

The Actual power Used to Produce the fabric by each of the basic mechanisms of the loom with respect to loom speed

By: Dr. Hashim Ali Salem
Sudan University of Science & Technology

College of Engineering

Department: Textile Engineering

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Abstract:-

The actual power used to produce the fabric was determined.

The picanol loom^[1] (4 president) was used for these Investigations. The actual power used by the sley , shedding and picking mechanisms of the loom was calculated and determined.

The computerized two – wattmeter designed and developed by Salem^[2] was used to measure the power consumption of each of the three basic weaving mechanisms. The effect of the loom speed on the actual power used to produce the fabric was also determined. It was found that nearly 23% of the total power consumption was used to produce the fabric while 77% of the power was dissipated as frictional and thermal losses.

المخلص:-

الطاقة الكهربائية الفعلية التي تستخدم لإنتاج القماش بواسطة ماكينة النسيج قد تم تحديدها في هذا البحث. إستخدمت ماكينة البكانول لإجراء هذه التجارب.

الطاقة المفيدة المستخدمة بواسطة حركات الدف وفتح النفس والحذف في ماكينة النسيج قد تم حسابها وتحديدها في هذا البحث. تم إستخدام الجهاز المحوسب لقياس الطاقة الكهربائية والمصمم بواسطة/ سالم^[2] لقياس الطاقة الكهربائية المفيدة المستخدمة بواسطة الحركات الأساسية الثلاثة في ماكينة النسيج.

تمت دراسة أثر السرعة على الطاقة المفيدة المستخدمة لإنتاج القماش. أثبت هذا البحث أن 23% من الطاقة الكهربائية تستخدم في إنتاج القماش بينما هناك 77% من الطاقة الكلية تذهب هدراً في شكل فقدان ميكانيكي وحراري.

1-Introduction:-

The demand for electric power continues to increase for both domestic and industrial sectors. The textile industry continues to be a major consumer of electric power particularly for motor drives.

The textile industry in general uses different energy sources^[3] oil , coal , gas & electricity for different processes. A report prepared by the Shirley institute^[4] for the department of industry stated that the textile industry (England) consumes about 5700 TJ (terajoules) of energy each year.

In Sudan the cost of electrical power receives a correspondingly small attention from management. If the power consumption of the weaving machine only is considered ,then the cost of electricity would be the main production cost especially in weaving mills where only grey fabric is produced. The conservation of energy^[5] is an essential step we should all work towards. There would be value in directing attention to power consumption in weaving, especially these days where the demand and price of electricity is increasing rapidly.

In this work an attempt is made to find the exact power used in producing the fabric. The three main basic weaving mechanisms namely (Sley, shedding and picking mechanisms) were investigated.

2. Materials & Methods:-

A series of experiments was conducted aimed to determine the actual power consumed in producing the fabric.

A computerized two – wattmeter designed by salem^[2] was used to measure the electrical power consumed by the various mechanisms of the loom. The loom was run at different speeds, firstly producing fabric having specifications given in Table (1.F) and secondly, after the warp yarns and cloth were removed and with no yarn in the shuttle. Loom speed was varied using different size motor pinions, ranging from 17 teeth to 22 teeth. The power consumption by the different mechanisms was determined by running those mechanisms alone, i.e., by disconnecting all other mechanisms and maintaining only the mechanisms being investigated. This technique of investigation

is identified in the results by the use of the subscript (0), i.e., $sley_0$, $picking_0$ and $shedding_0$.

The power actually consumed in producing the fabric. was calculated by subtracting the power consumed by the loom without material, from the power consumed by the loom with material. Then the actual power used in producing the fabric is calculated as a percentage of the power consumed by the mechanism with material. Only one fabric was produced and its specifications are given in Table (1.F).

Table.(1.F): The Specifications of the fabric woven on picanol loom

| Specification | Type |
|---|--|
| 1. material warp weft | Cotton Viscose Rayon |
| 2. Count (tex) warp weft | 084 149 |
| 3. Density (threads/cm) warp weft | 12 8 |
| 4. Crimp (%) warp weft | 4% 3% |
| 5. others Total no. of ends No. of shafts Reed sett Ends/ dent Width of fabric Design Drawing – in Weight of empty shuttle | 1860 2 27 (dents/ inch) (¹ / ₁) 155 cms Plain weave (¹ / ₁) In series 500.7 (gms) |

3. Results & Discussion:-

3.1 All mechanisms (TOTAL)

The Tables 1.G, 1.H and 1.I give the power consumed by the loom with material, without material and the actual power used in producing the fabric at different loom speeds.

