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APPENDICES

Appendix A Gas Chromatography (GC)

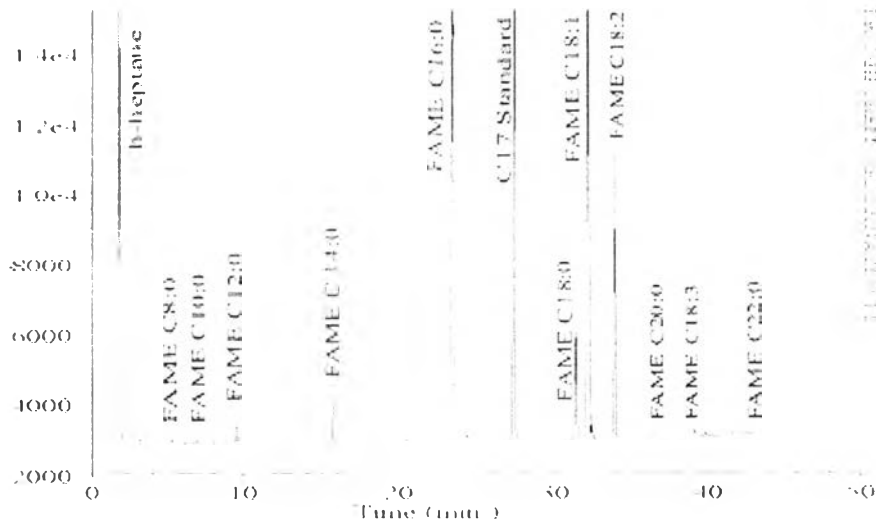


Figure A.1 Chromatogram of fatty acid methyl ester (FAMES) in biodiesel.

The methyl ester yield and conversion were determined using Equations (A.1).

$$C = \frac{(\sum A) - A_{EI}}{A_{EI}} \times \frac{C_{EI} \times V_{EI}}{m} \times 100 \quad (\text{A.1})$$

C Methyl ester content or Fatty acid methyl ester (FAME)

$\sum A$ The overall area of methyl ester from C_{14} to C_{24}

A_{EI} The peak area of that which is aligned with methylheptadecanoate solution

C_{EI} Concentration in mg/ml of methyl heptadecanoate solution

V_{EI} Volume of methyl heptadecanoate solution

m Weight in mg of sample

Appendix B Acid-Base Titration Method

Evaluation of the acidity of catalysts was calculated as follows, Equation (A.2).

$$c(\text{H}^+) = \frac{c(\text{OH}^-) \times \Delta V}{m} \quad (\text{A.2})$$

Where $c(\text{H}^+)$ = the acid quantity of sulfonated samples

$c(\text{OH}^-)$ = the concentration of the NaOH solution

ΔV = the volume of the NaOH solution consumed in titration

M = the quality of the catalyst samples in ultrasonic oscillation reaction

Appendix C Scanning Electron Microscopy (SEM)

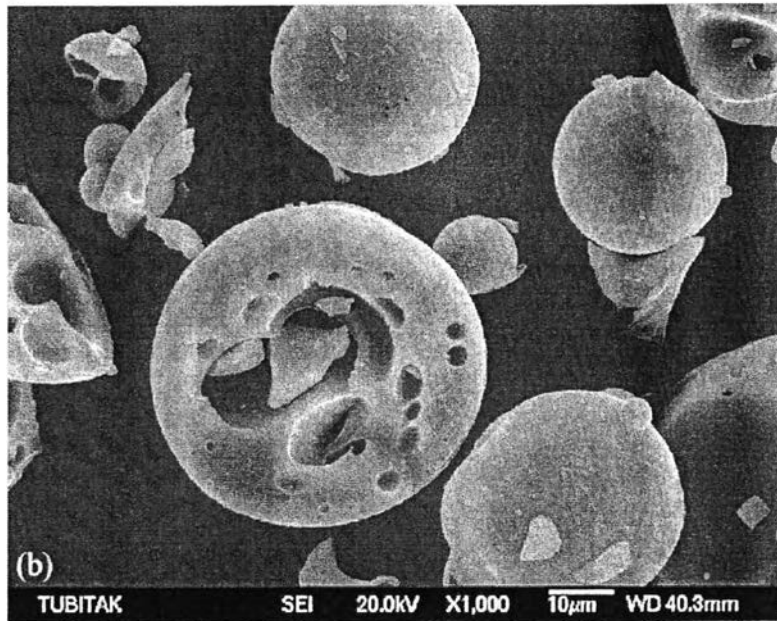


Figure C.1 Referable SEM image of commercial lignin (Soygun *et al.*, 2013).

