

# Analysis of Interaction Effects of Trans-Esterification Process Parameters on Cottonseed Biodiesel

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**Abstract**— The present research work deals with analysis of biodiesel yield through response surface methodology. An interaction effects of input process parameters on cottonseed biodiesel has been drawn in order to analyze the combine effect of input variables on response (biodiesel yield). It is observed that cottonseed biodiesel vary with change in one parameter keeping others fixed.

**Key words:** Cottonseed biodiesel, response surface methodology, trans-esterification, Interaction effects

## I. INTRODUCTION

The biodiesel research starts from vegetable oils and it is directly used in compression ignition engines. Several researchers (Hameed et al. 2009; Kaieda et al. 2001; Roy et al. 2013; 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) have been worked on biodiesel production through trans-esterification process. It is concluded from the research studies that biodiesel blended with diesel is the best alternative fuel to diesel engines. Hence current work is an attempt to use cottonseed oil for the production of biodiesel through response surface methodology. An interaction effects of input process parameters on cottonseed biodiesel are also drawn.

## II. METHODOLOGY AND INTERACTION EFFECTS OF INPUT PROCESS PARAMETERS ON COTTONSEED BIODIESEL

Table 1 shows the design of experiments from RSM approach based on central composite rotatable design. It is observed from the table 1 that biodiesel yield is different at various combination of input process parameters.

S. No.	EC	Rt	RT	CC	MS	CBY
1	22.5	50	44	2	240	80
2	22.5	30	56	2	240	90
3	17.5	50	56	1	465	85
4	22.5	50	56	1	240	45
5	22.5	50	44	1	465	65
6	22.5	30	44	2	465	75
7	17.5	30	56	2	465	30
8	17.5	50	44	2	465	75
9	22.5	30	56	1	465	65
10	17.5	50	56	2	240	75
11	17.5	30	44	1	240	55
12	15	40	50	1.5	350	65
13	25	40	50	1.5	350	85
14	20	20	50	1.5	350	75
15	20	60	50	1.5	350	65
16	20	40	40	1.5	350	85
17	20	40	60	1.5	350	65

18	20	40	50	0.5	350	75
19	20	40	50	2.5	350	85
20	20	40	50	1.5	150	75
21	20	40	50	1.5	550	65
22	20	40	50	1.5	350	90

Table 1: Main experimentation of cottonseed biodiesel from RSM approach

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, CBY- Cottonseed biodiesel yield (% by weight)

Figure 1 shows the interaction effects of ethanol concentration and reaction time on biodiesel yield of cottonseed oil. It is observed that at lower values of ethanol concentration biodiesel yield increases with increase in reaction time while the trend is reversed at higher values of ethanol concentration. Also at lower values of reaction time biodiesel yield increases with increase in ethanol concentration while reverse trend is observed at higher values of reaction time. The biodiesel yield is maximum at the highest value of ethanol concentration and the lowest value of reaction time.

Figure 2 show the interaction effects of cottonseed biodiesel yield. It is observed that yield increases with increase in catalyst concentration at all values of reaction temperature. 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.

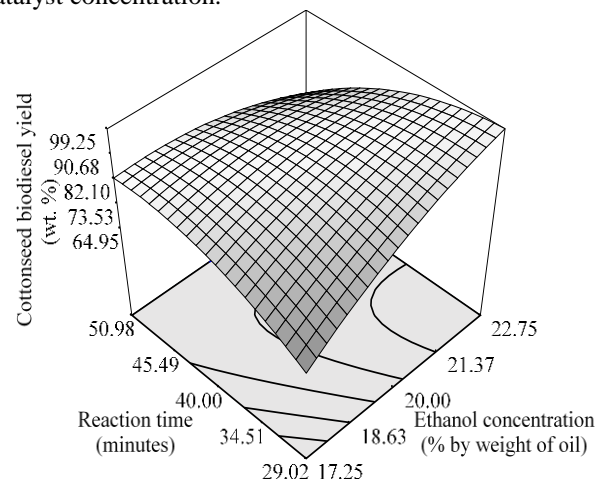


Fig. 1: Interaction effects of ethanol concentration and reaction time on cottonseed biodiesel yield

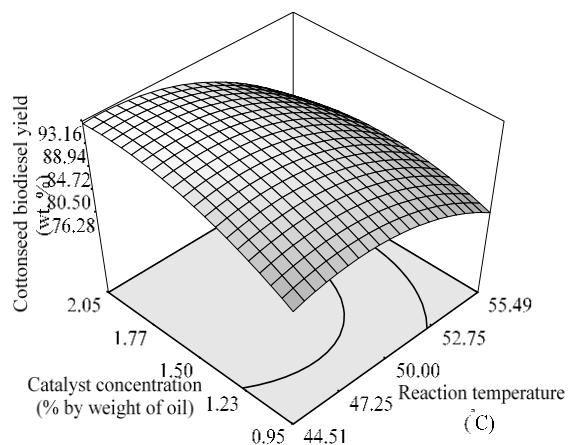


Fig. 2: Interaction effects of reaction temperature and catalyst concentration on cottonseed biodiesel yield

### III. CONCLUSION

RSM approach is found to be an effective tool for the analysis of three dimensional variation of polanga biodiesel with combined effects of input process parameters.

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