

THE EFFECT OF INCORPORATING "COMFORT" FABRIC SOFTENER WHEN  
DETERMINING FABRIC SHRINKAGE AND THE REFERENCE STATE  
OF KNITTED COTTON FABRICS

AUTHOR: ROBERT D. LEAH  
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## 1. INTRODUCTION

The test procedures adopted by TRD to determine the reference state and the tumble dry shrinkage of knitted cotton fabrics were established after considerable work had been carried out to identify what parameters were likely to influence the results.

Following this work, it was concluded that the actual washing operation itself was not critical and that the operation which had the major influence on the values returned by the shrinkage test was drying. In particular the importance of ensuring that fabrics are completely dry before the tumbling operation is terminated has been shown to be very important.

One factor which has not been investigated and which has been questioned on several occasions has been whether the inclusion of a fabric softener during the machine washing stage has any effect on the values of shrinkages recorded.

To remedy this omission a series of trials has been carried out where shrinkage evaluations both to line drying and to tumble drying have been determined on a range of knitted fabrics, both with and without the inclusion of "Comfort" fabric softener. This report presents the findings from these trials.

## 2. OUTLINE OF TRIALS

Shrinkage determinations to line drying and tumble drying were carried out on a range of cotton knitted fabrics. The test procedures used were the standard methods slightly amended, in that ten full wash cycles were carried out and fabric shrinkages and courses and wales were determined after each cycle.

Two sets of fabrics were subjected to the tumble dry shrinkage evaluation test and two sets to the line dry shrinkage evaluation test. Of these one set was washed by the established manner using Persil washing powder and the second set was washed using washing powder but with the addition of the recommended quantity of "Comfort" fabric softener to the last rinse.

Five test specimens were evaluated for each fabric variant.

## 3. FABRICS

Three fabric constructions, single jersey, 1 x 1 rib and interlock were used for the evaluation. Of these, both tight and slack fabrics were investigated. All fabrics were from TRD stock and were in the dyed and finished state. The fabrics used are detailed below.

### Single Jersey

24 gauge, 1/32's Ne, stitch length 0.291 cms  
18 gauge, 1/16's Ne, stitch length 0.419 cms

### 1 x 1 Rib

14 gauge, 1/26's Ne, stitch length 0.267 cms  
14 gauge, 1/34's Ne, stitch length 0.350 cms

### Interlock

20 gauge, 1/42's Ne, stitch length 0.307 cms  
20 gauge, 1/42's Ne, stitch length 0.377 cms

## 4. OBSERVATIONS

Shrinkage results and relaxed courses and wales are given in:

Tables 1 - 4 for single jersey  
Tables 5 - 8 for 1 x 1 rib  
Tables 9 - 12 for interlock

Confidence limits of the ten cycles have been averaged and are given for all fabrics in Table 13.

The shrinkage values over the ten cycles are shown graphically in Figures 1-12. The relaxed courses and wales are also shown graphically in Figures 13-24. Each fabric is considered independently in assessing the effect of the addition of fabric softener.

### 4.1 Single Jersey 24/1-32/291 (Figures 1, 2, 13, 14)

To all intents and purposes no differences are apparent in the values of shrinkage (both line and tumble) and the relaxed courses and wales recorded by the control test and that in which "Comfort" was included. The confidence limits are very similar for courses and wales but somewhat lower for shrinkage when Comfort was included.

### 4.2 Single Jersey 18/1-16/419 (Figures 3, 4, 15, 16)

With this quality consistent differences are apparent in both length and width shrinkages recorded by both the line dry and tumble dry methods. The inclusion of Comfort results in a lower length shrinkage and a higher width shrinkage. The differences are of the order of 1-1½ percentage points.

As regards reference courses and wales, clear differences are not apparent. Likewise there are no clear differences in the confidence limits for both shrinkage and courses/wales.

#### 4.3 1 x 1 Rib 14/1 26/27 (Figures 5, 6, 17, 18)

Once again consistent differences in recorded shrinkage are apparent. This is clearly the case in the tumble test, the inclusion of Comfort resulting in lower length but higher width shrinkage. With line drying width shrinkages are virtually the same whereas inclusion of Comfort has resulted in slightly higher length shrinkage being recorded.

No clear differences are apparent in the relaxed courses but the inclusion of Comfort does appear to result in slightly higher wales being recorded. No trend is apparent in the confidence limits.

#### 4.4 1 x 1 Rib 14/1-34/350 (Figures 7, 8,19, 20)

With tumble drying, Comfort inclusion results in lower length and higher width shrinkages being measured. With line drying the differences in length are not great but a clear difference occurs in width shrinkage (or in this case extension). Differences of 8 to 10 percentage points are apparent.

Clear differences are also apparent in the relaxed courses and wales. Particularly in the case of the latter, these differences can be as much as 3 wales. Again there is no indication that the inclusion of Comfort is changing the levels of confidence limits being achieved.

#### 4.5 Interlock 20/1-42/307 (Figures 9,10,21,22)

Once again with tumble drying the inclusion of Comfort has resulted in lower length and higher width shrinkages being recorded. To the line dry test the differences in length shrinkage are not clear cut but a distinct difference occurs in the width shrinkage values. The difference is of the order of 2-3 percentage points. Relaxed courses determined by line drying and tumble drying are apparently not influenced by the inclusion of Comfort but the relaxed wales tend to be higher when Comfort is present.

Once again confidence levels do not seem to be systematically altered by the inclusion of Comfort.

#### 4.6 Interlock 20/1-42/377 (Figures 11,12,23,24)

The effect of Comfort on shrinkage is very clear to see with this fabric quality. Again recorded length shrinkage is lower when Comfort is present and width shrinkage is greater (or lower extension). The differences particularly in width are of the order of 8-10 percentage points. Systematic differences in the relaxed courses are not apparent but clear differences in the wales are present.

Confidence limits do not appear to be altered systematically by the inclusion of Comfort.

## 5. CONCLUSIONS

This exercise has shown quite clearly that the inclusion of a fabric softener such as Comfort can affect the results recorded by a shrinkage test. The degree to which it is affected is not only dependent on the fabric type but also on fabric tightness. Generally the tighter fabrics show smaller differences than the more open fabrics. The general impression is that the recorded length shrinkage is reduced and the width shrinkage increased when Comfort is used in the final rinse of the washing operation.

These differences can be partly explained by a change in the reference courses and wales.

The implications of these findings is that whenever interlaboratory comparisons are being carried out or laboratories are adopting our testing procedures as part of a STARFISH cooperation then we need to be more specific in our details of the test method for determining shrinkage and reference state. In the past we have not been too specific regarding the washing procedure believing that the inclusion of tumble drying would override any differences which arise due to the washing operation. Since some washing powders contain fabric softeners, perhaps we should be more specific regarding the detergent used in the test procedure to determine fabric reference state.

Quality-----Single Jersey

SHRINKAGE TRIAL  
24/1-32/291

TABLE 1

CYCLE NUMBER	1 LS%	2 LS%	3 LS%	4 LS%	1 WS%	2 WS%	3 WS%	4 WS%
1	9.22	12.4	8.46	12.48	8.05	10.81	8.22	8.22
2	9.36	12.89	9.25	13.18	7.71	11.53	8.81	8.81
3	10.42	13.44	9.65	13.28	8.31	11.43	8.26	8.26
4	9.78	13.33	9.44	13.71	7.58	11.32	8.7	8.7
5	9.98	14.1	10.11	13.67	7.87	11.5	9.05	9.05
6	10.03	14.12	10.53	14.02	8.05	11.4	8.31	8.31
7	10.58	13.99	10.12	13.77	7.39	11.38	8.23	8.23
8	10.18	14.12	10.16	14.28	7.72	11.35	8.24	8.24
9	9.99	14.27	10.18	14.66	8.19	11.3	8.52	8.52
10	9.99	14.14	10.41	14.13	8.03	11.38	7.79	7.79

- 1-Line dried
- 2-Tumble dried
- 3-Line dried(Comfort)
- 4-Tumble dried(Comfort)

Quality-----SINGLE JERSEY

SHRINKAGE TRIAL  
24/1-32/291

TABLE 2

CYCLE NUMBER	1 C/3CM	2 C/3CM	3 C/3CM	4 C/3CM	1 W/3CM	2 W/3CM	3 W/3CM	4 W/3CM
1	54.7	55.1	54.2	57.4	41.9	42.9	42.4	43.7
2	54.7	57	55.2	57.8	42.2	44	42.8	43.9
3	55.5	57.7	55.2	57.9	41.6	43.4	41.7	43.5
4	55.1	58.1	54.1	58.1	42	43.1	42.5	44.2
5	54.5	57.5	54	58.1	42.4	44.2	41.9	44.3
6	53.8	57.9	55	58.2	42.1	43.6	42.5	44.4
7	55	57.4	54.2	57.1	41.9	43.9	42.7	44.5
8	54.2	57.9	54.5	57.9	42.2	43.9	42.6	44.5
9	55.2	58.1	56.1	58.6	41.9	44.2	42.9	44.2
10	56	58.8	55.9	58.9	42.1	44.4	41.5	43.8

- 1-Line dried
- 2-Tumble dried
- 3-Line dried(Comfort)
- 4-Tumble dried(Comfort)

