# EFFECT OF THE DEFLECTION OF SQUEEZING ROLLERS IN SIZING BOX ON THE SIZED YARNS

# تاثير انحناء اسطوانات العصر فى صندوق البوش على نسبة البوش فى الخيوط

By

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## الخلاصة :

فى عملية البوش يتم عصر الخيوط للتخلص من كميات البوش الزائدة فى الخيوط وذلك بواسطة أسطوانات العصر فى حوض البوش.

نتيجة تحميل اسطوانات العصر بين الاطراف يتم تقوس اسطوانة العصر العليا لاعلى واسطوانة العصر السفلى لاسفل وتكون المسافة بين تقوس اسطوانات العصر فى المنتصف اكبر ما يمكن. نتيجة هذا التقوس يتم عصر الخيوط فى الاطراف بدرجة أعلى عن المنتصف لخيوط السداء.

وفى هذا البحث تم دراسة تاثير تقوس اسطوانات العصر على توزيع نسبة البوش فى خيوط السداء وكذلك تاثير الكثافة الخطية للخيوط على نسبة البوش فى الخيوط .

## ABSTRACT

In this work the percentage of sizing material in the yarn was measured across the warp sheet after the sizing process.

The considered parameters in this experiment are :

- yarn count
- yarn material

The deflection of squeezing rollers affect the distribution of the sizing material across the warp sheet. It was found that, the percentage of the sizing material in the middle of the warp sheet is higher than in sides.

The deflection of the squeezing rollers was theoretically calculated for a Zell-sizing machine.

## INTRODUCTION

The sizing process is considered one of the important processes required to achieve a good weaving process and improve fabric quality and loom efficiency. The distribution of sizing material in warp threads should be homogeneous.

In Ref. /1/ it was found that the degree of cohesion increases with increasing the sizing percent in warp threads, up to sizing percent 10% the rate of increasing in the degree of cohesion is high, and for a sizing percent more than 10% the rate of increasing in the degree of cohesion is relatively low.

In Ref. /2/ and /4/ it was found that the sizing percent in warp threads decreases with increasing the pressure of squeezing rollers. As shown in Ref. /4/ the open end yarns have a higher value of size percent than the ring-spun yarns when the two types of yarns are under the same other conditions.

It was found in Ref. /2/ that the variation in sizing percent affects the hairiness of warp threads, i.e. with increasing the sizing percent the hairiness of warp threads will be decreased. In Ref. /3/ it was found that the variation in yarn structure due to the effect of yarn friction decreases with increasing the size percent of warp threads. It was found also that the abrasion cycles increases with increasing the sizing percent in warp threads.

In Ref. /5/ a numerical example for the deflection of squeezing rollers was calculated. In this experimental work the sizing percent in the yarn across warp sheet was measured, and the effect of the deflection for squeezing rollers on the distribution of sizing material across warp sheet was discussed.

