

**The Impact of Washing Regimes on the
Efficiency of Microfibre Cloths**

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Project Report Prepared for JLA Ltd

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**Prepared by
Dr Paul Humphreys**

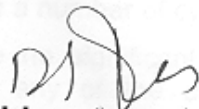




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The Impact of Washing Regimes on the Efficiency of Microfibre Cloths

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Author:  Signature: P. Humphrey Date: 27/8/09
Checked by: SIMON ROOT Signature:  Date: 27/8/09
Authorised by: P. Humphrey Signature:  Date: 27/8/09

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Whilst these analyses have been carried out carefully and have been checked, no liabilities can be accepted for consequential or indirect damages.

Executive Summary

The performance of Vermop (VM) and Johnson Diversey (JD) microfibre cloths were assessed after 1, 150 and 350 wash cycles in an Otex Laundry System, in addition cloths receiving 250 cycles of conventional detergent washing were also assessed. The assessment was carried out by comparing the ability of the washed cloths to remove bacteria from contaminated stainless steel coupons. In order to simulate how microfibre cloths are used, a Crock Meter was employed to wipe cloth samples across the surface of the contaminated coupons in a reproducible manner. The efficiency of the cloths was determined by comparing the number of bacteria recovered from wiped surfaces with the number recovered from control surfaces.

The results indicate that the Otex laundry system (1, 150 and 350 cycles) did not have a significant impact on the performance of Johnson Diversey or Vermop microfibre cloths. The only significant differences seen occurred when Vermop cloths having received 1 Otex wash cycle were compared with Johnson Diversey cloths which had received 150 and 350 Otex wash cycle. This suggests that new cloths may require a number of cycles before they reach optimum performance.

There were no significant differences found between the conventionally washed cloths and any of the other cloths tested. However, the performance of the conventionally washed cloths was more variable than the Otex washed cloths.

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1 Introduction

The aim of this investigation was to assess the impact of washing regimes on the cleaning efficiency of microfibre cloths. The performance of Vermop (VM) and Johnson Diversey (JD) microfibre cloths were assessed after 1, 150 and 350 wash cycles in an Otex Laundry System, in addition cloths receiving 250 cycles of conventional detergent washing were also assessed.

The assessment was carried by comparing the ability of the washed cloths to remove bacteria from contaminated stainless steel coupons. In order to simulate how microfibre cloths are used, a Crock Meter (Figure 1) was employed to wipe cloth samples across the surface of the contaminated coupons in a reproducible manner. The efficiency of the cloths was determined by comparing the number of bacteria recovered from wiped surfaces with the number recovered from control surfaces.



Figure 1. Crock Meter with Test Coupons and Cloth Samples Attached

2 Experimental Procedure

2.1 Testing Approach

Three cloths were tested per washing regime with each cloth being tested against three contaminated coupons giving nine replicates per washing regime. The efficiency of each set of cloths was assessed on the basis of a \log_{10} reduction in the number of bacteria recovered from the coupons. This was calculated as the difference between the numbers of bacteria recovered from control coupons vs the number recovered from the test coupons. Three control coupons were used per washing regime, these coupons were prepared and treated in exactly the same manner as the test coupons.

2.2 Test Culture

This investigation used 24 hour broth cultures of *Staphylococcus aureus* (NCIMB 9518) grown in Tryptone Soya Broth (TSB) (LabM Lab-004) at 37 °C.

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2.3 Preparation of Test and Control Coupons

This investigation used 4 cm² stainless steel coupons prepared in line with the approach outlined in BSEN 13697 [1]. Prior to use the coupons were soaked in a 5% v/v Decon 90 solution for 1hour. They were then rinsed in sterile water and transferred to 70% IPA for at least 15 minutes. They were then dried using a yellow Bunsen burner flame. The coupons were then contaminated with 0.1ml of *S. aureus* suspension allowed to dry in a Class II safety cabinet for a minimum of 30mins.

2.4 Preparation of Test Cloths

The test cloths were provided in sterile stomacher bags. The cloths were prepared in a Class II safety cabinet using sterile gloves and implements. The Cloths were cut into 6 cm² pieces and transferred to sterile bags prior to testing.

