



ExpeDRY

TESTING / DURABILITY / IN-FIELD TESTING / TOXICITY / ENVIRONMENTAL IMPACT

ALLIED
FEATHER
+ DOWN

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DURABILITY

IN-FIELD TESTING

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ExpeDRY™ is a new chemical-free alternative to WR treated hydrophobic down that performs better in real world situations, assists in consumer care and uses significantly fewer resources to produce.

Key advantages over existing hydrophobic treated down

dramatically lower environmental impact in production
performs as well or better in real world scenarios
chemical free / no PFAS or PFOA concerns
permanent
non-toxic

ExpeDRY™ is an active insulation to help keep the insulation chambers drier and ultimately maximize warmth and thermoregulation in extreme conditions.

ExpeDRY works through a permanent and chemical-free bonding of non-toxic gold particles to the down cluster which actively attack humidity inside the insulation and keeps the entire chamber, including the insulation, dry in extreme conditions.

The ExpeDRY gold particles create an electro-static shield that provides a small hydrophobic barrier and weakens the hydrogen bond that allows water to form. By attacking the hydrogen bond of the water molecule, ExpeDRY helps keeps moisture from condensing into droplets (as is the case with performance in use) and helps break that bond to help any water that may be present to dry faster (as is the case in home laundry).

This helps to create a drier insulative chamber in almost every real world applications. It also helps with moisture from within such as sweat in high energy activities which could ultimately lead to a more regulated warmth.

ExpeDRY, through its ability to increase the rate of evaporation, also helps potentially decrease drying time in home laundry significantly. This makes care of your down products that much easier so they can last longer and perform better.

Introducing FUZE technology



With a background and parent company firmly established in the biomedical space, fuze technologies is able to build on the nanoscience of parent company Evoq Nano and provide industry leading particle based drying and anti-fungal, anti-mold and anti-bacterial properties to the textile industry.

Fuze is able to produce and manufacture nano and micro particles of exacting shapes and sizes - unique to the nanoscience world. Many times, particle production is inconsistent in both shape and size which can affect potential toxicity. FUZE has developed patented ways to produce these particle in an exacting fashion which means that we can control the gold we use for ExpeDRY to use less for the performance needed and negate any fear of nano-toxicity.

Working with FUZE, we found that performance is based on a sine wave with varying sizes performing while others do not. This has allowed us to focus on performance above 100nm while retaining the mechanism found within nanoparticle technology.

Learn more about Fuze technologies at fuze47.com.

** please note:*

Most of the information found on the FUZE website features their non-ionic silver anti-microbial technology. ALLIED has removed all silver and simply uses FUZE gold particles for the ExpeDRY product

TESTING

The general effect of humidity on down insulation

ALLIED knew there was a better way to improve performance of down used in extreme environments and developed ExpeDRY as a higher performing, lower impact targeted solution.

Several years of research and testing has gone into the development of the ExpeDRY product.

We started by researching exactly what happens inside a down jacket and sleeping back in extreme situations. Hydrophobic down testing would suggest that direct contact with water was the culprit in the loss of loft we have all experienced. But that has always seemed misguided.

We found that - obviously enough - it wasn't extreme amounts of water, but high levels of humidity. And as much humidity was found to come from within as it does from exterior environments in all but the worst downpours. Even with the worst environmental conditions, the down is almost solely subject to high levels of humidity at periods of time.

Hydrophobic chemistry is a perfect solution for a shell where you want to move the water off the product, but inside the insulation chamber, we are not just interested in moving water, but in attacking humidity and removing any potential excess moisture or water; keeping the entire insulation chamber dry.

As with any extremely new and disruptive technology, there is no easy solution for testing. ALLIED continues to develop different tests to show efficacy and in-field testing of prototypes have proven extremely effective. As we continue to develop repeatable and comprehensive testing methods, we will work to build into a standardized testing method. For now, we rely on several different studies and tests developed in-house and with FUZE to study the effect of the ExpeDRY.

The following testing was all performed throughout development and may reflect different ExpeDRY solutions and particle sizes. Please review each comparative test independently. We continue to explore more precise and efficient testing methods to provide more comprehensive comparative and unified results.

HUMIDITY CHAMBER STUDY 01

Humidity Chamber Study 01

Our initial humidity chamber testing looked at the effect of high levels of humidity on the fill power of down.

Chambers were created that was able to pump a desired level of humidity through the middle of the down-filled chambers. Each chamber was perforated on the outer edges to decrease condensation as much as possible against the plexiglass structure.

The chambers were marked with approximate fill power equivalents and watched over several different periods of time.

For each test, we saw a large decrease in loft of the untreated material and small reduction of loft of the same amount in both the hydrophobic treated down and the ExpeDRY.

In some of the testing, following the periods of high humidity, the chambers were observed and return of loft was measured and noted.



RESULTS

Humidity Chamber Study 01 / moisture event and recovery to original fill power

ExpeDRY vs Nikwax 10,000 minute hydrophobic down vs untreated

Process

90% humidity was pumped into both 30g and 45g of insulation for 2 hours as well as 4 hours with 30g of insulation.

Measurements were taken every 2 hours to monitor drying / recovery to fill power.

Conclusion

In all cases, ExpeDRY shows a complete return to loft faster than WR treated down and performs as well or better than WR down during the moisture event.

Additional comments

Humidity was quite aggressively forced through the insulation and excessive condensation was seen to collect on the plexi canisters as a result. We feel skewed results and ability to return completely to full loft and provide easy reading of the fill power, but still provides general proof of concept of ExpeDRY's ability to manage moisture better than traditional WR treated down.

This initial testing was done with the first iteration of ExpeDRY using approximately 1.1 ppm of ExpeDRY gold particles. Current ExpeDRY application uses 2.4 - 3.0 ppm we expect to show even better results.

2 HR of moisture + 24 HR Recovery 30g

	Plain	FP	WR	FP	11ppm	FP
Start	0	800	0	800	0	800
2 HR moisture	-0.75	725	-0.375	762	-0.25	775
2 HR Recovery	-0.75	725	-0.375	762	-0.25	775
4 HR Recovery	-0.625	738	-0.375	762	-0.125	790
6 HR Recovery	-0.5	750	-0.25	775	-0.125	790
8 HR Recovery	-0.375	762	-0.125	790	0	800
12 HR Recovery	-0.25	775	0	800	0	800
24 Hr Recovery	0	800	0	800	0	800

4 HR of moisture + 24 HR Recovery 30g

	Plain	FP	WR	FP	11ppm	FP
Start	0	800	0	800	0	800
2 HR Moisture	-0.75	725	-0.375	762	-0.25	775
4 HR Moisture	-1.5	650	-1	700	-1	700
2 HR Recovery	-1.5	650	-1	700	-1	700
4 HR Recovery	-1.375	663	-0.75	725	-0.75	725
6 HR Recovery	-1.125	688	-0.75	725	-0.5	750
8 HR Recovery	-1	700	-0.5	750	-0.25	775
24 Hr Recovery	0	800	0	800	0	800

2 HR Moisture + 24 HR Recovery 45g

	Plain	FP	WR	FP	11ppm	FP
Start	0	800	0	800	0	800
2 HR Moisture	-0.875	713	-0.625	738	-0.625	738
2 HR Recovery	-0.875	713	-0.625	738	-0.625	738
4 HR Recovery	-0.75	725	-0.625	738	-0.5	750
6 HR Recovery	-0.75	725	-0.5	750	-0.5	750
8 HR Recovery	-0.625	738	-0.5	750	-0.375	762
12 HR Recovery	-0.5	750	-0.375	762	0	800
24 HR Recovery	0	800	0	800	0	800

RESULTS

Humidity Chamber Study 01 / 3 cycles

ExpeDRY vs Nikwax 10,000 minute hydrophobic down vs untreated

Process

90% humidity was pumped into insulation and approximate fill power was measured by marks on canisters at 30, 60 and 90 minutes. Humidity was shut off and canisters allowed to air dry for 12 hours. Measurements taken at 1, 2, 4, 8 and 12 hours.

