

Research Record No: 261

A PREDICTIVE MODEL FOR DOUBLE LACOSTE

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## INTRODUCTION

The production of a range of Double Lacoste fabrics has been described in Research Record No. 256. This report goes on to describe the testing and processing of those fabrics, evaluation of the finished products and the construction of a predictive model for describing their behavioural characteristics in multiple launderings.

### GREY FABRIC TESTING

Preliminary test data on the grey fabrics is reported in Research Record No. 256, and are reproduced in Table II of the present report. (Yarn test data are shown in Table I).

One important difference between Table II and the data previously reported concerns the course density figures. In Research Record 256 "visible" courses only were recorded; that is, because of the construction, two courses were counted as one. For the purposes of this report, the true course densities are recorded, and therefore the data given in Table II are double those shown in Table II of Research Record No. 256.

After the completion of the earlier report, it was decided that the grey fabric testing should be repeated, using a fresh set of samples. The results of this round of testing are shown in Table III, and show good agreement with the previous data. Both sets of figures have been combined to give the average values shown in Table IV.

## PROCESSING

Two complete sets of fabrics were produced for this study; one was designated for winch processing, the other for a jet-based treatment.

At the request of Abbey Hosiery, finishing was carried out at South Knighton Dyeworks Limited, Leicester; unfortunately, permission was not given for IIC staff to observe any of the processing operations, and no details have been made available.

However, to assist the finisher in achieving good results on these unfamiliar fabrics, the method of "finishing factors" was employed. Two samples of production fabric, one grey state, one finished were obtained from Abbey Hosiery. These were nominally knitted from Ne 24's yarn to a stitch length of 0.310cm. Reference state stitch densities were obtained using the IIC Reference Relaxation Procedure and were measured as:

	<u>Courses/3cm</u>	<u>Wales/3cm</u>
Grey state	51.75	30.55
Finished	46.55	31.45

Finishing factors (finished/grey state) were then calculated as: for courses, 0.90, for wales, 1.03.

These factors were then applied to the measured values for course and wale densities in the Reference State, indicated by AW in Table IV, to calculate targets for correct finishing of the experimental fabrics.

Recommendations based on these calculation were passed to Abbey Hosiery. However, in general, the fabrics were finished considerably wider than the recommended widths, with consequently high widthway shrinkages in the finished fabrics as will be shown later.

Samples of the finished fabrics were submitted to IIC, Manchester for testing. Two series of samples were sent from Abbey Hosiery, these being described as:

- Set 1 Bright Pink (winch)
- Set 2 Air Force Blue (Jet)

Both sets were delivered open-width, but it is understood that they were dyed in the tubular state. The dyes used are understood to be reactive.

Colour measurements were carried out on each set with the following results:

Chromaticity co-ordinates (CIE 1976)

	<u>X</u>	<u>Y</u>	<u>Z</u>
Set 1 Bright Pink	30.12	18.87	22.44
Set 2 Air Force Blue	9.65	10.60	15.52

These would both be classed as medium depth of shade.

Test results are given in Tables V (set 1, winch dyed) and VI (set 2, jet dyed).

### CONSTRUCTION OF A PREDICTIVE MODEL

The STARFISH system for the construction of a predictive model for knitted fabric shrinkage is built up by means of the following procedure:

1. Determine the yarn count (tex) and the stitch length (in cm) used in the construction of the grey fabric.
2. Determine the Reference State of the fabric after a specified finishing treatment. The Reference State is the configuration assumed by the fabric after having been subjected to the IIC Reference Relaxation Procedure (Figure 1), and is defined in terms of courses per cm, wales per cm, yarn count (tex) and stitch length (cm).
3. Derive equations relating the final Reference State yarn count and stitch length to the original yarn count and stitch length in the knitted fabric (STEP ONE).
4. Derive equations relating the course and wale densities to yarn count and stitch length, all in the Reference State (STEP TWO).

For the determination of yarn count in the grey state, two sets of data are available in this case; measurements from the yarn packages, and measurements on yarns taken from the knitted fabric.

Comparison of the data shown in Table I and IV shows the following:

#### GREY YARN COUNT

<u>Nominal</u> <u>Ne</u>	<u>Yarn</u> <u>Package</u> <u>(tex)</u>	<u>Knitted</u> <u>Fabric</u> <u>(tex)</u>	<u>Average</u> <u>Yarn + Fabric</u> <u>(tex)</u>
24	24.74	24.35	24.55
26	22.89	22.58	22.73
30	19.60	19.44	19.52
34	17.46	17.02	17.24

In accordance with earlier practice, the average values have been used to construct the STARFISH model. However, it should be noted that in this instance, results on yarn taken from the fabric are consistently lighter, by about 1.5%, than data from the packages.

Stitch length results have also been averaged where possible, as shown in Table IV.

The relationships between yarn count and stitch length in the finished Reference States, and corresponding data in the knitted state (the STEP ONE equations) are expressed in the form  $Y = aX$ .

The values of the coefficient,  $a$ , have been determined from the measured data by statistical methods, and are reported below and in Table VII.

	$\underline{a}$	$\underline{r^2}$	$\underline{a}$	$\underline{r^2}$
Grey	0.97169	0.999	0.98681	0.999
Winch dyed	0.97093	0.999	0.97699	0.999
Jet dyed	0.98235	0.999	0.97813	0.999

In the STEP TWO analysis, it is assumed that course and wale densities can be predicted from equations of the form:

$$Y = a + bX_1 + cX_2$$

where  $X_1$  is the reciprocal of the stitch length, and  $X_2$  is root (tex), all parameters being in the Reference State.

Statistical analysis of the data gave values for the coefficients  $a$ ,  $b$ , and  $c$  which are reported below and in Table VII.

#### Courses per cm

	$\underline{a}$	$\underline{b}$	$\underline{c}$	$\underline{r^2}$
Grey	-9.40717	12.01554	0.73655	0.9980
Winch dyed	-34.71585	13.58921	4.03450	0.9864
Jet dyed	-35.58131	14.08258	4.00522	0.9969

#### Wales per cm

	$\underline{a}$	$\underline{b}$	$\underline{c}$	$\underline{r^2}$
Grey	3.24191	2.55810	-0.32856	0.9948
Winch dyed	9.28510	1.74764	-0.97508	0.9890
Jet dyed	5.05655	2.32638	-0.52604	0.9914

Graphs showing the closeness of fit of the observed data to these equations are shown in Figures 2-7.

Fabric weight can be calculated from the predicted course and wale densities using the equation:

$$\text{Weight (gsm)} = \frac{\text{courses/cm} \times \text{wales/cm} \times \text{tex} \times \text{st.l.}}{10}$$

### OTHER LAUNDERING PROCESSES

The IIC Reference Relaxation Procedure, and the STARFISH predictive models which are based on its use, relate to the behaviour of cotton knitted fabrics which are subjected to a five-cycle laundering treatment, and tumble dried.

