


Preparation and Characterization of Porous “Baluko” (Local Pen Shell)/Fly Ash/Titania Composite Geopolymer Sphere

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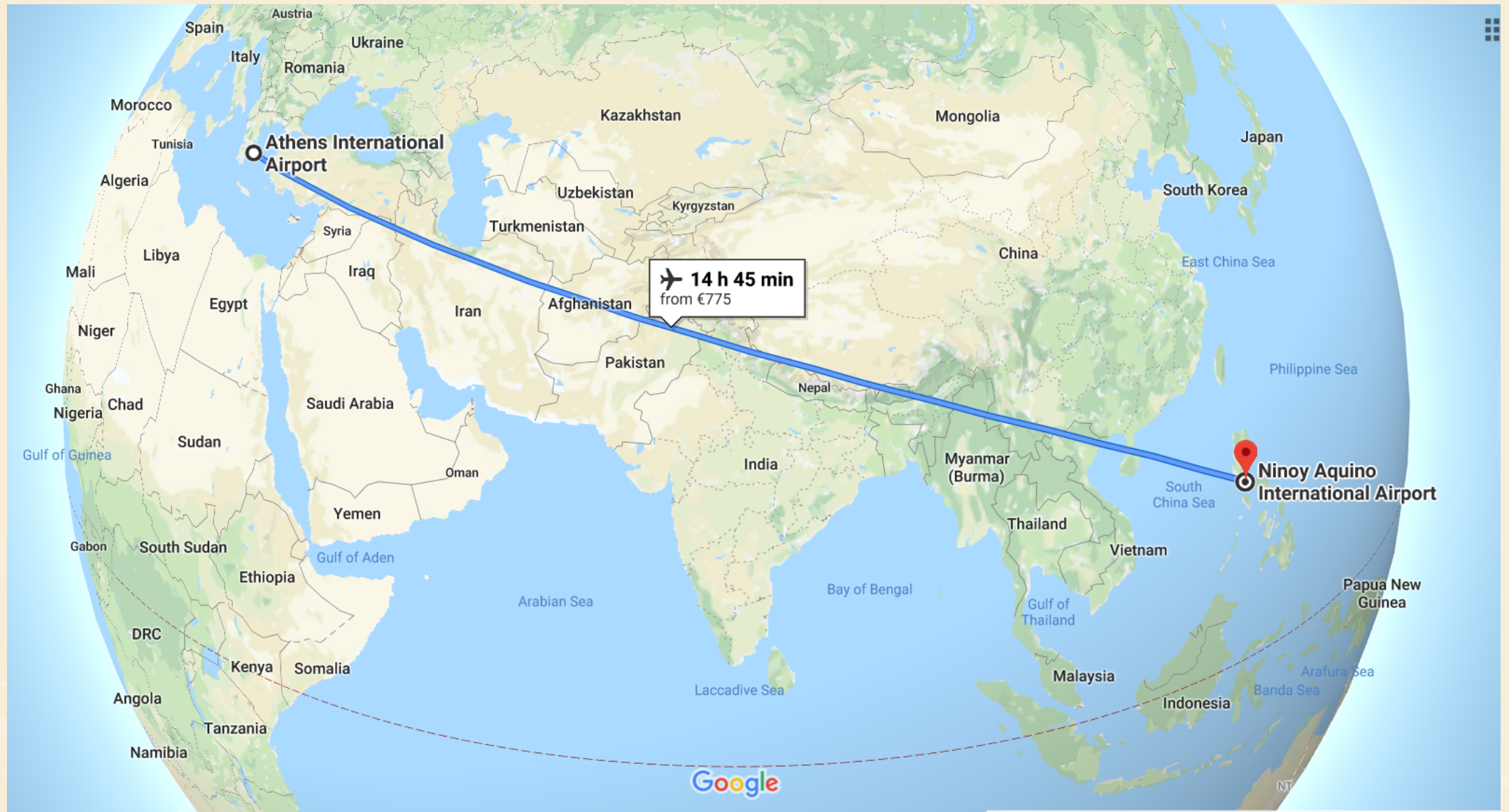
  

HERAKLION 2019

**7TH INTERNATIONAL CONFERENCE ON SUSTAINABLE SOLID WASTE
MANAGEMENT**

26-29 June 2019. AQUILA ATLANTIS HOTEL Heraklion, Crete Island.

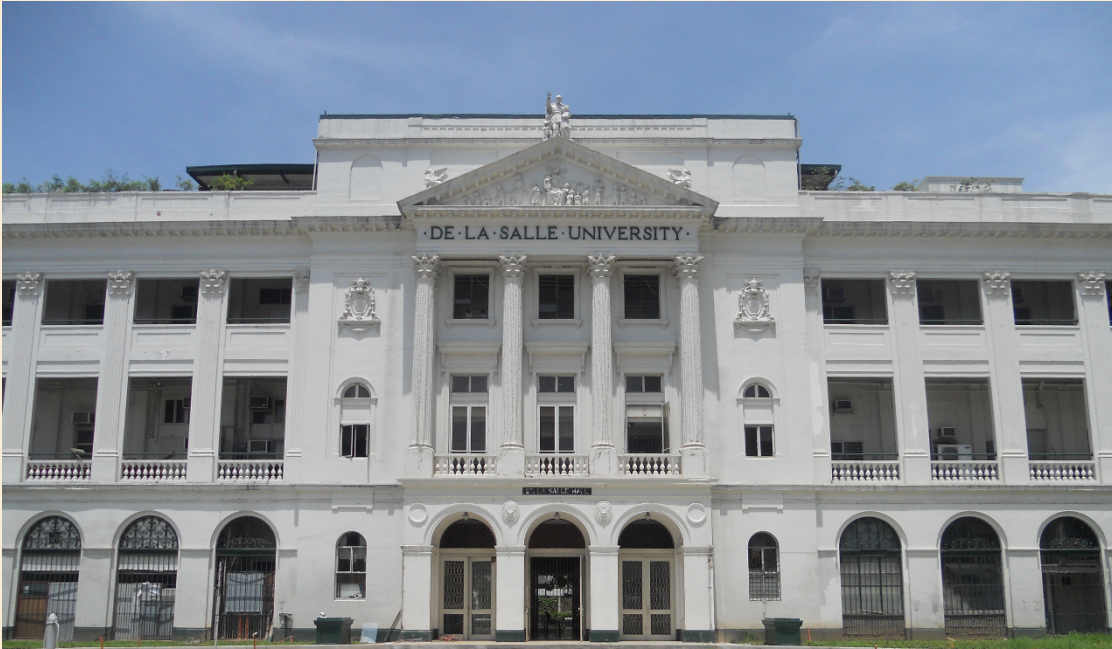
Where is the Philippines?



