Characterization of the physical properties of extruded composites from recycled wind turbine blade material

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Abstract

Wind turbine blades (WTB) mechanically recycled and used as a feedstock for thermoplastic composites. Physical properties (water sorption (WA), Thickness swelling (TS)) dataset of composites made from recycled wind turbine blades presented. Dataset also presented the influence of resin level, mill screen size and coupling agents on the physical properties of composites.

Keywords: Recycling, Wind turbine blade, Polymer-matrix composite, Glass fiber, Physical properties

Value of the Data

- Presented comparison between the recycled wind turbine blade composites and wood-base composites shows the potential utilization of this recycled material in different fields.
- Thickness swelling and water sorption of recycled wind turbine blade composites presented that give the researchers clear vision about their physical properties.
- Researchers could be referred to this dataset to design and analyze different experiments on recycled win turbine blades.

1. Data

For obtaining physical properties of composites fabricated using recycled wind turbine blade materials, water sorption and thickness swelling were performed based on ASTM D1037-12. Presented dataset include influence of refined particle size, resin content and coupling agents (maleic anhydride polyethylene (MAPE) and methacryloxypropyltriethoxysilane (Silane)) on the physical properties of recycled composites.

2. Experimental Design, Materials, and Methods

2.1 Materials

Recycled wind turbine blade (rWTB) material was supplied by Global Fiberglass Solutions at an incoming moisture content of 1.25%. A high-density polyethylene (HDPE) (0.3 MFI) was obtained from a commercial vender and used as the matrix for the second-generation extruded composite. The rWTB material was hammer-milled through 3.18, and 1.59 mm screen size (MSS) and particle size distribution of the refined material was performed with Ro-Tap sieve analysis procedures [2]. A commercially available 60-mesh pine (P. stobus) was used for baseline comparison to the rWTB filled extrudate. Methacryloxypropyltrimethoxysilane (Silane) (Gelest Inc.) and maleic anhydride polyethylene (MAPE) were used as the coupling agents [3].

Table 1. Extruded rWTB composite formulation

Sample #	Pine (40 mesh) (%)	Pine (60 mech) (%)	3.18 mm MSS rWTB (%)	1.59 mm MSS rWTB (%)	Talc (%)	MAP (%)	Silane (%)	HDPE(%)
1	55		0		6			36
2			40		6			51
3			45		6			46
4			50		6			41
5			55		6			36
6			60		6			31
7			50					47
8			55					42
9			60					37
10		55						42
11		55			6			36
12		55				2		40
13		54.5					0.5	42
14				50				47
15				55				42
16				60				37
17				50		2		45
18				55		2		40
19				60		2		35
20				49.5			0.5	47
21				54.5			0.5	42
22				59.5			0.5	37
23		13.75		41.25				42
24		27.5		27.5				42
25		41.25		13.75				42
26				65		2		30

27	70	2	25
28	65		32
29	70		27

2.2 Extruded rWTB composite preparation

The various milled size fractions of rWTB material were mixed with high density polyethylene, non-metallic stearate lubricant, MAPE and silane as coupling agents were also added to the formulation. Silane was received in a liquid form and sprayed to rWTB materials. They were then blended for 15 minutes and dried for 10 hours at 60 °C in an oven [4]. MAPE was added to the dry blend as a pellet. For comparison purposes, a commercial 60-mesh pine was used as a feedstock source.

2.3 Thickness swell and water sorption properties

To evaluate the thickness swell and water sorption of extruded rWTB composites, water immersion studies were performed in accordance with ASTM D1037-12 [5]. The samples were immersed until samples achieved an equilibrium state, where a negligible change in sample mass was observed or reached 2000 hours of immersion. The reference for the test was the composite (WPC) made from 60-mesh pine wood flour.

Comparing the data of thickness swell and water sorption for rWTB composites with WPCs shows a significant influence of rWTB material to reduce water sorption and thickness swell of extruded composites. After 2000h of water immersion, the thickness swell of composites with 0% pine (55% rWTB) was dramatically lower than the wood filled composite Due to the hydrophilic nature of wood, the addition of pine flour to the composite an expected increased the thickness swelling and water sorption was observed. However, even at a low loading of wood flour (13%) there was a 3x increase in dimensional change and weight gain compared to the composites with only rWTB material

Table 2. Water sorption of rWTB composites

	Time (Hour)					
WA	6	24	48	72	168	336
1--1	1.38600139	2.32155232	3.53430353	4.22730423	6.44490644	9.56340956
1--2	1.29779025	2.0343739	3.12171168	3.7530691	5.68221677	8.20764644
1--3	1.21233114	2.45930031	3.84482161	4.3643921	6.99688258	10.0103914
AVE	1.29870759	2.27174218	3.50027894	4.11492181	6.3746686	9.26048247
STD	0.08683876	0.21679806	0.3627537	0.32078234	0.66014132	0.93877365
3--1	0.10427529	0.10427529	0.34758429	0.52137643	0.52137643	0.72992701
3--2	-0.035791	0.03579098	0.32211883	0.46528275	0.46528275	0.68002863

3--3	0.1025641	0.1025641	0.44444444	0.44444444	0.58119658	0.68376068
Ave	0.05701614	0.08087679	0.37138252	0.47703454	0.52261859	0.69790544
STD	0.08037787	0.03905483	0.06454189	0.03978959	0.0579669	0.0277942
4--1	0.26782725	0.23434884	0.30130566	0.33478406	2.1091396	0.66956813
4--2	0.06578947	0.23026316	0.32894737	0.32894737	0.78947368	0.75657895
4--3	0.22668394	0.3238342	0.42098446	0.51813472	0.87435233	0.87435233
AVE	0.18676689	0.2628154	0.35041249	0.39395538	1.25765521	0.76683314
STD	0.10677005	0.0528833	0.06266033	0.10758205	0.73862735	0.10277647
5--1	0.19367334	0.22595223	0.45190445	0.45190445	0.87153002	0.96836669
5--2	0.18969333	0.18969333	0.50584888	0.56907999	0.91685109	1.13815997
5--3	0.25157233	0.25157233	0.56603774	0.56603774	0.6918239	0.97484277
AVE	0.21164633	0.22240596	0.50793036	0.52900739	0.826735	1.02712314
STD	0.03463414	0.03109155	0.0570951	0.06679043	0.11901367	0.09621522
6--1	0.46714419	0.46714419	3.92401121	0.8097166	1.15228901	1.71286204
6--2	0.31191516	0.49906425	0.81097941	0.84217093	1.24766064	1.59076731
6--3	0.24653313	0.24653313	0.58551618	0.73959938	1.201849	1.60246533
Ave	0.34186416	0.40424719	1.77350227	0.7971623	1.20059955	1.63536489
STD	0.1133138	0.1375137	1.8658041	0.05242555	0.04769809	0.06736888
7--1	0.420021	0.420021	0.420021	0.6300315	0.73503675	0.66503325
7--2	0.16909029	0.30436253	0.43963476	0.574907	0.74399729	0.81163341
7--3	0	0	0.31120332	0.5186722	0.38035961	0.44951591
AVE	0.19637043	0.24146118	0.39028636	0.5745369	0.61979789	0.64206086
STD	0.2113352	0.21696047	0.06918649	0.05568057	0.20740802	0.18214848
8--1	0.36654449	0.36654449	0.43318894	0.7664112	0.96634455	1.26624459
8--2	0.35935969	0.35935969	0.35935969	0.65338125	0.68605031	1.01274093
8--3	0.39499671	0.39499671	0.62541145	0.62541145	0.75707702	1.11915734
Ave	0.37363363	0.37363363	0.47265336	0.68173463	0.8031573	1.13271429
STD	0.01884652	0.01884652	0.13734616	0.07465365	0.14571808	0.12729442
9--1	0.34188034	0.41025641	0.85470085	0.99145299	1.43589744	2.01709402
9--2	0.50150451	0.46807088	1.00300903	1.00300903	1.33734537	2.07288532
9--3	0.35959464	0.35959464	0.55573717	0.71918928	1.01340307	1.47106898
AVE	0.40099316	0.41264064	0.80448235	0.90455043	1.26221529	1.85368277
STD	0.08749484	0.05427741	0.22782549	0.16063142	0.2210402	0.33252542
10--1	1.11196319	1.80214724	2.45398773	2.33895706	4.17944785	5.98159509
10--2	0.97891566	1.65662651	2.37198795	2.40963855	4.25451807	5.76054217
10--3	1.09186747	1.73192771	2.29668675	2.44728916	4.21686747	6.02409639
AVE	1.06091544	1.73023382	2.37422081	2.39862826	4.21694446	5.92207788
STD	0.07172121	0.07277515	0.07867426	0.05499892	0.03753517	0.14149887
11--1	1.29589633	1.94384449	2.73578114	2.87976962	5.00359971	7.37940965
11--2	1.00610852	1.97628458	2.94646065	3.05425799	5.13833992	7.22242185

