Research Record No: 210

S H R I N K A G E 85

Influence of Moisture Content on Shrinkage Development in Tumble Drying

Part 2 : INTERLOCK WINCH DYE

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C O N T E N T S

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1. INTRODUCTION

In Part 1 of this series (Research Record No. 208) the results from the preliminary investigation were reported. These indicated that, during tumble drying maximum length and width shrinkages are only achieved when the residual moisture content in the fabric falls below normal regain and approaches zero.

These results were however collected on one set of specimens measured at intervals during the tumble drying cycle without the additional cool down period normally included, and without reconditioning. Therefore, to discover whether similar trends would be apparent if specimens were allowed to tumble dry without disturbance for different lengths of time and with the inclusion of a cool down period at the end of each cycle, the second series of trials was devised. Also in this series, the influence of reconditioning on shrinkage measurements was monitored by allowing each set of specimens to recondition after tumbling and measuring, before the next cycle was carried out. An additional set, prepared from the same roll of fabric and washed/wet out under identical conditions was line dried in a conditioned atmosphere for 24 hours, for comparison.

2. SAMPLE PREPARATION

2.1. Tumble dry sets

Five sets, each comprising 5 standard shrinkage specimens (50 x 50cm^2 template) were prepared from a roll of 20G interlock, knitted from Ne 1/38 combed cotton at 0.338cm nominal stitch length, which had been winch dyed and finished during a separate investigation at Springfield Dyers and Finishers.
(NB: this was not the same piece which had been sampled for the preliminary investigation).

Each specimen was conditioned in the laboratory, marked, measured and weighed prior to laundering. Five standard loads of 2.75Kg were made up, including the test specimens, with make-weight fabric of a similar construction.

Initial moisture content and % regain were determined from four separate samples taken from the same roll.

2.2. Line Dry Sets

An additional set of 5 standard shrinkage specimens was prepared from the same roll of fabric, and the specimens conditioned, marked and measured. These were then included in a 6th standard load which was made up as before to 2.75Kg with make-weight fabric of a similar construction.

3. EXPERIMENTAL PROCEDURE

3.1. Tumble dry sets

Each set of 5 shrinkage specimens plus make-weights was washed in a Hoover automatic, domestic washing machine at 60°C.

On completion of the washing cycle the test specimens were weighed and then the full load transferred to a Hoover domestic, single direction, tumble dryer and tumble dried on the hottest temperature setting for a specified length of time. Tumbling was then continued for a further 10 minutes with the heat turned off, by using the cool down setting on the tumble dryer:-

Set 1 40 mins hot tumble + 10 mins cool down
Total time in tumble dryer = 50 mins.

Set 2 50 mins hot tumble + 10 mins cool down
Total time in tumble dryer = 60 mins

Set 3 60 mins hot tumble + 10 mins cool down
Total time in tumble dryer = 70 mins

Set 5 80 mins hot tumble + 10 mins cool down
Total time in tumble dryer = 90 mins

Set 7 100 mins hot tumble + 10 mins cool down
Total time in tumble dryer = 110 mins

On completion of the specified drying time, the test specimens were weighed and measured and then transferred to the laboratory for reconditioning in the standard atmosphere (65%RH, 20°C). Each specimen was allowed to recondition overnight (minimum 12 hours).

After reconditioning the specimens were reweighed and remeasured and then the complete load was re-wet-out in the washing machine using the rinse cycle. On completion of the rinse cycle the test specimens were weighed and the load transferred to the tumble dryer and dried for the appropriate length of time, i.e. set 1 40 + 10 mins, set 2 50 + 10 mins, etc.

On completion of the specified drying time, the test specimens were weighed and measured and then transferred to the laboratory for reconditioning, reweighing and remeasuring.

The rinse/tumble drying cycles were repeated a further 3 times for each set. Measurements being taken both straight from the tumble dryer and after reconditioning in the laboratory.

3.2. Line dry set

The line dry set was washed in a Hoover automatic, domestic washing machine at 60°C in the same way as the tumble dry sets.

On completion of the washing cycle the test specimens were weighed and then hung on a line in the laboratory in the standard conditioned atmosphere and left to dry for 24 hours. After 24 hours the test specimens were weighed and measured before being returned, with the make-weights, to the washing machine for rewetting using the rinse cycle.

On completion of the rinse cycle the specimens were reweighed and hung on a line in the laboratory for 24 hours before remeasuring and reweighing.

The rinse/line dry cycle was repeated a further three times.

After the 5th rinse/line dry cycle the specimens were left for a further 24 hours and reweighed and measured.

At the end of this period each specimen was oven dried and reweighed.

4. RESULTS

The individual results for shrinkage, weight and moisture content for each set are given in individual appendices at the end of this report.

Tables 1 and 2, and Figures 1-14 summarise the average results obtained from all sets.

Tables 3-7 give the results of the statistical analysis which compares results obtained before and after reconditioning for each of the tumble dry sets.

5. DISCUSSION

5.1. Measured straight from the tumble dryer

5.1.1. length shrinkage

In each of the tumble dry sets, length shrinkage increased progressively with the number of cycles. Generally, also, length shrinkage increased with the length of time in the tumble dryer. In particular, set 1 (40+10) and set 2 (50+10) did not develop the same amount of shrinkage as found in the other three sets. The differences in shrinkage found between sets 3,(60+10), 5 (80+10) and 7 (100+10) was, however, negligible. This would appear to indicate that the full shrinkage potential of a fabric during any one cycle can only be achieved if the average moisture content in the specimens falls below approximately 2%. Once the specimens are uniformly dry (between 0 and 2% residual moisture) tumbling for additional lengths of time does not appear to significantly increase the level of length shrinkage developed.

The shrinkage results recorded for set 1 (40+10) were similar to the results obtained from the line-dry set, which also showed progressive shrinkage with number of cycles. With the exception of set 1, the shrinkage recorded in tumble drying was always significantly higher than that recorded after line drying.

Variation between specimens within a set improved over sets 1, 2, and 3 but did not improve further with extended tumbling times. The variation between specimens for the line dry set was slightly better than set 1 and slightly worse than set 2.

5.1.2. width shrinkage

Width shrinkage was not progressive with number of cycles but increased slightly with length of time in the tumble dryer,(reducing mositure content). In particular, width shrinkages recorded for set 1 were lower than for the other sets. Maximum width shrinkage is only achieved with low levels of residual moisture (0-2%).

The amount of width shrinkage developed during line drying was significantly less than for any of the tumble dry sets, but similarly did not increase with the number of cycles.

Variation between specimens within a set improved between set 1 and set 2 but tended to increase slightly with extended tumbling times. Variation in width shrinkage measurements is generally higher than for length shrinkage. The variation in width shrinkage measurements for the line dry set were similar to set 1.

5.1.3. moisture content

Moisture content in the specimens reduced with length of time in the tumble dryer. Consistent minimum levels of moisture were only achieved with sets 5 (80+10) and 7 (100+10) although set 3 was also, on average, below 2% residual moisture immediately on leaving the tumble dryer.

Variation in moisture content between specimens also decreased with increased time in the tumble dryer and for set 1 in particular, with number of cycles.

The variation in moisture content of the line dry samples was insignificant.

5.2. Influence of Conditioning

5.2.1. length shrinkage

Conditioning after tumble drying generally reduced the variability between specimens for all sets, and with the exception of set 1, caused a significant reduction in the levels of recorded length shrinkage between approximately 1 and 2%. For set 1 length shrinkage on average increased with conditioning.

5.2.2. width shrinkage

Conditioning after tumble drying had little effect on width shrinkage either in the absolute values or the variability of the results, and although there was on average a small decrease in width shrinkage the improvement was not significant.

5.2.3. moisture content

Obviously the variation in moisture content after reconditioning was negligible for each set although there was a slight decrease in the absolute values as time in the tumble dryer increased. The moisture content of the line dry set was similar to that of set 1 after reconditioning. The moisture content in set 7 after reconditioning was approximately 1% less. The apparent reduction in final average moisture content with increasing lengths of time in the tumble dryer may be due to increasing weight loss in the test specimens, as well as to the effect of conditioning from the dry side.

6. CONCLUSIONS

1. For this fabric quality length shrinkage increases with length of time in the tumble dryer (reducing moisture content) but once the average moisture content of the specimens falls below approximately 2% no additional shrinkage appears to develop.

2. Length shrinkage increases with the number of cycles but unless the specimens are dried below approximately 2% residual moisture, maximum length shrinkage does not develop even after 5 cycles.

3. For this fabric quality width shrinkage increases with length of time in the tumble dryer but is apparently less sensitive to the level of residual moisture in the specimens than length shrinkage. Maximum width shrinkage was achieved with set 2 (50+10) where the residual moisture content in the specimens was on average 4.7%.

4. Width shrinkage did not increase with the number of cycles.

5. Moisture content reduced with the length of time in the tumble dryer but did not on average fall below approximately 1.4% over sets 3, 5 and 7. For set 1 in particular the apparent moisture content reduced with the number of cycles.

6. Conditioning after tumble drying reduced the variability in the length shrinkage measurements but did not have a significant influence on width shrinkage measurements.

7. Conditioning reduced length shrinkage in sets which had been dried below normal regain but caused a slight increase in the length shrinkage results for set 1.

8. Less length and width shrinkage is developed during line drying compared to tumble drying. Length shrinkage in line drying is progressive over cycles but width shrinkage may improve slightly with number of cycles.

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TABLE 1

INTERLOCK Ne 30, Stitch Length 0.338, FINISH Winch Dye

Average of 5 replications : Measured straight from the Tumble Dryer

Cycle No		LS%	SD	WS%	SD	MC%	SD
Set 1 Tumble Dry 40+10 mins							
1		10.94	0.93	10.42	1.4	15.95	4.7
2		12.74	0.82	10.04	1.18	12.49	1.75
3		11.7	2.54	11.66	2.24	13.75	2.69
4		13.38	1.24	9.58	1.1	14.15	2.6
5		15.2	0.81	11.58	0.54	9.06	1.26
	mean		1.27		1.29		2.6
	sd		0.73		0.62		1.32
Set 2 Tumble Dry 50+10 mins							
1		16.18	1.02	11.22	0.54	5.72	0.51
2		18.26	0.42	11.38	0.31	3.48	0.21
3		18.54	0.47	11.74	0.29	4.82	0.66
4		18	0.6	11.42	0.31	6.17	0.5
5		20.3	0.51	11.94	0.6	3.55	0.3
	mean		0.6		0.41		0.44
	sd		0.24		0.15		0.18
Set 3 Tumble Dry 60+10 mins							
1		17.34	0.56	12.16	0.73	1.78	0.61
2		19.26	0.78	11.6	0.63	1.34	0.09
3		20.22	0.28	11.32	1.02	1.32	0.21
4		20.26	0.36	12.24	0.84	3.09	0.6
5		20.94	0.44	11.96	0.47	1.35	0.08
	mean		0.48		0.74		0.32
	sd		0.2		0.21		0.27
Set 5 Tumble Dry 80+10 mins							
1		17.2	0.35	12.46	0.4	1.06	0.14
2		19.26	0.37	12	0.45	0.55	0.29
3		20.5	0.4	12	0.42	1.21	0.11
4		21.06	0.5	11.18	1.3	0.22	0.22
5		21.34	0.62	11.7	1.03	0.42	0.19
	mean		0.45		0.72		0.19
	sd		0.11		0.42		0.07
Set 7 Tumble Dry 100+10 mins							
1		17.18	0.47	11.32	1.16	1.71	0.11
2		18.82	0.25	11.4	0.62	1.58	0.13
3		19.74	0.46	11.4	0.68	1.63	0.14
4		20.5	0.59	11.44	0.73	1.78	0.14
5		20.9	0.37	11.1	0.89	1.43	0.32
	mean		0.43		0.82		0.17
	sd		0.13		0.22		0.09
Set 8 Line Dry 24Hrs Conditioned Atmosphere							
1		12.96	1.09	7.36	1.49	7.32	0.11
2		13.52	0.78	6.52	1.33	7.61	0.1
3		14.18	0.21	6.16	0.7	7.38	0.12
4		13.8	1.72	5.84	1.98	7.42	0.1
5		14.18	0.82	6.54	1.36	7.39	0.11
	mean		0.92		1.37		0.11
	sd		0.55		0.46		0.01

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TABLE 2

INTERLOCK Ne 30, Stitch Length 0.338, FINISH Winch Dye

Average of 5 replications : Measured after conditioning

Cycle No	LS%	SD	WS%	SD	MC%	SD
Set 1 Tumble Dry 40+10 mins						
1	12.46	1.13	9.12	2.32	7.75	0.07
2	13.2	0.62	10.66	0.54	7.56	0.07
3	13.94	0.27	10.1	1.06	7.86	0.14
4	14.44	0.79	9.7	0.73	7.63	0.15
5	15.08	0.36	11.2	0.97	7.64	0.17
mean		0.63		1.12		0.12
sd		0.35		0.7		0.05
Set 2 Tumble Dry 50+10 mins						
1	15.18	0.42	11.02	0.66	7.17	0.2
2	16.94	0.54	11.46	0.27	6.58	0.08
3	16.98	0.68	11.5	0.64	6.71	0.15
4	17.3	0.63	11.58	0.73	7.14	0.17
5	18.34	0.51	11.58	0.43	6.42	0.45
mean		0.56		0.55		0.21
sd		0.1		0.19		0.14
Set 3 Tumble Dry 60+10 mins						
1	15.78	0.36	12.04	0.66	5.99	0.5
2	17.38	0.61	12.04	0.67	6.23	0.03
3	18.66	0.5	11.84	0.29	6.05	0.07
4	18.5	0.5	12.12	0.55	6.4	0.09
5	19.1	0.42	12.32	0.94	6.26	0.08
mean		0.48		0.62		0.15
sd		0.09		0.23		0.19
Set 5 Tumble Dry 80+10 mins						
1	15.52	0.72	11.42	0.69	6.59	0.11
2	17.28	0.68	11.5	0.57	6.15	0.1
3	18.48	0.28	11.42	0.53	6.22	0.19
4	19.48	0.49	11.26	1.02	5.42	1.28
5	19.66	0.62	11.62	0.86	6.13	0.15
mean		0.56		0.73		0.37
sd		0.18		0.21		0.51
Set 7 Tumble Dry 100+10 mins						
1	15.34	0.37	11.6	0.51	6.13	0.08
2	16.98	0.32	11.68	0.52	6.35	0.09
3	18.62	0.39	11.02	1.23	6.3	0.06
4	19.42	0.25	11.96	1.15	5.75	0.07
5	19.58	0.45	10.88	0.67	6.11	0.03
mean		0.36		0.82		0.07
sd		0.08		0.35		0.02
Set 8 Line Dry 24Hrs Conditioned Atmosphere						
1	12.96	1.09	7.36	1.49	7.32	0.11
2	13.52	0.78	6.52	1.33	7.61	0.1
3	14.18	0.2	6.16	0.7	7.38	0.12
4	13.8	1.72	5.84	1.98	7.42	0.1
5	14.18	0.82	6.54	1.36	7.39	0.11
mean		0.92		1.37		0.11
sd		0.55		0.46		0.01

TABLE 3

STUDENTS T STATISTIC
DEGREES OF FREEDOM = 4 (N=5)
95% = 2.776 *
99% = 4.604 **
99.9% = 8.610 ***

SHRINKAGE MEASURED IMMEDIATELY / AFTER CONDITIONING

SET 1 : Tumble Dry 40mins + 10mins COOL Down

		Mean Difference	T		r sq
FULL WASH	LS	1.52	4.334	*	0.6162
	WS	-1.3	2.7107		0.9789
1st RINSE	LS	0.46	2.5715		0.8317
	WS	0.62	1.2266		0.2675
2nd RINSE	LS	2.24	1.827		0.1381
	WS	-1.56	1.1841		0.0273
3rd RINSE	LS	1.06	3.4482	*	0.8271
	WS	0.12	0.4441		0.8142
4th RINSE	LS	-0.12	0.4441		0.7174
	WS	-0.38	1.6506		0.9434

SHRINKAGE MEASURED IMMEDIATELY / AFTER CONDITIONING

TABLE 4

SET 2 : Tumble Dry 50mins + 10mins COOL Down

		Mean Difference	T		r sq
FULL WASH	LS	-1	3.2444	*	0.9474
	WS	-0.2	0.4924		0.0082
1st RINSE	LS	-1.32	14.758	***	0.929
	WS	0.08	0.5963		0.3391
2nd RINSE	LS	-1.56	5.1432	**	0.2489
	WS	-0.24	0.5787		0.2975
3rd RINSE	LS	-0.7	1.2888		0.3176
	WS	0.16	0.3915		0.0095
4th RINSE	LS	-1.96	7.0633	***	0.1736
	WS	-0.36	1.7566		0.5374

TABLE 5

STUDENTS T STATISTIC
DEGREES OF FREEDOM = 4 (N=5)
95% = 2.776 *
99% = 4.604 **
99.9% = 8.610 ***

SHRINKAGE MEASURED IMMEDIATELY / AFTER CONDITIONING

SET 3 : Tumble Dry 60mins + 10mins COOL Down

		Mean Difference	T		r sq
FULL WASH	LS	-1.56	8.7207	***	0.6122
	WS	-0.12	0.7171		0.79
1st RINSE	LS	-1.88	7.4901	**	0.5889
	WS	0.44	1.4506		0.3156
2nd RINSE	LS	-1.56	11.9647	***	0.8809
	WS	0.52	0.8348		0.5123
3rd RINSE	LS	-1.76	13.4986	***	0.7466
	WS	-0.12	0.3935		0.4722
4th RINSE	LS	-1.84	14.1122	***	0.6662
	WS	0.36	1.1272		0.6229

SHRINKAGE MEASURED IMMEDIATELY / AFTER CONDITIONING

TABLE 6

SET 5 : Tumble Dry 80mins + 10mins COOL Down

		Mean Difference	T		r sq
FULL WASH	LS	-1.68	5.6633	**	0.3253
	WS	-1.04	2.7478		0.0165
1st RINSE	LS	-1.98	8.2215	***	0.5223
	WS	-0.5	1.8257		0.1929
2nd RINSE	LS	-2.02	13.3195	***	0.4266
	WS	-0.58	1.8072		0.0103
3rd RINSE	LS	-1.58	9.0471	***	0.5366
	WS	0.08	0.2493		0.7661
4th RINSE	LS	-1.68	10.0399	***	0.7322
	WS	-0.08	0.2961		0.7247

TABLE 7

STUDENTS T STATISTIC
DEGREES OF FREEDOM = 4 (N=5)
95% = 2.776 *
99% = 4.604 **
99.9% = 8.610 ***

SHRINKAGE MEASURED IMMEDIATELY / AFTER CONDITIONING

SET 7 : Tumble Dry 100mins + 10mins COOL Down

		Mean Difference	T		r sq
FULL WASH	LS	-1.84	21.9922	***	0.8995
	WS	0.28	0.6374		0.5018
1st RINSE	LS	-1.84	14.1122	***	0.3643
	WS	0.28	0.9719		0.2477
2nd RINSE	LS	-1.12	9.823	***	0.7501
	WS	-0.38	1.1431		0.8414
3rd RINSE	LS	-1.08	5.2082	**	0.6636
	WS	0.52	1.1402		0.3739
4th RINSE	LS	-1.32	5.062	**	0.0433
	WS	-0.22	1.3148		0.894

FIGURE 1

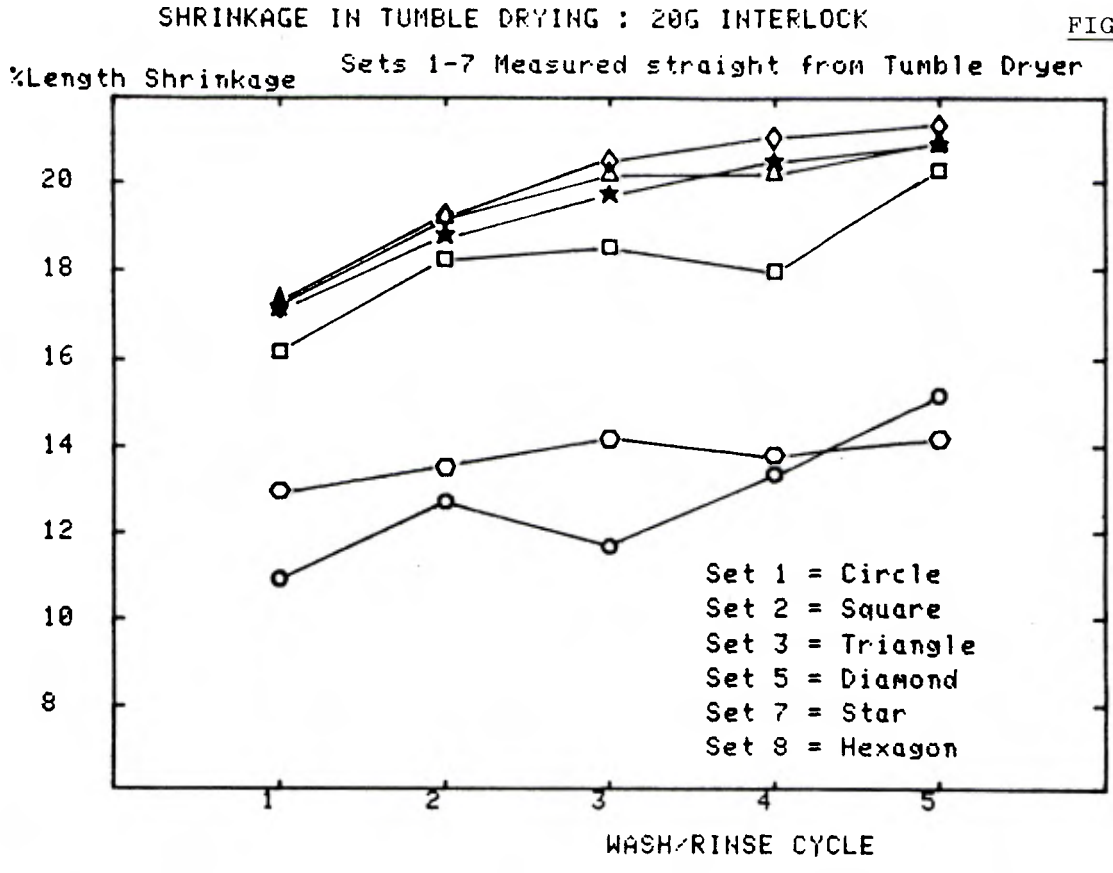


FIGURE 2

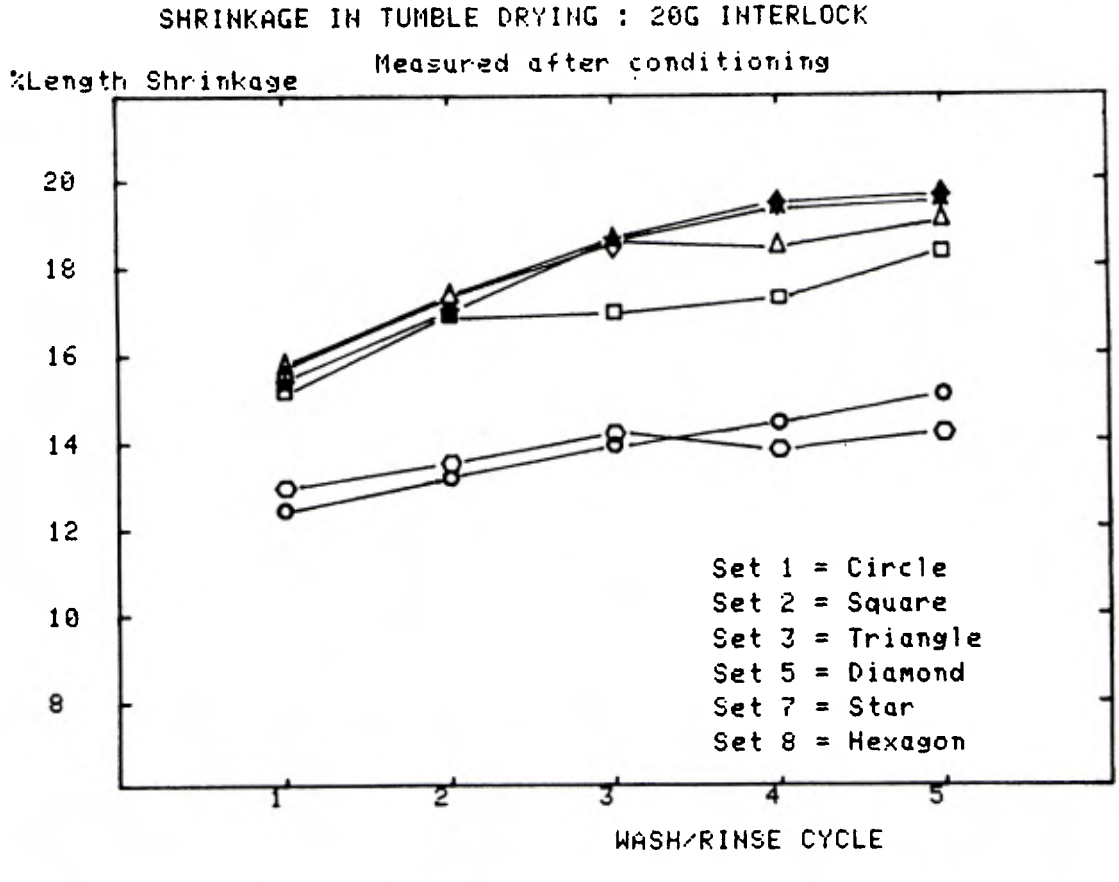
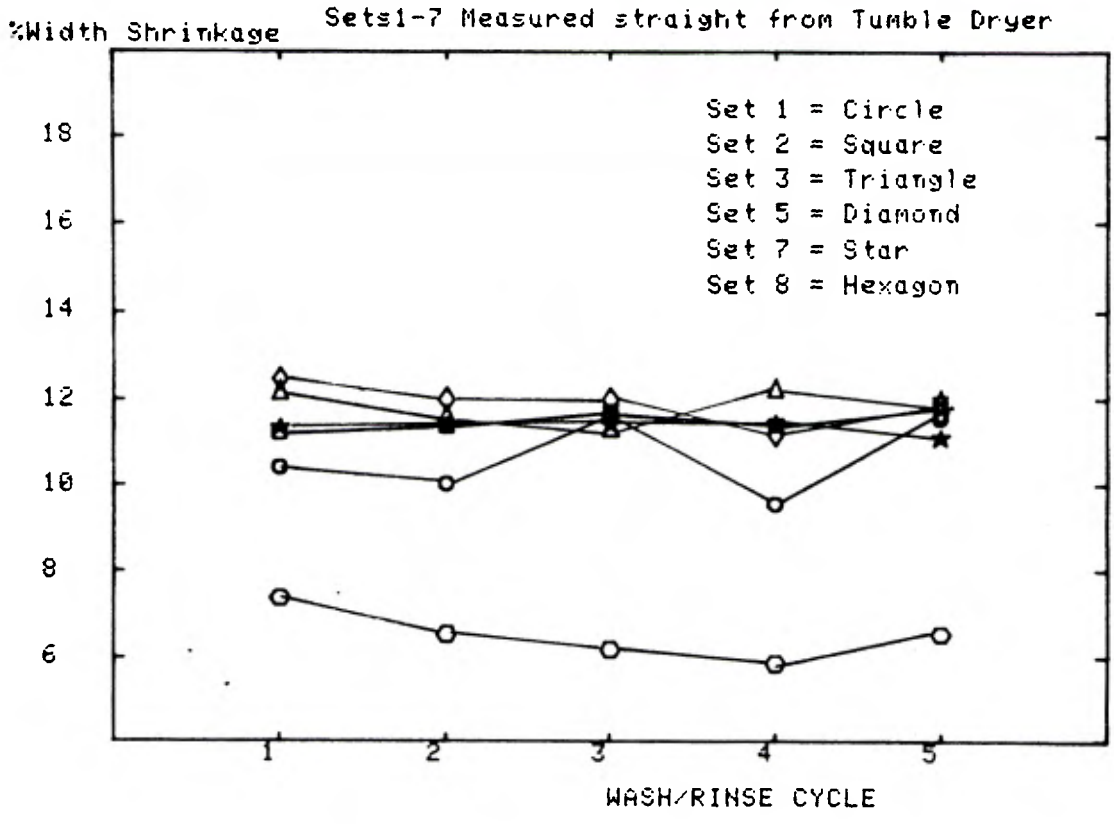


