



The Properties of Glycerine Pitch: A Cost-effective and Sustainable Feedstock for Bioconversion, Chemical Production and Energy Source

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INTRODUCTION



As the oil palm sector is a pillar of the Malaysian economy, it must be able to carry out its operations incorporating environmental sustainability. Due to disposal issues and the infeasibility of recovering the useful components in the wastes from the downstream processes i.e. glycerine pitch, alternative ways are studied to convert it into valuable products.

Glycerine pitch, a **residual from glycerol refining process**, is a highly viscous, and contains high organic content leading to **substantial disposal cost and environmental concerns**. This study conducts **analyses of glycerine pitch samples obtained from two different oleochemical refineries in Malaysia**. The characterisation of the glycerine pitch samples encompasses a comprehensive assessment of their composition and various properties, including physicochemical properties, ultimate and proximate analysis.

CHARACTERISATION

- The GP samples had **high glycerol content (64–72%)** and contain other impurities including water, ash, MONG, soap and salt (*Table 1*).
- The chemical composition of GP is affected by several factors such as the type of catalyst used in the production process, the efficiency of the transesterification or fat-splitting process, the recovery or post-treatment, and presence of other impurities in the feedstock.¹

Table 1: Composition of pure glycerol and glycerine pitch (GP)

Sample	Glycerol content (%)	Water content (%)	Ash content (%)	MONG ^d (%)	Soap content (%) ^a	Salt content (%) ^a
A^b	99.5	0.30	N/D ^c	N/D ^c	N/D ^c	0.18 ± 0.02
B	71.5	3.44	5.99	19.07	0.30 ± 0.01	9.18 ± 0.00
C	63.9	9.69	12.98	13.43	0.53 ± 0.01	4.57 ± 0.02

^a Values are expressed as the mean value ± standard deviation. ^b Pure glycerol (Kofa Chemical Works (M) Sdn Bhd, BP/USP grade (99.5%)). ^c N/D: Not detected. ^d MONG: matter organic non-glycerol

- Both GP samples from two different refineries had different physical appearances and color (*Table 2*).
- The samples were alkaline with pH >11 which is attributed by the **catalyst used in the biodiesel production**.¹

Table 2: Physicochemical properties of pure glycerol and GP

Sample	Appearance	Density (g/cm ³)	pH ^a	Viscosity (mPa·s) ^a
A^b	Colorless liquid	1.26	8.80	225.33
B	Black viscous liquid	1.31	11.07	ND ^c
C	Dark brownish paste	ND ^c	11.88	ND ^c

^a Values are expressed as the mean value. ^b Pure glycerol (Kofa Chemical Works (M) Sdn Bhd, BP/USP grade (99.5%)) ^c ND: not determined

- The ultimate and trace metal analysis of the GP samples gave an account of any metal/element present. The carbon (C), hydrogen (H), nitrogen (N) and sulfur (S) contents of glycerol samples ranged from 23.9 to 38.2%, from 5.7 to 9.5%, from 0.13 to 0.24% and from 0.01 to 0.19%, respectively (*Table 3*).

