- **Degradation**
  - **Photodegradation**
  - **Biological degradation**
- **Over all toxicity testing with biological seems proper to this propose**

1. Introduction

- **Mohee *et al*. (2007)**
  - **Used both aerobic and anaerobic degradations for commercial plastic**
  - **Cellulose membrane as control**
  - **Aerobic fermentation**
    - **Fermented plastic sheet with food waste for 72 days**
    - **% wt. loss at 26.9% of dried wt.**
  - **Anaerobic fermentation**
    - **Biogas production monitoring**
    - **7.6-245 cm^3 in 32 days (Very low volume)**

1. Introduction

- **Biodegradable plastics?**
  - **Aerobic fermentation**
  - **Anaerobic fermentaion**
- **Meltem *et al*. (2007) studied biological degradation of polyurethane foam under anaerobic digestion**

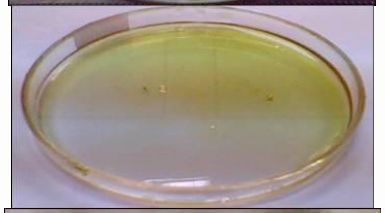
Objectives

- **To develop a biodegradability assessment method for rubber coagulant polymer**

2. Materials and Methods

2. Materials and Methods

2.1 Skimmed rubber coagulation efficiency

Polymer type	State	Color	
SKP (Songkhla)	Powder	White	
SRP (Surat thani)	Liquid	Yellow	
PLP (Phatthalung)	Liquid	Brown	

3.1 Results & Discussion

3.1 Rubber coagulation efficiency

Concentrated latex + 0.5% wt/wt polymer

2. Materials and Methods

2.1 Skimmed rubber coagulation efficiency

2.1.1 Coagulation efficiency

2.1.2 Skimmed latex, before and after coagulation

1) pH

2) EC

3) COD (Chemical oxygen demand)

2. Materials and Methods

2.2 Aerobic fermentation

Fermented materials	g
Fresh vegetables waste	38.5
Dried rain tree leaves	45.3
Office paper waste	3.8
Polymer	
Water to 100 g	

Polymers are in power or liquid state, How?

