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A comparative study between Modified Data Envelopment Analysis and Response Surface Methodology for optimisation of heterogeneous biodiesel production from waste cooking palm oil

Samrand Saeidi, Parvin Jouybanpour, Azadeh Mirvakilli, Davood Iranshahi, Jiří Jaromír Klemeš

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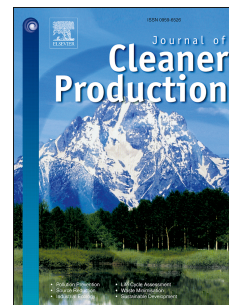
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1 **A Comparative Study between Modified Data Envelopment Analysis and Response**
2 **Surface Methodology for Optimisation of Heterogeneous Biodiesel Production from**
3 **Waste Cooking Palm Oil**

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5 Samrand Saeidi^{1,2}, Parvin Jouybanpour³, Azadeh Mirvakili⁴, Davood Iranshahi¹, Jiří Jaromír
6 Klemeš*⁵
7

8
9 ¹School of Chemical Engineering, Amirkabir University of Technology (Tehran Polytechnic), No. 424, Hafez
10 Avenue, 15914, Tehran, Iran

11 ²Department of Wood and Paper Science, Research Institute of Forests and Rangelands (RIFR), Tehran, Iran

12 ³Chemical Engineering and Industrial Management, California, USA

13 ⁴Chemical Engineering Department, Shiraz University, P.O. Box 71345, Shiraz, Iran

14 ⁵Faculty of Information Technology and Bionics, Pázmány Péter Catholic University, 1083 Budapest, Práter utca
15 50/a, Hungary
16
17
18

19 **Abstract:**

20 Biodiesel is a clean renewable fuel which is an alternative source of diesel fuel in compression
21 ignition engines without any modification. According to previous research, the importance of
22 biodiesel production through heterogeneous transesterification of waste cooking palm oil
23 (WCPO) over Sr/ZrO₂ catalyst has led to developing a new mathematical algorithm called
24 Modified Data Envelopment Analysis (MDEA). MDEA, a hybrid of Data Envelopment
25 Analysis (DEA) with Neural Network (NN), was proposed for experiment design of multi-
26 response problems. It was validated with Response Surface Methodology (RSM), which is a
27 statistical method. This method was developed to maximize Fatty Acid Methyl Ester (FAME)
28 yield and five decision variables were considered. The optimum amount of methanol to oil
29 molar ratio, catalyst loading, reaction temperature, reaction time on Ester yield, and free fatty
30 acid (FFA) conversion were calculated via MDEA method. The obtained results showed that
31 the derived optimal parameter-setting of the proposed method, MDEA, is more reliable and
32 accurate than RSM. The errors of predicted Ester yields are 5% and 14% in MDEA and
33 RSM. The calculated errors of conversions are 3% and 19% in MDEA and RSM.
34
35

36 **Keywords:** Biodiesel production, Waste Cooking Palm Oil, Transesterification, Modified
37 Data Envelopment Analysis (MDEA), Data Envelopment Analysis (DEA), Neural Network
38 (NN), Response Surface Methodology (RSM).

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