## THEORETICAL ANALYSIS

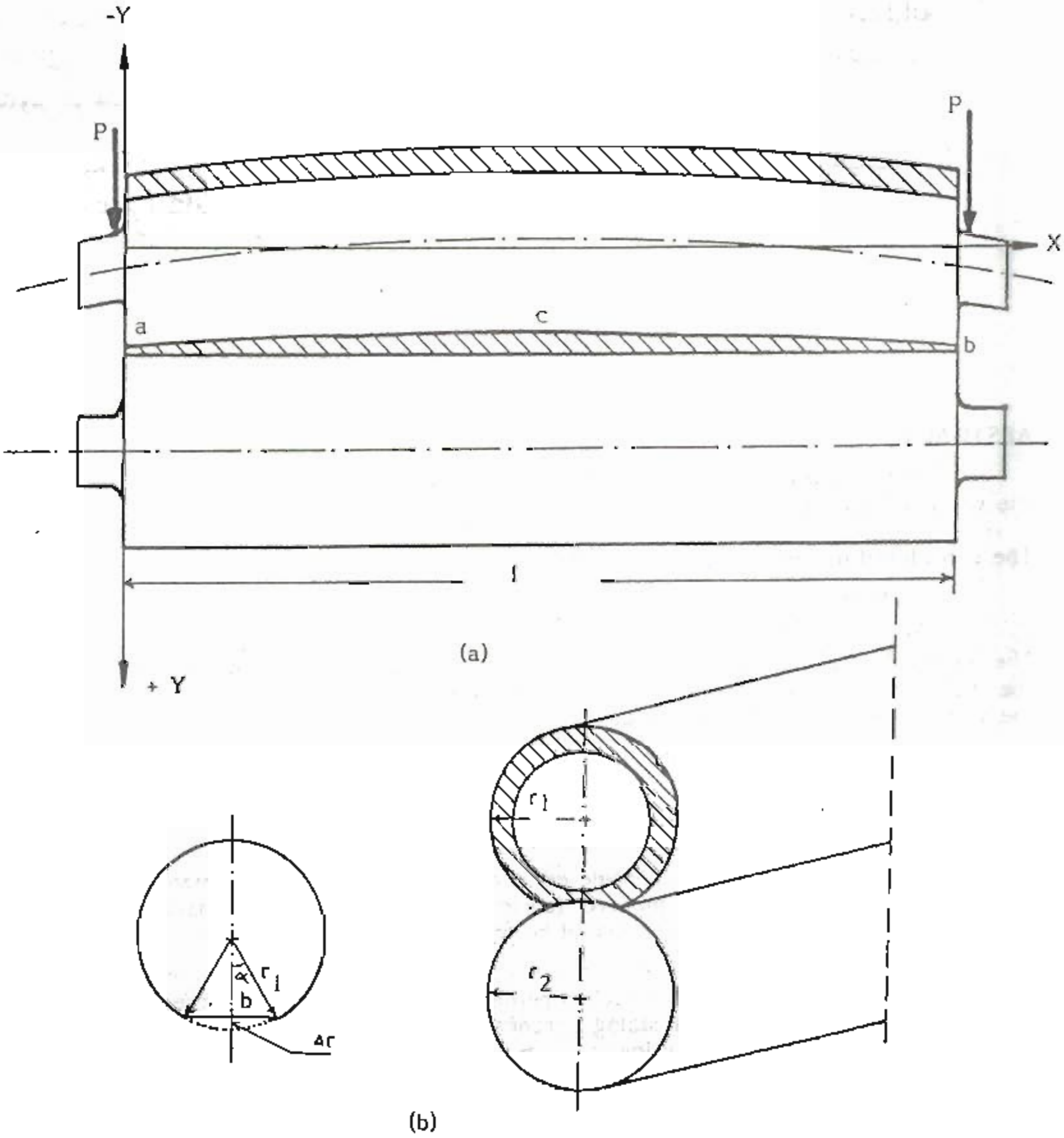

Fig. (1) : Deflection of squeezing rollers

As shown in Fig. (1.a) the arrangement of squeezing rollers, the two rollers are made from steel material. The upper squeezing roller is coated with a rubber material and loaded at the ends.. By neglecting the deflection of the lower squeezing roller, then the problem is considered as a loaded beam on elastic foundations. Fig.(1.b) shows the cross sectional deflection for the upper squeezing roller due to total load 2P.

According to Ref./6/the equation of elastic curve for a beam supported on elastic foundations and loaded at its ends can be described as followes:

$$Y_a = Y_b = \frac{2PB}{k} \cdot \frac{\text{Cosh } Bl + \text{Cos } Bl}{\text{Sinh } Bl + \text{Sin } Bl}$$

$$Y_c = \frac{4PB}{k} \cdot \frac{\text{Cosh } Bl/2 \cdot \text{Cos } Bl/2}{\text{Sinh } Bl + \text{Sin } Bl}$$

Where :

$$Bl = \sqrt[4]{\frac{k}{2EI_z}} \cdot l$$

$E$ = modulus of elasticity for upper squeezing roller (steel material)

$I_z$ = cross section moment of inertia for the upper squeezing roller

$k$ = modulus of foundation

$$k = \frac{\text{total acting load}}{\text{depressed length of rubber . length of squeezing roller}}$$

The deflection of rubber can be calculated by using the following equation /7/.