2. Materials and Methods

2.2 Aerobic fermentation

A 2 g Rubber sheet	
	g
Polymer	0.5
Latex concentrate	1.5
Ethanol	15.0

2. Materials and Methods

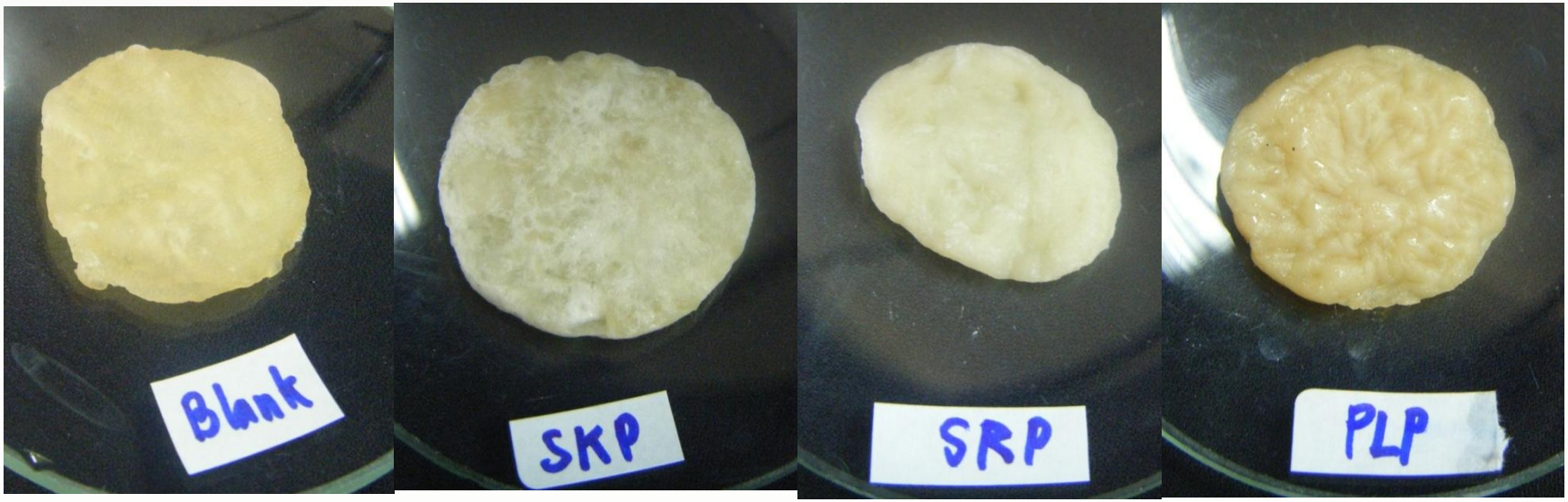
2.2 Aerobic fermentation

%Weight of rubber sheet

Before vs after

Left for 25 days at room temp.

2. Materials and Methods



2. Materials and Methods

2.3 Anaerobic fermentation of polymer

- Very low volume of biogas can be generated if polymer is toxic
- What should be the proper composition of fermentation?
- How can we easily measure the produced biogas?

2. Materials and Methods

2.3 Anaerobic fermentation

- Anaerobic fermentation system

setting up

  - 2-200 g Polymer : 1 kg of sludge
  - Water

2. Materials and Methods

2.3 Anaerobic fermentation

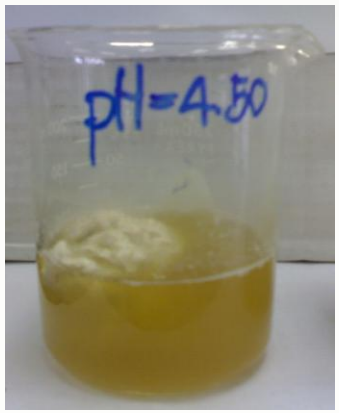
- Biogas volume was recorded every 4 days
- Day 0, 4, 8, 12, 16, 20, 24

