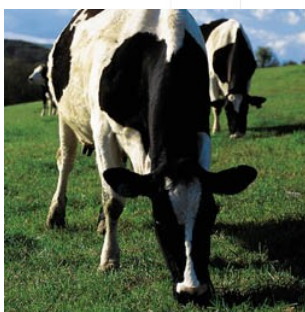


# Moisture Regulation of Wool and Polyester Based Insulation Materials

Terra Lana Limited

Client Report CLR 12-46 (FBP 23102)

September 2012





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September 2012

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A handwritten signature in black ink, appearing to read "S. Collie".

Dr Stewart Collie  
Team Leader  
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## 1. Aim

The aim of this research was to provide data to support the hypothesis that wool insulation provides a healthier living environment due to its ability to buffer changes in the humidity.

## 2. Materials

Two samples of nonwoven insulation material were supplied by Terra Lana:

- Wool blend
- Polyester

Test sample size = 25 cm by 40 cm

The samples were placed in a conditioned environment of 20°C and 60% relative humidity for 48 hours.

## 3. Method

The conditioned samples were weighed and each one placed on a zeroed three decimal place balance located inside a Contherm Precision environment chamber. The chamber had been pre-conditioned to 50% humidity and 20°C. The samples were then subjected to a cycle of humidity changes, with the temperature being held at constant 20°C. The cycle schedule is shown in Figure 1.

The sample weights, temperature and humidity were recorded every hour. In order to eliminate the issue of vibration the Contherm was switched off whilst weights were recorded. The full schedule equates to a 72 hour/3 day period and the daily plan is given in Table 1.



**Figure 1: Humidity Cycle Schedule**

**Table 1. Daily plan.**

Day	1	2	3	4	5	6	7
Activity	8 hours at 50%	Change from 50-90% (10% per hour) over 4 hours then hold at 90% for 8 hours	Change from 90-50% over 4 hours (10% per hour) then hold at 50% for 8 hours	Change from 50-90% over 4 hour (10% per hour) then hold at 90% for 8 hours	Change from 90-50% over 4 hours (10% per hour) then hold at 50% for 8 hours	Change from 50-90% over 4 hours (10% per hour) then hold at 90% for 8 hours	Change from 90-50% over 4 hours
Time (hours)	8	12	12	12	12	12	4
Measurements	9	13	13	13	13	13	5
Measurement Timing	8am-4pm	8am-8pm	8am-8pm	8am-8pm	8am-8pm	8am-8pm	8am-12pm

## 4. Results

The appendix contains the full data set obtained over the test period; no data was collected during the overnight periods.

To facilitate interpretation the results have been graphically represented.

Figure 2 shows the total weight of each sample throughout the duration of the trial. There are two Y axes, as the polyester insulation is far less dense than the wool and this allows the two samples to be viewed on the same chart. This chart clearly illustrates the difference in the magnitude of the changes in sample weight at different humidity levels. The wool fabric's weight changes to a much greater degree than the polyester, both in terms of absorbing moisture at high humidity and releasing it at low humidity.

Figure 3 represents the actual weight losses and increases for each sample. The results have been obtained by subtracting the original conditioned sample weight from each measurement. The wool sample was absorbing up to 6 grams of water at 90% humidity whilst the polyester only absorbed up to 0.578 grams. In addition the wool sample was releasing up to 5.7 grams of water at 50% humidity whilst the polyester was only releasing up to 0.628 grams. This clearly demonstrates wool's ability to respond to a change in the humidity of the environment and provide a buffering effect by absorbing moisture in a high humidity environment and releasing it in a low humidity environment.

It was also noted that overnight, when the samples were held at either 50% or 90% for the following day, the wool sample continued to absorb or release moisture (0.5-0.9 grams), whilst the polyester exhibited negligible change (0.02-0.045 grams).

## 5. Discussion

This preliminary trial has demonstrated that the wool insulation sample is capable of absorbing and releasing moisture to the surrounding environment as the humidity levels change. The polyester sample did exhibit some ability to absorb and release moisture but at an order of magnitude ten times less than the wool fabric.