$$b = \sqrt{\frac{4}{\pi} \cdot \frac{(1 - v^2)\, 2P \left(\frac{1}{E_1} + \frac{1}{E_2}\right)}{l \left(\frac{1}{r_1} + \frac{1}{r_2}\right)}}$$

where,

2b = width of depressed rubber
V = poisson - number
$E_1$ = modulus of elasticity for rubber material
$E_2$ = modulus of elasticity for lower squeezing roller

and the depressed length of rupper is $(r_1 - r_1 \cos\alpha)$

Numerical Calculations:

For a Zell-sizing machine the following data are given:

- diameter of the upper squeezing roller (without rupper) = 172 mm

- diameter of the lower squeezing roller = 200 mm
- length of squeezing rollers = 1915 mm
- thickness of rubber = 14 mm
- total acting loads up to 40 KN

and,

$E_1 = 120\ N/mm^2$ , $E_2 = 21.10^4\ N/mm^2$

$V = 0,5$ , $b = 2,88$ mm

$\Delta r = 0.04$ mm $k \doteq 522\ N/mm^2$

The deflection is $Y_a = Y_b = 0.18$ mm

$Y_c = -0.0235$ mm

Fig.(2) shows the deflection of elastic line for upper squeezing roller. The variation in the thickness of rubber at point C is smaller than at the sides of squeezing roller (point a,b). This variation in the depressed rubber thickness leades to a variation in the sizing percent in warp yarns, and this is proved in the experimental work.

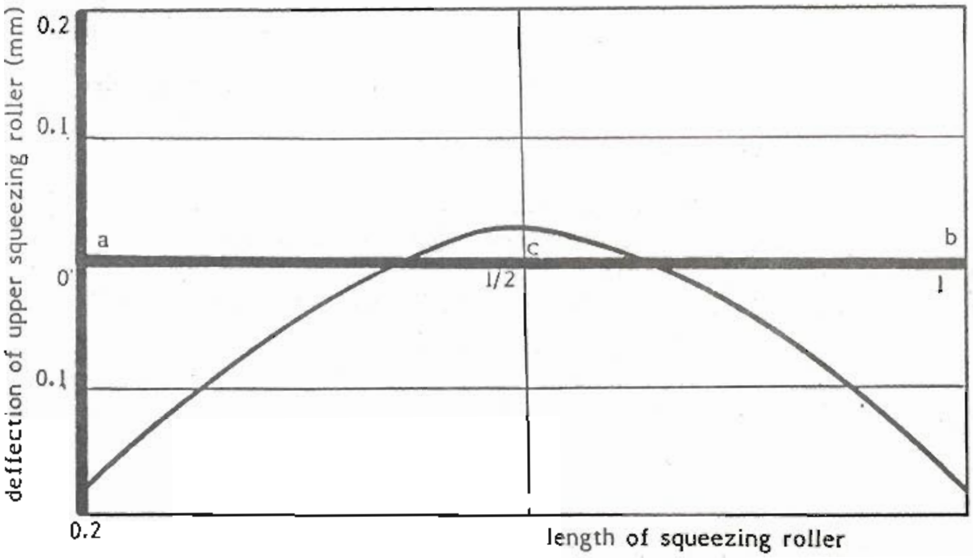

Fig. (2) Deflection of elastic curve versus length of squeezing roller.

## EXPERIMENTAL

After the sizing process a six specimens were selected across the warp sheet. At standard conditions the weight of the sized yarns for each group was measured. The chemical processes for desizing these groups were carried out and the weights of the desized groups of yarns were recorded. The standard conditions are R.H. 65% and T 21C°.

The size percent can be calculated as followes :

$$\text{size percent} = \frac{\text{weight of sized yarns-weight of desized yarns}}{\text{weight of sized yarns}}$$

As shown in Figs. (3, 4, 5 and 6) the size percent versus width of warp sheet was plotted for different yarn materials.

Specification of Sizing Machine

- machine type : Zell-sizing machine
- speed of warp sheet 50 - 80 m/min
- the specifications for squeezing rollers and the acting load were described previously in the numerical calculations.

## DISCUSSION

- Asshown in the theoretical analysis the rubber layer on the upper squeezing rollers was depressed against thelower squeezing roller. But due to the support of the upper squeezing roller on elastic foundations (rubber material) with a side load P the deflection of the upper squeezing roller at the sides is more than that at the middle. Due to this form of deflection the depressed rubber layer at the sides is higher than that at the middle. This leads to a variation in the degree of squeezing process (more size percent in yarn at the middle than the sides).