11--3	1.1187297	1.94875496	2.99530855	3.06748466	5.26885601	7.18152292
AVE	1.14024485	1.95629468	2.89251678	3.00050409	5.13693188	7.26111814
STD	0.14608703	0.01748501	0.13791692	0.10476806	0.13263375	0.10446455
12--1	0.76306753	1.37352156	1.67874857	1.67874857	2.97596337	4.19687142
12--2	0.94126506	1.35542169	1.6189759	1.69427711	2.89909639	4.10391566
12--3	0.9859689	1.36518771	1.55479712	1.82025028	2.99582859	4.32309443
AVE	0.89676717	1.36471032	1.6175072	1.73109199	2.95696278	4.2079605
STD	0.11792499	0.00905937	0.06198878	0.07760274	0.05108862	0.11000936
14--1	0.32822757	0.21881838	0.3646973	0.3646973	0.43763676	0.83880379
14--2	0.36900369	0.14760148	0.73800738	0.29520295	0.66420664	0.70110701
14--3	0.37133309	0.33419978	0.4455997	0.37133309	0.66839955	0.66839955
AVE	0.35618812	0.23353988	0.51610146	0.34374445	0.59008099	0.73610345
STD	0.02424254	0.0941662	0.19638731	0.0421689	0.13203722	0.0904321
15--1	0.25362319	0.32608696	0.36231884	0.32608696	0.57971014	0.76086957
15--2	0.18375597	0.40426314	0.29400956	0.14700478	0.69827269	0.77177508
15--3	-0.2624672	-0.2249719	-0.1874766	-0.0749906	0.33745782	0.2999625
AVE	0.05830399	0.16845941	0.15628394	0.13270037	0.53848022	0.61086905
STD	0.27998387	0.34295628	0.29965815	0.20092105	0.18390697	0.26930817
16--1	0.20869565	0.34782609	0.34782609	0.34782609	0.90434783	1.32173913
16--2	0.39468963	0.21528525	0.32292788	0.35880875	0.89702189	1.4711159
16--3	0.50596314	0.1445609	0.28912179	0.32526202	0.93964583	1.33718829
AVE	0.36978281	0.23589075	0.31995859	0.34396562	0.91367185	1.37668111
STD	0.15019072	0.10318733	0.02946457	0.01710331	0.02279042	0.08214692
17--1	0.35101404	0.27301092	0.23400936	0.07800312	0.54602184	0.54602184
17--2	0.73367572	0.18341893	0.2567865	0.11005136	0.33015407	0.44020543
17--3	0.07501875	0.11252813	0.30007502	0	0.3375844	0.37509377
AVE	0.3865695	0.18965266	0.26362363	0.06268483	0.40458677	0.45377368
STD	0.33076486	0.08042279	0.03355931	0.05660223	0.12254269	0.08626804
18--1	0.27500859	0.58439326	0.1375043	0	0.34376074	0.41251289
18--2	0.42179262	0.24604569	0.456942	0.10544815	0.38664323	0.56239016
18--3	0.36483035	6.31156512	0.25538125	0.25538125	0.54724553	0.5107625
AVE	0.35387719	2.38066803	0.28327585	0.12027647	0.42588317	0.49522185
STD	0.07400248	3.40845768	0.16153543	0.12833474	0.10726763	0.07613759
19--1	0.32585083	0.25343954	0.39826213	0.25343954	0.43446778	0.28964518
19--2	0.5788712	0.4341534	0.2894356	0.2170767	0.39797395	0.4341534
19--3	0.5409304	0.5409304	0.39668229	0.14424811	0.39668229	0.5409304
AVE	0.48188414	0.40950778	0.36146001	0.20492145	0.40970801	0.42157633
STD	0.13645392	0.14532138	0.06237997	0.0556013	0.02145231	0.12611385
20--1	0.75458139	0.89831117	0.89831117	0.71864894	1.36543299	1.50916277
20--2	0.68592058	0.72202166	0.97472924	0.68592058	1.37184116	-2.0216606