Manila and DLSU



About Manila and DLSU



- Scimago Institution Ranking 714
- THE World University Ranking 801+
- Assessed at institutional level by **AUN QA**
- 3000+ Scopus-indexed publications
- QS World Ranking 801+
- QS Asian Ranking 155

- 1,100 academic staff (40% full time)
- 14,000 undergraduate students
- 4,500 graduate students
- 11 research centers, 4 research support offices, 1 technology business incubator
- 8 colleges, 36 academic departments
 - ✓ Br. Andrew Gonzalez College of Education (BAGCED)
 - ✓ College of Computer Studies (CCS)
 - ✓ College of Law (COL)
 - ✓ College of Liberal Arts (CLA)
 - ✓ College of Science (COS)
 - ✓ Ramon V. Del Rosario College of Business (RVRCOB)
 - ✓ School of Economics
 - ✓ **Gokongwei College of Engineering (GCOE)**

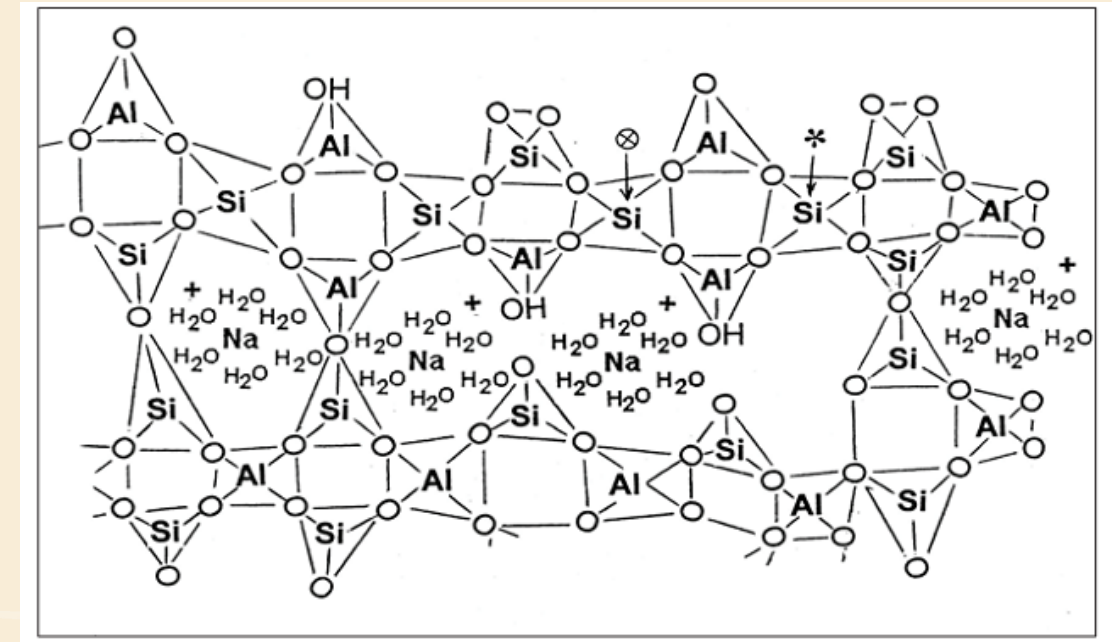
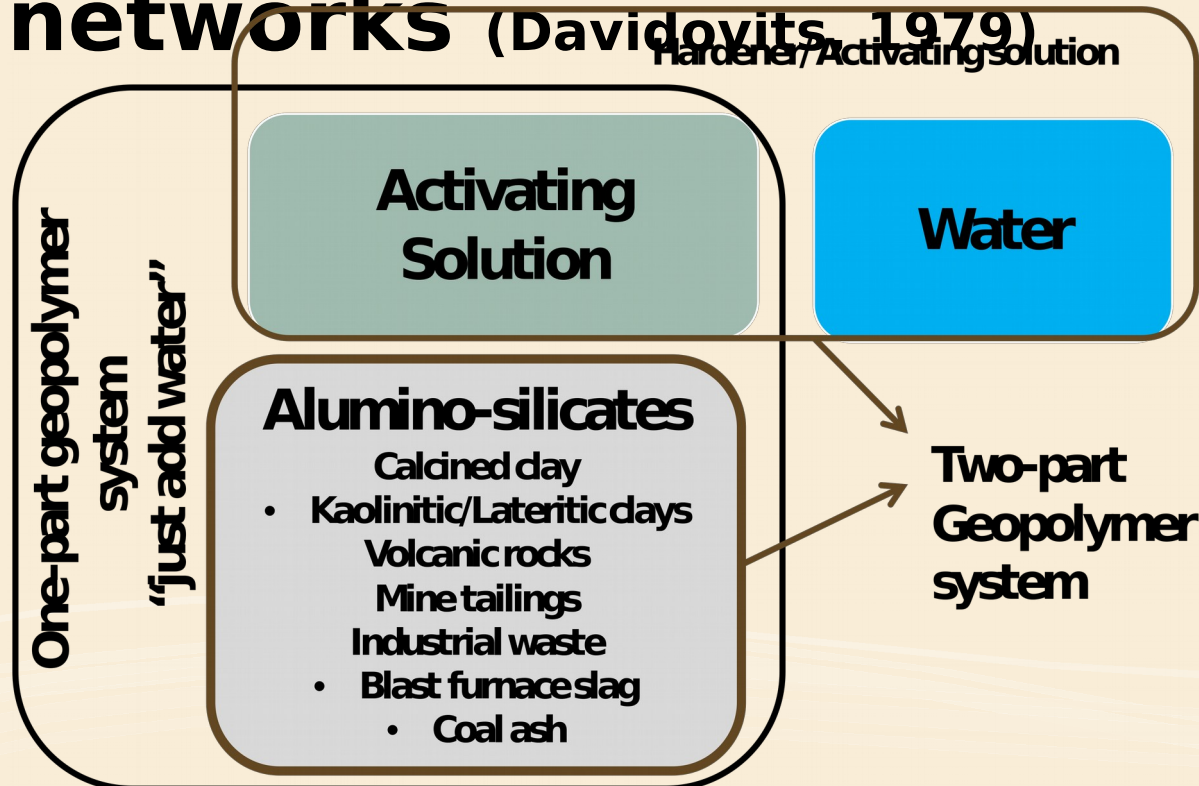
Background of the Study