3. Results and discussion

3. Results & Discussion

3.1 The efficiency of rubber coagulants

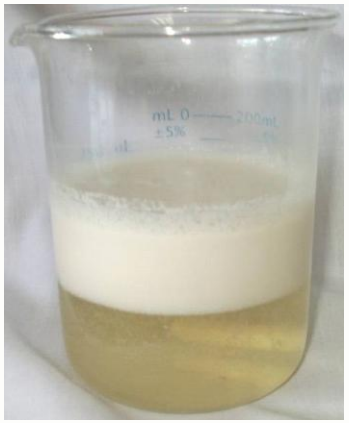
3.1.1 Coagulation efficiency



H_2SO_4

SKP

SRP

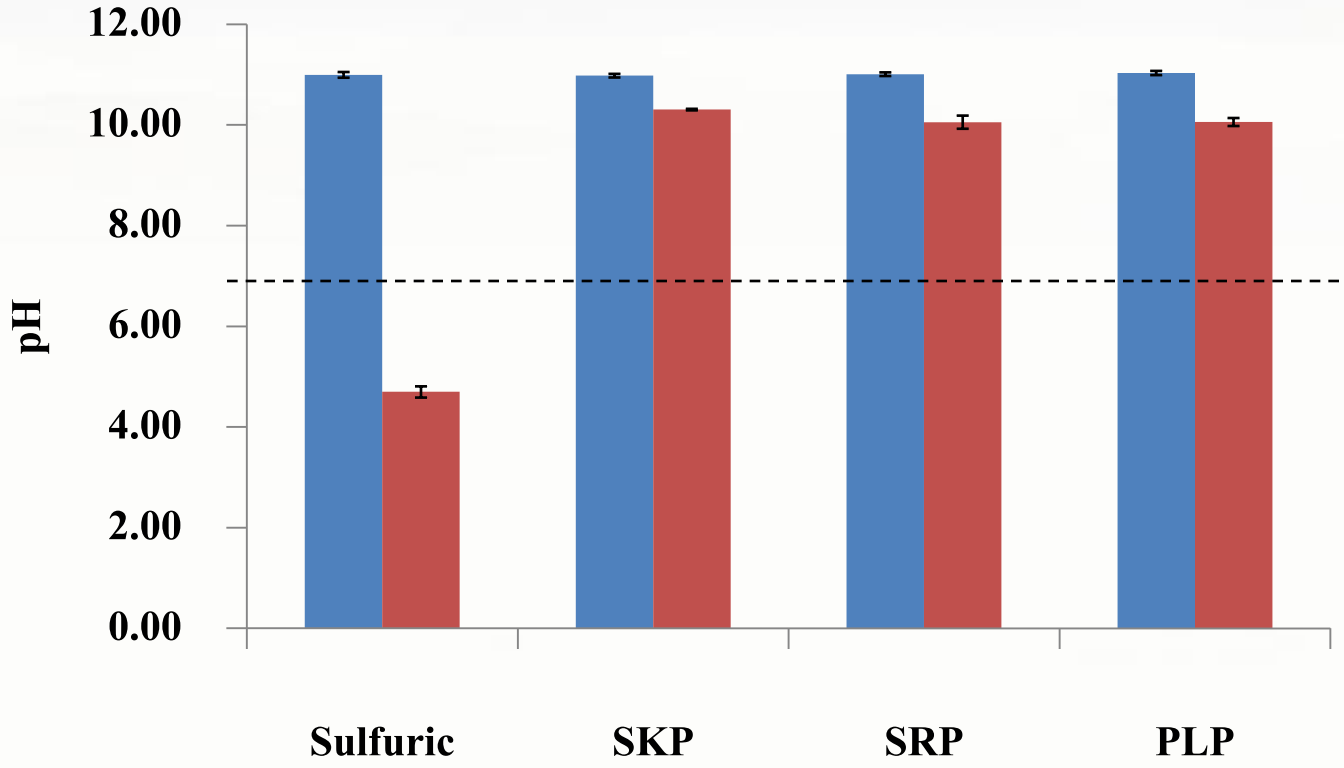


PLP

- H_2SO_4 : Cheapest, fastest and the most powerful
- Can be utilized by sulfur reducing bacteria
- Polymers: SKP> SRP = PLP