FIGURE 3



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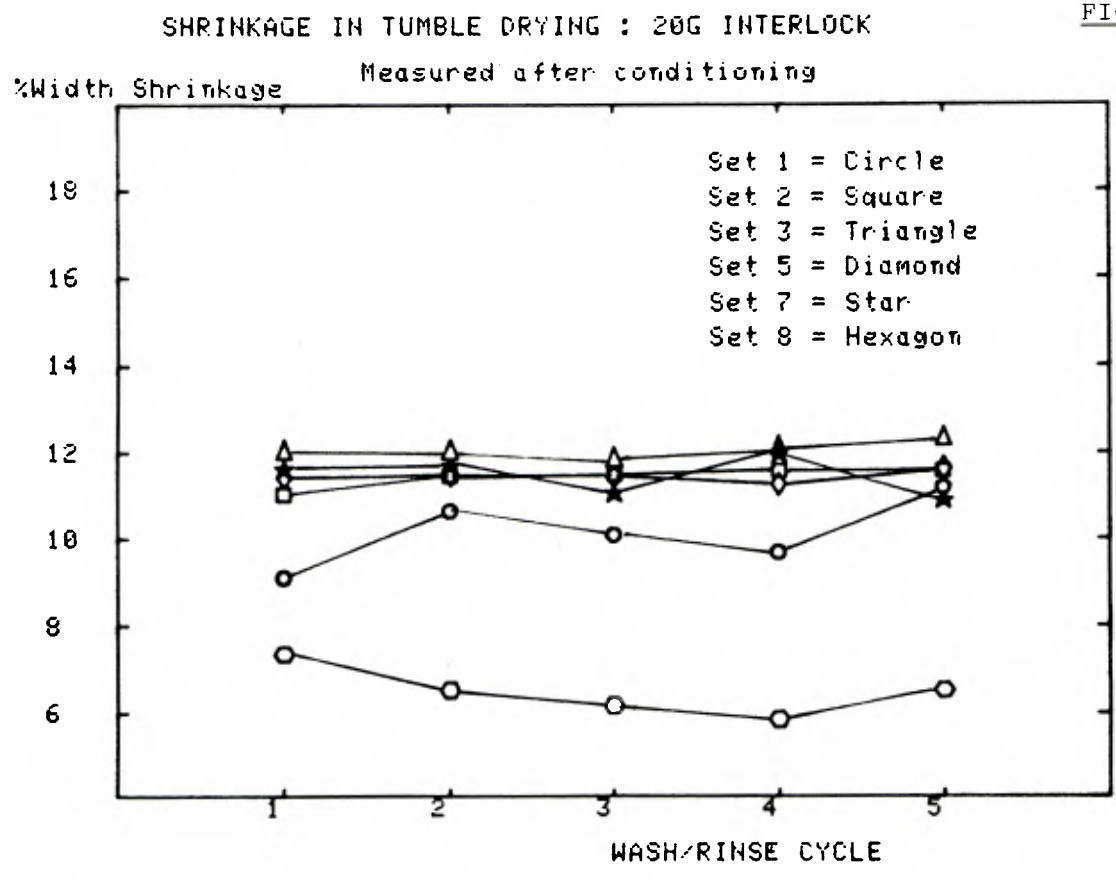

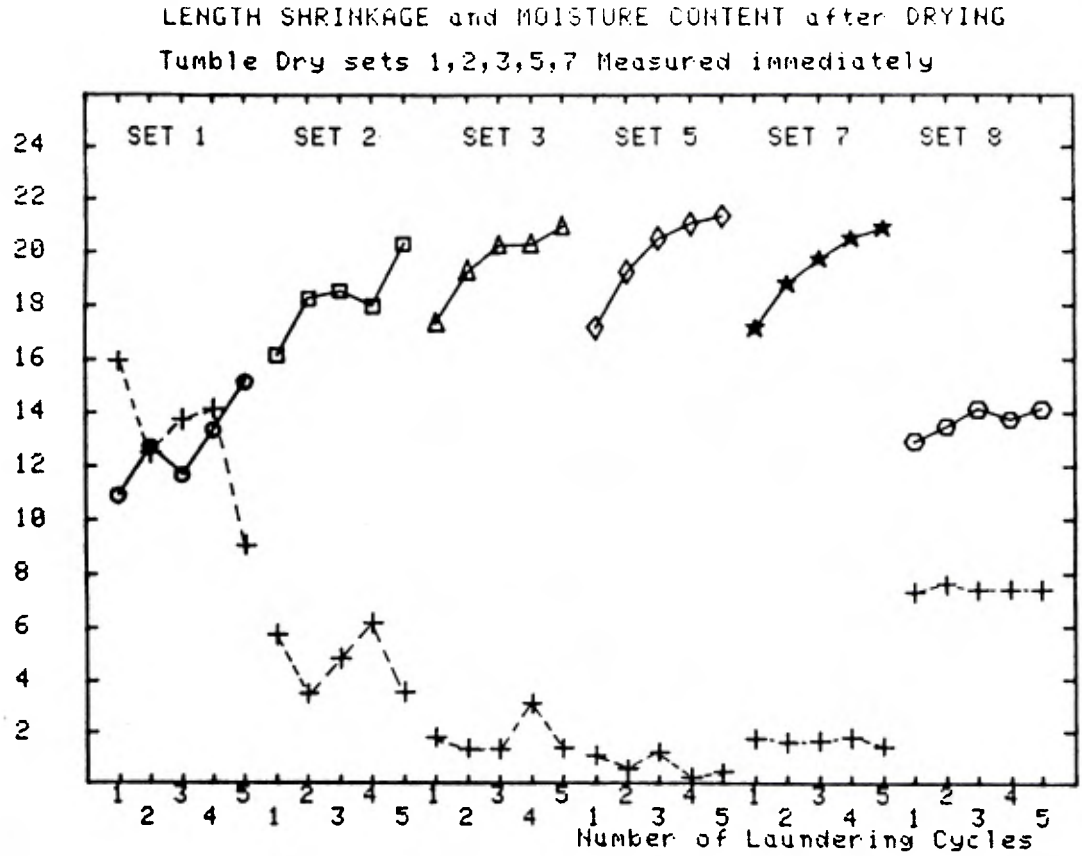

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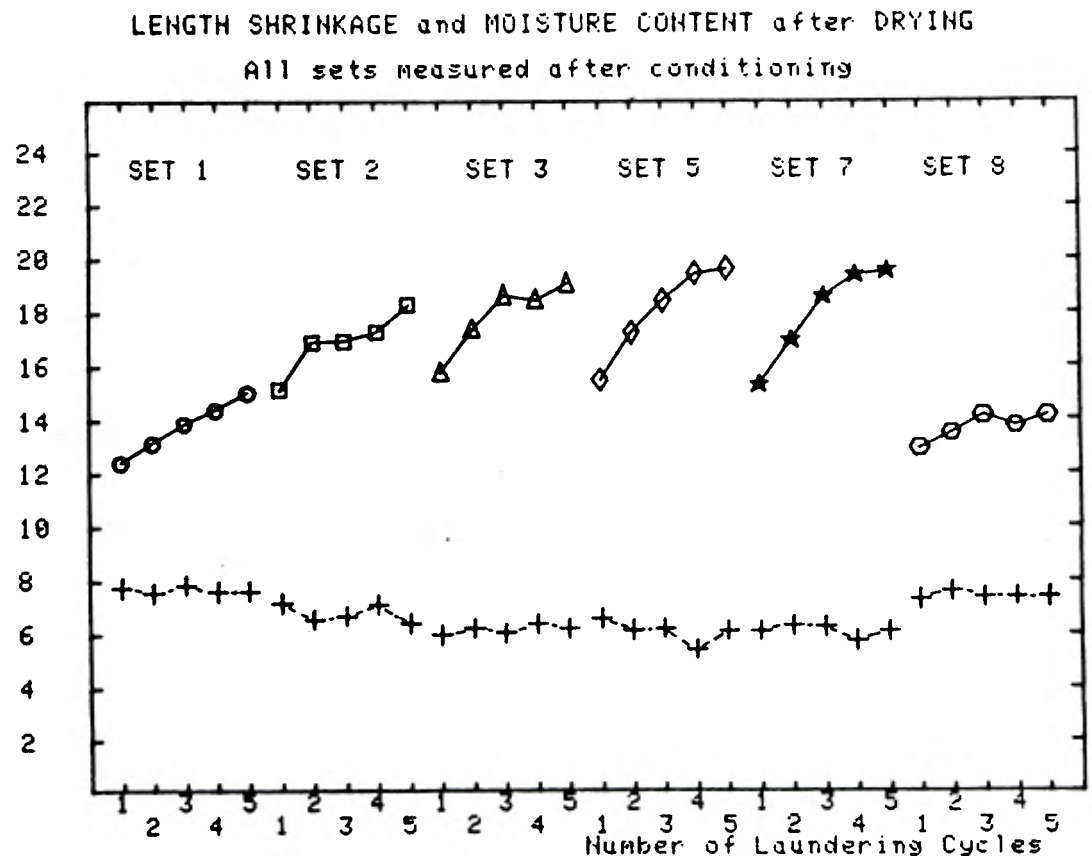

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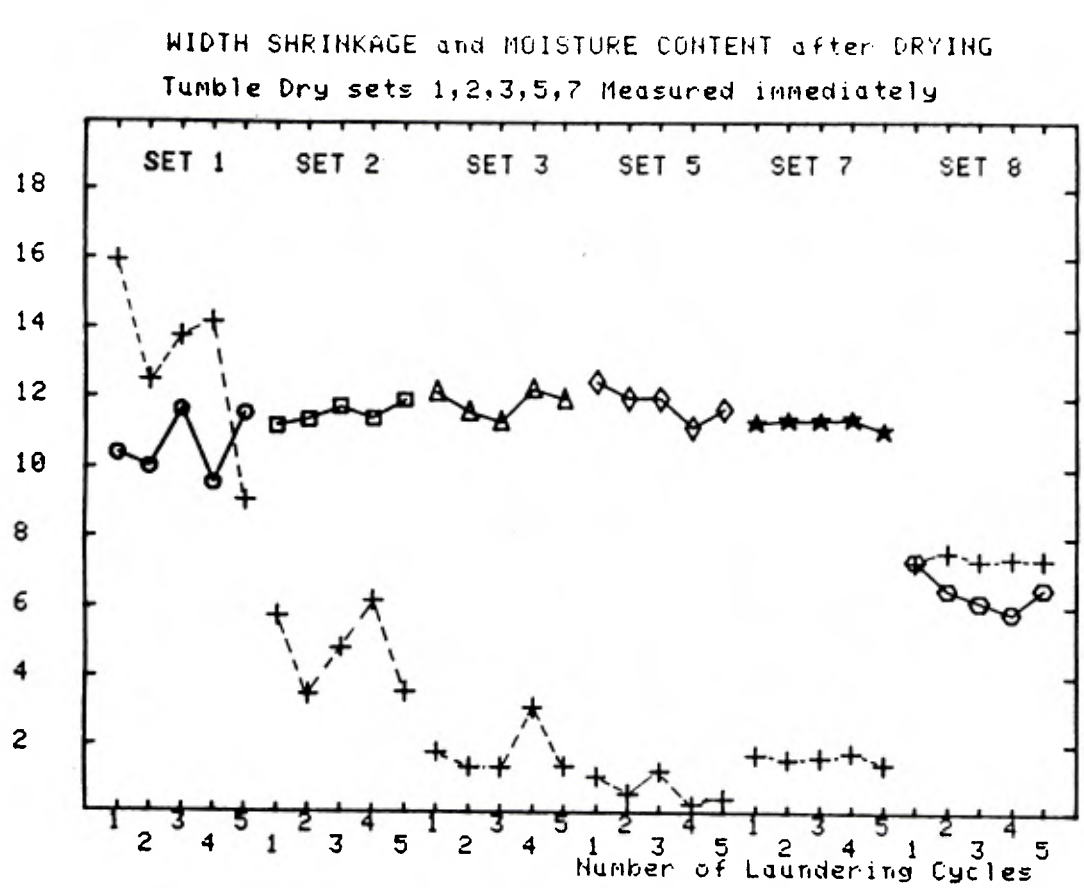

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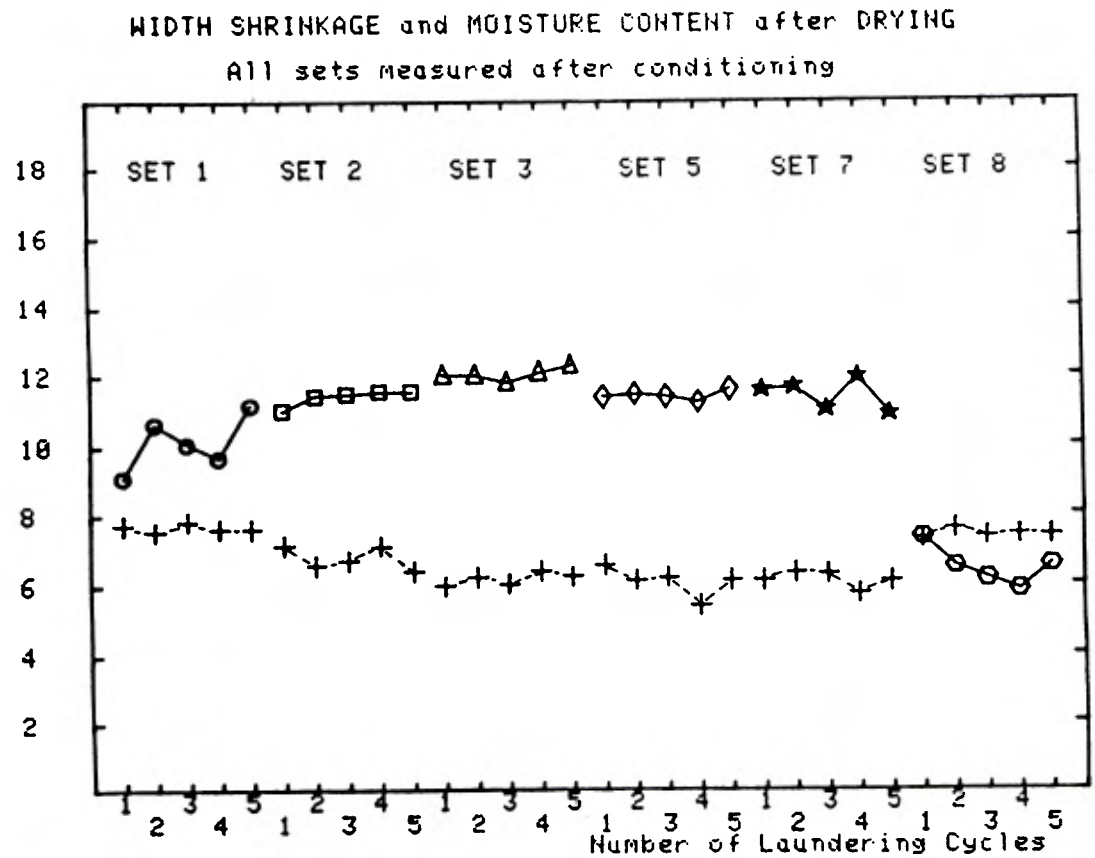
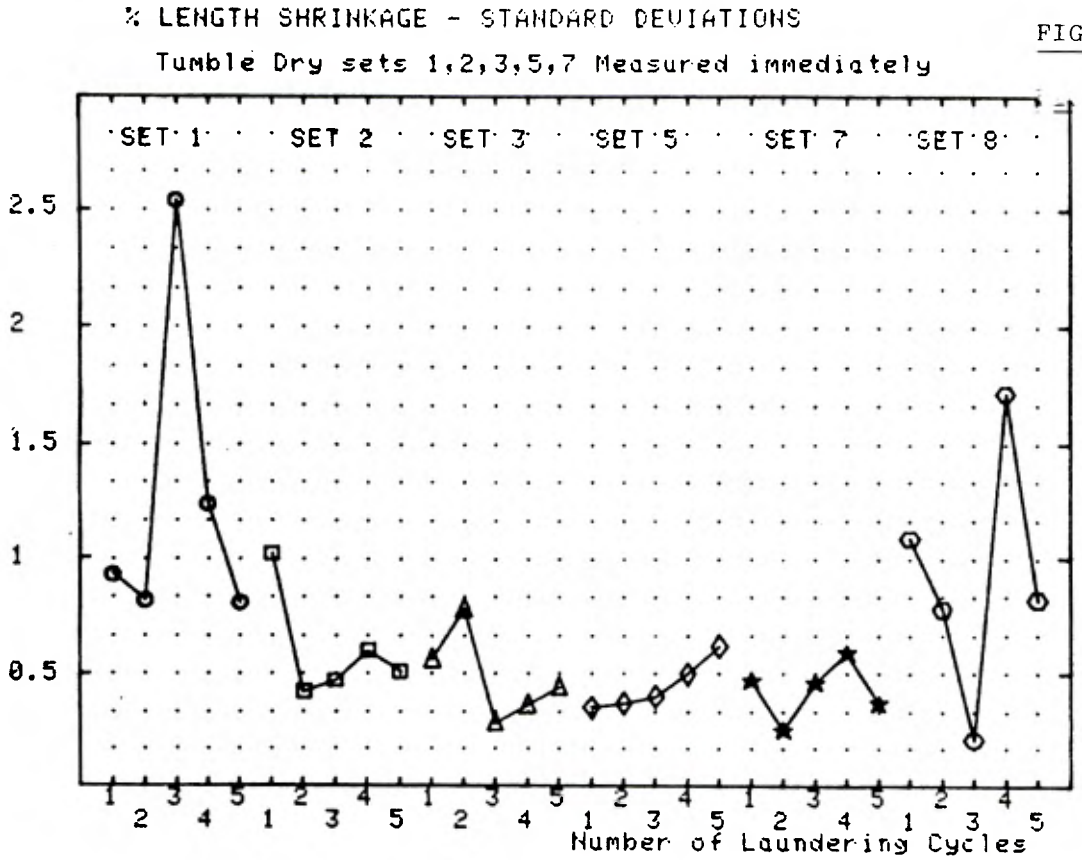


FIGURE 8

FIGURE 9



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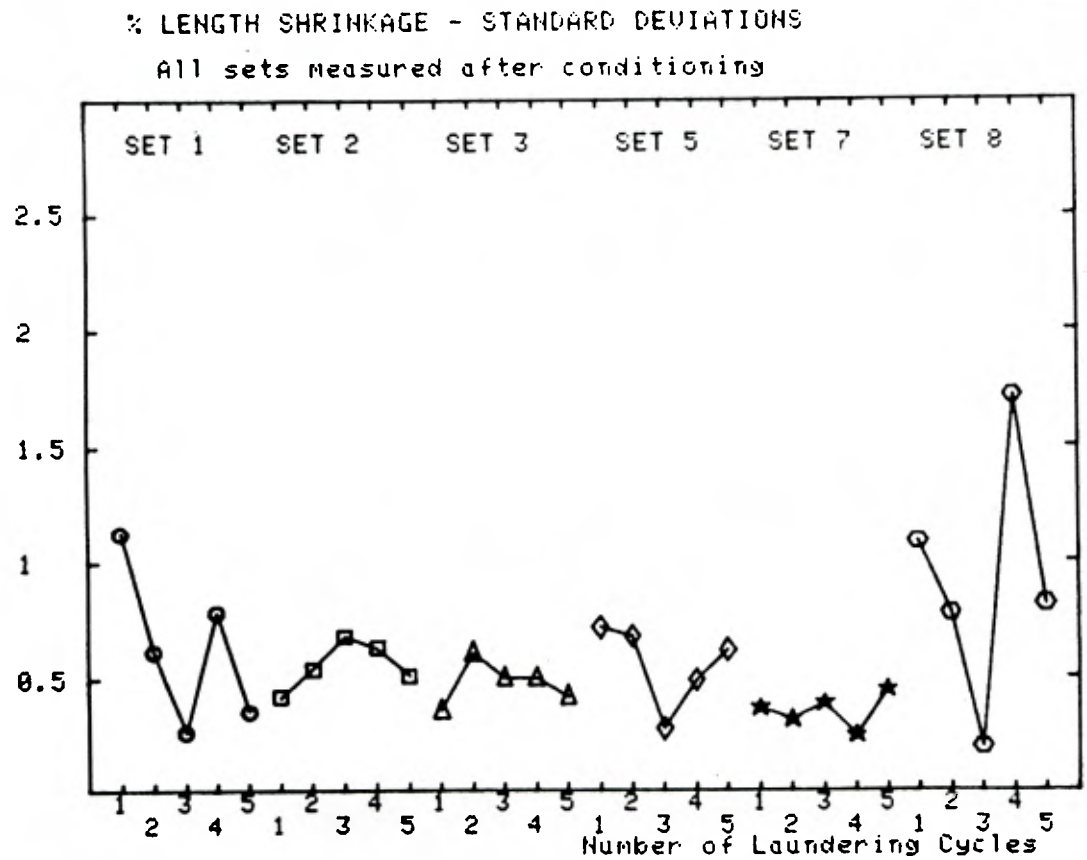

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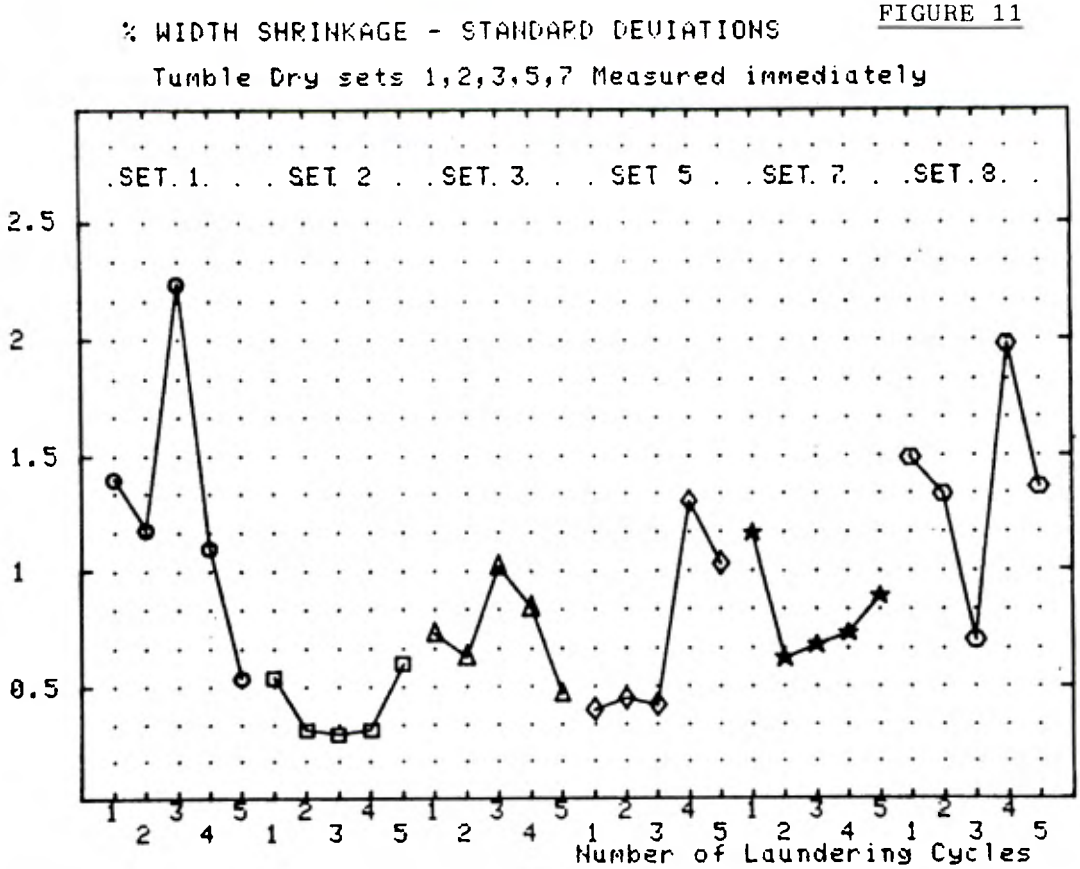