Table 3: Elemental analysis of pure glycerol, CG and GP

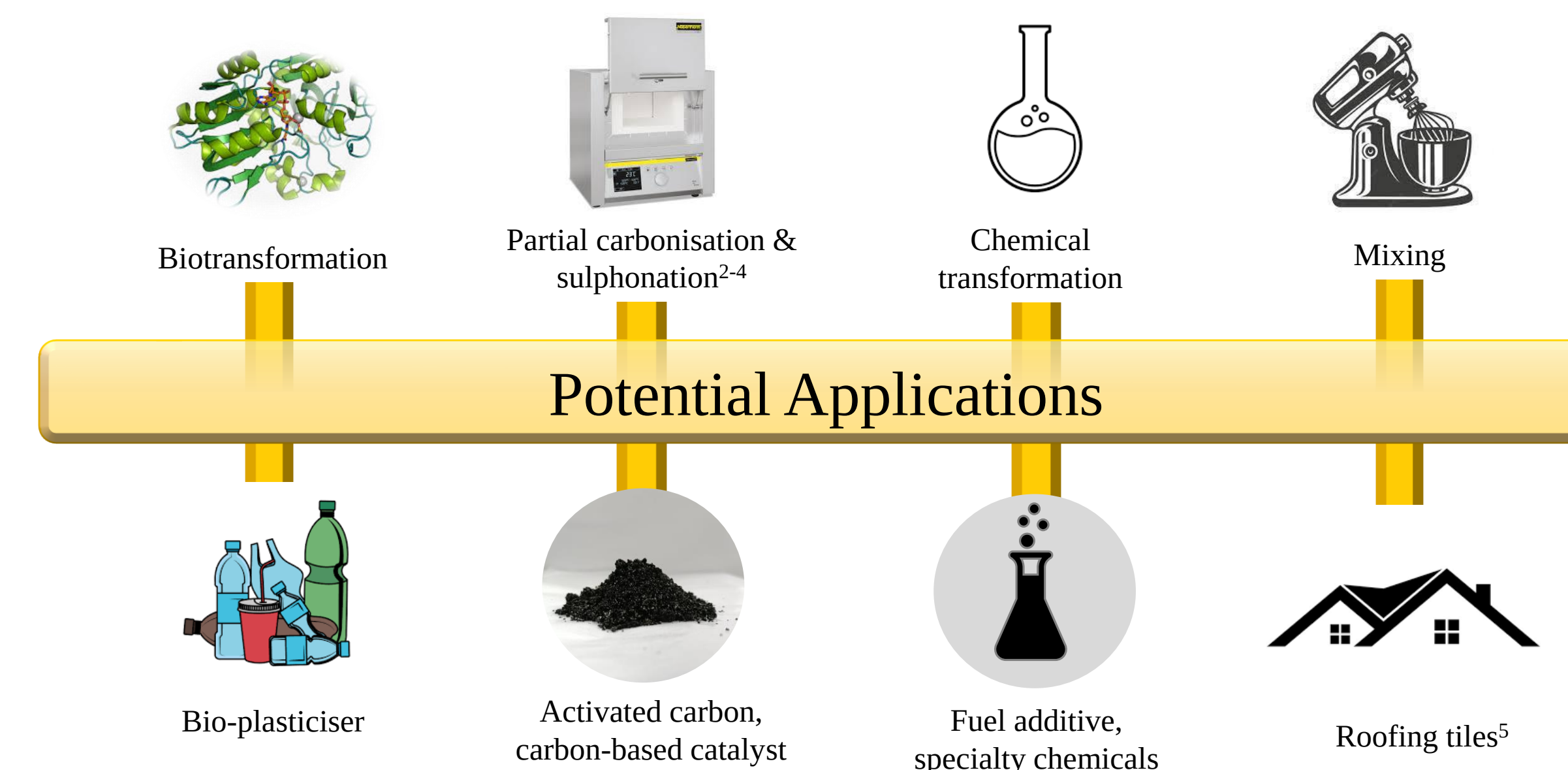
Sample	Elemental composition (%)					Metal analysis (ppm)					
	C	H	N	S	O	Na	K	P	Ca	Mg	Fe
A	35.69	8.37	0.13	0.02		55.79	0.056	0.021	0.004	0.065	0.005
	±	±	±	±							
	0.54	0.13	0.04	0.01							
B	23.91	5.74	0.24	0.01		70.09	0.465	0.006	0.018	0.020	BDL ^a
	±	±	±	±							
	0.86	0.28	0.04	0.003							
C	34.80	7.76	0.20	0.01		57.23	0.857	0.007	0.005	0.023	BDL ^a
	±	±	±	±							
	0.99	2.48	0.05	0.001							

CHARACTERISTICS

- High **organic & carbon** content
- Comparable **calorific value** to biomass
- Trace amount of metal content



Transformation



UN Sustainable Development Goals



CONCLUSION

The palm-based GP collected from two different oleochemical refineries, had varied colors and properties. Nevertheless, high and consistent glycerol content up to 72% was observed in both samples with the major contaminant in GP was MONG. The presence of various level of impurities led to the differences of physical appearance, pH, viscosity, density, elemental and metal composition as well as the energy content in the CG and GP investigated. The variation of the impurities is related to the contaminants in the feedstock for the biodiesel production, processes involved during the production and post-treatment of the by-product.

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REFERENCES

- Armylisas, A. H. N., Hoong, S. S., Tuan Ismail, T. N. M. (2023). *Biomass Conv Bioref* **2023**, 1-13. <https://doi.org/10.1007/s13399-023-04003-4>.
- Okoye, P. U., Abdullah, A. Z., Hameed, B.H. (2017). *Fuel* **209**, 538–544. <https://doi.org/10.1016/j.fuel.2017.08.024>.
- Malaika, A., Ptaszynska, K., Kozlowski, M. (2021). *Fuel* **288**, 119609. <https://doi.org/10.1016/j.fuel.2020.119609>.
- Prabhavathi Devi, BLAP, Gangadhar KN, Siva Kumar KLN, Shiva Shanker K, Prasad RBN, Sai Prasad PS (2011). *J Mol Catal A Chem* **345**, 96–100. <https://doi.org/10.1016/j.molcata.2011.05.025>.
- Teoh, W. P., Chee, S. Y., Habib, N. Z., Bashir, M. J. K., Chok, V. S., Ng, C. A. (2021). *J Build Eng* **43**, 102869. <https://doi.org/10.1016/j.job.2021.102869>.