# Transesterification Parameter Ranges for Model Training

This document summarizes literature-based parameter ranges for the transesterification of waste cooking oil with methanol into biodiesel. These ranges reflect typical variations reported in the literature to aid in accurate parameter selection and subsequent model training.

## Physical/Chemical Constants

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| --- | --- |
| Parameter | Range/Value |
| Triglyceride (TG) Molecular Weight | Approximately 800 – 900 g/mol |
| Methanol (MeOH) Molecular Weight | 32.04 g/mol (constant) |
| FAME (Biodiesel) Molecular Weight | Approximately 270 – 310 g/mol (varies with fatty acid composition) |
| Glycerol (Gly) Molecular Weight | Approximately 92.09 g/mol (constant) |

## Process Conditions

|  |  |
| --- | --- |
| Parameter | Typical Range |
| Reaction Temperature | 50 – 65 °C (Optimum: ~60 °C) |
| Methanol-to-Oil Molar Ratio | 6:1 to 12:1 (Optimum: ~8:1–10:1) |
| Catalyst Concentration | 0.5 – 2.5 wt% (Optimum: ~1.0–1.5 wt%) |
| Reaction Time | 60 – 180 minutes (Optimum: 60–120 minutes) |
| Mixing Speed | 300 – 800 rpm (Commonly ~600 rpm) |
| Activation Energy (Ea) | Approximately 50 – 65 kJ/mol (for base-catalyzed transesterification) |

## Kinetic Parameters

|  |  |
| --- | --- |
| Parameter | Typical Range |
| Pre-exponential Factor (A\_f) | Approximately 1×10⁷ to 1×10¹¹ min⁻¹ (varies widely with reaction order/unit system) |
| Initial Kinetic Parameter Guesses | INITIAL\_K\_CAT\_GUESS ≈ 1.0 (model units), INITIAL\_KM\_GUESS ≈ 0.1 (model units) |

## Normalization Values (Suggested)

|  |  |
| --- | --- |
| Condition | Suggested Range/Value |
| Temperature & Catalyst Concentration | Temperature: 55 – 65 °C (mean ~60 ±5 °C), Catalyst: ~1.0–2.0 wt% (mean ~1.5 ±0.5 wt%) |

## Notes

• Molecular weights for methanol and glycerol are constants; FAME molecular weight can vary based on the fatty acid profile of the oil.  
• Process conditions such as temperature, molar ratio, catalyst concentration, and reaction time are derived from numerous studies in the biodiesel production literature.  
• Kinetic parameters (activation energy and pre-exponential factor) vary with process conditions and experimental setups. The ranges provided here are representative for homogeneous base-catalyzed transesterification.  
• These ranges are meant to serve as a guide; specific values may be further refined with experimental data.