The Effect of Diaper Biodegradability on Absorbency

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Supporting Information

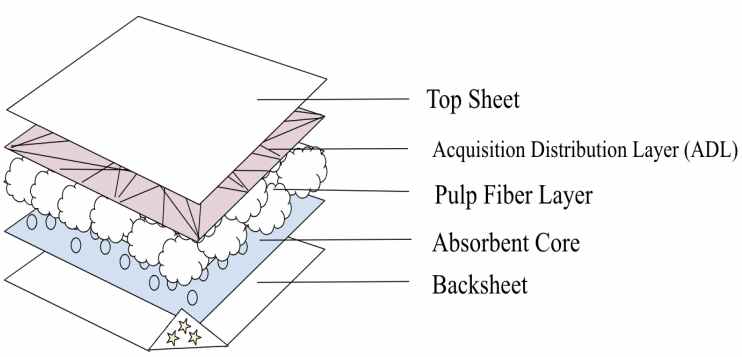

Figure S1. Graphical Representation of Diaper Layers

Table S1. Diaper Prices

Diaper	Diaper A	Diaper B	Diaper C	Diaper D	Diaper E
Overall Price	$55.94	$88.00	$13.00	$13.15	$109.99
# Diaper in Standard Box	150	168	30	24	144
Constant Size	4	4	4	4	4
Price per Diaper	$0.37	$0.52	$0.43	$0.55	$0.76
Main Material	Poly-Propolene	Cotton	Cotton	Cotton	Bamboo

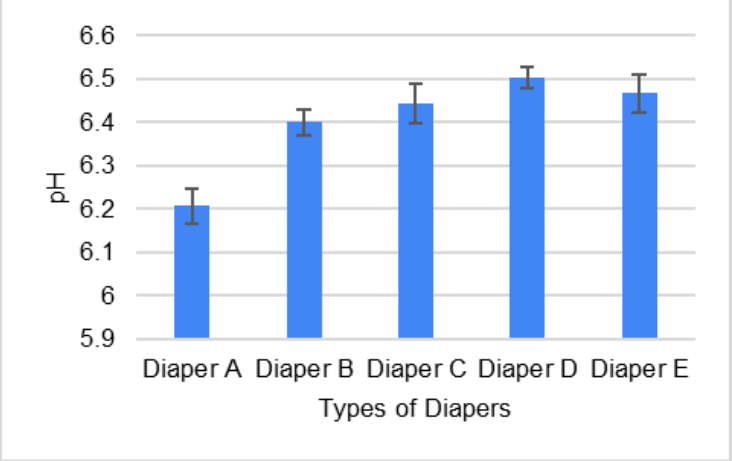

Figure S2. Average pH Results**.** The Measure pH (MP) test finds the pH of the SAP to infer the amount of crosslinking that occurs when the liquid enters the absorbent core. The pH was measured in 3 separate trials and the average was taken. All the diapers were relatively close to neutral, mostly centering around 6.4-6.5, making the pH beneficial to the absorbency because it is crosslinked the optimal amount. Diaper A: 6.21, Diaper B: 6.4, Diaper C: 6.44, Diaper D: 6.5, and Diaper E: 6.47. The absorption is related to pH in that as the pH gets more acidic, the absorbency decreases because the low amount of H+ ions lowers the amount of bonding, so the "wells" in the SAP are looser. As the pH gets more basic, the hydrogel stiffens due to being highly crosslinked from more H+ ions bonding with the COO- ions [1]. All the diapers were relatively close to neutral, making the pH beneficial to the absorbency, showing that there was no clear trend for biodegradability and absorbency. These similar values could be due to all of the SAP in the diapers being mostly plastic-based and companies aiming to use SAP pellets that have a pH close to 7 so they crosslink the right amount.