20--3	0.65288357	0.65288357	0.87051143	0.87051143	1.41458107	1.59593761
AVE	0.69779518	0.7577388	0.91451728	0.75836031	1.38395174	0.36114658
STD	0.05187838	0.12655221	0.05396588	0.09849462	0.02671859	2.06402766
21--1	0.51564111	1.10003438	1.13441045	1.0656583	1.85630801	2.44070127
21--2	0.82107424	1.23161136	1.43687992	1.26582278	1.91583989	2.565857
21--3	0.48933939	0.83886753	1.08353722	1.04858441	1.71268787	2.09716882
AVE	0.60868491	1.05683775	1.21827586	1.1266885	1.82827859	2.36790903
STD	0.18440408	0.19990345	0.19101785	0.12079587	0.10443621	0.24267506
22--1	0.60341938	0.80455917	0.97217566	1.00569896	1.57559504	2.4807241
22--2	-2.525089	-2.2661055	-2.3308514	-2.4279702	-1.8776303	-1.1654257
22--3	0.66334992	0.89552239	1.09452736	1.09452736	1.52570481	2.08955224
AVE	-0.4194399	-0.1886747	-0.0880495	-0.109248	0.40788985	1.13495021
STD	1.82379181	1.79968271	1.94328663	2.00856349	1.97947569	2.00176194
13--1	1.45190563	2.50453721	3.19419238	3.4845735	5.51724138	7.87658802
13--2	1.61350844	2.73921201	3.48968105	3.78986867	5.74108818	8.33020638
13--3	1.47961025	2.52616384	3.39227716	3.28401299	5.48538434	7.65066763
AVE	1.51500811	2.58997102	3.35871686	3.51948505	5.58123797	7.95248734
STD	0.0864212	0.12969804	0.15057592	0.25472849	0.13934772	0.34606901
23--1	0.92751632	1.16798351	1.33974579	1.68327035	2.09549983	2.7481965
23--2	0.41710115	0.62565172	1.00799444	1.49461244	1.70316302	2.3983316
23--3	0.39145907	0.78291815	0.85409253	1.10320285	1.63701068	2.56227758
AVE	0.57869218	0.85885113	1.06727759	1.42702855	1.81189117	2.56960189
STD	0.30236251	0.27902564	0.24819477	0.29588049	0.24782945	0.17504741
24--1	0.86088154	0.96418733	1.99724518	2.3415978	2.7892562	3.71900826
24--2	0.96585029	1.48327009	1.41428079	1.82821663	2.72507761	4.00137979
24--3	0.85531005	1.17605132	1.53243051	1.99572345	2.67284391	4.52601568
AVE	0.89401396	1.20783625	1.64798549	2.05517929	2.72905924	4.08213458
STD	0.06227443	0.26099701	0.30818272	0.26180394	0.05830819	0.40951953
25--1	0.93717459	1.42311697	1.77021867	-0.8677543	3.50572718	4.99826449
25--2	0.8022323	2.02302058	1.95326125	3.38332752	3.73212417	5.4063481
25--3	0.63943162	1.98934281	1.84724689	2.45115453	3.51687389	5.11545293
AVE	0.79294617	1.81182679	1.85690894	1.65557593	3.58490841	5.17335517
STD	0.14908854	0.33705346	0.09190301	2.23442007	0.12761435	0.21011321
26--1	0.06445375	0.12890751	0.16113439	0.22558814	0.58008379	1.03126007
26--2	0.16051364	0.06420546	0.09630819	0.28892456	0.60995185	0.60995185
26--3	-3.0987734	0.74241446	0.19367334	-1.3879923	0.51646223	0.83925113
AVE	-0.9579353	0.31184248	0.15037197	-0.2911599	0.56883262	0.82682102
STD	1.85464218	0.37428701	0.04956678	0.95041247	0.04774954	0.21092898
27--1	0.09743423	0.61708347	0.422215	0.58460539	0.87690809	1.33160117
27--2	0.06482982	0.51863857	0.45380875	0.55105348	0.81037277	1.45867099

27--3	-3.0821918	0.249066	0.34246575	0.46699875	0.62266501	0.90286426
AVE	-0.9733092	0.46159601	0.40616317	0.53421921	0.76998195	1.23104547
STD	1.82641861	0.19052455	0.05738085	0.06058362	0.13184631	0.2912282
28--1	0.29870561	0.43146366	0.79654829	4.28144706	1.42714902	2.25688682
28--2	0.09686794	0.35518243	0.58120762	1.13012593	1.45301905	2.29254117
28--3	0.06347191	0.79339892	0.60298318	0.15867978	1.52332593	2.28498889
AVE	0.15301515	0.52668167	0.66024636	1.85675093	1.46783133	2.27813896
STD	0.12727178	0.23411167	0.118542	2.15529358	0.04976999	0.01878827
29--1	0.65638333	1.31276666	1.83787332	3.18345914	3.67574664	5.41516245
29--2	0.45469308	1.23416694	1.7213381	2.56576811	3.18285158	4.31958428
29--3	0.3796267	1.01233787	1.04397343	1.64504904	2.30939576	3.63808921
AVE	0.49690104	1.18642382	1.53439495	2.46475876	3.05599799	4.45761198
STD	0.14312474	0.15580089	0.42869577	0.77416315	0.69195199	0.89654117

Table 2. continue…

	Time (Hour)					
WA	504	672	840	1008	1344	2016
1--1	11.8156618	14.033264	14.7262647	17.1864172	20.0623701	21.55
1--2	10.3121712	12.4517713	13.8197124	14.6264469	17.5026307	19.50
1--3	12.3657776	14.4786976	16.6262556	17.8385868	20.6442674	25.08
AVE	11.4978702	13.6545777	15.0574109	16.5504836	19.4030894	22.0440621
STD	1.0630468	1.06520425	1.43227602	1.697872	1.6713643	2.82034014
3--1	0.90371915	0.97323601	1.04275287	1.11226973	1.45985401	1.60
3--2	0.68002863	1.07372942	1.1095204	1.14531138	1.46743021	1.50
3--3	0.68376068	0.82051282	0.88888889	1.09401709	1.4017094	1.61
Ave	0.75583616	0.95582608	1.01372072	1.1171994	1.44299787	1.56964884
STD	0.12808402	0.1275029	0.11314467	0.02600004	0.03595696	0.0576652
4--1	0.93739538	1.50652829	1.5734851	1.80783395	1.80783395	1.74
4--2	0.88815789	1.21710526	1.31578947	1.71052632	1.80921053	1.61
4--3	0.87435233	1.26295337	1.48963731	3.04404145	1.71632124	1.85
AVE	0.89996854	1.32886231	1.45963729	2.18746724	1.77778857	1.73285805
STD	0.03313948	0.15556161	0.13144109	0.74340886	0.05323672	0.11721232
5--1	1.19431892	1.64622337	1.61394448	1.83989671	2.38863783	2.74
5--2	1.3278533	1.89693329	1.89693329	-0.4742333	2.43439772	2.53
5--3	1.3836478	1.72955975	1.79245283	1.32075472	2.04402516	2.77
AVE	1.30194001	1.75757214	1.76777687	0.8954727	2.28902024	2.68008187
STD	0.09728813	0.1276808	0.14309907	1.21426852	0.21340205	0.13116051
6--1	2.18000623	2.39800685	2.46029274	0.99657428	3.6437247	4.08

6--2	1.84029944	1.99625702	2.30817218	3.27510917	3.36868372	3.74
6--3	2.15716487	2.15716487	2.31124807	1.60246533	3.45146379	3.88
Ave	2.05915685	2.18380958	2.35990433	1.95804959	3.4879574	3.90186821
STD	0.18987984	0.20219591	0.08695252	1.18015272	0.14110536	0.16917173
7--1	0.840042	0.980049	1.15505775	1.260063	1.6100805	1.47
7--2	1.01454177	1.11599594	1.18363206	-1.9614474	1.52181265	1.72
7--3	0.72614108	1.07192254	1.17565698	3.66528354	1.38312586	1.35
AVE	0.86024162	1.05598916	1.17144893	0.98796638	1.50500634	1.51444741
STD	0.14525755	0.06935991	0.01474461	2.82321674	0.11440691	0.19197231
8--1	1.6661113	1.59946684	1.6661113	-2.3325558	2.19926691	2.40
8--2	1.33943156	1.33943156	1.568115	0.09800719	2.12348906	2.06
8--3	1.54707044	1.54707044	1.57998683	2.69914417	2.50164582	2.30
Ave	1.51753777	1.49532295	1.60473771	0.15486518	2.2748006	2.25383289
STD	0.16533012	0.13752432	0.05348152	2.51633182	0.20007408	0.17600378
9--1	2.46153846	3.04273504	3.24786325	5.53846154	4.20512821	4.75
9--2	3.00902708	3.17619525	3.30992979	3.47709796	4.11233701	4.61
9--3	2.05949657	2.713305	2.90944753	1.53644982	3.26904217	3.82
AVE	2.5100207	2.97741177	3.15574686	3.51733644	3.86216913	4.39691921
STD	0.47661824	0.23825867	0.21554717	2.00130927	0.51575405	0.50028933
10--1	7.59202454	9.08742331	10.4294479	11.1196319	11.7714724	14.69
10--2	7.22891566	8.73493976	10.1656627	10.8057229	12.311747	14.68
10--3	7.56777108	9.03614458	10.3915663	10.7680723	12.2740964	14.57
AVE	7.46290376	8.95283588	10.3288923	10.897809	12.1191053	14.6467003
STD	0.20300217	0.19043744	0.14262427	0.19302444	0.30164689	0.06575269
11--1	9.39524838	11.3030958	12.3830094	13.6429086	15.0827934	17.89
11--2	9.59396335	11.3187208	12.7200862	13.7980596	14.5167086	17.86
11--3	9.77986287	11.4399134	12.4503789	13.4247564	14.5073981	17.50
AVE	9.58969153	11.35391	12.5178248	13.6219082	14.7023	17.7505672
STD	0.19234282	0.07488975	0.17837298	0.18753557	0.32954981	0.21525434
12--1	5.03624571	6.06638688	6.82945441	7.36360168	8.50820298	9.88
12--2	5.19578313	6.13704819	6.77710843	7.49246988	8.24548193	10.43
12--3	5.11945392	6.40879788	7.05346985	7.62229807	9.1391733	10.73
AVE	5.11716092	6.20407765	6.88667756	7.49278987	8.63095274	10.3476112
STD	0.07979343	0.18077897	0.14679842	0.12934849	0.45931655	0.43091869
14--1	0.80233406	1.0940919	1.02115244	1.02115244	1.20350109	1.39
14--2	0.99630996	1.18081181	1.14391144	1.10701107	1.29151292	1.59
14--3	0.77979948	1.2996658	1.26253249	1.2996658	1.67099889	2.01
AVE	0.85948117	1.19152317	1.14253212	1.14260977	1.38867097	1.65925476
STD	0.11903168	0.10320468	0.12069594	0.14262844	0.2484317	0.3159821
15--1	1.05072464	1.48550725	1.70289855	1.41304348	1.41304348	1.52