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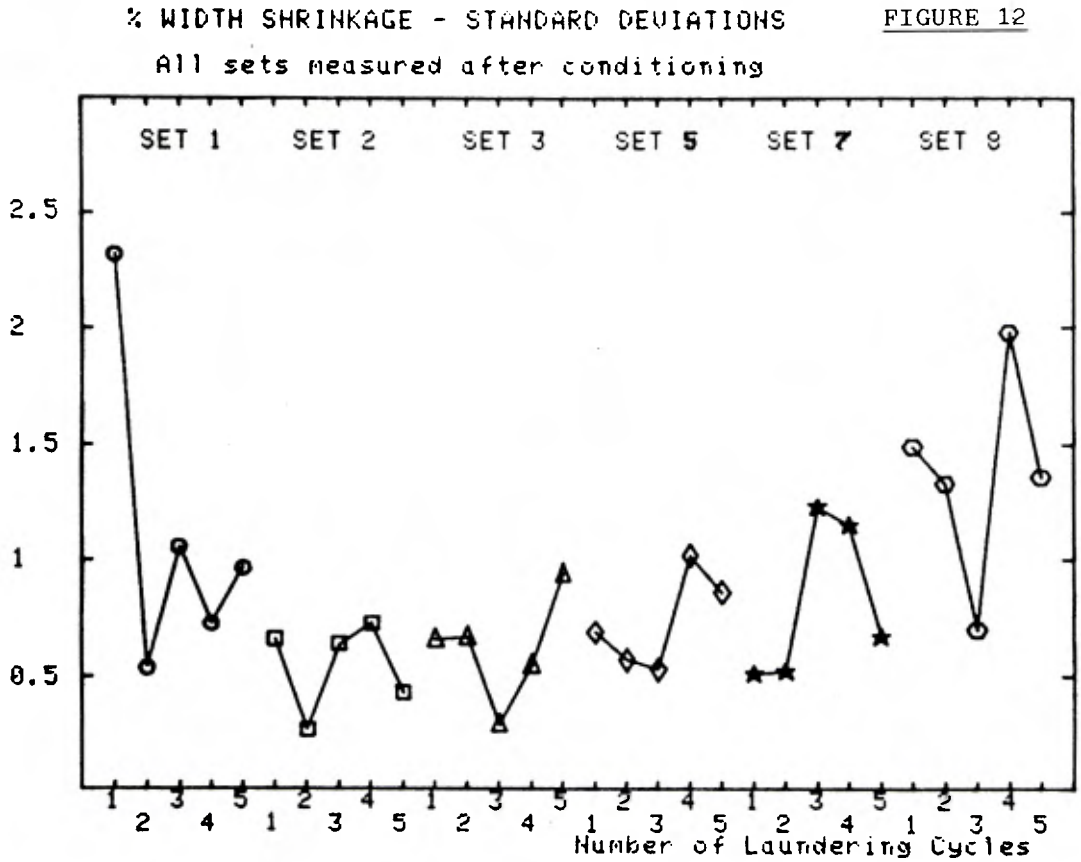


FIGURE 13

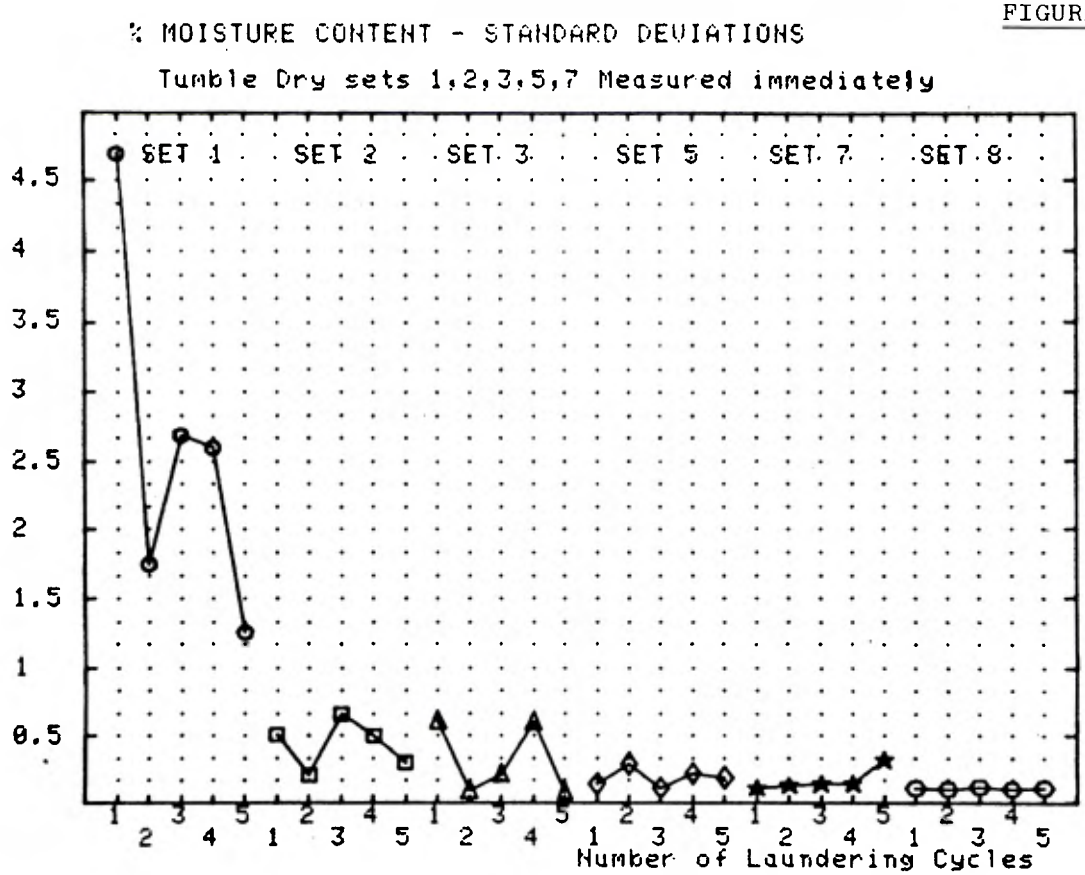
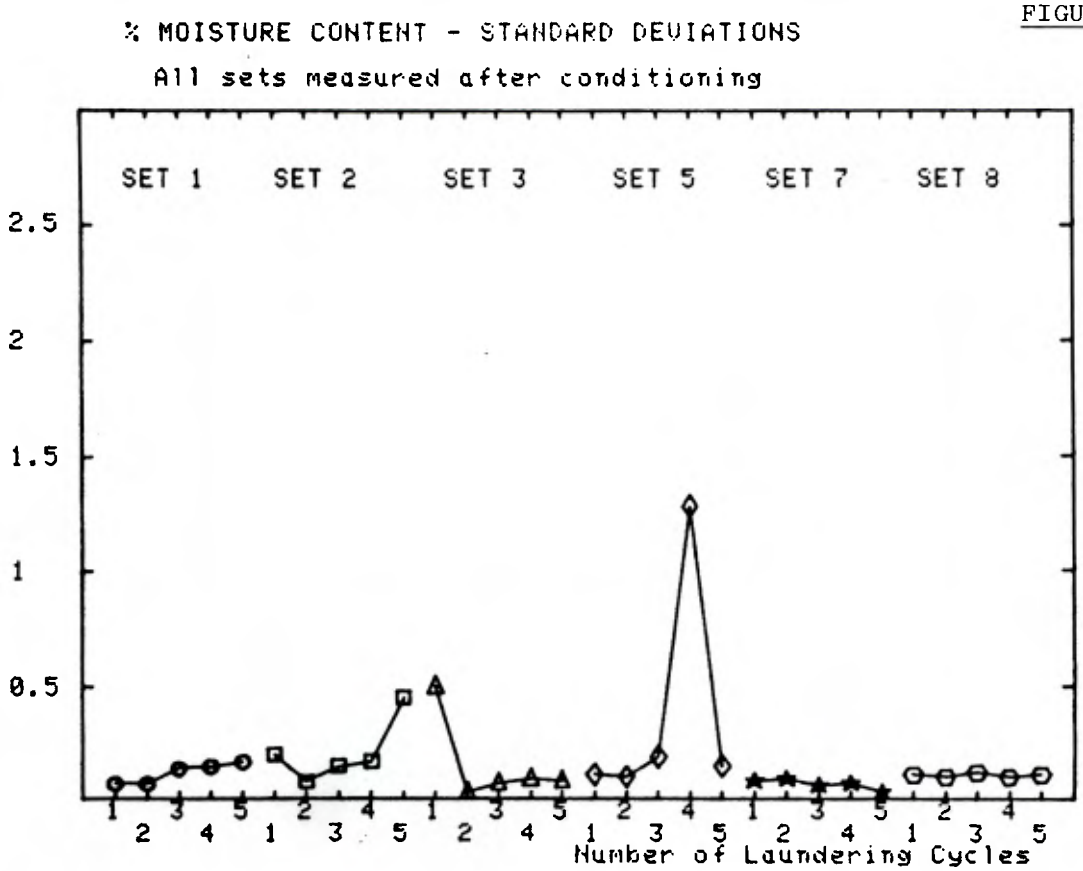


FIGURE 14



APPENDIX 1

SHRINKAGE IN TUMBLE DRYING

SET 1 : 40mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED IMMEDIATELY

Sample Reference	FULL WASH LS%	FULL WASH WS%	1st RINSE LS%	1st RINSE WS%	2nd RINSE LS%	2nd RINSE WS%	3rd RINSE LS%	3rd RINSE WS%	4th RINSE LS%	4th RINSE WS%
A	11	9.4	12.8	11	12.8	10.8	14.9	8.2	16.3	11.6
B	10.2	12.1	11.6	10.4	12.6	11.2	13.9	11	14.5	12.5
C	9.9	11	12.3	11.2	12.5	12.2	11.5	10.1	14.5	11.2
D	11.4	8.6	13.4	9	7.2	15.1	13.4	9.8	15.8	11.4
E	12.2	11	13.6	8.6	13.4	9	13.2	8.8	14.9	11.2

*** COLUMN STATISTICS ***

			N	Mean	SD	CV%
1.	FULL	LS%	5	10.9400	0.9263	8.47
2.	WASH	WS%	5	10.4200	1.4007	13.44
3.	1st	LS%	5	12.7400	0.8173	6.42
4.	RINSE	WS%	5	10.0400	1.1781	11.73
5.	2nd	LS%	5	11.7000	2.5397	21.71
6.	RINSE	WS%	5	11.6600	2.2445	19.25
7.	3rd	LS%	5	13.3800	1.2398	9.27
8.	RINSE	WS%	5	9.5800	1.1009	11.49
9.	4th	LS%	5	15.2000	0.8124	5.34
10.	RINSE	WS%	5	11.5800	0.5404	4.67

SHRINKAGE IN TUMBLE DRYING

SET 1 : 40mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED AFTER CONDITIONING

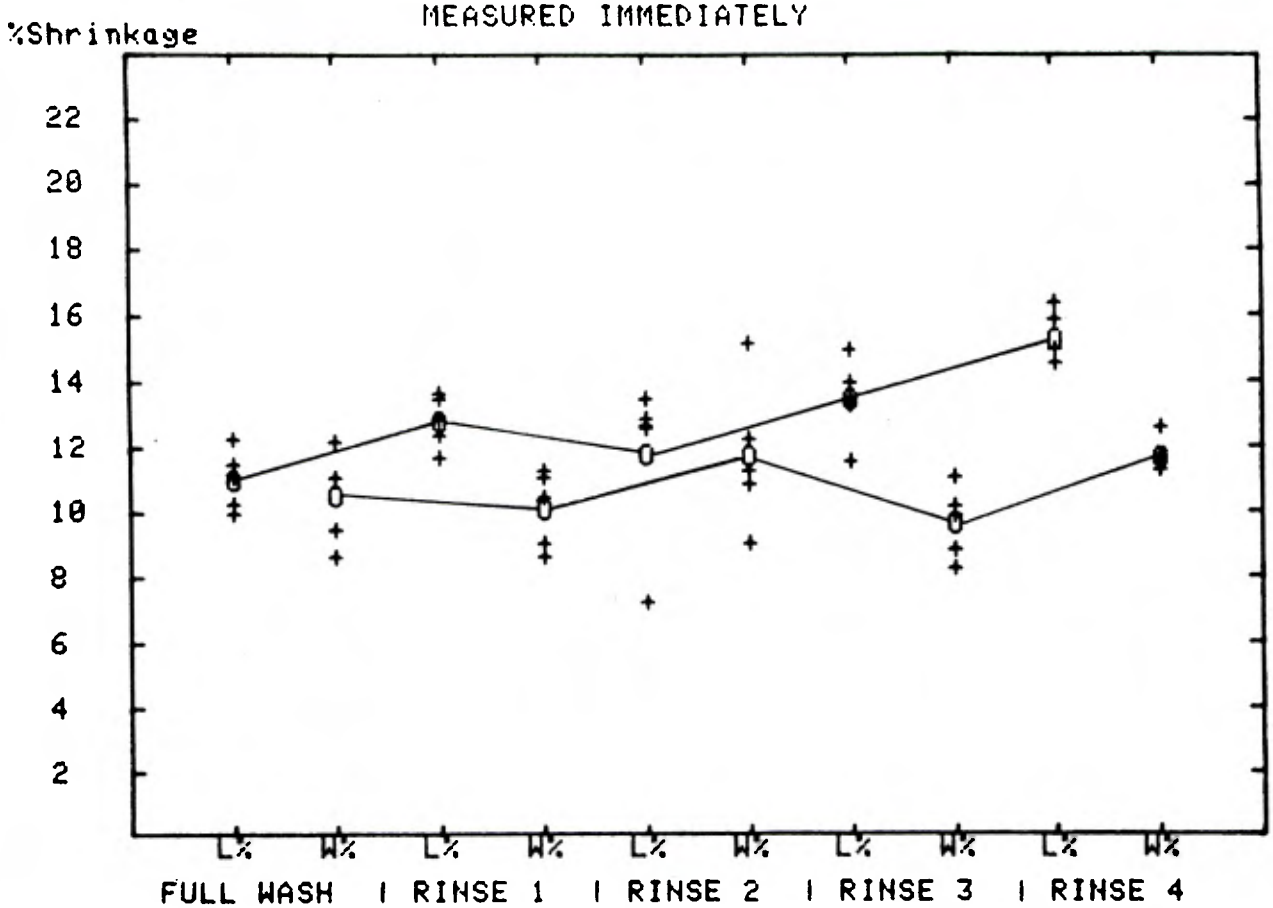
Sample Reference	FULL WASH LS%	FULL WASH WS%	1st RINSE LS%	1st RINSE WS%	2nd RINSE LS%	2nd RINSE WS%	3rd RINSE LS%	3rd RINSE WS%	4th RINSE LS%	4th RINSE WS%
A	13.6	7.2	13	11.2	13.9	10	15.1	8.8	15.5	11.6
B	11.4	12.1	12.4	11.2	13.6	11.5	14.7	10.2	14.7	12.7
C	11.1	10.3	13.1	10.3	14.1	10.8	13.1	10.3	14.7	10.3
D	13.2	6.4	13.4	10.6	13.8	9	14.4	10.2	15.2	10.8
E	13	9.6	14.1	10	14.3	9.2	14.9	9	15.3	10.6

*** COLUMN STATISTICS ***

			N	Mean	SD	CV%
1.	FULL	LS%	5	12.4600	1.1305	9.07
2.	WASH	WS%	5	9.1200	2.3231	25.47
3.	1st	LS%	5	13.2000	0.6205	4.70
4.	RINSE	WS%	5	10.6600	0.5367	5.03
5.	2nd	LS%	5	13.9400	0.2702	1.94
6.	RINSE	WS%	5	10.1000	1.0583	10.48
7.	3rd	LS%	5	14.4400	0.7925	5.49
8.	RINSE	WS%	5	9.7000	0.7348	7.58
9.	4th	LS%	5	15.0800	0.3633	2.41
10.	RINSE	WS%	5	11.2000	0.9670	8.63

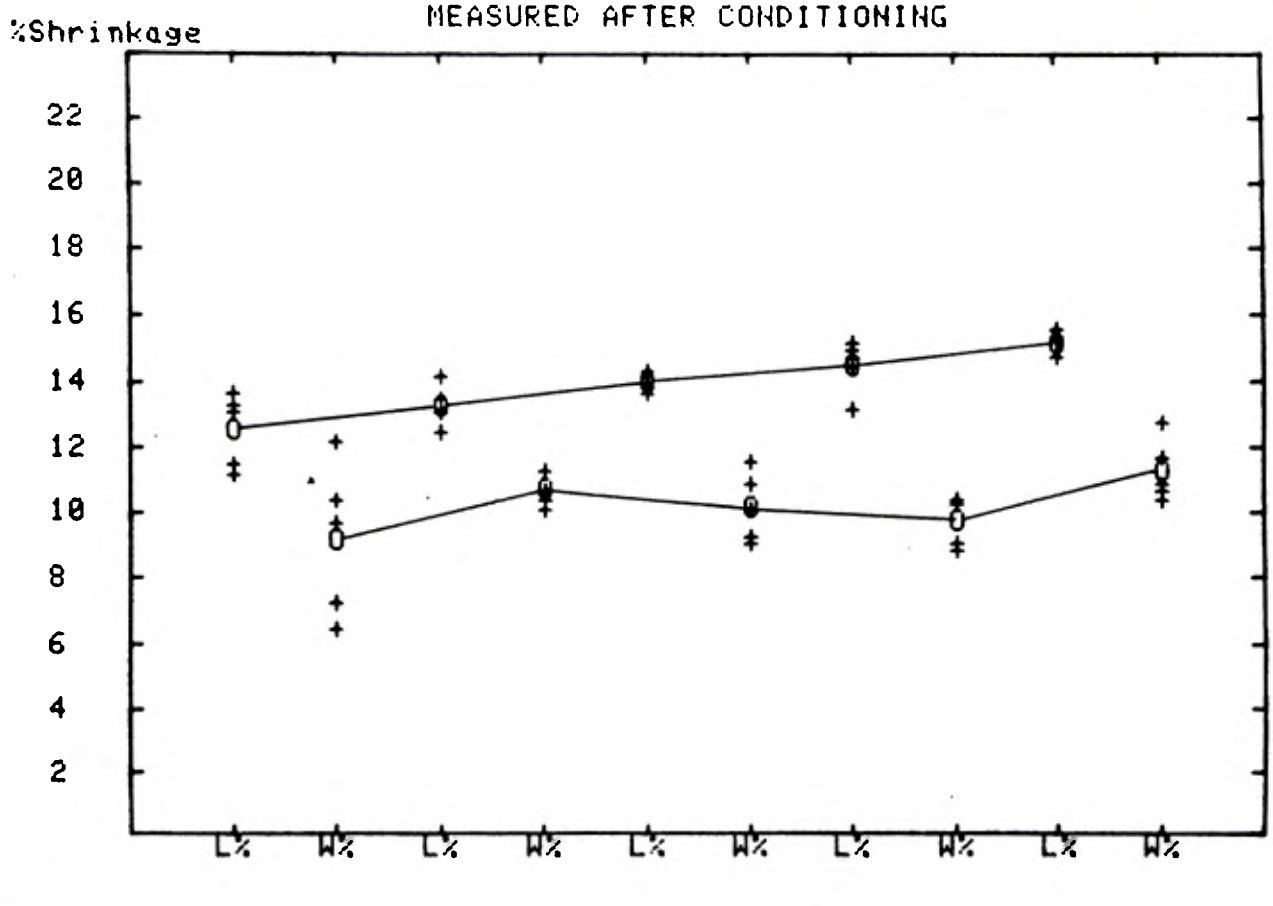
SHRINKAGE IN TUMBLE DRYING : SET 1 : ALL CYCLES

MEASURED IMMEDIATELY



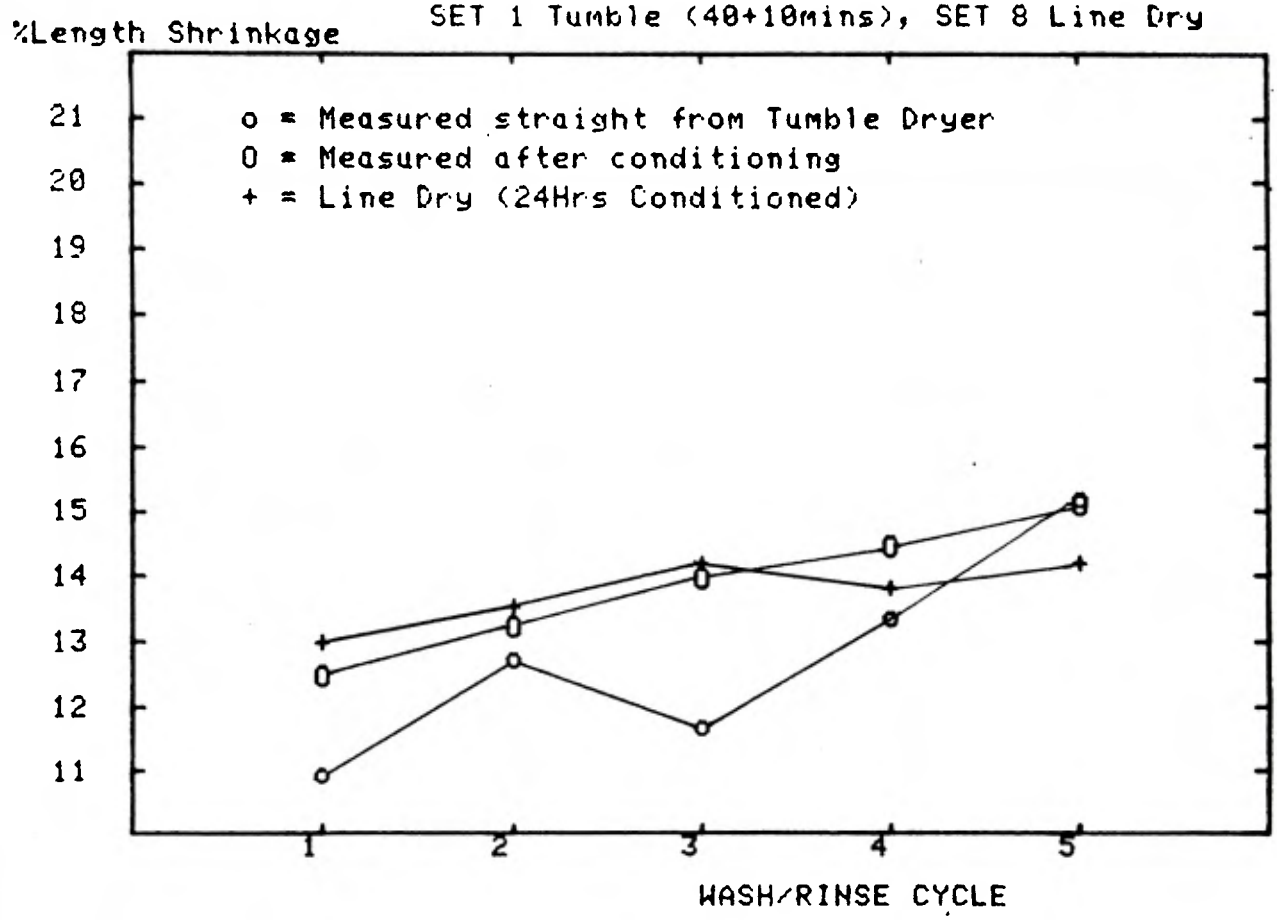
SHRINKAGE IN TUMBLE DRYING : SET 1 : ALL CYCLES

MEASURED AFTER CONDITIONING



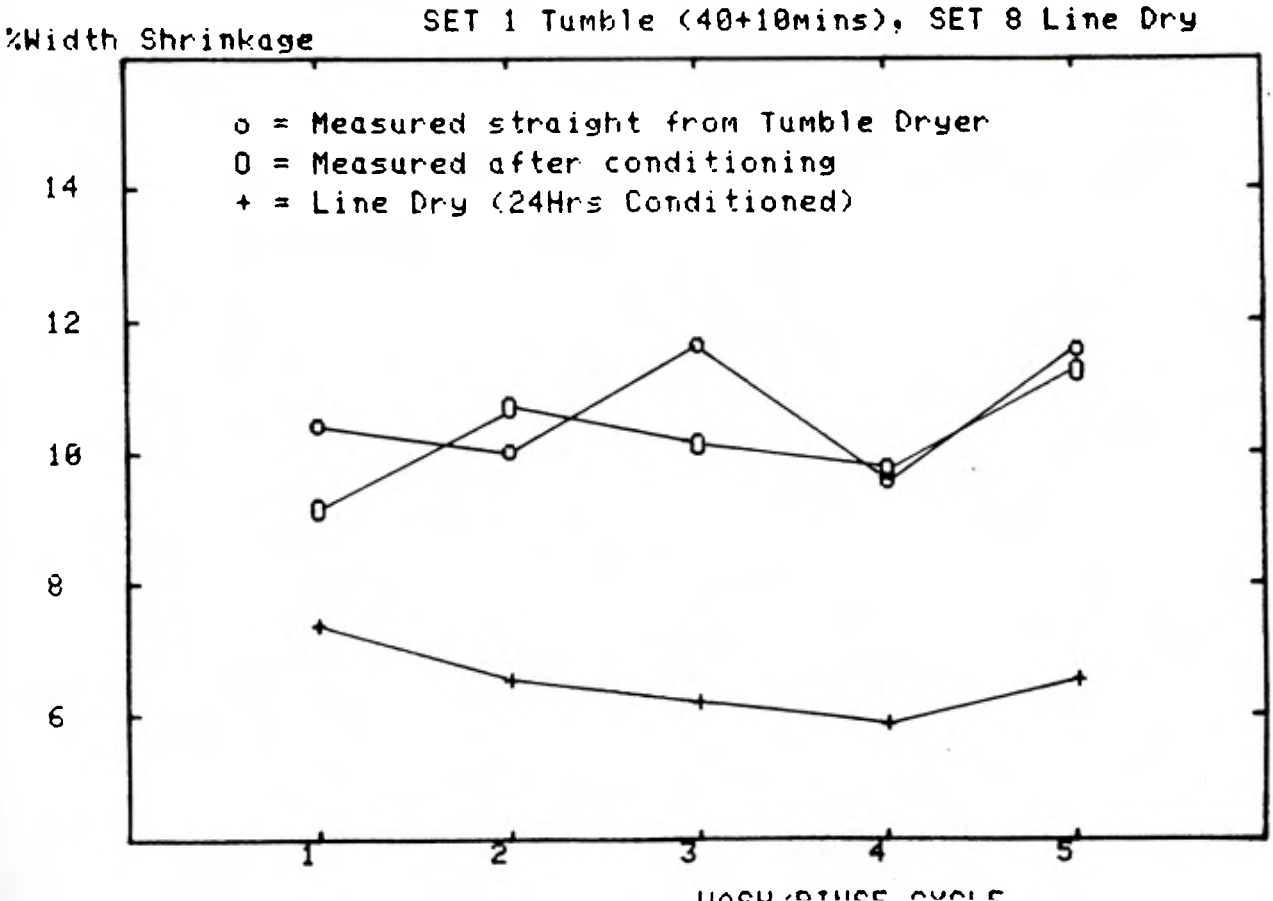
SHRINKAGE IN TUMBLE DRYING : 20G INTERLOCK

SET 1 Tumble (40+10mins), SET 8 Line Dry



SHRINKAGE IN TUMBLE DRYING : 20G INTERLOCK

SET 1 Tumble (40+10mins), SET 8 Line Dry



SHRINKAGE IN TUMBLE DRYING

SET 1 : 40mins HOT Tumble + 10mins COOL Down

SAMPLE WEIGHTS g

Sample Reference	A	B	C	D	E
Oven Dry	88.81	88.17	91.27	83.08	83.9
Orig Cond	94.68	94	97.3	88.57	89.45
1W+T Wet	158.36	152.99	163.43	150.8	145.08
1W+T Dry	110.93	101.83	104.36	106.56	95.13
1W+T Cond	96.27	95.67	98.82	90.04	90.99
2W+T Wet	153.38	162.56	159.06	144.65	145.33
2W+T Dry	99.53	103.79	103.75	93.55	96.89
2W+T Cond	96.12	95.28	98.8	89.82	90.79
3W+T Wet	146.63	144.86	149.59	142.44	136.65
3W+T Dry	100.82	101.82	102.01	100.07	99.77
3W+T Cond	96.28	95.78	99.28	90.07	90.97
4W+T Wet	150.29	146	147	134.26	139.02
4W+T Dry	105.53	106.71	104.54	93.06	97.71
4W+T Cond	96.06	95.35	99.05	90.04	90.71
5W+T Wet	141.68	140.4	150.4	140.52	136
5W+T Dry	95.84	98.27	100.57	90.57	93.42
5W+T Cond	95.87	95.65	98.86	89.98	90.86

N.B. Oven Dry sample weights calculated from Original Conditioned sample weights using Average Moisture Content established on samples of the same fabric in a separate test.