Geopolymer

Inorganic polymer- formation of polysialate and polysialate-siloxo networks (Davidovits, 1979)



www.geopolymer.org



(Barbosal et al., 2000)

Background of the Study

Geopolymer



Green
Material

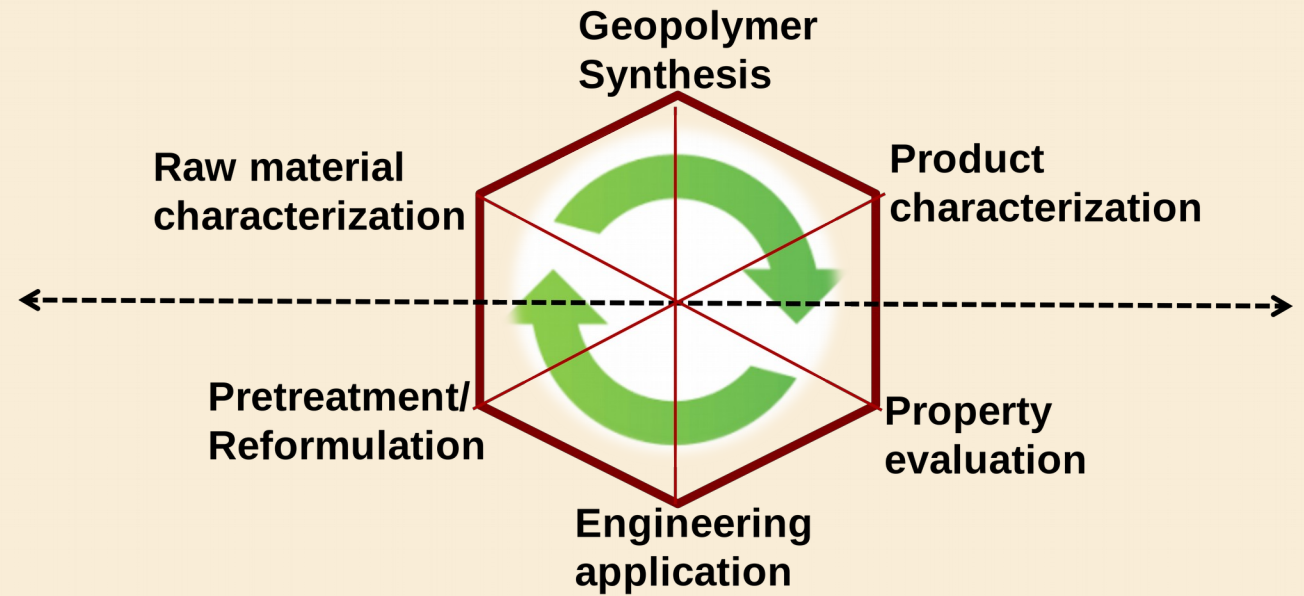
<https://greenimpactstudenthomes.wordpress.com/>



Waste
Utilization

[https://www.uneceppp-icoe.org/news-and-events/news/2016/04/21/expert-meeting-on-the-unece-ppp-work-in-waste-disposal-\(incineration-and-utilization\)/](https://www.uneceppp-icoe.org/news-and-events/news/2016/04/21/expert-meeting-on-the-unece-ppp-work-in-waste-disposal-(incineration-and-utilization)/)

Product Engineering



Background of the Study

Solid Waste

Energy Industry

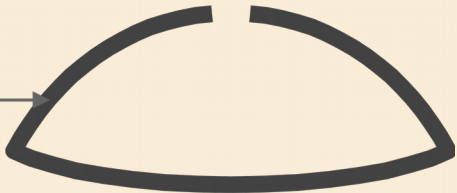


COAL POWER PLANT
(Steam Engine Revolution, 2017)

by-product



FLY ASH
(NSSGA, n.d.)

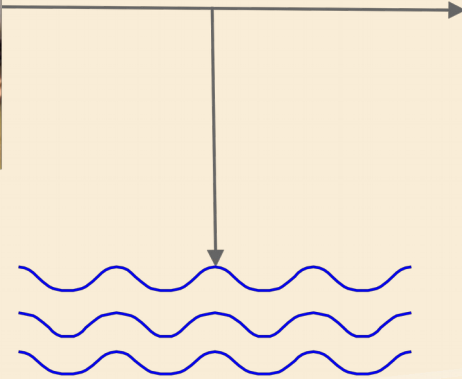


LANDFILL

Food & Fisheries Industry



BALUKO
(BICOLANOMAN, 2016)



WATER
POLLUTANT



DECORATION
(Bicol Standard, 2014)