15--2	1.06578464	1.323043	1.2862918	1.17603822	1.24954061	1.43
15--3	0.44994376	0.89988751	0.89988751	0.82489689	0.93738283	0.90
AVE	0.85548434	1.23614592	1.29635929	1.13799286	1.19998897	1.28497441
STD	0.35128916	0.30232589	0.40160017	0.29591331	0.24167082	0.33641412
16--1	1.70434783	2.0173913	2.12173913	2.15652174	2.85217391	3.27
16--2	1.68640115	2.15285253	2.22461428	2.29637603	2.65518479	3.44
16--3	1.55402963	2.31297434	2.38525479	2.24069389	2.60209613	3.61
AVE	1.64825954	2.16107272	2.2438694	2.23119722	2.70315161	3.44271722
STD	0.08209736	0.14796287	0.13280887	0.07040913	0.13175863	0.17223602
17--1	0.5850234	0.81903276	0.85803432	0.7800312	0.7800312	0.82
17--2	0.55025679	0.73367572	0.66030814	0.62362436	0.69699193	0.77
17--3	0.52513128	0.78769692	0.75018755	0.67516879	0.75018755	0.94
AVE	0.55347049	0.78013513	0.75617667	0.69294145	0.74240356	0.84237557
STD	0.03007511	0.04317802	0.09899905	0.07970367	0.04206332	0.08609446
18--1	0.58439326	0.68752149	0.61876934	0.68752149	0.89377793	1.13
18--2	0.7029877	0.84358524	0.98418278	0.77328647	0.98418278	1.58
18--3	0.65669464	1.02152499	1.1309741	0.94855892	1.09449106	1.31
AVE	0.6480252	0.85087724	0.91130874	0.80312229	0.99081726	1.34317401
STD	0.05977064	0.16712111	0.26376391	0.13305175	0.10052091	0.22513846
19--1	0.79652426	0.76031861	0.76031861	0.79652426	1.15858074	1.38
19--2	0.75976845	0.7959479	0.8683068	0.7959479	0.97684515	1.45
19--3	0.82942661	0.97367472	0.97367472	0.97367472	1.15398485	1.62
AVE	0.79523977	0.84331374	0.86743338	0.85538229	1.09647025	1.48192794
STD	0.03484684	0.11429282	0.10668074	0.10244465	0.10362385	0.12710242
20--1	2.04814948	2.58713618	3.09019044	3.19798778	3.52137981	4.49
20--2	1.87725632	2.27436823	2.41877256	2.63537906	3.35740072	3.83
20--3	1.81356547	2.39390642	2.3213638	2.46644904	3.19187523	3.74
AVE	1.91299042	2.41847028	2.61010894	2.76660529	3.35688525	4.01807185
STD	0.12130585	0.15782422	0.41860579	0.38301759	0.16475289	0.41255319
21--1	3.23135098	3.64386387	4.02200069	4.22825713	4.91577862	5.67
21--2	3.11323982	3.86589121	4.00273691	4.34485118	4.51590831	6.02
21--3	2.83117791	3.67004544	3.77490388	4.26424327	5.24292206	5.91
AVE	3.05858957	3.72660017	3.93321383	4.27911719	4.89153633	5.86676295
STD	0.2056079	0.12133781	0.13743836	0.05970317	0.36411264	0.17802746
22--1	2.95005028	3.78813275	3.78813275	3.82165605	4.32450553	5.30
22--2	-0.4208482	0.03237294	0.12949174	0.25898349	1.81288443	2.98
22--3	2.65339967	3.2172471	3.58208955	3.74792703	3.88059701	4.44
AVE	1.72753393	2.3459176	2.49990468	2.60952219	3.33932899	4.23981192
STD	1.86645644	2.02381923	2.05542126	2.03596	1.34044338	1.1726538
13--1	9.69147005	9.7277677	13.0671506	14.0834846	15.6442831	18.19

