IMPACT OF THE MICROCLIMATE IN PRINTING PROCESS

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ABSTRACT

Each printing process tends to reduce the disadvantage of the core material. The basic material in the printing houses is paper. Microclimate has a strong influence on the the paper disadvantage. This paper presents the study of the impact of the microclimate on the influence in a printing house for a certain period. The microclimate includes internal and external temperature, brightness and humidity. In this paper, we present the impact of each of these factors and their ideal values in order not to damage the paper.

KEYWORDS

Printing, Paper damage, Microclimate, External and Internal temperature, Humidity, Brightness.

I. INTRODUCTION

During the printing process, the impact of the microclimate is importance for the reduction of the paper damage. In the microclimate we will look at internal and external temperature, brightness and humidity. This paper is organized in several sections, in each one is described the examined characteristics that lead to paper damage. From the experimental research we came to the conclusion.

II. RELATED WORK

The basic material in printing houses is paper, so its damage is important in order to get quality printing. Paper characteristics are given in [1],[2]. Also, optical brightening agents or fluorescent whitening agents are chemicals added to paper during the paper making process to increase the brightness [4],[8],[9]. Papers with agents for optical brightening are often represented on the market [5]. All other necessary conditions for avoidance the paper damage are given in [3], [6],[7],[10].

III. INFLUENCE OF TEMPERATURE

The temperature in graphic processes is an important feature for getting the finished product. Starting from the process of storage of the graphic materials through the printing process to the graphic finishing process, the temperature should range from 19-23°C. Temperature deviation leads to distortion of cellulosic fibers, rigidity and cracking of the paper. It also leads to a distortion of drying

and absorption of color, and this leads to increased disadvantage. Increasing the temperature in the drive can lead to evaporation of moisture from the paper and the appearance of corrugated tobacco.

The temperature in the graphics drives is quite variable because, besides the air conditioning systems, there are machines that emit heat during their work and affect the temperature change. The external influences affect the temperature when opening the doors, the internal and external air interfere, which leads to sudden changes in temperature.

In this paper we will measure internal and external temperature and define the dependence of the paper damage. The measurements were made on KBA Rapid 72 offset machine in 2015/16, and Adast Dominant 816 monochrome offset machine in 2018 (Fig.1). The temperature measurements were made using a mercury thermometer.

Fig1. KBA Rapid 72 offset machine and Adast Dominant 816 monochrome offset machine

The measurement of internal and external temperature are given in the following tables.

Table 1. Measured internal temperature on KBA Rapid 42 (lowest values)

Internal T (°C)	22.5	23	23	23	23	23	23.25
Paper damage (%)	0.67	0.35	0.51	0.65	0.832	0.834	0.42

Table 2. Measured internal temperature on KBA Rapid 42 (highest values)

Internal T (°C)	25	25	25	25	25	25	25	25	25	25.5	25.5	26
Paper damage (%)	0.22	0.32	0.449	0.5	0.738	0.8	0.819	0.829	1.21	0.46	0.638	0.42

Table 3. Measured internal temperature on Adast Dominant 816 (lowest values)

Internal T (°C)	19.5	20.25	20.3	20.4	20.45	20.55	20.65	21.25	21.4	21.5	21.55
Paper damage (%)	10.28	5.6	3.6	1.57	7.75	2.82	7.92	3.06	4.98	4.05	1.6

Table 4. Measured internal temperature on Adast Dominant 816 (highest values)

Internal T (°C)	21.65	21.7	21.95	21.95	22.15	22.2	22.2	22.4	22.4	22.5	22.75	23.25
Paper damage (%)	4.06	4.73	6.57	4.07	2.96	4.31	6.19	4.68	6.02	5.14	4.95	4.07

Table 5. Measured external temperature on KBA Rapid 42 (lowest values)

Internal T (°C)	14	17	17	18	18	18.5	18.5	19	19	19.5	19.5
Paper damage (%)	0.688	0.91	2.19	0.58	0.46	1.21	0.93	1.94	0.92	0.83	0.96

Table 6. Measured external temperature on KBA Rapid 42 (highest values)

Internal T (°C)	34	34	34	34	35	35	35.5	36	36	36.5
Paper damage (%)	0.42	0.83	0.5	0.3	0.819	0.8	0.189	0.67	0.42	0.88

Table 7. Measured external temperature on Adast Dominant 816 (lowest values)

Internal T (°C)	2	4.5	6.5	7	8.5	9	10	10	12	12	14.5	15
Paper damage (%)	10.28	3.6	7.75	5.6	7.92	6.57	4.07	4.05	2.96	3.06	1.57	5.14

Table 8. Measured external temperature on Adast Dominant 816 (highest values)

Internal T (°C)	15.5	15.5	16	16.5	16.5	17.5	18.5	19	19.5	20	23
Paper damage (%)	2.82	4.98	1.6	4.68	6.19	4.06	6.02	4.73	4.31	4.95	4.07

IV. HUMIDITY

Humidity significantly affects the printing process. For maintenance of paper and in warehouses and in graphic drives, the relative humidity should be 50%. The following problems arise in the event of inadequate humidity:

- dimensional deferrals
- paper wavelength
- static charge on the paper.

