

يهدف البحث الى معرفة مايلي :

- ا - صلاحية الاصواف العراقية المعروفة بالعواسي والحمداني في تصنيع خيوط السجاد النافذ
- ب - افضل نظام لتصنيع خيوط السجاد النافذ .

الدكتور ناصر حسين الربيعي  
قسم الهندسة الكيماوية  
مقرر دورة الغزل والنسيج

## A comparison of the Use of woolen, Semi-worsted and Worsted spun yarns from Awasi, Blackface, Hammadani and crossbred wool in Tufted Carpets

By

Dr. Nasser Al-Rubaiey Ph.D. T. D. B. Sc. ( Text. AT )

Dr. J.A Iredale Ph.D F.T.I.

### Abstract

The object of this paper is concerned with :

- a. The evaluation of the suitability of Awasi and Hammadani wool in tufted Carpets. after Subjectively examining Various wools widely employed in machine made carpets manufacturing .
- b. To ascertain the optimum method of spinning to produce the suitable yarn for machine - made Carpets



## 1. Introduction

The primary object of this work was to evaluate suitability of Awasi and Hammadani wools and the optimum method of pinning to produce the suitable yarn for machine-made carpet manufacturing.

For this purpose, carpet samples with a diameter of 20 cm were produced using a "venor" type 16 gauge of tufting machine. The samples were produced using the woollen, semi-worsted and worsted systems.

The resultant carpets were tested for performance characteristics by applying standard carpet tests.

Initially, the fiber length<sup>(1)</sup> and diameter<sup>(2)</sup> of Awasi and Hammadani wools were ascertained after which a decision was made to compare these two types of wool with similar wools of British origin.

After subjectively examining various wools using woolen and worsted carpets, the two samples chosen matched Iraq wools in respect of fibre diameter and length. These were Blackface wool to match the Awasi wool and crossbred wool to match the Hammadani. It should be mentioned that although these wools were chosen for matching there were minor differences in fibre diameter and length. Although these differences were only small, when reference was made to the U.A. standard specifications<sup>(3)</sup> the wools were placed in different quality groups. Thus the Blackface wool was considered to be 46's quality, whereas the crossbred wool of 48's quality.

The crossbred wool was found to be 56's quality, whereas the Hammadani wool was 58's quality. These differences were noted at the preliminary stages of this work, but it was considered that this would not invalidate this type of comparison.

The whole object was initially divided into two phases, each of which related to a particular type of Iraq wool.

Phase I involved the Awasi and Blackface wools, both of which were spun on the woollen and semi-worsted systems.

Phase II involved the Hammadani and crossbred wools, both of which were spun through the semi-worsted and worsted systems.

In each phase the two types of wool were identically processed, the yarns produced were converted into tufted carpets and an evaluation was carried out, to lead to a clear comparison between the four types of wools under consideration.

## 2. Processing

### 2.1 Phase I woollen and semi-worsted processes.

Initially, the scoured Awasi and Blackface wools were examined in respect to fibre length and diameter: the results are given in table No 1.

The Awasi wool was shown to have a diameter of 33  $\mu$ m and length of 11.88 cm, the Blackface fibre having an average diameter of 33.86  $\mu$ m and average length of 11.7 cm. As a result, the Awasi and the Blackface wools were placed within 48's and 46's quality groups respectively.



For comparison both types of wool were treated similarly and processed through the woollen and semi-worsted systems, the processing routine employed for this work is outlined in Figure 1 and the details are shown in table No 2. The single yarns produced, of approximately 300 tex., were tested for count, twist, irregularity, strength and yarn extensibility. The mean results are given in table No 3.

These results confirmed that the yarns were similar in terms of count and twist, but that the Blackface yarn had slightly less irregularity in comparison with Awasi yarns. The difference being, in the case of woollen spun yarn, 8.2 and 9.2 u% ; in the case of semi-worsted spun yarn 10.06 and 10.18 u% .