## SHRINKAGE TRIAL

TABLE 3

Quality-----Single Jersey 18/1-16/419

CYCLE NUMBER	1 LS%	2 LS%	3 LS%	4 LS%	1 WS%	2 WS%	3 WS%	4 WS%
1	11.11	13.14	10.47	12	5.41	7.95	5.9	9.12
2	11.74	13.99	10.87	13.17	4.58	8.47	6.48	9.57
3	12.57	14.79	11.19	13.65	5.1	8.55	5.64	9.54
4	11.51	14.95	11.78	14.25	5.13	8.31	5.64	9.69
5	12.06	15.54	11.87	14.24	5.14	8.18	6.51	9.64
6	13	15.55	12.08	14.45	4.32	8.11	6.1	10.04
7	12.1	15.25	11.68	14.72	4.21	7.79	6.01	9.27
8	12.94	15.63	12.28	14.5	4.43	7.7	5.54	9.53
9	12.36	15.85	12.78	14.96	4.97	7.67	5.51	9.76
10	12.15	15.56	12.46	14.46	4.68	7.34	5.12	9.62

1-Line dried

2-Tumble dried

3-Line dried(Comfort)

4-Tumble dried(Comfort)

## SHRINKAGE TRIAL

TABLE 4

Quality-----SINGLE JERSEY 18/1-16/419

CYCLE NUMBER	1 C/3CM	2 C/3CM	3 C/3CM	4 C/3CM	1 W/3CM	2 W/3CM	3 W/3CM	4 W/3CM
1	39.1	40	38.7	41	28.9	29.6	29.2	30
2	39.6	40.7	39.3	41.3	28.8	30.2	29.4	30.4
3	40.2	41	39.7	41.8	28.4	29.8	28.3	30
4	39.4	41.7	39.3	41.8	28.6	30.1	29.1	30.7
5	40.3	41.4	38.9	42.1	28.7	30.4	28.7	30.6
6	38.8	41	39.1	41.1	28.1	30.2	28.8	30.2
7	38.9	41.5	39.5	41.2	28.4	30.1	29	30
8	39.5	41.5	38.9	41.6	28.2	30.3	28.7	30.1
9	39.3	41.8	40.4	41.8	29.1	30.3	28.5	30.1
10	40.5	42.2	40.4	42.8	28.9	29.9	28.6	30.1

1-Line dried

2-Tumble dried

3-Line dried(Comfort)

4-Tumble dried(Comfort)



SHRINKAGE TRIAL  
14/1-26/267

TABLE 5

Quality-----1X1 RIB.

CYCLE NUMBER	1 LS%	2 LS%	3 LS%	4 LS%	1 WS%	2 WS%	3 WS%	4 WS%
1	8.25	8.63	9.07	8.68	4.21	7.66	4.21	8.77
2	9.01	9.84	9.79	9.13	2.74	8.08	3.38	8.68
3	9.85	10.97	10.02	9.5	2.43	7.1	2.74	8.27
4	9.96	11.27	10.45	10.22	0.35	6.05	2.05	8.22
5	9.97	11.64	10.79	10.1	1.53	5.8	2.51	8.21
6	9.89	11.73	11.07	10.28	1.34	5.14	1.47	8
7	10.04	11.82	11.01	10.54	1.36	5.6	0.85	6.97
8	10.24	11.89	11.47	10.44	0.32	4.77	0.58	7.21
9	10.43	11.89	11.33	10.84	-0.25	4.5	0.4	7.25
10	10.24	12.05	11.54	10.71	0.87	3.98	0.28	6.64

- 1-Line dried  
2-Tumble dried  
3-Line dried(Comfort)  
4-Tumble dried(Comfort)

SHRINKAGE TRIAL  
14/1-26/267

TABLE 6

Quality-----1X1 RIB

CYCLE NUMBER	1 C/3CM	2 C/3CM	3 C/3CM	4 C/3CM	1 W/3CM	2 W/3CM	3 W/3CM	4 W/3CM
1	57.3	57.6	57.2	57.9	32.5	34.9	33.4	34.7
2	58	57.8	57.5	58.5	32.8	34.5	33.5	34.9
3	58.3	58.9	58.1	58.6	31.9	34.4	32.9	34.8
4	58.3	59.3	58.3	59.4	31.5	34.3	32.8	34.8
5	59	59.5	57.6	59.2	32	33.8	32.4	34.9
6	58	59.3	58.2	58.8	31.7	33.6	32.5	34.3
7	58.5	59.5	58.4	58.8	32.1	33.8	32.2	34.1
8	58.5	59.5	58.3	58.9	31.3	32.9	32.4	34.1
9	58.8	59.5	59.1	59.5	31	33.7	32.3	34.2
10	58.4	60.3	58.9	59.9	31.5	33.4	31.9	34.3

- 1-Line dried  
2-Tumble dried  
3-Line dried(Comfort)  
4-Tumble dried(Comfort)

SHRINKAGE TRIAL  
14/1-34/350

TABLE 7

Quality-----1X1 RIB.

CYCLE NUMBER	1 LS%	2 LS%	3 LS%	4 LS%	1 WS%	2 WS%	3 WS%	4 WS%
1	15.33	15.25	13.91	16.21	-6.78	9.87	2.09	10.14
2	17.08	17.79	15.91	17.67	-10.63	7.86	-3.33	10.04
3	18.44	19.31	18.43	17.48	-14.59	4.45	-11.02	7.63
4	19.85	20.25	19.78	19.15	-21.54	2.66	-14.49	5.02
5	18.79	21.51	18.21	19.39	-15.36	0.9	-11.08	4.75
6	21.42	22.08	20.74	19.71	-26.58	-2.56	-16.24	4.34
7	19.97	21.92	19.46	19.99	-24.38	-1.98	-18.14	1.46
8	21.49	21.68	20.17	20.06	-25.9	-3.36	-19.33	2.68
9	19.99	22.09	20.24	20.2	-26.49	-4.61	-19.61	1.55
10	19.25	21.88	20.02	20.01	-23.14	-4.6	-23.19	1.44

- 1-Line dried  
2-Tumble dried  
3-Line dried(Comfort)  
4-Tumble dried(Comfort)

SHRINKAGE TRIAL  
14/1-34/350

TABLE 8

Quality-----1X1 RIB

CYCLE NUMBER	1 C/3CM	2 C/3CM	3 C/3CM	4 C/3CM	1 W/3CM	2 W/3CM	3 W/3CM	4 W/3CM
1	38.3	38.8	38.1	39.3	25.5	29.6	27.3	29.8
2	39.8	40.7	38.7	40.3	24.8	28.7	26.5	29.6
3	39.6	41.3	39.7	40.6	23.7	28.3	24.5	29
4	41	41.4	40.6	41.2	22.4	27.2	23.8	28.1
5	39.8	41.9	39.4	41	23.3	26.2	23.6	28.9
6	40.8	41.9	40.1	40.7	20.72	25.7	22.7	28.9
7	41	41.7	40.1	40.9	22.7	26.7	23	26.9
8	41.6	42.1	40.3	41.3	22.1	26.1	22.9	27.6
9	39.8	42.2	41.5	42.2	21.9	25.3	22.1	27.8
10	39.9	43.3	41.8	42.7	22.7	25.8	21.4	27.4

- 1-Line dried  
2-Tumble dried  
3-Line dried(Comfort)  
4-Tumble dried(Comfort)

Quality-----INTERLOCK

SHRINKAGE TRIAL  
20/1-42/307

TABLE 9

CYCLE NUMBER	1 LS%	2 LS%	3 LS%	4 LS%	1 WS%	2 WS%	3 WS%	4 WS%
1	10.74	12.48	11.06	11.88	5.25	9.62	6.22	10.84
2	11.78	14.93	12.69	13.72	3.35	9.34	5.21	10.68
3	13.3	15.96	13.38	14.11	2.7	8.06	4.03	10.62
4	13.63	16.72	14.42	15.24	1.72	7.44	2.16	10.39
5	13.26	17.65	14.15	15.52	2.27	7.71	3.62	10.26
6	14.91	18.07	14.58	15.85	-0.1	6.9	2.85	9.69
7	14.26	18.23	14.6	16.11	0.81	6.49	2.12	8.98
8	14.61	18.32	15	16.1	-0.79	6.17	2.28	9.17
9	14.4	18.65	15.2	16.33	0.14	6.05	2.1	9.45
10	14.61	18.55	15.79	15.95	0.08	5.12	-0.42	9.25

1-Line dried

2-Tumble dried

3-Line dried(Comfort)

4-Tumble dried(Comfort)

Quality-----INTERLOCK

SHRINKAGE TRIAL  
20/1-42/307

TABLE 10

CYCLE NUMBER	1 C/3CM	2 C/3CM	3 C/3CM	4 C/3CM	1 W/3CM	2 W/3CM	3 W/3CM	4 W/3CM
1	48.9	48.9	47.8	49.6	44	46.9	44.8	46.8
2	49.6	51.4	49.1	51	43.4	46.8	44.5	46.6
3	49.7	51.2	49.7	50.8	42.2	46.3	44.1	46.3
4	49.3	51.5	49.3	51.8	43	45.8	43.1	46.3
5	49.4	51.4	48.6	52.1	43.2	45.2	44	46.6
6	49.9	52.2	49.3	51.5	41.4	45	42.3	46
7	49.2	51.7	49.7	52.4	41.7	45.6	42.9	45.5
8	49.9	52.6	49.6	52	42	45.5	43	45.8
9	50	52.8	50.6	51.4	41.4	45.2	42.7	45.6
10	50.9	53.1	51	52.8	41.6	45.5	41.8	46.8

1-Line dried

2-Tumble dried

3-Line dried(Comfort)

4-Tumble dried(Comfort)