13--2	10.2439024	12.120075	13.69606	14.521576	15.6472795	18.87
13--3	9.34680621	11.5120895	12.2699387	13.3525803	14.0743414	18.04
AVE	9.76072623	11.1199774	13.0110498	13.9858803	15.121968	18.3678139
STD	0.4525403	1.2434217	0.71471395	0.59057826	0.90727251	0.44426346
23--1	3.40089316	3.77877018	3.88182755	4.22535211	5.22157334	5.57
23--2	3.26729232	3.30205075	3.92770247	4.2057699	5.21376434	5.39
23--3	3.23843416	3.38078292	3.62989324	4.34163701	4.94661922	5.44
AVE	3.30220655	3.48720128	3.81314109	4.25758634	5.12731897	5.46583141
STD	0.08667459	0.25555627	0.16034637	0.07344557	0.15653927	0.09061304
24--1	4.82093664	5.23415978	6.09504132	6.43939394	8.12672176	9.30
24--2	4.76026216	5.48464988	6.07105899	6.76095205	8.45119007	9.49
24--3	5.1318603	5.52387741	6.55737705	6.80684248	8.41054882	9.12
ave	4.90435303	5.41422902	6.24115912	6.66906282	8.32948688	9.30228584
STD	0.19934898	0.15717315	0.27411516	0.20021821	0.1767716	0.18140818
25--1	6.4908018	7.11558487	8.15688997	9.89239847	10.4824714	10.83
25--2	6.62713638	7.0108127	8.47575863	10.6034182	10.9173352	11.27
25--3	6.35879218	6.82060391	8.31261101	9.37833037	10.7992895	11.08
AVE	6.49224346	6.98233382	8.31508654	9.95804902	10.733032	11.0597288
STD	0.13417791	0.14953838	0.15944875	0.61517684	0.22487592	0.21924651
26--1	1.1279407	1.16016758	1.57911698	1.57911698	1.61134386	1.68
26--2	0.86677368	0.51364366	1.12359551	1.12359551	1.21990369	1.32
26--3	0.90380891	0.67785668	1.32343447	1.38799225	1.48482892	1.52
AVE	0.96617443	0.78388931	1.34204899	1.36356825	1.43869216	1.5030391
STD	0.14131223	0.33605131	0.22833053	0.2287408	0.19975686	0.18020522
27--1	1.81877233	1.88372848	2.46833387	2.53329003	2.69568042	2.76
27--2	1.81523501	2.00972447	2.6904376	2.78768233	2.88492707	2.95
27--3	1.15193026	1.21419676	1.71232877	1.77459527	1.80572852	1.84
AVE	1.59531253	1.70254991	2.29036675	2.36518921	2.462112	2.51575174
STD	0.38398438	0.4275925	0.51276549	0.52704816	0.57626646	0.59549166
28--1	2.92067707	2.75472951	3.65084633	3.98274145	4.3810156	4.48
28--2	2.68001292	2.68001292	3.58411366	3.90700678	4.10074265	4.23
28--3	2.38019676	2.72929229	3.99873056	4.12567439	4.31609013	4.41
AVE	2.66029558	2.7213449	3.74456352	4.00514087	4.26594946	4.37392735
STD	0.2707791	0.03798701	0.22262969	0.11104135	0.1467099	0.12945297
29--1	6.43255661	6.79356744	7.84378077	8.17197243	8.5001641	8.60
29--2	5.19649237	5.65118545	6.88535239	7.0152647	7.21013316	7.31
29--3	4.42897817	4.74533376	5.69440051	6.01075609	6.54856058	6.71
AVE	5.35267572	5.73002888	6.80784455	7.06599774	7.41961928	7.53764245
STD	1.01087911	1.02639053	1.07678432	1.08150099	0.99252325	0.96669873

Considering the influence of MSS on the thickness swelling of composites, reducing the MSS from 3.18 mm to 1.59 mm had no visible influence on thickness swelling of composites. However, with water sorption, there did appear to be a slight increase in water uptake with the larger MSS material as seen in Tables 2 and 3.

Modifying the composites with MAPE reduced the water sorption of composites significantly. Increasing the rWTB content up to 70% increased water sorption as well on the contrary, modifying the extruded composites with silane increased the water sorption and thickness swell of composites as shown in Tables 2 and 3.

Table 3. Thickness Swelling of rWTB composites.

	Time (Hour)					
TS	6	24	48	72	168	336
1--1	1.34357006	1.9193858	2.87907869	3.07101727	4.03071017	6.90978887
1--2	1.17647059	1.37254902	2.15686275	2.35294118	2.94117647	5.88235294
1--3	0.390625	1.7578125	2.5390625	3.515625	3.515625	6.25
AVE	1.07719126	1.88250748	2.49425307	2.73670519	4.00320775	6.19092384
STD	0.436841	0.62651103	0.74600487	0.75687725	1.24807817	1.30199287
3--1	0.19646365	0.39292731	0.19646365	0.39292731	0.39292731	0.58939096
3--2	-0.1934236	0	0.1934236	0.1934236	0.1934236	0.1934236
3--3	0	0	0.19607843	0.19607843	0.19607843	0.19607843
AVE	0.09894653	0.19687046	0.29534228	0.376282	0.35994213	0.53911432
STD	0.17809808	0.20699947	0.28816856	0.28715019	0.31475993	0.42139192
4--1	0.38834951	0.38834951	0.38834951	0.38834951	0.38834951	0.58252427
4--2	0.19417476	0.19417476	0.19417476	0.19417476	0.19417476	0.38834951
4--3	0.38986355	0.38986355	0.38986355	0.38986355	0.38986355	0.58479532
AVE	-0.3980146	-0.3828752	-0.3170623	-0.204044	-0.204044	-0.139256
STD	2.18832097	2.13250353	2.15414735	2.1405359	2.1405359	2.16055287
5--1	0	0	0.38986355	0.19493177	0.19493177	0.38986355
5--2	-0.1949318	-0.1949318	0.19493177	0.19493177	0.19493177	0.38986355
5--3	0.7797271	0.58479532	0.58479532	0.58479532	0.58479532	1.16959064
AVE	0.08144579	0.1140296	0.24427191	0.24433549	0.27714502	0.45631251
STD	0.28165195	0.21136794	0.18858023	0.18870584	0.15524641	0.28043336
6--1	0.39447732	0.59171598	0.59171598	0.59171598	0.59171598	1.77514793
6--2	-0.3838772	-0.3838772	-0.3838772	-0.3838772	-0.3838772	0.57581574
6--3	0	0.19379845	0.19379845	1.5503876	1.5503876	0.58139535
AVE	0.1474104	0.14756587	0.22850867	0.40612686	0.43839561	0.61724491
STD	0.30198208	0.33344809	0.36086331	0.49986937	0.50422693	0.47455621
7--1	0.1934236	0.1934236	0.1934236	0.1934236	0.1934236	0.3868472

7--2	0	0	0	0	0	0.19267823
7--3	-0.1926782	-0.1926782	0.19267823	0.57803468	0.38535645	0.38535645
AVE	0.21108033	0.13011256	0.27527542	0.32369562	0.27521355	0.46898441
STD	0.40206211	0.42666573	0.40255408	0.45770628	0.41096147	0.51541174
8--1	1.35135135	0.19305019	0.38610039	0.57915058	0.57915058	0.57915058
8--2	0.38834951	0.38834951	0.77669903	0.77669903	0.58252427	0.38834951
8--3	0.19230769	0	0.19230769	0.38461538	0.38461538	0.19230769
AVE	0.24168687	0.09702298	0.32218921	0.35427149	0.37020353	0.35420841
STD	0.39590097	0.21018431	0.20845105	0.20009943	0.19308943	0.19975533
9--1	0.38910506	0.58365759	0.77821012	0.77821012	0.77821012	1.16731518
9--2	0	0	0.19417476	0.38834951	0.19417476	0.77669903
9--3	0.58365759	0	0.58365759	0.97276265	0.97276265	0.97276265
AVE	0.29208249	0.25965706	0.47045452	0.61652768	0.63296162	0.89258745
STD	0.22742628	0.23974072	0.25506103	0.24627839	0.31210161	0.30459653
10--1	0.97465887	1.36452242	1.55945419	1.75438596	2.33918129	3.11890838
10--2	0.97087379	1.3592233	1.55339806	1.3592233	3.10679612	3.68932039
10--3	0.96899225	1.35658915	1.5503876	1.74418605	2.90697674	3.48837209
AVE	0.93924515	1.3763653	12.7793702	1.76512773	2.671351	3.40008104
STD	0.1408145	0.13312951	38.7634936	0.24461778	0.25155569	0.29689494
11--1	0.19493177	0.7797271	1.16959064	1.55945419	2.53411306	4.87329435
11--2	0.77369439	1.35396518	1.93423598	1.74081238	3.09477756	4.25531915
11--3	0.96899225	1.35658915	1.5503876	1.74418605	2.90697674	3.87596899
AVE	0.74355564	1.3414807	1.34232715	1.56688996	3.00636989	4.42850976
STD	0.27278514	0.2677226	1.18942364	1.05880615	0.32678635	0.55792789
12--1	0.390625	0.9765625	0.9765625	1.171875	1.953125	2.5390625
12--2	0	0.97087379	0.77669903	1.16504854	2.13592233	3.10679612
12--3	0.58479532	0.58479532	0.97465887	1.36452242	1.75438596	2.53411306
AVE	0.53648238	0.82882239	1.02404158	1.30048443	1.90210493	2.48633694
STD	0.30179558	0.23827965	0.26759908	0.29627506	0.46289606	0.41204386
14--1	0	-0.2004008	-0.4008016	-0.6012024	-0.4008016	-0.4008016
14--2	-0.1984127	-0.1984127	0	0.1984127	0.1984127	0.1984127
14--3	0	-0.3883495	-0.5825243	-0.5825243	0	-0.3883495
AVE	-0.0161263	-0.0488251	-0.130796	-0.0976075	-0.0173348	0.03190921
STD	0.25651693	0.28908923	0.31559272	0.36800888	0.3399315	0.39075481
15--1	-0.1945525	-0.5836576	-0.5836576	-0.9727626	-0.5836576	-0.5836576
15--2	0	-0.1980198	0.1980198	0.3960396	-0.1980198	1.18811881
15--3	0.39138943	0.39138943	0.19569472	0	0.19569472	0.39138943
AVE	-0.0162461	-0.1302215	-0.1460722	-0.1610297	-0.1134273	0.14950775
STD	0.19468221	0.26762771	0.27805512	0.43938177	0.33737685	0.51058761
16--1	0.19646365	0.19646365	0.39292731	0.39292731	0.58939096	0.58939096