Background of the Study

Composite Material



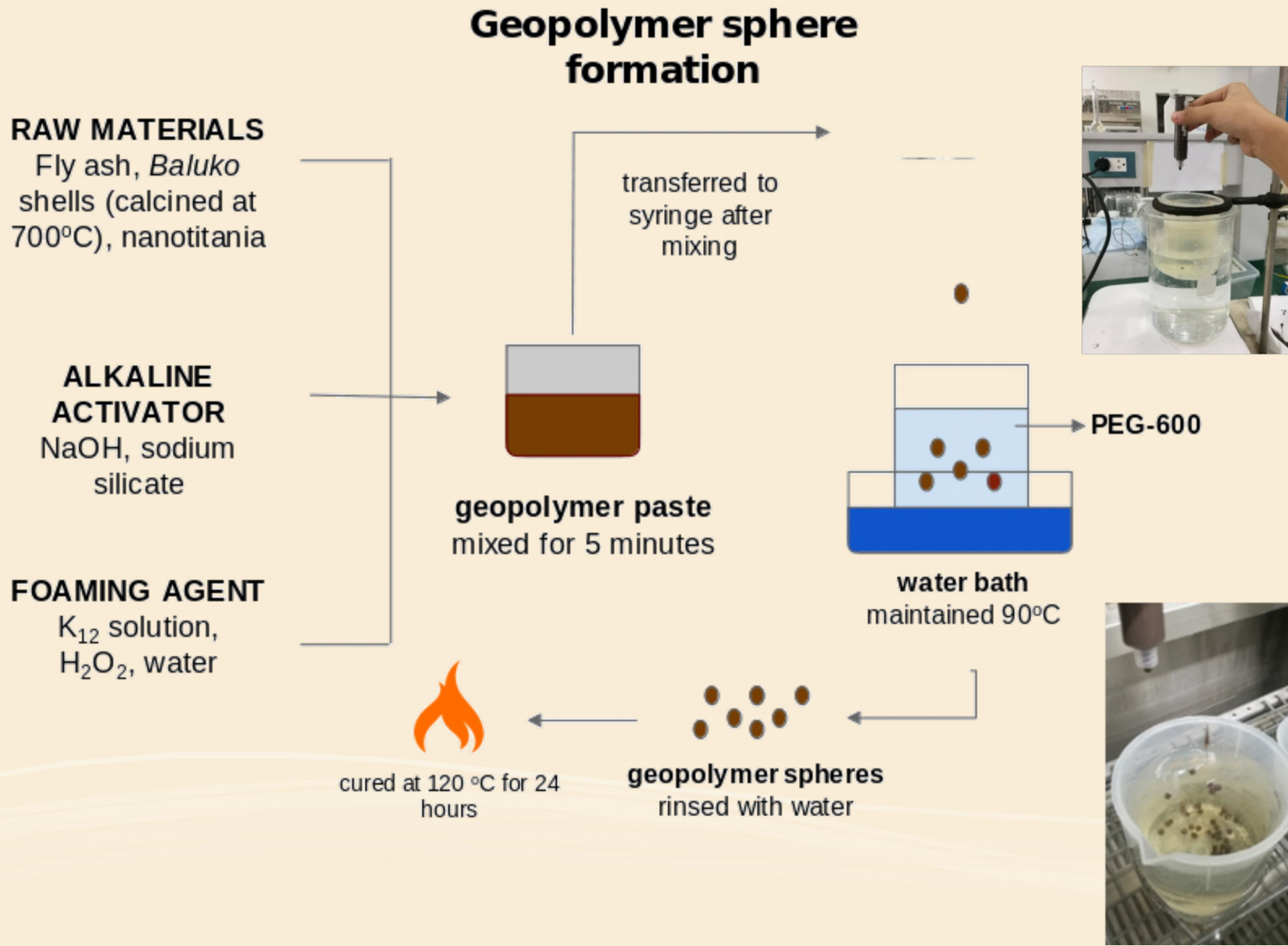
GEOPOLYMERIZATION

**PHOTOCATALYTIC POROUS
GEOPOLYMER SPHERE**

Objectives of the Study

- To evaluate the potential of “*Baluko*” shell, fly ash, and nanotitania as composite material for the synthesis of porous geopolymer sphere was investigated.
- To characterized the composite geopolymer spheres in terms of SEM-EDX, FTIR, XRD, bulk density, open porosity and water absorption capacity.
- The evaluate the impact of nanotitana in geopolymer sphere for dye degradation in wastewater.

Methodology



MECHANICAL PROPERTIES TESTING

Setting Time
- ASTM C191



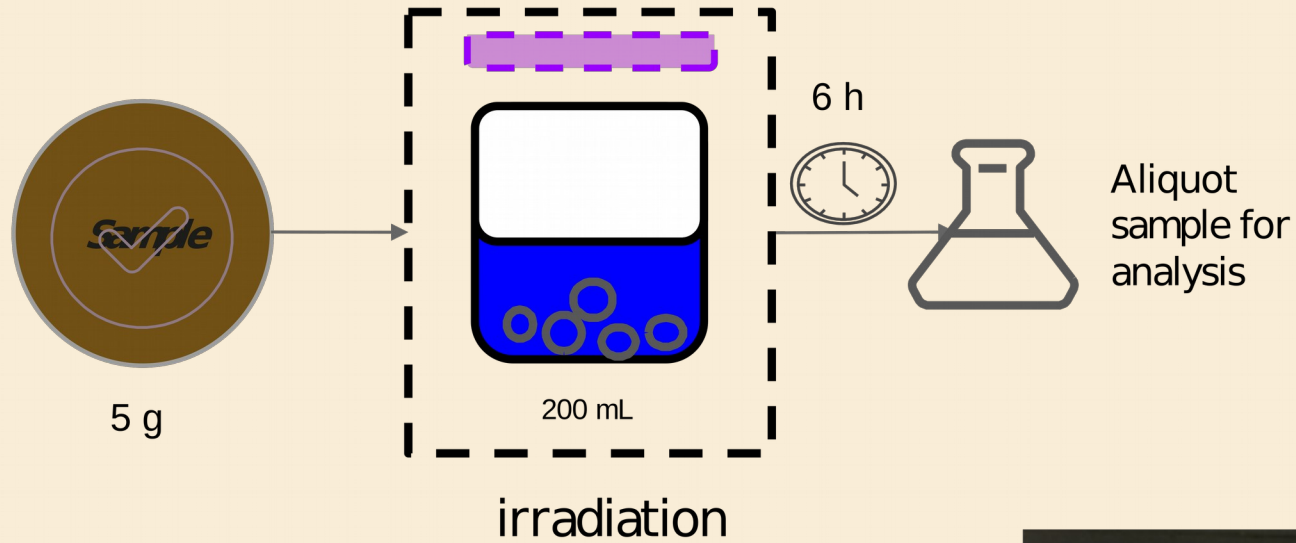
Bulk Density, Open Porosity, and Water Absorption

- Archimedes Principle



Methodology

PHOTOCATALYTIC ACTIVITY TEST



PHOTOCATALYTIC SET-UP



Results and Discussion

Porous Photocatalytic Geopolymer Sphere

**Composite
Geopolymer
Sphere of Fly
Ash and
Baluko Shell**

B0T0



(a)

B5T0



(b)

B7T0



(c)

B10T0



(d)

B0T1



(a)

B0T2



(b)