It was found that the power consumed by all mechanisms (total) with material, without material and actual power used in producing the fabric increased with the speed of the loom. The results obtained are plotted in Figure (1).

The results tabulated on all the Tables are having four decimals as given by the digital technique^[2] used.

As shown in Figure (1), the power required to weave the fabric (used power) is quite low in comparison with the power required to keep the loom running even without material. Further, the power required to weave the fabric increases rapidly with an increase in loom speed. Over the speeds used, approximately 23% of the total power consumption is used to produce the fabric while (77%) is dissipated as frictional and heat losses. Min-Hao Michael ^[6] found a direct increase relationship between the power consumption and the temperature rise.

**Table.(1.G): power Consumption of Picanol loom
(with material)**

| mechanisms | Power in Watts | | | | | |
|-------------------------------|------------------|----------|----------|-----------|-----------|-----------|
| | Speed (revs/min) | | | | | |
| | 161 | 170 | 180 | 189 | 199 | 208 |
| All mechanisms (Total) | 789.6754 | 840.0570 | 959.0190 | 1020.0456 | 1142.8008 | 1223.3997 |
| Sley_o | 281.1177 | 289.9413 | 301.8963 | 334.6038 | 378.4200 | 423.0765 |
| Picking_o | 485.5334 | 520.4102 | 579.9915 | 620.3861 | 715.0917 | 775.2709 |
| Shedding_o | 340.0797 | 347.9919 | 371.9136 | 388.4181 | 413.0457 | 437.0084 |

**Table.(1.H): power Consumption of Picanol loom
(without material)**

| mechanisms | Power in Watts | | | | | |
|-------------------------------|------------------|----------|----------|----------|----------|----------|
| | Speed (revs/min) | | | | | |
| | 161 | 170 | 180 | 189 | 199 | 208 |
| All mechanisms (Total) | 623.1365 | 658.7019 | 738.7296 | 780.3954 | 860.0717 | 914.9756 |
| Sley_o | 186.7780 | 190.2864 | 195.4043 | 214.2830 | 238.5026 | 264.5715 |
| Picking_o | 480.3383 | 510.7272 | 577.9667 | 600.6057 | 710.7317 | 775.9929 |
| Shedding_o | 248.9100 | 251.1723 | 261.6869 | 269.4886 | 277.5189 | 291.6798 |

**Table.(1.I): power Consumption of Picanol loom
(used power)**

| mechanisms | Power in Watts | | | | | |
|-------------------------------|------------------|----------|----------|----------|----------|----------|
| | Speed (revs/min) | | | | | |
| | 161 | 170 | 180 | 189 | 199 | 208 |
| All mechanisms (Total) | 166.5389 | 181.3551 | 220.2894 | 239.6502 | 282.7291 | 308.4241 |
| Sley_o | 94.3397 | 99.6549 | 106.4920 | 120.3208 | 139.9174 | 158.5050 |
| Picking_o | 5.1957 | 9.6830 | 1.9480 | 19.7804 | 4.3600 | 0.7220 |
| Shedding_o | 91.1697 | 96.8196 | 110.2267 | 118.9295 | 135.5268 | 145.3286 |