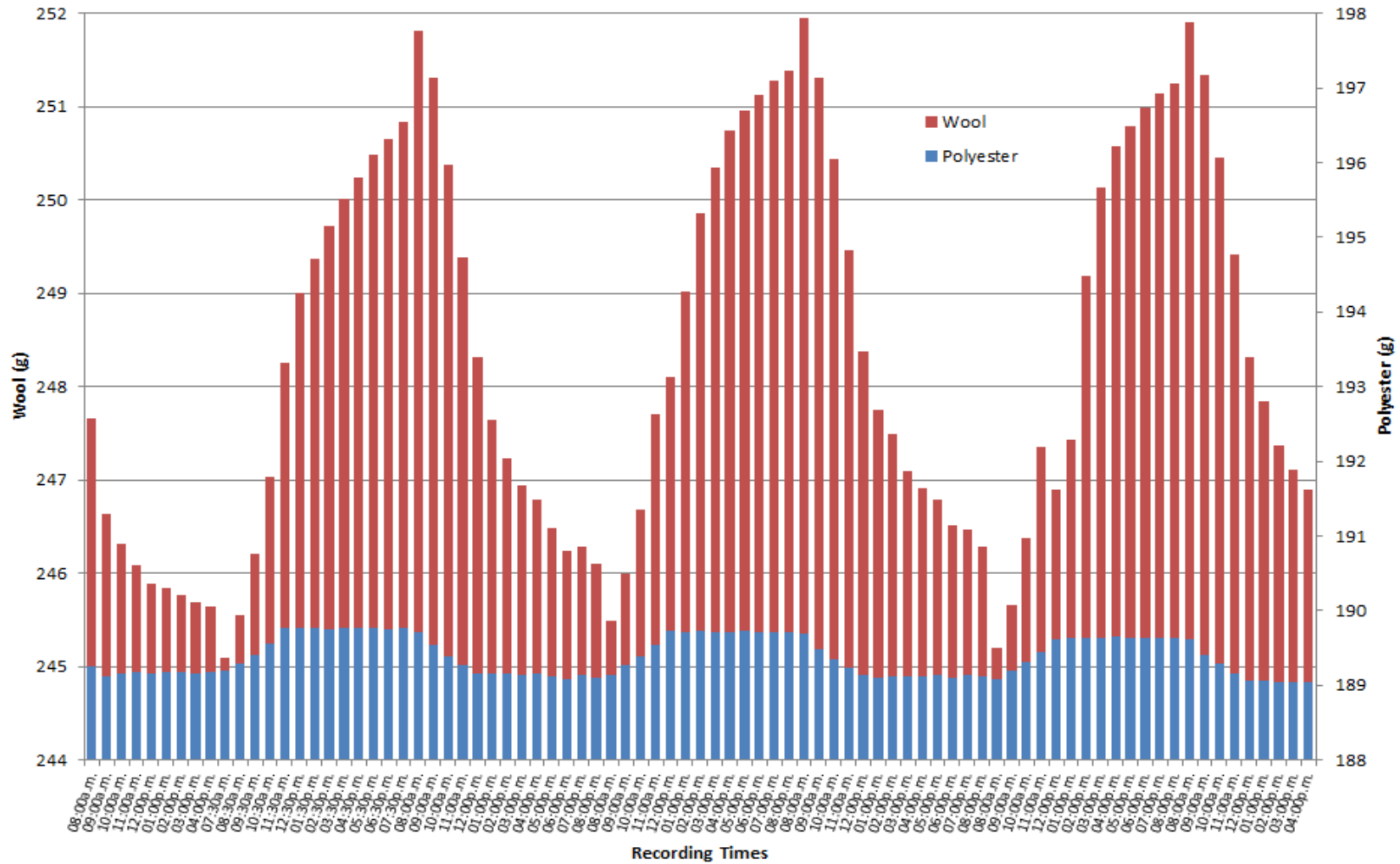


Figure 2. Effect of humidity flux on weight of insulation materials.