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	87.0460	3.4585	3.97
2.Orig Cond	5	92.8000	3.6858	3.97
3.1W+T Wet	5	154.1320	7.0476	4.57
4.1W+T Dry	5	103.7620	5.8696	5.66
5.1W+T Cond	5	94.3580	3.7174	3.94
6.2W+T Wet	5	152.9960	8.0127	5.24
7.2W+T Dry	5	99.5020	4.4351	4.46
8.2W+T Cond	5	94.1620	3.7689	4.00
9.3W+T Wet	5	144.0340	4.8825	3.39
10.3W+T Dry	5	100.8980	1.0063	1.00
11.3W+T Cond	5	94.4760	3.8645	4.09
12.4W+T Wet	5	143.3140	6.5169	4.55
13.4W+T Dry	5	101.5100	5.8784	5.79
14.4W+T Cond	5	94.2420	3.8007	4.03
15.5W+T Wet	5	141.8000	5.2729	3.72
16.5W+T Dry	5	95.7340	3.9323	4.11
17.5W+T Cond	5	94.2440	3.7270	3.95

SHRINKAGE IN TUMBLE DRYING

SET 1 : 40mins HOT Tumble + 10mins COOL Down

% MOISTURE CONTENT

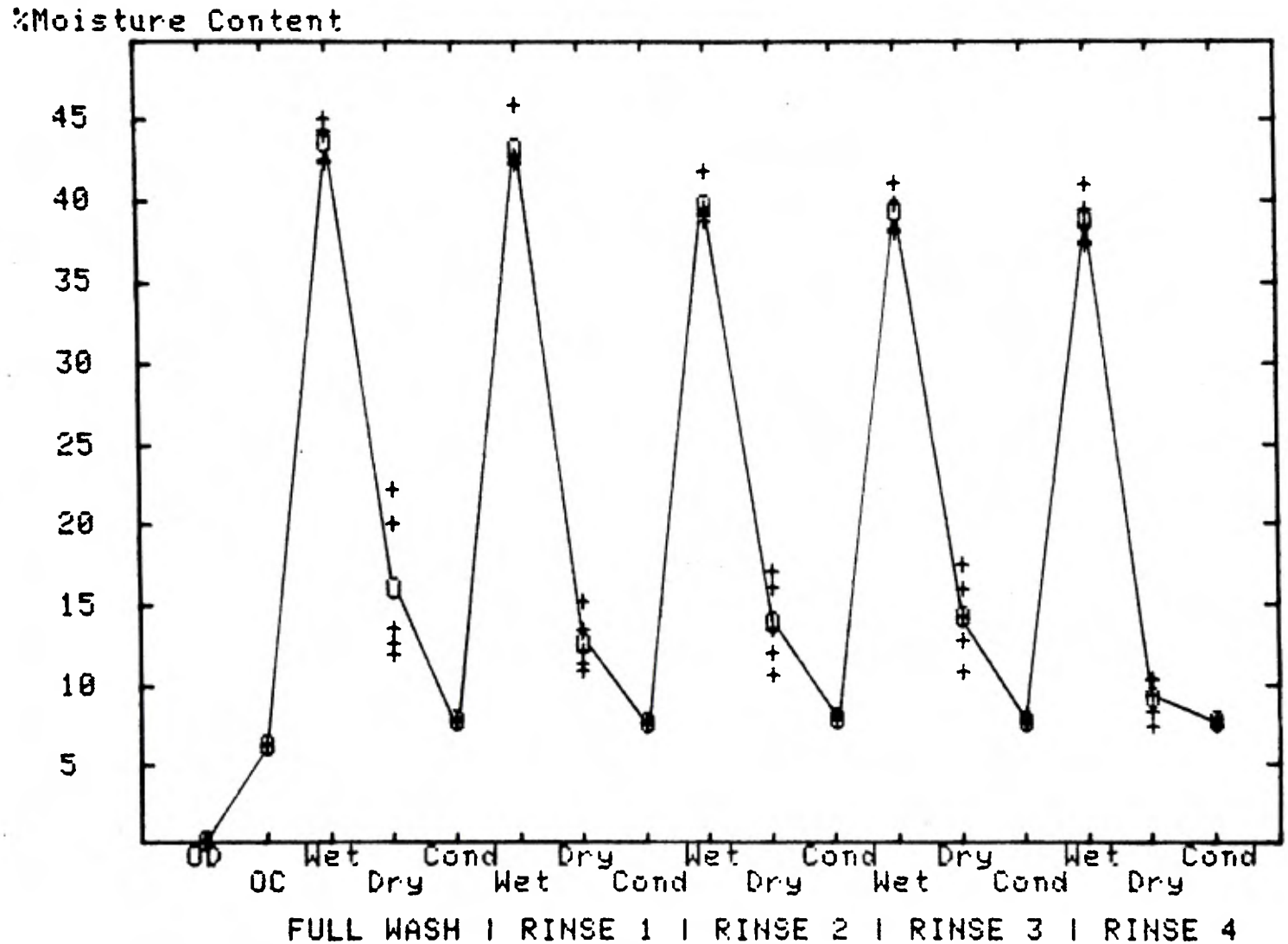
Sample Reference	A	B	C	D	E
Oven Dry	0	0	0	0	0
Orig Cond	6.2	6.2	6.2	6.2	6.2
1W+T Wet	43.92	42.37	44.15	44.91	42.17
1W+T Dry	19.94	13.41	12.54	22.03	11.8
1W+T Cond	7.75	7.84	7.64	7.73	7.79
2R+T Wet	42.1	45.76	42.62	42.56	42.27
2R+T Dry	10.77	15.05	12.03	11.19	13.41
2R+T Cond	7.61	7.46	7.62	7.5	7.59
3R+T Wet	39.43	39.13	38.99	41.67	38.6
3R+T Dry	11.91	13.41	10.53	16.98	15.91
3R+T Cond	7.76	7.95	8.07	7.76	7.77
4R+T Wet	40.91	39.61	37.91	38.12	39.65
4R+T Dry	15.84	17.37	12.69	10.72	14.13
4R+T Cond	7.55	7.53	7.85	7.73	7.51
5R+T Wet	37.32	37.2	39.32	40.88	38.31
5R+T Dry	7.34	10.28	9.25	8.27	10.19
5R+T Cond	7.36	7.82	7.68	7.67	7.66

N.B.Moisture Content calculated from sample weights
%MC = (Sample Weight - Calc Oven Dry Weight)/Sample Weight *100

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	0.0000	0.0000	0.00
2.Orig Cond	5	6.2005	0.0029	0.05
3.1W+T Wet	5	43.5036	1.1865	2.73
4.1W+T Dry	5	15.9475	4.6948	29.44
5.1W+T Cond	5	7.7501	0.0746	0.96
6.2R+T Wet	5	43.0626	1.5239	3.54
7.2R+T Dry	5	12.4896	1.7497	14.01
8.2R+T Cond	5	7.5563	0.0694	0.92
9.3R+T Wet	5	39.5659	1.2156	3.07
10.3R+T Dry	5	13.7463	2.6901	19.57
11.3R+T Cond	5	7.8609	0.1401	1.78
12.4R+T Wet	5	39.2396	1.2353	3.15
13.4R+T Dry	5	14.1539	2.6039	18.40
14.4R+T Cond	5	7.6339	0.1518	1.99
15.5R+T Wet	5	38.6036	1.5317	3.97
16.5R+T Dry	5	9.0641	1.2645	13.95
17.5R+T Cond	5	7.6381	0.1667	2.18

SHRINKAGE IN TUMBLE DRYING : SET 1 : ALL CYCLES



APPENDIX 2

SHRINKAGE IN TUMBLE DRYING

SET 2 : 50mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED IMMEDIATELY

Sample Reference	FULL WASH LS%	FULL WASH WS%	1st RINSE LS%	1st RINSE WS%	2nd RINSE LS%	2nd RINSE WS%	3rd RINSE LS%	3rd RINSE WS%	4th RINSE LS%	4th RINSE WS%
A	17	11.3	18.6	11.7	18.8	12.1	18.2	11.5	19.8	12.9
B	17.2	10.4	18.8	11.6	19.2	11.8	18.9	11.4	20.0	11.8
C	14.7	11.2	17.9	11	18.1	11.4	17.9	11.6	19.9	11.4
D	16.3	11.3	18.1	11.1	18.1	11.9	17.3	10.9	20.1	12.1
E	15.7	11.9	17.9	11.5	18.5	11.5	17.7	11.7	20.9	11.5

*** COLUMN STATISTICS ***

			N	Mean	SD	CV%
1.	FULL	LS%	5	16.1000	1.0183	6.29
2.	WASH	WS%	5	11.2200	0.5357	4.77
3.	1st	LS%	5	18.2600	0.4159	2.28
4.	RINSE	WS%	5	11.3800	0.3114	2.74
5.	2nd	LS%	5	18.5400	0.4722	2.55
6.	RINSE	WS%	5	11.7400	0.2881	2.45
7.	3rd	LS%	5	18.0000	0.6000	3.33
8.	RINSE	WS%	5	11.4200	0.3114	2.73
9.	4th	LS%	5	20.3000	0.5148	2.54
10.	RINSE	WS%	5	11.9400	0.6025	5.05

SHRINKAGE IN TUMBLE DRYING

SET 2 : 50mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED AFTER CONDITIONING

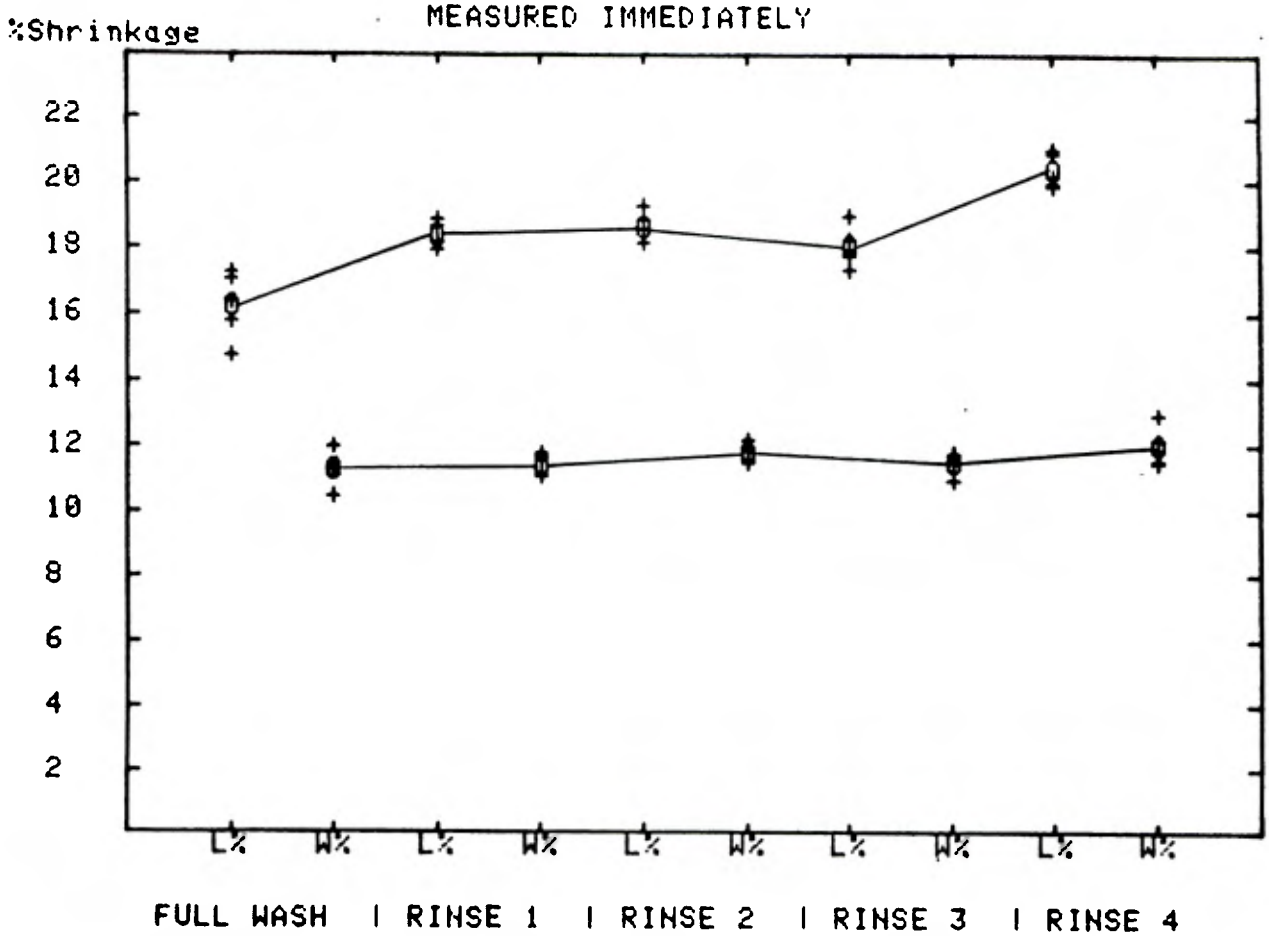
Sample Reference	FULL WASH LS%	FULL WASH WS%	1st RINSE LS%	1st RINSE WS%	2nd RINSE LS%	2nd RINSE WS%	3rd RINSE LS%	3rd RINSE WS%	4th RINSE LS%	4th RINSE WS%
A	15.4	12.1	17.4	11.5	17	11.5	17.6	11.7	18.4	12.1
B	15.6	10.8	17.6	11.4	17.8	11	16.4	12.4	19.2	11
C	14.5	11	16.3	11.2	16.3	11.6	17.3	12	18.1	11.4
D	15.3	10.3	16.7	11.3	17.5	10.9	17.1	11.3	17.9	11.9
E	15.1	10.9	16.7	11.9	16.3	12.5	18.1	10.5	18.1	11.5

*** COLUMN STATISTICS ***

			N	Mean	SD	CV%
1.	FULL	LS%	5	15.1800	0.4207	2.77
2.	WASH	WS%	5	11.0200	0.6611	6.00
3.	1st	LS%	5	16.9400	0.5413	3.20
4.	RINSE	WS%	5	11.4600	0.2702	2.36
5.	2nd	LS%	5	16.9800	0.6834	4.02
6.	RINSE	WS%	5	11.5000	0.6364	5.53
7.	3rd	LS%	5	17.3000	0.6285	3.63
8.	RINSE	WS%	5	11.5800	0.7259	6.27
9.	4th	LS%	5	18.3400	0.5128	2.80
10.	RINSE	WS%	5	11.5800	0.4324	3.73

SHRINKAGE IN TUMBLE DRYING : SET 2 : ALL CYCLES

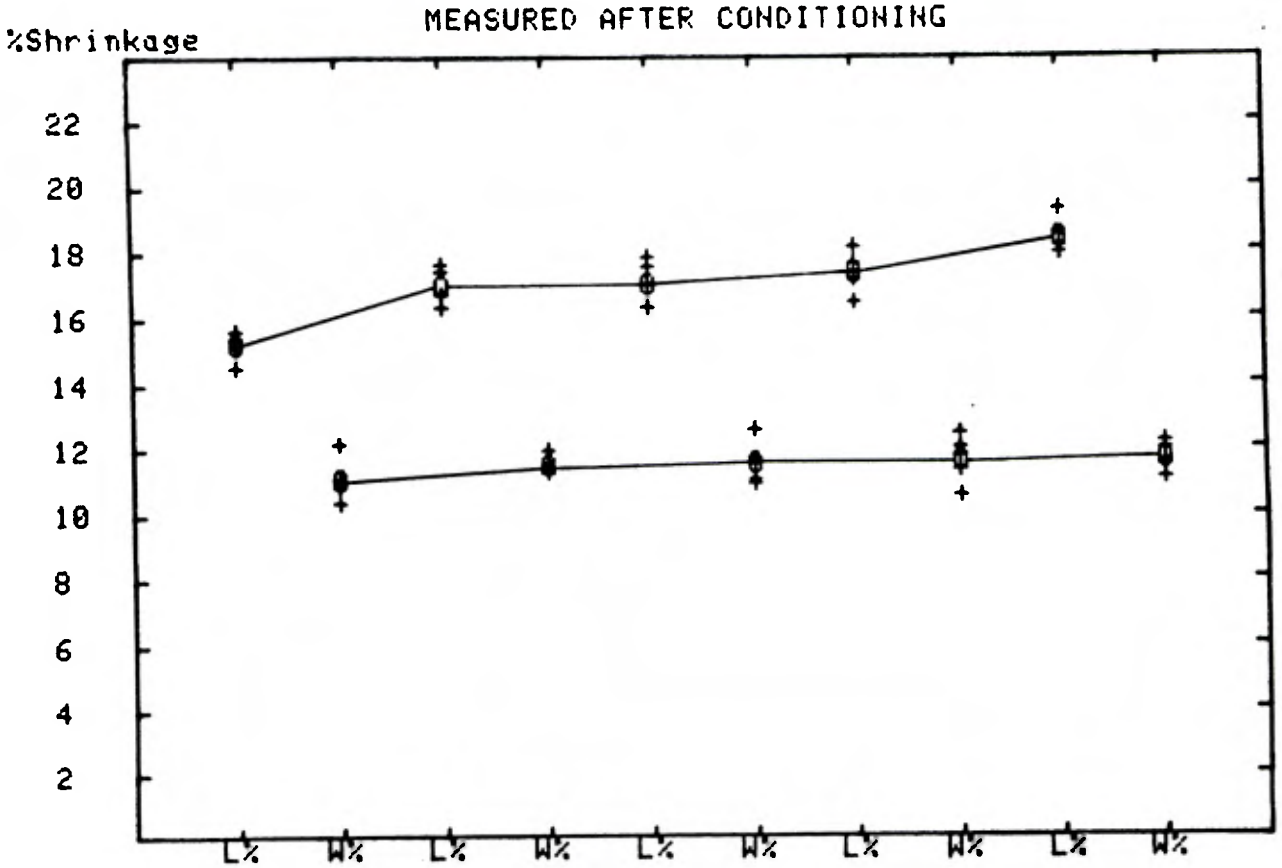
MEASURED IMMEDIATELY



FULL WASH | RINSE 1 | RINSE 2 | RINSE 3 | RINSE 4

SHRINKAGE IN TUMBLE DRYING : SET 2 : ALL CYCLES

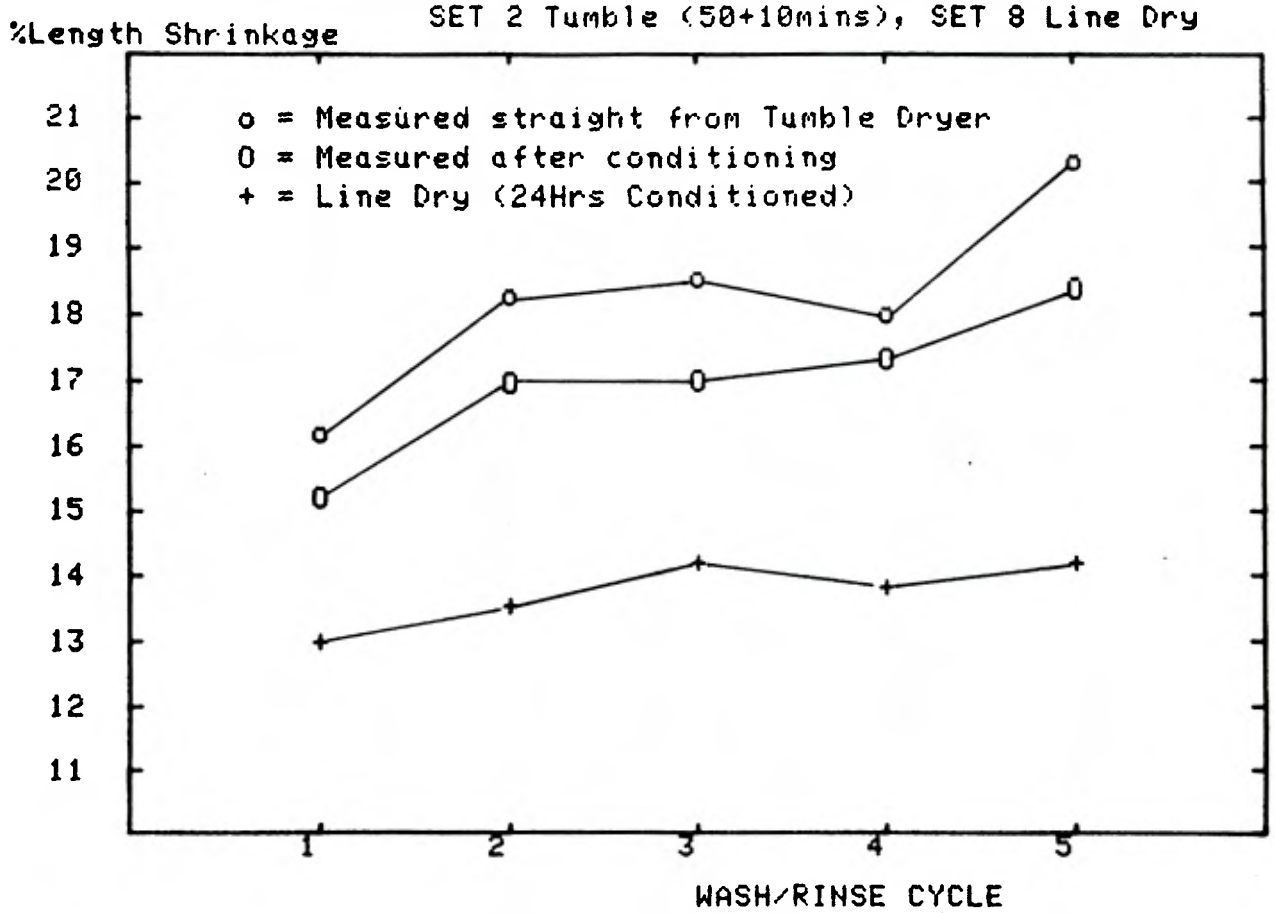
MEASURED AFTER CONDITIONING



FULL WASH | RINSE 1 | RINSE 2 | RINSE 3 | RINSE 4

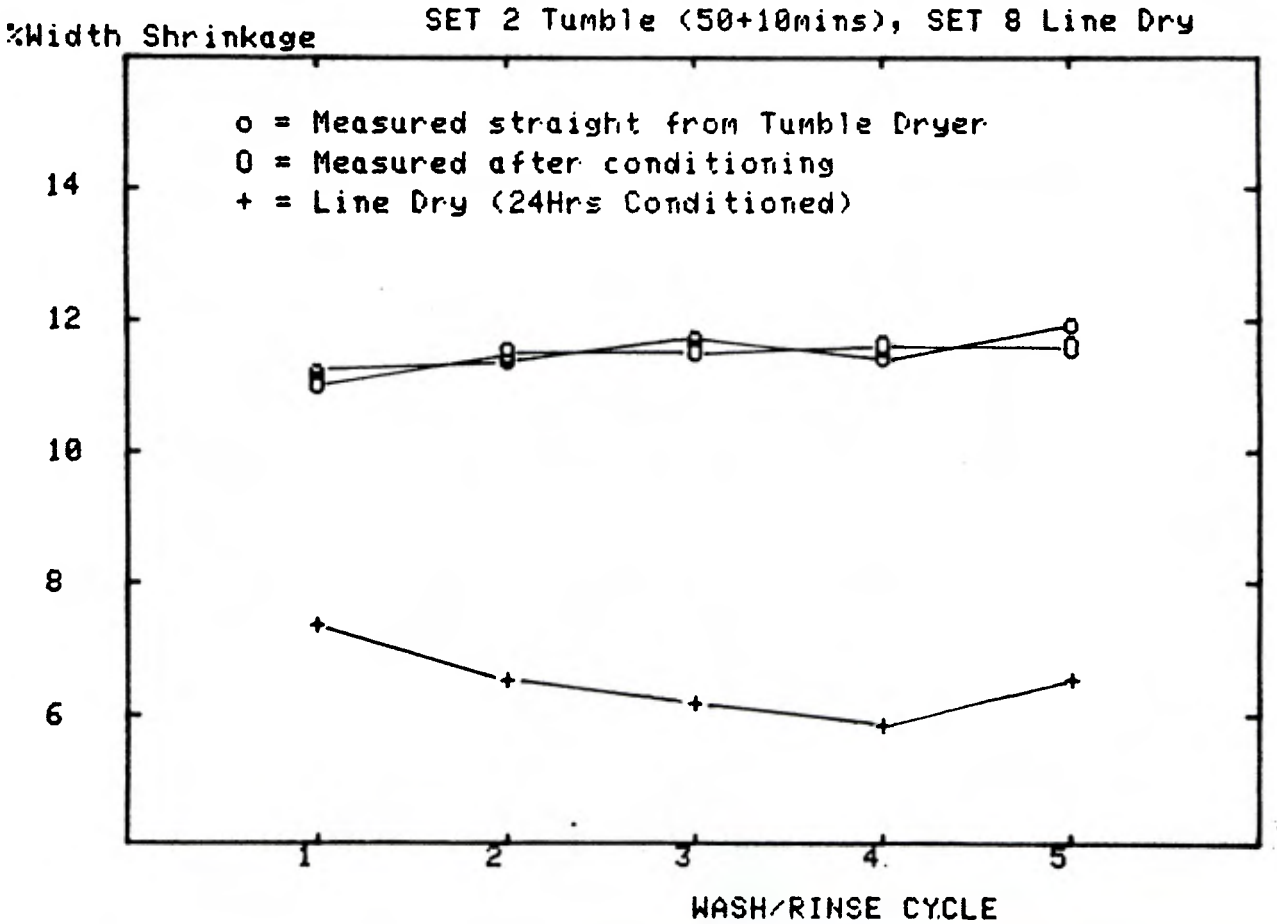
SHRINKAGE IN TUMBLE DRYING : 20G INTERLOCK

SET 2 Tumble (50+10mins), SET 8 Line Dry



SHRINKAGE IN TUMBLE DRYING : 20G INTERLOCK

SET 2 Tumble (50+10mins), SET 8 Line Dry



SHRINKAGE IN TUMBLE DRYING

SET 2 : 50mins HOT Tumble + 10mins COOL Down

% MOISTURE CONTENT

Sample Reference	A	B	C	D	E
Oven Dry	0	0	0	0	0
Orig Cond	6.19	6.2	6.21	6.2	6.2
1W+T Wet	42.74	43.47	43.77	45.33	42.61
1W+T Dry	5.16	5.82	6.35	6.04	5.25
1W+T Cond	6.94	7.21	7.4	7.3	6.99
2R+T Wet	44.65	40.33	44.83	42.37	40.09
2R+T Dry	3.5	3.47	3.18	3.47	3.77
2R+T Cond	6.53	6.55	6.51	6.61	6.71
3R+T Wet	43.38	43.01	41.78	45.95	43.78
3R+T Dry	4.24	4.54	4.94	5.9	4.48
3R+T Cond	6.61	6.63	6.76	6.96	6.62
4R+T Wet	38.95	40.17	41.5	44.1	40.84
4R+T Dry	5.99	6	5.74	7.04	6.06
4R+T Cond	7.03	7.12	7.01	7.43	7.1
5R+T Wet	38.76	38.08	37.45	39.88	36.71
5R+T Dry	3.85	3.53	3.83	3.29	3.22
5R+T Cond	6.68	5.63	6.75	6.52	6.49