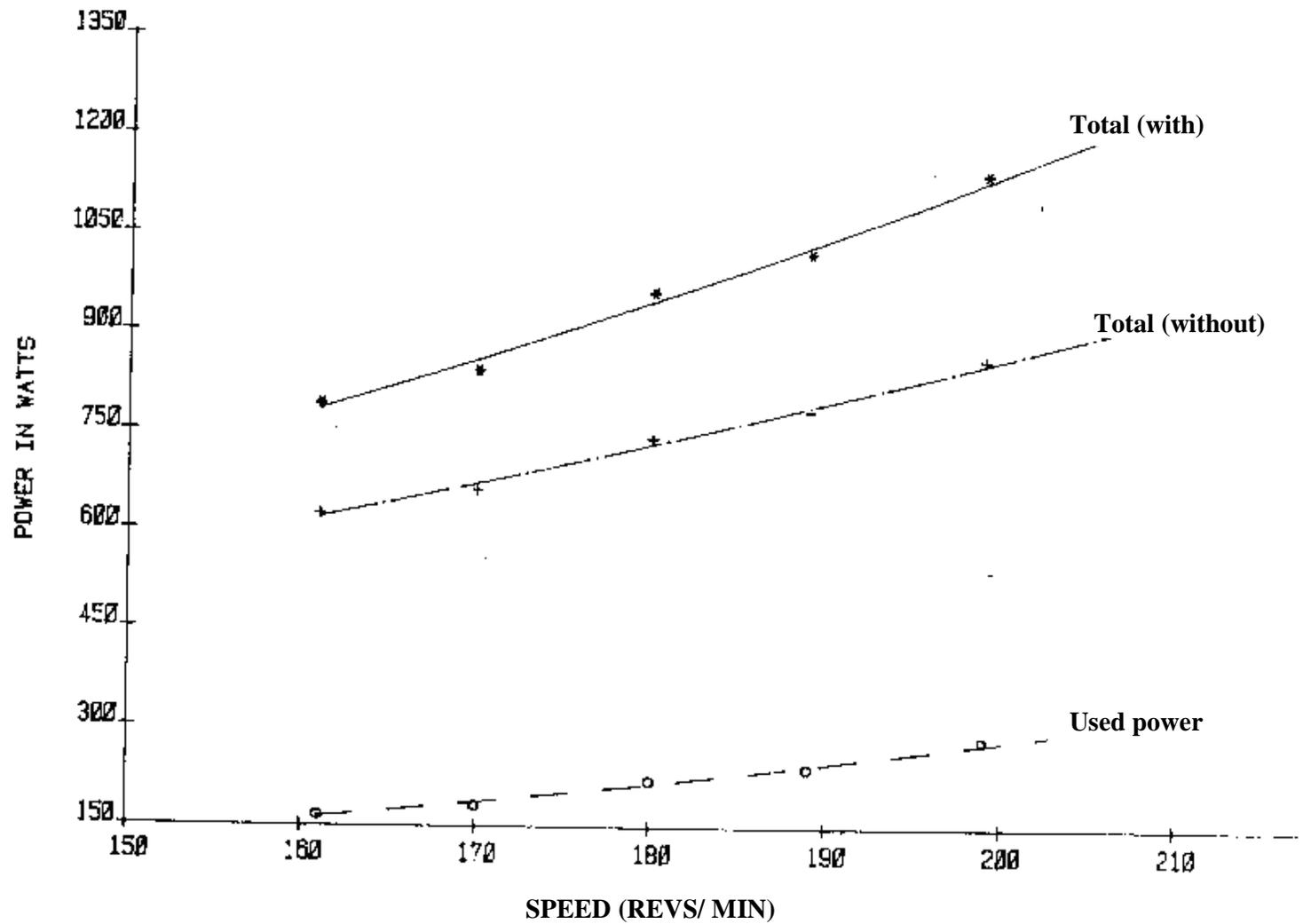


Fig. (1): The relationships between the power consumed by all mechanisms (Total) with & without material, power actually used in producing the fabric & the speed of the picanol loom

3. 2. SLEY Mechanism:-

The power consumed by the sley mechanism with material, without material and the useful power used in producing the fabric, increases with the speed of the loom. The results obtained are plotted in Figure (2). The actual power used by the sley in producing the fabric increases rapidly with loom speed. This quantity power is quite low in comparison to the power required to keep the loom running even without material. The results obtained showed that approximately 30% of the power consumed by the sley mechanism is used in producing the fabric while 70% dissipated as heat and frictional losses.

At lower loom speeds a gradual increase in the amount of the power consumed by the sley mechanism was noticed. While at higher speeds a sharp increase was observed.

