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AIR DRAG MEASUREMENTS ON YARNS SPUN FROM EGYPTIAN COTTON AND COTTON/POLYESTER BLENDS

BY

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الخلاصة :

في هذا البحث تم قياس قوة سحب الهواء على أطوال خيوط مختلفة خلال ماسورة ودليل الهواء . ولقد وجد أن الخيوط المغزولة من قطن جيزة ٧٥ تعطى قوة سحب هواء أكبر من الخيوط الاخرى المغزوله من قطن جيزة ٣١ وقطن جيزة ٧٠ . ولقد ثبت أن وجود شعيرات البولى أستر في الخلط يؤدى الى نقصان في قوة سحب الهواء على الخيوط . تمت المقارنة بين الخيوط الممشطة والخيوط المسرحة من حيث قوة سحب الهواء ووجد أن الخيوط الممشطة تعطى قوة سحب هواء أقل وكذلك أن الزوى وطريقة برم الخيوط لهـا تأثير ملحوظ على قوة سحب الهواء للخيوط .

ABSTRACT - The air drag force on stationary yarn at different lengths was measured through a tube and confuser guides. It was found that, yarns spun from G 75 Cotton fibers showed a higher air drage force than those spun from G 31 and G 70 Cottons. The presence of polyester fibers in the blend led to a decrease in air drag force. Comparison between yarns made from carded and combed cotton was made, combed cotton yarns have less air drage than those spun from carded cotton. Egyptian cotton yarns plyed on the two-for-one twister showed a higher air drage than those plyed on the ring twister.

1. INTRODUCTION

On an air jet loom, the weft yarn is inserted by means of compressed air and a nozzle. The compressed air, upon release, leaves the nozzle at high velocity carying the weft yarn across the loom. The auxilliary jets, which are distributed along the loom width, help the main nozzle in keeping the air stream at high velocity. The working air pressure depends on the design of the insertion system, up to 7 bars pressure is being used on some air jet looms. On any loom, the air pressure is changed according to the fabric width and type of weft yarn. At any pressure, the higher the drag force created by the air on the yarn, the higher the yarn velocity, thus, the lower the insertion time. This allows the loom to operate at high speeds with low air consumption.

The drag force which is generated by the air stream accelerates the yarn through the guide system inside the warp shed. The air drag force (ΔF) on stationary yarn length (ΔL) was studied by many researchers / 1, 2, 4 /, who found that :

$$\Delta F = 1/2\, C \pi\, D \rho V^2 (\Delta L) \qquad \ldots (1)$$

where :

- C = the drage coefficient
- D = the yarn diameter
- ρ = the air density
- V = the average air stream velocity

The drag coefficient is a function of the nature of the yarn surface and Reynold's number of the flow. Thus, the air drag force on a yarn length is highly affected by the yarn characteristics (such as bulk and hairiness) and air stream velocity.

Ishida /2/ measured the drag force on stationary yarns passed through the warp shed of an experimental air jet loom with a single nozzle. He found that the air drag force initially increased with the yarn length from the nozzle. After 40 cm away from the nozzle, the drag force did not incrase. Measurements of air drag force were made on cotton Ne 30/3, 42/4, 60/2, polyester blend 34/2 and nylon 110 denier yarns at different air pressure. His results showed that the air drag force was affected by the yarn count and fiber type.

Krause and Kissling /3/ measured the air drag force on different types of yarns in an air stream at a velocity of 60 m/sec. From equation /1/. They found that the coefficient of air resistance for cotton yarn was twice that of singed cotton yarn. In the case of textured yarn, this coefficient depended on yarn bulkness. The effect of this coefficient on air consumption at the main nozzle of an air jet loom was found to be dependent on yarn type.

Lünenschloss and Wahhoud /5/ studied the weft insertion behavior of spun yarn in the air jet. They measured the insertion time of different yarn lengths. They found that the yarn structure in terms of type of fibers, twist and spinning method had a large influence on the insertion time. The surface characteristics of the yarn played an important role on yarn novement during insertion. A high degree of hairiness improved the yarn velocity and thus, insertion time was reduced.