SHRINKAGE TRIAL  
20/1-42/377

TABLE 11

Quality-----INTERLOCK

CYCLE NUMBER	1 LS%	2 LS%	3 LS%	4 LS%	1 WS%	2 WS%	3 WS%	4 WS%
1	13.61	15.71	13.97	16.22	3.83	15.14	6.31	16.01
2	17.1	18.36	14.48	18.12	-1.69	14.62	6.2	15.05
3	18.31	19.87	18.03	18.75	-2.13	12.09	-0.87	14.53
4	20.21	21.07	19.29	20.08	-7.21	9.72	-2.37	14.11
5	19.89	22.3	18.5	20.46	-6.31	9.97	-1.24	11.96
6	20.46	23.01	19.43	20.28	-8.31	8.4	-3.19	13.03
7	21.09	23.1	18.25	20.99	-11.7	8.05	-3.77	11.19
8	22.02	22.9	19.65	21.22	-13.48	7.85	-4.66	10.94
9	20.62	22.92	20.17	21.66	-11.5	7.67	-7.75	11.6
10	19.24	22.48	19.62	20.7	-9.84	6	-9.67	10.62

- 1-Line dried  
2-Tumble dried  
3-Line dried(Comfort)  
4-Tumble dried(Comfort)

SHRINKAGE TRIAL  
20/1-42/377

TABLE 12

Quality-----INTERLOCK

CYCLE NUMBER	1 C/3CM	2 C/3CM	3 C/3CM	4 C/3CM	1 W/3CM	2 W/3CM	3 W/3CM	4 W/3CM
1	37.6	37.8	37.3	38.6	38.3	42.9	38.9	42.8
2	38.5	39.5	38.1	39.3	36.5	43	38.3	42.8
3	38.5	40	38.8	39.3	35.6	42.5	36.9	42.2
4	39.5	40.3	39.3	40.6	34.2	40.8	35.1	42.4
5	39.1	41.2	38.5	40.1	35.4	40.5	36.8	42.4
6	39.4	40.9	39.1	40	34.4	40.5	35.3	41.8
7	39.4	39.8	38.5	40.5	32	39.8	35.7	41.5
8	40	41.3	39.8	41.2	32.2	39.9	34.3	41.6
9	40.1	41.6	40.9	40.2	32.6	40.2	34.7	41.4
10	3	41.8	40.7	42	33.5	40.4	32.9	42.1

- 1-Line dried  
2-Tumble dried  
3-Line dried(Comfort)  
4-Tumble dried(Comfort)

% CONFIDENCE LIMITS  
Quoted values are the average of 10 wash/dry cycles

TABLE 13

	L.D.	L.D. +C.	T.D.	T.D. +C.
S.J.-1 COURS	0.78	0.61	0.63	0.49
WALES	0.64	0.6	0.43	0.45
LEN.S	1.42	0.53	0.96	0.55
WID.S	1.14	0.69	1.32	0.57
S.J.-2 COURS	0.58	0.57	0.4	0.43
WALES	0.45	0.36	0.39	0.93
LEN.S	1.39	1	0.83	1.95
WID.S	1.62	1.61	0.63	1.95
RIB -1 COURS	0.56	0.54	0.36	0.34
WALES	0.57	0.51	0.39	0.38
LEN.S	0.62	0.49	0.41	0.32
WID.S	1.28	1.33	0.92	1.08
RIB -2 COURS	0.74	0.72	0.94	0.57
WALES	0.46	0.46	0.49	0.53
LEN.S	2.82	1.74	0.79	0.91
WID.S	7.18	3.66	2.37	1.65
INT.-1 COURS	0.69	0.67	0.53	0.46
WALES	0.72	0.72	0.52	0.55
LEN.S	1.43	1.14	0.52	1.18
WID.S	2.12	1.83	0.71	1.06
INT.-2 COURS	0.75	0.7	0.61	0.57
WALES	0.65	0.69	0.62	0.64
LEN.S	2.55	2.1	0.86	0.86
WID.S	4.26	3.12	1.19	1.58

KEY TO FABRICS

S.J.-1      24/1-32/291  
S.J.-2      18/1-16/419  
RIB -1      14/1-26/267  
RIB -2      14/1-34/350  
INT.-1      20/1-42/307  
INT.-2      20/1-42/377

L.D.          LINE DRY  
L.D. +C      LINE DRY (COMFORT)  
T.D.          TUMBLE DRY  
T.D. +C      TUMBLE DRY (COMFORT)