These appearances later cause adverse printing occurrences, such as doubling raster points, illicit growth of scoring points, moving registers, etc.

In this paper we will measure humidity and define the dependence of the card. The results are given in the following tables.

Table 9. Measured relative humidity on KBA Rapid 42 (lowest values)

Humidity (%)	23.5	24.5	25.5	26.5	27	27.5	28	28.5	29	29.5	29.5	30
Paper damage (%)	0.42	0.88	0.51	0.3	1.45	0.42	0.819	0.8	0.51	0.279	0.83	0.25

Table 10. Measured relative humidity on KBA Rapid 42 (highest values)

Humidity (%)	56.5	58.5	59.5	59.5	62	62	62	63	64	69	71.5
Paper damage (%)	0.96	0.46	0.67	0.83	0.58	0.829	1.21	0.93	2.19	0.688	0.93

Table 11. Measured relative humidity on Adast Dominant 816 (lowest values)

Humidity (%)	32	34	35.5	37.5	38.5	39.5	44.5	47	48	51	51	51
Paper damage (%)	4.07	4.31	2.82	4.73	1.6	1.57	2.96	3.06	4.98	5.14	4.06	4.95

Table 12. Measured relative humidity on Adast Dominant 816 (highest values)

Humidity (%)	55.5	60.5	60.5	63.5	65	71.5	72	72	72.5	73.5	77.5
Paper damage (%)	4.07	6.57	4.68	6.02	5.6	7.75	4.05	6.19	3.6	7.92	10.28

V. BRIGHTNESS IN THE PRINTING HOUSE

Lighting is important in the working premises and is an important requirement for creating a pleasant ambience for work. In conditions of quality illumination, the employee slows down slower, and thus produces a better quality product and reduces the card.

In the printing house where we performed the measurement, artificial light sources, such as neon rods and neon lamps, are used, but also natural sunlight. On the same spot at different times of the day we get different results because natural light decreases during the day. The table and the values we obtained from the measurements refer to the secondary, i.e., the large illumination (250-1000lx).

To see how brightness affects the card, we set aside the lowest and highest values of lighting and showed them in a table and graphs. The measures were made with digital light meter.

Table 13. Measured brightness on KBA Rapid 42 (lowest values)

Brightness (lx)	243.2	247.8	249.7	250.8	251.1	253	253.2	253.5	254.8	255.5	256.2	259.1	259.6
Paper damage (%)	0.67	0.83	0.72	0.8	0.83	0.92	0.27	0.82	0.42	0.3	1.98	1.21	0.93

Table 14. Measured brightness on KBA Rapid 42 (highest values)

Brightness (lx)	419.6	420.5	421.5	422.2	423	429.6	431	433.7	438.5	440.1	442.6
Paper damage (%)	0.82	0.33	0.51	0.38	0.67	0.88	2.53	0.5	0.83	0.32	0.75

Table 15. Measured brightness on Adast Dominant 816 (lowest values)

Brightness (lx)	385.1	385.3	387.3	397.1	397.2	400.1	404.6	405.2	447	499.6	507.1	510
Paper damage (%)	4.68	1.57	6.19	4.98	4.95	2.82	4.73	6.02	1.6	4.31	5.6	4.07

Table 16. Measured brightness on Adast Dominant 816 (highest values)

Brightness (lx)	536.8	537.6	544.5	551.1	557.2	596.8	628.2	641.2	641.2	677.5	738.5
Paper damage (%)	2.96	10.28	3.06	7.75	5.14	4.06	4.07	6.57	7.92	3.6	4.05

VI. CONCLUSION

The measurements were made in 2015, 2016 and 2018. Internal and external temperature are measured with thermometer Greisinger GTH 175 / MO, brightness is measured with Digital light meter HS1010 and humidity is measured by hydrometeorological plant. Days and test time are randomly selected. The obtained results are presented in the following tables. It is obvious that impact of the microclimate in printing process is very important. The microclimate has a particular impact of paper damage.

From total tables can be concluded that:

- if the temperature is in range (19-23°C) the percent of paper damage is normal.
- for the lowest values of humidity (the normal humidity is 50%) the percent of paper damage is low.
- for the highest values of brightness the percent of paper damage is lowest.