B0T3



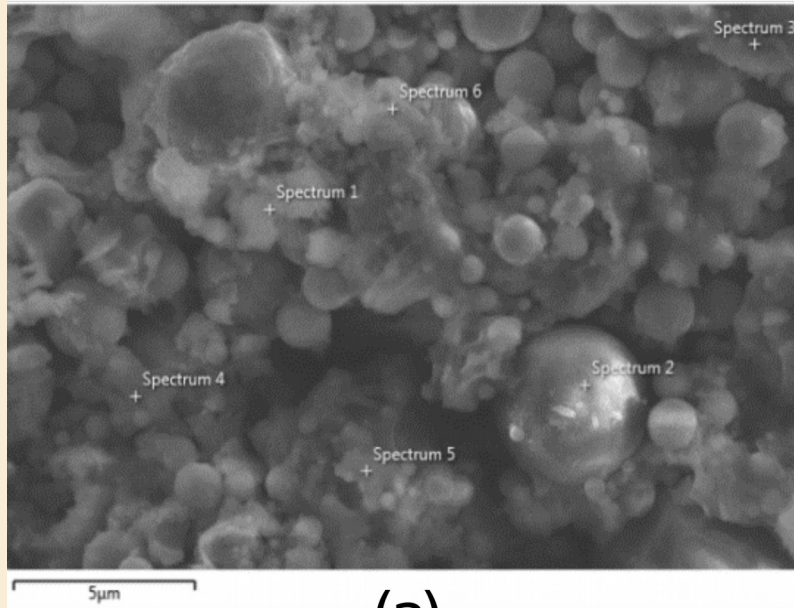
(c)

**Composite
Geopolymer
Sphere of Fly Ash,
Baluko Shell, and
Fly Ash**

Results and Discussion

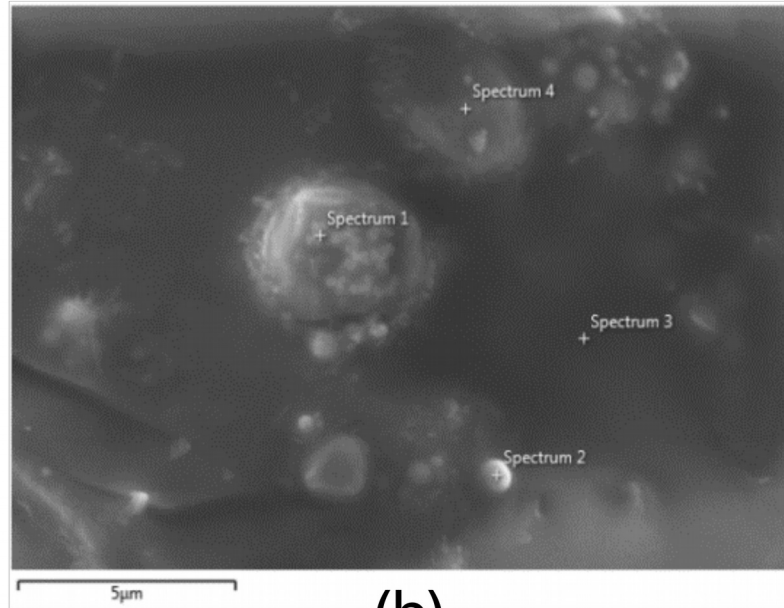
Characterization of Geopolymer Sphere: SEM

BOTO



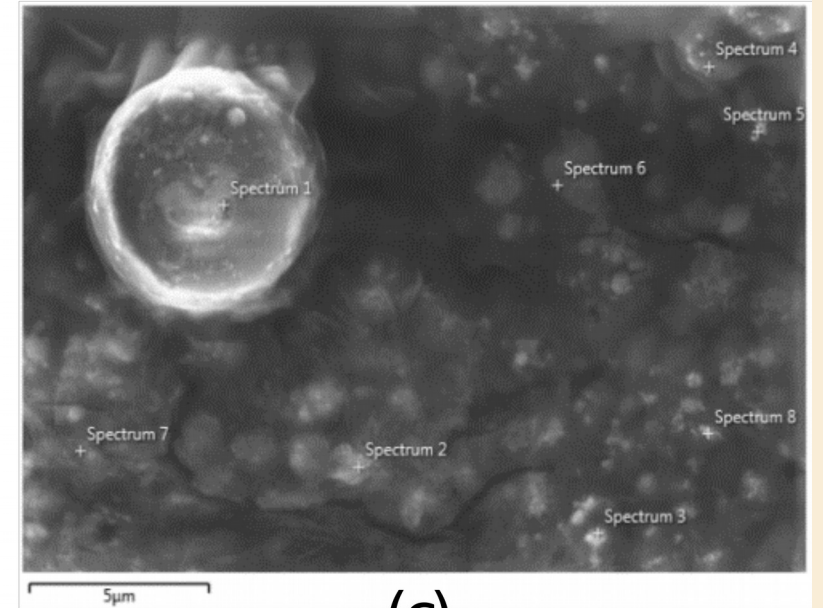
(a)

B10T0



(b)

B10T3

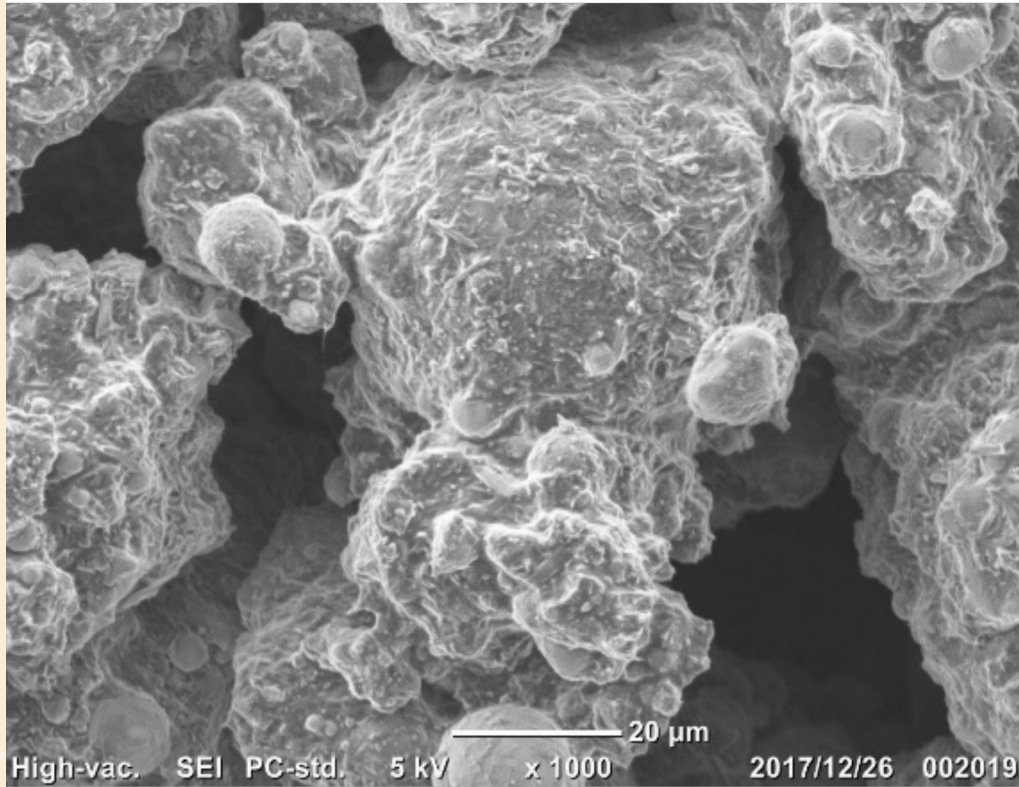


(c)

