

## The calculation of the pile length and its height in pile fabrics

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**Abstract:** In this article, the consumption of 3 types of threads used for a towel of size 80\*90 cm is calculated in a mathematical way. Thread consumption was also calculated in samples of different weights of this type of towel.

**Keywords:** density, towel, warp yarn, weft yarn, shortening, shrinkage, pile part.

### Introduction

Terry fabrics are used in various fields because of their water absorption properties. Piles are formed on one or both sides by the variable periodic movement of the reed or cloth fell position, mostly over three picks. According to this principle, the first two picks are beaten up by the short movement of the reed some distance before the cloth fell position. In the third pick, the reed makes an exact movement, and all three picks are carried up to the cloth fell position. During this movement, the three picks slide between the ground warp yarns. The pile warp yarns move forward together with three picks and take on the pile form. If piles are to be formed on the surface of a terry fabric, the pile warp yarns must be over the third and first picks; similarly, if the piles are to be formed on the back side of a terry fabric, then the pile warps must be under the third and first picks.

Terry fabrics must be produced at a certain weight per square metre, using mostly 100% cotton yarns as weft-, ground- and pile warp yarns. Certain yarn counts, such as Ne20/2, Ne24/2, Ne16/1 1), and warp density are used by factories producing terry fabrics. After the ground and pile warp yarns are prepared and drafted as one ground and one pile warp yarn, the weight per square metre of a terry fabric is adjusted by changing the pile height, or in some cases the weft density. Generally, the trial and error method is used in the terry fabric industry to adjust the weight per square metre; this method is based on experience, and therefore requires an experienced person to do the adjustment. The warp density, weft density and pile height should be changed by keeping a balance among them in adjusting weight per square metre. Otherwise, the weight per square metre, the widthwise and lengthwise contractions, pile height and shearing waste of a terry fabric will not attain optimum values.

### 1. Materials and methods

For a 50x90 size towel, 6 rows are woven on 1 knitting machine.

- The number of threads on the floor (for 6) - 4328 pieces.  $N_m = 34/2 = 17$  tex. (721.33 pcs for 1 towel)
- Argoq thread  $N_m = 27/1$  (37.03 tex) for 6 towels, length by width 370 cm.  $370/6 = 61.66$  cm for 1 towel. The density of 1 cm of rope is 16, or the number of ropes in 1 meter is 1600.
- The number of threads in a pile (for 6 towels - 3600 pieces, for 1 towel 600 pieces.  $N_m = 40/2$ ,  $N_e = 24/2$ , 5 0.0 tex.

The weight of a 50x90 cm towel with surface density of 500gr/m (50x90) = 450 cm<sup>2</sup> = 45m<sup>2</sup>. 500 x 0.45=2.25 gr.

- We determine the weight of the threads on the floor in 1 piece of towel
- The length of the finished towel is 90 cm
- The length of the edge is (2\*2) = 4 cm

The amount of shortening in the process of weaving and finishing is 12.6% of the total length of the weaving loom (90+4)\*1126=105.84cm=1.0584 meters based on the conducted experiments.

The length of the floor for 1 towel: 721.33\*1.0584 = 763.45 meters

Its weight: 0.76345\*58.8=44.89gr.

The weight of yarn used for 1 towel can be calculated as follows:

$$C_{\text{ra}} = \frac{L_{\text{3aM}} * Z_a * B_a * T * gr}{n}$$

Here - the  $L_{\text{3aM}}$  length of ironing towels in cm.

$Z_a$ - the density of weft thread in 1 cm.

$B_a$ - the total width of the towels is in m.

The linear density of T-rope yarn is in tex.

n- the number of towels to be woven in one full machine .

For our example.

The weight of hemp thread used for 1 towel.

$$C_{\text{ra}} = \frac{1.0584 * 1600 * 3.7 * 37.03}{6} = \frac{232019,9}{6} = 38,67gr$$

weight of ground yarn and rope threads used for 1 piece of hair q:

$$44.89+38.67 = 83.56gr$$

Surface of 1 finished towel: 0.5\*0.9 =0.45M<sup>2</sup>

And its weight is 500\*0.45 =225gr.

One hair weighs 225-83.56 = 141.44 grams.

The length of the finished towel is 90 cm, and the pile part is 86 cm. According to their reduction, the length is  $88 * 1.126 = 99.08$  cm. and the length of the hair on the shore is  $105.84 - 99.08 = 6.76$  cm or the length of one towel is  $6.76 \text{ cm} * 600 = 4056$  cm or 40.56 meters. Its weight is equal to  $0.04056 * 50 = 2.08$  gr.

The weight of the national price of wool used for 1 piece of towels is  $141.44 - 2.08 = 139,412$  gr. And its length is  $139,412 / 50 = 2,788$  km.

The number of loops on the length of 1 piece of hair in the looped part of the towel is equal to: (1 loop is woven after 3 loops)  $(99.08 * 16) / 3 = 528$ .

The total number of carpets in 1 hair is  $528 * 600 = 316800$  pieces. The length of 1 ring is  $2788000 / 316800 = 8.8$  mm.

His height and  $8.8 / 2 = 4.4$  mm .

Tables 1-2 show the height of loops and weights of warp and weft threads in towels measuring 80\*90 cm with different linear densities calculated by the proposed method.

