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Mathematical modeling of moisture properties of terry towel products

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Annotation: This article is about mathematical modeling of the dependence of the moisture properties of different textile fabrics on geometric properties. The article builds a mathematical model of various towel products using the spss statistics program to determine the moisture properties of the hair thread and the geometric parameters of its shape in the fabric.

Keywords: multi-layered fabric, terry towel, moisture property, linear density of hair yarn, number of hair loops, tissue thickness, tissue surface density tensile strength.

The hygroscopic properties of woolen fabrics are characterized by their ability to absorb and absorb moisture. We took 18 different samples of woolen fabrics and measured them as the desired parameter by measuring the number of hair strands, the number of loops, the length, thickness and surface density of the loop thread in 1 cm. Using the obtained unwanted parameters, we constructed a mathematical model to predict the properties of high surface wetting time and predicting high surface moisture absorption. Table 1 shows the practically determined values for constructing a mathematical model of the high surface wetting time of woolen fabrics [67].

X_1- Linear density of the pile thread, [Ne];
X_2- the number of pile rings in 1 cm^2;
X_3- the length of the hair band in 1 cm^2, [cm];
X_4- tissue thickness, [mm];
X_5- tissue surface density, [g / 10 cm^2]
Y_1- High surface wetting time, [s];

Table 1
High surface wetting time mathematical model

sample	Linear density of the pile thread, [Ne]	the number of pile rings in 1 cm^2	the length of the hair band in 1 cm^2	tissue thickness, [mm]	tissue surface density, [g/10 cm^2]	High surface wetting time, [s]
	X_1	X_2	X_3	X_4	X_5	Y_1
1	15/1	48	51,4	3,92	4,97	6,46
2	27/1	48	50,4	4,78	4,99	6,78
3	27/1	48	49,0	4,25	5,07	5,68
4	27/1	42	49,1	3,04	3,63	16,29
5	27/1	42	48,3	3,04	3,66	17,26
6	27/1	42	48,7	3,02	3,69	16,89
7	36/2	48	79,7	3,03	3,69	1,31
8	36/2	48	81,6	3,07	3,68	2,35
9	27/1	72	79,9	2,81	3,65	1,98
10	27/1	72	80,6	3,08	3,68	23,21

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11	27/1	72	80,6	3,35	3,76	22,90
12	27/1	64	58,2	3,40	3,73	22,96
13	27/1	64	58,9	3,44	4,70	5,34
14	27/1	64	58,2	3,30	4,64	6,15
15	36/2	56	46,5	3,30	4,67	5,89
16	36/2	56	47,6	3,41	3,98	71,51
17	36/2	56	45,9	3,16	4,00	70,27
18	36/2	56	45,9	3,16	3,98	70,59

Y_1- We construct the model using regression analysis to calculate the high surface wetting time (s). This model allows the calculation of the time of absorption of a drop of water into the tissue on the basis of 5 unwanted factors and has the following appearance [2].

$Y_1=83,12+0,58*X_1+1,47*X_2-1,5*X_3+26,05*X_4-40,49*X_5$

Table 2

Mathematical model matrix with high surface moisture absorption rate

sample	Linear density of the pile thread, [Ne]	the number of pile rings in 1 cm^2	the length of the hair band in 1 cm^2	tissue thickness, [mm]	tissue surface density, [g/10 cm^2]	Mathematical model matrix with high surface moisture absorption rate (% c)
	X_1	X_2	X_3	X_4	X_5	**Y_2**
1	27/1	48	51,4	3,92	4,97	49,80
2	27/1	48	50,4	4,78	4,99	48,58
3	27/1	48	49,0	4,25	5,07	48,65
4	27/1	42	49,1	3,04	3,63	24,12
5	27/1	42	48,3	3,04	3,66	23,98
6	27/1	42	48,7	3,02	3,69	24,15
7	36/2	48	79,7	3,03	3,69	19,93
8	36/2	48	81,6	3,07	3,68	19,26
9	27/1	72	79,9	2,81	3,65	20,21
10	27/1	72	80,6	3,08	3,68	31,95
11	27/1	72	80,6	3,35	3,76	30,25
12	27/1	64	58,2	3,40	3,73	32,52
13	27/1	64	58,9	3,44	4,70	24,83
14	27/1	64	58,2	3,30	4,64	24,56
15	36/2	56	46,5	3,30	4,67	25,01
16	36/2	56	47,6	3,41	3,98	7,55
17	36/2	56	45,9	3,16	4,00	7,85
18	36/2	56	45,9	3,16	3,98	7,26

Y_2- High surface moisture absorption rate (% C)

$Y_2=-30,869-0,3*X_1-0,33*X_2+0,35*X_3+11,84*X_4+6,81*X_5$

The main purpose of mathematical modeling is to predict and predict the expected properties of products. Weaving towels of different compositions and taking samples from them, we took the measured parameters as an unwanted parameter. Using the obtained unwanted parameters, we predicted the water absorption rate and absorption time of our products [3].