Other laundering processes can be expected to give results which will differ to some degree from the predicted data supplied by the STARFISH models.

In order to assess these differences, the finished samples were subjected to three other laundering treatments:

- one cycle wash and tumble dry
- one cycle wash and line dry
- five cycle wash and line dry

Average values, combining data for the fifteen winch-dyed and fifteen jet-dyed fabrics, are shown in Figure 8. Taking the five-cycle tumble test as the standard, the differentials are:

	<u>Length</u>	<u>Width</u>
one cycle tumble	-2.8	-0.3
one cycle line	-7.2	-2.0
five cycles line	-7.1	-1.3

The difference between the line-dry and tumble-dry length shrinkage levels is marked, in comparison with other types of cotton knitted structures. On the other hand, width shrinkage appears to be comparatively insensitive to the laundry treatment.

The average width shrinkage of about 11%, to the tumble-dry test is rather higher than the target figure of 8-9%, and could have been improved by finishing to the widths suggested by calculations from the "finishing factors".



## CONCLUSIONS

A series of equations has been derived whereby the behaviour of cotton double Lacoste structures, when subjected to a specified laundering treatment, can be modelled by means of a computer programme.

It must be remembered, however, that these equations relate only to the confines of the available data base. In particular, they could give misleading results if yarns outside the count range Ne 24-34 were to be employed, or if changes were to be made in any part of the dyeing and finishing processes. It is therefore regrettable that we are unable to describe more exactly in this report the nature of the processes which were employed.

Table I

## Lacoste Project - Yarns

	Ne24	Ne26	Ne30	Ne34
Yarn count (Tex)	24.74	22.89	19.60	17.46
Twist (turns per metre)	694	729	797	831
Single end strength (g)	348.66	327.63	287.26	245.42
Extension at break (%)	6.46	6.41	6.29	6.09
Coefficient of friction ( $\mu$ )	0.13	0.12	0.13	0.13
Twist liveliness (tpm)	48.90	54.80	59.60	63.20
Yarn count (Ne)	23.87	25.80	30.13	33.83
Turns per inch	17.61	18.52	20.24	21.09
Twist Factor - alpha Tex	34.50	34.87	35.29	34.70
Twist Factor - English	3.61	3.65	3.69	3.63
Tenacity (g./Tex)	14.09	14.32	14.65	14.06

Table II (cont.)

## Lacoste Project - Grey Fabrics (Abbey Hosiery)

## 28 GAUGE

	30/247	30/260	30/269	30/286	34/234	34/247	34/260	34/269
Weight (gsm), AW	244.48	232.15	223.33	209.31	222.39	211.05	198.99	191.62
Courses per 3cm, AW	126.90	121.50	116.20	107.60	134.70	125.60	120.60	115.30
Wales per 3cm, AW	36.60	35.30	34.10	32.05	30.05	36.00	35.15	34.10
Stitch length (mm) BW	2.50	2.62	2.71	2.89	2.37	2.50	2.61	2.70
Stitch length (mm) AW	2.47	2.58	2.68	2.85	2.34	2.47	2.58	2.67
Angle of spirality, AW	8.16	9.62	10.00	11.73	9.52	11.42	11.55	12.36
Width (cm), BW	101.13	104.07	105.93	108.33	100.13	102.20	103.57	106.87
Yarn count (tex), BW	19.22	19.52	19.69	19.37	17.07	17.10	16.94	16.97
Yarn count (tex), AW	18.95	19.14	19.33	19.25	16.68	16.79	16.64	16.57
Thickness (mm x 1000), BW	815	840	866	878	732	771	784	809
Thickness (mm x 1000), AW	1168	1198	1227	1214	1113	1130	1140	1131
Turns per metre, BW	877	854	827	866	946	967	950	941
Twist liveliness, t/m, BW	62.20	64.65	63.50	69.00	66.35	73.65	72.00	73.25
Twist liveliness, t/m, AW	52.45	49.65	52.00	53.90	57.20	56.25	55.00	57.25

## NOTES

- 5x after 5 machine wash (60 deg.C.)/tumble dry cycles
- BW as received (before wash)
- AW after 5 wash/tumble dry cycles (after wash)

Table III

## Lacoste Study - Replication 2

## GREY-24GAUGE

	24/283	24/297	24/312	26/271	26/283	26/297	26/312
Length shrinkage (%), 5x	30.85	32.91	33.18	32.37	32.78	33.78	33.25
Width shrinkage (%), 5x	7.32	6.31	3.53	9.29	6.17	5.63	2.95
Weight (gsm), BW	177.27	167.74	168.67	166.44	162.82	158.81	149.65
Weight (gsm), AW	267.68	253.44	237.73	258.45	244.17	232.69	228.51
Courses per 3cm, BW	77.18	78.78	66.58	79.88	74.68	69.48	66.88
Courses per 3cm, AW	118.88	104.88	98.18	116.68	109.48	103.68	98.28
Wales per 3cm, BW	29.25	28.75	27.75	38.38	29.85	28.85	28.18
Wales per 3cm, AW	31.98	30.65	29.25	33.15	31.98	30.88	29.45
Stitch length (mm) BW	2.86	3.88	3.15	2.74	2.84	2.99	3.15
Stitch length (mm) AW	2.82	2.97	3.11	2.69	2.81	2.96	3.11
Angle of spirality, AW	3.84	7.22	8.13	5.37	4.39	8.21	8.66
Yarn count (tex), BW	24.27	24.44	24.32	22.57	22.68	22.77	22.53
Yarn count (tex), AW	23.85	23.82	23.96	21.89	22.33	22.18	22.81
Thickness (mm x 1000), BW	948	963	991	981	911	931	971
Thickness (mm x 1000), AW	1363	1387	1423	1326	1316	1345	1348
Turns per metre, BW	721	781	675	781	756	743	769
Turns per metre, AW	785	699	788	768	788	799	762
Twist liveliness, t/a, BW	58.38	53.45	55.58	63.48	59.18	61.45	62.85
Twist liveliness, t/a, AW	43.35	47.15	46.35	51.88	52.85	54.15	53.18

## NOTES

5x after 5 machine wash (60 deg.C.)/tumble dry cycles

BW as received (before wash)

AW after 5 wash/tumble dry cycles (after wash)

Table III (cont.)