	Plain	FP	WR	FP	ExpeDry	FP	
Starting		0	800	0	800	0	800
30 min w/ humidifier	-0.125	782	0	800	0	800	
60 min w/ humidifier	-0.5	727	-0.25	763	-0.25	763	
90 min w/ humidifier	-0.875	672	-0.375	727	-0.5	727	
1 HR Recovery	-0.875	672	-0.5	727	-0.5	727	
2 HR Recovery	-0.875	672	-0.5	727	-0.5	727	
4 HR Recovery	-0.75	690	-0.375	745	-0.375	745	
8 HR Recovery	-0.625	709	-0.375	745	-0.25	763	
12 HR Recovery	-0.625	709	-0.25	763	-0.125	782	
30 min w/ humidifier	-0.75	690	-0.25	763	-0.25	763	
60 min w/ humidifier	-1	654	-0.375	735	-0.375	745	
90 min w/ humidifier	-1.125	636	-0.625	709	-0.625	709	
1 HR Recovery	-1.125	636	-0.625	709	-0.625	709	
2 HR Recovery	-1.125	636	-0.625	709	-0.625	709	
4 HR Recovery	-1	654	-0.5	727	-0.5	727	
8 HR Recovery	-1	654	-0.5	727	-0.5	727	
12 HR Recovery	-0.875	672	-0.375	735	-0.375	745	
30 min w/ humidifier	-1.125	636	-0.5	727	-0.375	745	
60 min w/ humidifier	-1.25	618	-0.75	690	-0.5	727	
90 min w/ humidifier	-1.375	600	-0.875	672	-0.625	709	
1 HR Recovery	-1.375	600	-0.875	672	-0.625	709	
2 HR Recovery	-1.375	600	-0.875	672	-0.625	709	
4 HR Recovery	-1.375	600	-0.75	690	-0.5	727	
8 HR Recovery	-1.25	618	-0.75	690	-0.5	727	
12 HR Recovery	-1.25	618	-0.75	690	-0.375	745	

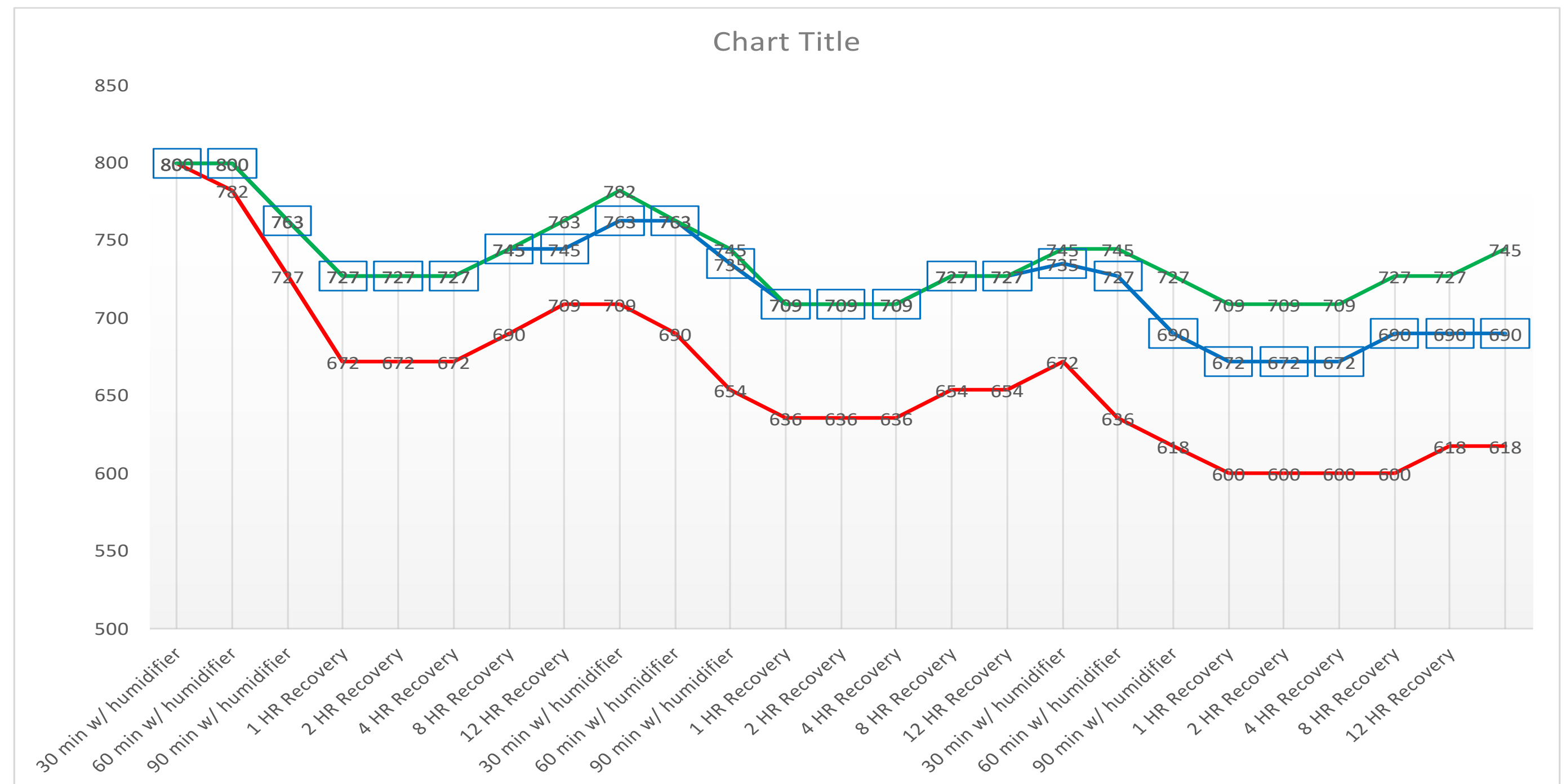
Conclusion

Over wet / dry cycles simulating real world scenarios, ExpeDRY shows the potential to retain more performance / loft than WR treated down. As WR down begins with higher saturation point with every cycle, we anticipate even more extreme drop-offs for every cycle. We also anticipate increased performance and even wider spread when put in touch with body heat as the additional heat we have found to accelerate the ExpeDRY mechanism

Additional comments

Humidity was quite aggressively forced through the insulation and excessive condensation was seen to collect on the plexi canisters as a result. We feel skewed results and ability to return completely to full loft as has been seen in mesh pillows, but still provides general proof of concept of ExpeDRY's ability to manage moisture better than traditional WR treated down.

This initial testing was done with the first iteration of ExpeDRY using approximately 0.87ppm of ExpeDRY gold particles. Current ExpeDRY application uses 2.4 - 3.0 ppm showing even greater potential results.



DRY TIME TESTING / ISOLATING MATERIAL

Dry time testing overview

Critical to understand the performance potential of the ExpeDRY is to understand it's potential to accelerate drying.

We have been looking at this from many different angles - from full saturation to a more real world in-field pick up of moisture (appx 60% saturation by weight).

To test, 6" x 6" mesh pillows were created to isolate the ExpeDRY and filled at a volume that is representative of garment or sleeping bag density.

Testing was done in both ambient room temperature as well as within a refrigerated environment on top of hot plate set at 98 deg F to simulate the product working in a cold environment against a body. As part of this testing, the most accurate real world scenario is when the down is only saturated to 60% saturation by weight. We have found in our research of down-filled products in the field, that this level of saturation or wetness of the down is most accurate to test real world use scenarios.

Down almost never attains a fully saturated level inside a jacket or sleeping bag unless being laundered.