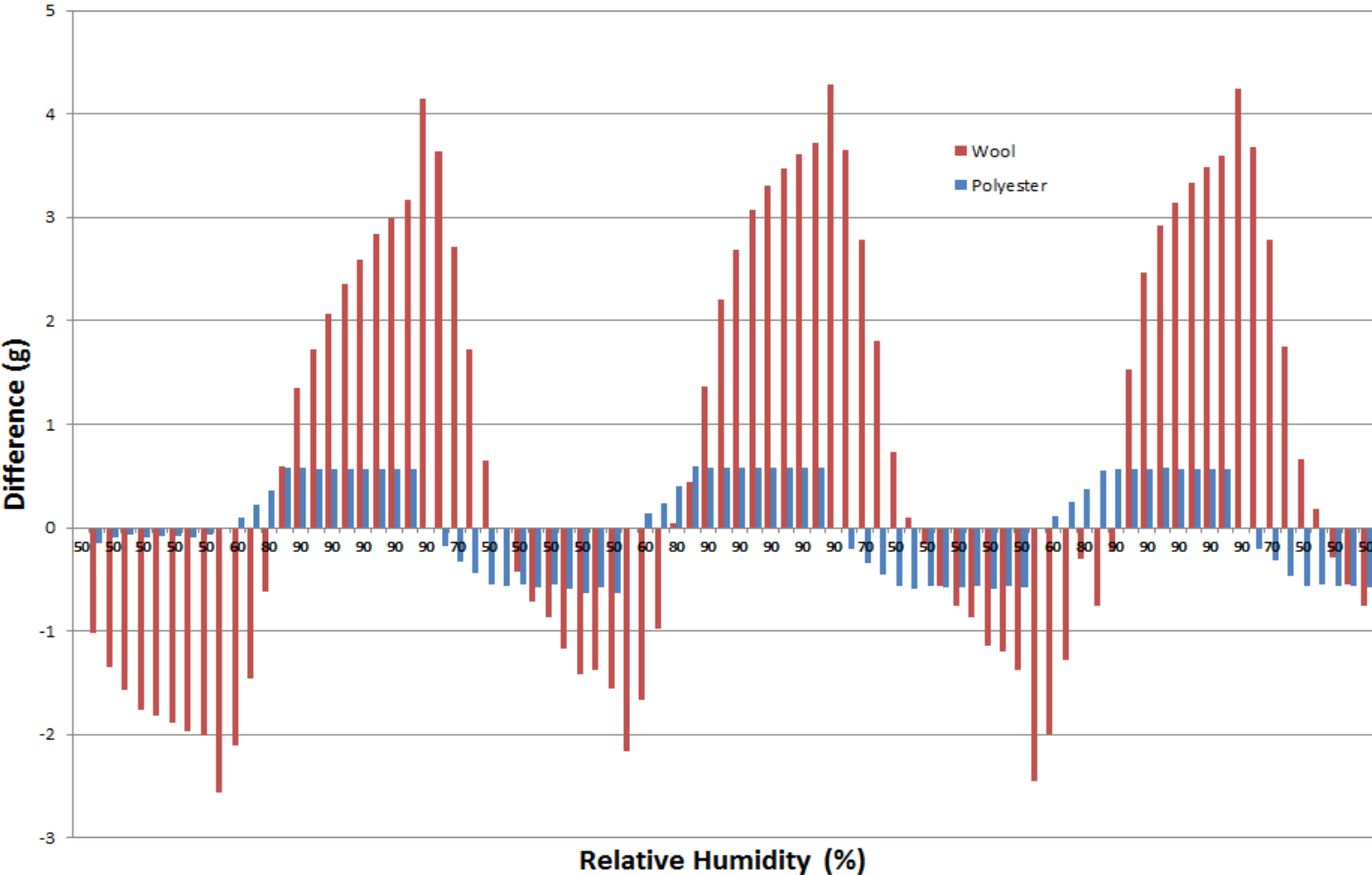


Figure 3. Humidity response of wool and polyester insulation.



## Appendix

### Moisture Trial Data

Day 1 Measurement Time	Target Relative Humidity	WEIGHT (g)						Temperature/ Relative Humidity
		Wool Sample	Difference	Overall Difference	Polyester Sample	Difference	Overall Difference	
08:00a.m.	50	247.658	N/A	N/A	189.257	N/A	N/A	-
09:00a.m.	50	246.636	-1.022	-1.022	189.112	-0.145	-0.145	19.0°C/52%
10:00a.m.	50	246.314	-0.322	-1.344	189.165	0.053	-0.092	-
11:00a.m.	50	246.086	-0.228	-1.572	189.186	0.021	-0.071	20.7°C/56%
12:00p.m.	50	245.890	-0.196	-1.768	189.162	-0.024	-0.095	20.7°C/52%
01:00p.m.	50	245.835	-0.055	-1.823	189.175	0.013	-0.082	20.7°C/55%
02:00p.m.	50	245.764	-0.071	-1.894	189.177	0.002	-0.080	20.7°C/49%
03:00p.m.	50	245.694	-0.070	-1.964	189.165	-0.012	-0.092	20.4°C/54%
04:00p.m.	50	245.651	-0.043	-2.007	189.182	0.017	-0.075	19.9°C/52%