2.5 Recovery of Bacteria from Test Coupons, Control Coupons and Cloths

Bacteria were recovered from test and control coupons in line with the approach outlined in BSEN 13697 [1]. This involved the use of sterile containers containing 5g of glass beads and 10 ml of sterile maximum recovery diluent (MRD) (LabM Lab-103). The recovery process involves placing the coupons contaminated side down on the bed of glass beads and placing the containers on an orbital shaker for 15 minutes at 150 rpm.

The numbers of bacteria recovered from the coupons were enumerated by plating out 2 x 1ml samples and 2 x 4ml¹ samples of the MRD in Tryptone Soya Agar (TSA) (LabM Lab-011) and incubated at 37 °C for 24 hours. Any bacteria still present on the coupons were enumerated by overlaying the coupons with TSA (Figure 2) and incubating as specified above.

The number of bacteria present on the cloths after testing was determined by placing the sample in a sterile stomacher bag with 10 ml of sterile MRD and stomaching for 10 minutes. The numbers of bacteria recovered from the cloth samples were enumerated by plating out 2 x 1ml samples and 2 x 2 ml samples of the MRD in

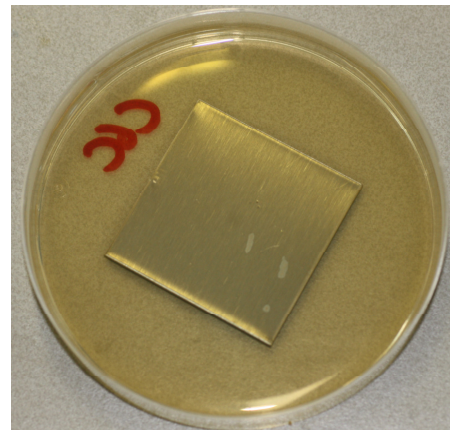


Figure 2. Test Coupon Overlaid with TSA

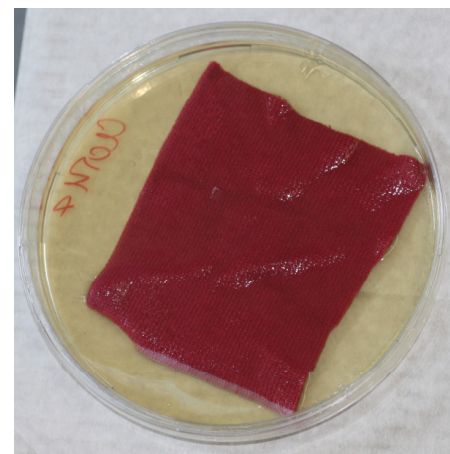


Figure 3. Test Cloth Overlaid with TSA

¹ 150 cm diameter Petri dishes used.

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Tryptone Soya Agar (TSA) (LabM Lab-011). Any bacteria still present on the cloth sample were enumerated by overlaying the cloth with TSA¹ (Figure 3) and incubating as specified above.

2.6 Testing Regime

Three test coupons were fixed to the Crock meter bed (Figure 1). Prior to testing the cloth samples were sprayed four times with sterile water (approximately 3.8 ml). The cloth samples were then attached to the Crock meter head (6.5 cm diameter) using a rubber band. The cloth samples were handled with sterile gloves and care was taken to ensure the rubber band did not touch the test surface of the cloth.

The test cloths were then wiped across the coupons 10 times at a speed of 30 rpm. After wiping the numbers of bacteria remaining on the test coupons and the test cloths were determined as outlined in Section 2.5.

Cloth samples were analysed in an order that was independent of the number of wash cycles they had received, i.e. they were not analysed in any specific order.

2.7 Statistical analysis

All statistical analysis was carried out using SPSS V12.0.1 for Widows.

3 Results

The log reduction values for all the microfibre cloths tested are listed in Table 1 and presented graphically in Figure 1 (raw data can be found in the appendix). Log reduction values for all microfibre cloths tested were compared via Analysis of Variance (Anova) and a Tukey HSD post hoc test. The validity of this approach was establishing by ensuring that the data distributions were not significantly different to a normal distribution using a Kolmogorov-Smirnov test (No significant difference at 95% confidence limits).