Table 3

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Analysis of the values of high surface wetting time and high surface moisture absorption properties determination models

Намуна	Y_1-Юқори сирт намлаш вақти (с)		Y2-Юқори сирт намлик ютиш даражаси (% С)	
	Амалий	Модел ҳисоби	Амалий	Модел ҳисоби
1	6,46	6,86	49,8	43,43
2	6,78	16,08	48,58	53,35
3	5,68	1,3	48,65	47,11
4	16,29	19,19	24,12	25,06
5	17,26	19,32	23,98	24,98
6	16,89	16,89	24,15	25,14
7	1,31	5,42	19,93	20,57
8	2,35	3,97	19,26	21,67
9	1,98	10,1	20,21	23,3
10	23,21	14,78	31,95	27,02
11	22,9	18,63	30,25	30,79
12	22,96	42,87	32,52	25,9
13	5,34	4,1	24,83	33,25
14	6,15	3,69	24,56	30,88
15	5,89	34,38	25,01	16,25
16	71,51	63,45	7,55	13,23
17	70,27	58,62	7,85	9,8
18	70,59	59,72	7,26	9,62

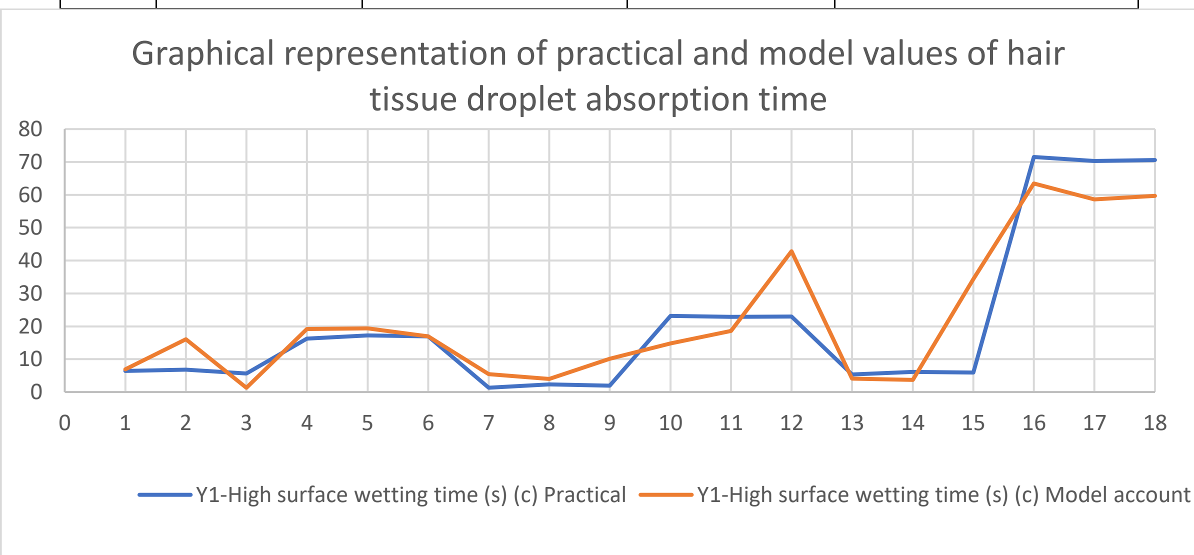

Figure 2. Graphical representation of practical and model values in terms of water absorption time of terry tissue

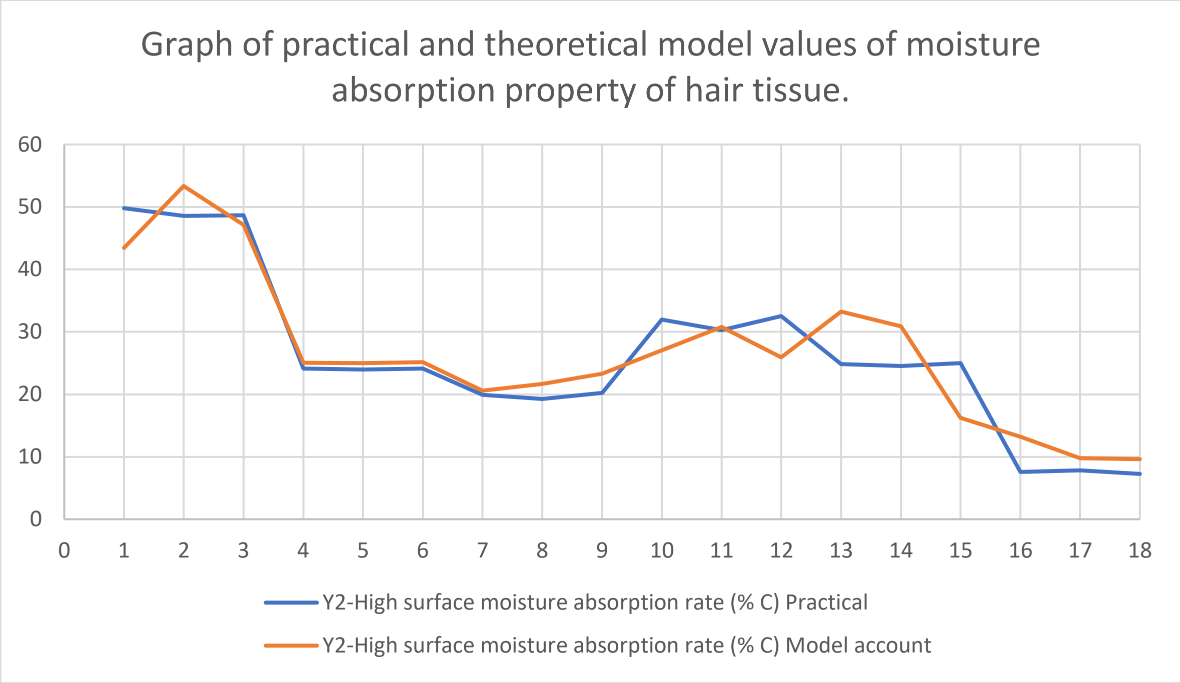

Figure 2. Graph of practical and theoretical model values of moisture absorption property of terry tissue.

The values of the mathematical model are compared with the practical values given in the graphs above. It can be seen from the graphs that the values of these properties calculated from the model and the values measured from the finished product samples are very close to each other.

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