The results for both the woollen and semi-worsted spun yarn were perhaps somewhat higher than might have been expected from industrial yarns. When single yarn strength and extensions were compared for Awasi and Blackface yarns the difference was in the case of woollen spun yarn 1089 and 955.85 g; the extensibility being 11.51 and 11.35%; in the case of semi-worsted spun yarn the difference was 1225.6 and 1128 g., the extensibility being 9.59 and 8.75% respectively. In all cases the yarn spun through the semi-worsted system had greater strength but less extension.

Folded yarns were produced having a count of approximately R 600 tex/2. These yarns were tested for count, twist, strength and yarn extensibility. These results again are shown in table No 3. The tests for the four yarns showed only marginal difference in count and twist, but again the yarn spun through the semi-worsted system showed a considerable difference in strength and extension as was initially identified in the single yarn.

The resultant yarns were converted into tufted carpets. During the production of the carpets an attempt was made to maintain pile height and density as uniform as possible. Following this the carpets were subjected to an evaluation, after confirming that the pile height and density were comparable. Tests were carried out for the following.

1. Durability of the carpet (4) measured by wira dynamic loading machine
2. Loss of carpet thickness% (5) Mcesured by wira dynamic loading machine .

The results of these tests are summarized and given in table No 4, from which it can be seen that the carpet samples produced from semi-worsted spun yarn. showed a better abrasion resistance of 15,000 rubs for the Awasi samples and 14,500 rubs for Blackface samples, resulting in 500 rubs more than the Blackface type to reach the 100% wear point. The Awasi sample produced from woollen spun yarn required the same unnumber of rubs as that for the Blackface samples, being 13,000 rubs, to reach the 100% rubs, wear point.

Additionally, the carpet samples produced from Awasi wools indicated a marked difference in terms of loss of carpet thickness percentage as shown after 1000 impacts on the wira dynamic loading machine<sup>(5)</sup>. Difference of the same order of magnitude was noticed between the sample composed of woollen and semi-worsted yarns, the difference in the case of carpet made from yarn spun through the woollen system was 23.25% for Awasi and 26.12% for Blackface wool. In the case of semi-worsted spun yarns, the difference was 19.61% for Awasi type and 23.78% for Blackface sample.

These results obtained from testing the carpets, the yarns and fibres all confirmed the acceptability of Awasi wool when used in this type of end product as compared with Blackface wool a fibre regularly used in tufted carpet.

## 12 Phase 11 semi-worsted and worsted processes.

This Phase was concerned with the evaluation of the suitability of the Hammadani wool for machine-made tufted carpets, For the purpose of comparison crossbred was chosen. The fibre length and diameter were ascertained for both crossbred and Hammedani wools. The average results for these tests are given in table No.1 It was found that the two types of wool were very similar in diameter and fibre length but were classified as 56's and 58's quality. respectively



These wools were then subjected to identical processing treatment. Carpet yarns of approximately 315 tex were produced using the worsted system. Similar yarns, approximately 300 tex were produced using the semi-worsted system. The processing routine used for this part is outlined on Figure No.2 and the details are shown in tables No 5 and 6. The yarns produced were examined in terms of count, twist, regularity extensibility and yarn strength. These results are summarized and given in table No. 2. The single yarns were folded, the resultant yarn being of approximately R 600 tex/2 and R 630 tex/2<sup>(6)</sup> for semi-worsted and worsted yarn respectively. These yarns were examined in terms of yarn twist, strength and extensibility. The average results are also indicated in table No.3. From the results obtained after testing the single and folded yarns, it could be seen that the Hammadani wool spun through both worsted and semi-worsted systems showed a greater strength but decrease in extensibility. The result of the strength test for the worsted spun single yarns were 1210.37 g for Hammadani wool and 964.28 g for the crossbred samples. In the case of semi-worsted spun yarn, it was 1208 g for Hammadani wool, 899 g for crossbred samples.

The single yarn extension obtained for worsted spun yarn was 8.27% for Hammadani wool and 9.83% for crossbred wool. In the case of semi-worsted spun yarns the results obtained were 9.29% and 13.3% respectively. In all cases the yarn spun through the worsted system had greater strength with less extensibility.