Results and Discussion

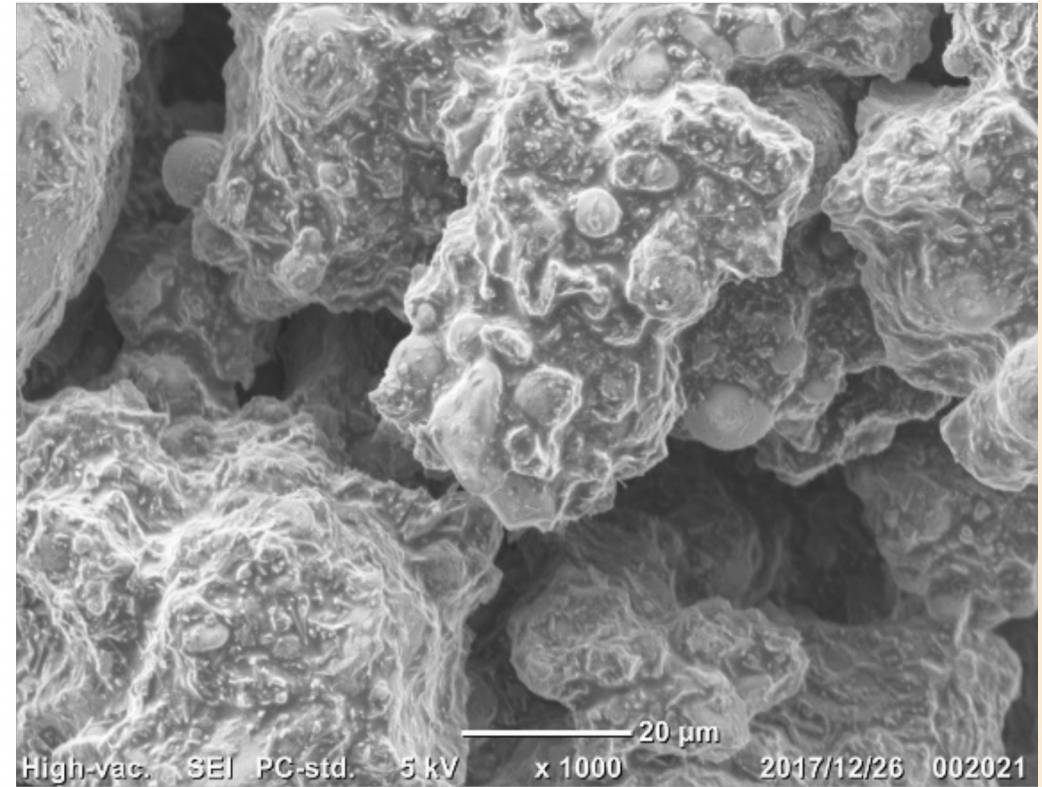
Characterization of Geopolymer Sphere: SEM

B0T0



(a)

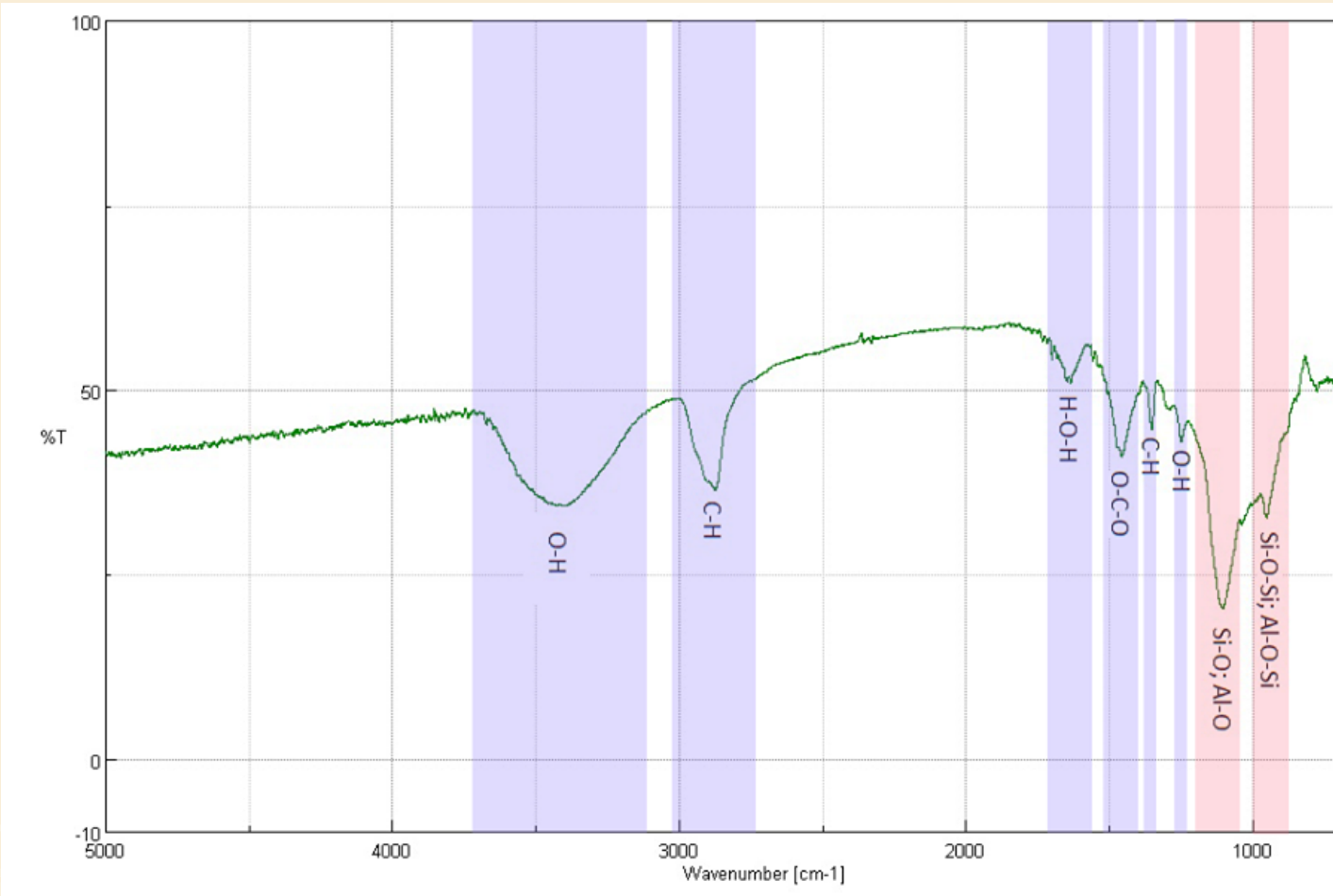
B5T3



(b)