Appendix D Thermo Gravimetric Analysis (TGA)

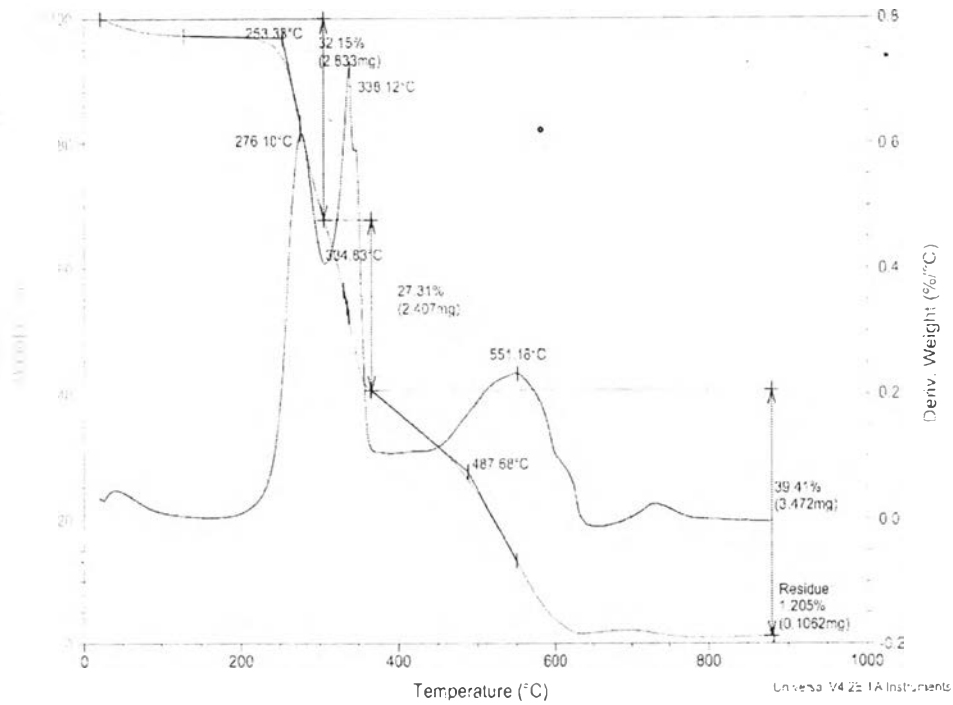


Figure D.1 TGA thermogram of fresh corncob.