Also the Hammadani wool spun through both worsted and semi-worsted systems, showed more irregularity than the crossbred yarns, the difference in the case of worsted yarns being 11.31 u% and 10.55 u%. In the case of semi-worsted yarns the difference was 9.7 u% and 9.58 u%.

The folded yarns produced were tested for count, twist, strength and extensibility. These results are again given in table No 3. The tests of the four yarns indicated only marginal difference in yarn count and twist but again the Hammadani wools showed a considerable difference in terms of yarn strength, as was initially identified in the single yarn test.

The folded yarns were converted into tufted carpet. During the processing an attempt was made to maintain the pile height and density as uniform as possible. This was achieved by employing Techniques to convert identical processing the four yarns into tufted carpets.

The carpet samples were tested in terms of durability and Loss of carpet thickness percentage averages of these tests are summarized and given in table No 4 from which it can be noticed that the carpet samples produced from Hammadani wool, when spun on both the worsted and semi-worsted systems, performed better and less thickness under the wira dynamic Loading test than crossbred wool.

The difference in the case of carpet sample made of worsted spun yarn being 17.98 and 21.58%, and in the case of carpet made of semi-worsted spun yarn being 25.28% and 27.31%. Additionally, the carpet sample produced from Hammadani wool indicated better abrasion resistance requiring approximately 1000 more rubs to reach the 100% wear point. This being true in the case of both carpet samples made of worsted and semi-worsted yarns.

The results obtained from testing of the carpet samples all indicated that carpets made from yarns spun through the worsted system performed better and lost less carpet thickness under wira dynamic loading machine than the samples of tufted carpet made from yarn spun through the semi-worsted system. Difference in the case of carpet sample made from Hammadani wool, spun through the worsted and semi-worsted systems being 17.98 and 25.28% and for Crossbred the difference was 21.59% and 27.31%.

Additionally the carpet samples made from yarns spun through the worsted system showed better abrasion resistance requiring 1500 more rubs to reach the 100% wear point.

### —3. Conclusion

A comparison was carried out in respect of the influence of the type, and processing being employed on woollen, semi-worsted and worsted systems.



An evaluation was made to ascertain the difference in carpet durability and loss of carpet thickness percentage under dynamic loading test in respect to these systems.

It is clear that carpet samples produced from wool spun through the worsted system and compared with semi-worsted spun yarn indicated a higher abrasion resistance, the difference being of a similar size to that found between the semi-worsted and woollen spun material - in the order of 1500-2000 rubs ( a difference of approximately 12.5% ). Again, these worsted- spun carpet yarns gave a reduced loss of thickness percentage. The difference was 6.8% when compared with carpet produced from yarn spun through the semi-worsted system. These differences can be considered to be due to the difference in fibre arrangement in relation to the yarn axis in the three types of carpets yarns.

Besides, the results obtained from testing carpet samples, yarns and the fibres properties,, confirm the acceptability of Awasi and Hammadani wools when used in tufted carpets.

FIGURE(1)