## Lacoste Study - Replication 2

## GREY-28GAUGE

	30/247	30/260	30/269	30/286	34/234	34/247	34/260	34/269
Length shrinkage (%), 5x	30.42	31.53	29.79	30.40	28.24	30.98	31.49	33.35
Width shrinkage (%), 5x	7.20	6.62	5.73	1.29	9.19	7.36	5.05	3.93
Weight (gsm), BW	162.48	154.58	154.07	144.96	150.27	138.70	130.97	123.12
Weight (gsm), AW	244.93	236.01	227.80	213.21	226.04	214.23	203.56	194.31
Courses per 3cm, BW	89.20	83.30	81.80	76.80	98.40	88.10	82.40	76.90
Courses per 3cm, AW	127.30	120.40	116.20	109.10	135.60	127.50	120.10	116.00
Wales per 3cm, BW	33.85	32.85	31.65	31.00	34.30	33.30	32.65	32.15
Wales per 3cm, AW	36.00	35.55	34.60	32.75	38.00	37.15	35.65	34.55
Stitch length (mm) BW	2.50	2.61	2.71	2.89	2.37	2.51	2.61	2.71
Stitch length (mm) AW	2.47	2.58	2.67	2.86	2.34	2.47	2.58	2.68
Angle of spirality, AW	8.74	9.43	10.33	11.63	9.30	10.01	11.84	12.59
Yarn count (tex), BW	19.26	19.49	19.48	19.56	17.14	17.01	16.95	16.95
Yarn count (tex), AW	18.88	18.97	19.09	18.99	16.67	16.82	16.60	16.62
Thickness (mm x 1000), BW	812	832	880	923	734	756	785	792
Thickness (mm x 1000), AW	1189	1215	1238	1248	1112	1136	1157	1158
Turns per metre, BW	835	857	809	847	853	865	877	859
Turns per metre, AW	848	883	842	842	873	899	916	902
Twist liveliness, t/m, BW	68.30	65.30	66.80	70.35	65.30	65.45	66.50	69.25
Twist liveliness, t/m, AW	53.50	55.50	53.35	53.90	60.00	60.25	59.30	58.20

## NOTES

5x after 5 machine wash (60 deg.C.)/tumble dry cycles

BW as received (before wash)

AW after 5 wash/tumble dry cycles (after wash)

Table IV - Average Grey State Test Data

## - 24 gauge

	24/283	24/297	24/312	26/271	26/283	26/297	26/312
Weight AW	264.5	251.8	236.6	257.1	242.7	231.4	219.1
C/3cm AW	110.2	103.6	97.9	116.5	110.1	103.8	98.5
W/3cm AW	32.2	30.8	29.5	33.5	32.2	31.0	29.7
St.Length BW	2.864	3.008	3.157	2.742	2.855	2.995	3.154
St.Length AW	2.823	2.968	3.110	2.698	2.815	2.961	3.110
Spirality AW	4.0	7.1	7.9	5.5	4.4	8.5	8.4
Tex BW	24.3	24.4	24.4	22.5	22.6	22.8	22.5
Tex AW	23.7	23.8	23.9	22.0	22.3	22.2	21.9
Thickness BW	927.6	951.4	979.8	894.3	893.3	920.2	949.6
Thickness AW	1361.5	1385.7	1410.5	1310.8	1315.7	1340.6	1339.4
Turns/m BW	722.0	702.8	701.8	787.8	750.8	768.3	777.3
Tw.Lvlns BW	51.8	55.6	55.7	61.0	56.9	63.5	63.4
Tw.Lvlns AW	43.4	46.3	46.4	50.0	51.9	53.1	53.6

## - 28 gauge

	30/247	30/260	30/269	30/286	34/234	34/249	34/260	34/269
Weight AW	244.7	234.1	225.6	211.3	224.2	212.6	201.3	193.0
C/3cm AW	127.1	121.0	116.2	108.4	135.2	126.6	120.4	115.7
W/3cm AW	36.7	35.4	34.4	32.4	38.0	37.0	35.4	34.3
St.Length BW	2.502	2.615	2.708	2.887	2.371	2.504	2.613	2.706
St.Length AW	2.472	2.582	2.673	2.852	2.343	2.469	2.582	2.674
Spirality AW	8.5	9.5	10.2	11.7	9.4	10.7	11.7	12.5
Tex BW	19.2	19.5	19.6	19.5	17.1	17.1	16.9	17.0
Tex AW	18.9	19.1	19.2	19.1	16.7	16.8	16.6	16.6
Thickness BW	813.5	836.4	873.1	900.6	732.7	763.6	784.1	800.6
Thickness AW	1178.2	1206.9	1232.4	1230.8	1112.5	1132.7	1148.4	1144.5
Turns/m BW	855.8	855.3	818.0	856.5	899.5	915.5	913.3	899.5
Tw.Lvlns BW	61.3	65.0	65.2	69.7	65.8	69.6	69.3	71.3
Tw.Lvlns AW	53.0	52.6	52.7	53.9	58.6	58.3	57.2	57.7

Table V

## Abbey Hosiery Lacoste - Winch Dyed

## WINCH

	24/283	24/297	24/312	26/271	26/283	26/297	26/312	30/247	30/260	30/269	30/286
Length shrinkage (%), 5x	8.64	8.95	11.44	6.67	8.83	8.85	12.39	10.87	9.30	10.54	13.24
Width shrinkage (%), 5x	12.41	14.41	12.61	15.11	12.50	14.84	12.85	11.85	11.83	8.93	6.73
Weight (gsm), BW	192.12	183.86	168.78	198.43	177.33	165.73	151.94	175.59	179.23	178.72	158.53
Weight (gsm), AW	243.89	227.89	214.58	235.18	222.79	211.39	198.57	228.58	212.19	206.81	188.32
Courses per 3cm, BW	98.68	85.18	76.48	108.28	91.88	84.38	74.38	103.78	108.38	92.68	82.68
Courses per 3cm, AW	99.88	93.78	85.98	106.38	99.48	93.88	85.78	115.18	108.28	102.88	92.88
Wales per 3cm, BW	28.45	26.98	26.88	28.75	28.78	26.98	27.85	32.95	32.15	31.95	31.65
Wales per 3cm, AW	32.35	31.38	30.75	33.58	32.75	31.75	31.35	36.88	36.88	35.35	33.48
Stitch length (mm) BW	2.84	2.96	3.09	2.69	2.82	2.95	3.18	2.47	2.58	2.68	2.85
Stitch length (mm) AW	2.88	2.94	3.08	2.67	2.79	2.92	3.09	2.44	2.56	2.65	2.82
Burst strength (kPa), BW	642.28	622.68	584.28	654.38	617.98	581.88	515.88	588.58	558.58	495.88	472.18
Burst strength (kPa), AW	653.18	595.38	553.78	615.58	626.78	527.68	584.48	592.98	562.78	532.88	474.68
Distension at burst (mm), BW	28.55	21.53	21.13	19.73	19.29	21.37	28.58	28.17	21.63	21.79	22.87
Distension at burst (mm), AW	23.35	21.88	23.66	22.44	22.68	22.59	23.99	22.51	22.64	23.15	24.88
Angle of spirality, BW	8.67	2.53	1.25	1.97	1.61	2.54	1.18	4.48	3.97	2.68	2.89
Angle of spirality, AW	2.92	4.49	4.31	4.41	3.65	4.87	5.87	5.25	5.38	6.33	6.74
Width (cm), BW	147.17	158.33	157.97	147.53	146.77	157.28	157.23	207.23	209.78	209.68	111.78
Yarn strength (g), BW	368.35	356.84	375.65	339.48	327.92	326.48	348.91	384.32	298.88	385.89	269.97
Yarn strength (g), AW	379.25	384.88	389.49	363.88	357.87	359.72	346.81	318.95	313.16	323.89	387.91
Yarn ext. at break (%), BW	7.17	7.24	7.48	7.89	6.55	6.92	7.41	6.75	7.82	6.67	6.65
Yarn ext. at break (%), AW	7.35	7.26	7.63	7.42	7.55	7.52	7.46	7.85	7.76	8.25	8.14
Yarn count (tex), BW	23.18	23.97	23.92	21.78	22.86	22.11	21.91	18.74	18.98	19.12	18.89
Yarn count (tex), AW	23.76	23.75	23.76	22.24	22.18	22.18	21.98	18.92	18.85	19.11	19.34
Thickness (mm x 1000), BW	1041	1065	1041	998	977	992	984	918	953	948	933
Thickness (mm x 1000), AW	1239	1249	1255	1178	1191	1195	1281	1872	1182	1118	1131
Turns per metre, BW	684	689	677	768	748	737	766	745	779	791	789
Turns per metre, AW	694	689	699	751	742	774	751	886	773	766	821