RESULTS

Dry Time Testing 01 / Drying at room temperature from full saturation

ExpeDRY vs Nikwax 10,000 minute hydrophobic down vs untreated

	Regular	WR	Expedry				
Dry	6.83	6.88	6.83				
Wet	14.13	14.77	14.46				
5	12.86	12.52	13	5	83%	71%	81%
10	12.32	11.77	12.41	10	75%	62%	73%
15	12	11.12	12.08	15	71%	54%	69%
20	11.7	10.79	11.84	20	67%	50%	66%
25	11.46	10.49	11.53	25	63%	46%	62%
30	11.24	10.3	11.29	30	60%	43%	58%
35	11	10	11	35	57%	40%	55%
40	10.8	9.87	10.69	40	54%	38%	51%
45	10.6	9.61	10.48	45	52%	35%	48%
50	10.37	9.46	10.13	50	48%	33%	43%
55	10.23	9.32	9.9	55	47%	31%	40%
60	10	9.18	9.68	60	43%	29%	37%
65	9.92	9.09	9.43	65	42%	28%	34%
70	9.74	8.93	9.13	70	40%	26%	30%
75	9.54	8.82	8.89	75	37%	25%	27%
80	9.4	8.7	8.7	80	35%	23%	25%
85	9.31	8.59	8.54	85	34%	22%	22%
90	9.19	8.49	8.39	90	32%	20%	20%
95	9	8.35	8.19	95	30%	19%	18%
100	9	8.3	8.07	100	30%	18%	16%
105	8.85	8.24	7.95	105	28%	17%	15%
110	8.75	8.13	7.85	110	26%	16%	13%
115	8.67	8.09	7.78	115	25%	15%	12%
120	8.61	8	7.73	120	24%	14%	12%
125	8.56	8	7.61	125	24%	14%	10%
130	8.42	7.93	7.41	130	22%	13%	8%
135	8.35	7.88	7.41	135	21%	13%	8%
140	8.25	7.85	7.37	140	19%	12%	7%
145	8.21	7.83	7.35	145	19%	12%	7%
150	8.15	7.8	7.31	150	18%	12%	6%
155	8.07	7.78	7.27	155	17%	11%	6%
160	8.05	7.77	7.24	160	17%	11%	5%
165	8.01	7.74	7.23	165	16%	11%	5%
170	8	7.72	7.21	170	16%	11%	5%
175	7.97	7.71	7.2	175	16%	11%	5%
180	7.94	7.68	7.15	180	15%	10%	4%
185	7.9	7.66	7.12	185	15%	10%	4%
190	7.85	7.65	7.12	190	14%	10%	4%
195	7.83	7.62	7.11	195	14%	9%	4%
200	7.8	7.6		200	13%	9%	
205	7.78	7.58		205	13%	9%	
210	7.78	7.57		210	13%	9%	
215	7.77	7.55		215	13%	8%	
220	7.75	7.55		220	13%	8%	
225	7.71	7.53		225	12%	8%	
230	7.7	7.52		230	12%	8%	
235	7.67	7.5		235	12%	8%	
240	7.66	7.49		240	11%	8%	
245	7.64	7.47		245	11%	7%	
250	7.63	7.46		250	11%	7%	
255	7.6	7.46		255	11%	7%	
260	7.57	7.46		260	10%	7%	
265	7.57	7.44		265	10%	7%	
270	7.53	7.43		270	10%	7%	
275	7.51	7.41		275	9%	7%	
280	7.5	7.4		280	9%	7%	
285	7.48	7.4		285	9%	7%	
290	7.47	7.38		290	9%	6%	
295	7.45	7.35		295	8%	6%	
300	7.45	7.32		300	8%	6%	
305	7.44	7.32		305	8%	6%	
310	7.42	7.31		310	8%	5%	
315	7.41	7.31		315	8%	5%	
320	7.4			320	8%		
325	7.38			325	8%		
330	7.37			330	7%		
335	7.35			335	7%		
340	7.34			340	7%		
345	7.33			345	7%		
350	7.31			350	7%		
355	7.3			355	6%		
360	7.29			360	6%		
365	7.27			365	6%		
370	7.25			370	6%		
375	7.25			375	6%		
380	7.24			380	6%		
385	7.23			385	5%		

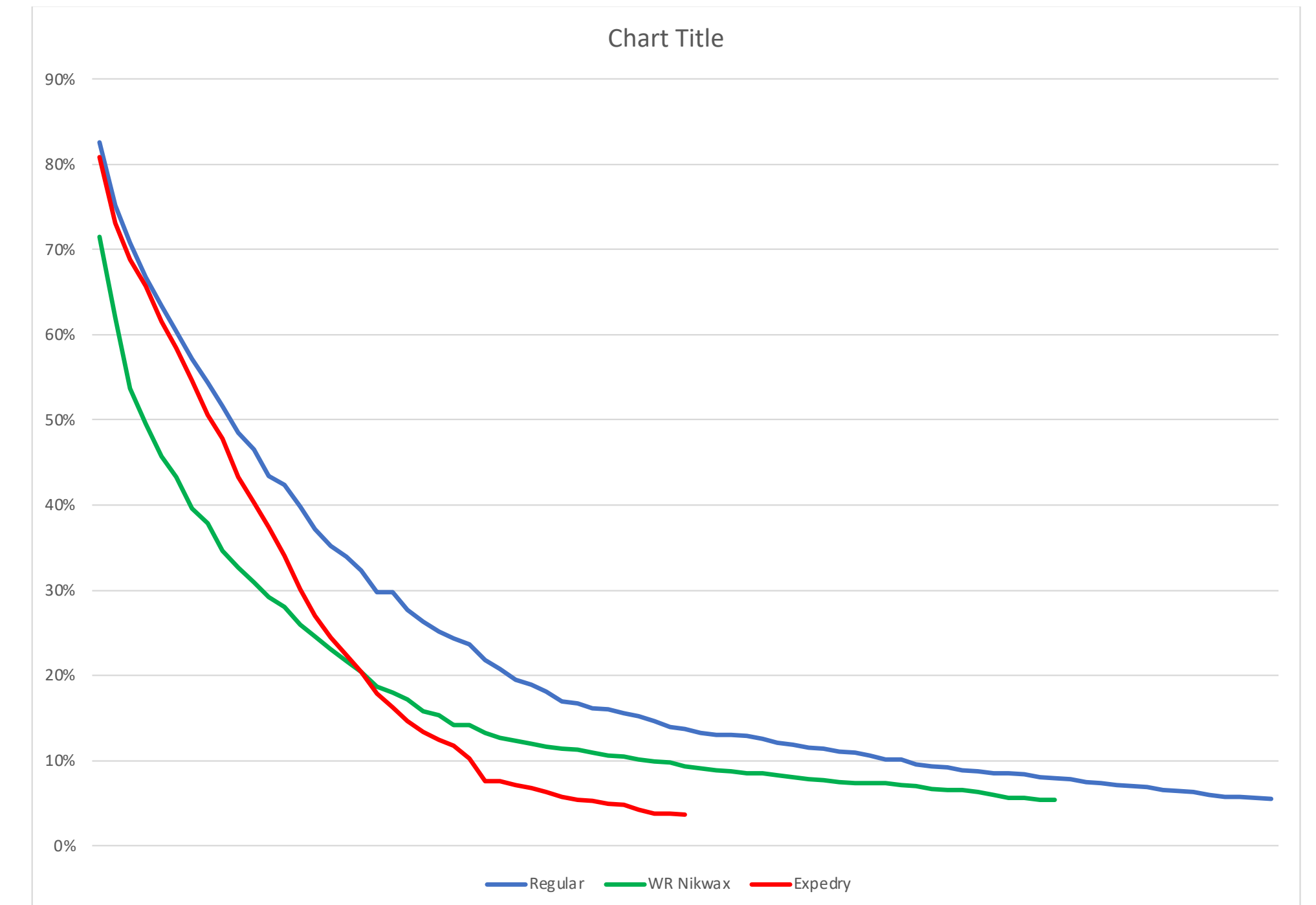
Process

For this test, mesh pillows were fully submerged in room temperature water for a consistent amount of time. Wetted weights were measured. Pillows were allowed to air dry in humidity controlled room.

Measurements were taken until 95% dryness was achieved.

Conclusion

Testing shows that ExpeDRY in this scenario dries over 50% faster.