16--2	-0.5813953	994086.047	-0.7751938	-0.5813953	-0.1937984	-0.1937984
16--3	-0.1945525	0.19455253	-0.1945525	-0.3891051	0.19455253	0.58365759
AVE	0.00037806	82840.4726	-0.095772	-0.1929533	0.06582518	0.30798303
STD	0.28622208	286967.933	0.40869211	0.30964837	0.43950274	0.40004498
17--1	0	-0.2016129	-0.4032258	-0.2016129	-0.2016129	0
17--2	0	0	0	0.1980198	0	0.1980198
17--3	0.81466395	1.22199593	1.22199593	0.40733198	0.81466395	1.01832994
AVE	-0.064692	-0.0975942	-0.0980695	-0.3348163	-0.2162942	-0.1318899
STD	0.40459671	0.50561148	0.4761742	0.33628823	0.42520842	0.441013
18--1	0	-1.1764706	-0.1960784	-0.1960784	0	0.19607843
18--2	0.19455253	0	0	-0.1945525	0.19455253	0.19455253
18--3	0	0.1984127	0.1984127	0	0.1984127	0.1984127
AVE	-0.0489257	-0.3062381	-0.0314144	0.21561331	-0.0482565	0.03227607
STD	0.12131104	0.65828261	0.37916569	1.18094163	0.22204262	0.20050981
19--1	-1.3671875	-0.78125	-0.5859375	-0.9765625	-0.390625	-0.390625
19--2	0	-0.591716	-0.591716	-0.7889546	-0.591716	-0.591716
19--3	-0.1976285	0	0.39525692	0.19762846	0	0.19762846
AVE	-0.1466098	-0.2289037	-0.1963936	-0.3296205	-0.16573	-0.06602
STD	0.53788036	0.34552865	0.32588274	0.45772728	0.33735436	0.33041635
20--1	0.38535645	0.19267823	0.38535645	0.19267823	0.57803468	0.38535645
20--2	0.19267823	0	0.38535645	0	0.38535645	0.38535645
20--3	0.7751938	0.19379845	0.19379845	0.58139535	0.58139535	0.58139535
AVE	0.27374177	-0.6686711	0.11230324	0.12895148	0.28923636	0.32135168
STD	0.22559109	1.18698051	0.20912796	0.19047501	0.24009225	0.22258933
21--1	0.19267823	0.19267823	0.57803468	-0.3853565	0.96339114	1.15606936
21--2	0.19455253	0	0.19455253	0.19455253	0.38910506	0.58365759
21--3	0	-0.78125	-0.78125	-0.1953125	-0.5859375	-0.1953125
AVE	0.14613156	-0.5464804	0.03210618	-0.0312986	0.275407	0.43734752
STD	0.39018233	0.73633206	0.45924495	0.37613051	0.42585005	0.42270296
22--1	0.96899225	0.19379845	0.58139535	0.19379845	0.7751938	0.96899225
22--2	0	0	-0.1937984	-0.5813953	-0.1937984	0
22--3	0	-0.2312139	0	0.19267823	0.57803468	0.77071291
AVE	0.42175234	-0.4021977	0.09755729	0.16259986	0.56714062	0.69605818
STD	0.74102733	0.84167834	0.41784384	0.42831807	0.50776318	0.44293196
13--1	0.38387716	0.76775432	1.15163148	1.34357006	2.68714012	3.64683301
13--2	0.96153846	1.34615385	1.34615385	1.53846154	4.23076923	5.19230769
13--3	0.58479532	1.16959064	1.36452242	1.94931774	3.11890838	5.06822612
AVE	0.73845853	0.10642935	1.3329064	1.62187476	2.72896774	4.26703832
STD	0.34673284	1.88608293	0.48406853	0.40266763	0.76018646	0.90419193
23--1	0.39761431	0.59642147	1.19284294	1.19284294	1.19284294	2.7833002

23--2	0.19455253	0.58365759	0.58365759	0.77821012	1.55642023	2.14007782
23--3	0	0	0.19417476	0.38834951	0.77669903	0.97087379
AVE	0.37390277	0.50383382	0.73197899	0.74875775	1.10493553	1.8059298
STD	0.31464887	0.32509006	0.47049418	0.58554607	0.36317126	0.72839122
24--1	0.19920319	0.39840637	0.79681275	0.99601594	1.5936255	2.58964143
24--2	0.39292731	0.58939096	0.78585462	0.98231827	1.57170923	2.1611002
24--3	0.19607843	0.19607843	0.39215686	0.58823529	0.98039216	2.15686275
AVE	0.27763944	0.16606018	0.41213683	0.67403877	1.16474936	2.34347547
STD	0.30297441	0.42303097	0.4466812	0.38062985	0.36415334	0.48710697
25--1	0.97276265	1.3618677	0.97276265	-0.3891051	2.33463035	3.307393
25--2	0.58139535	0.7751938	1.1627907	1.35658915	2.13178295	3.68217054
25--3	0.19379845	0.7751938	0.96899225	1.35658915	2.13178295	3.29457364
AVE	0.45116983	0.83739447	0.96664929	1.09952975	1.75924204	2.90079797
STD	0.36103677	0.35238932	0.20564426	0.78459873	0.68956691	0.68802374
26--1	0.19493177	0.19493177	0	0.19493177	0.7797271	0.97465887
26--2	0	0.19685039	0.39370079	0.59055118	0.98425197	0.98425197
26--3	0	0.19493177	0.38986355	0.58479532	0.58479532	0.97465887
AVE	0.00046571	-0.0152772	-0.0149042	0.08262402	0.29396033	0.50416634
STD	0.14217507	0.23949184	0.39037919	0.47647938	0.59713252	0.64629725
27--1	0.1953125	0.390625	0.1953125	0.390625	0.5859375	0.78125
27--2	0	0	0	0.19569472	0.19569472	0.58708415
27--3	0	0	0	0.1980198	0.3960396	0.79207921
AVE	0.11425168	0.17951598	0.21200411	0.30991819	0.45682078	0.65277685
STD	0.10085458	0.15545966	0.15526831	0.13046351	0.17355706	0.17489093
28--1	0	0.39138943	0.39138943	0.39138943	0.58708415	2.15264188
28--2	0.1953125	0.390625	0.5859375	0.78125	0.9765625	1.5625
28--3	0.39525692	0	0.19762846	0.59288538	0.59288538	1.38339921
AVE	0.08186201	0.1959193	0.29408819	0.62104836	0.73536437	1.35660623
STD	0.17704438	0.23642347	0.27063379	0.54055907	0.38343905	0.44541389
29--1	0	0.19417476	0.19417476	0.38834951	1.16504854	1.55339806
29--2	0	0.19646365	0.58939096	0.78585462	1.17878193	2.1611002
29--3	0.19685039	0.39370079	0.59055118	0.59055118	1.37795276	2.55905512
AVE	0.1142533	0.29396264	0.4736716	0.70256093	1.11090601	2.15626204
STD	0.1310061	0.21350151	0.22865448	0.28425923	0.31783635	0.50658062