## NOTES

5x after 5 machine wash (68 deg.C.)/tumble dry cycles

BW as received (before wash)

AW after 5 wash/tumble dry cycles (after wash)

Table V (cont.)

## Abbey Hosiery Lacoste - Winch Dyed

## WINCH

	34/234	34/247	34/260	34/269
Length shrinkage (%), 5x	5.81	10.77	11.49	11.67
Width shrinkage (%), 5x	13.00	11.64	11.64	10.29
Weight (gsm), BW	167.50	151.12	140.42	141.39
Weight (gsm), AW	203.00	189.73	181.29	172.95
Courses per 3cm, BW	117.30	100.90	94.40	88.90
Courses per 3cm, AW	122.70	110.50	104.90	99.50
Wales per 3cm, BW	33.00	32.95	32.40	31.60
Wales per 3cm, AW	38.20	37.45	36.25	35.70
Stitch length (mm) BW	2.35	2.46	2.59	2.67
Stitch length (mm) AW	2.31	2.44	2.56	2.65
Burst strength (kPa), BW	539.70	493.40	450.20	450.70
Burst strength (kPa), AW	537.20	505.00	459.30	442.70
Distension at burst (mm), BW	21.92	20.78	20.50	22.98
Distension at burst (mm), AW	22.06	23.94	23.81	23.44
Angle of spirality, BW	3.02	3.50	5.04	2.89
Angle of spirality, AW	5.26	6.03	6.96	7.47
Width (cm), BW	205.33	206.32	210.40	212.02
Yarn strength (g), BW	251.11	260.17	249.17	250.21
Yarn strength (g), AW	270.11	265.00	273.60	260.73
Yarn ext. at break (%), BW	6.05	6.39	6.75	6.66
Yarn ext. at break (%), AW	6.95	7.45	7.85	7.79
Yarn count (tex), BW	16.56	16.53	16.50	16.45
Yarn count (tex), AW	16.65	16.75	16.65	16.75
Thickness (mm x 1000), BW	852	843	882	867
Thickness (mm x 1000), AW	1023	1038	1042	1040
Turns per metre, BW	827	866	837	886
Turns per metre, AW	873	908	848	847

## NOTES

5x after 5 machine wash (60 deg.C.)/tumble dry cycles

BW as received (before wash)

AW after 5 wash/tumble dry cycles (after wash)



Table VI

## Abbey Hosiery Lacoste - Jet Dyed

## JET DYED

	24/283	24/297	24/312	26/271	26/283	26/297	26/312	30/247	30/260	30/269	30/286
Length shrinkage (%), 5x	7.93	9.58	11.36	6.66	8.78	9.32	11.25	7.42	8.18	8.35	13.17
Width shrinkage (%), 5x	12.27	13.34	18.81	14.77	13.87	13.88	11.63	18.93	18.68	8.44	4.67
Weight (gsm), BW	283.18	181.79	172.45	191.39	183.39	178.19	159.81	188.68	182.43	171.88	159.14
Weight (gsm), AW	247.82	236.86	228.82	238.71	225.81	217.66	287.13	225.81	216.17	286.38	193.19
Courses per 3cm, BW	94.68	87.88	79.38	99.78	92.18	86.48	78.48	187.58	183.58	95.88	83.78
Courses per 3cm, AW	183.88	96.88	89.18	187.88	188.78	94.78	87.78	118.18	111.78	185.38	95.58
Wales per 3cm, BW	28.68	27.15	26.75	28.98	28.38	26.95	26.98	32.65	31.95	31.55	31.28
Wales per 3cm, AW	32.78	31.28	38.85	33.48	32.65	31.35	38.15	36.88	35.95	34.78	32.95
Stitch length (mm) BW	2.84	2.98	3.11	2.78	2.83	2.97	3.12	2.47	2.59	2.68	2.85
Stitch length (mm) AW	2.88	2.94	3.88	2.68	2.79	2.93	3.87	2.45	2.56	2.65	2.82
Burst strength (kPa), BW	674.38	618.68	556.98	632.28	612.68	543.88	498.38	585.38	532.28	526.98	448.68
Burst strength (kPa), AW	629.58	613.28	565.28	627.78	566.48	539.28	496.38	531.78	515.88	485.98	452.28
Distension at burst (mm), BW	22.18	22.42	21.31	21.34	28.95	23.42	23.76	22.98	21.99	22.59	23.88
Distension at burst (mm), AW	21.58	23.82	21.86	21.89	22.25	23.18	23.93	21.76	23.51	22.94	23.23
Angle of spirality, BW	-8.38	1.37	8.73	8.12	8.44	8.58	-8.85	-1.95	2.38	1.93	3.82
Angle of spirality, AW	3.28	4.89	5.26	3.65	3.95	5.58	4.63	5.11	6.82	5.61	6.43
Width (cm), BW	147.18	156.43	157.28	146.17	147.88	155.58	156.78	286.33	218.37	212.58	214.83
Yarn strength (g), BW	296.21	384.35	295.89	277.67	314.85	313.75	381.83	235.73	278.88	244.89	248.61
Yarn strength (g), AW	342.32	353.41	345.99	323.52	319.73	322.48	337.41	289.16	271.97	291.48	265.11
Yarn ext. at break (%), BW	8.14	7.57	7.47	7.18	8.35	7.68	7.65	7.42	8.32	7.87	7.48
Yarn ext. at break (%), AW	6.99	7.17	7.26	7.85	7.84	7.17	7.31	7.11	6.83	7.13	6.83
Yarn count (tex), BW	24.86	24.25	24.18	22.48	22.59	22.32	22.25	18.95	19.31	18.94	19.56
Yarn count (tex), AW	24.23	24.13	24.24	22.29	22.87	22.47	22.54	18.94	19.87	19.31	19.42
Thickness (mm x 1000), BW	1855	1822	1837	987	1828	976	994	936	964	971	971
Thickness (mm x 1000), AW	1265	1278	1272	1189	1286	1212	1228	1188	1131	1139	1134
Turns per metre, BW	689	784	785	759	759	778	766	811	884	792	831
Turns per metre, AW	678	698	663	753	737	733	748	792	754	791	818

## NOTES

5x after 5 machine wash (60 deg.C.)/tumble dry cycles

BW as received (before wash)

AW after 5 wash/tumble dry cycles (after wash)

Table VI (cont.)