N.B.Moisture Content calculated from sample weights
%MC = (Sample Weight - Calc Oven Dry Weight)/Sample Weight *100

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	0.0000	0.0000	0.00
2.Orig Cond	5	6.1990	0.0047	0.08
3.1W+T Wet	5	43.5826	1.0912	2.50
4.1W+T Dry	5	5.7247	0.5094	8.90
5.1W+T Cond	5	7.1686	0.2003	2.79
6.2R+T Wet	5	42.4535	2.2669	5.34
7.2R+T Dry	5	3.4804	0.2078	5.97
8.2R+T Cond	5	6.5805	0.0815	1.24
9.3R+T Wet	5	43.5787	1.5200	3.49
10.3R+T Dry	5	4.8199	0.6558	13.61
11.3R+T Cond	5	6.7135	0.1512	2.25
12.4R+T Wet	5	41.1131	1.9172	4.66
13.4R+T Dry	5	6.1650	0.5036	8.17
14.4R+T Cond	5	7.1369	0.1678	2.35
15.5R+T Wet	5	38.1746	1.2175	3.19
16.5R+T Dry	5	3.5455	0.2955	8.33
17.5R+T Cond	5	6.4152	0.4527	7.06

SHRINKAGE IN TUMBLE DRYING

SET 2 : 50mins HOT Tumble + 10mins COOL Down

SAMPLE WEIGHTS g

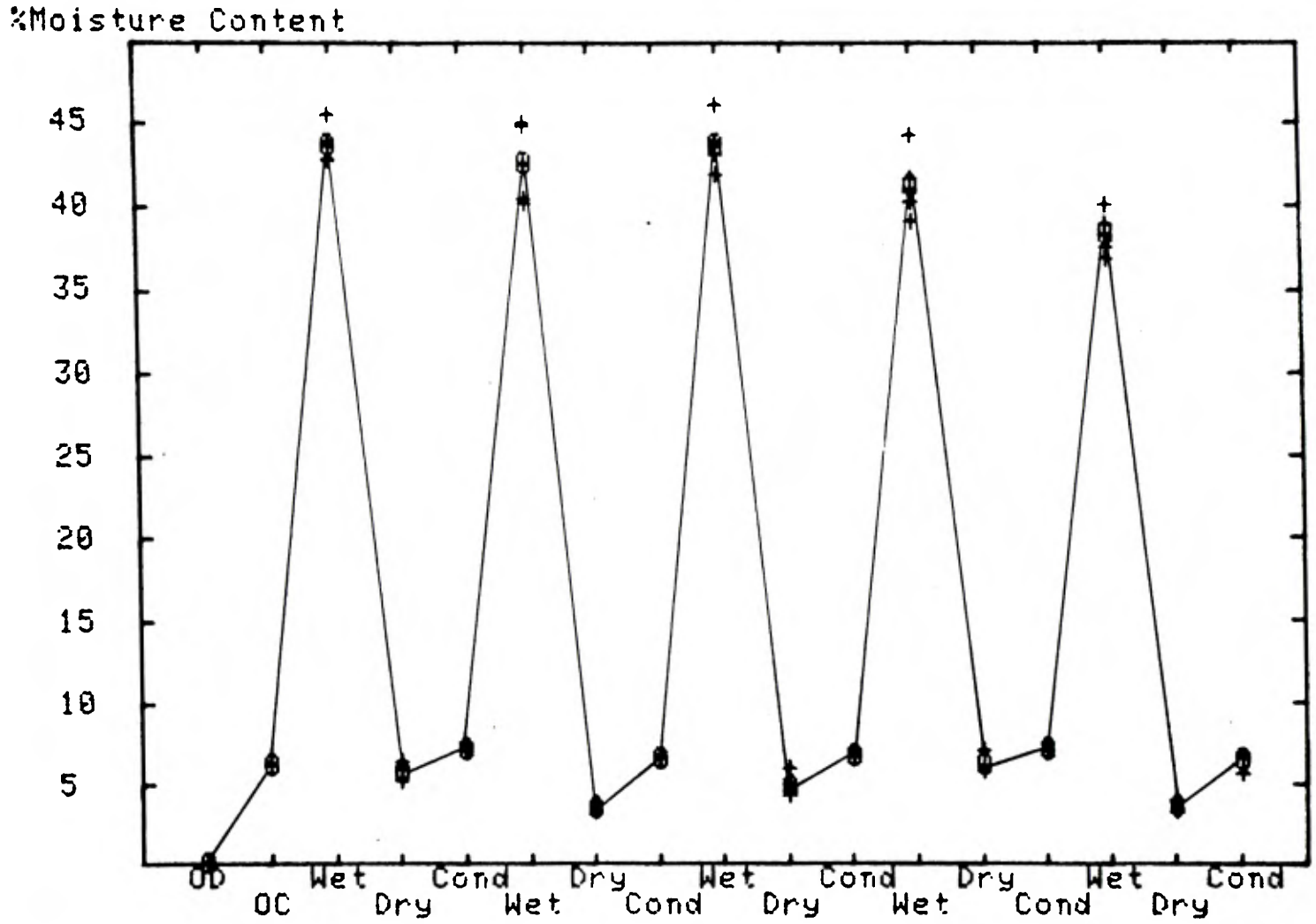
Sample Reference	A	B	C	D	E
Oven Dry	78.6	78.64	79.05	77.8	77.06
Orig Cond	83.79	83.84	84.28	82.94	82.15
1W+T Wet	137.27	139.1	140.58	142.31	134.27
1W+T Dry	82.88	83.5	84.41	82.8	81.33
1W+T Cond	84.46	84.75	85.37	83.93	82.85
2W+T Wet	142	131.8	143.28	135	128.62
2W+T Dry	81.45	81.47	81.65	80.6	80.08
2W+T Cond	84.09	84.15	84.55	83.31	82.6
3W+T Wet	138.81	137.99	135.78	143.93	137.07
3W+T Dry	82.08	82.38	83.16	82.68	80.67
3W+T Cond	84.16	84.22	84.78	83.62	82.52
4W+T Wet	128.75	131.45	135.12	139.18	130.26
4W+T Dry	83.61	83.66	83.86	83.69	82.03
4W+T Cond	84.54	84.67	85.01	84.04	82.95
5W+T Wet	128.35	127	126.38	129.4	121.75
5W+T Dry	81.75	81.52	82.2	80.45	79.62
5W+T Cond	84.23	83.33	84.77	83.23	82.41

N.B. Oven Dry sample weights calculated from Original Conditioned sample weights using Average Moisture Content established on samples of the same fabric in a separate test.

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	78.2300	0.7955	1.02
2.Orig Cond	5	83.4000	0.8506	1.02
3.1W+T Wet	5	138.7060	3.0982	2.23
4.1W+T Dry	5	82.9840	1.1270	1.36
5.1W+T Cond	5	84.2720	0.9498	1.13
6.2W+T Wet	5	136.1400	6.3641	4.67
7.2W+T Dry	5	81.0500	0.6782	0.84
8.2W+T Cond	5	83.7400	0.7796	0.93
9.3W+T Wet	5	138.7160	3.1245	2.25
10.3W+T Dry	5	82.1940	0.9407	1.14
11.3W+T Cond	5	83.8600	0.8543	1.02
12.4W+T Wet	5	132.9520	4.2026	3.16
13.4W+T Dry	5	83.3700	0.7550	0.91
14.4W+T Cond	5	84.2420	0.8019	0.95
15.5W+T Wet	5	126.5760	2.9424	2.32
16.5W+T Dry	5	81.1080	1.0514	1.30
17.5W+T Cond	5	83.5940	0.9208	1.10

SHRINKAGE IN TUMBLE DRYING : SET 2 : ALL CYCLES



APPENDIX 3

SHRINKAGE IN TUMBLE DRYING

SET 3 : 60mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED IMMEDIATELY

Sample Reference	FULL WASH LS%	FULL WASH WS%	1st RINSE LS%	1st RINSE WS%	2nd RINSE LS%	2nd RINSE WS%	3rd RINSE LS%	3rd RINSE WS%	4th RINSE LS%	4th RINSE WS%
A	17.8	11.7	19.4	11.9	20.4	10.1	20.2	11.5	21.2	12.3
B	17.7	11.6	20.1	10.6	20.5	11.8	20.7	12.2	21.3	11.6
C	17.5	12.2	19.9	11.4	20.3	12.8	20.5	11.6	21.1	11.8
D	17.3	11.9	18.5	11.9	20.1	10.9	20.1	12.3	20.9	11.5
E	16.4	13.4	18.4	12.2	19.8	11	19.8	13.6	20.2	12.6

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1. FULL	LS%	5	17.3400	0.5595	3.23
2. WASH	WS%	5	12.1600	0.7301	6.00
3. 1st	LS%	5	19.2600	0.7829	4.07
4. RINSE	WS%	5	11.6000	0.6285	5.42
5. 2nd	LS%	5	20.2200	0.2775	1.37
6. RINSE	WS%	5	11.3200	1.0232	9.04
7. 3rd	LS%	5	20.2600	0.3507	1.73
8. RINSE	WS%	5	12.2400	0.8385	6.85
9. 4th	LS%	5	20.9400	0.4393	2.10
10. RINSE	WS%	5	11.9600	0.4722	3.95

SHRINKAGE IN TUMBLE DRYING

SET 3 : 60mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED AFTER CONDITIONING

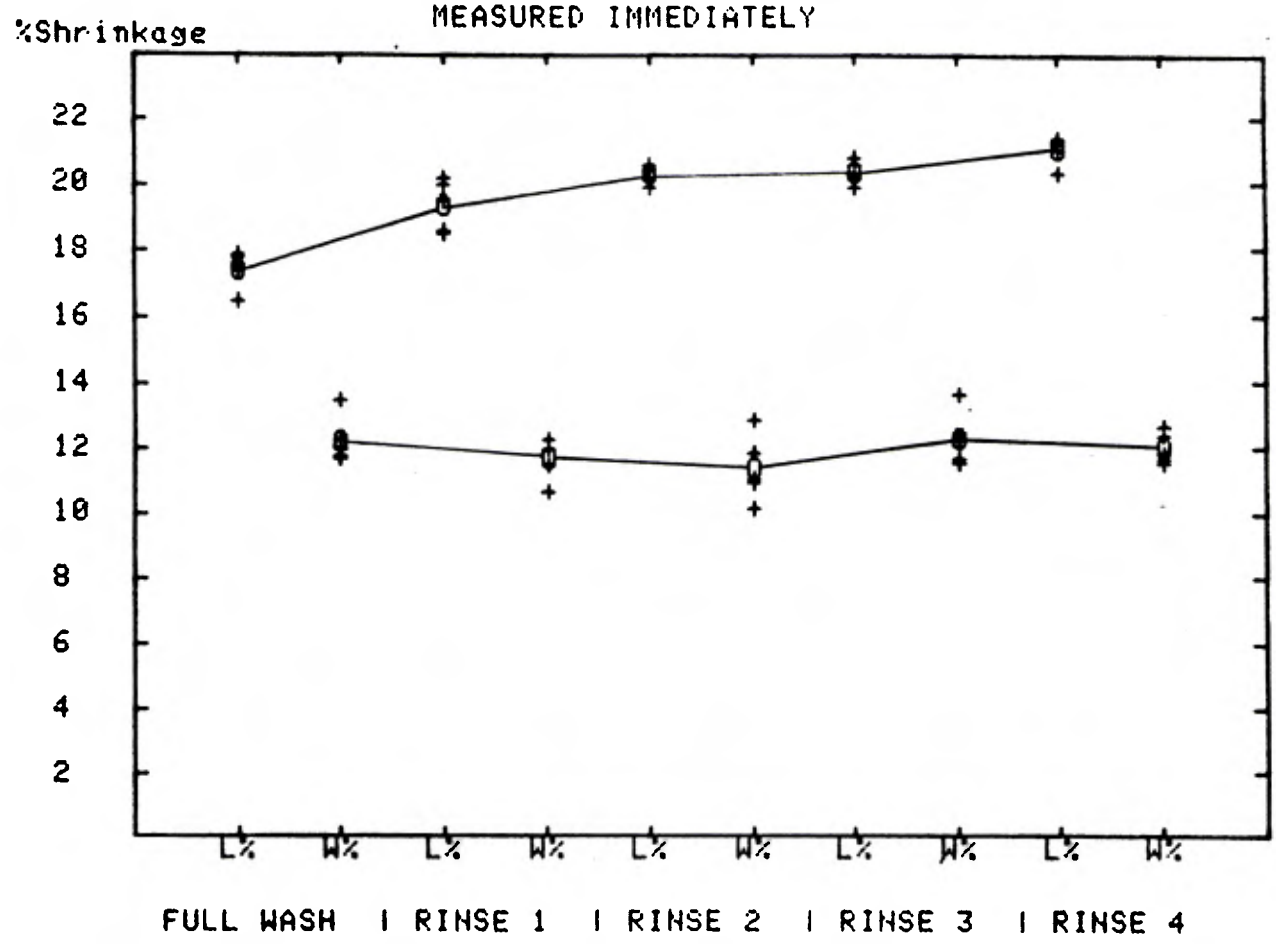
Sample Reference	FULL WASH LS%	FULL WASH WS%	1st RINSE LS%	1st RINSE WS%	2nd RINSE LS%	2nd RINSE WS%	3rd RINSE LS%	3rd RINSE WS%	4th RINSE LS%	4th RINSE WS%
A	16	11.9	17.4	11.9	19	12.1	18.8	12.3	19	12.3
B	15.7	11.8	18.3	11.4	19.3	11.6	19.1	11.8	19.7	11.2
C	15.9	11.6	17.3	12.4	18.5	11.6	18.5	11.8	19.3	12
D	16.1	11.7	17.3	11.5	18.5	11.7	18.3	11.7	18.9	12.3
E	15.2	13.2	16.6	13	18	12.2	17.8	13	18.6	13.8

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1. FULL	LS%	5	15.7800	0.3564	2.26
2. WASH	WS%	5	12.0400	0.6580	5.47
3. 1st	LS%	5	17.3800	0.6058	3.49
4. RINSE	WS%	5	12.0400	0.6656	5.53
5. 2nd	LS%	5	18.6600	0.5030	2.70
6. RINSE	WS%	5	11.8400	0.2881	2.43
7. 3rd	LS%	5	18.5000	0.4950	2.68
8. RINSE	WS%	5	12.1200	0.5450	4.50
9. 4th	LS%	5	19.1000	0.4183	2.19
10. RINSE	WS%	5	12.3200	0.9418	7.64

SHRINKAGE IN TUMBLE DRYING : SET 3 : ALL CYCLES

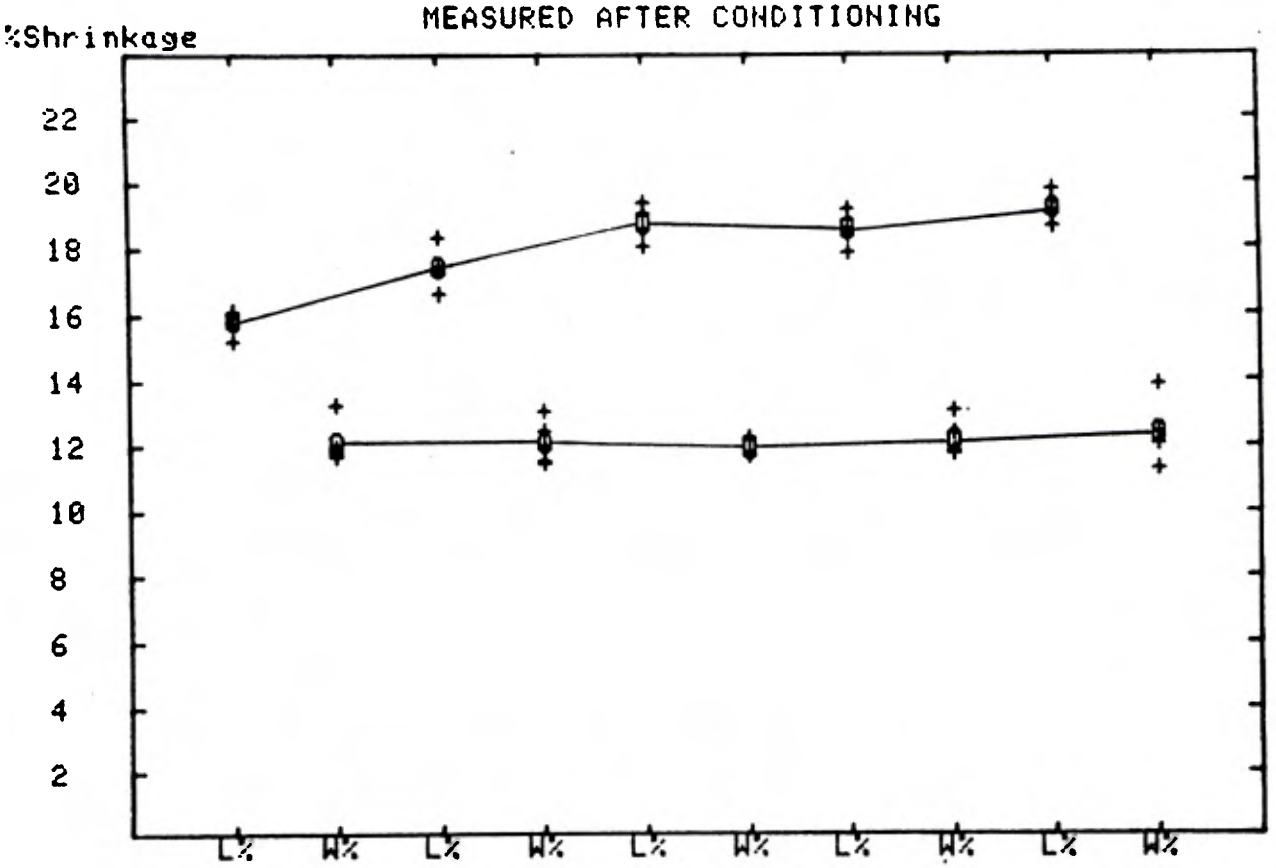
MEASURED IMMEDIATELY



FULL WASH | RINSE 1 | RINSE 2 | RINSE 3 | RINSE 4

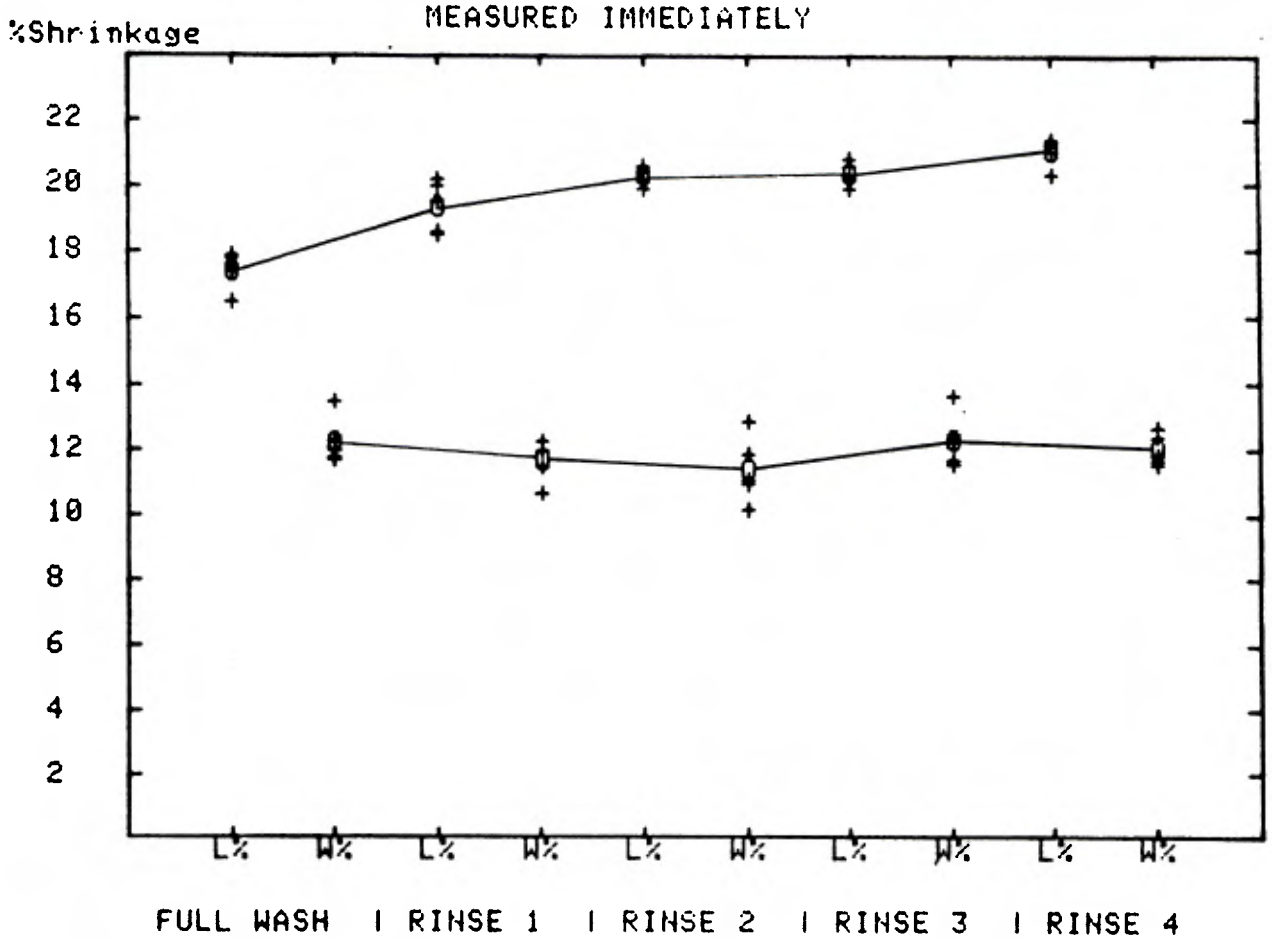
SHRINKAGE IN TUMBLE DRYING : SET 3 : ALL CYCLES

MEASURED AFTER CONDITIONING



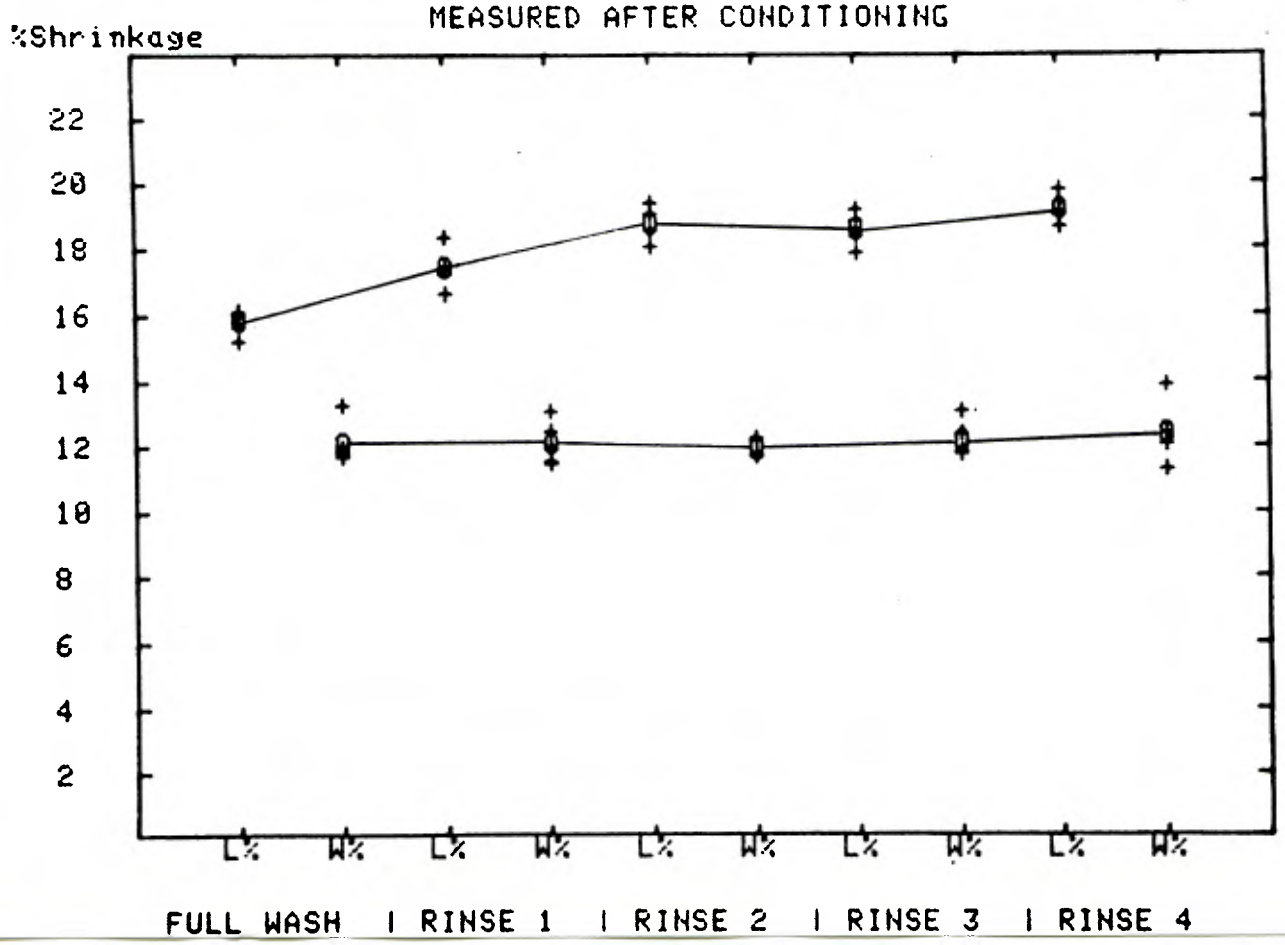
SHRINKAGE IN TUMBLE DRYING : SET 3 : ALL CYCLES

MEASURED IMMEDIATELY



SHRINKAGE IN TUMBLE DRYING : SET 3 : ALL CYCLES

MEASURED AFTER CONDITIONING



SHRINKAGE IN TUMBLE DRYING

SET 3 : 60mins HOT Tumble + 10mins COOL Down

SAMPLE WEIGHTS g

Sample Reference	A	B	C	D	E
Oven Dry	80.04	80.63	80.73	81.87	85.3
Orig Cond	85.33	85.96	86.07	87.28	90.94
1W+T Wet	140.88	145.9	141.76	150.62	154.58
1W+T Dry	81.35	82.01	83.08	83.08	86.43
1W+T Cond	85.44	85	85.81	87.38	91
2W+T Wet	145.4	137.08	140.93	142	141.64
2W+T Dry	81.09	81.84	81.76	82.92	86.49
2W+T Cond	85.4	85.98	86.06	87.33	90.94
3W+T Wet	135.8	132.94	129.74	134.8	137
3W+T Dry	81.1	81.53	81.65	83.17	86.6
3W+T Cond	85.23	85.74	86	87.15	90.76
4W+T Wet	153.27	137.66	158.23	143.15	168.09
4W+T Dry	82.91	82.33	83.4	84.9	88.08
4W+T Cond	85.53	86.11	86.31	87.56	91.01
5W+T Wet	140.99	131.53	132.66	134.1	137.45
5W+T Dry	81.1	81.68	81.94	82.96	86.49
5W+T Cond	85.27	86.05	86.18	87.35	91.03

N.B. Oven Dry sample weights calculated from Original Conditioned sample weights using Average Moisture Content established on samples of the same fabric in a separate test.