The results tabulated in Table (1.I) indicate that the sley action accounts for approximately half of the total power used to produce the fabric. This can only be an approximation, because the Figures derived by the technique used (which take the sley in isolation) cannot account for interferences between the mechanisms that have been referred to earlier and which influence the absolute level of power consumption for individual mechanisms.

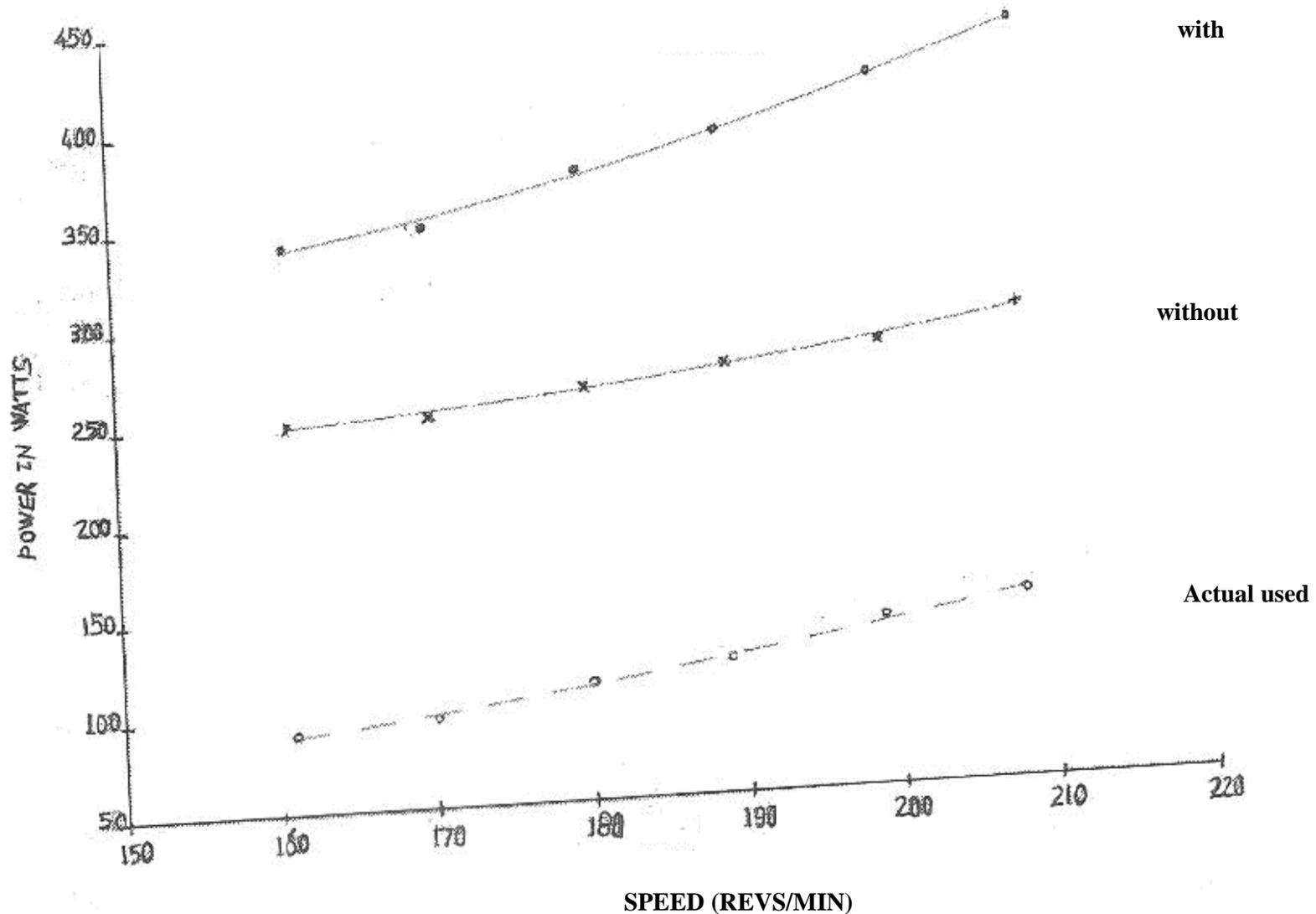


Fig. (2): The relationships between the power consumed by the sley mechanism with & without material, power actually used by the sley in producing the fabric & the speed of the picanol loom