RESULTS

Dry Time Testing 02 / Drying at cold ambient temperature on hot plate from full saturation

ExpeDRY vs Nikwax 10,000 minute hydrophobic down vs untreated

	Regular	WR	Expedry				
Dry	6.78	6.82	6.76				
Wet	16.82	16.48	16.64		Regular	WR	Expedry
5	15.07	15.73	15.34	5	83%	93%	87%
10	14.82	15.64	15.07	10	80%	92%	85%
15	14.68	15.22	14.9	15	79%	87%	83%
20	14.41	15.03	14.81	20	76%	85%	82%
25	14.24	14.89	14.69	25	74%	84%	81%
30	14.06	14.66	14.43	30	73%	82%	78%
35	13.94	14.46	14.2	35	71%	79%	76%
40	13.78	14.17	14.03	40	70%	76%	74%
45	13.52	13.96	13.98	45	67%	74%	73%
50	13.36	13.8	13.82	50	66%	73%	72%
55	13.3	13.61	13.65	55	65%	71%	70%
60	13.15	13.41	13.5	60	63%	68%	68%
65	13	13.28	13.33	65	62%	67%	67%
70	12.88	13.08	13.23	70	61%	65%	66%
75	12.71	12.86	13.08	75	59%	63%	64%
80	12.57	12.61	12.89	80	58%	60%	62%
85	12.15	12.4	12.67	85	53%	58%	60%
90	12.01	12.08	12.45	90	52%	55%	58%
95	11.79	11.9	12.22	95	50%	53%	55%
100	11.67	11.8	11.87	100	49%	52%	52%
105	11.57	11.71	11.39	105	48%	51%	47%
110	11.35	11.63	11	110	46%	50%	43%
115	11.19	11.3	10.75	115	44%	46%	40%
120	11.09	11.17	10.52	120	43%	45%	38%
125	10.95	11.08	10.18	125	42%	44%	34%
130	10.75	10.81	9.88	130	40%	41%	31%
135	10.56	10.77	9.73	135	38%	41%	30%
140	10.42	10.62	9.39	140	36%	39%	26%
145	10.24	10.46	9	145	34%	38%	22%
150	10	10.35	8.87	150	32%	36%	21%
155	9.95	10	8.73	155	32%	33%	19%
160	9.78	9.78	8.43	160	30%	30%	16%
165	9.56	9.41	8.19	165	28%	27%	14%
170	9.37	9.3	7.97	170	26%	25%	12%
175	9.22	9.21	7.7	175	24%	24%	9%
180	9.02	9.12	7.61	180	22%	23%	8%
185	8.76	9	7.4	185	20%	22%	6%
190	8.63	8.89	7.32	190	18%	21%	5%
195	8.41	8.74		195	16%	19%	
200	8.28	8.54		200	15%	17%	
205	8.15	8.4		205	14%	16%	
210	7.93	8.23		210	11%	14%	
215	7.74	8.16		215	10%	13%	
220	7.59	7.97		220	8%	11%	
225	7.48	7.83		225	7%	10%	
230	7.37	7.66		230	6%	8%	
235	7.26	7.47		235	5%	6%	
240		7.35		240		5%	
245							

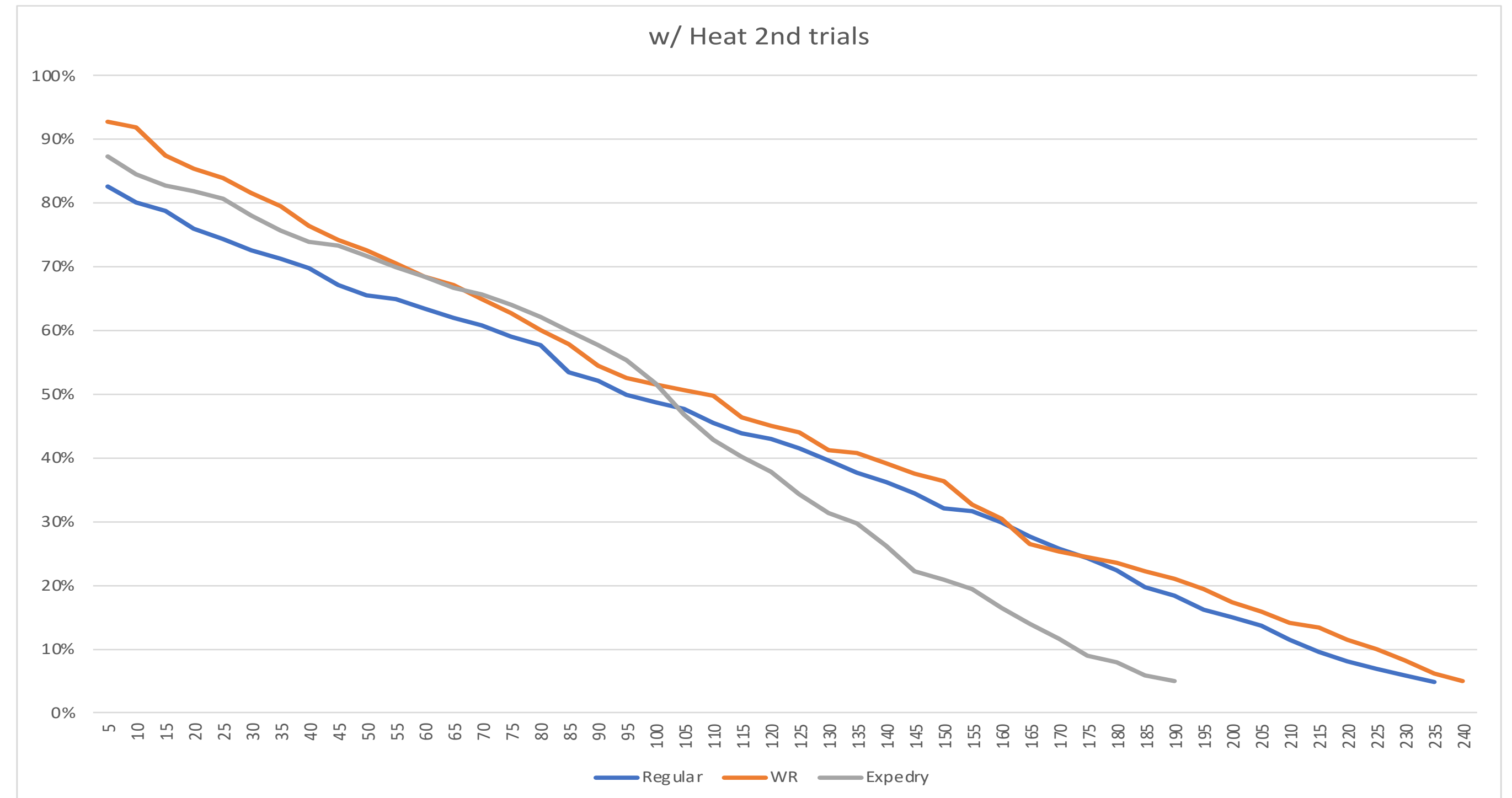
Process

For this test, the same mesh pillows were filled and saturated as they were in the previous test.

The pillows were then placed in a refrigerated environment (40 degrees F) on top of a hot plate to simulate a real world scenario in cold weather with body heat on the alternate side.

Conclusion

ExpeDRY continue to dry faster than WR treat down and both heat (and UV) have the potential to increase efficacy of the gold particles.