The number of threads used for a 50x90 fluffy towel

**1 Table**

| No | Thread type                                     | Surface density gr/m <sup>2</sup>             |       |                       |       |                      |       |                       |       |                      |       |
|----|---|---|-------|-----------------------|-------|----------------------|-------|-----------------------|-------|----------------------|-------|
|    |   | 300 g/m <sup>2</sup>                          |       | 350 gr/m <sup>2</sup> |       | 400 g/m <sup>2</sup> |       | 450 gr/m <sup>2</sup> |       | 500 g/m <sup>2</sup> |       |
|    |   | 1 towel weighs gr                             |       |                       |       |                      |       |                       |       |                      |       |
|    |   | 135 gr  |       | 157.5 gr              |       | 180 gr               |       | 202.5 gr              |       | 225 gr               |       |
|    |   | The percentage of threads in a towel is gr; % |       |                       |       |                      |       |                       |       |                      |       |
|    |   | Gr  | %     | Gr                    | %     | Gr                   | %     | Gr                    | %     | Gr                   | %     |
| 1  | ground part<br>Nm34/2. Ne20/2                   | 44.89   | 33.25 | 44.89                 | 28.51 | 44.89                | 24.94 | 44.89                 | 22.16 | 44.89                | 19.96 |
| 2  | warp Nm 27 / 1 .<br>Ne 16 / 1                   | 38.67   | 28.65 | 38.67                 | 24.55 | 38.67                | 21.48 | 38.67                 | 19.19 | 38.67                | 17.18 |
| 3  | Weft Nm 40 / 2 .<br>Ne2 4 / 2                   | 51.44   | 38.1  | 73.94                 | 46.94 | 96.44                | 53.58 | 111.94                | 58.74 | 141.44               | 62.86 |
|    | Total weight of 1<br>piece of product<br>( gr ) | 135.0   | 100.0 | 157.5                 | 100.0 | 180.0                | 100.0 | 202.5                 | 100.0 | 225                  | 100.0 |

The production of a 50x90 cm towel , the length of the ring and its height.

**2 Table**

|   |                                 | Surface density of towels gr/m <sup>2</sup> |       |       |       |       |       |        |       |        |       |
|---|---------------------------------|---|-------|-------|-------|-------|-------|--------|-------|--------|-------|
|   |                                 | 300.0                                       |       | 350.0 |       | 400.0 |       | 450.0  |       | 500.0  |       |
|   |                                 | Gr  | %     | Gr    | %     | Gr    | %     | Gr     | %     | Gr     | %     |
| 1 | consumption ( Nm 40/2, Ne 24/2) | 51.44                                       | 100   | 73.94 | 100   | 96.44 | 100   | 118.94 | 100   | 141.44 | 100   |
|   | public part                     | 49.36                                       | 95.95 | 71.86 | 97.18 | 94.36 | 97.84 | 116.86 | 98.25 | 139.41 | 98.54 |
|   | coastal part                    | 2.08  | 4.05  | 2.08  | 2.82  | 2.08  | 2.16  | 2.08   | 1.75  | 2.08   | 1.46  |
| 2 | Ring length in mm               | 3.12  |       | 4.54  |       | 5.96  |       | 7.38   |       | 8.8    |       |
| 3 | Circle height                   | 1.56  |       | 2.57  |       | 2.98  |       | 3.69   |       | 4.4    |       |

The size is 50x90 cm. description of raw materials used for the production of towels .

|     |   | Surface density gr/m <sup>2</sup> |       |       |       |       |       |        |       |        |       |
|-----|---|-----------------------------------|-------|-------|-------|-------|-------|--------|-------|--------|-------|
|     |   | 300.0                             |       | 350.0 |       | 400.0 |       | 450.0  |       | 500.0  |       |
|     |   | Gr                                | %     | Gr    | %     | Gr    | %     | Gr     | %     | Gr     | %     |
| 1   | Standard weight of 1 towel                  | 135.0                             | 100.0 | 157.5 | 100.0 | 180.0 | 100.0 | 202.5  | 100.0 | 225.0  | 100.0 |
| 2   | Nm 34/2 OE on the floor No 20/2             | 44.89                             | 33.25 | 44.89 | 28.51 | 44.89 | 24.93 | 44.89  | 22.16 | 44.89  | 19.95 |
| 3   | Thread thread Nm27/1 OE Ne16/1              | 38.67                             | 28.64 | 38.67 | 24.55 | 38.67 | 21.48 | 38.67  | 19.19 | 38.67  | 17.18 |
| 4   | Hair is on the body Nm 40/2 OE , CD No 24/2 | 51.44                             | 38.1  | 73.94 | 46.94 | 96.44 | 53.58 | 118.94 | 58.74 | 141.44 | 62.86 |
| 4.1 | The gray part of pile                       | 49.36                             | 95.95 | 71.86 | 97.18 | 94.36 | 97.84 | 116.86 | 58.25 | 139.36 | 98.54 |
| 4.2 | Coastal section in warp yarn                | 2.08                              | 4.05  | 2.08  | 2.82  | 2.08  | 2.16  | 2.08   | 1.75  | 2.08   | 1.46  |

### Conclusion

The following conclusions were reached in this research work.

- In order to increase the surface weight of the terry fabric, the height of the pile loop is increased.
- The distribution of threads is different in the types of the same type of woven fabrics with different surface weights.
- As a result of this research, we can determine the amount of types of threads used in the terry towel assortment.

**References**

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