SHRINKAGE TRIAL Quality S.J. 24/1-32/291 LENGTH SHRINKAGE

LENGTH SHRINKAGE %

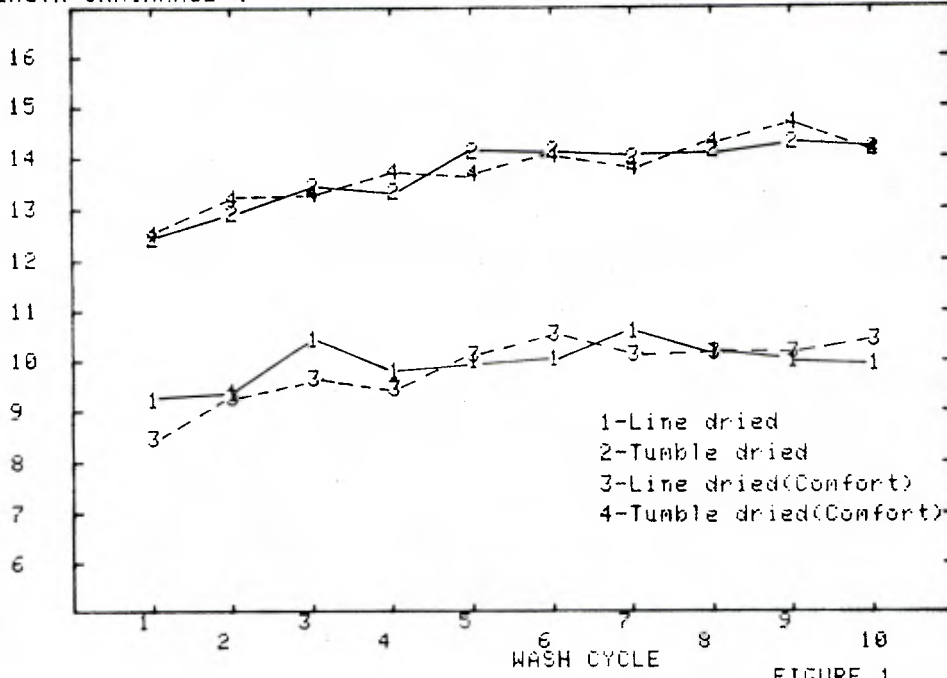


FIGURE 1

SHRINKAGE TRIAL Quality S.J. 24/1-32/291 WIDTH SHRINKAGE

WIDTH SHRINKAGE %

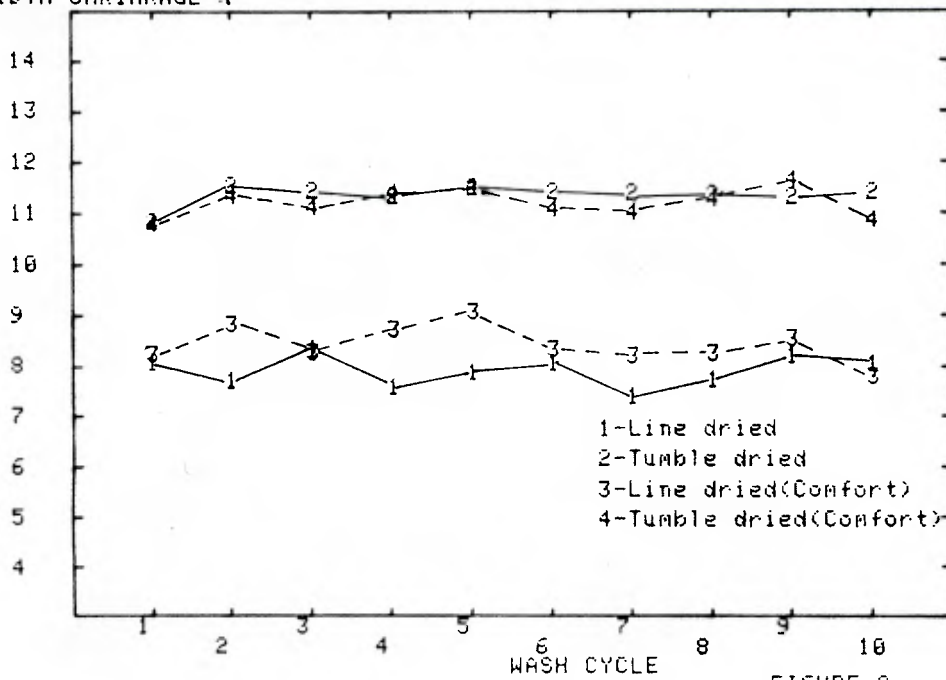


FIGURE 2

SHRINKAGE TRIAL Quality S.J. 19/1-16/419 LENGTH SHRINKAGE

LENGTH SHRINKAGE %

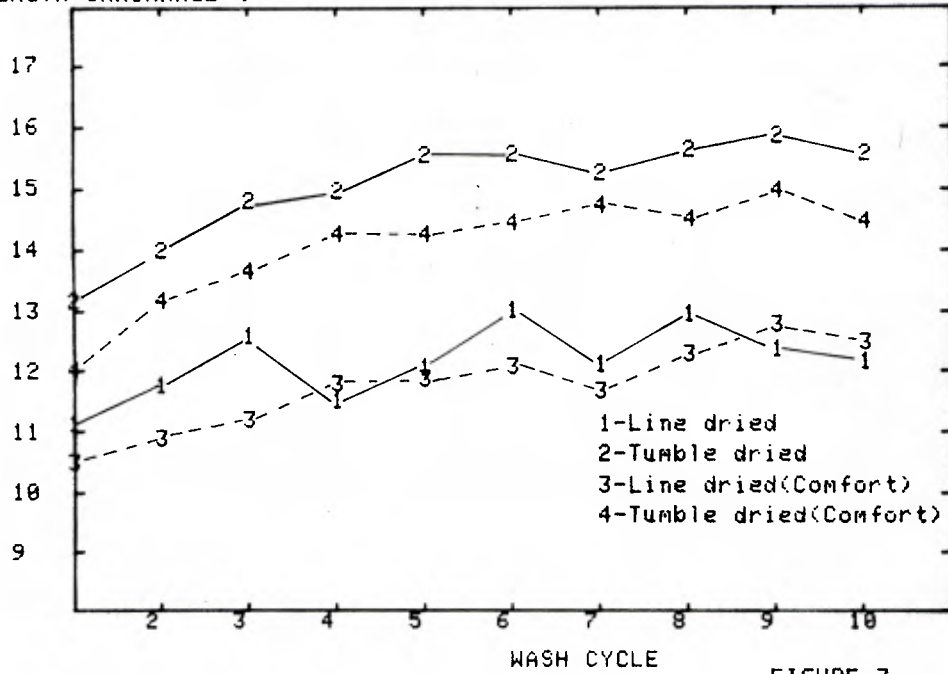


FIGURE 3

SHRINKAGE TRIAL Quality S.J. 18/1-16/419 WIDTH SHRINKAGE

WIDTH SHRINKAGE %

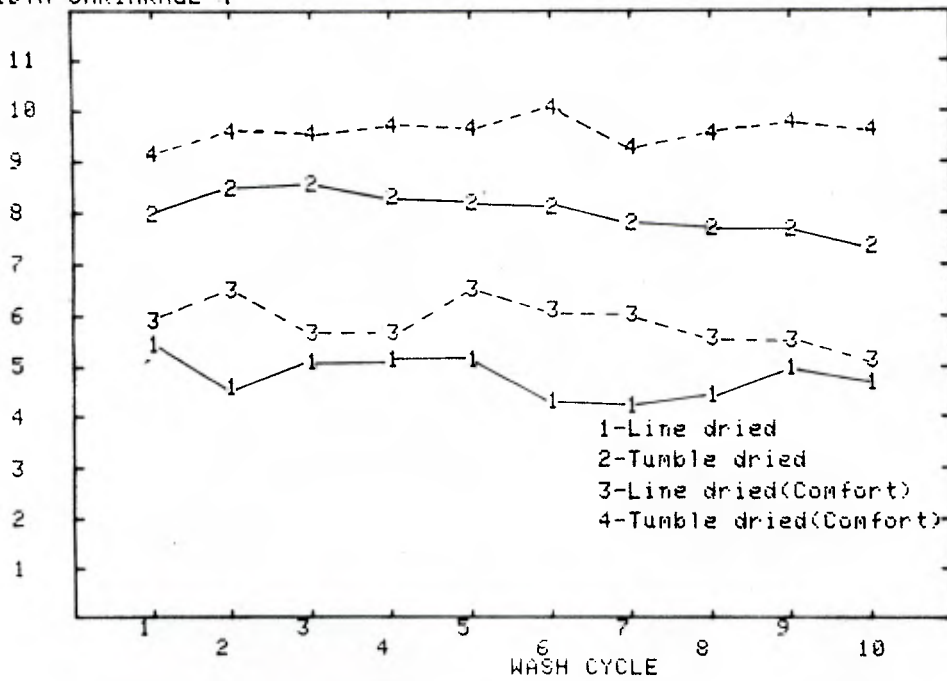


FIGURE 4