Table 3. continue….

	Time (Hour)					
TS	504	672	840	1008	1344	2016
1--1	7.67754319	10.7485605	11.3243762	11.9001919	13.6276392	13.6276392

1--2	6.66666667	8.62745098	9.01960784	9.21568627	10.9803922	11.1764706
1--3	8.203125	9.375	10.7421875	10.3515625	10.9375	12.890625
AVE	7.28705406	8.30320288	9.20272609	9.86032703	11.0666804	10.2372529
STD	1.45988099	1.53890084	1.51718186	1.45125959	1.72519295	4.66901806
3--1	1.37524558	1.76817289	1.57170923	1.57170923	1.37524558	1.17878193
3--2	0.1934236	0	0	0.1934236	0.3868472	0.58027079
3--3	0.19607843	0	0	0.19607843	0.19607843	0.39215686
AVE	0.62077268	0.55551776	0.4899669	0.52237195	0.60512515	0.63661438
STD	0.60860572	0.63064015	0.51253654	0.42170067	0.41933839	0.25641056
4--1	0.58252427	-1.3592233	-0.9708738	0.77669903	1.16504854	1.16504854
4--2	0.38834951	0.38834951	0.38834951	0.77669903	0.58252427	0.97087379
4--3	0.7797271	0.58479532	0.58479532	0.7797271	0.58479532	0.7797271
AVE	-0.1227227	-0.3167965	-0.2191355	0.10541112	0.18572317	0.32987471
STD	2.1658745	2.17485507	2.18180377	2.23497595	2.20925351	2.13362033
5--1	0.19493177	0.38986355	0.38986355	0.58479532	0.58479532	0.7797271
5--2	0.19493177	0	0.19493177	0.58479532	0.97465887	1.36452242
5--3	1.16959064	1.36452242	1.55945419	0.58479532	3.31384016	3.7037037
AVE	0.48886509	0.55400299	0.61917098	0.66847726	1.09064157	1.22066166
STD	0.33837003	0.43112887	0.43908719	0.40480853	0.78123033	0.85154053
6--1	2.56410256	1.18343195	1.57790927	3.15581854	2.95857988	2.76134122
6--2	0.38387716	0.57581574	0.57581574	-0.5758157	1.34357006	1.34357006
6--3	1.1627907	1.9379845	1.9379845	1.5503876	1.35658915	1.5503876
AVE	0.84433366	0.85842727	0.9237007	0.78075861	1.55412885	1.69869336
STD	0.63758052	0.52948116	0.57361401	1.05043744	0.57390525	0.45016325
7--1	0.3868472	0	0.1934236	0	0.1934236	0.58027079
7--2	0.19267823	0.38535645	0.57803468	0.57803468	0.38535645	0.77071291
7--3	0.38535645	0.57803468	0.57803468	0.19267823	0.96339114	0.77071291
AVE	0.42065938	0.3718044	0.3878924	0.27537264	0.50097467	0.53305574
STD	0.47692301	0.5021532	0.47796536	0.52107566	0.49499155	0.4712489
8--1	0.57915058	0.57915058	0.57915058	0.96525097	1.35135135	1.54440154
8--2	0.58252427	0.38834951	0.58252427	1.16504854	0.97087379	0.97087379
8--3	0.19230769	0.19230769	0.38461538	-0.1923077	0.38461538	0.19230769
ave	0.35436352	0.35430057	0.35451863	0.45175955	0.62779134	0.6922356
STD	0.21604767	0.23062189	0.29556511	0.52424461	0.46653141	0.49750974
9--1	0.97276265	0.97276265	1.16731518	1.75097276	1.3618677	1.55642023
9--2	1.16504854	0.97087379	1.16504854	0.97087379	2.33009709	2.7184466
9--3	0.97276265	1.3618677	1.3618677	1.75097276	1.94552529	1.94552529
AVE	0.92485497	0.95743854	1.00607679	1.34768479	1.39534295	1.55778671
STD	0.35333269	0.36580357	0.34993544	0.42040747	0.41946608	0.50288309
10--1	3.89863548	4.87329435	5.06822612	5.84795322	6.23781676	7.79727096

10--2	4.27184466	5.24271845	5.4368932	6.01941748	6.60194175	9.32038835
10--3	4.06976744	4.84496124	5.62015504	5.81395349	6.39534884	7.94573643
AVE	4.11212932	4.93756959	5.26173351	5.69891503	6.83306268	8.0309566
STD	0.26118174	0.45415511	0.42095934	0.32948206	0.67567681	0.65672426
11--1	7.21247563	7.21247563	7.60233918	7.40740741	8.1871345	9.35672515
11--2	5.22243714	6.57640232	7.15667311	7.73694391	8.1237911	10.4448743
11--3	4.84496124	6.00775194	6.39534884	7.17054264	7.94573643	10.0775194
AVE	5.6097471	6.53110933	7.12890846	7.5812947	8.24397628	10.5866272
STD	0.81052761	1.01532899	0.92879832	1.00711989	0.8319602	0.56274501
12--1	3.3203125	5.6640625	6.8359375	7.2265625	7.6171875	8.0078125
12--2	4.85436893	6.99029126	7.37864078	7.37864078	8.15533981	8.73786408
12--3	3.11890838	5.84795322	5.84795322	5.65302144	6.62768031	8.1871345
AVE	3.4624089	4.58407203	5.0722643	5.26713534	5.8682756	6.72993464
STD	1.00296003	1.69620505	1.90258778	1.82506386	2.06528568	2.28148588
14--1	0.4008016	-0.2004008	-0.2004008	0	0	0
14--2	0.79365079	1.19047619	0.99206349	0.79365079	0.99206349	1.19047619
14--3	-0.1941748	0.38834951	0.19417476	0.38834951	0.38834951	0.38834951
AVE	0.29615746	0.37771881	0.36150828	0.39413388	0.41066827	0.70376888
STD	0.35919202	0.44683726	0.41708197	0.38172628	0.40423776	1.21941002
15--1	-0.3891051	-0.1945525	0.19455253	0	0	0.19455253
15--2	0.79207921	1.18811881	0.99009901	1.18811881	1.18811881	1.18811881
15--3	0.39138943	0.58708415	0.39138943	0.58708415	0.58708415	0.78277886
AVE	0.19875709	0.52518472	0.50875616	0.54208274	0.54208274	0.62356137
STD	0.45061657	0.44602844	0.36109716	0.47614623	0.47614623	0.4431879
16--1	0.98231827	1.57170923	1.57170923	1.57170923	1.57170923	1.57170923
16--2	0.19379845	0.96899225	1.1627907	0.96899225	0.96899225	1.35658915
16--3	0.58365759	1.3618677	1.3618677	1.3618677	1.3618677	1.3618677
AVE	84133.0279	11.476928	0.97031123	0.98633687	1.00261145	1.16373784
STD	291443.338	36.5795424	0.32500725	0.29686366	0.3231916	0.27815726
17--1	0	0.2016129	0	0.2016129	0.2016129	0
17--2	0.1980198	0.99009901	0.79207921	0.79207921	0.79207921	0.59405941
17--3	0	1.22199593	1.01832994	0.81466395	0.81466395	1.01832994
AVE	-0.1006067	0.11815693	0.01839343	0.00155567	0.00142287	0.06720856
STD	0.2175581	0.50326694	0.49547592	0.49099345	0.48368027	0.44128271
18--1	0	0.19607843	0.39215686	0.19607843	0.19607843	0
18--2	0.38910506	0.19455253	0.38910506	0.38910506	0.19455253	0.19455253
18--3	0.3968254	0.1984127	0.1984127	0.1984127	0.1984127	0.3968254
AVE	0.17861351	0.29292528	0.19570263	0.17942684	0.16321413	0.16350273
STD	0.22637788	0.19627032	0.1662581	0.19462757	0.18334974	0.21835175
19--1	-0.1953125	0	-0.1953125	-0.1953125	-0.1953125	-0.390625