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	81.7140	2.1112	2.58
2.Orig Cond	5	87.1160	2.2511	2.58
3.1W+T Wet	5	146.7480	5.8388	3.98
4.1W+T Dry	5	83.1900	1.9557	2.35
5.1W+T Cond	5	86.9260	2.4478	2.82
6.2W+T Wet	5	141.4100	2.9707	2.10
7.2W+T Dry	5	82.8200	2.1538	2.60
8.2W+T Cond	5	87.1420	2.2369	2.57
9.3W+T Wet	5	134.0560	2.8344	2.11
10.3W+T Dry	5	82.8100	2.2584	2.73
11.3W+T Cond	5	86.9760	2.2292	2.56
12.4W+T Wet	5	152.0800	12.0752	7.94
13.4W+T Dry	5	84.3240	2.3059	2.73
14.4W+T Cond	5	87.3040	2.2000	2.52
15.5W+T Wet	5	135.3460	3.8604	2.85
16.5W+T Dry	5	82.8340	2.1517	2.60
17.5W+T Cond	5	87.1760	2.2791	2.61

SHRINKAGE IN TUMBLE DRYING

SET 3 : 60mins HOT Tumble + 10mins COOL Down

% MOISTURE CONTENT

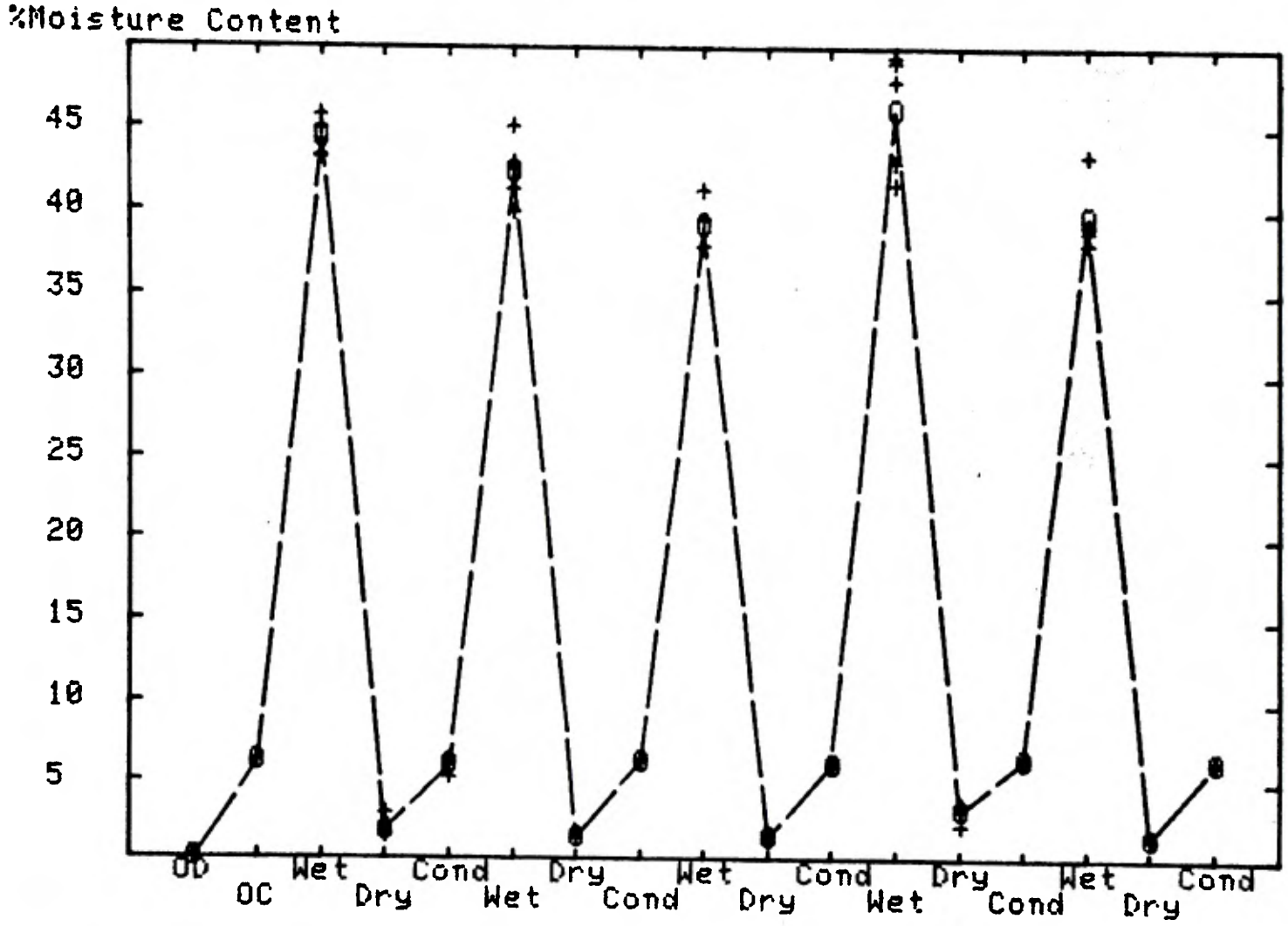
Sample Reference	A	B	C	D	E
Oven Dry	0	0	0	0	0
Orig Cond	6.2	6.2	6.2	6.2	6.2
1W+T Wet	43.19	44.74	43.05	45.64	44.82
1W+T Dry	1.61	1.68	2.83	1.46	1.31
1W+T Cond	6.32	5.14	5.92	6.31	6.26
2R+T Wet	44.95	41.18	42.72	42.35	39.78
2R+T Dry	1.29	1.48	1.26	1.27	1.38
2R+T Cond	6.28	6.22	6.19	6.25	6.2
3R+T Wet	41.06	39.35	37.78	39.27	37.74
3R+T Dry	1.31	1.1	1.13	1.56	1.5
3R+T Cond	6.09	5.96	6.13	6.06	6.02
4R+T Wet	47.78	41.43	48.98	42.81	49.25
4R+T Dry	3.46	2.06	3.2	3.57	3.16
4R+T Cond	6.42	6.36	6.47	6.5	6.27
5R+T Wet	43.23	38.7	39.15	38.95	37.94
5R+T Dry	1.31	1.29	1.48	1.31	1.38
5R+T Cond	6.13	6.3	6.32	6.27	6.29

N.B.Moisture Content calculated from sample weights
%MC = (Sample Weight - Calc Oven Dry Weight)/Sample Weight *100

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	0.0000	0.0000	0.00
2.Orig Cond	5	6.2009	0.0023	0.04
3.1W+T Wet	5	44.2873	1.1254	2.54
4.1W+T Dry	5	1.7771	0.6054	34.06
5.1W+T Cond	5	5.9902	0.5023	8.38
6.2R+T Wet	5	42.1941	1.9217	4.55
7.2R+T Dry	5	1.3351	0.0925	6.93
8.2R+T Cond	5	6.2292	0.0347	0.56
9.3R+T Wet	5	39.0375	1.3715	3.51
10.3R+T Dry	5	1.3204	0.2098	15.89
11.3R+T Cond	5	6.0503	0.0652	1.08
12.4R+T Wet	5	46.0495	3.6640	7.96
13.4R+T Dry	5	3.0906	0.5990	19.38
14.4R+T Cond	5	6.4041	0.0885	1.38
15.5R+T Wet	5	39.5926	2.0840	5.26
16.5R+T Dry	5	1.3518	0.0775	5.73
17.5R+T Cond	5	6.2649	0.0756	1.21

SHRINKAGE IN TUMBLE DRYING : SET 3 : ALL CYCLES



APPENDIX 4

SHRINKAGE IN TUMBLE DRYING

SET 5 : 80mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED IMMEDIATELY

Sample Reference	FULL WASH LS%	FULL WASH WS%	1st RINSE LS%	1st RINSE WS%	2nd RINSE LS%	2nd RINSE WS%	3rd RINSE LS%	3rd RINSE WS%	4th RINSE LS%	4th RINSE WS%
A	16.9	12.3	19.5	11.5	20.7	11.9	21.7	9.4	21.3	10.6
B	17.2	12	19.4	11.6	20.6	11.4	21	10.6	21.2	11
C	16.8	12.4	18.6	12.4	19.8	12.4	20.4	12.6	20.4	12.4
D	17.5	13.1	19.4	12	20.6	12.4	21.2	11	22	11.4
E	17.6	12.5	19.4	12.5	20.8	11.9	21	12.3	21.8	13.1

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1. FULL	LS%	5	17.2000	0.3536	2.06
2. WASH	WS%	5	12.4600	0.4037	3.24
3. 1st	LS%	5	19.2600	0.3715	1.93
4. RINSE	WS%	5	12.0000	0.4528	3.77
5. 2nd	LS%	5	20.5000	0.4000	1.95
6. RINSE	WS%	5	12.0000	0.4183	3.49
7. 3rd	LS%	5	21.0600	0.4669	2.22
8. RINSE	WS%	5	11.1800	1.3046	11.67
9. 4th	LS%	5	21.3400	0.6229	2.92
10. RINSE	WS%	5	11.7000	1.0296	8.80

SHRINKAGE IN TUMBLE DRYING

SET 5 : 80mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED AFTER CONDITIONING

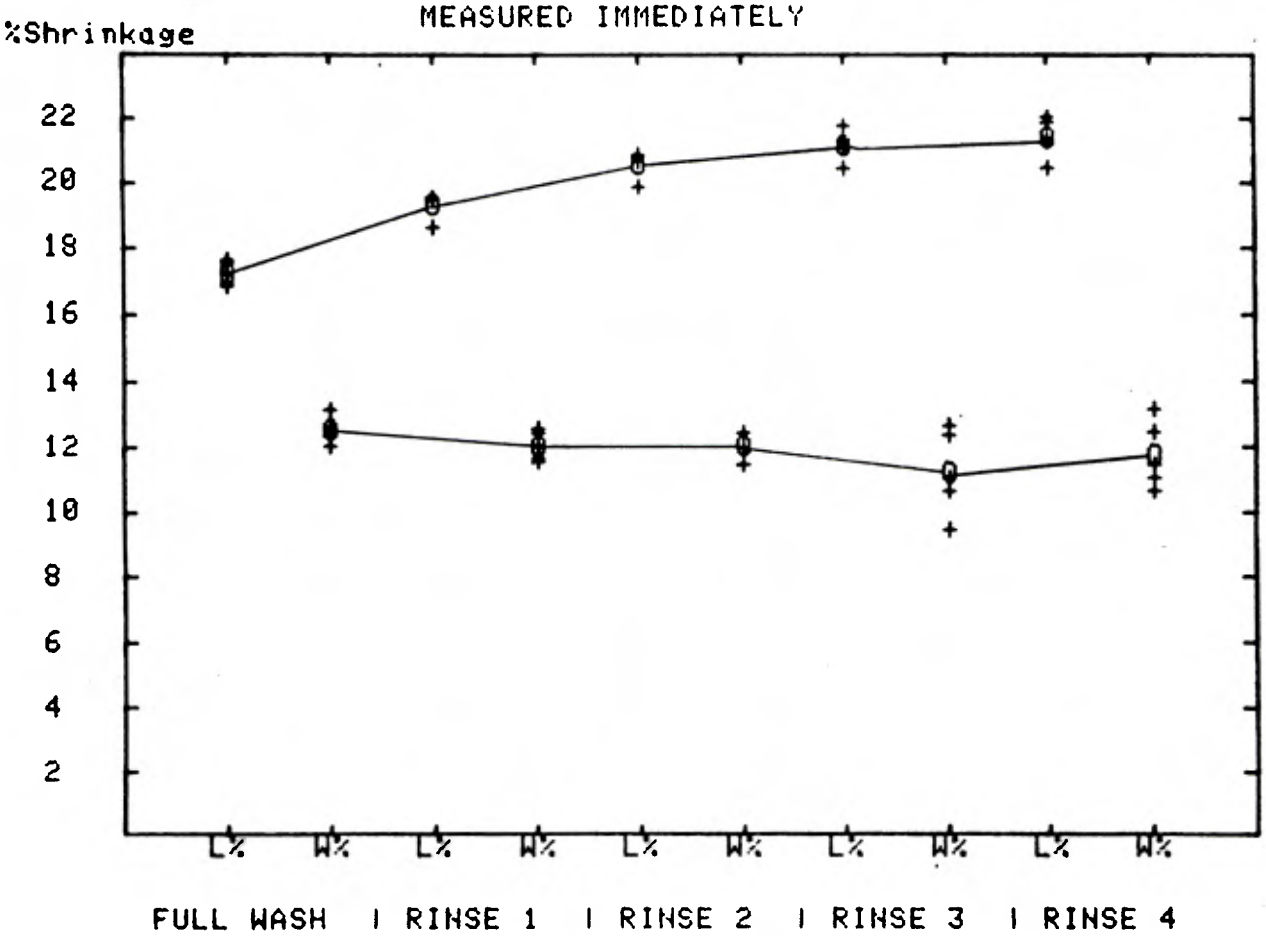
Sample Reference	FULL WASH LS%	FULL WASH WS%	1st RINSE LS%	1st RINSE WS%	2nd RINSE LS%	2nd RINSE WS%	3rd RINSE LS%	3rd RINSE WS%	4th RINSE LS%	4th RINSE WS%
A	16.1	10.2	17.5	10.8	18.5	11.6	19.9	9.8	20.1	10.2
B	15.2	11.8	16.8	12	18.2	11.4	19.4	10.6	19.2	11.6
C	14.4	11.6	16.4	12	18.2	10.8	18.8	12.2	18.8	12
D	15.9	11.6	18.1	11	18.7	12.2	19.3	12	20	11.8
E	16	11.9	17.6	11.7	18.8	11.1	20	11.7	20.2	12.5

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1. FULL	LS%	5	15.5200	0.7190	4.63
2. WASH	WS%	5	11.4200	0.6943	6.08
3. 1st	LS%	5	17.2800	0.6760	3.91
4. RINSE	WS%	5	11.5000	0.5657	4.92
5. 2nd	LS%	5	18.4800	0.2775	1.50
6. RINSE	WS%	5	11.4200	0.5310	4.65
7. 3rd	LS%	5	19.4800	0.4868	2.50
8. RINSE	WS%	5	11.2600	1.0237	9.09
9. 4th	LS%	5	19.6600	0.6229	3.17
10. RINSE	WS%	5	11.6200	0.8614	7.41