SHRINKAGE TRIAL Quality RIB. 14/1-26/267 LENGTH SHRINKAGE

LENGTH SHRINKAGE %

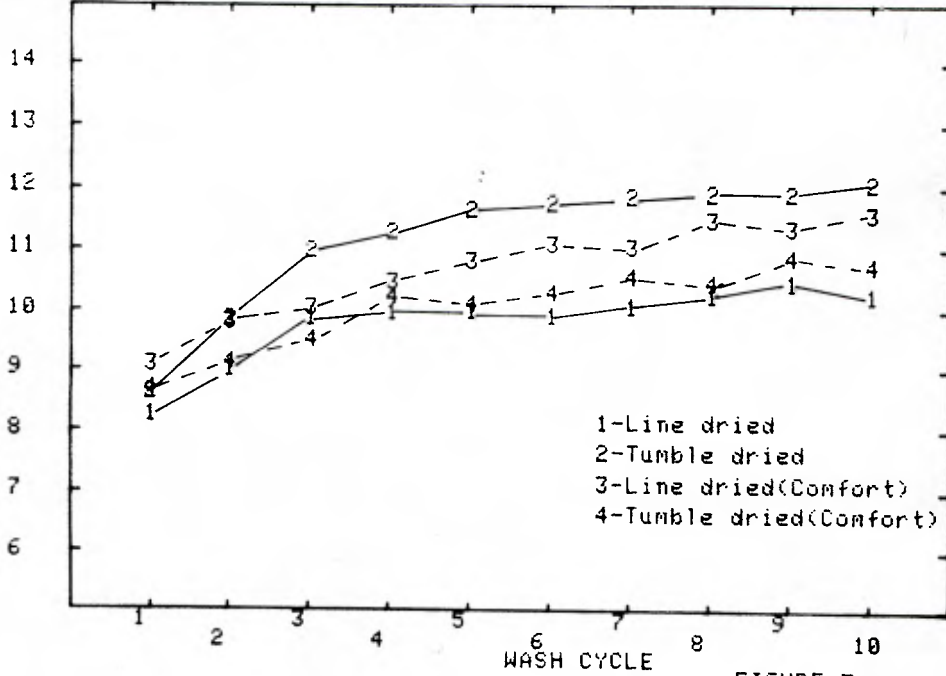


FIGURE 5

SHRINKAGE TRIAL Quality RIB. 14/1-26/267 WIDTH SHRINKAGE

WIDTH SHRINKAGE %

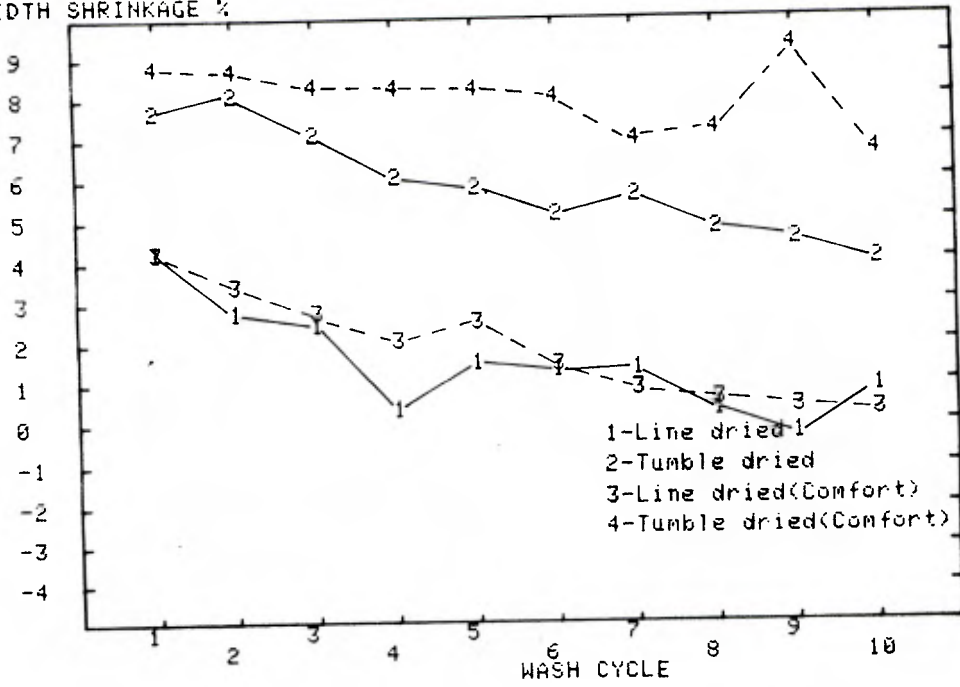


FIGURE 6



SHRINKAGE TRIAL Quality RIB. 14/1-34/350 LENGTH SHRINKAGE

LENGTH SHRINKAGE %

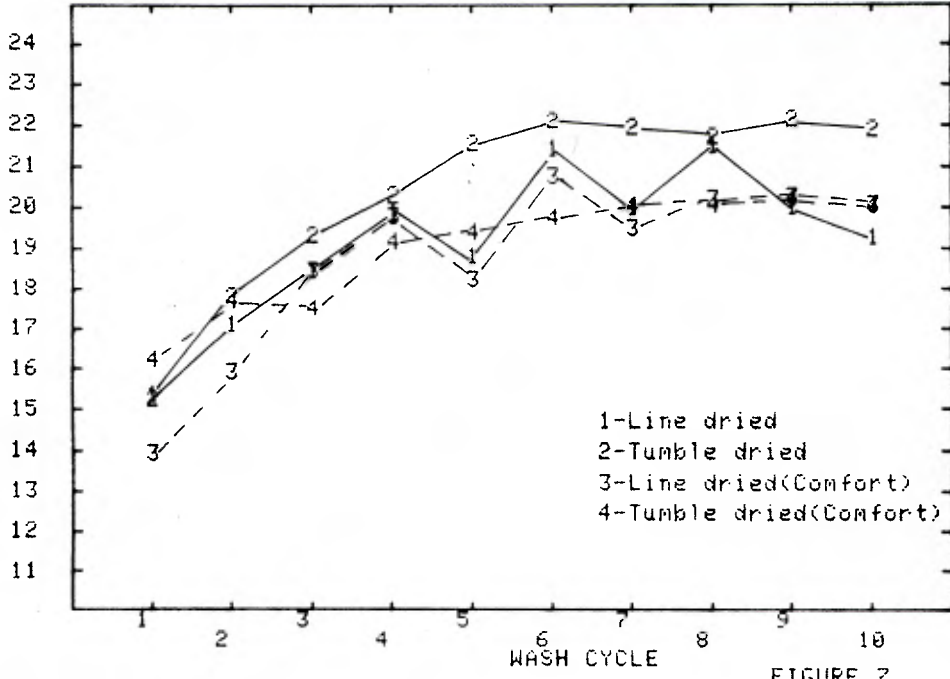


FIGURE 7

SHRINKAGE TRIAL Quality RIB. 14/1-34/350 WIDTH SHRINKAGE

WIDTH SHRINKAGE %

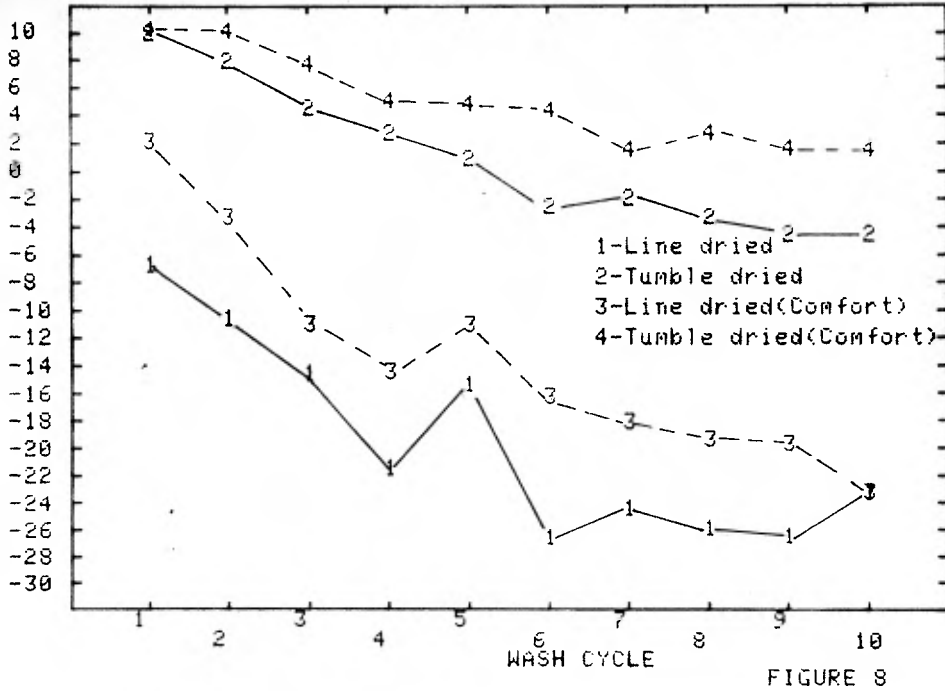


FIGURE 8

SHRINKAGE TRIAL Quality INT. 20/1-42/307 LENGTH SHRINKAGE