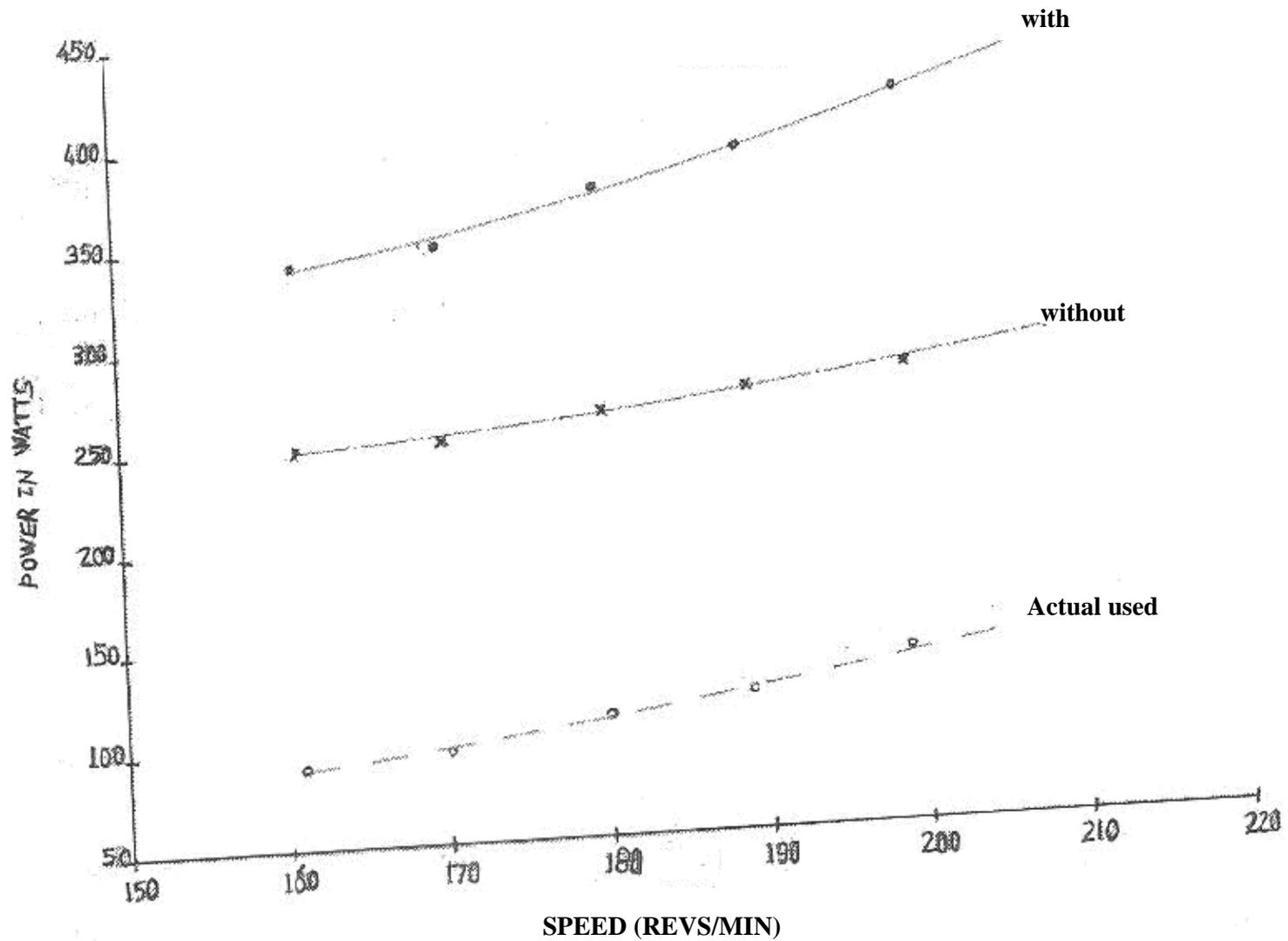


Fig. (3): The relationships between the power consumed by the shedding mechanism with & without material, power actually used by the shedding mechanism in producing the fabric & the speed of the picanol loom

