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**“Distillation waste-based heterogeneous catalyst for the production of glycerol carbonate using glycerol as a biodiesel waste: Optimization and Green metric studies”**

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**Abstract**

Biodiesel prices could be made competitive with petrol-diesel prices by valorizing the by-product glycerol. Valorization of waste glycerol could mitigate the overall prize and support the biodiesel production. Glycerol carbonate is one of the widely needed chemical having high price and extensive applications for different industrial purposes. Glycerol carbonate can be synthesized by many route; among them catalytic route gives promising activity and selectivity towards glycerol carbonate. Distillation waste-based catalyst were explored and used as a heterogeneous catalyst for the first time to check the conversion of glycerol (Gl) to glycerol carbonate (GC). Solvent-free synthesis of glycerol carbonate can be achieved using glycerol and DMC as a reactant using conventional heating (90 ℃). The catalyst's physicochemical properties were studied by performing TGA-DSC, XRD, FT-IR, SEM- EDAX, HRTEM, and basicity using the Hammet indicator. The validation of the synthesized product was performed through proton and carbon NMR analysis. In addition to this, HR-MS was performed to check the composition of the product formed. A plausible mechanism for the transesterification of glycerol (Gl) to glycerol carbonate (GC) was also designed. Higher conversion and selectivity towards glycerol carbonate (GC) were achieved at mild reaction conditions, viz., 1:3 molar ratio of glycerol to DMC, reaction temperature 90 ℃, reaction duration is 90 min with catalyst dose of 300 mg. This optimized reaction condition gives a 99.2 % conversion of Gl towards GC. Green metric parameters were also calculated to show that the overall process is sustainable and the environment benign.

**Keywords**: Biodiesel by-product utilization, Glycerol valorization, catalysis, transesterification, E- metric studies, TOF.

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**Figure 1.** Schematic representation of synthesis of glycerol carbonate using distillation waste based catalyst.