LENGTH SHRINKAGE %

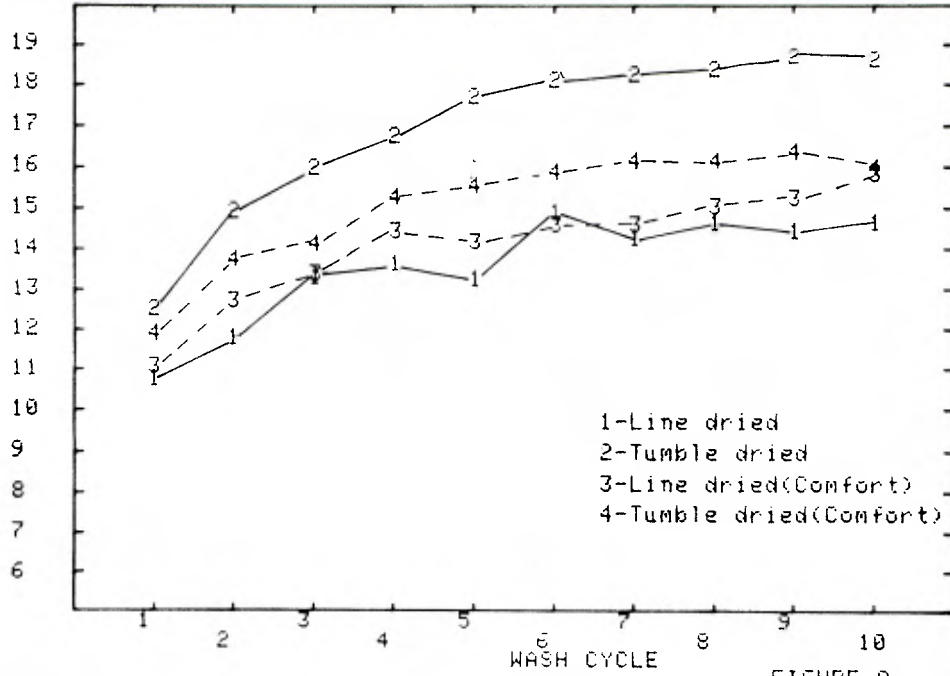


FIGURE 9

SHRINKAGE TRIAL Quality INT. 20/1-42/307 WIDTH SHRINKAGE

WIDTH SHRINKAGE %

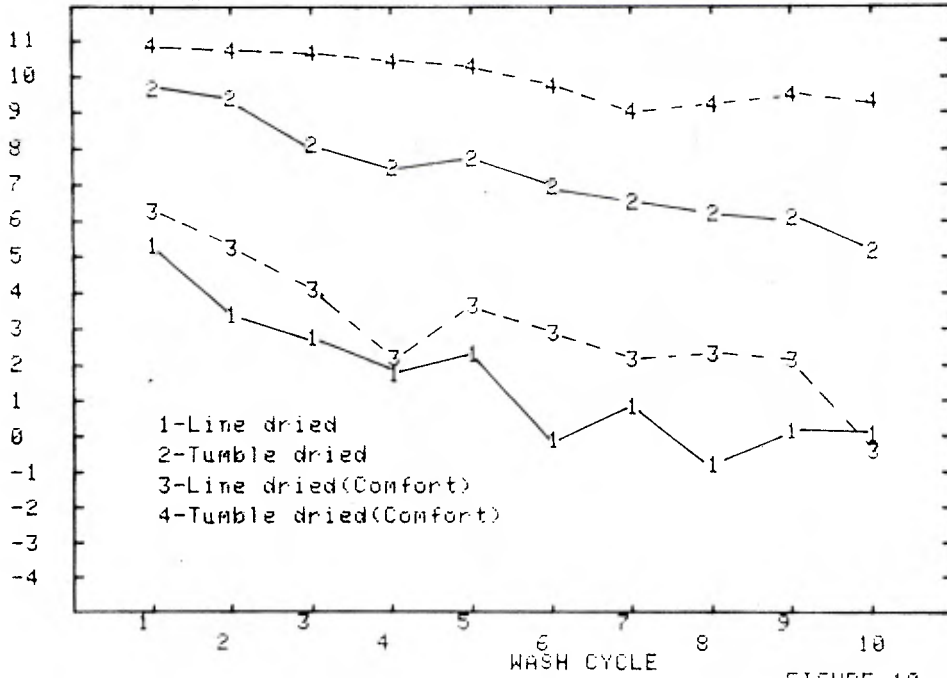


FIGURE 10

SHRINKAGE TRIAL Quality INT. 20/1-42/377 LENGTH SHRINKAGE

LENGTH SHRINKAGE %

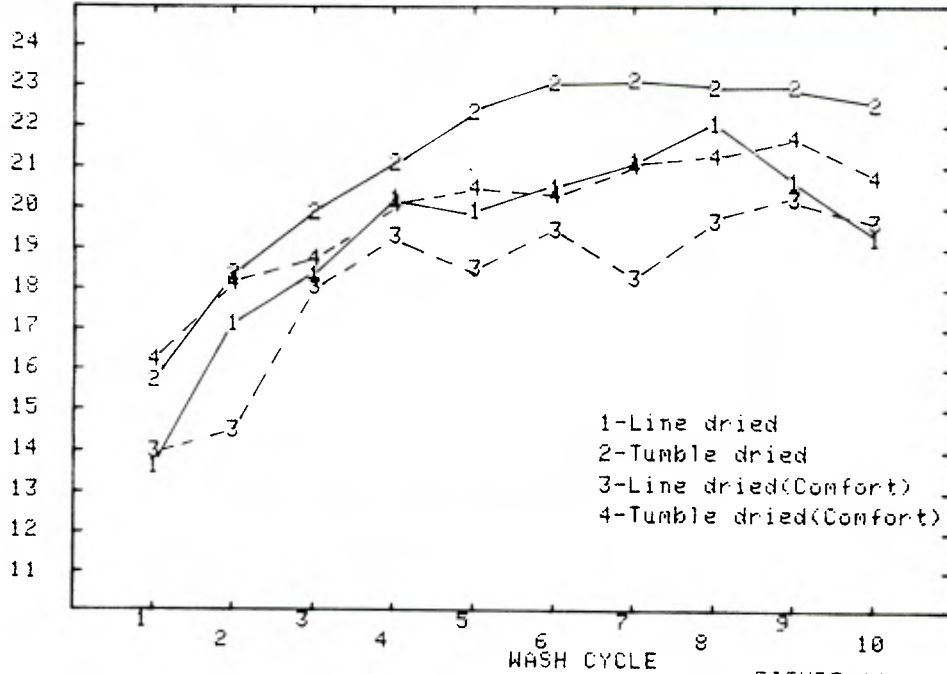


FIGURE 11

SHRINKAGE TRIAL Quality INT. 20/1-42/377 WIDTH SHRINKAGE

WIDTH SHRINKAGE %

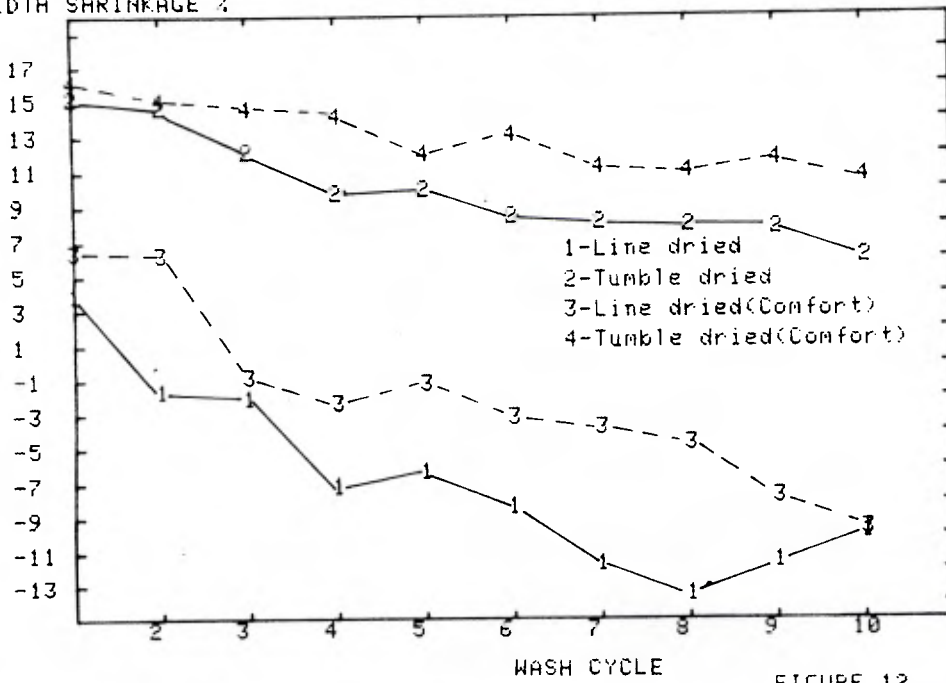


FIGURE 12

SHRINKAGE TRIAL Quality S.J. 24/1-32/291 RELAXED COURSES