The Processing routine employed for woollen for Awasi and Blackface wools

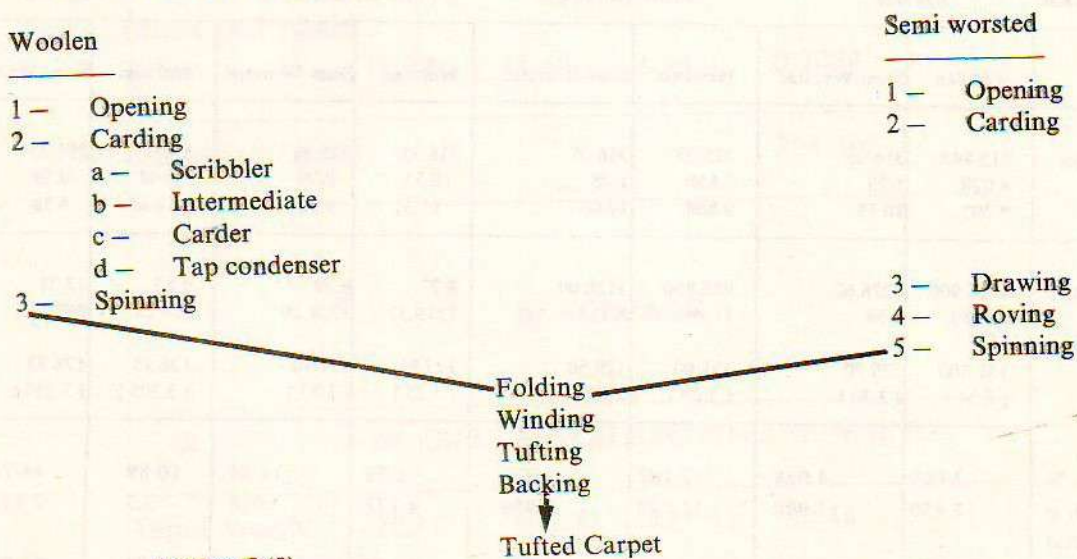


FIGURE (2)

List of Processing for Worsted and Semi - Worsted for both Hammadanian and Crossbred Wools.

<u>Semi - Worsted</u>	<u>Worsted</u>
1. Opening	1. Carding
2. Carding	2. Gilling
3. Drawing	3. Combing
4. Roving	4. Gilling
5. Spinning ( flyer )	5. Drawing
6. Folding	6. Roving
7. Winding ( Cone )	7. Spinning ( flyer )
8. Setting the tufting machine	8. Twister folding
9. Tufting	9. Winding ( Cone )
10. Backing the carpet	10. Setting the tufting machine
	11. Backing the carpet

Carpet Testing

1. Pile height and density
2. dynamic loading
3. Durability of carpet



TABLE 1

TESTS	AWASI	BLACKFACE	HAMMADANIAN	CROSSBRED
Mean Fibre Length cm	11.88	11.70	9.68	10.497
C.V. %	49.49	42.30	46.08	33.94
S.D.	5.88	4.95	4.46	3.56
Mean Fibre Diameter $\mu\text{m}$	33.00	33.86	25.54	27.24
C.V. %	17.99	22.24	20.05	14.89
S.D.	5.92	5.08	5.21	4.058
Wool Quality	48 's	46 's	58 's	56 's

TABLE(3)

TYPE OF WOOL	AWASI		BLACKFACE		HAMMADANIAN		CROSSBRED	
	Woollen	Semi-Worsted	Woollen	Semi-Worsted	Worsted	Seim-Worsted	Worsted	Semi-Worsted
Tests								
Yarn Count - Tex	315.840	316.35	315.275	316.35	316.35	292.34	316.35	295.35
C / <sub>2</sub>	4.020	1.23	3.850	1.28	0.53	0.70	0.48	0.78
Evenness U %	9.200	10.18	8.800	10.06	11.31	9.70	10.55	9.58
single Yarn								
1. Extension %	1008.900	1228.60	955.850	1128.00	8.27	9.29	9.83	13.31
2. Strength g	11.480	9.59	11.340	8.75	1210.37	1208.20	964.28	899.63
3. Twist (single)								
T.P.M.	131.500	129.20	131.00	129.50	127.95	131.10	126.18	128.23
(t.p.i.)	(3.34)	(3.30)	(3.29)	(3.33)	(3.25)	(3.33)	(3.205)	(3.257)
1. Extension %	2.805	4.088	2.102	3.228	8.79	14.56	10.89	14.75
2. Strength g	12.430	11.090	11.120	9.950	4.172	3.066	3.7	2.895
3. Twist (folded)								
T.P.M.	70.000	72.400	71.300	73.200	79.10	69.53	80.04	61.02
(t.a.i.)	(1.780)	(1.840)	(1.810)	(1.860)	(1.933)	(1.766)	(2.033)	(1.55)

TABLE 4

TYPE OF WOOL	AWASI		BLACKFACE		HAMMADANIAN		CROSSBRED	
	Woollen	Semi-Worsted	Woollen	Semi-Worsted	Worsted	Semi-Worsted	Worsted	Semi-Worsted
Tests								
1. Pile Density	1212.30	1233.32	1207.03	1213.30	1212.30	1219.23	1205.45	1233.32
(g/m <sup>2</sup> )								
2. Pile Height (inch)	0.501	0.522	0.504	0.515	0.63	0.63	0.63	0.64
3. Durability (NO. of Rubs)	13000	15000	13000	14500	15000	13500	14000	12500
4. Loss of Thickness %	23.25	19.61	26.12	23.78	47.98	25.28	21.59	27.31