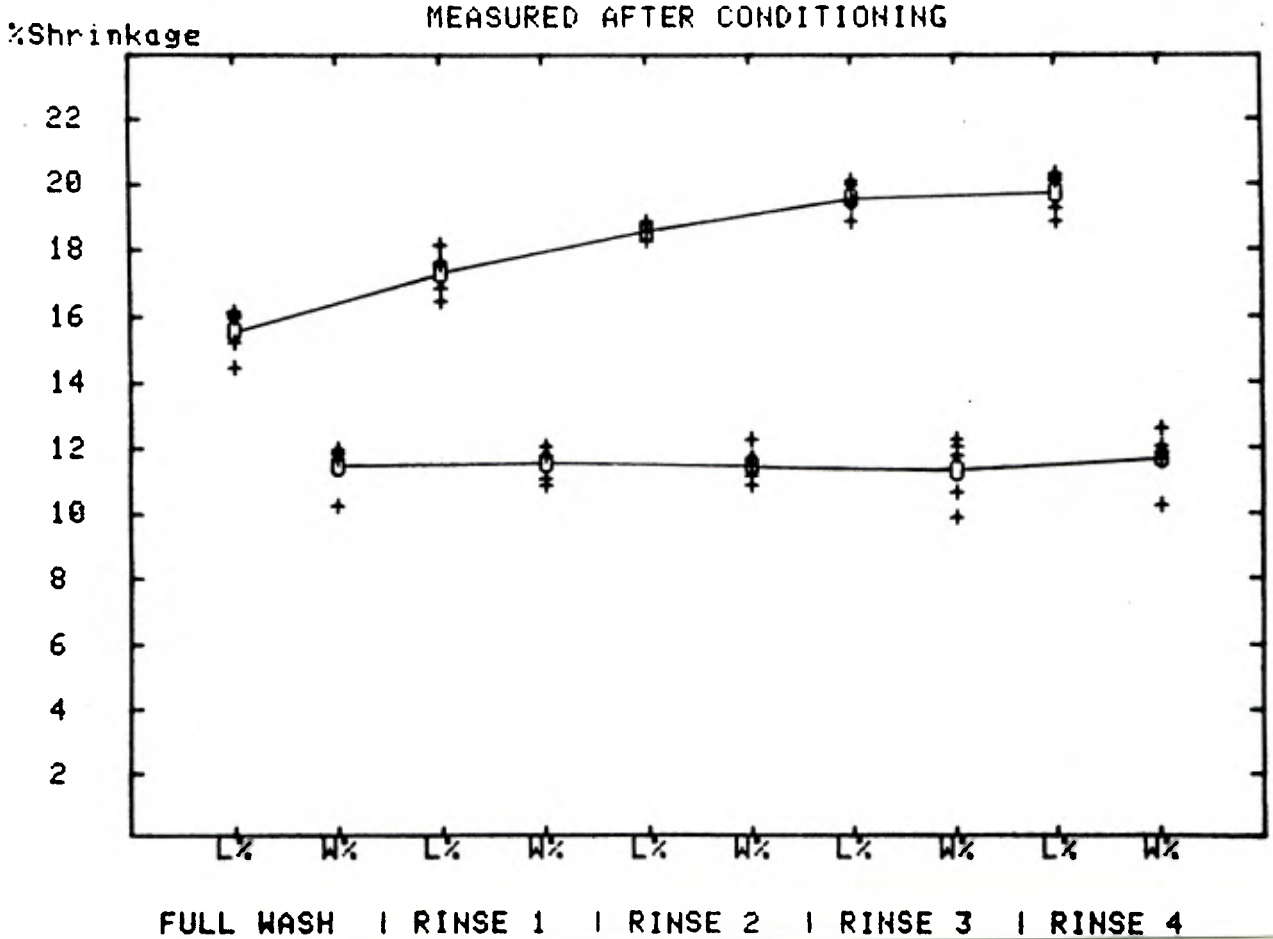
SHRINKAGE IN TUMBLE DRYING : SET 5 : ALL CYCLES

MEASURED IMMEDIATELY



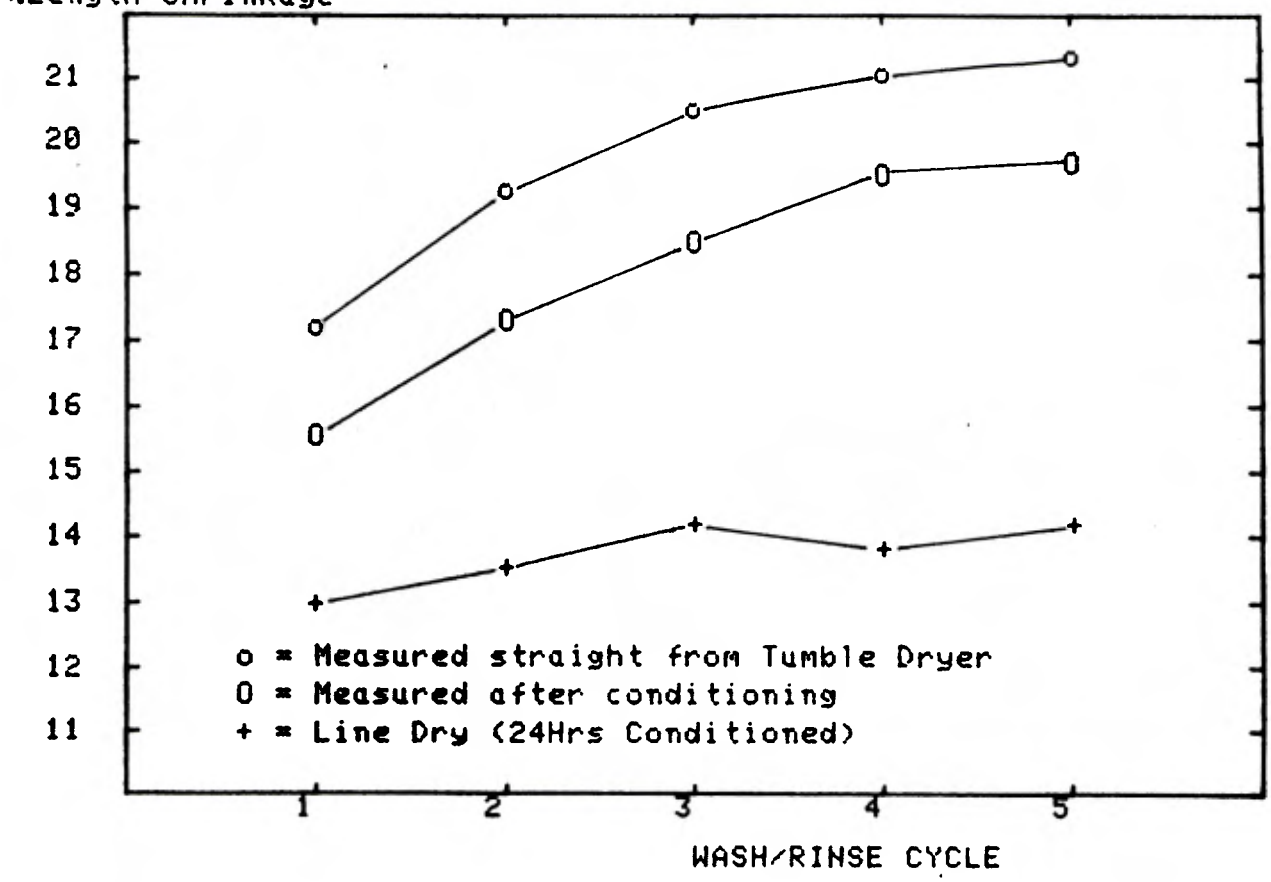
SHRINKAGE IN TUMBLE DRYING : SET 5 : ALL CYCLES

MEASURED AFTER CONDITIONING



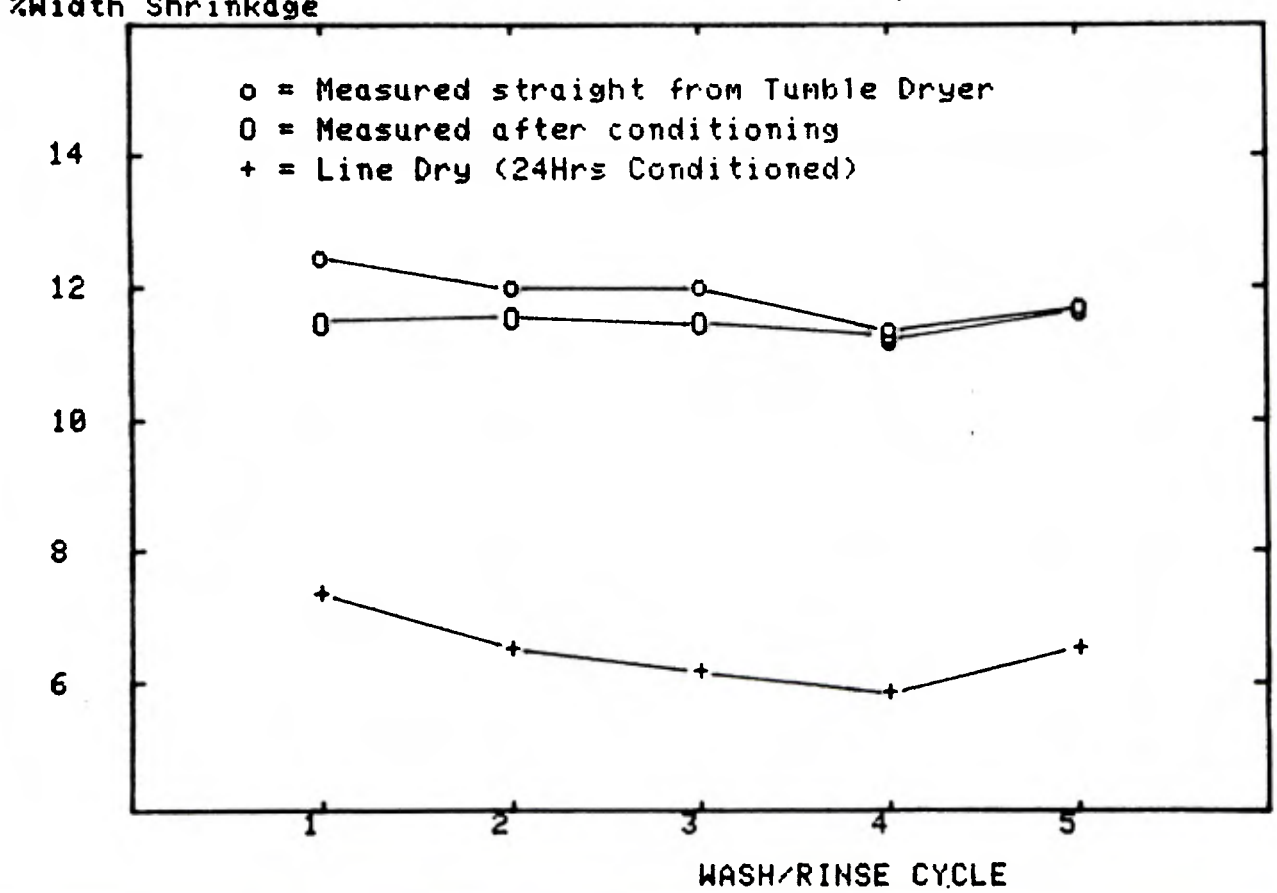
SHRINKAGE IN TUMBLE DRYING : 20G INTERLOCK

SET 5 Tumble (80+10mins), SET 8 Line Dry



SHRINKAGE IN TUMBLE DRYING : 20G INTERLOCK

SET 5 Tumble (80+10mins), SET 8 Line Dry



SHRINKAGE IN TUMBLE DRYING

SET 5 : 80mins HOT Tumble + 10mins COOL Down

SAMPLE WEIGHTS g

Sample Reference	A	B	C	D	E
Oven Dry	99.47	105.7	98.43	84.19	77.75
Orig Cond	106.05	112.69	104.94	89.76	82.89
1W+T Wet	183.48	189.66	179.73	156.25	136.12
1W+T Dry	100.74	106.64	99.54	85.03	78.56
1W+T Cond	106.58	112.95	105.4	90.08	83.32
2W+T Wet	163.76	178.75	163.41	140.45	132.44
2W+T Dry	100.18	106.1	99.31	84.31	78.23
2W+T Cond	106.14	112.68	104.75	89.74	82.77
3W+T Wet	166.39	183.58	166.72	140.63	138.2
3W+T Dry	100.67	106.94	99.5	85.36	78.73
3W+T Cond	105.69	112.74	105.12	89.83	83
4W+T Wet	156.57	175.72	161.73	141.07	121.66
4W+T Dry	100	105.82	98.6	84.15	78
4W+T Cond	105.7	109.11	104.82	89.52	82.73
5W+T Wet	157.69	179.99	159.6	134.82	125.18
5W+T Dry	99.89	105.89	98.89	84.46	78.3
5W+T Cond	106.08	112.56	104.63	89.63	82.99

N.B. Oven Dry sample weights calculated from Original Conditioned sample weights using Average Moisture Content established on samples of the same fabric in a separate test.

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	93.1080	11.6486	12.51
2.Orig Cond	5	99.2660	12.4193	12.51
3.1W+T Wet	5	169.0480	22.3343	13.21
4.1W+T Dry	5	94.1020	11.7759	12.51
5.1W+T Cond	5	99.6660	12.4120	12.45
6.2W+T Wet	5	155.7620	18.9029	12.14
7.2W+T Dry	5	93.6260	11.7759	12.58
8.2W+T Cond	5	99.2160	12.4510	12.55
9.3W+T Wet	5	159.1040	19.2901	12.12
10.3W+T Dry	5	94.2400	11.7230	12.44
11.3W+T Cond	5	99.2760	12.3562	12.45
12.4W+T Wet	5	151.3500	20.7127	13.69
13.4W+T Dry	5	93.3140	11.6998	12.54
14.4W+T Cond	5	98.3760	11.5500	11.74
15.5W+T Wet	5	151.4560	21.7173	14.34
16.5W+T Dry	5	93.4860	11.5775	12.38
17.5W+T Cond	5	99.1780	12.3456	12.45

SHRINKAGE IN TUMBLE DRYING

SET 5 : 80mins HOT Tumble + 10mins COOL Down

% MOISTURE CONTENT

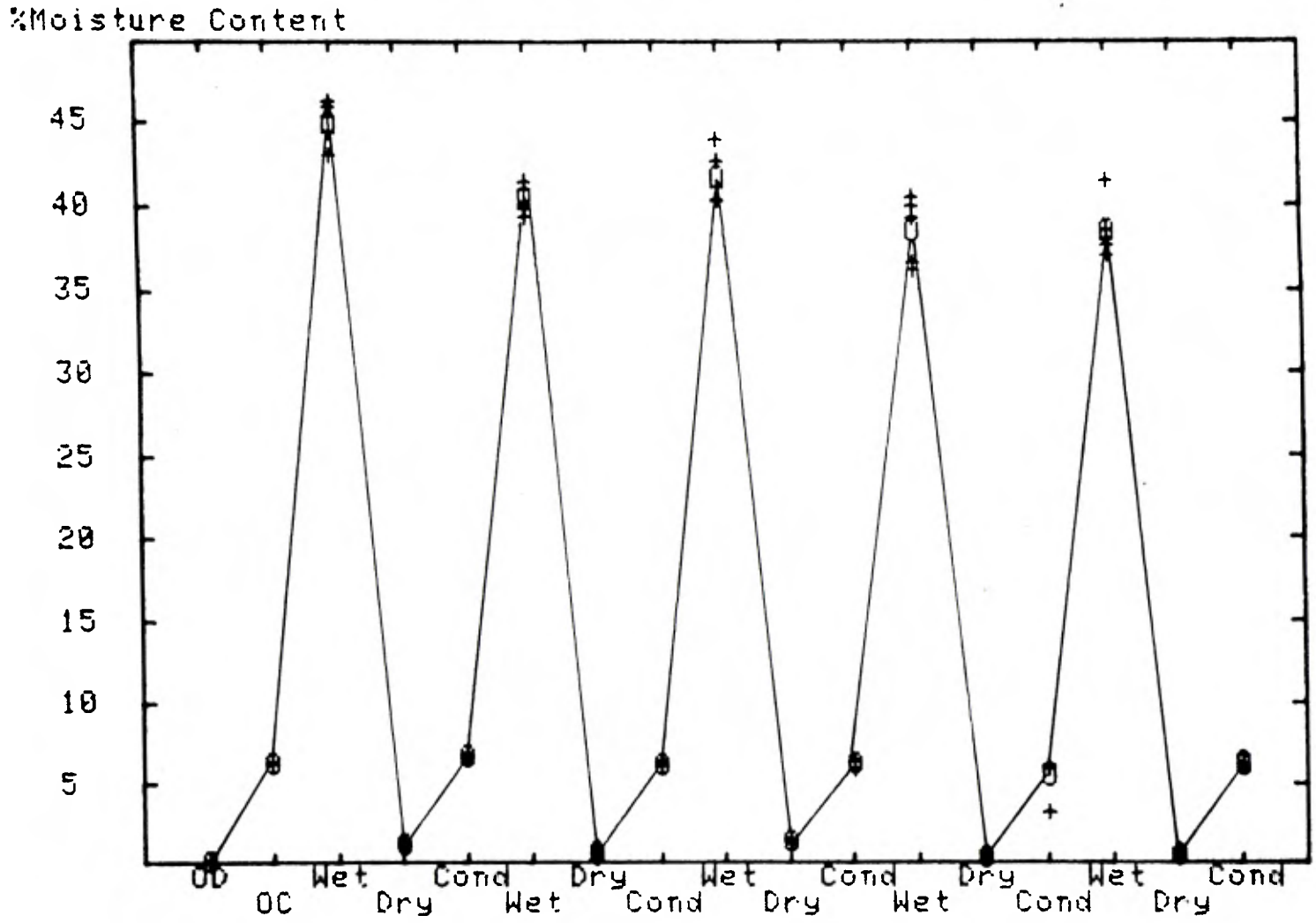
Sample Reference	A	B	C	D	E
Oven Dry	0	0	0	0	0
Orig Cond	6.2	6.2	6.2	6.21	6.2
1W+T Wet	45.79	44.27	45.23	46.12	42.88
1W+T Dry	1.26	0.88	1.12	0.99	1.03
1W+T Cond	6.67	6.42	6.61	6.54	6.69
2R+T Wet	39.26	40.87	39.77	40.06	41.29
2R+T Dry	0.71	0.38	0.89	0.14	0.61
2R+T Cond	6.28	6.19	6.03	6.18	6.06
3R+T Wet	40.22	42.42	40.96	40.13	43.74
3R+T Dry	1.19	1.16	1.08	1.37	1.24
3R+T Cond	5.89	6.24	6.36	6.28	6.33
4R+T Wet	36.47	39.85	39.14	40.32	36.09
4R+T Dry	0.53	0.11	0.17	-0.05	0.32
4R+T Cond	5.89	3.13	6.1	5.95	6.02
5R+T Wet	36.92	41.27	38.33	37.55	37.89
5R+T Dry	0.42	0.18	0.47	0.32	0.7
5R+T Cond	6.23	6.09	5.93	6.07	6.31

N.B.Moisture Content calculated from sample weights
%MC = (Sample Weight - Calc Oven Dry Weight)/Sample Weight *100

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	0.0000	0.0000	0.00
2.Orig Cond	5	6.2035	0.0017	0.03
3.1W+T Wet	5	44.8580	1.3084	2.92
4.1W+T Dry	5	1.0552	0.1424	13.49
5.1W+T Cond	5	6.5853	0.1095	1.66
6.2R+T Wet	5	40.2484	0.8256	2.05
7.2R+T Dry	5	0.5455	0.2908	53.30
8.2R+T Cond	5	6.1523	0.1024	1.66
9.3R+T Wet	5	41.4954	1.5550	3.75
10.3R+T Dry	5	1.2085	0.1095	9.07
11.3R+T Cond	5	6.2195	0.1924	3.09
12.4R+T Wet	5	38.3738	1.9608	5.11
13.4R+T Dry	5	0.2178	0.2187	100.45
14.4R+T Cond	5	5.4178	1.2838	23.70
15.5R+T Wet	5	38.3931	1.6907	4.40
16.5R+T Dry	5	0.4174	0.1935	46.35
17.5R+T Cond	5	6.1269	0.1506	2.46

SHRINKAGE IN TUMBLE DRYING : SET 5 : ALL CYCLES



APPENDIX 5

SHRINKAGE IN TUMBLE DRYING

SET 7 : 100mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED IMMEDIATELY

Sample Reference	FULL WASH LS%	FULL WASH WS%	1st RINSE LS%	1st RINSE WS%	2nd RINSE LS%	2nd RINSE WS%	3rd RINSE LS%	3rd RINSE WS%	4th RINSE LS%	4th RINSE WS%
A	17.1	11.2	18.9	11.4	20.1	10.4	20.5	11.2	21.1	9.9
B	18	9.6	19.2	11.8	20	11.8	21.4	10.6	21.2	11.2
C	17	11.2	18.6	10.8	20	11.2	20.6	11.4	20.6	11
D	17	11.8	18.8	10.8	19	11.4	20.2	11.4	20.4	11
E	16.8	12.8	18.6	12.2	19.6	12.2	19.8	12.6	21.2	12.4

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1. FULL	LS%	5	17.1000	0.4712	2.74
2. WASH	WS%	5	11.3200	1.1628	10.27
3. 1st	LS%	5	18.8200	0.2490	1.32
4. RINSE	WS%	5	11.4000	0.6164	5.41
5. 2nd	LS%	5	19.7400	0.4561	2.31
6. RINSE	WS%	5	11.4000	0.6782	5.95
7. 3rd	LS%	5	20.5000	0.5916	2.89
8. RINSE	WS%	5	11.4400	0.7266	6.35
9. 4th	LS%	5	20.9000	0.3742	1.79
10. RINSE	WS%	5	11.1000	0.8888	8.01

SHRINKAGE IN TUMBLE DRYING

SET 7 : 100mins HOT Tumble + 10mins COOL Down

SHRINKAGE MEASURED AFTER CONDITIONING

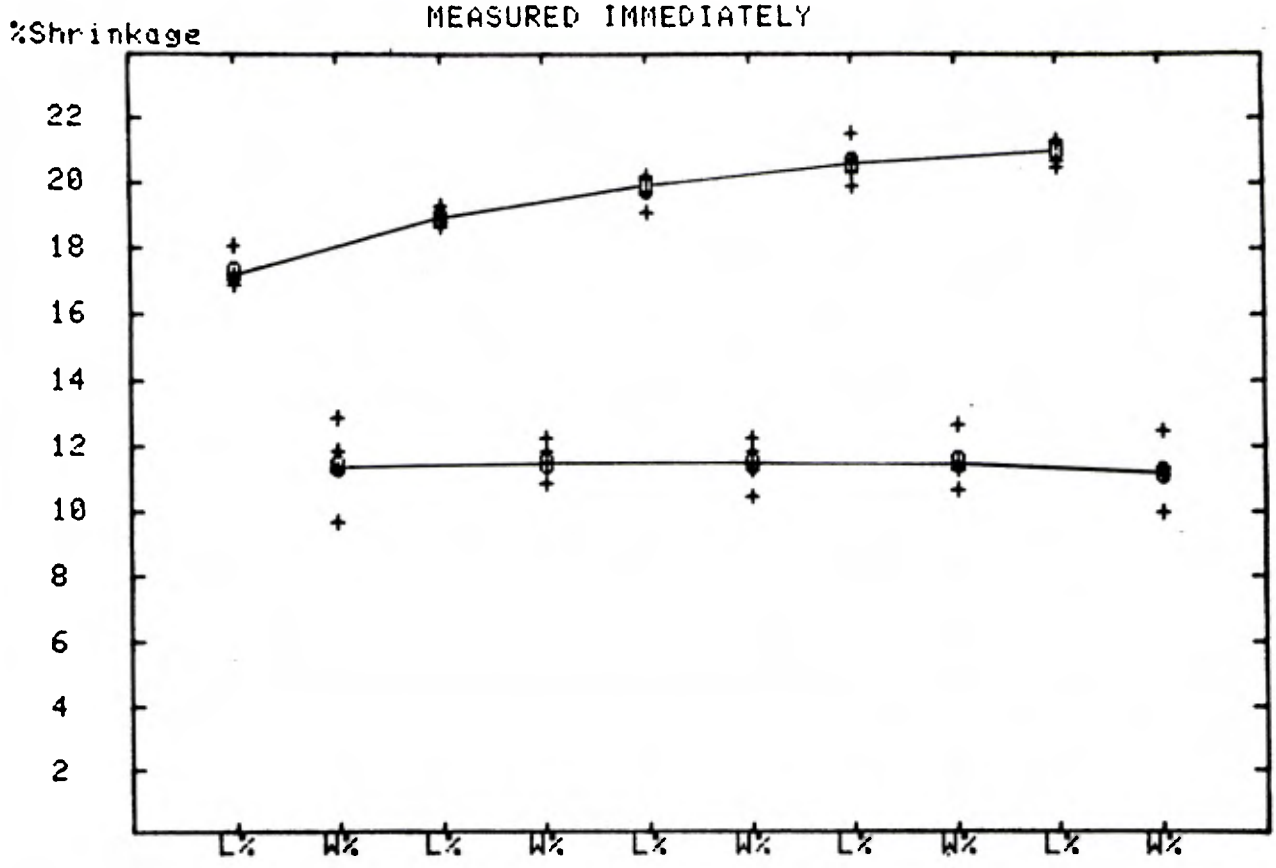
Sample Reference	FULL WASH LS%	FULL WASH WS%	1st RINSE LS%	1st RINSE WS%	2nd RINSE LS%	2nd RINSE WS%	3rd RINSE LS%	3rd RINSE WS%	4th RINSE LS%	4th RINSE WS%
A	15.1	11.6	16.9	11.2	18.9	9.7	19.5	10.2	19.9	10.2
B	16	11	17.4	11.6	19	11.2	19.8	11.4	20	10.6
C	15.2	12	16.6	12	18.8	10.6	19.2	12.6	19.8	10.8
D	15.2	11.2	16.8	11.2	18.2	10.6	19.4	12.6	19.2	10.8
E	15.2	12.2	17.2	12.4	18.2	13	19.2	13	19	12

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1. FULL	LS%	5	15.3400	0.3715	2.42
2. WASH	WS%	5	11.6000	0.5099	4.40
3. 1st	LS%	5	16.9000	0.3194	1.88
4. RINSE	WS%	5	11.6800	0.5215	4.47
5. 2nd	LS%	5	18.6200	0.3899	2.09
6. RINSE	WS%	5	11.0200	1.2296	11.16
7. 3rd	LS%	5	19.4200	0.2490	1.28
8. RINSE	WS%	5	11.9600	1.1524	9.64
9. 4th	LS%	5	19.5800	0.4494	2.30
10. RINSE	WS%	5	10.8800	0.6723	6.18