19--2	-0.3944773	-0.3944773	-0.3944773	-0.3944773	-0.3944773	-0.1972387
19--3	0.39525692	1.18577075	0.98814229	0.98814229	0.39525692	0.59288538
AVE	0.00016297	0.27889504	0.14703347	0.16383454	0.09802323	0.14778783
STD	0.26604287	0.50954343	0.50769208	0.48329832	0.41748175	0.41440741
20--1	0.77071291	1.15606936	1.54142582	1.34874759	1.34874759	1.54142582
20--2	0.77071291	0.77071291	0.57803468	0.77071291	0.77071291	0.77071291
20--3	0.96899225	0.96899225	0.96899225	0.7751938	0.7751938	0.7751938
AVE	0.49859804	0.83635059	0.82051057	0.82048091	0.83653743	0.90073298
STD	0.27904282	0.26479991	0.34123742	0.36109133	0.35353531	0.33320579
21--1	1.34874759	1.73410405	1.73410405	1.54142582	1.73410405	1.92678227
21--2	0.97276265	1.3618677	1.16731518	1.3618677	1.55642023	1.75097276
21--3	0	1.3671875	1.5625	1.5625	1.5625	1.171875
AVE	0.79384919	1.1996584	1.26428911	1.37799945	1.41026868	1.50742528
STD	0.50048967	0.4051767	0.36582935	0.39405143	0.40756731	0.40825048
22--1	1.1627907	1.9379845	1.9379845	2.13178295	2.3255814	2.51937984
22--2	0.58139535	1.1627907	1.35658915	1.35658915	1.35658915	1.1627907
22--3	0.96339114	0.96339114	0.96339114	1.15606936	1.15606936	0.96339114
AVE	1.00309962	1.34363137	1.35990852	1.39202046	1.4242886	1.53733818
STD	0.30981466	0.7132686	0.70163292	0.64925004	0.62991572	0.58522314
13--1	6.33397313	7.67754319	7.67754319	8.06142035	8.4452975	9.21305182
13--2	6.15384615	8.26923077	8.26923077	8.46153846	9.42307692	10.3846154
13--3	6.23781676	7.40740741	7.99220273	8.57699805	8.9668616	9.55165692
AVE	5.47098925	6.5945719	7.15692926	7.63683207	8.13481038	8.93700246
STD	0.8899365	1.2534309	1.1837623	0.89721022	0.75976101	0.67781393
23--1	2.7833002	2.98210736	3.57852883	3.57852883	3.57852883	3.57852883
23--2	2.14007782	2.14007782	3.11284047	2.91828794	2.91828794	3.11284047
23--3	1.3592233	1.3592233	2.7184466	2.91262136	3.49514563	3.49514563
AVE	1.96873527	2.05047681	2.73344624	2.74959598	2.8952273	2.99250417
STD	0.7057245	0.62558241	0.51671928	0.51902433	0.4966262	0.49132886
24--1	2.98804781	3.187251	4.18326693	4.18326693	4.38247012	4.38247012
24--2	2.5540275	2.75049116	3.33988212	3.53634578	3.92927308	4.12573674
24--3	2.74509804	3.33333333	3.7254902	3.92156863	4.11764706	4.11764706
AVE	2.59006205	2.91837701	3.54259547	3.7552801	3.98485194	4.06700274
STD	0.42533178	0.35945326	0.47630321	0.39661312	0.40436273	0.44917251
25--1	4.08560311	4.47470817	5.25291829	5.44747082	5.64202335	5.64202335
25--2	4.45736434	5.03875969	5.81395349	6.00775194	6.39534884	6.58914729
25--3	4.65116279	5.03875969	5.62015504	5.81395349	6.00775194	6.00775194
AVE	3.36865483	3.65911004	5.05928846	5.22097714	5.47888578	5.54336103
STD	0.83739374	0.93223388	0.89877195	0.94018986	0.92958268	0.96925786
26--1	0.7797271	5.06822612	1.36452242	1.36452242	1.16959064	1.36452242

26--2	1.37795276	1.57480315	1.57480315	1.57480315	1.57480315	1.57480315
26--3	0.7797271	0.7797271	0.7797271	0.7797271	0.58479532	0.58479532
AVE	0.53681561	0.8946035	0.61798168	0.61798168	0.52070782	0.63394592
STD	0.67165521	1.4836789	0.66678258	0.66678258	0.57722168	0.61559048
27--1	0.78125	0.9765625	1.171875	1.171875	1.171875	1.171875
27--2	0.58708415	0.78277886	0.78277886	0.78277886	0.58708415	0.78277886
27--3	0.59405941	0.3960396	1.18811881	0.99009901	0.79207921	0.99009901
AVE	0.65258359	0.71752598	0.88096711	0.81566894	0.75033879	0.78314833
STD	0.17385889	0.22527394	0.3488349	0.35169859	0.35132178	0.35354341
28--1	2.15264188	1.95694716	2.15264188	2.15264188	2.15264188	2.15264188
28--2	1.3671875	1.5625	1.5625	1.5625	1.7578125	1.7578125
28--3	0.98814229	0.98814229	1.58102767	1.58102767	1.38339921	1.58102767
AVE	1.4053996	1.48709945	1.66722577	1.9946973	1.8304321	1.84693311
STD	0.3712029	0.36750599	0.28348667	1.13964548	0.31527203	0.2824595
29--1	1.94174757	1.94174757	2.13592233	1.94174757	1.74757282	1.94174757
29--2	2.35756385	2.5540275	2.75049116	2.5540275	2.35756385	2.35756385
29--3	2.95275591	2.95275591	3.1496063	2.95275591	2.95275591	3.1496063
AVE	2.33546149	2.48233194	2.61343476	2.54813749	2.45012812	2.56454169
STD	0.40959755	0.36262681	0.38494453	0.37225483	0.37610841	0.39532837

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