RELAXED COURSES/3CM

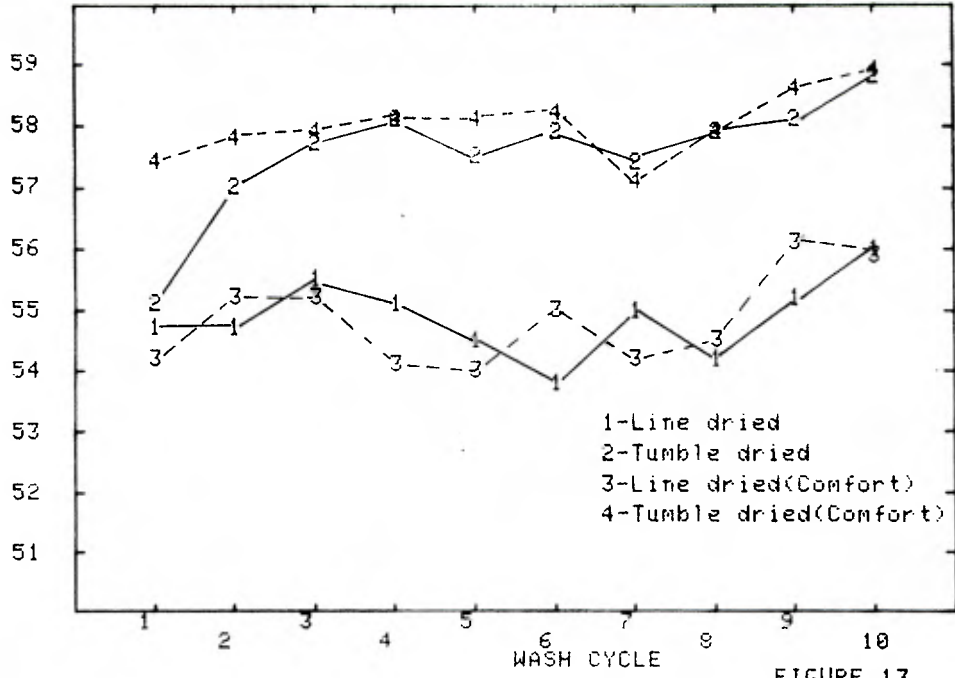


FIGURE 13

SHRINKAGE TRIAL Quality S.J. 24/1-32/291 RELAXED WALES

RELAXED WALES/3CM

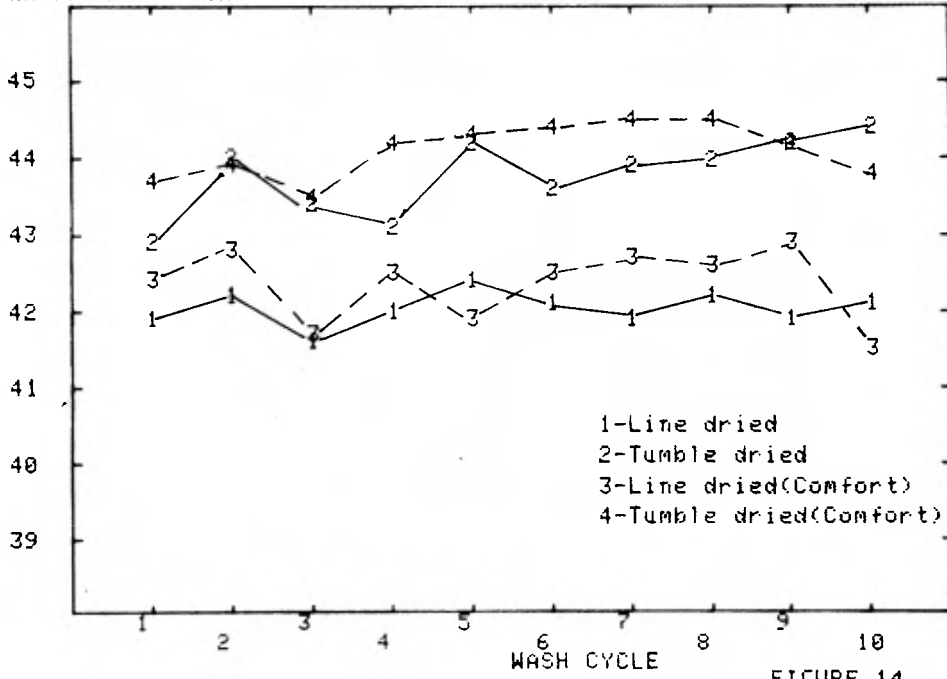


FIGURE 14

SHRINKAGE TRIAL Quality S.J. 18/1-16/419 RELAXED COURSES

RELAXED COURSES/3CM

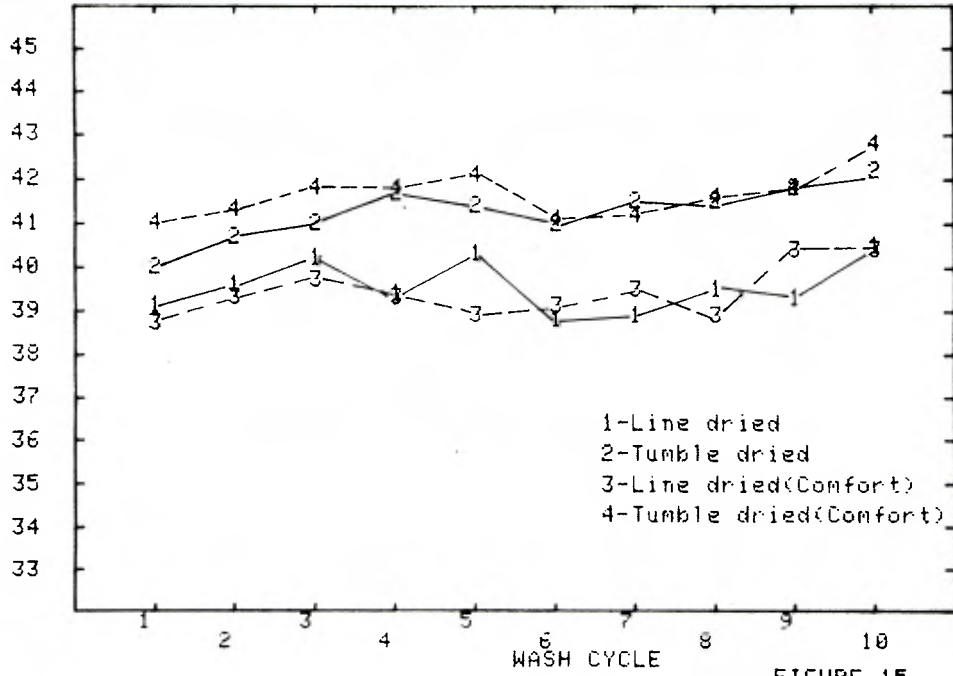


FIGURE 15

SHRINKAGE TRIAL Quality S.J. 18/1-16/419 RELAXED WALES

RELAXED WALES/3CM

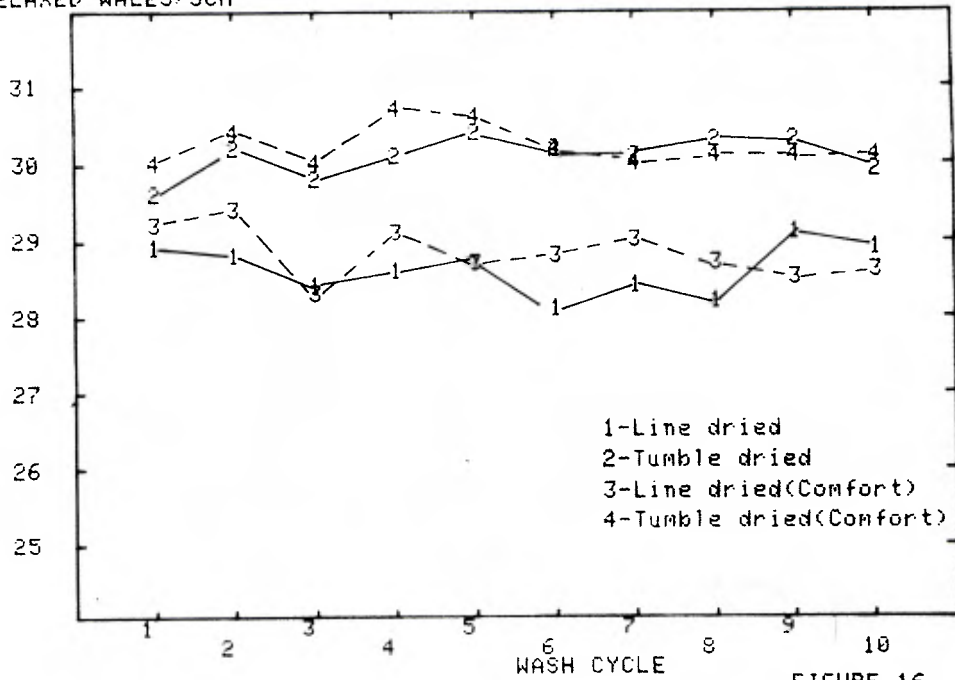
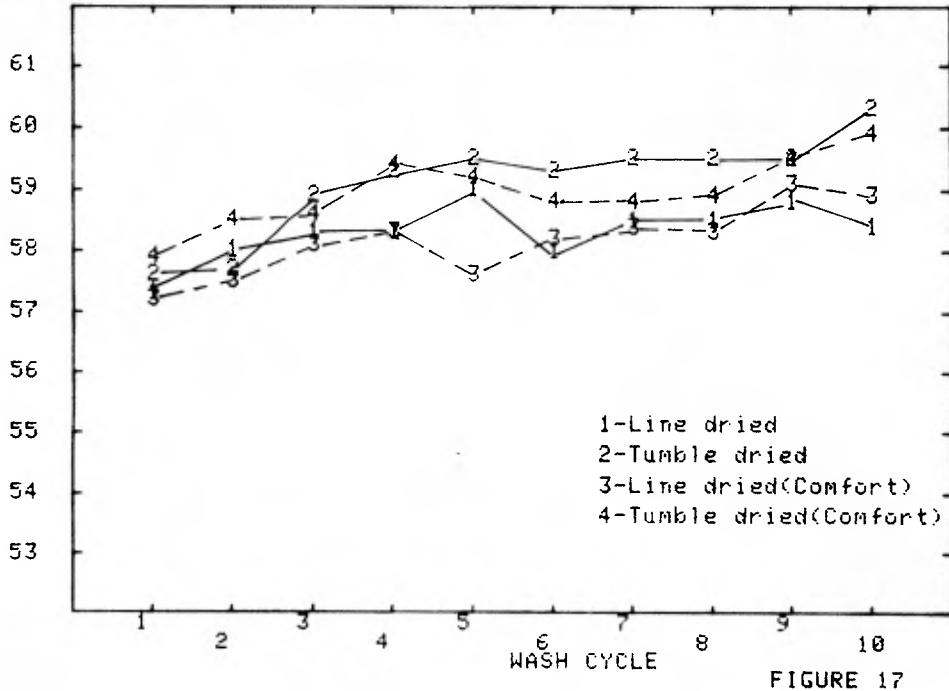
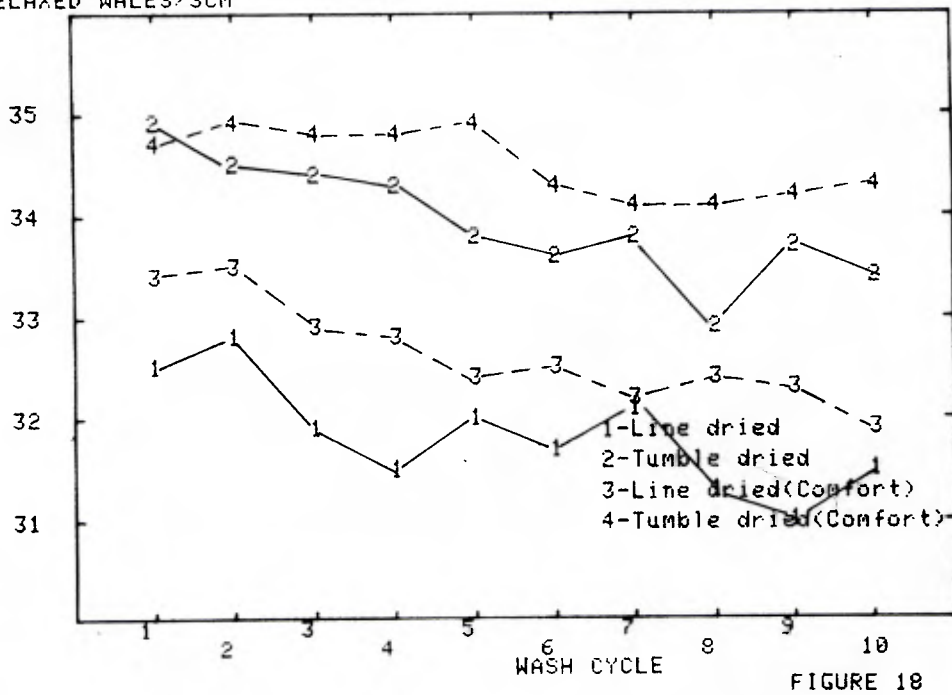