SHRINKAGE IN TUMBLE DRYING : SET 7 : ALL CYCLES

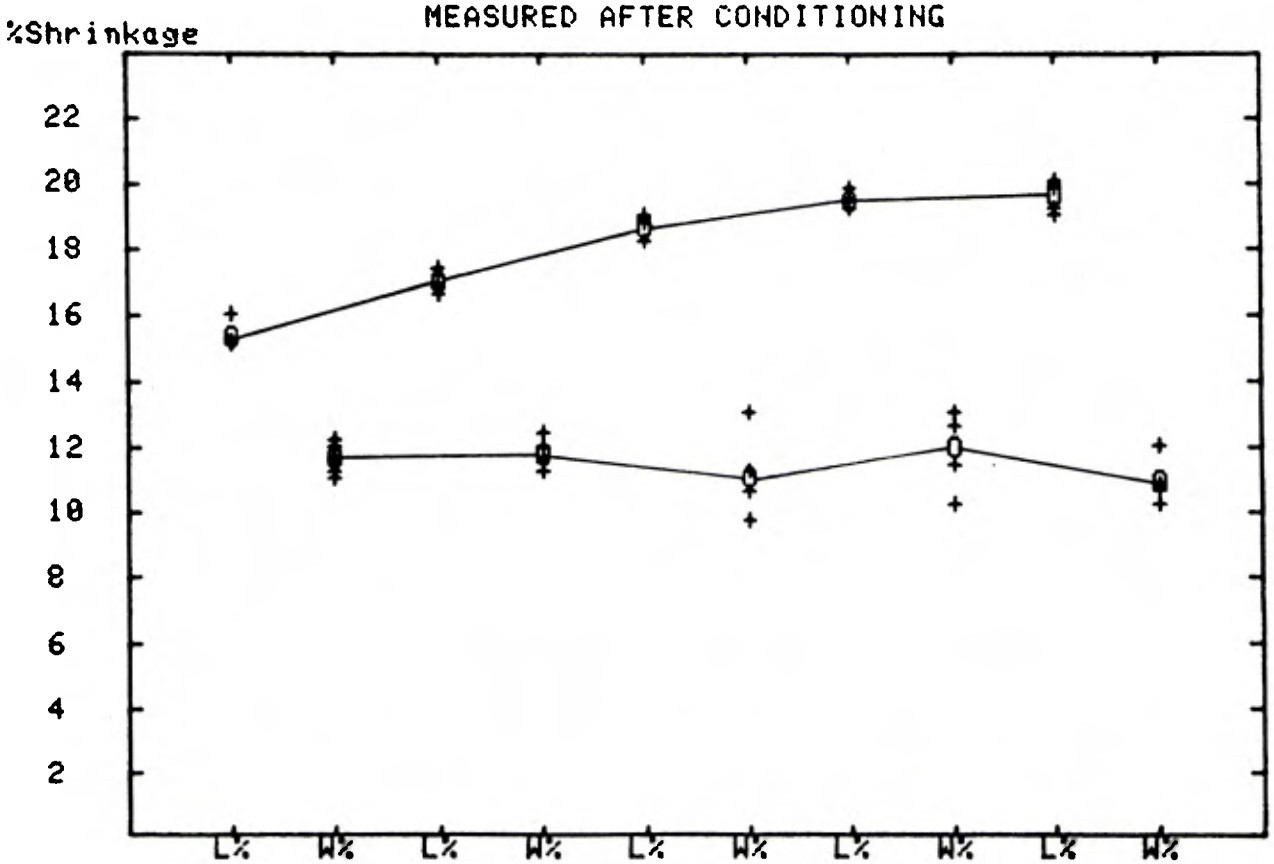
MEASURED IMMEDIATELY



FULL WASH | RINSE 1 | RINSE 2 | RINSE 3 | RINSE 4

SHRINKAGE IN TUMBLE DRYING : SET 7 : ALL CYCLES

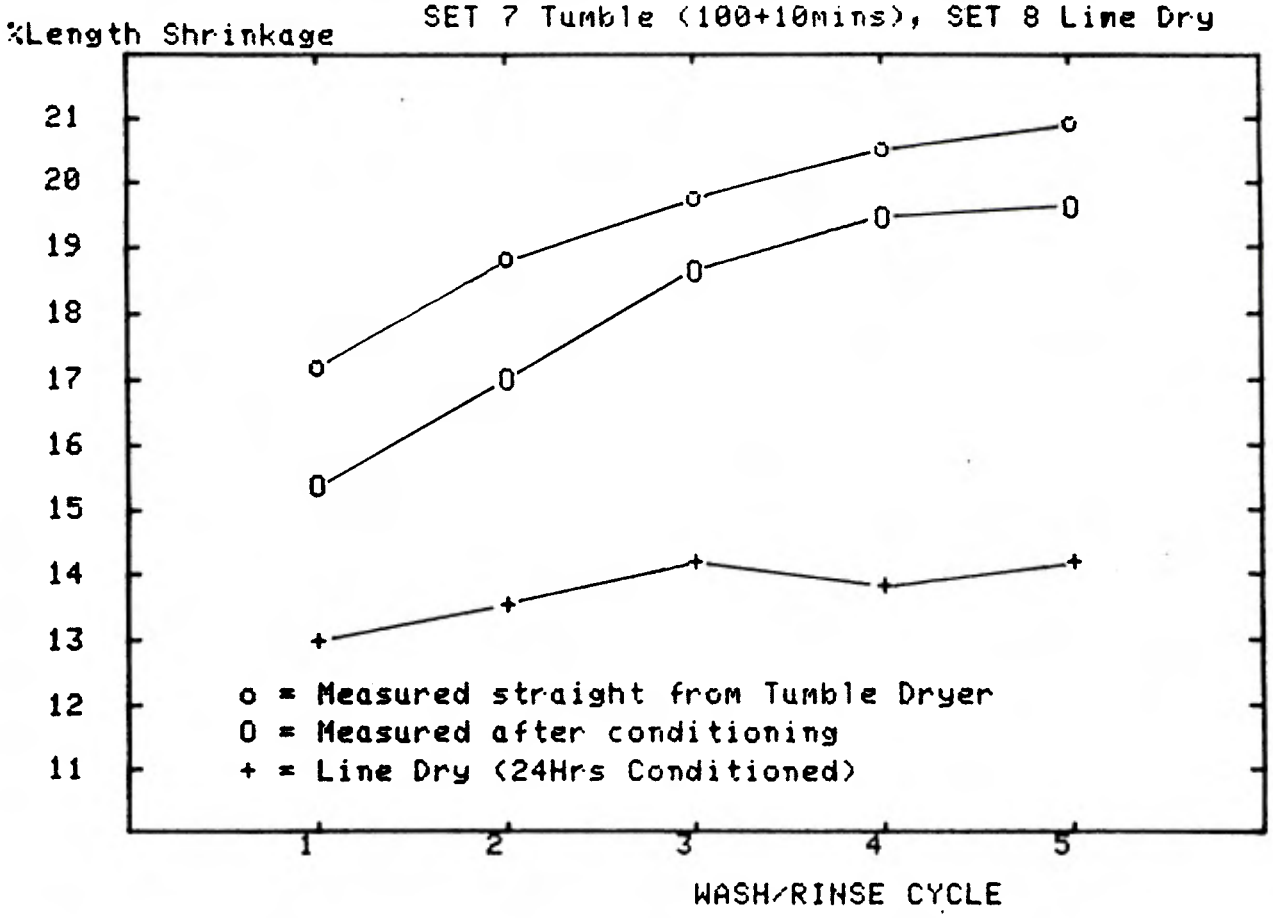
MEASURED AFTER CONDITIONING



FULL WASH | RINSE 1 | RINSE 2 | RINSE 3 | RINSE 4

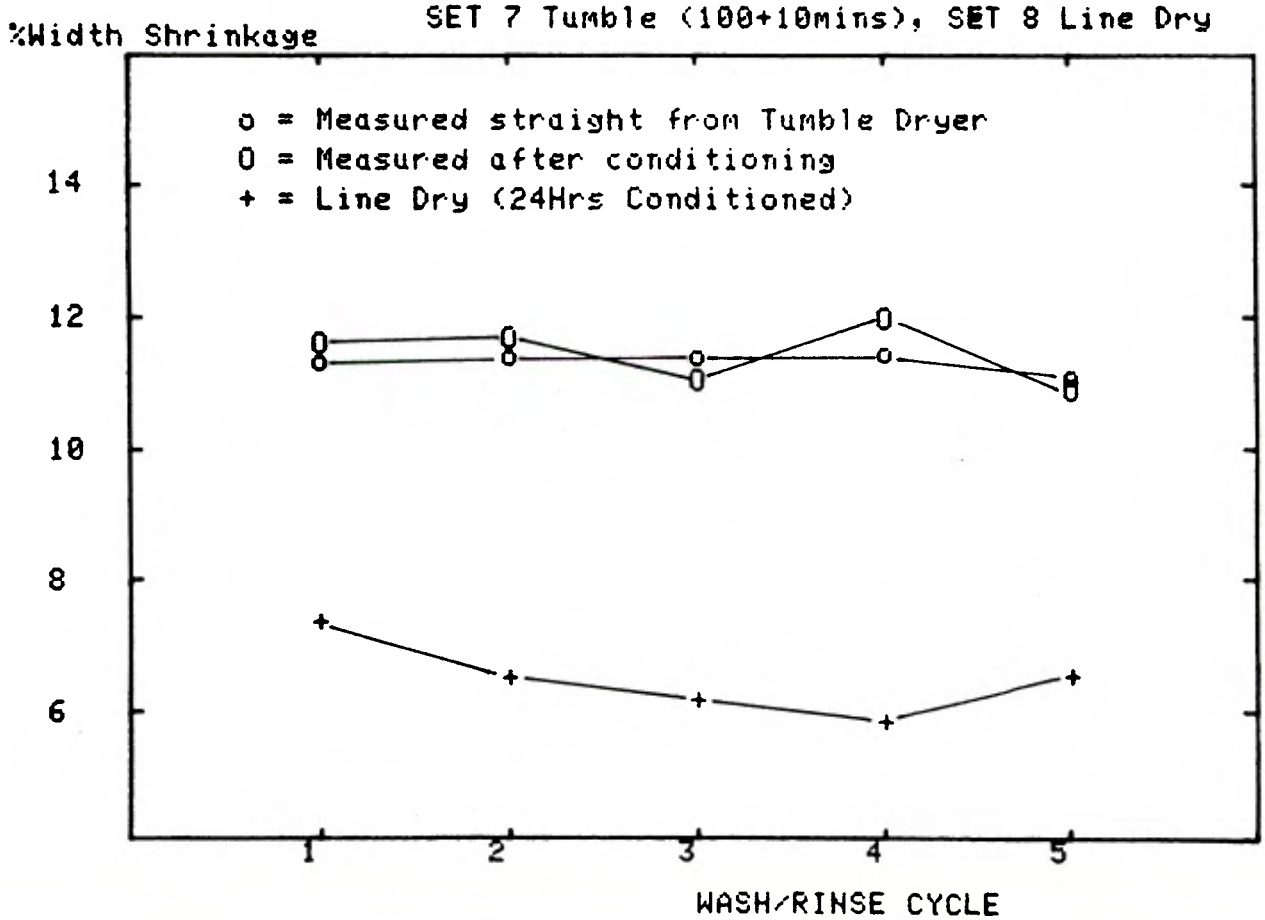
SHRINKAGE IN TUMBLE DRYING : 20G INTERLOCK

SET 7 Tumble (100+10mins), SET 8 Line Dry



SHRINKAGE IN TUMBLE DRYING : 20G INTERLOCK

SET 7 Tumble (100+10mins), SET 8 Line Dry



SHRINKAGE IN TUMBLE DRYING

SET 7 : 100mins HOT Tumble + 10mins COOL Down

SAMPLE WEIGHTS g

Sample Reference	A	B	C	D	E
Oven Dry	83.54	76.98	82.84	78.78	87.18
Orig Cond	89.06	82.07	88.32	83.99	92.94
1W+T Wet	146.56	135.7	146.56	149.56	155.52
1W+T Dry	85.08	78.4	84.22	80.15	88.56
1W+T Cond	88.97	82.01	88.26	83.83	93
2W+T Wet	134.5	132.62	145.68	132.62	153.24
2W+T Dry	84.9	78.34	84.22	79.89	88.54
2W+T Cond	89.14	82.32	88.49	84.06	93.06
3W+T Wet	150.18	126.36	139.95	126.72	142.73
3W+T Dry	84.88	78.3	84.11	80	88.82
3W+T Cond	89.23	82.19	88.39	84.02	93
4W+T Wet	132.08	122.5	132.7	124.14	149.14
4W+T Dry	84.98	78.24	84.38	80.38	88.74
4W+T Cond	88.63	81.76	87.87	83.51	92.51
5W+T Wet	142.51	127.7	138.45	134	137.1
5W+T Dry	84.95	78.37	84.04	79.54	88.38
5W+T Cond	89.02	81.99	88.21	83.89	92.87

N.B. Oven Dry sample weights calculated from Original Conditioned sample weights using Average Moisture Content established on samples of the same fabric in a separate test.

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	81.8640	4.0431	4.94
2.Orig Cond	5	87.2760	4.3085	4.94
3.1W+T Wet	5	146.7800	7.1934	4.90
4.1W+T Dry	5	83.2820	4.0501	4.86
5.1W+T Cond	5	87.2140	4.3643	5.00
6.2W+T Wet	5	139.7320	9.3056	6.66
7.2W+T Dry	5	83.1780	4.0933	4.92
8.2W+T Cond	5	87.4140	4.2782	4.89
9.3W+T Wet	5	137.1880	10.4158	7.59
10.3W+T Dry	5	83.2220	4.1678	5.01
11.3W+T Cond	5	87.3660	4.3085	4.93
12.4W+T Wet	5	132.1120	10.5622	7.99
13.4W+T Dry	5	83.3440	4.1141	4.94
14.4W+T Cond	5	86.8560	4.2810	4.93
15.5W+T Wet	5	135.9520	5.5333	4.07
16.5W+T Dry	5	83.0560	4.0994	4.94
17.5W+T Cond	5	87.1960	4.3180	4.95

SHRINKAGE IN TUMBLE DRYING

SET 7 : 100mins HOT Tumble + 10mins COOL Down

% MOISTURE CONTENT

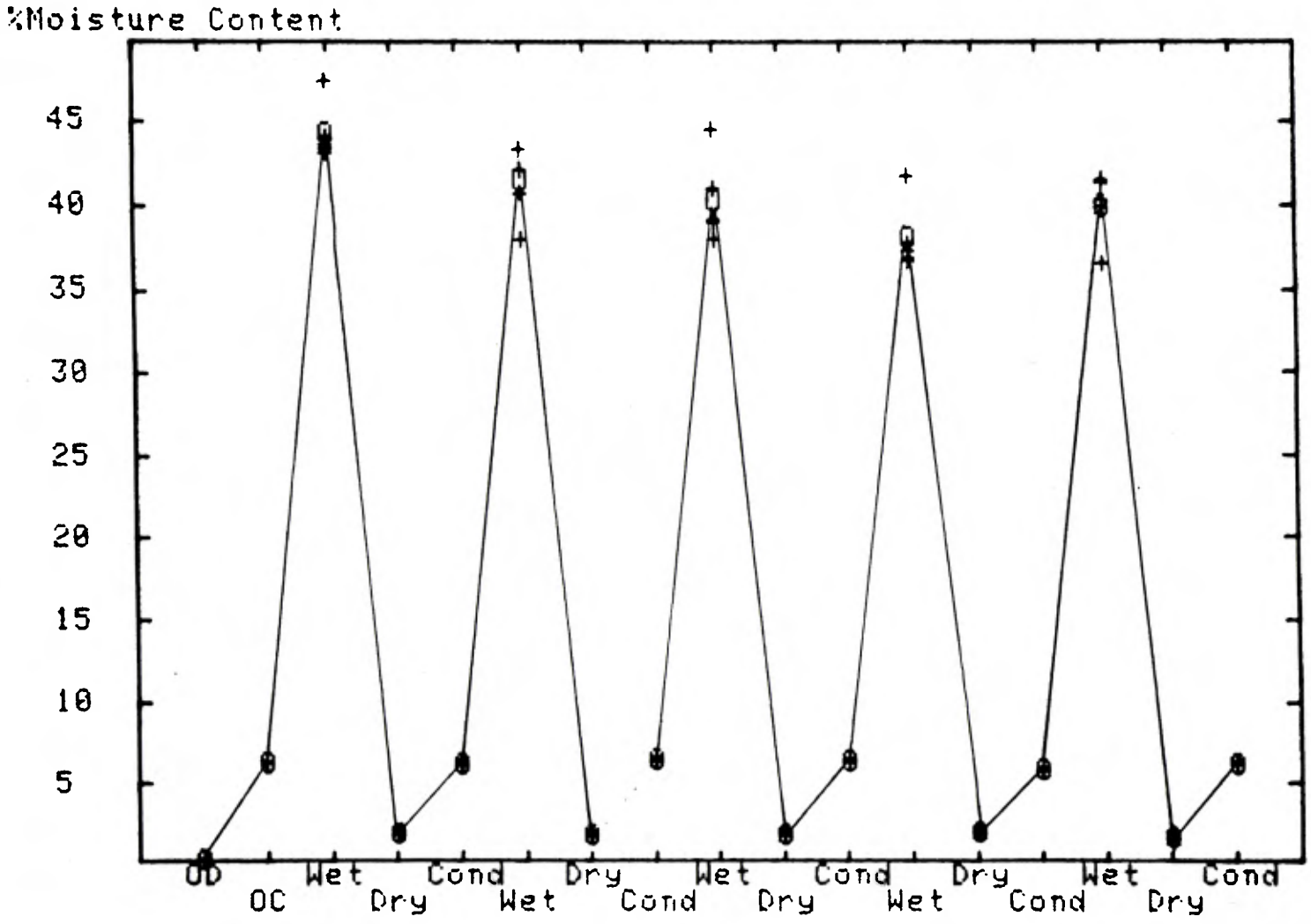
Sample Reference	A	B	C	D	E
Oven Dry	0	0	0	0	0
Orig Cond	6.2	6.2	6.2	6.2	6.2
1W+T Wet	43	43.27	43.48	47.33	43.94
1W+T Dry	1.81	1.81	1.64	1.71	1.56
1W+T Cond	6.1	6.13	6.14	6.02	6.26
2R+T Wet	37.89	41.95	43.14	40.6	43.11
2R+T Dry	1.6	1.74	1.64	1.39	1.54
2R+T Cond	6.28	6.49	6.38	6.28	6.32
3R+T Wet	44.37	39.08	40.81	37.83	38.92
3R+T Dry	1.58	1.69	1.51	1.53	1.85
3R+T Cond	6.38	6.34	6.28	6.24	6.26
4R+T Wet	36.75	37.16	37.57	36.54	41.54
4R+T Dry	1.69	1.61	1.83	1.99	1.76
4R+T Cond	5.74	5.85	5.72	5.66	5.76
5R+T Wet	41.38	39.72	40.17	41.21	36.41
5R+T Dry	1.66	1.77	1.43	0.96	1.36
5R+T Cond	6.16	6.11	6.09	6.09	6.13

N.B.Moisture Content calculated from sample weights
%MC = (Sample Weight - Calc Oven Dry Weight)/Sample Weight *100

*** ROW STATISTICS ***

	N	Mean	SD	CV%
1.Oven Dry	5	0.0000	0.0000	0.00
2.Orig Cond	5	6.2011	0.0032	0.05
3.1W+T Wet	5	44.2034	1.7790	4.02
4.1W+T Dry	5	1.7055	0.1099	6.44
5.1W+T Cond	5	6.1319	0.0843	1.38
6.2R+T Wet	5	41.3369	2.1906	5.30
7.2R+T Dry	5	1.5804	0.1289	8.16
8.2R+T Cond	5	6.3508	0.0870	1.37
9.3R+T Wet	5	40.2022	2.5638	6.38
10.3R+T Dry	5	1.6292	0.1397	8.57
11.3R+T Cond	5	6.2979	0.0583	0.93
12.4R+T Wet	5	37.9135	2.0683	5.46
13.4R+T Dry	5	1.7757	0.1439	8.10
14.4R+T Cond	5	5.7479	0.0661	1.15
15.5R+T Wet	5	39.7768	2.0063	5.04
16.5R+T Dry	5	1.4349	0.3167	22.07
17.5R+T Cond	5	6.1145	0.0280	0.46

SHRINKAGE IN TUMBLE DRYING : SET 7 : ALL CYCLES



APPENDIX 6

SHRINKAGE IN LINE DRYING

SET 8 : Line Dried

SHRINKAGE MEASURED AFTER LINE DRYING IN CONDITIONED ATMOSPHERE

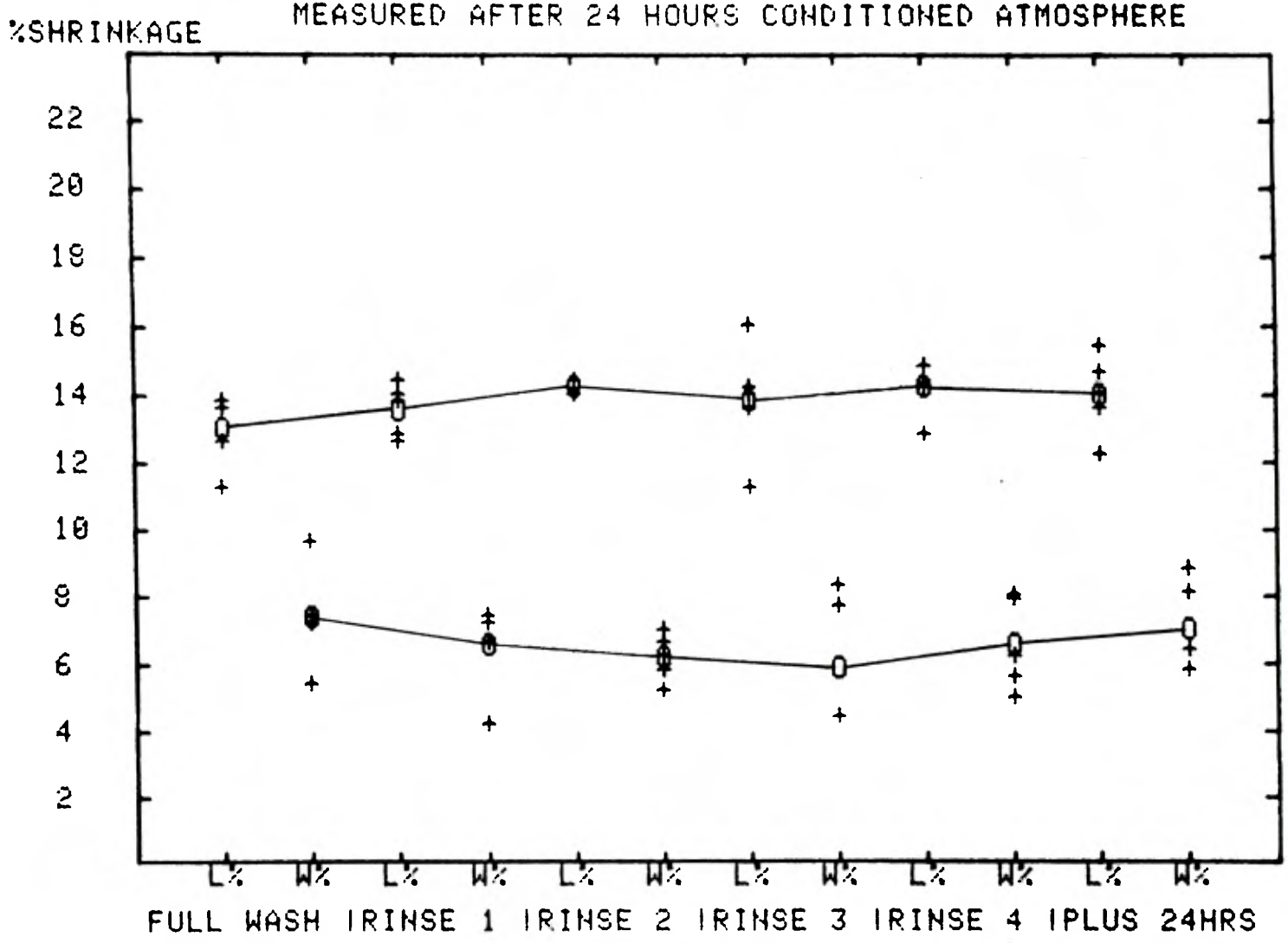
	FULL WASH :		1st RINSE :		2nd RINSE :		3rd RINSE :		4th RINSE :		Recondition	
	LS%	WS% :	LS%	WS% :	LS%	WS% :	LS%	WS% :	LS%	WS% :	LS%	WS%
A	13.8	5.4	14	7.4	14	5.2	16	4.4	14.8	5	15.4	5.8
B	13.6	7.2	14.4	4.2	14.4	6.2	14.2	7.7	14.2	6.2	14.6	6.4
C	12.6	7.4	13.8	7.2	14.1	7	11.2	8.3	14.3	7.9	13.6	8.1
D	11.2	9.6	12.6	6.6	14.4	6.6	13.6	4.4	12.8	8	12.2	8.8
E	13.6	7.2	12.8	7.2	14	5.8	14	4.4	14.8	5.6	14	5.8

*** COLUMN STATISTICS ***

		N	Mean	SD	CV%
1. FULL	LS%	5	12.9600	1.0900	8.41
2. WASH	WS%	5	7.3600	1.4926	20.28
3. 1st	LS%	5	13.5200	0.7823	5.79
4.RINSE	WS%	5	6.5200	1.3312	20.42
5. 2nd	LS%	5	14.1800	0.2049	1.45
6.RINSE	WS%	5	6.1600	0.6986	11.34
7. 3rd	LS%	5	13.8000	1.7205	12.47
8.RINSE	WS%	5	5.8400	1.9832	33.96
9. 4th	LS%	5	14.1800	0.8198	5.78
10.RINSE	WS%	5	6.5400	1.3557	20.73
11. Recon	LS%	5	13.9600	1.1950	8.56
12.dition	WS%	5	6.9800	1.3864	19.86

SHRINKAGE IN LINE DRYING : SET 8 : ALL CYCLES

MEASURED AFTER 24 HOURS CONDITIONED ATMOSPHERE



SHRINKAGE IN LINE DRYING

SET B : LINE DRY FOR 24HRS IN CONDITIONED ATMOSPHERE

SAMPLE WEIGHTS

Sample Reference	Oven Dry	Cond AW	FULL WASH Wet	FULL WASH Dry	1st RINSE Wet	1st RINSE Dry	2nd RINSE Wet	2nd RINSE Dry	3rd RINSE Wet	3rd RINSE Dry	4th RINSE Wet	4th RINSE Dry
A	97.19	103.16	165.14	104.65	173.32	105.04	165.01	104.78	160.98	104.86	169.79	104.75
B	96.34	102.42	176.63	104.02	159.77	104.25	157.85	104.05	170.56	104.12	157.88	104.09
C	94.34	100.17	168.56	101.78	171.05	102.1	166.02	101.76	156.47	101.79	160.26	101.83
D	101.3	107.64	178	109.34	172.93	109.7	172.81	109.45	163.18	109.41	174.54	109.38
E	87.67	93.34	154.17	94.7	146.92	95.02	157.34	94.81	150.46	94.84	148.88	94.8

N.B. Oven Dry established after 5 laundering cycles
Conditioned AW established from Oven Dried samples

*** COLUMN STATISTICS ***

			N	Mean	SD	CV%
1.	Oven	Dry	5	95.3680	4.9942	5.24
2.	Cond	AW	5	101.3460	5.2330	5.16
3.	FULL	Wet	5	168.5000	9.6565	5.73
4.	WASH	Dry	5	102.8980	5.3452	5.19
5.	1st	Wet	5	164.7980	11.4318	6.94
6.	RINSE	Dry	5	103.2220	5.3586	5.19
7.	2nd	Wet	5	163.8060	6.4169	3.92
8.	RINSE	Dry	5	102.9700	5.3498	5.20
9.	3rd	Wet	5	160.3300	7.5086	4.68
10.	RINSE	Dry	5	103.0040	5.3351	5.18
11.	4th	Wet	5	162.2700	10.1206	6.24
12.	RINSE	Dry	5	102.9700	5.3282	5.17

SHRINKAGE IN LINE DRYING

SET 8 : LINE DRY FOR 24HRS IN CONDITIONED ATMOSPHERE

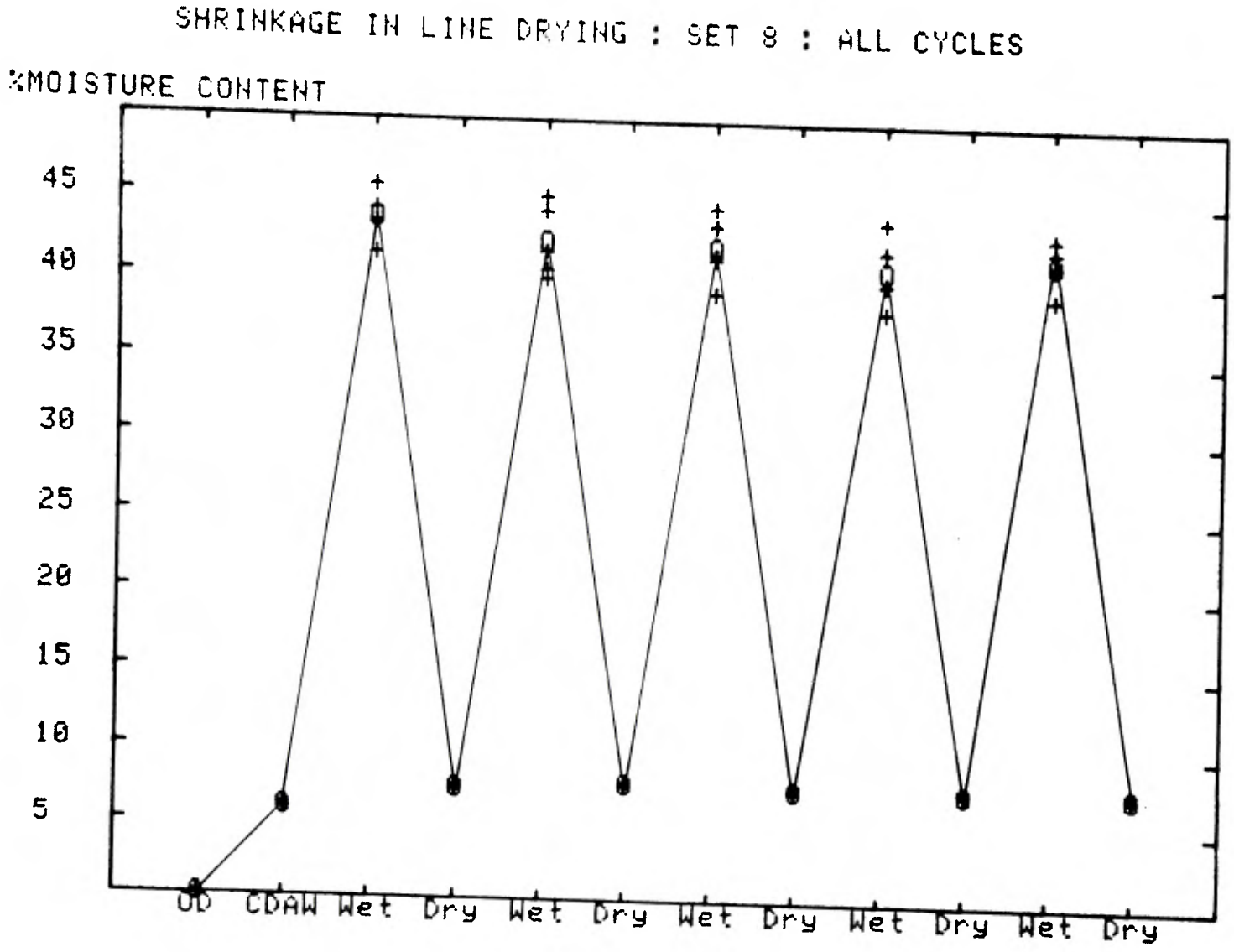
% MOISTURE CONTENT

Sample Reference	Oven Dry	Cond AW	1W+L Wet	1W+L Dry	1R+L Wet	1R+L Dry	2R+L Wet	2R+L Dry	3R+L Wet	3R+L Dry	4R+L Wet	4R+L Dry
A	0	5.79	41.15	7.13	43.92	7.47	41.1	7.24	39.63	7.31	42.76	7.22
B	0	5.94	45.46	7.38	39.7	7.59	38.97	7.41	43.52	7.47	38.98	7.45
C	0	5.82	44.03	7.31	44.85	7.6	43.18	7.29	39.71	7.32	41.13	7.36
D	0	5.89	43.09	7.35	41.42	7.66	41.38	7.45	37.92	7.41	41.96	7.39
E	0	6.07	43.13	7.42	40.33	7.74	44.28	7.53	41.73	7.56	41.11	7.52

N.B. Oven Dry established after 5 laundering cycles
Conditioned AW established from Oven Dried samples

*** COLUMN STATISTICS ***

			N	Mean	SD	CV%
1.	Oven	Dry	5	0.0000	0.0000	0.00
2.	Cond	AW	5	5.9016	0.1129	1.91
3.	1W+L	Wet	5	43.3719	1.5707	3.62
4.	1W+L	Dry	5	7.3197	0.1146	1.57
5.	1R+L	Wet	5	42.0443	2.2480	5.35
6.	1R+L	Dry	5	7.6107	0.0964	1.27
7.	2R+L	Wet	5	41.7808	2.0451	4.89
8.	2R+L	Dry	5	7.3845	0.1165	1.58
9.	3R+L	Wet	5	40.5004	2.1594	5.33
10.	3R+L	Dry	5	7.4156	0.1045	1.41
11.	4R+L	Wet	5	41.1892	1.4102	3.42
12.	4R+L	Dry	5	7.3852	0.1132	1.53


SHRINKAGE IN LINE DRYING : SET 8 : ALL CYCLES
%MOISTURE CONTENT
45
40
35
30
25
20
15
10
5
OD
CDAW
Wet
Dry
Wet
Dry
Wet
Dry
Wet
Dry
Wet
Dry