RESULTS

Dry Time Testing 02.02 / Drying at cold ambient temperature on hot plate from 60% saturation

ExpeDRY vs Nikwax 10,000 minute hydrophobic down vs untreated

Process

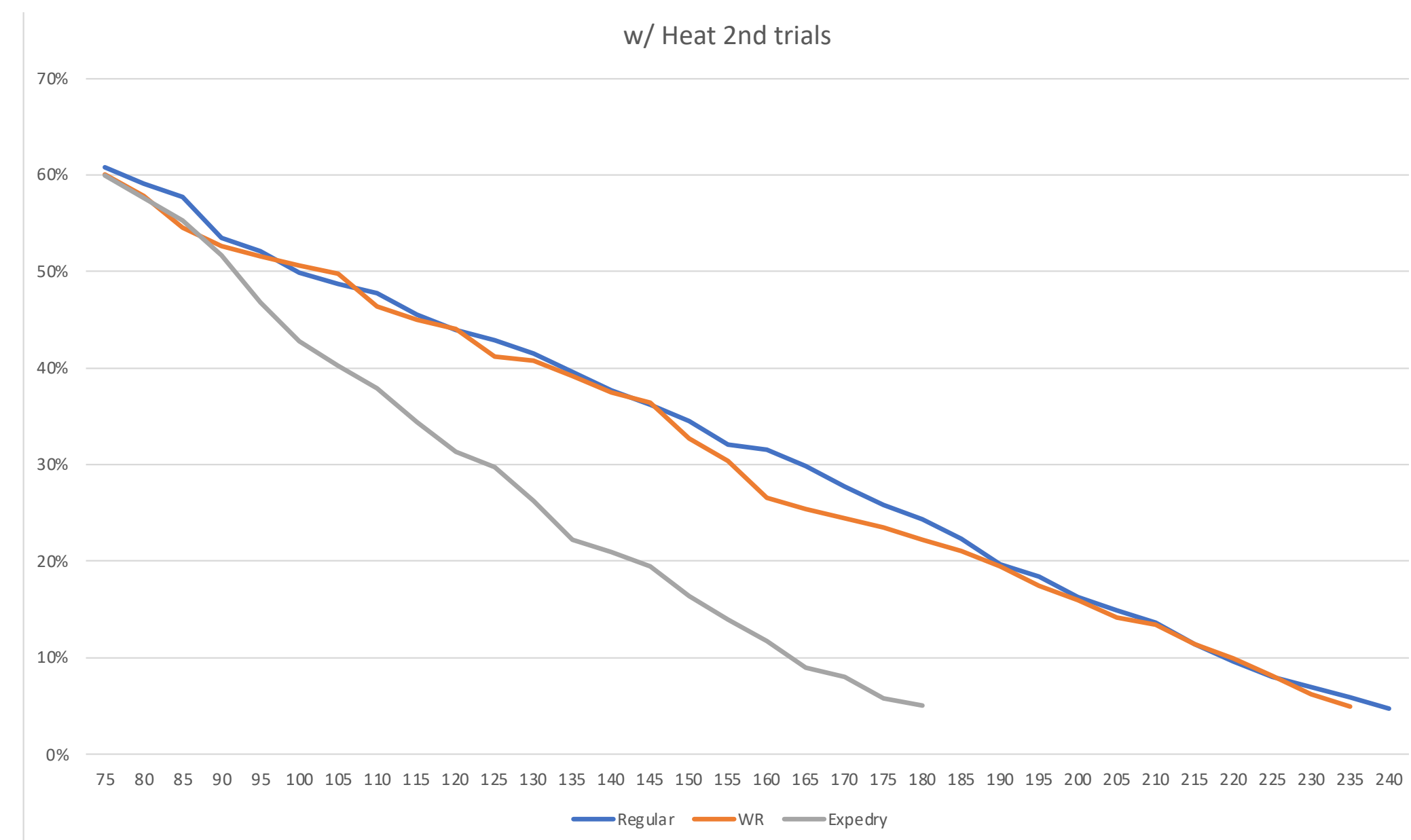
For this test, the same mesh pillows were filled and saturated to 60% saturation by weight simulating what we have found to approximate the amount of maximum amount of moisture picked up in real world use scenario.

The pillows were then placed in a refrigerated environment (40 degrees F) on top of a hot plate to simulate a real world scenario in cold weather with body heat on the alternate side.

Conclusion

In this real world scenario, ExpeDRY performs even better than WR treated down. Here, WR treated down starts to perform only as well as untreated down. It may be the case that WR treated down will take slightly longer to achieve 60% saturation, but we wanted to isolate performance curves from the same baseline that reflects a very real world likelihood (albeit worst case scenario).

	Regular	WR	Expedry				
Dry	6.78	6.82	6.76				
Wet	16.82	16.48	16.64	Regular	WR	Expedry	
75	12.88	12.61	12.67	75	61%	60%	60%
80	12.71	12.4	12.45	80	59%	58%	58%
85	12.57	12.08	12.22	85	58%	55%	55%
90	12.15	11.9	11.87	90	53%	53%	52%
95	12.01	11.8	11.39	95	52%	52%	47%
100	11.79	11.71	11	100	50%	51%	43%
105	11.67	11.63	10.75	105	49%	50%	40%
110	11.57	11.3	10.52	110	48%	46%	38%
115	11.35	11.17	10.18	115	46%	45%	34%
120	11.19	11.08	9.88	120	44%	44%	31%
125	11.09	10.81	9.73	125	43%	41%	30%
130	10.95	10.77	9.39	130	42%	41%	26%
135	10.75	10.62	9	135	40%	39%	22%
140	10.56	10.46	8.87	140	38%	38%	21%
145	10.42	10.35	8.73	145	36%	36%	19%
150	10.24	10	8.43	150	34%	33%	16%
155	10	9.78	8.19	155	32%	30%	14%
160	9.95	9.41	7.97	160	32%	27%	12%
165	9.78	9.3	7.7	165	30%	25%	9%
170	9.56	9.21	7.61	170	28%	24%	8%
175	9.37	9.12	7.4	175	26%	23%	6%
180	9.22	9	7.32	180	24%	22%	5%
185	9.02	8.89		185	22%	21%	
190	8.76	8.74		190	20%	19%	
195	8.63	8.54		195	18%	17%	
200	8.41	8.4		200	16%	16%	
205	8.28	8.23		205	15%	14%	
210	8.15	8.16		210	14%	13%	
215	7.93	7.97		215	11%	11%	
220	7.74	7.83		220	10%	10%	
225	7.59	7.66		225	8%	8%	
230	7.48	7.47		230	7%	6%	
235	7.37	7.35		235	6%	5%	
240	7.26			240	5%		



DRY TIME TESTING / HOME LAUNDRY SIMULATION

Dry time testing home laundry

ExpeDRY is able to have value outside of technical performance stories through it's ability to help a jacket or sleeping bag dry faster in home laundry.

The two most critical factors that ensure longevity of a down product is using the right detergent when washing and making sure that the insulation is thoroughly dry.

This can be difficult in parts of the world where there is limited access to heated driers and where heated driers are accessible, the amount of time needed consumes a significant amount of energy.

To test this, we built nylon panels with 2" baffles and filled according to a potential jacket construction.

The panels were washed according to industry standards using down specific detergent at 1 and 5 washes to determine both efficacy of the ExpeDRY and durability.

RESULTS

Dry Time Testing Jacket Simulation / Drying at room temperature in synthetic baffled panels - 1 wash

ExpeDRY vs Nikwax 10,000 minute hydrophobic down vs untreated

Process

For this test, nylon panels were made to mimic jacket construction with 2" baffles filled with an approximate jacket density. The panels were washed according to industry standard washing method using down specific detergent.

The pillows were then allowed to air dry and weighed to measure dryness.