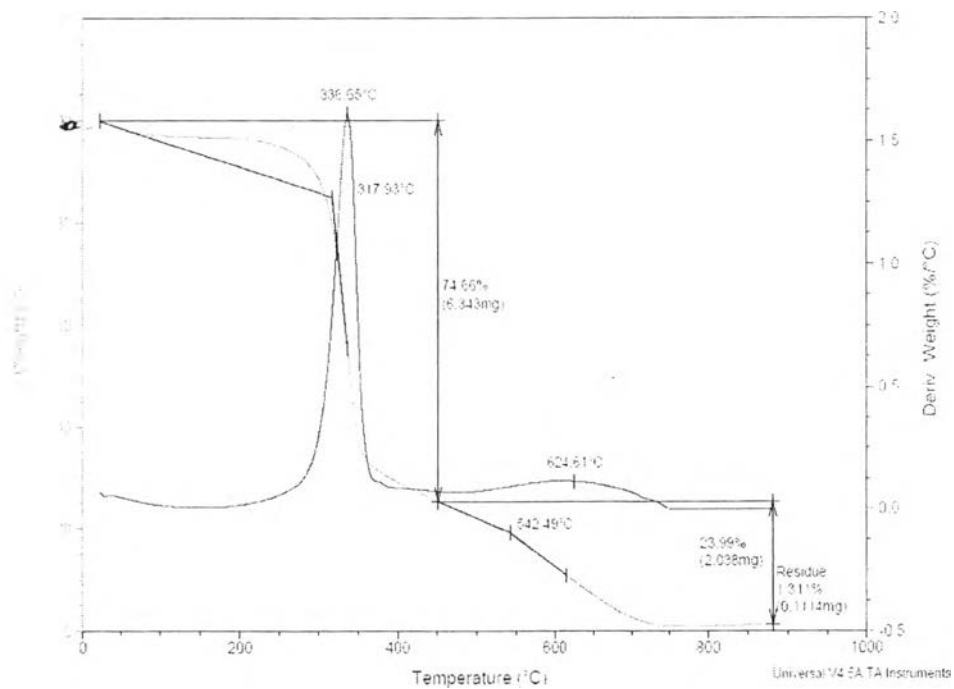


Figure D.2 TGA thermogram of pretreated corncob.

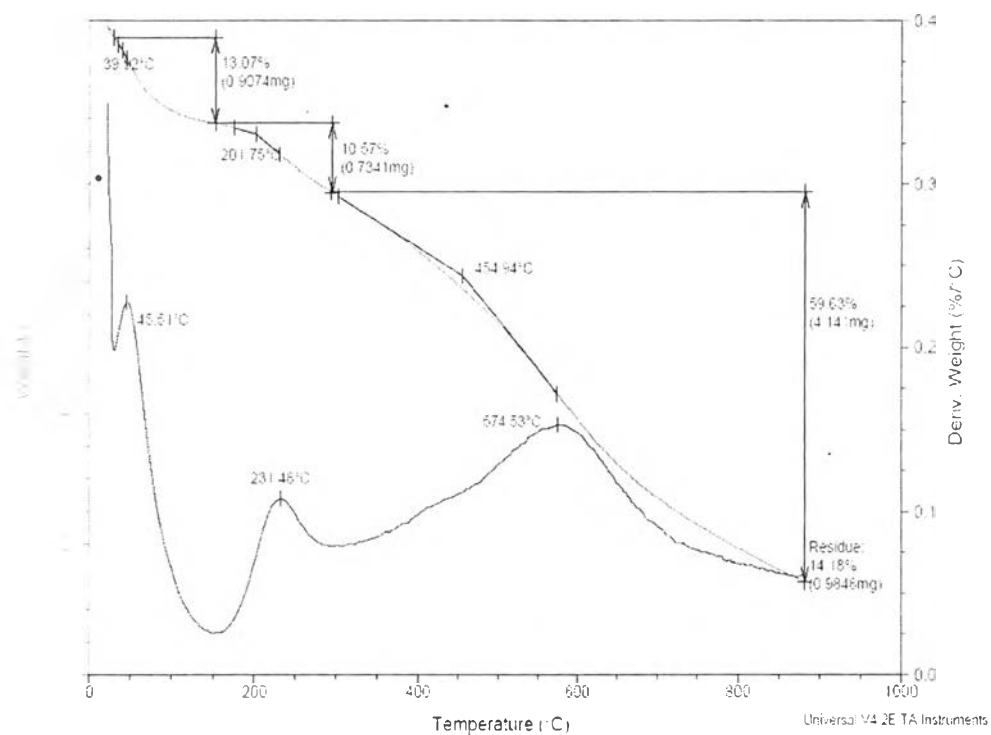


Figure D.3 TGA thermogram of Corn-184g-H₂SO₄ catalyst.