## Abbey Hosiery Lacoste - Jet Dyed

## JET DYED

	34/234	34/247	34/260	34/269
Length shrinkage (%), 5x	6.19	8.70	8.55	11.38
Width shrinkage (%), 5x	13.19	11.43	10.49	8.51
Weight (gsm), BW	172.63	159.37	148.49	144.84
Weight (gsm), AW	200.21	195.27	186.43	176.44
Courses per 3cm, BW	119.20	105.30	98.40	90.10
Courses per 3cm, AW	126.00	115.10	107.50	101.50
Wales per 3cm, BW	32.80	32.60	31.00	32.30
Wales per 3cm, AW	36.50	37.30	35.65	35.35
Stitch length (mm) BW	2.35	2.47	2.58	2.68
Stitch length (mm) AW	2.32	2.44	2.55	2.66
Burst strength (kPa), BW	536.70	492.20	485.20	426.20
Burst strength (kPa), AW	521.60	469.50	463.60	446.00
Distension at burst (mm), BW	22.95	23.10	22.10	20.93
Distension at burst (mm), AW	22.48	23.19	22.07	22.33
Angle of spirality, BW	1.14	-1.09	1.53	4.85
Angle of spirality, AW	6.25	6.44	4.60	5.76
Width (cm), BW	205.60	206.13	210.13	210.97
Yarn strength (g), BW	233.04	234.45	210.69	217.29
Yarn strength (g), AW	250.29	240.71	231.49	227.99
Yarn ext. at break (%), BW	7.62	7.70	7.29	7.83
Yarn ext. at break (%), AW	6.60	6.45	6.75	6.43
Yarn count (tex), BW	16.79	17.07	16.80	16.80
Yarn count (tex), AW	16.88	16.88	16.87	16.69
Thickness (mm x 1000), BW	882	882	897	908
Thickness (mm x 1000), AW	1052	1059	1075	1067
Turns per metre, BW	852	876	841	908
Turns per metre, AW	814	842	890	855

## NOTES

5x after 5 machine wash (60 deg.C.)/tumble dry cycles

BW as received (before wash)

AW after 5 wash/tumble dry cycles (after wash)

Table VII - Coefficients

Equation  $Y=aX$

	a	r squared
Tex		
- Greige	0.97169	0.999
- Winch dyed	0.97093	0.999
- Jet dyed	0.98235	0.999
Stitch length		
- Greige	0.98681	0.999
- Winch dyed	0.97699	0.999
- Jet dyed	0.97813	0.999

Equation  $Y=a+bX(1)+cX(2)$

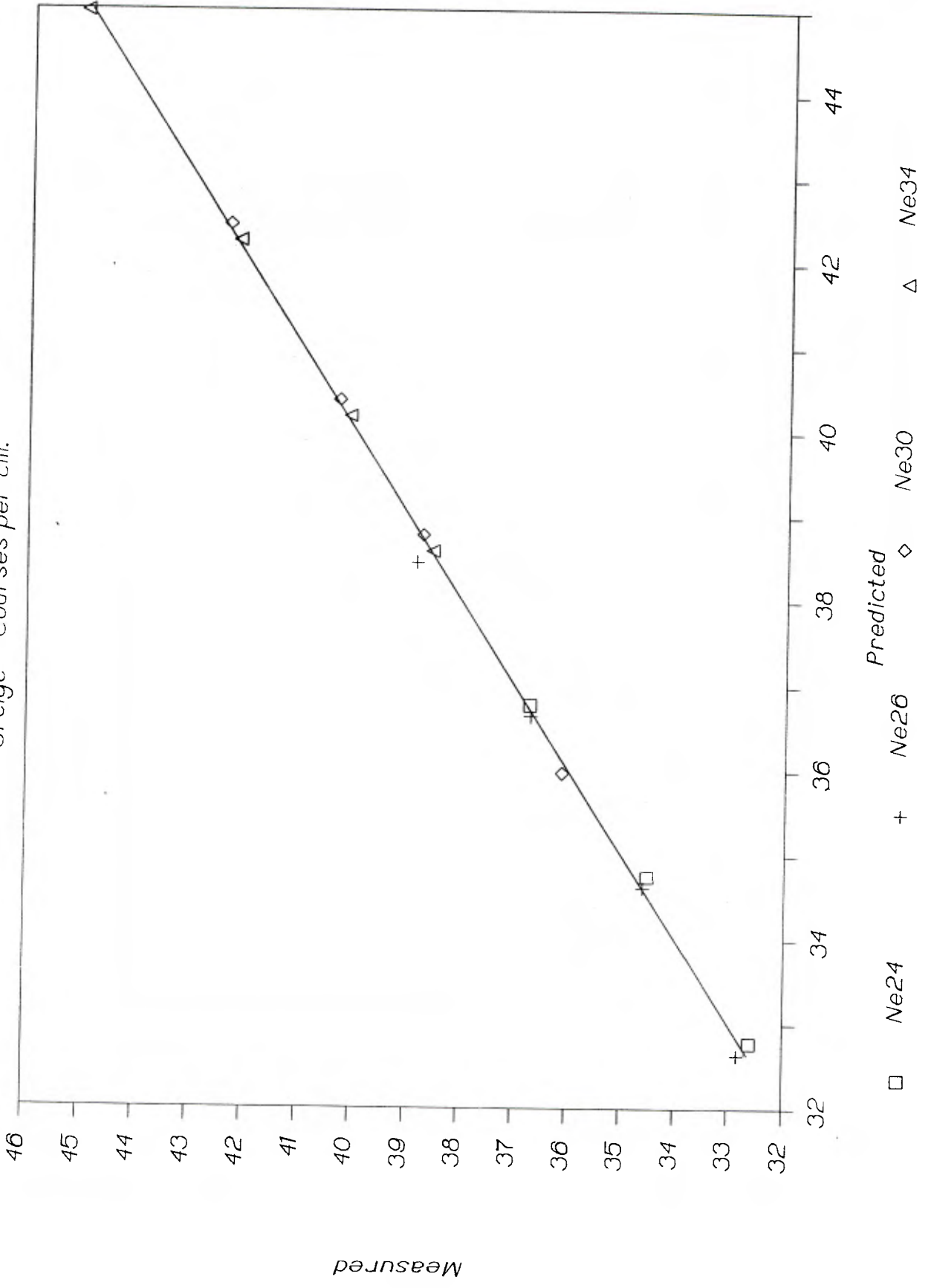
	a	b	c	r squared
Courses per cm.				
- Greige	-9.4072	12.0155	0.7365	0.998
- Winch dyed	-34.7159	13.5892	4.0345	0.986
- Jet dyed	-35.5813	14.0826	4.0052	0.997
Wales per cm.				
- Greige	3.2419	2.5581	-0.3286	0.995
- Winch dyed	9.2851	1.7476	-0.9751	0.989
- Jet dyed	5.0565	2.3264	-0.5260	0.991