- From the equation of deflection, the degree of deflection is a function of the following parameters:

  - length and diameter of squeezing rollers,
  - total acting load on squeezing rollers, and
  - modulus of elasticity for steel and rubber materials.

- It was found in the experimental work that the size percent is variable across the warp sheet and has a definite distribution. By measuring the sizing percent in the warp yarns under standard conditions, it was found that the size percent at the sides of warp sheet is lower than that at the middle. These results are the same for all different yarn counts and yarn materials.

- The measurments show that the size percent increases with increasing the linear density of yarn

## CONCLUSIONS

- The irregularity of size percent across warp sheet can be improved by modifying the characteristics of squeezing rollers as follows:

  - the thickness of the coating rubber for upper squeezing roller must be varied along the squeezing roller. (increased gradually from the sides towords the middle of squeezing roller).

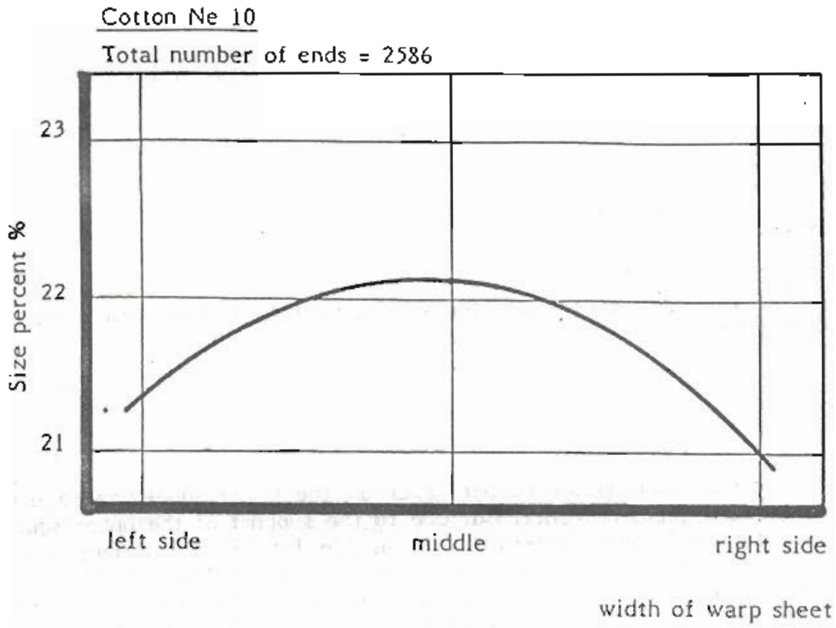

Fig. (3) : Distribution of size percent across warp sheet

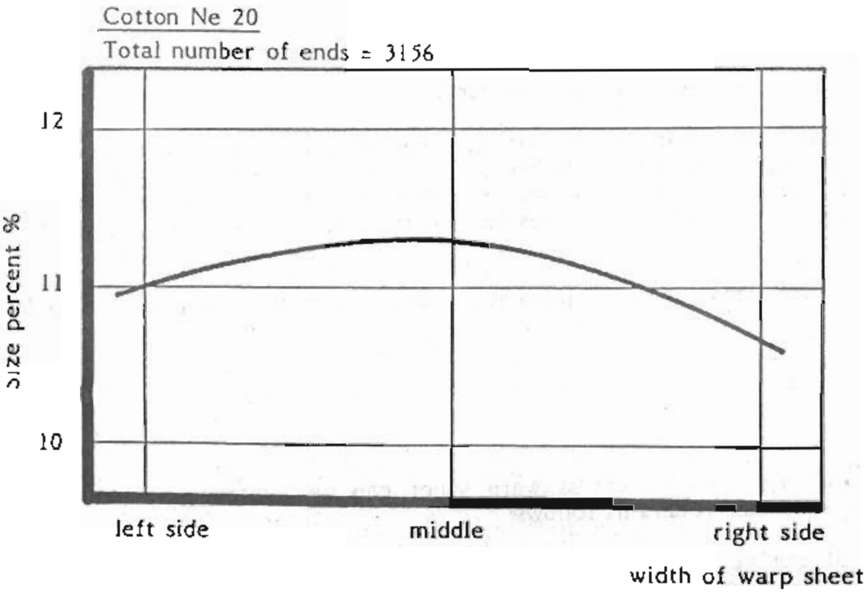

Fig. (4) : Distribution of size percent across warp sheet

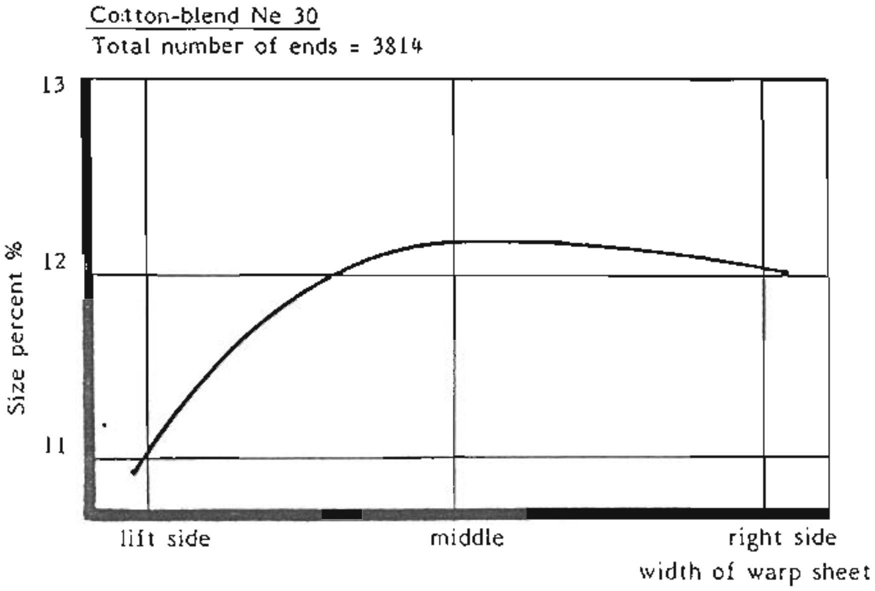

Fig. (5) : Distribution of size percent across warp sheet

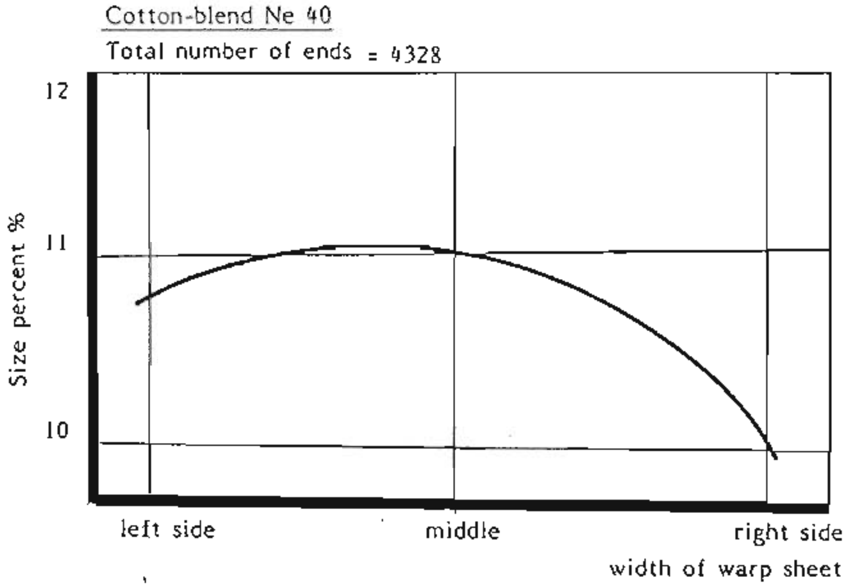

Fig. (6) Distribution of size percent across warp sheet

- the rubber stiffness (shore) must be low at the sides of squeezing roller than at the middle
- the stiffness of steel material for upper squeezing-roller must be high as allowable as possible to decrease the deflection of elastic curve.
- some references show that the size percent decreases with decreasing the linear density. But it was found in this measurement that size percent decreases with increasing the linear density. This is due to the effect of the other parameters on sizing percent. From these parameters are:

  --degree of pressure between squeezing rollers
  - concentration of sizing solution in the size box.

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