Results and Discussion

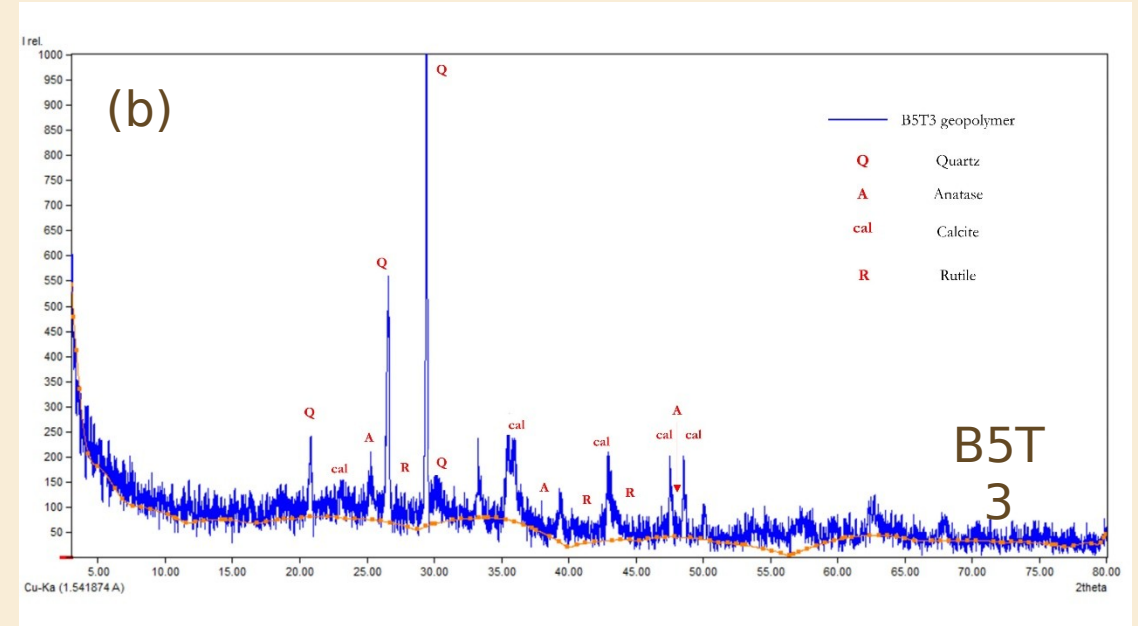
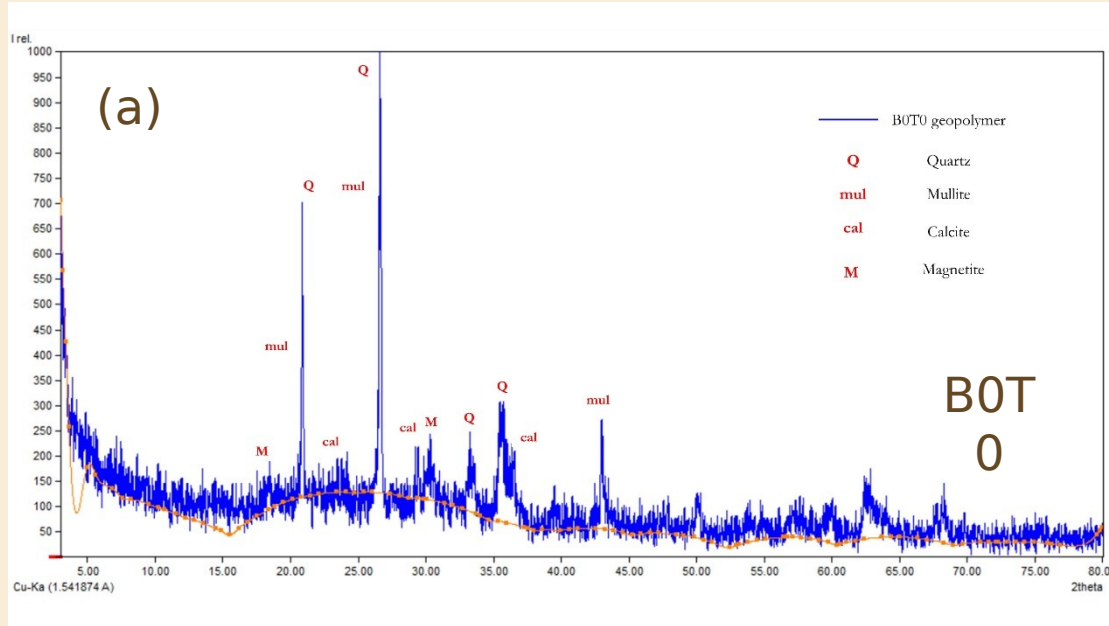
Characterization of Geopolymer Sphere: FTIR



| wavelength (cm ⁻¹) | Peak characteristic |
|--------------------------------|---|
| 1000-1100 | asymmetric Si-O and Al-O stretching |
| 900-1000 | asymmetric Si-O-Si and Al-O-Si stretching |
| 3200-3800 | O-H stretching of Si-O-H groups bonded to the geopolymer matrix |
| 1600-1700 | presence of water molecules bonded to the geopolymer backbone |
| 1400-1450 | existence of O-C-O or carbonate bonds |
| 700-800 | unreacted fly ash |

Results and Discussion

Characterization of Geopolymer Sphere: XRD



$2\theta = 20.75^\circ, 26.5^\circ, \text{ and } 36.4^\circ$ (quartz)