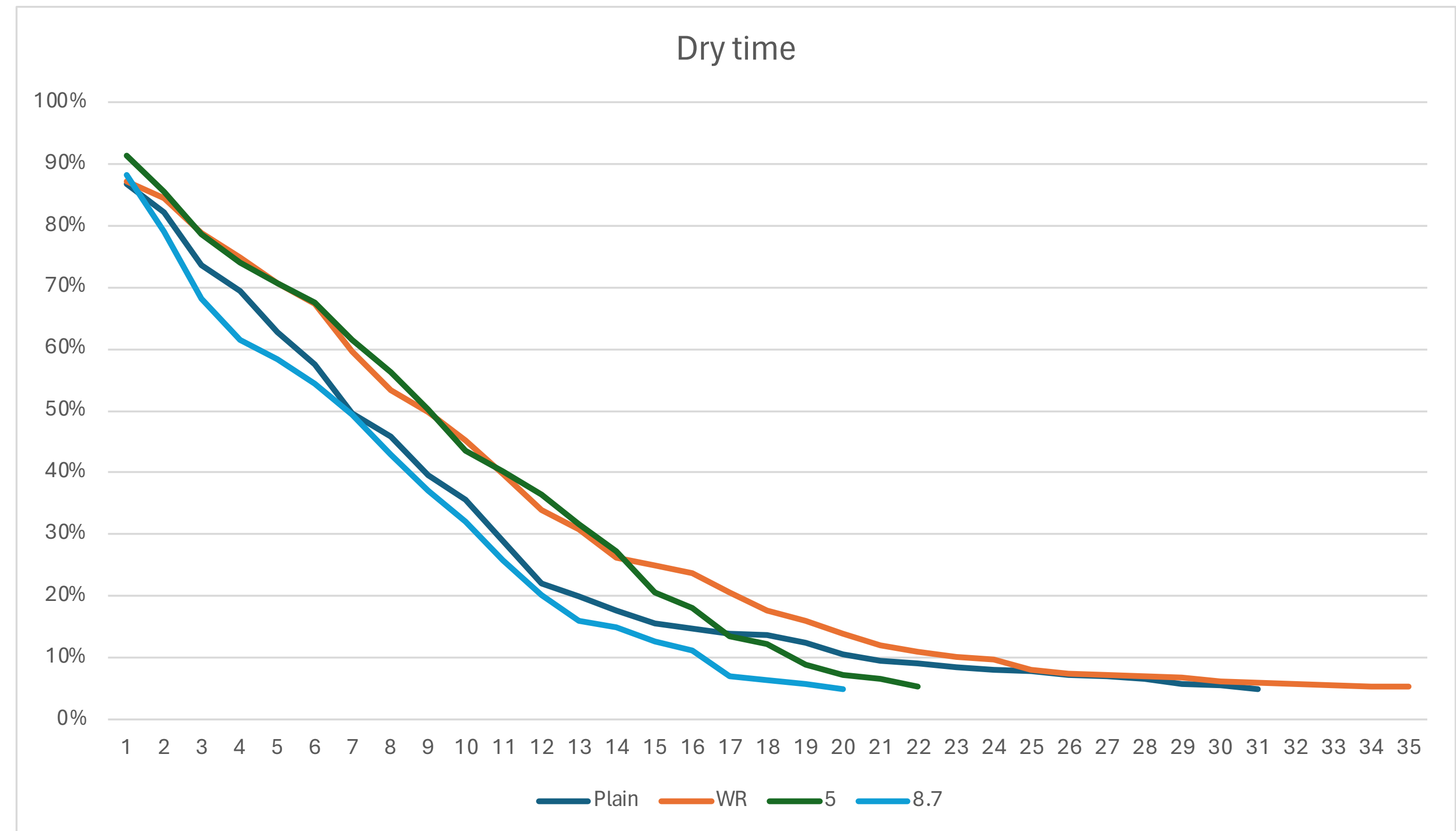
Conclusion

After washing, ExpeDRY panels are shown to dry significantly faster (~45% compared to WR down) in home laundry situation as compared to both untreated and WR treated down.

Additional comments

This initial testing was done with the first iteration of ExpeDRY using 0.5ppm and 0.87ppm of ExpeDRY gold particles. Current ExpeDRY application uses 2.4 - 3.0 ppm showing even greater potential results.

Time	P	WR	5	8.7	P	WR	5	8.7	
Dry		52.3	51.82	52.21	51.77	Dry Percentage			
Wet		60.17	62.51	60.05	59.98				
5		59.13	61.14	59.37	59.02	87%	87%	91%	88%
10		58.76	60.86	58.91	58.26	82%	85%	85%	79%
15		58.1	60.25	58.37	57.36	74%	79%	79%	68%
20		57.76	59.83	58.02	56.82	69%	75%	74%	62%
25		57.24	59.37	57.75	56.57	63%	71%	71%	58%
30		56.83	59.02	57.5	56.24	58%	67%	67%	54%
40		56.21	58.2	57.04	55.82	50%	60%	62%	49%
50		55.9	57.53	56.62	55.3	46%	53%	56%	43%
60		55.42	57.14	56.14	54.82	40%	50%	50%	37%
70		55.1	56.65	55.62	54.41	36%	45%	43%	32%
80		54.57	56.07	55.37	53.89	29%	40%	40%	26%
90		54.03	55.45	55.07	53.43	22%	34%	36%	20%
100		53.87	55.11	54.69	53.09	20%	31%	32%	16%
110		53.69	54.63	54.34	52.99	18%	26%	27%	15%
120		53.52	54.48	53.82	52.81	16%	25%	21%	13%
130		53.46	54.36	53.63	52.68	15%	24%	18%	11%
140		53.4	54.02	53.27	52.35	14%	21%	14%	7%
150		53.37	53.7	53.16	52.29	14%	18%	12%	6%
160		53.28	53.52	52.9	52.25	12%	16%	9%	6%
170		53.13	53.31	52.78	52.17	11%	14%	7%	5%
180		53.04	53.1	52.73		9%	12%	7%	
190		53.01	52.99	52.62		9%	11%	5%	
200		52.97	52.91			9%	10%		
210		52.94	52.85			8%	10%		
220		52.91	52.68			8%	8%		
230		52.87	52.62			7%	7%		
240		52.85	52.59			7%	7%		
250		52.82	52.56			7%	7%		
260		52.76	52.54			6%	7%		
270		52.73	52.49			5%	6%		
280		52.69	52.45			5%	6%		
290			52.44				6%		
300			52.42				6%		
310			52.4				5%		
320			52.4				5%		



RESULTS

Dry Time Testing Jacket Simulation / Drying at room temperature in synthetic baffled panels - 5 washes

ExpeDRY vs Nikwax 10,000 minute hydrophobic down vs untreated

Process

For this test, nylon panels were made to mimic jacket construction with 2" baffles filled with an approximate jacket density. The panels were washed according to industry standard washing method using down specific detergent.

The pillows were then allowed to air dry and weighed to measure dryness.