	Micro Fibre Samples						
	Johnson Diversey				Vermop		
Treatment	Otex			CDW	Otex		
Wash Cycles	1	150	350	250	1	150	350
Mean Log Reduction	2.1	2.2	2.3	2.0	1.6	1.8	2.1
± SD	0.3	0.4	0.3	0.4	0.2	0.3	0.3
CDW = Conventional Detergent Wash							

Table 1. Log Reduction Data

Whilst these analyses have been carried out carefully and have been checked, no liabilities can be accepted for consequential or indirect damages.

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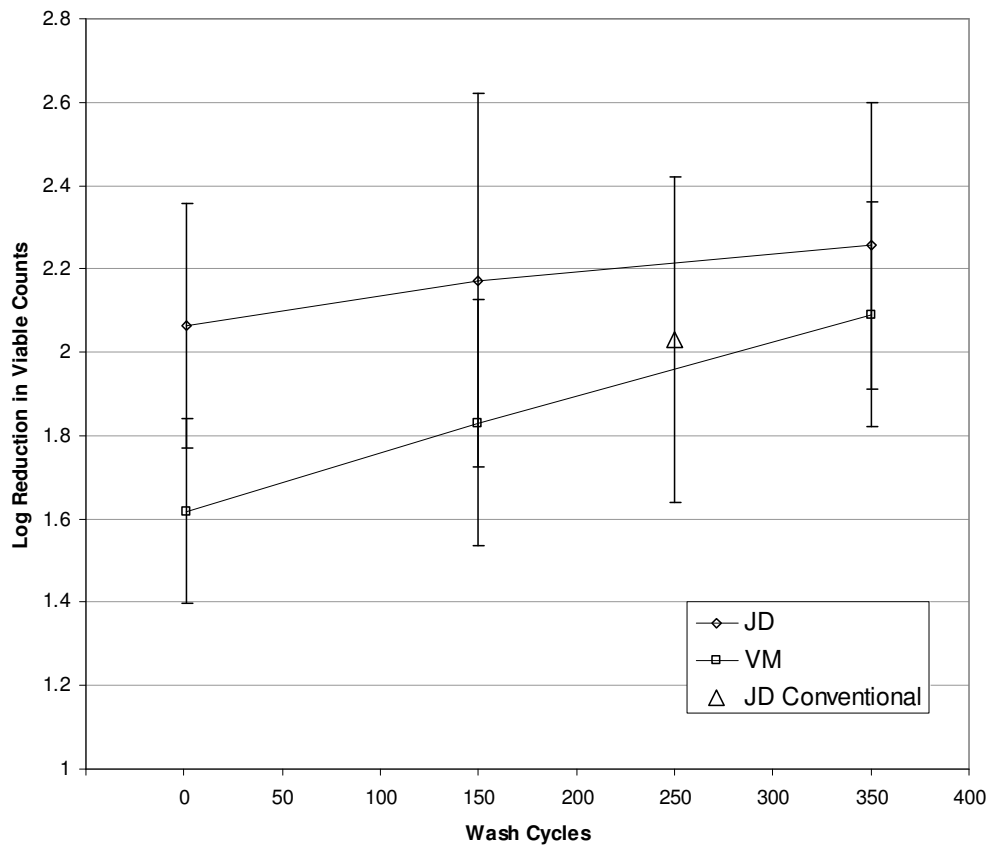


Figure 1. Log Reduction Values

Although both sets of data suggest a general increase in the log reduction values statistical analysis (Table 2) indicated that:

- there are no significant differences between the performance of 1, 150 and 350 wash cycle Otex treated JD cloths ($p \geq 0.05$);
- there are no significant differences between the performance of 1, 150 and 350 wash cycle Otex treated VM cloths ($p \geq 0.05$);
- there are no significant differences between the performance of any of the Otex treated cloths and the conventional detergent washed cloths ($p \geq 0.05$);
- VM cloths receiving 1 Otex cycle had significantly poorer performance than JD cloths receiving 150 and 350 wash cycles.

Whilst these analyses have been carried out carefully and have been checked, no liabilities can be accepted for consequential or indirect damages.