$2\theta = 15^\circ \text{ and } 40^\circ$ (amorphous material)

$2\theta = 25.3^\circ, 37.9^\circ, \text{ and } 48.03^\circ$ (anatase, a crystalline form of TiO_2)

Results and Discussion

| Geopolymer Sphere (FA/BS + NT)* | Setting Time (min) | Water Absorption (g water/g solid) | Bulk Density (g/cm ³) | Open Porosity | Percent MB ⁺ degradation |
|------------------------------------|-----------------------|--|--------------------------------------|------------------|--|
| 100/0 + 0 | 157.75 | 0.5185 | 1.91 | 0.0915 | 53.45 |
| 95/5 + 0 | 132.11 | 0.9028 | 1.10 | 0.0906 | 51.49 |
| 93/7 + 0 | 36.49 | 0.4712 | 2.04 | 0.0282 | 47.35 |
| 90/10 + 0 | 16.57 | 0.4456 | 2.26 | 0.0459 | 31.34 |
| 100/0 + 3 | No data | 0.7535 | 1.38 | 0.0269 | 85.54 |
| 95/5 + 3 | | 0.4904 | 1.94 | 0.0416 | 63.54 |
| 93/7 + 3 | | 0.9498 | 1.19 | 0.0280 | 75.25 |
| 90/10 + 3 | | 0.4309 | 2.26 | 0.0499 | 65.38 |

* FA – percent Fly Ash, BS – percent calcined “*Baluko*” Shell, NT – percent nanotitania replacement

⁺ MB – methylene blue degradation

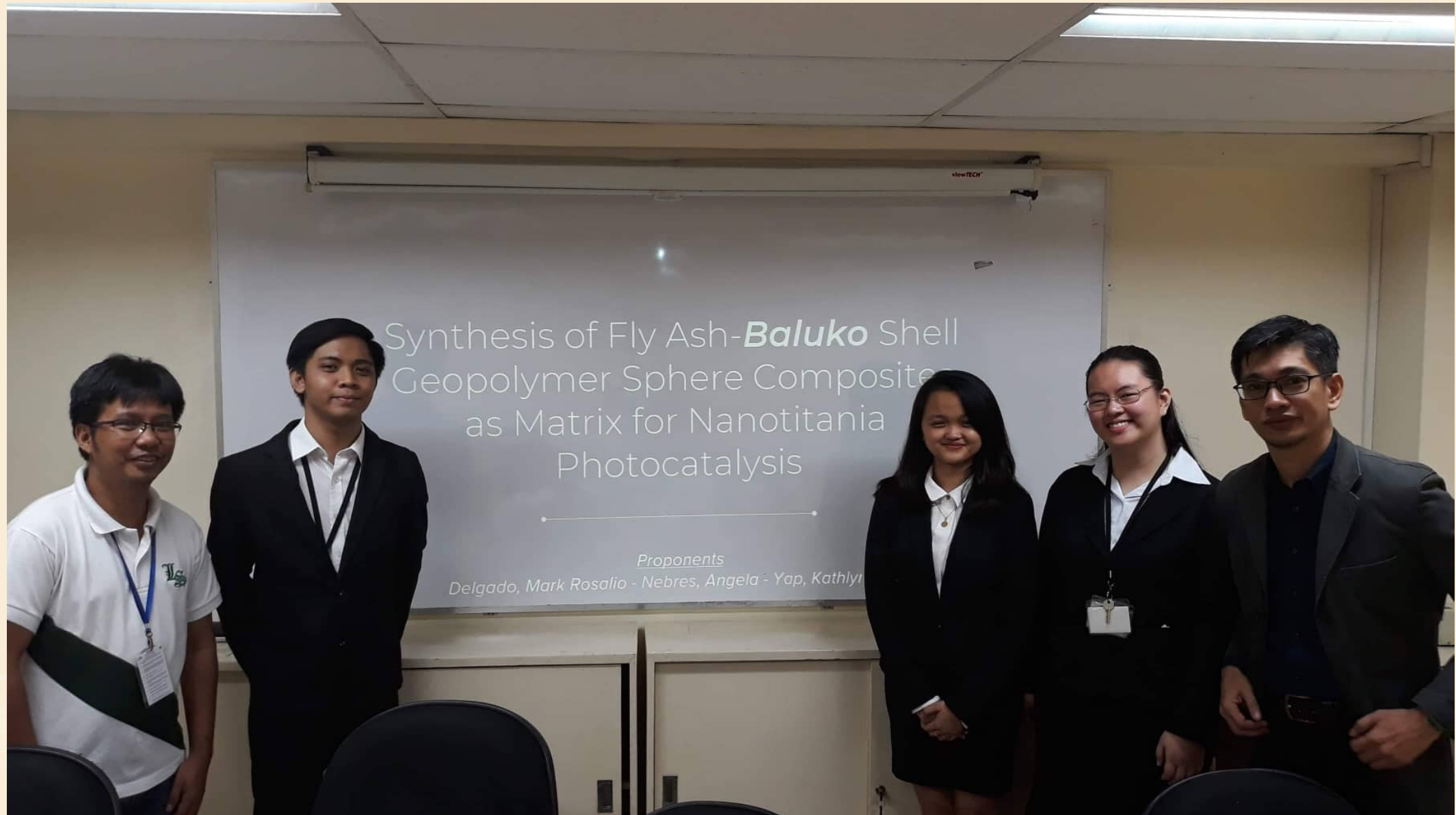
Conclusion

- Coal fly ash and waste “*Baluko*” shell were utilized to produce a porous geopolymer sphere with nanotitania.
- It was identified via XRD and FTIR analysis that geopolymerization is still effective even with the Baluko shell replacement to fly ash.
- “*Baluko*” shell replacement has no statistically significant effect in bulk density, open porosity and water absorption of the geopolymer sphere.
- However, the addition of the shells affected its setting time, allowing the mixture to set at a faster rate with the increasing addition of “*Baluko*” shells.
- The methylene blue degradation decreases as the amount of “*Baluko*” shell replacement increases but improved significantly with the addition of nanotitania.

Acknowledgement

This study is supported by a grant from Philippine Council for Industry, Energy and Emerging Technology Research and Development (PCIEERD) and Advanced Device and Materials Testing Laboratory (ADMATEL) of the Department of Science and Technology. The researchers also acknowledge the support provided by Hinode Laboratory of Tokyo

Research Group



**Thank you
very much!**

**Ευχαριστώ
πολύ!**

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