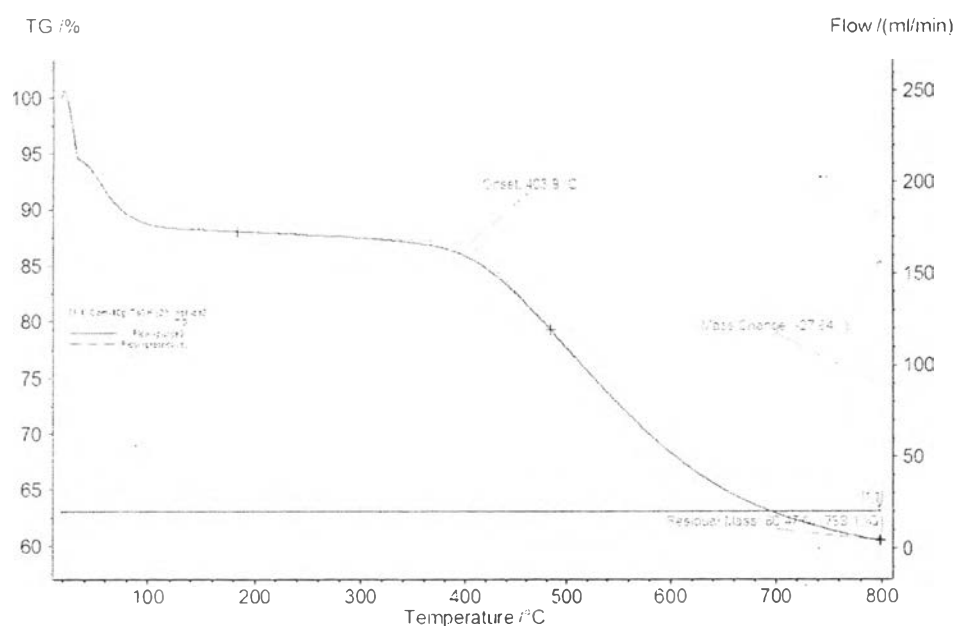


Figure D.4 TGA thermogram of Corn-10g-TsOH catalyst.

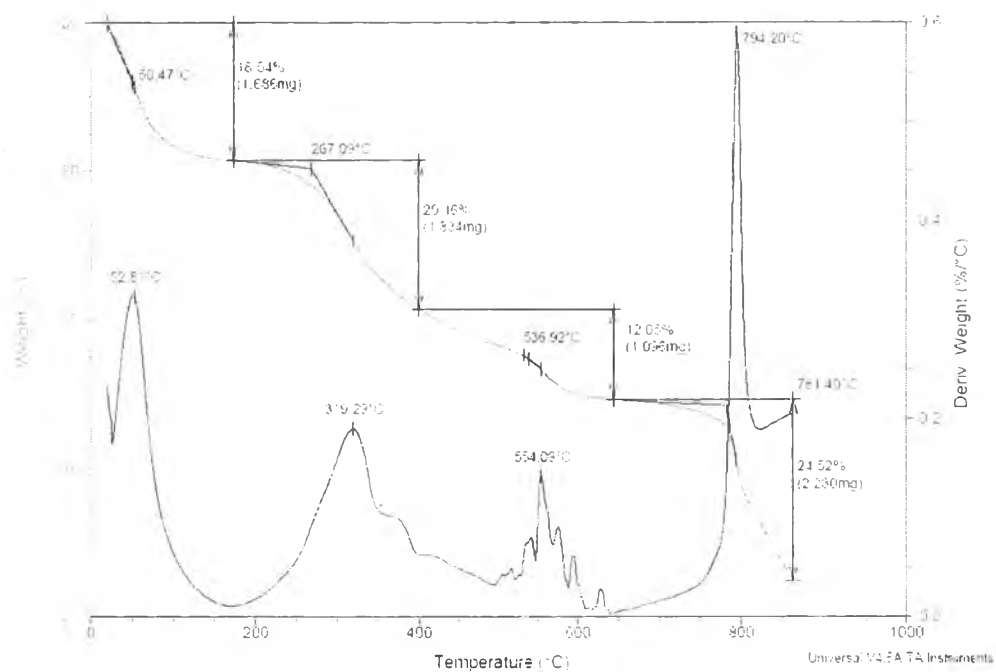


Figure D.5 TGA thermogram of commercial lignin.