3. Results & Discussion

3.1.2 pH of serum after coagulation

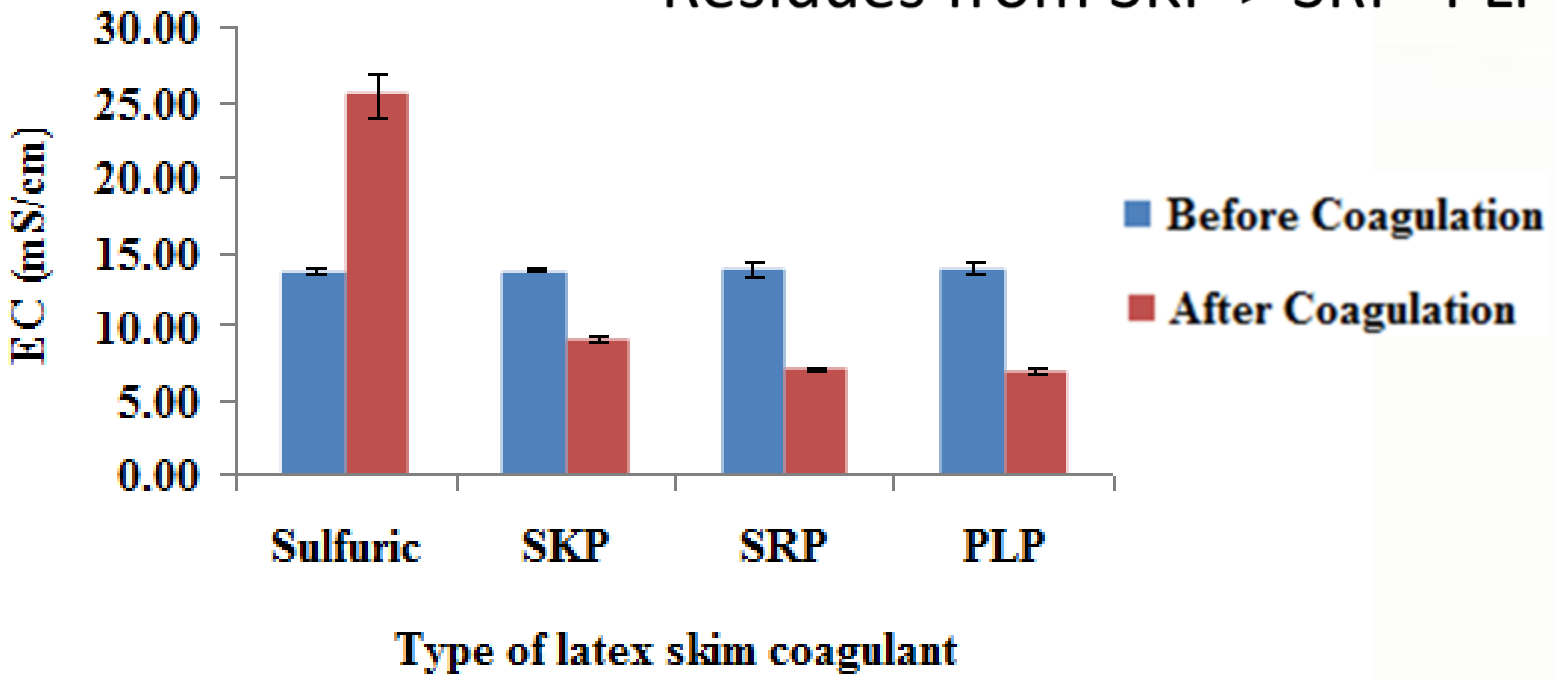


pH of serum before and after coagulation

3. Results & Discussion

3.1.2 EC of serum after coagulation

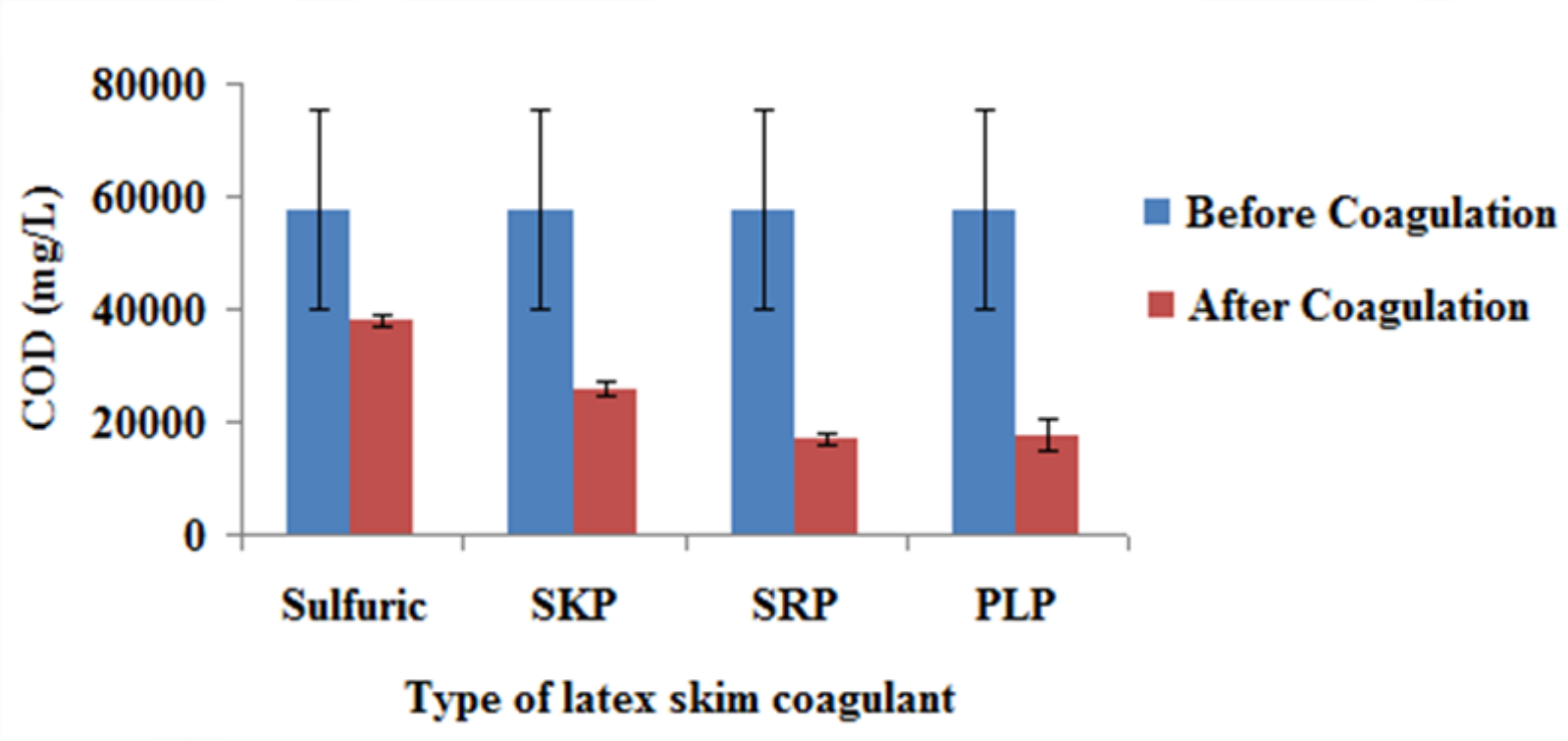