The objective of this work is to investigate the air drag force on yarns spun from Egyptian Cottons and cotton polyester blends. Single and ply yarns were tested as well as the twisting system.

This helps to adjust the working air pressure on air jet looms according to the type of weft yarn. The matter which results in a reduction in the consumption of compressed air during weaving, and consequently the energy cost is reduced.

II. EXPERIMENTAL WORK

1. Materials

a) Single yarns spun from three Egyptian cottons Giza 31, Giza 70 and Giza 75 with different counts at a twist factor of 3.4. Table 1 gives details of the fibers used.

b) Blended yarns spun from polyester blended with G 70 carded and combed cotton slivers at different blend ratios.

c) Ply yarns with different counts were made on ring twisting as well as two-for-one twisting machines.

2. Measurement of air drag force

The air drag force on stationary yarns with different lengths was measured by the Rotschild Tension Meter Model (R 1192) with a measuring head (0-100) gm. Figure (1) shows the arrangement of air drag measurement The air drag force was measured on the yarn passing through :

1) A tube 5/8" inside diameter, 142 cm length.
2) Elitex loom guides, 142 cm length.

Both of these glude systems were placed at 1 inch distance from nozzle air tube. The nozzle used in this study was taken from an Elitex air jet loom model P 165. The air pressure at the nozzle was constant at value of 3.5 kg/cm.

It was necessary to measure the air drag force on the yarn through complete tube, because the average air velocity along the tube axis is constant /6/.

III. RESULTS AND DISCUSSIONS

Figure (2 to 14) show the results obtained for air drag force on different yarns. It can be seen that the air drag force is affected by the yarn linear density, type of cotton, blend ratio, twisting system and air guid system.

Figure (2) shows that the air drag force increased as the yarn became coarser. This is explained by equation (1). This equation shows that air drage force is propotional to the yarn diameter.

Figure (3) shows that the air drag force on yarns spun from G 75 is higher than that on yarns spun from G 31 or G 70. This is because G 75 Cotton fibers are coarse and shorter than G 70. The difference between the fiber length of G31 and G 75 is not large but the cotton fibers G 31 are finer than those of G 75, as shown in Table (1). This means that, the fineness of cotton fibers has a large influence on air drag force on yarns. Yarns spun from short and coarse fibers are known to have a large amount of hairiness /5/. The matter which increases the air drag force. This is clearly shown in Fig. (4 and 5) . Where the air drag was measured on yarns spun from carded and combed cotton fibers type G 75 and G 70, respectively. This fact can also be supported by the low air drag force obtained with 100% PES which is longer than all cotton fibers used. The round cross-section of the polyester fibers is another factor in reducing the air drag force, as shown in Figure 6 for the PES/C blends. The effect of % polyester fibers in the blend on air drag force was observed to be very small when the cotton fibers in the blend were combed, as shown in Fig. 7. This can also be observed from Fig. 8, which shows a comparison between blended yarns 50 C/50 PES when carded cotton and combed cotton were used in the blend.

Ply yarns showed a higher air drag force than single yarns because of the difference in linear density and surface characterstics, as shown in Fig. 9. Although the linear density of two ply yarn is twice that of the single yarn. The difference in air drag force was observed to be small. This is attributed to the fact that plying results in a reduction in yarn diameter and hairiness, relaltively to single yarn, the matter which affects to a large extend the air drag force. Figure (10, 11 and 12) show a comparison between the air drag force on yarns plyed on ring twister and others plyed on two-for-one twister. It is obvious that the two ply yarn produced on the two-for-one twister showed a higher air drag that those produced on the ring twister. This is due to the fact that two-for-one plyed yarns possess higher amount of hairiness than those of ring twisted yarns /7/ .

Fig. (13 and 14) show a comparison between the drag force on yarns inside the 5/8" I. D. tube and confuser guides for cotton yarn Ne 30 and 40/2, respectively. The drag force inside the confuser guides was observed to be higher than that inside the tube over a yarn length of 50 cm. This is attributed to the interaction between the air jet at the entrance of confuser guides /6/ . The drag force on longer length inside the confuser was less than that inside the tube because of the loss in air flow through the confuser lamella beyond the first 50 cm.