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	JD 1	JD 150	JD 350	VM 1	VM 150	VM 350	Conventional 250
JD 1		x	x	x	x	x	x
JD 150	x		x	✓	x	x	x
JD 350	x	x		✓	x	x	x
VM 1	x	✓	✓		x	x	x
VM 150	x	x	x	x		x	x
VM 350	x	x	x	x	x		x
Conventional 250	x	x	x	x	x	x	

✓ = Significant Difference at 95% CLs, x = No Significant Difference at 95% CLs

Table 2. Statistical Comparison of Log Reduction Values

4 Discussion and Conclusions

The Otex laundry system (1, 150 and 350 cycles) did not have a significant impact on the performance of Johnson Diversey or Vermop microfibre cloths when tested against contaminated stainless steel coupons. The only significant differences seen occurred when Vermop cloths having received 1 Otex wash cycle were compared with Johnson Diversey cloths which had received 150 and 350 Otex wash cycle. This suggests that new cloths may require a number of cycles before they reach optimum performance.

There were no significant differences found between the conventionally washed cloths and any of the other cloths tested. However, the performance of the conventionally washed cloths was more variable than the Otex washed cloths.

Generally speaking the data suggests an improvement in performance as the number of wash cycles increases, especially for the Vermop cloths. However, this trend is not statistically significant given the number of replicates analysed in this study.

5 References

1. BSI, *BS EN 13697:2001. Chemical disinfectants and antiseptics — Quantitative non-porous surface test for the evaluation of bactericidal and/or fungicidal activity of chemical disinfectants used in food, industrial, domestic and institutional areas — Test method and requirements without mechanical action (phase 2/step 2)*, British Standards Institute 2001.

6 Appendix 1

Cloth	JD 1	JD 150	JD 350	VM 1	VM 150	VM 350	Conventional 250
Test Culture (cfu/ml)	4.6x10 ⁴	3.6x10 ⁴	2.6x10 ⁴	3.0x10 ⁴	4.5x10 ⁴	4.6x10 ⁴	3.7x10 ⁴
Cfu's added to coupons	4.6x10 ³	3.6x10 ³	2.6x10 ³	3.0x10 ³	4.5x10 ³	4.6x10 ³	3.7x10 ³
Average cfu's recovered from control coupons (±SD)	3.3x10 ³ ± 2.7x10 ²	1.6x10 ³ ± 9.5x10 ¹	2.0x10 ³ ± 1.3x10 ²	1.5x10 ³ ± 2.4x10 ²	2.4x10 ³ ± 7.4x10 ²	3.3x10 ³ ± 2.6x10 ²	1.8x10 ³ ± 1.7x10 ²
% Recovery	72	44	77	50	53	72	49

Table A1. Summary of Viable Count Data.

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JD MICROFIBRE CLOTH 1 CYLCE (BLUE)															
Stock		4.60E+04		4.67E+04		Added									
						4635									
Count(Cfu)															
Cloth	1ml Pour Plate	2ml Pour Plate	Cloth	Total	Coupon	1ml Pour Plate	4ml Pour Plate	Coupon	Total	Reduction	log Reduction				
1	102	119	260	236	13	934.25	A	0	0	3	1	10	3241.33333	2.36646743	
							B	0	1	2	4	22	3226.33333	2.050197467	
							C	0	0	5	3	15	3232.33333	2.150867629	
2	38	34	62	60	15	257.5	A	0	2	1	6	8	3238.33333	2.282146544	
							B	0	3	5	8	10	3229.33333	2.097622117	
							C	0	0	3	1	8	3243.33333	2.433414219	
3	59	60	101	119	8	431.75	A	0	4	4	10	17	3220.33333	1.968527421	
							B	7	6	24	30	17	3171.33333	1.588316179	
							C	6	6	20	25	16	3182.33333	1.649272605	
							Validation	232	244	1124	937	640	3177	Ave	2.065203512
							Validation	368	356	1280	1021	535	3560	SD	0.294062951
							Validation	244	248	880	947	710	3029		
													Average	3255.333	
													SD	274.0298	

Table A2. JD Cloth 1 Otex Cycles.