Residues from SKP > SRP=PLP



EC of serum before and after coagulation

3. Results & Discussion

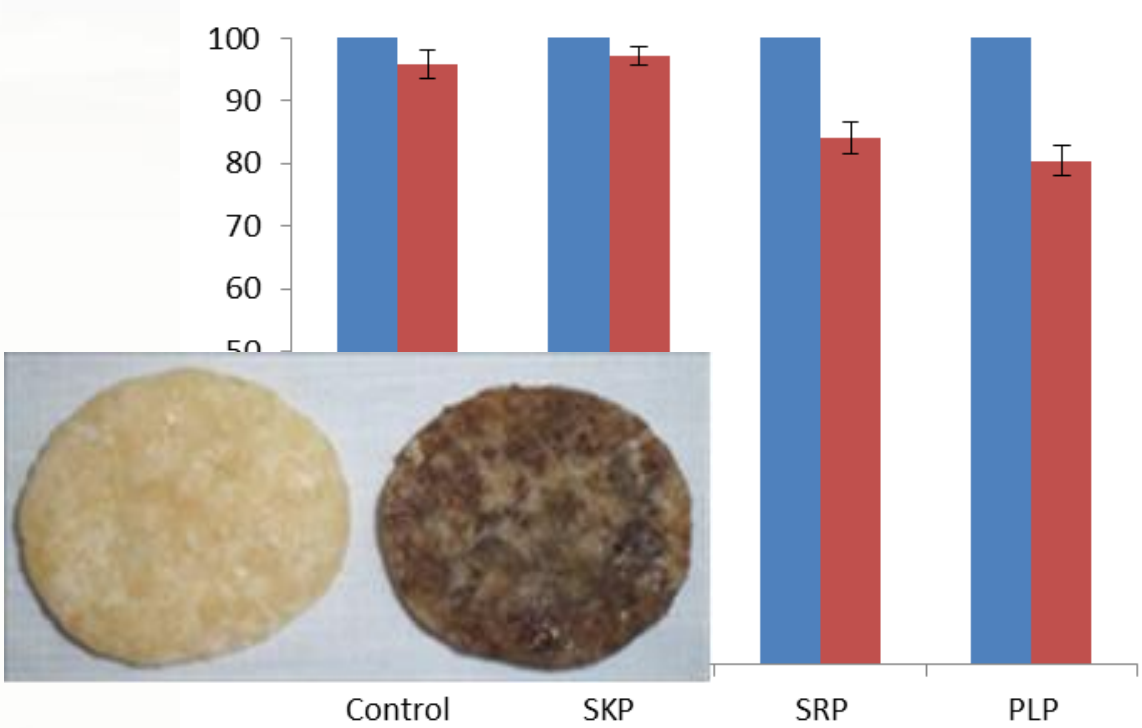
Residues from SKP > SRP=PLP



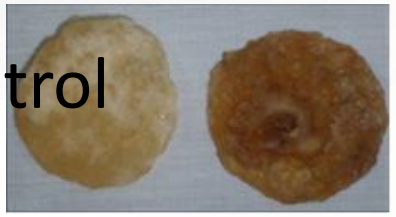
COD of skimmed serum before and after coagulation

