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# **Optimization of Surfactant Addition in Cellulosic Ethanol Process Using Integrated Techno-Economic and Life Cycle Assessment for Bioprocess Design**

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### Supplementary 3

Figure S3:S1: Effect of surfactants on glucose release in the 1<sup>st</sup> experiment.

Factor	Type	Levels	Values
Surfactant %	fixed	4	0, 2, 5, 8
Surfactant Type	fixed	5	PEG3000, PEG4000, PEG6000, PEG8000, Tween

Analysis of Variance for Glucose, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Surfactant %	3	5392.62	5392.62	1797.54	20.17	0.000
Surfactant Type	4	392.69	392.69	98.17	1.10	0.400
Surfactant %*Surfactant Type	12	1069.41	1069.41	89.12	2.52	0.014
Error	40	1414.05	1414.05	35.35		
Total	59	8268.77				

S = 5.94569    R-Sq = 82.90%    R-Sq(adj) = 74.78%

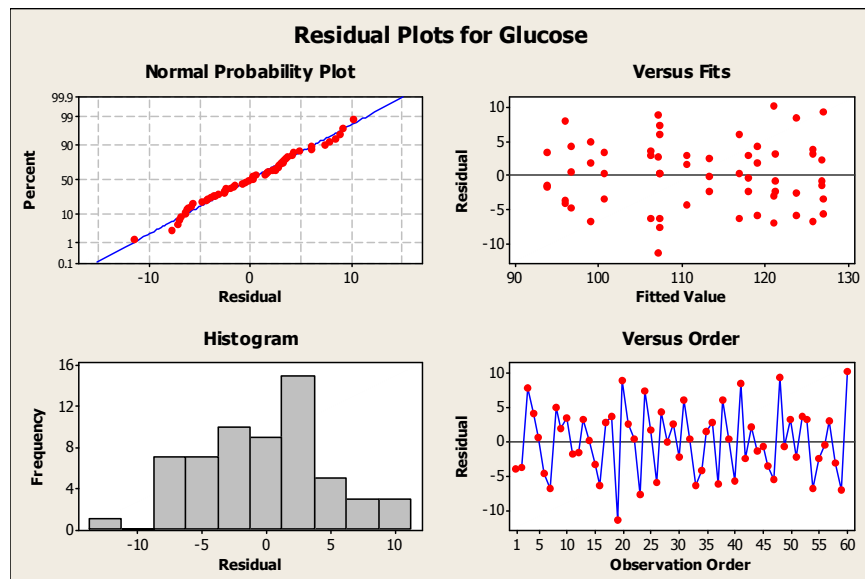


Figure S3:S2: Effect of surfactants on ethanol production in the 1<sup>st</sup> experiment.

Factor	Type	Levels	Values
Surfactant %	fixed	4	0, 2, 5, 8
Surfactant Type	fixed	5	PEG3000, PEG4000, PEG6000, PEG8000, Tween

Analysis of Variance for Ethanol, using Adjusted SS for Tests

Source	DF	Seq SS	Adj SS	Adj MS	F	P
Surfactant %	3	2307.68	2307.68	769.23	40.10	0.000
Surfactant Type	4	150.91	150.91	37.73	1.97	0.118
Surfactant %*Surfactant Type	12	127.63	127.63	10.64	0.55	0.865
Error	40	767.24	767.24	19.18		
Total	59	3353.45				

S = 4.37962 R-Sq = 77.12% R-Sq(adj) = 66.25%

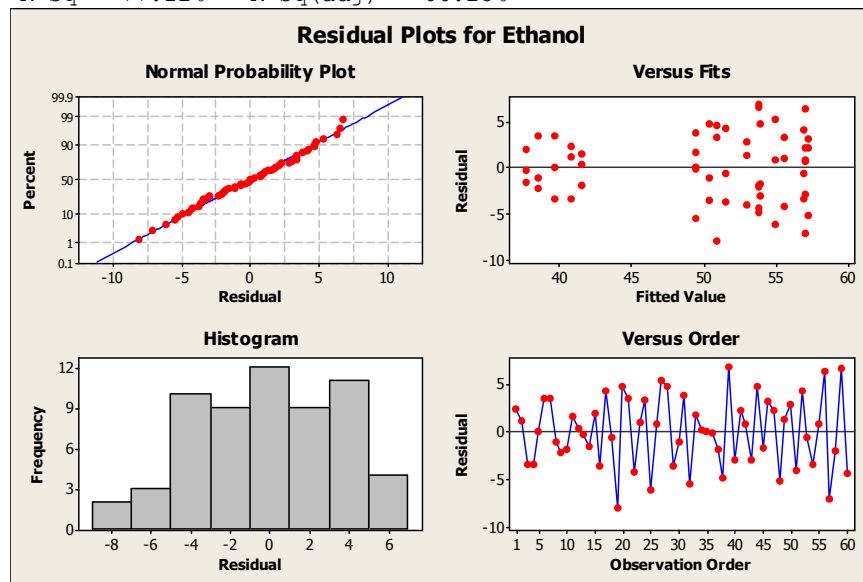


Figure S3:S3: Effect of PEG 6000 on glucose release in the 2<sup>nd</sup> experiment.

Source	DF	SS	MS	F	P
PEG 6000	4	387.5	96.9	1.41	0.299
Error	10	685.7	68.6		
Total	14	1073.2			

S = 8.281    R-Sq = 36.11%    R-Sq(adj) = 10.55%

Individual 95% CIs For Mean Based on Pooled StDev

Level	N	Mean	StDev
PEG 0%	3	82.07	9.15
PEG 0.25%	3	92.66	4.60
PEG 0.5%	3	89.22	10.17
PEG 0.75%	3	92.08	10.51
PEG 1%	3	97.54	4.91

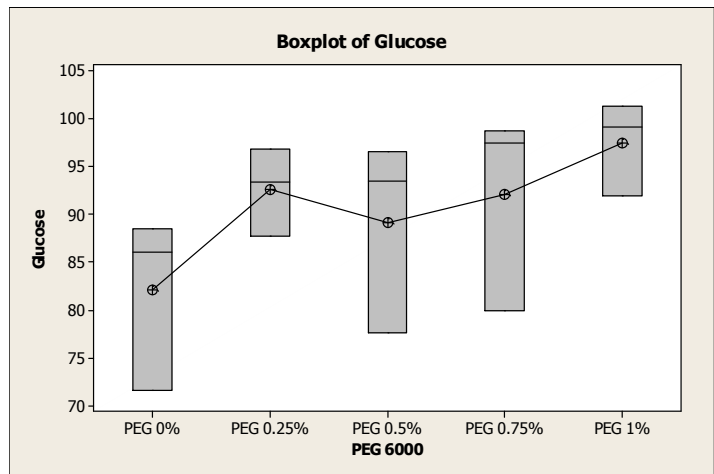




Figure S3:S5: Two sample T-Test comparing control and PEG 1%.

Two-sample T for control vs PEG 1%

	N	Mean	StDev	SE Mean
control	3	38.59	1.09	0.63
PEG 1%	3	42.49	1.43	0.82

Difference =  $\mu$  (control) -  $\mu$  (PEG 1%)

Estimate for difference: -3.91

95% CI for difference: (-7.21, -0.60)

T-Test of difference = 0 (vs not =): T-Value = -3.76 P-Value = 0.033 DF = 3