Table. (1.J): % Actual power used in producing the fabric by various mechanisms

| mechanisms | | | | | | | | |
|------------------------|--------------|----------|--------------|----------|--------------|----------|--------------|----------|
| All mechanisms (TOTAL) | | | Sley | | Shedding | | Picking | |
| Speed revs/min | % Used power | % Losses |
| 161 | 21.0895 | 78.9105 | 26.8083 | 73.1917 | 33.5588 | 66.4412 | 1.0701 | 98.9299 |
| 170 | 21.5884 | 78.4116 | 27.8224 | 72.1776 | 34.3707 | 65.6293 | 1.8606 | 98.1394 |
| 180 | 22.9703 | 77.0297 | 29.6377 | 70.3623 | 35.2744 | 64.7256 | 0.3359 | 99.6641 |
| 189 | 23.4941 | 76.5059 | 30.6189 | 69.3811 | 35.9592 | 64.0408 | 3.1884 | 96.8116 |
| 199 | 24.7400 | 75.2600 | 32.8116 | 67.1884 | 36.9741 | 63.0259 | 0.6097 | 99.3903 |
| 208 | 25.2104 | 74.7896 | 33.2553 | 66.7447 | 37.4646 | 62.5354 | 0.0000 | 100.0000 |
| Mean % | 23.18 | 76.82 | 30.16 | 69.84 | 35.60 | 64.40 | 1.1775 | 98.8225 |

3. 3. Shedding Mechanism:-

The power consumed by the shedding mechanism with material, without material and the power used in producing the fabric increases with the speed of the loom. The results obtained are plotted in Figure (3). Table (1.I) indicates that the shedding mechanism accounts for approximately half of the power used in fabric formation. This can only be an estimate for the reasons discussed earlier.

The actual power used by the shedding mechanism for producing the fabric was also quite low. As shown in Table (1.I), only 36% of the power consumed by the shedding mechanism was used in producing the fabric and 64% of the power dissipated as mechanical losses.

3. 4. Picking Mechanism:-

Tables (1.G) and (1.H) show that for all range of speeds used, picking (with and without material) has the highest consumption of power of all the other individual mechanisms. Further, it can be seen that the energy required for picking increases with loom speed. Table (1.I), where the power consumed in forming the fabric is tabulated, shows that the power used in picking is very low in relation to other mechanisms and to the total power requirement. The Figures do not reveal a trend with respect to speed.

Due to the high mechanical losses experienced by this mechanism it is of interest to mention that this mechanism is an unbalanced mechanism. This finding agreed also with Alexsurt^[7] findings.