IV. CONCLUSIONS

From the previous experimental results and discussions the following conclusions can be drawn :

1. Yarns spun from Egyptian cotton type Giza 75 which is relatively coarse and short shows a higher air drag than yarns spun from Giza 31 and Giza 70 .
2. Yarns spun from combed Egyptian cotton have less air drag than those spun from carded cotton.
3. The presence of polyester fibers in the blend with Egyptian cotton results in a reduction in air drag force. When the percentage of polyester in the blend increases, the reduction in the air drag force will be high .
4. Egyptian cotton yarns plyed on the two-for-one twister shows a higher air drag than those plyed on the ring twister .

V. REFERENCES

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Table (1) Properties of fibers used

Cotton fibers	G 31	G 70	G 75
Fiber length at 2.5% (mm)	29	32,3	29,8
C.V.% of fiber length	47	46	47
Fiber fineness (M/inch)	4	4,2	4,5
Fiber strength (pressly)	8,5	9,8	9,8

Polyester Fibers	
Cutting length (mm)	38,5 ± 1
Denier	1,4 ± 0,09
Elongation %	22 ± 3
Strength (gm/den)	5,9 ± 0,3
Shrinkage	4,2 ± 1,2
No. of crimps/cm	9 ± 1,2
Regain %	0,6
Oil %	0,12 ± 0,03