## TO ACHIEVE THE IIC REFERENCE STATE

1. WASH IN AUTOMATIC DOMESTIC WASHING MACHINE AT 60°C
2. TUMBLE DRY UNTIL DRY
3. WET OUT IN WASHING MACHINE (RINSE CYCLE)
4. TUMBLE DRY UNTIL DRY
5. REPEAT STEPS 3 AND 4 THREE MORE TIMES
6. CONDITION

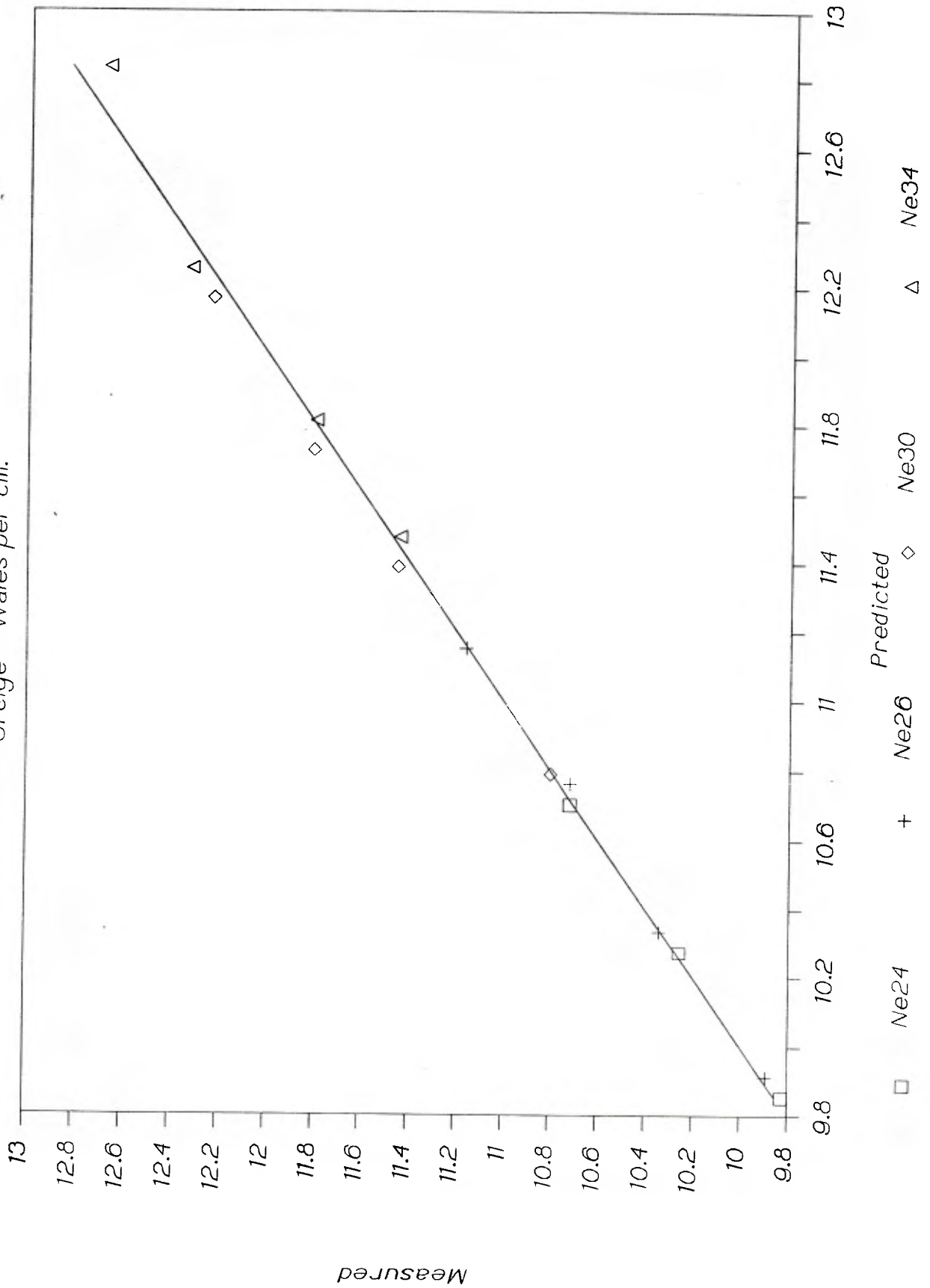
# Figure 2.

Greige - Courses per cm.



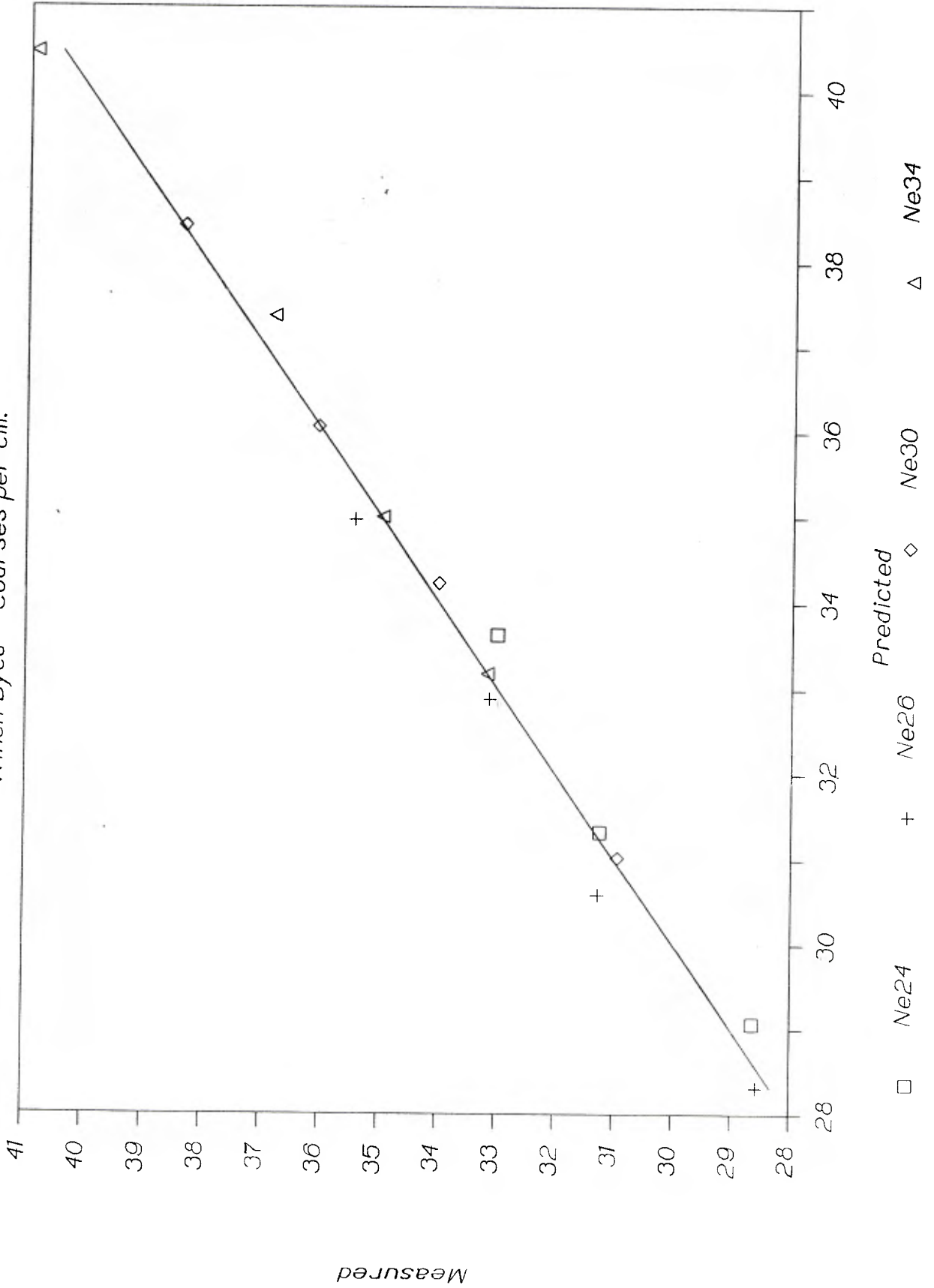
# Figure 3.