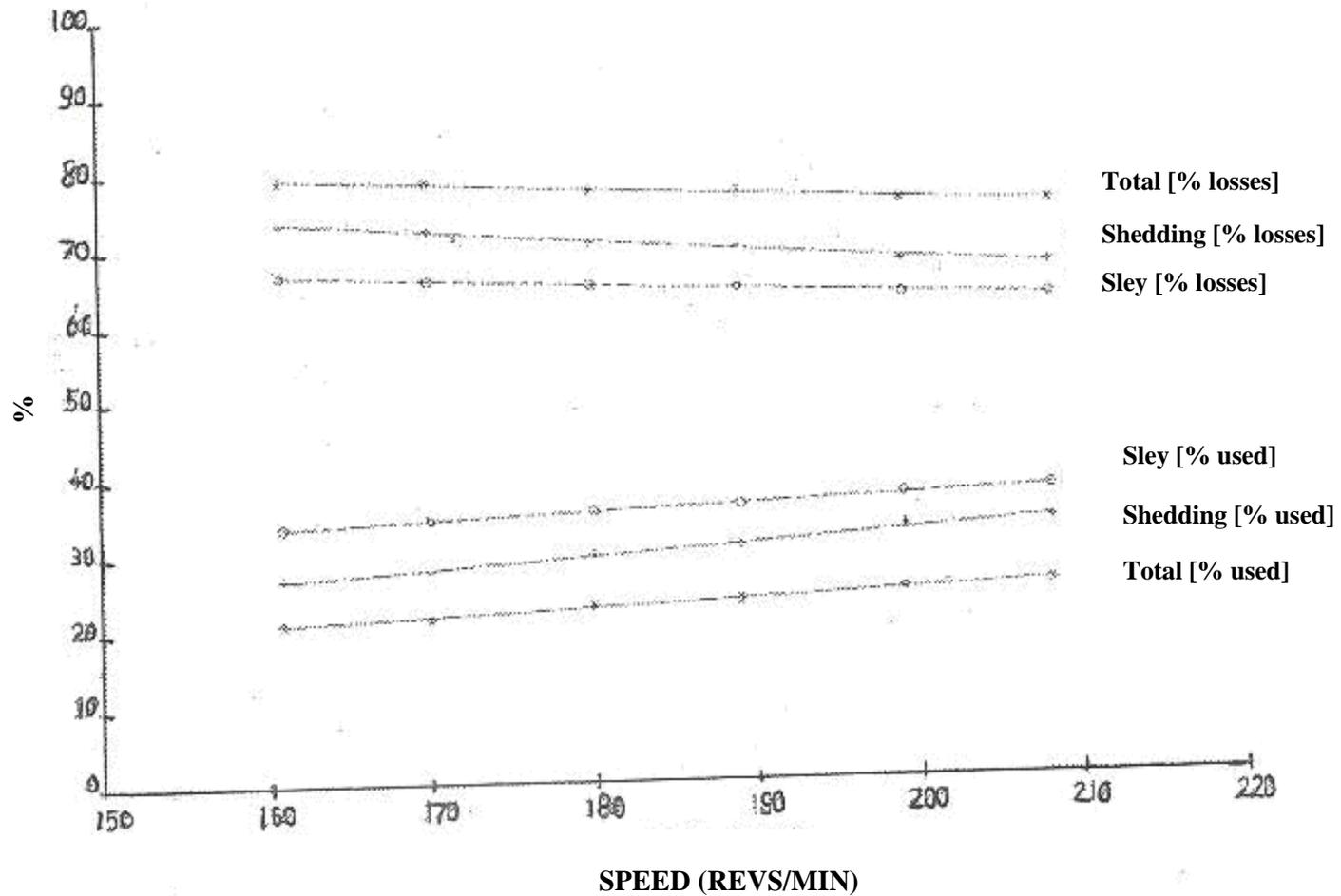


Fig. (4): The % Used and lost power of picanol loom

3. 5. MECHANICAL (frictional) LOSSES:

Table (1.J) shows the actual power used by all mechanisms, shedding, and the sley mechanisms at different speeds calculated as a percentage of the power consumed by the same mechanisms with material in the loom. The balance of power consumed is dissipated as mechanical and heat losses.

The mean % power used in producing the fabric and the total mean percentage power losses are also given in Table (1.J). It is clear from these results that only small part of the power input to the motor was actually used in producing the fabric and the rest of the power dissipated. The results of Table (1.J) are plotted against the speed of the loom in Figure (4).

Figure (4) shows that the sley and the shedding (tappets) mechanisms of the picanol loom are inadequate from the power consumption point of view. These mechanisms demand high power and actually use little power in producing the fabric. Most of the power consumed by these mechanisms is dissipated as mechanical and thermal losses. Inadequacy of the picking mechanism from the power consumption point of view was not doubted. If the mean % power used in producing the fabric is considered as the power efficiency of the loom then the shuttle loom gave a very low result average 23.2% over the speed range used.

4. CONCLUSION :-

The actual power required to weave the fabric was found to be quite low in comparison to the power required to keep the loom running even without material. This power is found to increase significantly with the increase of speed. It was found that approximately 23% of the total power consumption is used to produce the fabric while 77% of the power is dissipated as mechanical & thermal losses.

The sley, the shedding and the picking mechanisms of the loom investigated were found inadequate from the power consumption point of view. These mechanisms consumed the bulk of the power required to run the loom. The percentage of power consumed by each mechanism actually producing fabric is only approximately 30%, 36% and 1% respectively.

The techniques described in this work allow for analysis of the energy intensity in conventional picking which may be applied in optimizing the use of this particular mechanism.

5- References:-

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