**TABLE (2)**

**The Processing Routine for Awasi and Blackface**

<b>AWASI</b>				
<b>R</b>	<b>1st GILL 2nd GILLROVING SPINNING</b>			
Input weight (dram / 40 yards)	180	450	241.07	40.17
Kiltex	8.712	21.78	11.67	1.94
Doubling	14	3	1	1
Drafting	5.6	5.6	6.0	6.4
Output weight (dram / 40 yards)	450	251.07	40.17	6.3
Kiltex	21.78	11.67	1.94	0.3038
Calculated Count				304 tex

<b>BLACKFACE</b>				
<b>R</b>	<b>1st GILL 2nd GILLROVING SPINNING</b>			
Input weight (dram / 40 yards)	203.8	400.32	214.46	40.46
Kiltex	9.86	19.38	10.38	1.96
Doubling	11	3	1	1
Drafting	5.6	5.6	5.3	6.4
Output weight (dram / 40 yards)	400.32	214.46	40.46	6.32
Kiltex	19.38	10.38	1.96	0.306
Calculated Count				306 tex



Table 5  
Worsted Processing

Crossbred	1st Gill	2 nd Gill	Roving	Spinning
Input (drams / 40 yards)	(465.06)	450.64	(262)	(40)
Kiltex	22.52	21.88	12.69	1.94
Doubling	5	3	1	1
Draft	5.16	5.16	6.55	6.45
Output (drams / 40 yards)	(450.64)	(262.00)	(40)	(6.2)
Kiltex	21.83	12.69	1.94	0.30027
Calculated Count				316.35 tex

Hammadanian	1st Gill	2 nd Gill	Roving	Spinning
Input ( drams / 40 yards )	(465.00)	(450.58)	(261.96)	(40)
Kiltex	21.52	21.83	12.69	1.94
Doubling	5	3	1	1
Draft	5.16	6.17	6.55	6.45
Output ( drams / 40 yards)	( 450.58 )	( 251.96 )	( 40 )	( 6.2 )
Kiltex	21.83	12.89	1.94	0.30027
Calculated Count				316.35 tex..

Table 6  
Semi - Worsted Processing

Hammadani	1st Gill	2 nd Gill	Roving	Spinning
Input ( drams /40 yards )	( 218.00 )	( 811.43 )	( 181.06 )	( 80.18 )
Kiltex	10.46	14.94	8.89	1.45
Doubling	8.00	8.00	1.00	1.00
Draft	5.6	5.16	6.00	5.00
Output ( drams /40 yards )	( 311.43 )	( 181.06 )	( 30.18 )	( 6.04 )
Kiltex	14.94	8.69	1.15	0.28959
Calculated Count				292.34 tex



Crossbred	1st Gill	2nd Gill	Roving	Spinning
Input ( drams /40 yards )	( 215.48	( 344.00 )	( 200.00 )	( 33.60 )
Kiltex	10.45	16.77	9.75	1.63
Doubling	9.00	8.00	1.00	1.00
Draft	5.60	5.16	6.00	5.40
Output ( drams /40 yards )	( 344.00 )	( 200.00 )	( 33.30 )	( 5.16 )
Kiltex	16.77	9.76	1.68	0.29817
Calculated Count				295.26 tex

#### References

1. British standard, Handbook No.11 P 2-4 1976.
2. British standard Hand book. No. 2043 P 57 1967.
3. Jelihel M. ph.D Thesis The university of Bradford 1967 P.4.
4. Lord P.R., spinning 70 s' P 163 , 1970 . MERROW pub.
5. Haddad , N., In inter Carpet" 1976 Baderbeiwien. Austrsn. WIRA pub.
6. Brcarley , A. and Iredale , A.J. " The woollen Industry " P 81 1977 PITMAN pub .