JD MICROFIBRE CLOTH 150 CYLCE (BLUE)															
Stock		3.30E+04		3.80E+04		Added									
						3550									
Count(Cfu)															
Cloth	1ml Pour Plate	2ml Pour Plate	Cloth	Total	Coupon	1ml Pour Plate	4ml Pour Plate	Coupon	Total	Reduction	log Redu				
1	7	5	16	12	49	99	A	0	0	0	0	6	1588.333	2.424428	
							B	0	0	0	0	7	1587.333	2.357481	
							C	0	0	1	0	7	1586.333	2.299489	
2	10	12	20	22	33	113	A	0	0	0	0	3	1591.333	2.725458	
							B	6	3	18	20	4	51	1543.333	1.495009
							C	3	3	12	12	0	30	1564.333	1.725458
3	9	8	18	17	43	108	A	0	0	3	0	0	3	1591.333	2.725458
							B	0	0	2	2	9	13	1581.333	2.088636
							C	0	0	2	0	29	31	1563.333	1.711217
							Validation	140	137	480	400	328	1485	Average	2.172515
							Validation	177	121	404	360	595	1657	SD	0.447771
							Validation	149	138	472	424	458	1641		
													Average	1594.333	
													SD	95.0228	

Table A3. JD Cloth 150 Otex Cycles.

JD MICROFIBRE CLOTH 350 CYLCE (BLUE)															
Stock		2.58E+04		2.61E+04		Added									
						2595									
Count(Cfu)															
Cloth	1ml Pour Plate	2ml Pour Plate	Cloth	Total	Coupon	1ml Pour Plate	4ml Pour Plate	Coupon	Total	Reduction	log Redu				
1	32	23	61	50	7	214.5	A	0	0	0	0	10	1954.333	2.293215	
							B	0	0	0	0	7	1957.333	2.448117	
							C	0	0	2	0	5	7	1957.333	2.448117
2	15	15	27	29	29	136.5	A	2	0	8	3	12	25	1939.333	1.895275
							B	0	0	0	0	10	10	1954.333	2.293215
							C	0	0	1	0	2	3	1961.333	2.816094
3	5	4	9	12	17	54.5	A	0	0	1	4	2	7	1957.333	2.448117
							B	2	1	10	6	3	22	1942.333	1.950793
							C	2	1	7	8	20	38	1926.333	1.713432
							Validation	165	169	656	675	317	1982	Average	2.256264
							Validation	175	179	697	688	343	2082	SD	0.343667
							Validation	156	136	620	538	379	1829		
													Average	1964.333	
													SD	127.4219	

Table A4. JD Cloth 350 Otex Cycles.

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VERMOP MICROFIBRE CLOTH 1 CYCLE (GREEN)																	
Stock		2.77E+04	3.21E+04	Added													
				2990													
Count(Cfu)					Count (Cfu)												
Cloth	1ml Pour Plate	2ml Pour Plate	Cloth	Total	Coupon	1ml Pour Plate	4ml Pour Plate	Coupon	Total	Reduction	log Redu						
1	134	136	308	318	13	1133	A	0	0	3	2	42	47	1501.333	1.517767		
							B	0	0	2	3	40	45	1503.333	1.536652		
							C	0	0	1	0	52	53	1495.333	1.465589		
2	106	115	264	259	26	956	A	1	1	3	4	38	47	1501.333	1.517767		
							B	1	5	19	5	20	50	1498.333	1.490894		
							C	2	0	6	2	42	52	1496.333	1.473861		
3	101	109	202	214	28	810.5	A	0	0	2	0	9	11	1537.333	2.148472		
							B	2	0	4	6	15	27	1521.333	1.758501		
							C	2	0	3	6	23	34	1514.333	1.658386		
					Validation					145	164	624	587	247	1767	Average	1.618654
					Validation					130	110	404	410	244	1298	SD	0.220692
					Validation					130	171	512	536	231	1580		
										Average		1548.333					
										SD		236.0981					

Table A5. VM Cloth 1 Otex Cycles.