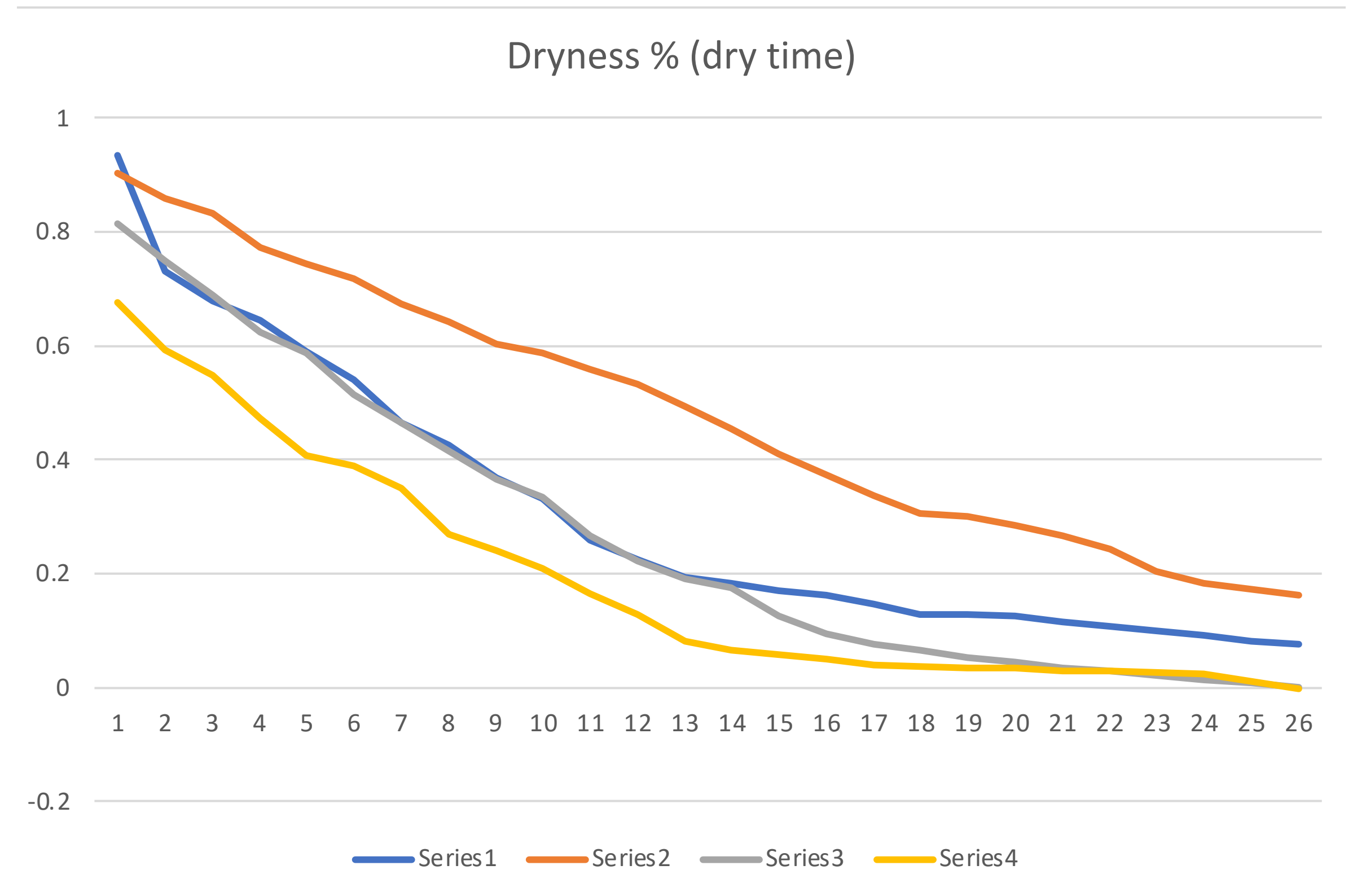
Time	P	WR	5	8.7	P	WR	5	8.7
Dry	51.76	51.1	51.8	50.02	Dry Percentage			
Wet	58.21	63.66	58.72	57.84	Plain	WR	5 ppm	8.7 ppm
5	57.78	62.43	57.43	55.31	93%	90%	81%	68%
10	57.41	61.89	56.98	54.65	73%	86%	75%	59%
15	57.01	61.56	56.56	54.3	68%	83%	69%	55%
20	56.76	60.79	56.12	53.72	64%	77%	62%	47%
25	56.34	60.43	55.87	53.21	59%	74%	59%	41%
30	55.98	60.12	55.35	53.07	54%	72%	51%	39%
40	55.4	59.54	55.02	52.76	46%	67%	47%	35%
50	55.12	59.17	54.67	52.13	43%	64%	41%	27%
60	54.68	58.67	54.32	51.89	37%	60%	36%	24%
70	54.41	58.46	54.12	51.65	33%	59%	34%	21%
80	53.87	58.12	53.64	51.31	26%	56%	27%	16%
90	53.61	57.78	53.34	51.02	22%	53%	22%	13%
100	53.37	57.29	53.12	50.65	19%	49%	19%	8%
110	53.29	56.8	53.01	50.54	18%	45%	17%	7%
120	53.21	56.25	52.67	50.46	17%	41%	13%	6%
130	53.14	55.78	52.46	50.41	16%	37%	10%	5%
140	53.02	55.32	52.32	50.32	15%	34%	8%	4%
150	52.89	54.94	52.26	50.3	13%	31%	7%	4%
160	52.88	54.86	52.17	50.29	13%	30%	5%	3%
170	52.87	54.67	52.11	50.28	13%	28%	4%	3%
180	52.79	54.45	52.04	50.25	11%	27%	3%	3%
190	52.73	54.16		50.25	11%	24%	-749%	3%
200	52.67	53.67		50.23	10%	20%	-749%	3%
210	52.61	53.41			9%	18%	-749%	-640%
220	52.54	53.27			8%	17%	-749%	-640%
230	52.5	53.12			8%	16%	-749%	-640%
240	52.41	53.04			6%	15%	-749%	-640%
250	52.37	52.95			6%	15%		
260	52.32	52.78			5%	13%		
270		52.41				10%		
280		52.45				11%		
290		52.17				9%		
300		52.09				8%		
310		52.01				7%		
320		51.89				6%		
330		51.79				5%		

Conclusion

After washing, ExpeDRY panels are shown to dry 50% faster than untreated down and in almost 1/3 of the time of WR treated down showing a further loss of performance in the WR when compared to the ExpeDRY.

Additional comments

This initial testing was done with the first iteration of ExpeDRY using 0.5ppm and 0.87ppm of ExpeDRY gold particles. Current ExpeDRY application uses 2.4 - 3.0 ppm showing even greater potential results.



DURABILITY

Durability of ExpeDRY particles bonded to down

Due to the molecular weight of gold, it bonds permanently to a structure like the down cluster and provides life-long performance.

Even the most robust c0 WR treatments are notoriously non-durable and require re-coating after even a single wash. In our experience WR treated down loses almost all efficacy after 5 or 10 washes - depending on the material applied.

Down is a protein based structure with fat and oils required to remain resilient. Applying a chemical to a structure like that will always be difficult. The nature of the ExpeDRY gold is such that permanence can easily be achieved without any added bonding agents.

We have seen almost no loss of material in ICP testing after 100 washes of the ExpeDRY and the previous home laundry jacket simulation testing shows the efficacy of ExpeDRY over as few as five washes.

IN-FIELD TESTING

ExpeDRY products in the field

Brand partners who have done in-field testing have seen excellent results and have been building claims based on their findings and content coming from those studies.

As with any new disruptive technology, material testing lags well behind actual findings in real world use. ALLIED partners have tested ExpeDRY prototypes from the city to the top of Mont Blanc and developed products with Polar Explorers.

An excellent test and review was also published by gear junkie and can be found here.

<https://gearjunkie.com/apparel/artilect-divide-fusion-stretch-down-hoodie-review>

ALLIED is happy to provide whatever material samples are needed to prototype and test. Our R&D team can work closely with yours to further develop appropriate tests and help analyze and quantify results.

TOXICITY

General safety of ExpeDRY

“Size-dependent toxicity of AuNPs was demonstrated by in vitro studies with Balb/3T3 mouse fibroblasts. Results from colony-forming efficiency and trypan blue assays revealed cytotoxicity only in cells treated with 5 nm AuNPs, whereas no cytotoxic effects were observed in cells exposed to 15 nm AuNPs.”

Toxicity of Gold Nanoparticles, Encarnacion Caballero-Diaz and Miguel Valcarcel, Department of Analytical Chemistry, University of Cordoba, Cordoba, Spain

Gold is inherently non-toxic and completely inert.

However, even then, there are concerns of nanotoxicity at sizes and shapes that allow any metal to break the blood barrier and collect in different parts of the body. This, at extreme levels, can be fatal and is what drives general nanotoxicity fears. However, there is a lot of misunderstanding with a generalize fear over anything “nano.”

In general, there are two elements that can create nanotoxicity - size and shape.

It is estimated that particles of 5 nm or less can easily break the blood barrier and thus be seamlessly integrated into our bodies. Anything larger than that has to be ingested in other more deliberate ways. And potential cytotoxicity is dependent upon very specific sizes that can enter the cellular structure - predominantly around the 15nm size. Anything larger than that has almost zero likelihood of finding their way through the cell walls and remain non-toxic.

Shape is also crucial. Most nanoparticles are created with very little to no control over their shape. This leads to nanoparticles with jagged edges that can act like grappling hooks and allow the metal in question to accumulate. This accumulation is what can lead to further nanotoxicity.