FIGURE 16

RELAXED COURSES/3CM



RELAXED WALES/3CM



SHRINKAGE TRIAL Quality RIB. 14/1-34/350 RELAXED COURSES

RELAXED COURSES/3CM

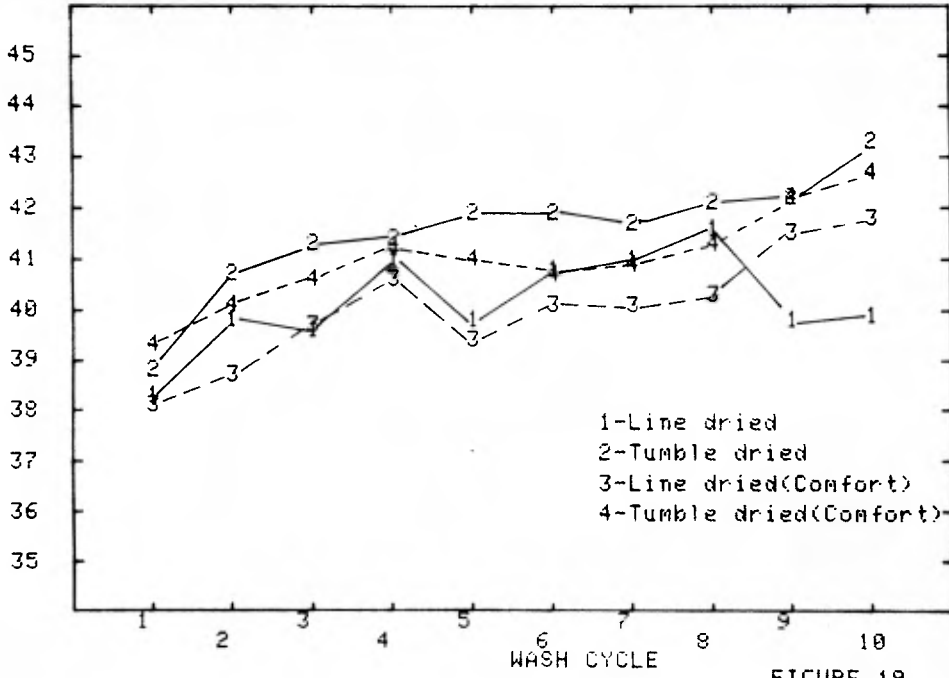


FIGURE 19

SHRINKAGE TRIAL Quality RIB. 14/1-34/350 RELAXED WALES

RELAXED WALES/3CM

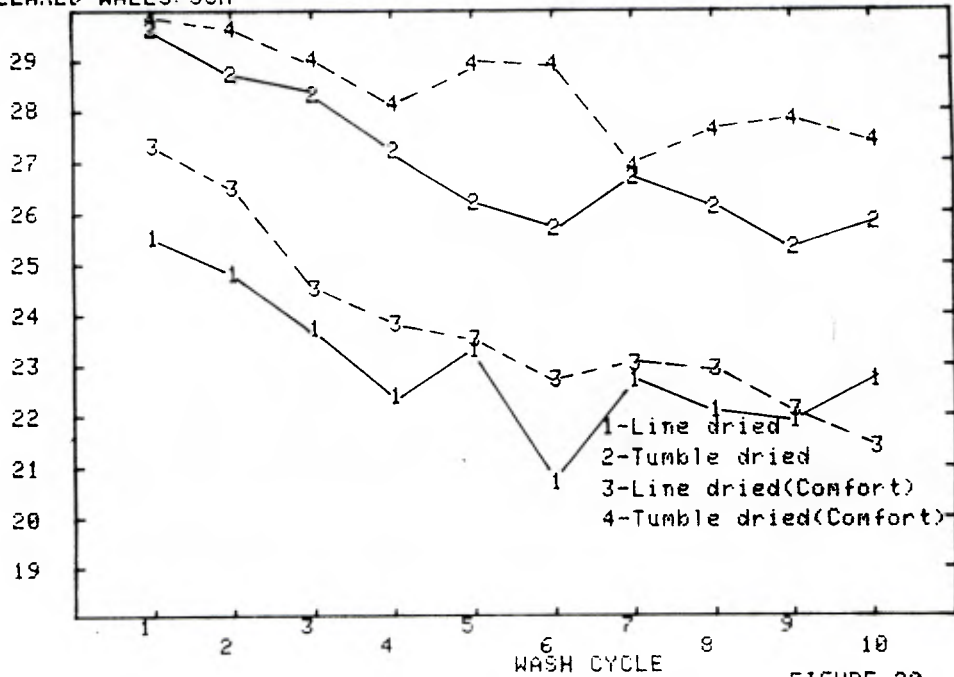


FIGURE 20

SHRINKAGE TRIAL Quality INT. 20/1-42/307 RELAXED COURSES

RELAXED COURSES/3CM

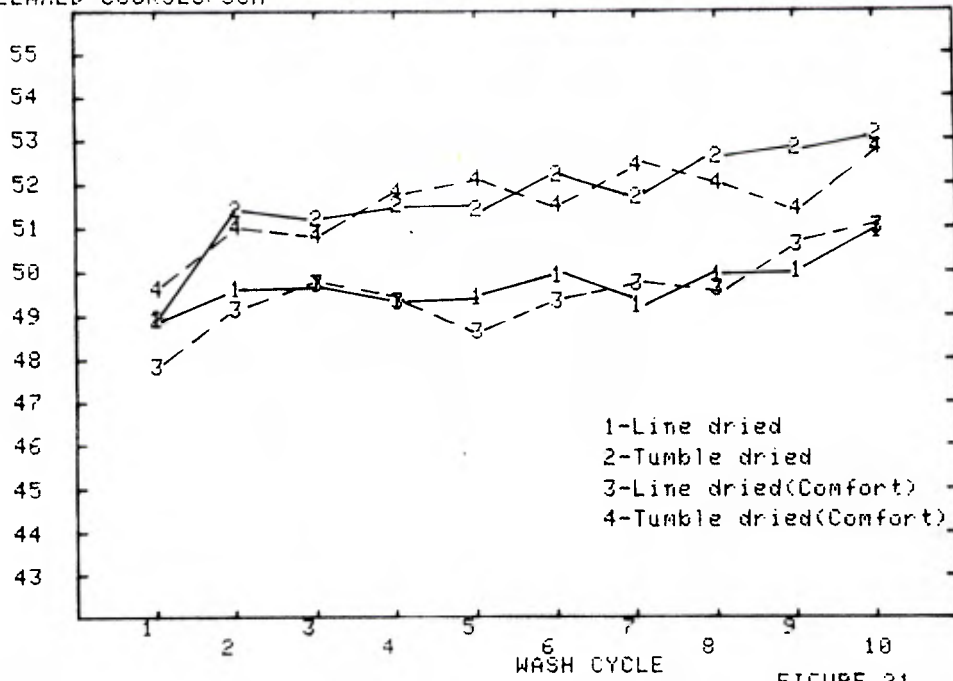


FIGURE 21

SHRINKAGE TRIAL Quality INT. 20/1-42/307 RELAXED WALES

RELAXED WALES/3CM

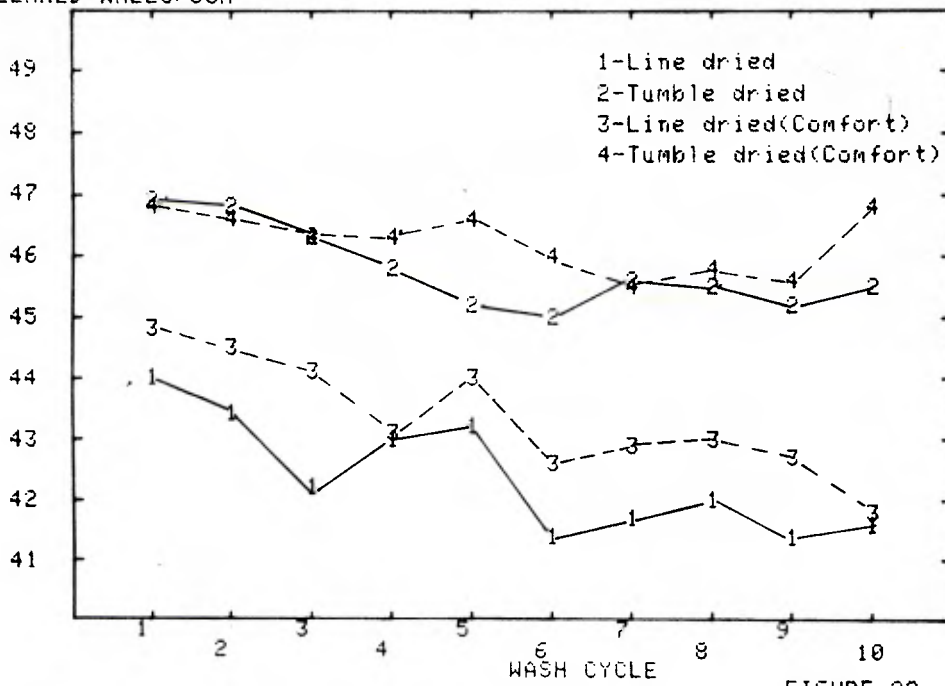


FIGURE 22



SHRINKAGE TRIAL Quality INT. 20/1-42/377 RELAXED COURSES

RELAXED COURSES/3CM

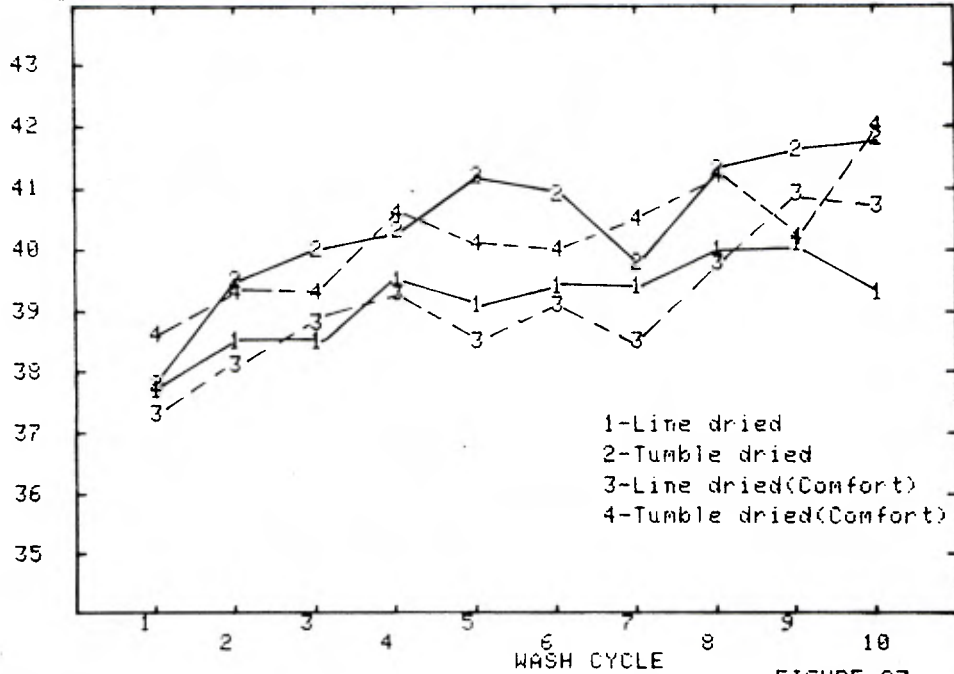


FIGURE 23

SHRINKAGE TRIAL Quality INT. 20/1-42/377 RELAXED WALES

RELAXED WALES/3CM

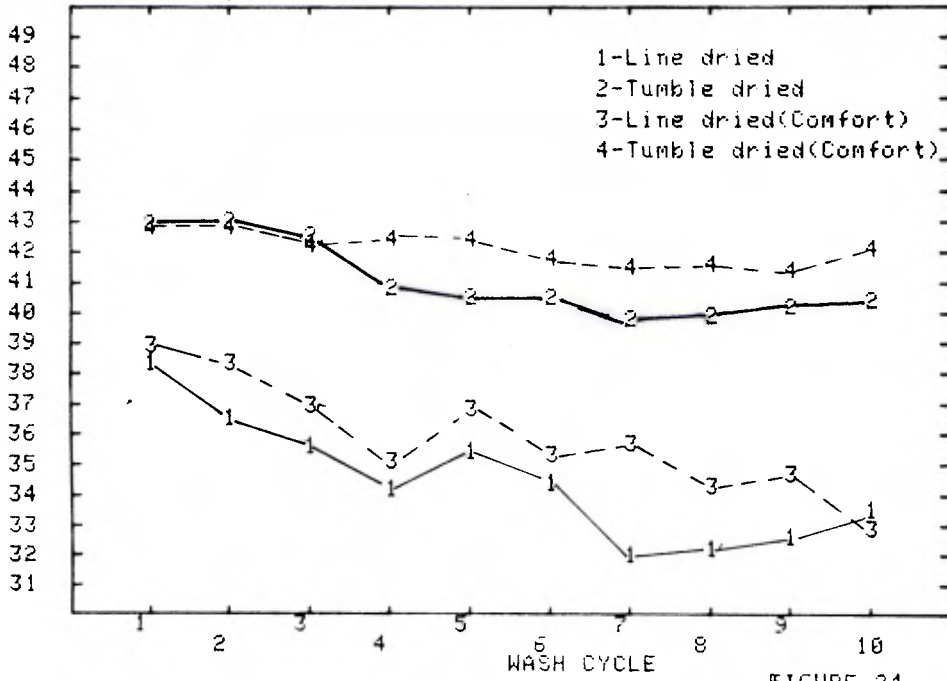


FIGURE 24