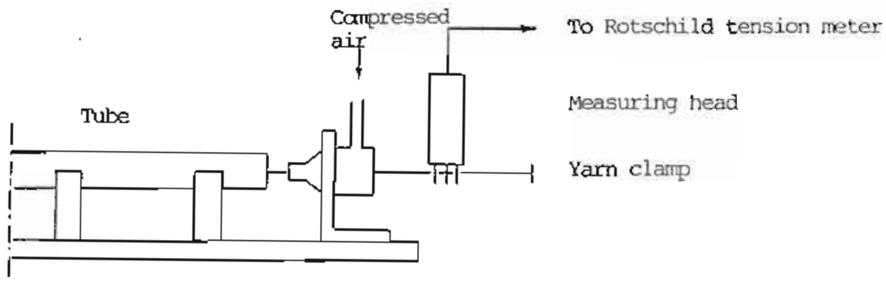

Fig. 1: Air drag force measurement

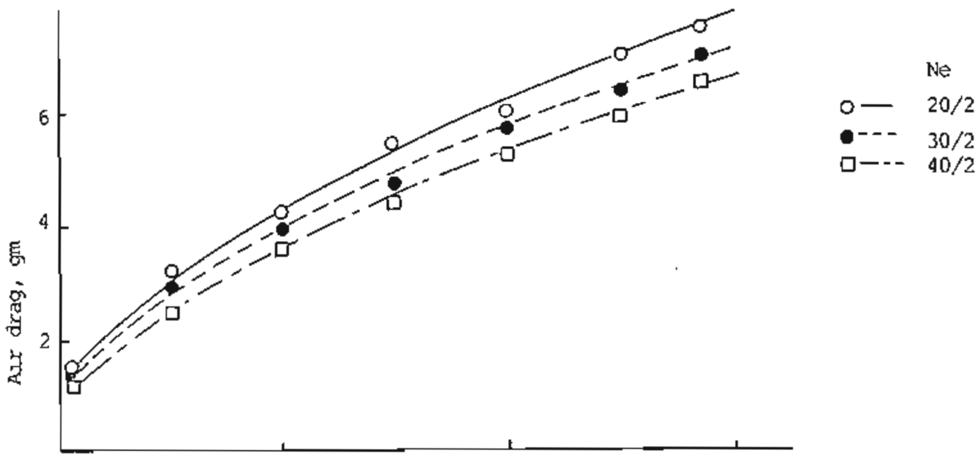

Fig. 2: Influence of yarn linear density on air drag

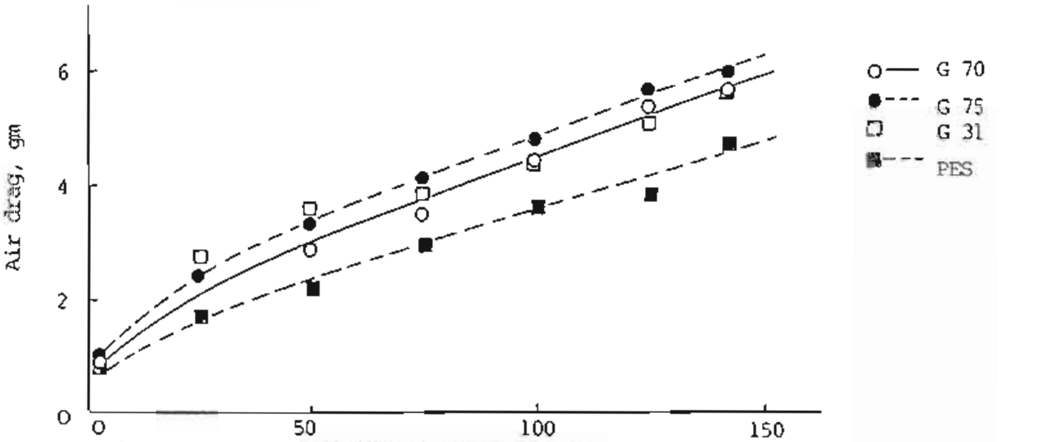

Fig. 3: Influence of fiber type on air drag, Ne 40

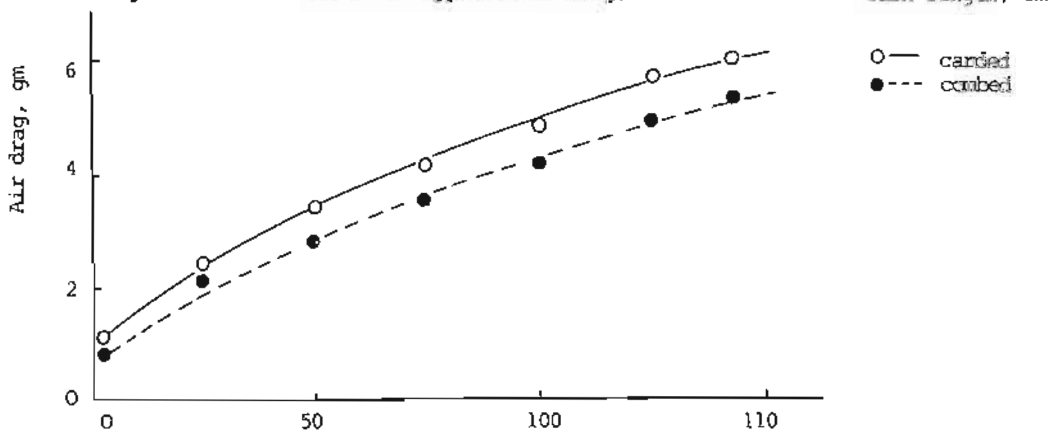

Fig. 4: Comparison between air drag on carded and combed Cotton G 75 yarn, Ne 40