Day 2 Measurement Time	Target Relative Humidity	WEIGHT (g)						Temperature/ Relative Humidity
		Wool Sample	Difference	Overall Difference	Polyester Sample	Difference	Overall Difference	
07:30a.m.	50	245.098			189.196			20.5°C/52%
08:30a.m.	60	245.548	0.450	0.450	189.297	0.101	0.101	20.6°C/59%
09:30a.m.	70	246.202	0.654	1.104	189.412	0.115	0.216	20.7°C/71%
10:30a.m.	80	247.036	0.834	1.938	189.561	0.149	0.365	20.7°C/80%
11:30a.m.	90	248.257	1.221	3.159	189.773	0.212	0.577	20.4°C/90%
12:30p.m.	90	249.006	0.749	3.908	189.771	-0.002	0.575	20.4°C/91%
01:30p.m.	90	249.376	0.370	4.278	189.767	-0.004	0.571	20.4°C/91%
02:30p.m.	90	249.722	0.346	4.624	189.759	-0.008	0.563	20.3°C/89%
03:30p.m.	90	250.008	0.286	4.910	189.764	0.005	0.568	20.3°C/90%
04:30p.m.	90	250.247	0.239	5.149	189.760	-0.004	0.564	20.3°C/90%
05:30p.m.	90	250.490	0.243	5.392	189.766	0.006	0.570	20.5°C/91%
06:30p.m.	90	250.653	0.163	5.555	189.755	-0.011	0.559	20.3°C/89%
07:30p.m.	90	250.829	0.176	5.731	189.765	0.010	0.569	20.5°C/91%

Day 3 Measurement Time	Target Relative Humidity	WEIGHT (g)						Temperature/ Relative Humidity
		Wool Sample	Difference	Overall Difference	Polyester Sample	Difference	Overall Difference	
08:00a.m.	90	251.812			189.720			20.3°C/90%
09:00a.m.	80	251.302	-0.510	-0.510	189.543	-0.177	-0.177	20.5°C/81%
10:00a.m.	70	250.372	-0.930	-1.440	189.391	-0.152	-0.329	20.4°C/69%
11:00a.m.	60	249.380	-0.992	-2.432	189.274	-0.117	-0.446	20.1°C/62%
12:00p.m.	50	248.310	-1.070	-3.502	189.165	-0.109	-0.555	20.6°C/52%
01:00p.m.	50	247.647	-0.663	-4.165	189.151	-0.014	-0.569	20.7°C/49%
02:00p.m.	50	247.227	-0.420	-4.585	189.166	0.015	-0.554	20.6°C/53%
03:00p.m.	50	246.947	-0.280	-4.865	189.144	-0.022	-0.576	20.6°C/50%
04:00p.m.	50	246.785	-0.162	-5.027	189.164	0.020	-0.556	20.1°C/50%
05:00p.m.	50	246.488	-0.297	-5.324	189.124	-0.040	-0.596	20.0°C/50%
06:00p.m.	50	246.233	-0.255	-5.579	189.085	-0.039	-0.635	19.9°C/51%
07:00p.m.	50	246.280	0.047	-5.532	189.145	0.060	-0.575	20.1°C/51%
08:00p.m.	50	246.102	-0.178	-5.710	189.092	-0.053	-0.628	19.9°C/49%

Day 4 Measurement Time	Target Relative Humidity	WEIGHT (g)						Temperature/ Relative Humidity
		Wool Sample	Difference	Overall Difference	Polyester Sample	Difference	Overall Difference	
08:00a.m.	50	245.498			189.138			20.7°C/49%
09:00a.m.	60	245.993	0.495	0.495	189.272	0.134	0.134	20.5°C/63%
10:00a.m.	70	246.681	0.688	1.183	189.379	0.107	0.241	20.7°C/72%
11:00a.m.	80	247.704	1.023	2.206	189.533	0.154	0.395	20.7°C/81%
12:00p.m.	90	248.106	0.402	2.608	189.726	0.193	0.588	20.4°C/90%
01:00p.m.	90	249.018	0.912	3.520	189.717	-0.009	0.579	20.4°C/89%
02:00p.m.	90	249.866	0.848	4.368	189.723	0.006	0.585	20.5°C/91%
03:00p.m.	90	250.345	0.479	4.847	189.719	-0.004	0.581	20.3°C/90%
04:00p.m.	90	250.737	0.392	5.239	189.718	-0.001	0.580	20.3°C/89%
05:00p.m.	90	250.959	0.222	5.461	189.723	0.005	0.585	20.3°C/91%
06:00p.m.	90	251.130	0.171	5.632	189.720	-0.003	0.582	20.4°C/91%
07:00p.m.	90	251.275	0.145	5.777	189.716	-0.004	0.578	20.3°C/89%
08:00p.m.	90	251.385	0.110	5.887	189.716	0.000	0.578	20.3°C/90%

