

Supporting Information

Life Cycle Assessment and Techno-Economic Analysis of Pressure Sensitive Bio-Adhesive Production

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Table S1. Electricity sources in Iowa, 2016 (adapted from [26]).

Energy Source	Percentage
Fossil fuels	57.83%
Hydroelectric	17.81%
Wind	13.82%
Nuclear	3.65%
Wood and wood-derived fuel	2.41%
Solar Photovoltaic	1.95%
Geothermal	1.01%
Landfill gas	0.67%
Biogenic municipal waste	0.44%

Table S2. Assumptions of total capital investment (C_{TCI}) in the pressure sensitive bio-adhesive production plant.

Parameters	Assumptions	Sources
1. Direct fixed capital cost (C_{DFC})	$C_{DC} + C_{IC} + C_{OC}$	
(1) Direct cost (C_{DC})		
Equipment purchase cost (C_{PC})		SuperPro Designer database
Piping	$0.68 \times C_{PC}$	[32]
Instrumentation	$0.50 \times C_{PC}$	[32]
Insulation	$0.03 \times C_{PC}$	[32]
Electrical facilities	$0.30 \times C_{PC}$	[32]
Building	$0.45 \times C_{PC}$	[32]
Yard improvement	$0.20 \times C_{PC}$	[32]
Auxiliary facilities	$0.55 \times C_{PC}$	[32]
Installation	$0.55 \times C_{PC}$	[32]
Land	$0.08 \times C_{PC}$	[32]
(2) Indirect cost (C_{IC})		
Engineering	$0.30 \times C_{DC}$	[52]
Construction	$0.35 \times C_{DC}$	[52]
(3) Other cost (C_{OC})		
Contractor's fee	$0.06 \times (C_{DC} + C_{IC})$	[32]
Contingency	$0.08 \times (C_{DC} + C_{IC})$	[32]
2. Working capital (C_W)	$0.15 \times C_{DFC}$	[33]
3. Start-up and validation cost (C_S)	$0.10 \times C_{DFC}$	[32]

Table S3. Assumptions of annual operating cost (CAOC) in the pressure sensitive bio-adhesive production plant.

Parameters	Assumptions	Sources
1. Material cost (C_M)		
Glycerol	1.04 \$/kg	[35]
Acrylic acid	0.90 \$/kg	[53]
Phenothazine (PTZ)	11.30 \$/kg	[53]
Amberlyst 15	104.00 \$/kg	[53]
Ethanethiol	5.48 \$/kg	[53]
Carbon disulfide	1.37 \$/kg	[53]
3-chloro-2-butanone	35.22 \$/kg	[53]
Acetone	0.10 \$/kg	[53]
Azobisisobutyronitrile (AIBN)	5.81 \$/kg	[53]
4, 4'-Azobis	565.00 \$/kg	[53]
Potassium hydroxide (KOH)	1.05 \$/kg	[53]
Isosorbide	71.00 \$/kg	[53]
Succinic anhydride	5.00 \$/kg	[53]
2. Utilities cost (C_U)		
Electricity	5.08 cents/kWh	[36]
Steam	12.00 \$/t	SuperPro Designer database
Process Water	0.12 \$/t	
3. Labor cost (C_L)		
4. Facilities cost (C_F)		
Maintenance	$0.02 \times C_{PC}$	[32]
Depreciation	Straight-line method	[37]
Insurance	$0.01 \times C_{DFC}$	[32]
Tax	$0.02 \times C_{DFC}$	[32]
Plant overhead	$0.50 \times C_L$	[32]

Table S4. Techno-economic analysis results of bio-glycerol based PSA plant with five different plant scales.

Plant Scale (t/d)	Total Capital Investment (\$)	Annual Operating Cost (\$)	Revenue (\$)	Unit Production Cost (\$/kg)
1	48,909,738	3,876,334	1,457,553	19.37
2	51,057,911	4,845,825	2,937,544	11.79
5	53,681,083	6,393,394	7,348,741	5.73
10	55,937,860	10,313,591	14,705,088	4.07
40	62,293,007	33,506,923	58,801,354	2.76

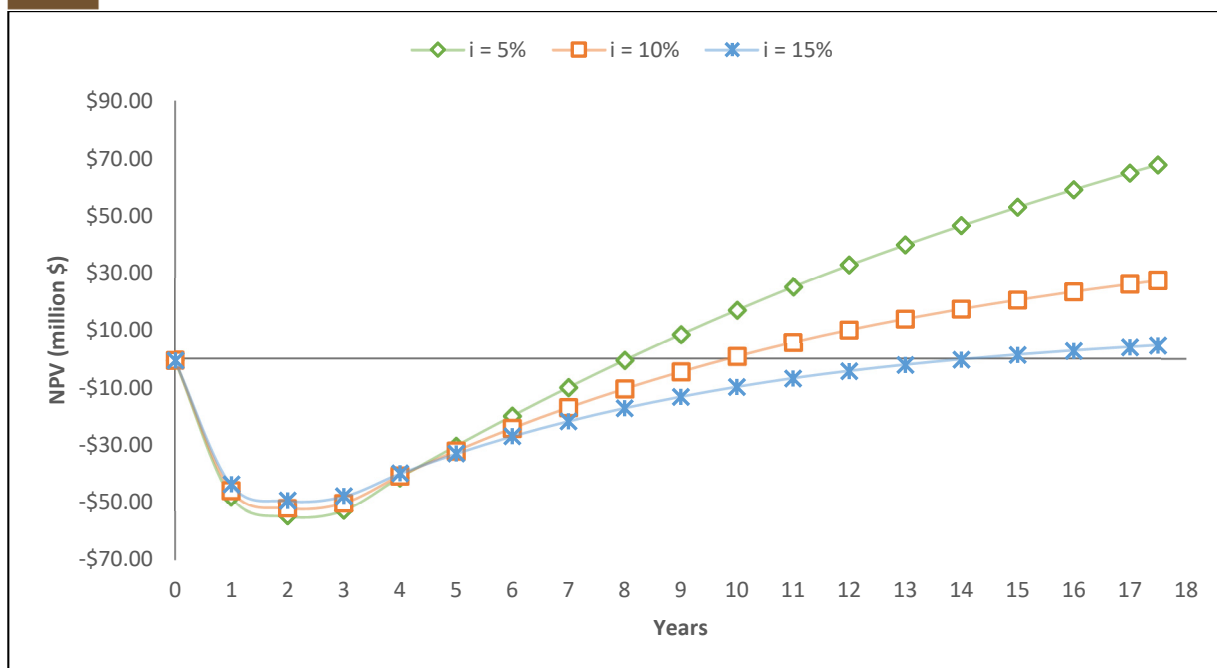


Figure S1. Discounted cash flow results for the 40 t/d PSA production plant at different discount rates.
NPV: net present value.



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