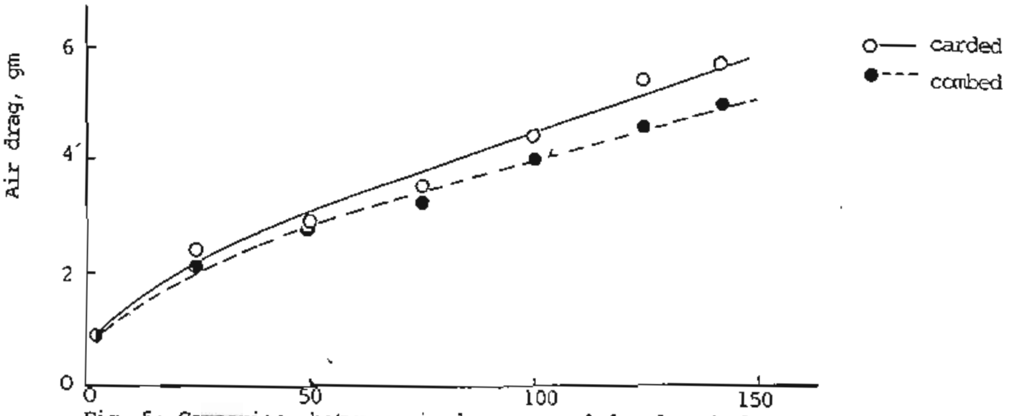

Fig. 5: Comparison between air drag on carded and combed cotton G 70 yarn, Ne 40

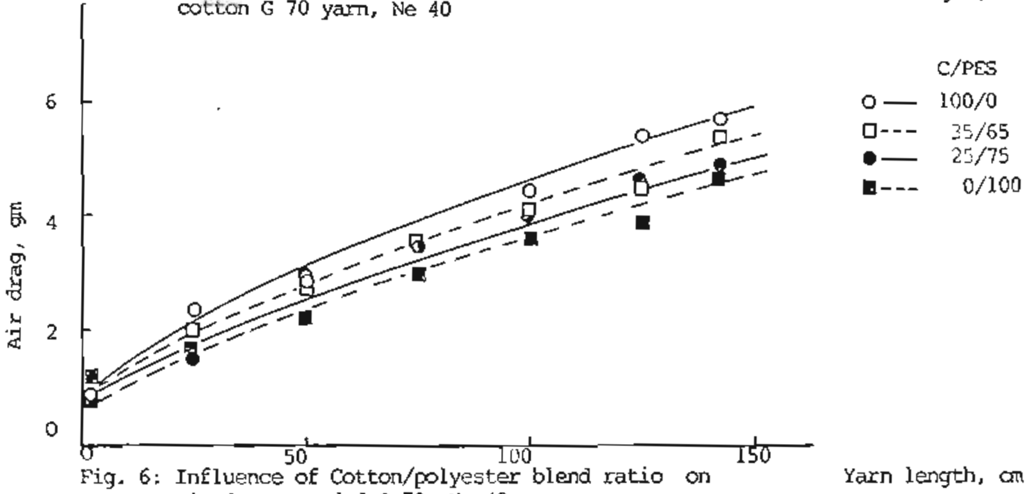

Fig. 6: Influence of Cotton/polyester blend ratio on air drag, carded G 70, Ne 40

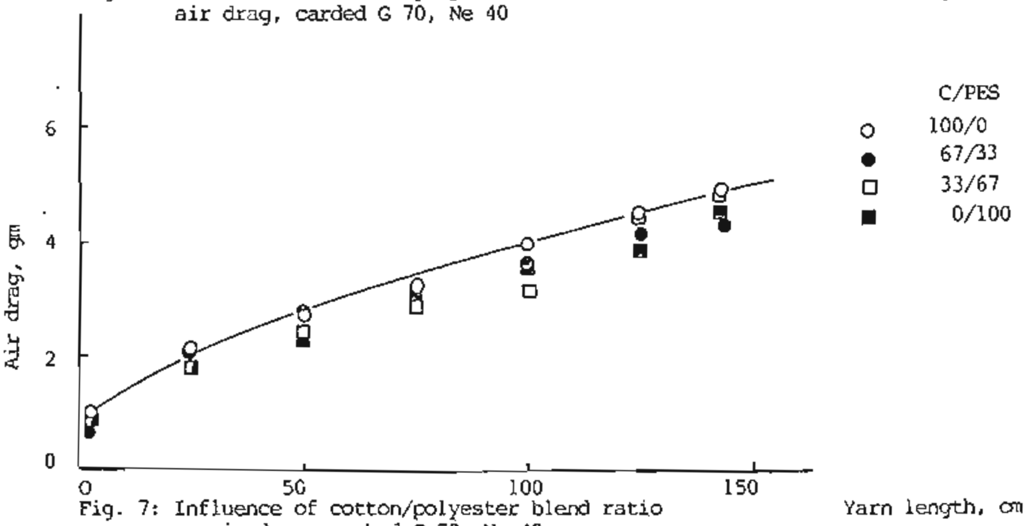

Fig. 7: Influence of cotton/polyester blend ratio on air drag, combed G 70, Ne 40