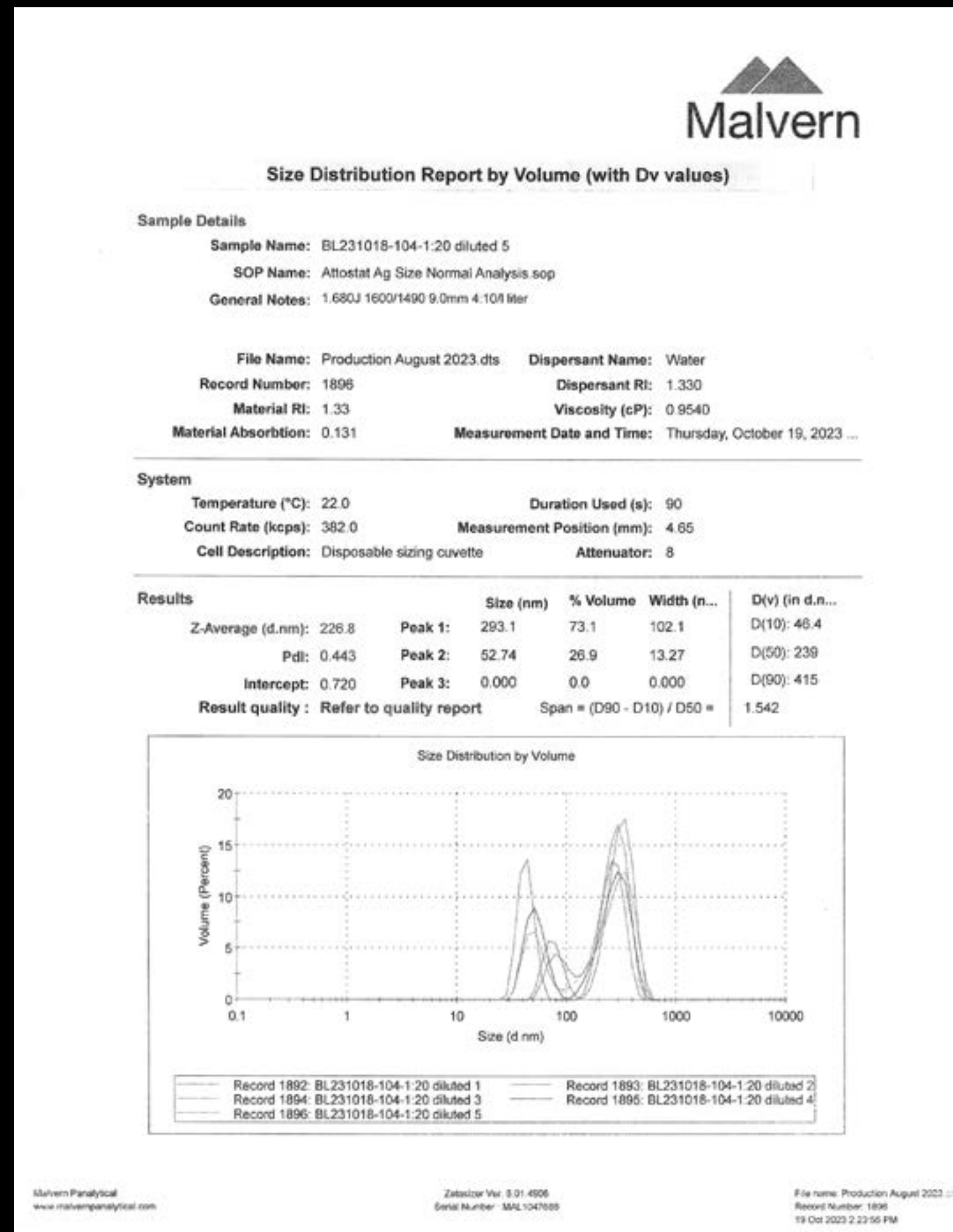
The gold particles used in ExpeDRY FAR exceed anything that has the potential to break the blood barrier and as an average, are above the nanoparticle-defining size of 100nm.

Fuze also has the unique ability to create particles of very precise shape. This was developed by their parent company to control the transport of drugs to very particular cells. For us, that means we can take advantage of the efficacy and safety of a smooth, spherical shape. This shape provides a better barrier between suspended particles and lowers any toxicity risk.

And with the combination of size and shape, we are confident in the safety of the ExpeDRY material. There are some at Fuze that even drink the solution daily as a health tonic, though we advise against eating a down jacket.

We have also estimated that the amount of gold inside one parka filled with ExpeDRY is equivalent to less than one grain of salt. Almost every toxicity report for AuNPs considers extreme amounts of ingestion.

ExpeDRY particle size



We have found that the nanoparticle mechanism works along a sine wave. This allowed us to look at the highest end of the particle size spectrum to build a product that performs with the same characteristics and efficiency but with a much larger particle size.

We are aware of the general nanoparticle fear and have worked to keep our particles above the official, though somewhat ambiguous, nanoparticle size of 100nm.

In our latest solution, we have found an average particle size of approximately 150nm. about 25% fall just under 100nm, but still far above the 5nm that would cause concern past the blood barrier.

The shape of the particles is not a perfect sphere so those 25% are likely looking at the side of the particles and do not necessarily suggest significantly smaller particles within the solution.

We continue to look at better and more precise particle size testing and methods of filtering out any smaller particles found.

Again, as was mentioned previously, even with this test result here, there should be no concern over nanotoxicity as a whole. And when looking at AuNP toxicity studies, it is important to note both ingestion method and amounts.

ExpeDRY uses about the equivalent of 3 grains of salt per Kilogram of down. At any level that recent studies showed that could be toxic, one would have to directly ingest the down from an entire REI's worth of jackets.

ENVIRONMENTAL IMPACT

Environmental impact of ExpeDRY compared to Hydrophobic treatments in production

vs. Nikwax HD (bath process)

WATER CONSUMPTION

Nikwax HD	ExpeDRY	
8.34 liters / Kg*	0.15 liters / Kg*	55.6x more water consumed

ENERGY USAGE / DRYING + CURING

Nikwax HD	ExpeDRY	
22 min @ 150c	9 min @ 120c	4x more energy needed **

vs. ALLIED HyperDRY (spray application)

WATER CONSUMPTION

Nikwax HD	ExpeDRY	
0.64 liters / Kg*	0.15 liters / Kg*	4.3x more water consumed

ENERGY USAGE / DRYING + CURING

Nikwax HD	ExpeDRY	
22 min @ 150c	9 min @ 120c	4x more energy needed **

* Water consumption is based on Kg of down processed.

** Energy use is conservatively estimated as ALLIED finalizes dryer efficiencies and metered difference between temperatures.

ExpeDRY demonstrates a significantly lower environmental impact when compared to other hydrophobic treated down products.

Utilizing gold reclaimed from recycled electronics and processed in sustainable processing facilities, we estimate that the impacts associated with the gold production is lower than the production of current c0 chemicals.

Without even considering the impacts of chemical production, the method of producing the ExpeDRY against Hydrophobic treated down alone shows a tremendous savings.

The two biggest hot spots in the processing of down are water consumption and the energy needed to heat the industrial driers.

ALLIED recycles and reclaims as much water as possible throughout all facilities, but when considering other hydrophobic treatments, most of those are applied through a bath within the processing of the down. This means that this water can not be reclaimed and is generally drained - bad for both consumption and literally flushing chemicals down the drain - regardless of their c0 nature.

ExpeDRY is applied through a very fine mist eliminating the need to process in a large bath thus saving a tremendous amount of water.

The hydrophobic chemistry also requires a full dry plus a high temperature curing while the ExpeDRY only requires a low temp dry at less than 1/2 time of the normal drying procedures.

Sustainability of ExpeDRY gold

All gold use for ALLIED's ExpeDRY comes from recycled sources and processed in facilities that feature sustainable processing without the use of harmful chemicals.

The gold is laser ablated at FUZE facilities run on renewable energy and suspended in solution used to treat the ALLIED down.





ALLIED FEATHER + DOWN

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ALLIED is happy at any point to establish meetings and presentations with the FUZE team to discuss toxicity and mechanism in more details.