Day 5 Measurement Time	Target Relative Humidity	WEIGHT (g)						Temperature/ Relative Humidity
		Wool Sample	Difference	Overall Difference	Polyester Sample	Difference	Overall Difference	
08:00a.m.	90	251.945			189.696			20.5°C/90%
09:00a.m.	80	251.303	-0.642	-0.642	189.487	-0.209	-0.209	20.7°C/81%
10:00a.m.	70	250.439	-0.864	-1.506	189.353	-0.134	-0.343	20.7°C/71%
11:00a.m.	60	249.458	-0.981	-2.487	189.241	-0.112	-0.455	20.5°C/62%
12:00 p.m.	50	248.382	-1.076	-3.563	189.134	-0.107	-0.562	20.7°C/53%
01:00p.m.	50	247.750	-0.632	-4.195	189.109	-0.025	-0.587	20.7°C/48%
02:00p.m.	50	247.496	-0.254	-4.449	189.126	0.017	-0.570	20.7°C/51%
03:00p.m.	50	247.098	-0.398	-4.847	189.114	-0.012	-0.582	20.5°C/52%
04:00p.m.	50	246.907	-0.191	-5.038	189.114	0.000	-0.582	20.7°C/50%
05:00p.m.	50	246.791	-0.116	-5.154	189.135	0.021	-0.561	20.6°C/53%
06:00p.m.	50	246.520	-0.271	-5.425	189.099	-0.036	-0.597	20.5°C/49%
07:00p.m.	50	246.466	-0.054	-5.479	189.136	0.037	-0.560	20.7°C/53%
08:00p.m.	50	246.282	-0.184	-5.663	189.117	-0.019	-0.579	20.5°C/53%

Day 6 Measurement Time	Target Relative Humidity	WEIGHT (g)						Temperature/ Relative Humidity
		Wool Sample	Difference	Overall Difference	Polyester Sample	Difference	Overall Difference	
08:00a.m.	50	245.207			189.074			20.9°C/48%
09:00a.m.	60	245.666	0.459	0.459	189.189	0.115	0.115	20.3°C/60%
10:00a.m.	70	246.370	0.704	1.163	189.316	0.127	0.242	20.5°C/71%
11:00a.m.	80	247.350	0.980	2.143	189.444	0.128	0.370	20.7°C/80%
12:00p.m.	90	246.900	-0.450	1.693	189.625	0.181	0.551	20.5°C/90%
01:00p.m.	90	247.428	0.528	2.221	189.642	0.017	0.568	20.4°C/90%
02:00p.m.	90	249.188	1.760	3.981	189.644	0.002	0.570	20.4°C/90%
03:00p.m.	90	250.130	0.942	4.923	189.644	0.000	0.570	20.3°C/90%
04:00p.m.	90	250.576	0.446	5.369	189.648	0.004	0.574	20.5°C/90%
05:00p.m.	90	250.797	0.221	5.590	189.640	-0.008	0.566	20.3°C/89%
06:00p.m.	90	250.989	0.192	5.782	189.637	-0.003	0.563	20.3°C/90%
07:00p.m.	90	251.147	0.158	5.940	189.640	0.003	0.566	20.4°C/89%
08:00p.m.	90	251.251	0.104	6.044	189.635	-0.005	0.561	20.3°C/89%

Day 7 Measurement Time	Target Relative Humidity	WEIGHT (g)						Temperature/ Relative Humidity
		Wool Sample	Difference	Overall Difference	Polyester Sample	Difference	Overall Difference	
08:00a.m.	90	251.899			189.618			20.3°C/90%
09:00a.m.	80	251.335	-0.564	-0.564	189.406	-0.212	-0.212	20.7°C/80%
10:00a.m.	70	250.448	-0.887	-1.451	189.297	-0.109	-0.321	20.5°C/72%
11:00a.m.	60	249.412	-1.036	-2.487	189.156	-0.141	-0.462	20.3°C/63%
12:00p.m.	50	248.313	-1.099	-3.586	189.059	-0.097	-0.559	20.5°C/53%
01:00p.m.	50	247.837	-0.476	-4.062	189.065	0.006	-0.553	20.7°C/53%
02:00p.m.	50	247.371	-0.466	-4.528	189.052	-0.013	-0.566	20.7°C/55%
03:00p.m.	50	247.109	-0.262	-4.790	189.048	-0.004	-0.570	20.3°C/51%
04:00p.m.	50	246.900	-0.209	-4.999	189.045	-0.003	-0.573	20.5°C/49%