Greige - Wales per cm.



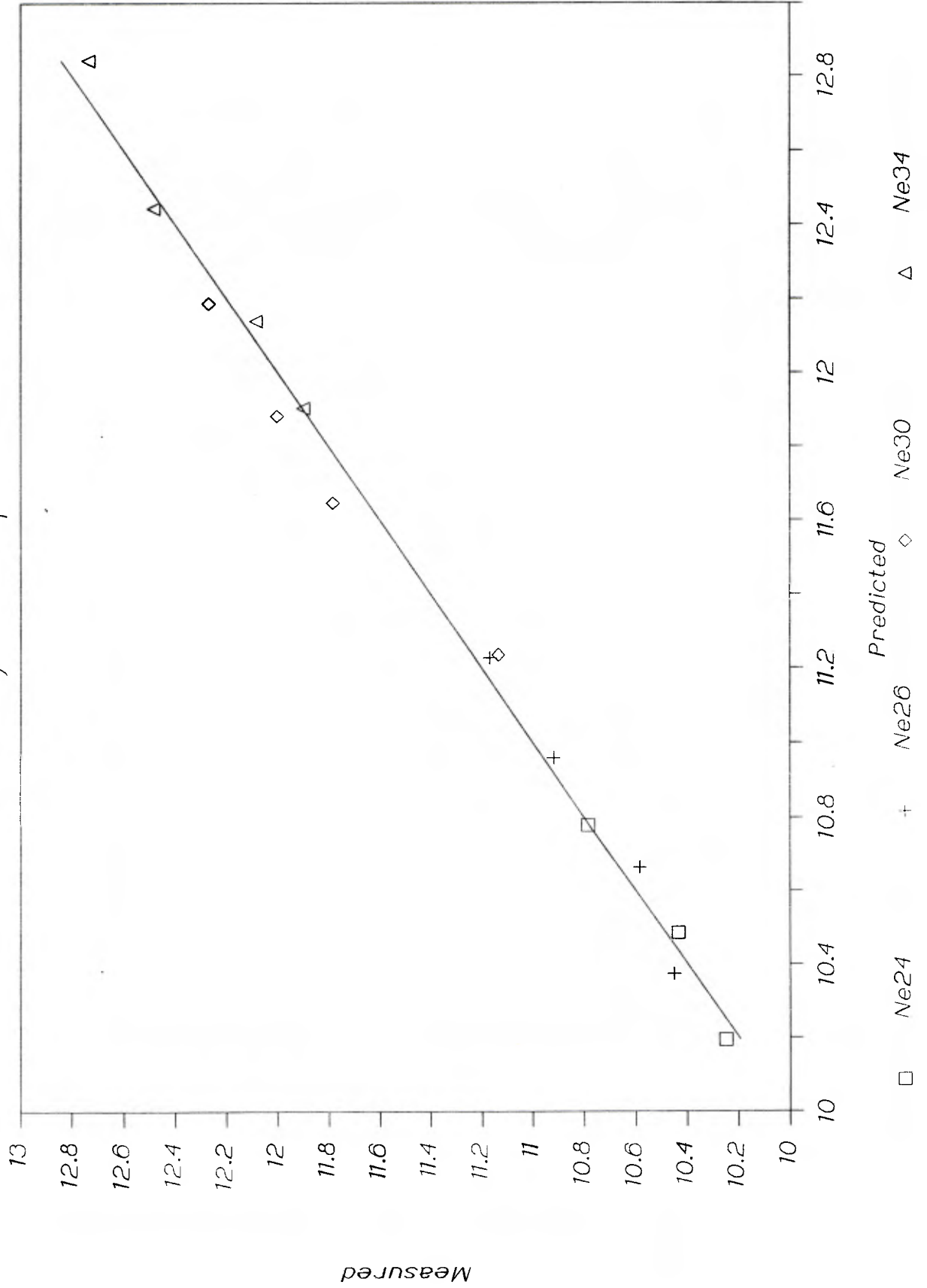
# Figure 4.

Winch Dyed - Courses per cm.



