Application of Statistical Tool in Predicting Interaction Effects of Input Process Parameters on Waste Cooking Biodiesel Yield

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Abstract— Waste cooking cottonseed oils are used in the present work for the production of biodiesel through trans-esterification process by applying RSM based on CCRD approach. The interaction effects of input process parameters on waste cooking cottonseed biodiesel are also analyzed in order to predict the nature of response (biodiesel yield).

Key words: Waste cooking cottonseed biodiesel, response surface methodology, trans-esterification, Interaction effects

I. Introduction

The non-edible oils are best be utilized in making a biodiesel through trans-esterification process. Various researchers [Dhingra et al., 2013a; Dhingra et al., 2013b; Dhingra et al., 2014a; Dhingra et al., 2014b; Dhingra et al., 2014c; Dhingra et al., 2014d; Dhingra et al., 2016a; Dhingra et al., 2016b; James et al., 1996; Pereyra-Irujo et al., 2009] have been worked on biodiesel production from various edible and non-edible oils including waste cooking oils. The current work used waste cooking cottonseed oil for the production of biodiesel using RSM based on CCRD approach. The interaction effects of input process parameters on waste cooking cottonseed biodiesel are also drawn in order to analyze the variation of response with combined effects of input process parameters.

II. Methodology and Interaction Effects of Input Process Parameters on Waste Cooking Biodiesel Yield

Design matrix is obtained from RSM approach by selecting various input process parameters and their ranges from research studies as shown in table 1. It has been observed that biodiesel yield of waste cooking cottonseed oil is different for various combination of input process parameters.

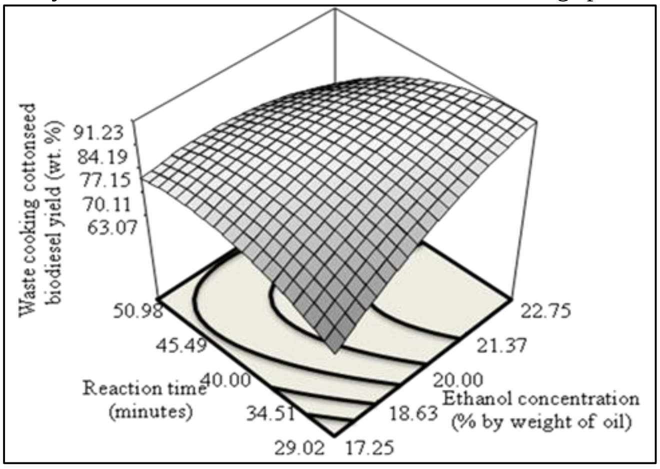
S. No.	EC	Rt	RT	CC	MS	WCCBY
	22.5	50	44	2	240	80
	22.5	30	56	2	240	75
	17.5	50	56	1	465	82
	22.5	50	56	1	240	45
	22.5	50	44	1	465	60
	22.5	30	44	2	465	70
	17.5	30	56	2	465	30
	17.5	50	44	2	465	45
	22.5	30	56	1	465	60
	17.5	50	56	2	240	70
	17.5	30	44	1	240	50
	15	40	50	1.5	350	60
	25	40	50	1.5	350	80
	20	20	50	1.5	350	70
	20	60	50	1.5	350	60
	20	40	40	1.5	350	80
	20	40	60	1.5	350	50
	20	40	50	0.5	350	70
	20	40	50	2.5	350	80
	20	40	50	1.5	150	70
	20	40	50	1.5	550	60
	20	40	50	1.5	350	85

Table 1: Design matrix of waste cooking cottonseed biodiesel through RSM based on CCRD

Legend: EC: Ethanol concentration (% by weight of oil), Rt: Reaction time in minutes, RT: Reaction temperature in ° C, CC: Catalyst concentration on % by weight of oil, MS: Mixing speed n rpm, WCCBY- Waste cooking cottonseed biodiesel yield (% by weight)

Figure 1 shows the interaction effects of ethanol concentration and reaction time on waste cooking cottonseed biodiesel yield. It is observed that yield increases with increase in ethanol concentration at all values of reaction time. Further yield decreases with increase in reaction temperature for all values of catalyst concentration. The maximum biodiesel yield is observed at the lowest values of reaction temperature and the highest value of reaction temperature. The maximum biodiesel yield is observed at the lowest value of reaction temperature and the highest value of catalyst concentration.

Figure 2 show the interaction effects of catalyst concentration and mixing speed on biodiesel yield of waste cooking cottonseed. Biodiesel yield increases with increase in mixing speed at lower values of catalyst concentration. Maximum biodiesel yield is observed at the highest value of catalyst concentration and the lowest value of mixing speed.



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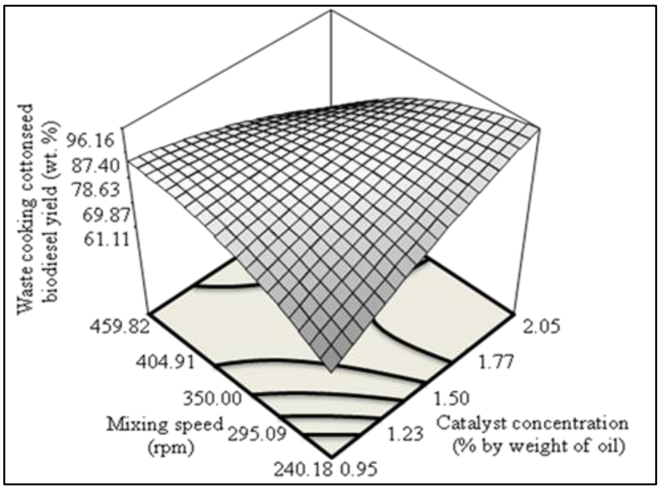

Fig. 2: Interaction effects of catalyst concentration and mixing speed on waste cooking cottonseed biodiesel yield

III. Conclusion

1) Response surface methodology is an effective tool in predicting interaction effects of input process parameters on waste ooking biodiesel yield.
2) Enhanced biodiesel yield can be produced by applying desirability approach in response surface methodology.

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