VERMOP MICROFIBRE CLOTH 150 CYCLES (GREEN)																	
Stock		4.31E+04	4.67E+04	Added													
				4490													
Count(Cfu)					Count (Cfu)												
Cloth	1ml Pour Plate	2ml Pour Plate	Cloth	Total	Coupon	1ml Pour Plate	4ml Pour Plate	Coupon	Total	Reduction	log Redu						
1	41	45	82	84	105	420	A	0	0	3	2	49	54	2311.333	1.641499		
							B	6	4	14	10	21	55	2310.333	1.63353		
							C	1	0	3	1	55	60	2305.333	1.595741		
2	21	26	42	38	18	176.75	A	1	0	4	0	4	9	2356.333	2.419655		
							B	1	0	0	4	9	14	2351.333	2.227764		
							C	1	1	4	5	37	48	2317.333	1.692651		
3	12	16	32	28	27	137	A	0	0	0	0	40	40	2325.333	1.771832		
							B	3	4	11	9	5	32	2333.333	1.868742		
							C	2	2	7	10	35	56	2309.333	1.625704		
					Validation					276	263	980	1268	312	3099	Average	1.83079
					Validation					211	204	916	756	292	2379	SD	0.295887
					Validation					150	134	486	512	336	1618		
										Average		2365.333					
										SD		740.5946					

Table A6. VM Cloth 150 Otex Cycles.

VERMOP MICROFIBRE CLOTH 350 CYCLES (GREEN)																	
Stock		4.60E+04	4.67E+04	Added													
				4635													
Count(Cfu)					Count (Cfu)												
Cloth	1ml Pour Plate	2ml Pour Plate	Cloth	Total	Coupon	1ml Pour Plate	4ml Pour Plate	Coupon	Total	Reduction	log Redu						
1	2	3	5	10	24	49	A	0	0	2	2	16	20	3262.333	2.215153		
							B	0	0	3	1	6	10	3272.333	2.516183		
							C	0	0	1	0	13	14	3268.333	2.370055		
2	3	3	6	8	30	55	A	1	0	7	4	33	45	3237.333	1.86297		
							B	2	1	10	7	16	36	3246.333	1.95988		
							C	2	3	11	7	20	43	3239.333	1.882714		
3	15	20	31	34	42	167	A	1	1	4	5	24	35	3247.333	1.972115		
							B	1	0	4	4	7	16	3266.333	2.312063		
							C	6	3	12	8	32	61	3221.333	1.730853		
					Validation					323	244	1124	937	640	3268	Average	2.091332
					Validation					358	356	1280	1021	535	3550	SD	0.269106
					Validation					244	248	880	947	710	3029		
										Average		3282.333					
										SD		260.7956					

Table A7. VM Cloth 350 Otex Cycles.

JD MICROFIBRE CLOTH CONVENTIONAL DETERGENT 250 CYCLES																	
Stock		3.50E+04	3.87E+04	Added													
				3685													
Count(Cfu)					Count (Cfu)												
Cloth	1ml Pour Plate	2ml Pour Plate	Cloth	Total	Coupon	1ml Pour Plate	4ml Pour Plate	Coupon	Total	Reduction	log Reduction						
1	158	162	331	432	32	1385.75	A	0	1	3	0	17	21	1776.333	1.932409334		
							B	0	2	0	2	11	15	1782.333	2.07853737		
							C	1	1	0	3	27	32	1765.333	1.74947865		
2	75	72	156	177	37	637	A	0	0	1	2	6	9	1788.333	2.300386119		
							B	0	0	1	2	5	8	1789.333	2.351538642		
							C	0	0	7	8	26	41	1756.333	1.641844772		
3	133	120	266	242	43	994.25	A	0	0	6	0	16	22	1775.333	1.912205948		
							B	3	3	11	10	22	49	1748.333	1.564432549		
							C	0	0	0	0	3	3	1794.333	2.777507374		
					Validation					115	107	534	520	408	1684	Average	2.034260084
					Validation					212	196	464	412	432	1716	SD	0.388420633
					Validation					120	140	636	504	592	1992		
										Average		1797.333					
										SD		169.3438					

Table A8. JD Cloth Conventional Detergent Washing 250 Cycles.

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