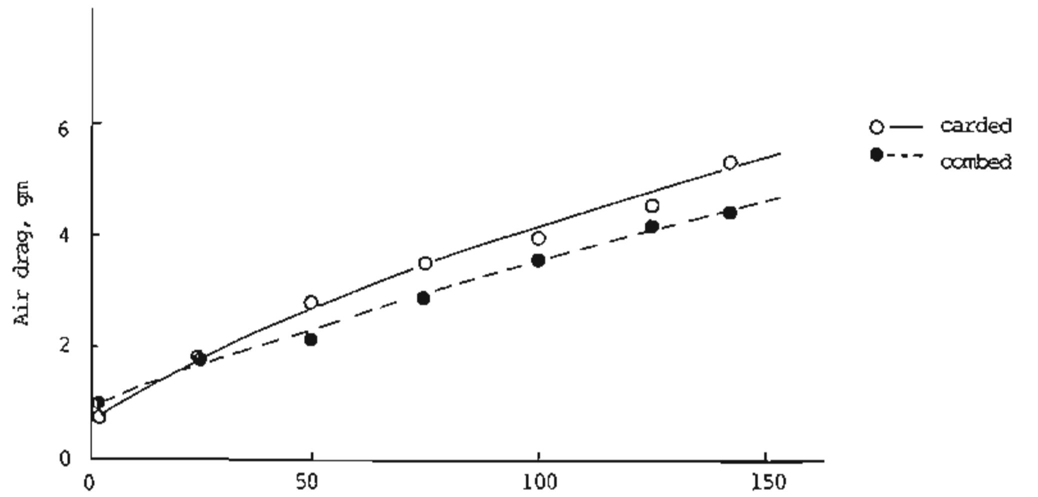

Fig. 8: Influence of cotton fiber in the blend on air drag, G 70, 50 C/50 PES, Ne 40