Table S2. Fluid Run-Off Standard Deviation

Diaper Type	Standard Deviation of Fluid Run-Off		
	Primary Value	Secondary Value	Tertiary Value
Diaper A	3.398151458	4.128345108	4.684573976
Diaper B	8.673501792	7.644222219	0.121243557
Diaper C	6.971972461	3.63791607	8.550339175
Diaper D	1.855622088	1.632676739	5.763040286
Diaper E	0	1.449149176	0.710140831

Table S3. Liquid Strike Through

Diaper Type	Drop Time (sec)			
	Trial 1	Trial 2	Trial 3	Average
Diaper A	10.14	10.24	14.2	11.52666667
Diaper B	8.59	8.39	6.23	7.736666667
Diaper C	13.41	12.91	15.13	13.81666667
Diaper D	15.12	15.87	15.22	15.40333333
Diaper E	18.55	22.93	22.06	21.18

Table S4. Total Absorptive Capacity

Diaper Type	(W2/W1)*100 (%)				
	Trial 1	Trial 2	Trial 3	Average	Standard Deviation
Diaper A	1157.59903	919.3053312	1255.980669	1110.961677	173.115143
Diaper B	1547.381034	1604.492852	1682.757441	1611.543776	67.96307483
Diaper C	1390.997831	1635.826558	1751.10999	1592.644793	183.8985873
Diaper D	1868.415716	1744.543483	1902.935966	1838.631722	83.29081183
Diaper E	1516.396243	1448.079065	1564.182077	1509.552461	58.3532807

Table S5. Dimensional Measurements

Diaper Type	Mass/(Length*Width*Thickness) (g/cm^3)
Diaper A	0.011184752
Diaper B	0.01658456486
Diaper C	0.01561859193
Diaper D	0.01055340557
Diaper E	0.015818794

Table S6. Moisture Content

Diaper Type	Moisture Content (g)				
	Trial 1	Trial 2	Trial 3	Average	Standard Deviation
Diaper A	5.665024631	4.75	3.75	4.721674877	0.9578264813
Diaper B	8.5	10.75	8	9.083333333	1.464866319
Diaper C	8.728179551	9.75	11.5	9.992726517	1.401761132
Diaper D	11.4713217	11.75	19.25	14.15710723	4.412774973
Diaper E	12.5	15.75	14.25	14.16666667	1.626601775

Table S7. Free Swell Capacity

Diaper Type	**Fa* (g/g)**	**(W2 - (W1 - Fa) - W1 - W0)/W0* (g/g)**				
	(T2 - T1)/T1*	**Trial 1**	**Trial 2**	**Trial 3**	**Average**	**Standard Deviation**
Diaper A	2.776470588	48.07294118	50.07294118	49.13294118	49.09294118	1.00059982
Diaper B	2.900584795	64.72116959	52.12116959	57.04116959	57.96116959	6.3501811
Diaper C	2.720930233	48.06186047	50.56186047	46.44186047	48.3551938	2.07560433
Diaper D	2.701219512	48.39454806	49.59062649	40.94126431	46.30881296	4.686745646
Diaper E	2.87804878	37.70205643	48.35609756	48.37609756	44.81141718	6.156895137

* F_a represents the absorption factor of the teabag, T_2 represents the weight of the empty strained teabag, and T_1 represents the weight of the dry empty teabag. W_2 represents the weight of the swollen sample, W_1 represents the weight of the dry empty teabag, W_0 represents the original weight of the SAP sample.

Table S8. Absorption Under Load

Diaper Type	(W2 - W1)/W1* (g/g)				
	Trial 1	Trial 2	Trial 3	Average	Standard Deviation
Diaper A	19.8	24.1	23.62222222	22.50740741	2.356821812
Diaper B	10.38888889	20.76666667	16.67777778	15.94444444	5.227609514
Diaper C	21.55555556	17.03333333	18.95555556	19.18148148	2.269560607
Diaper D	19.26666667	23.52222222	28.26666667	23.68518519	4.502212533
Diaper E	19.33333333	20.85555556	23.24444444	21.14444444	1.971494388

* We recorded the weight of the apparatus with SAP as W1. After an hour of fluid absorption, the SAP in the apparatus was reweighed as W2.

Figure S3. Experiment Photo of Absorption Under Load