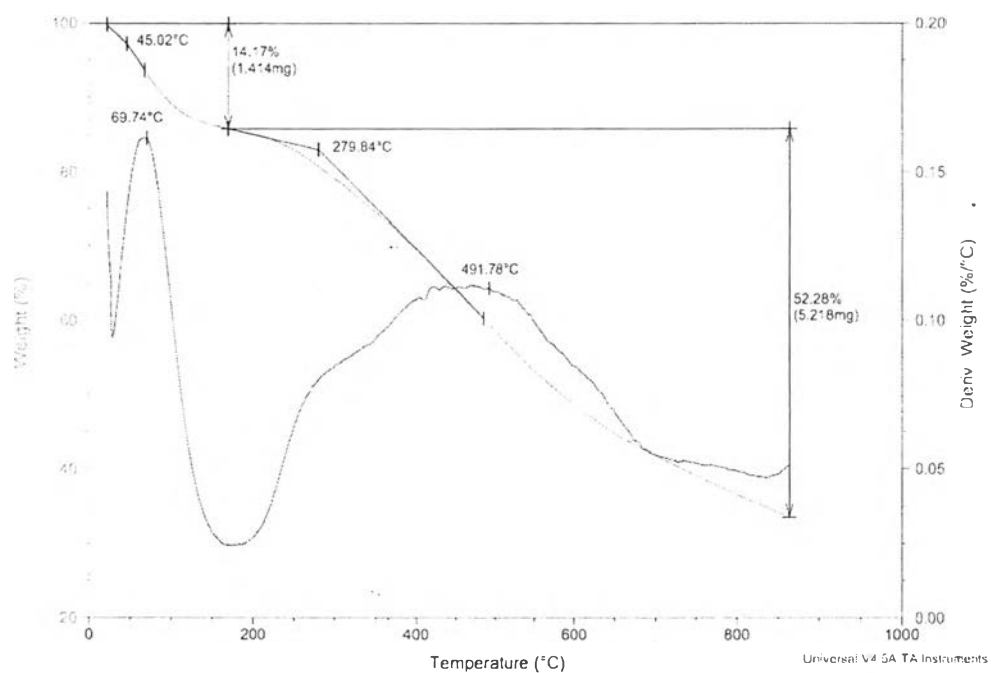


Figure D.6 TGA thermogram of ComLig-184g- H₂SO₄ catalyst.

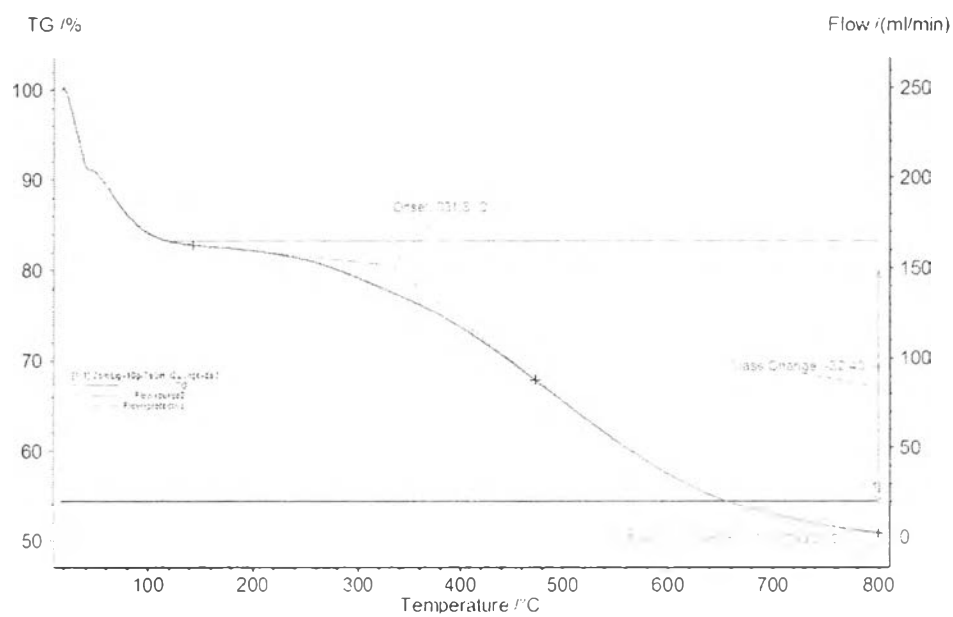


Figure D.7 TGA thermogram of ComLig-10g-TsOH catalyst.

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1. Dechakhumwat, S.; and Luengnaruemitchai, A. (2015, April 21) Solid Acid Catalyst for Biodiesel Production via Esterification from Oleic Acid. Proceedings of the 6th Research Symposium on Petrochemical and Materials Technology; and 21th PPC Symposium on Petroleum, Petrochemicals, and Polymers, Bangkok, Thailand.
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