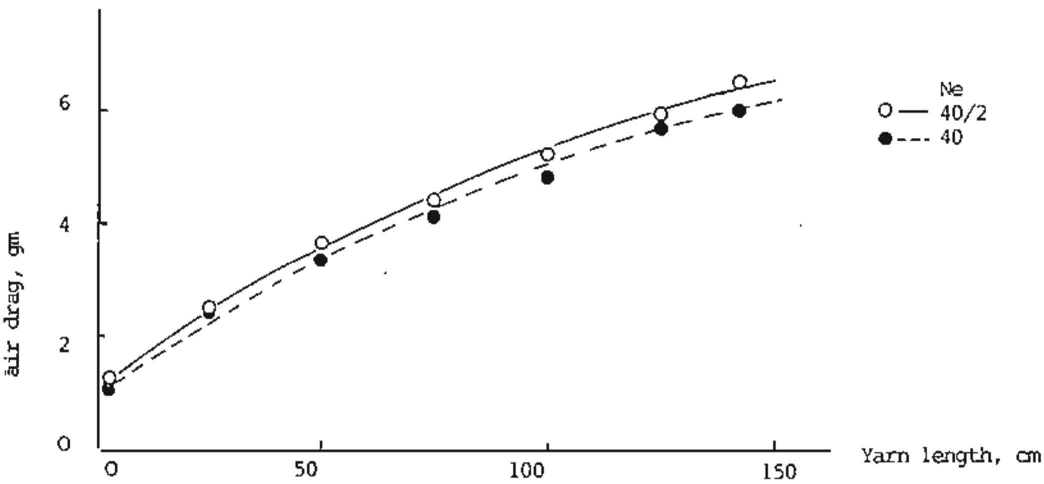

Fig. 9: Influence of plying on air drag, yarn twisted on two-for-one twister

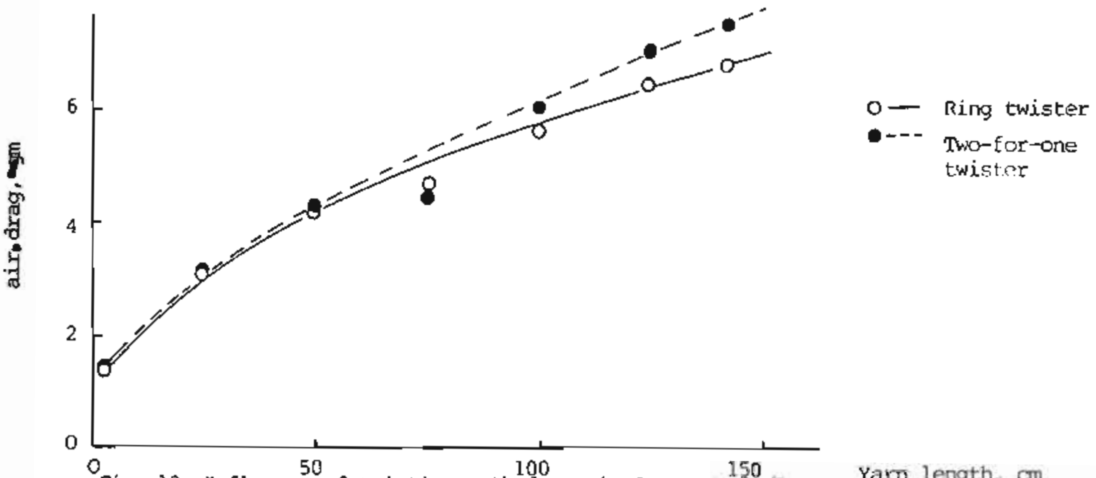

Fig. 10: Influence of twisting method on air drag, Ne 20/2

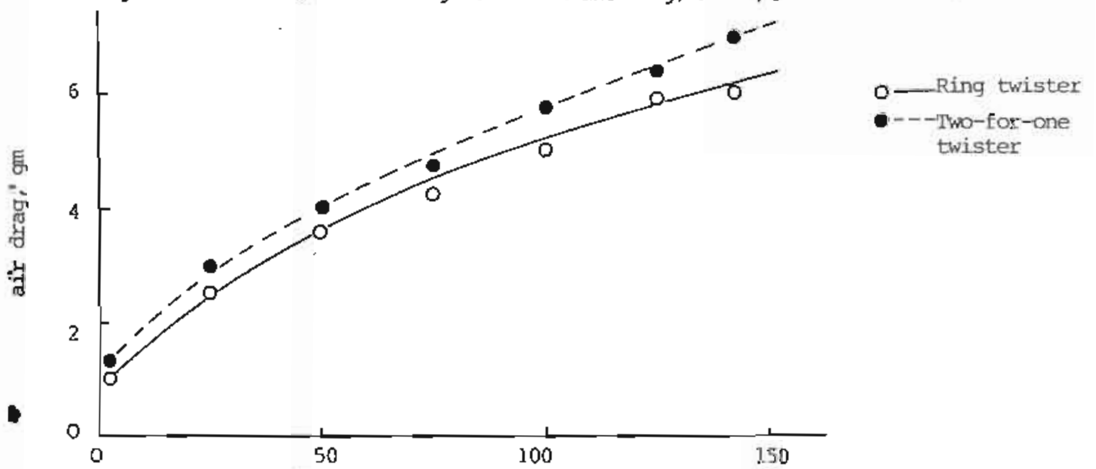

Fig. 11: Influence of twisting method on air drag, Ne 30/2