3. Results & Discussion

3.2 Aerobic fermentation: % Weight loss



Control



SKP

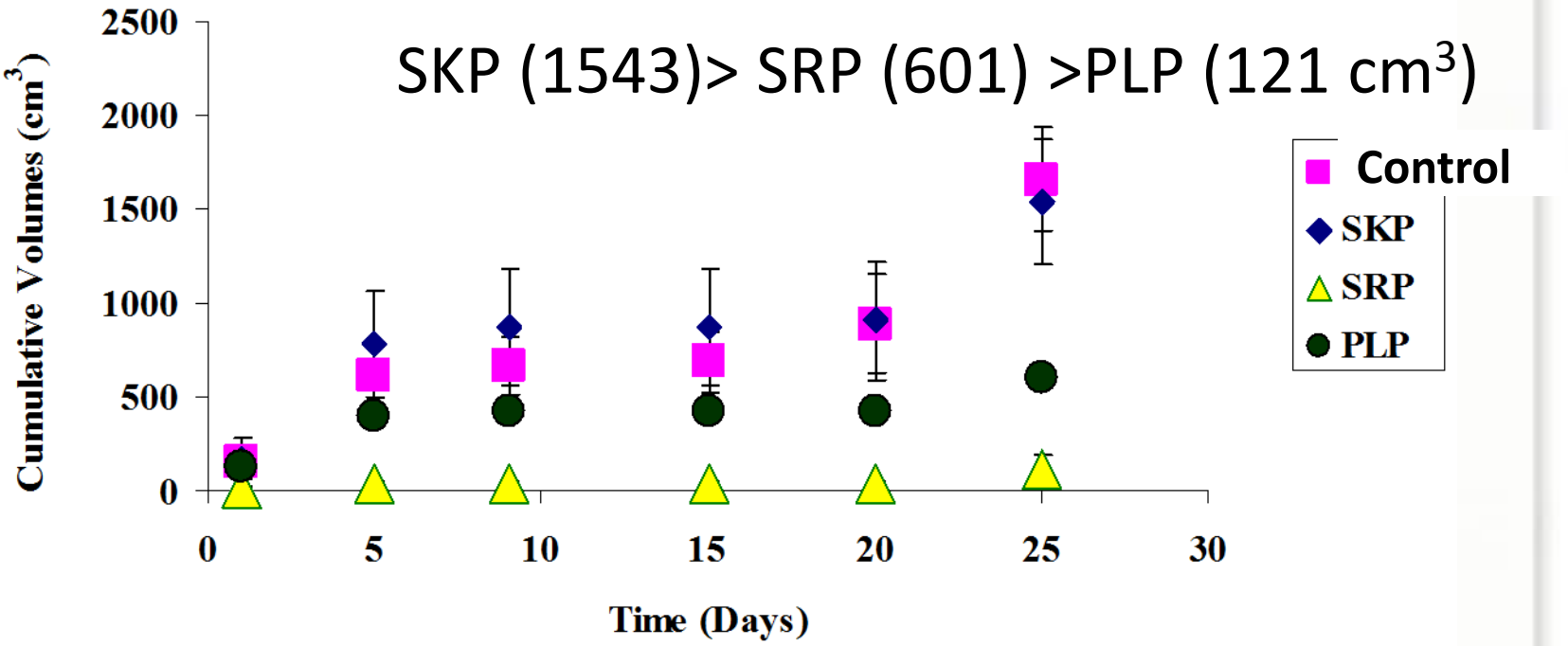
SRP

PLP

%Weight of rubber sheet before and after fermentation

3. Results and discussion

3.3 Anaerobic fermentation



Accumulated biogas in anaerobic fermentation system with different types of coagulant polymer

4. Conclusion

- **Anaerobic fermentation**
  - **Simpler and more effective method for polymer degradability assessment than aerobic fermentation**
  - **Biogas can be assessed within 1 week in comparison with control**
  - **No need for expensive tool**
- **The biodegradability assessment should be performed before application of coagulant polymer**

Ackhnowledgement

- **Prince of Songkla University**
- **Thailand research fund**
- **Science Park, PSU**



Thank you very much
for your attention

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