# Figure 5.

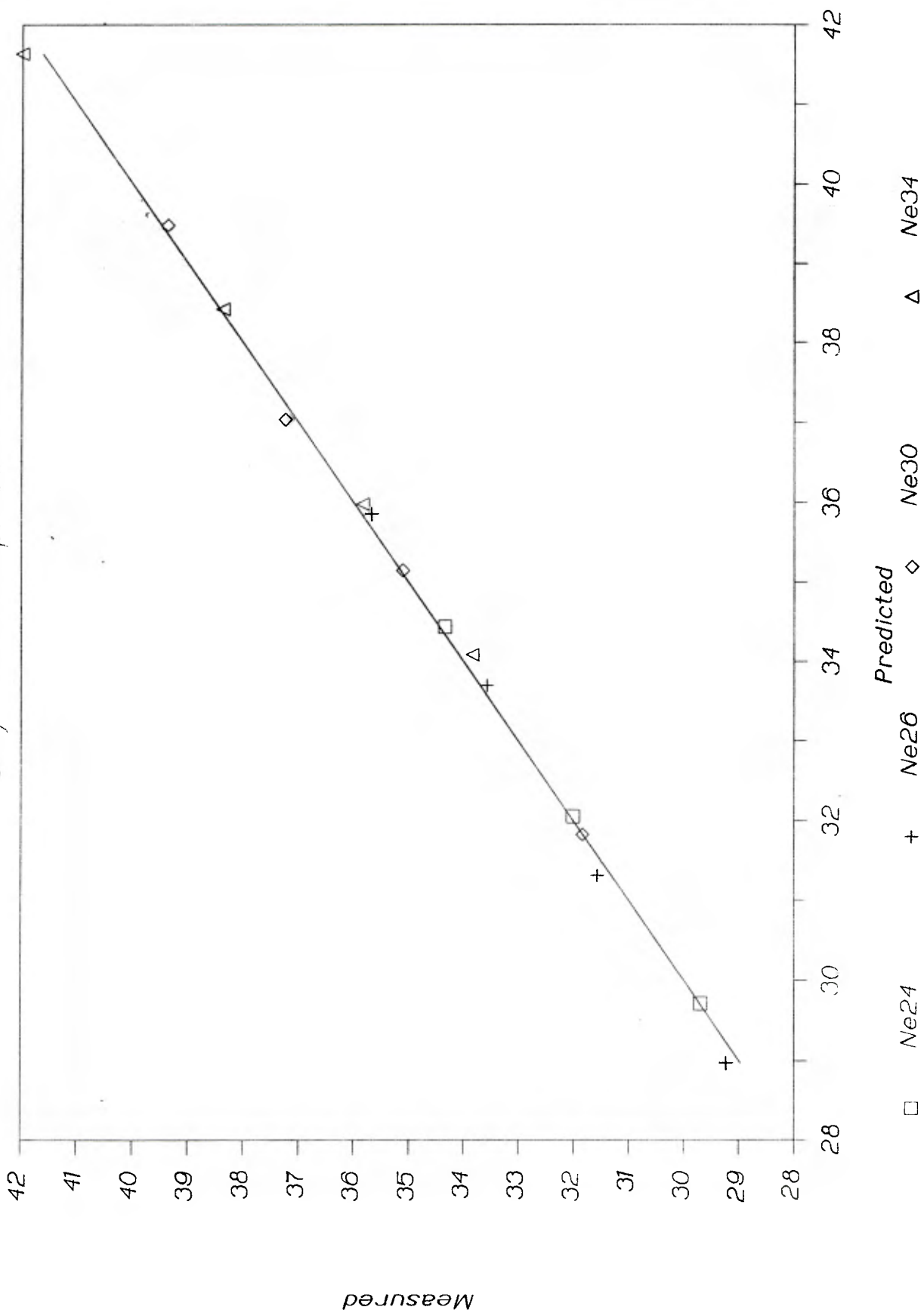
Winch Dyed - Wales per cm.





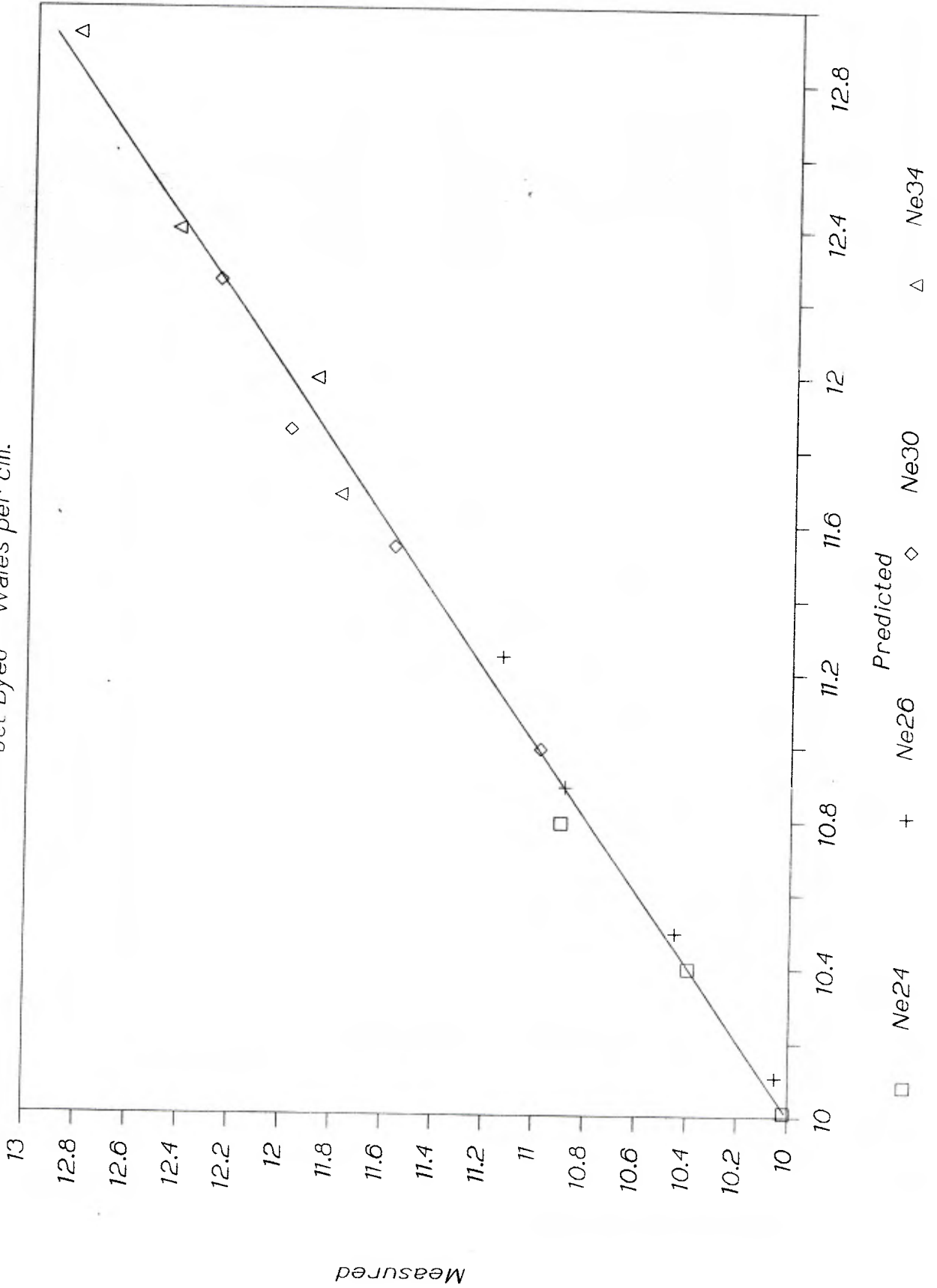
# Figure 6.

*Jet Dyed - Courses per cm.*



# Figure 7.

*Jet Dyed - Wales per cm.*



# Figure 8.

Effect of drying treatment on shrinkage