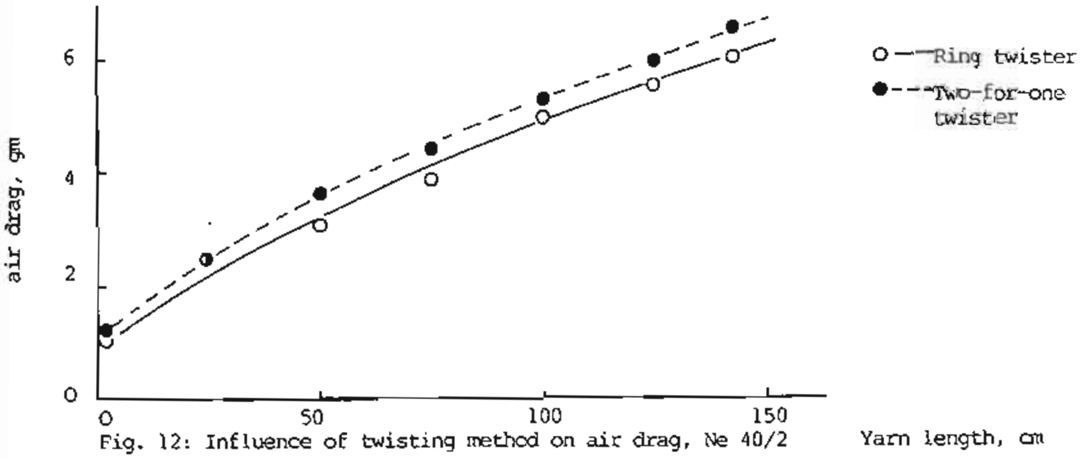

Fig. 12: Influence of twisting method on air drag, Ne 40/2

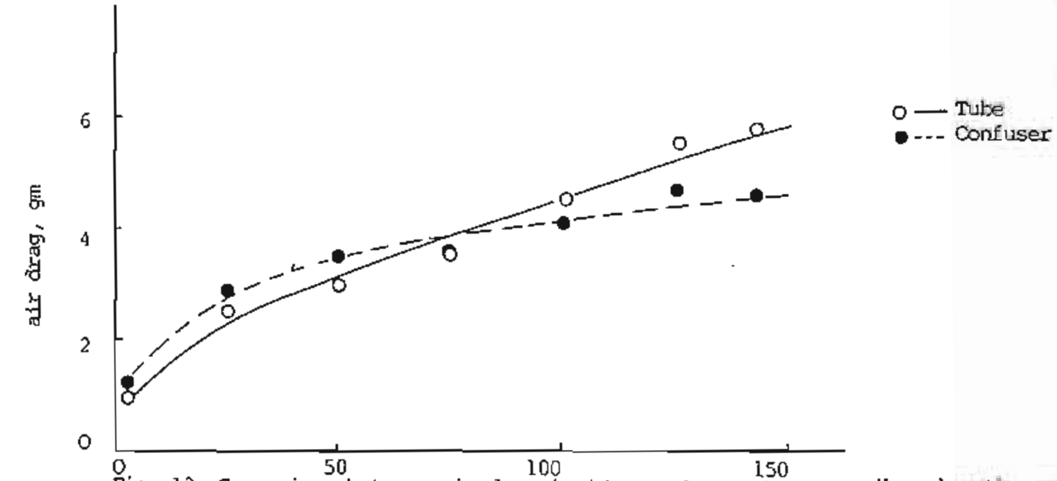

Fig. 13: Comparison between air drag inside complete tube 5/8 inch and confuser, Ne 30

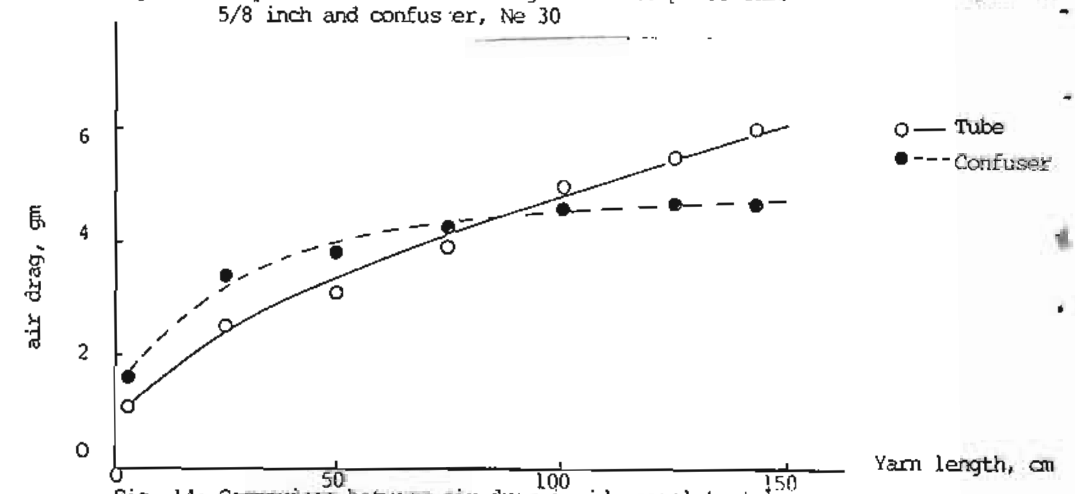

Fig. 14: Comparison between air drag inside complete tube 5/8 inch and confuser, Ne 40/2