Table 17. KBA Rapid 72 total measurement chart in 2015

date	time	brightness (lx)	internal T (°C)	external T (°C)	humidity (%)	paper damage (%)
13.07.2015	15 h	429.62	24	36.5	24.5	0.886
13.07.2015	17 h	389	24	34	31	0.4207
13.07.2015	19 h	381	24	31	40.5	0.5482
14.07.2015	14 h	420.5	24.5	33.5	40.5	0.3302
14.07.2015	18 h	406.37	23.25	28.5	38	0.4252
14.07.2015	19 h	404.25	23	26.5	41	0.6541
15.07.2015	14 h	413.25	24.5	35.5	43.5	0.1898
15.07.2015	18 h	403.5	23.5	31.5	32	0.6067
15.07.2015	19 h	422.25	23.5	28	34.5	0.3861
16.07.2015	16 h	423	24	36	35	0.6748
16.07.2015	18 h	421.5	23	32.5	29	0.5139
16.07.2105	20 h	396.25	23	30	30	0.3545
20.07.2015	9 h	442.62	24	29	40.5	0.7581
20.07.2015	11 h	438.5	24.5	34	29.5	0.8301
21.07.2015	8 h	431	24	30	44	2.537
21.07.2015	12 h	419.62	25	35	28	0.8199
22.07.2015	7 h	415.25	24.5	24.5	54	0.8236
22.07.2015	9h	440.12	25	30	42.5	0.3265
22.07.2015	12 h	433.75	25	34	38.5	0.5035

Table 18. KBA Rapid 72 total measurement chart in 2016

date	time	brightness (lx)	internal T (°C)	external T (°C)	humidity (%)	paper damage (%)
31.05.2016	14 h	278.375	24.5	26.5	35.5	2.1464
31.05.2016	17 h	273.25	24.5	23.5	44	1.2638
31.05.2016	19 h	256.25	24.5	19	54	1.9482
1.06.2016	15 h	278.75	24	26.5	37	1.0587
1.06.2016	18 h	269	23.75	21	62	0.8292
1.06.2016	20 h	263.5	24.5	17	71.5	0.9317
2.06.2016	14 h	262.5	24	22.5	49	0.9528
2.06.2016	16 h	271.625	23.5	22	51.5	1.7841
6.07.2016	12 h	278.5	23.5	31	32	0.5994
7.07.2016	7 h	264.5	24.5	18	62	0.5877
7.07.2016	9 h	253.5	25	23	54	0.829
7.07.2016	12h	281.62	24	25.5	38	0.5648
8.07.2016	7 h	253	24.75	19	42.5	0.9234

8.08.2016	12 h	276.87	24.25	25.5	25.5	0.5166
9.07.2016	8 h	274.12	24.25	24	34	0.2855
9.07.2016	12 h	253.25	23.5	28.5	29.5	0.2791
11.07.2016	14 h	262.87	24.25	33.5	27.5	0.4222
11.07.2016	16 h	247.87	23	30	33.75	0.8348
11.07.2016	20 h	243.25	22.25	20	59.5	0.671
13.07.2016	14 h	250.87	25	35	28.5	0.8008
13.07.2016	17 h	249.75	24	31	36.5	0.7236
14.07.2016	14 h	254.87	26	36	23.5	0.4267
14.07.2016	15 h	255.87	24.5	34	26.5	0.3061
16.07.2016	15 h	267.12	25	25.5	42.5	0.4492
16.07.2016	19 h	251.12	23	19.5	59.5	0.8327
18.07.2016	7 h	260.37	24.5	14	69	0.6884
18.07.2016	9 h	261	25.5	18	58.5	0.4632
19.07.2016	7 h	259.12	25	18.5	62	1.2175
19.07.2016	12 h	267.12	25	25	43.5	0.2223
20.07.2016	14 h	286.5	23.5	27.5	33	0.8079
20.07.2016	16 h	274	24	26.5	36.5	0.2807
20.07.2016	19 h	265.62	24.5	17	64	2.1985
21.07.2016	7 h	259.6	24.5	18.5	63	0.9309
21.07.2016	9h	273.12	25.5	22.5	53.5	0.6384
21.07.2016	12h	277.25	24.5	26	39	1.2168
22.07.2016	7 h	263.62	24.5	19.5	56.5	0.9613
22.07.2016	9 h	268.37	25	26	42.5	0.7385
22.07.2016	12 h	268.87	24.5	31	27	1.4559

Table 19. Adast Dominant 816 total measurement chart in 2018

date	**time**	**brightness (lx)**	**internal T (°C)**	**external T (°C)**	**humidity (%)**	**paper damage (%)**
28.03.2018	7h	507.1	20.25	7	65	5.6
28.03.2018	10h	628.25	21.95	10	55.5	4.07
28.03.2018	12h	536.87	22.15	12	44.5	2.96
29.03.2018	7h	537.6	19.5	2	77.5	10.28
29.03.2018	9h	677.5	20.3	4.5	72.5	3.6
29.03.2018	11h	544.5	21.25	12	47	3.06
30.03.2018	7h	551.12	20.45	6.5	71.5	7.75
30.03.2018	9h	641.25	21.95	9	60.5	6.57
30.03.2018	11h	557.25	22.5	15	51	5.14
31.03.2018	7h	641.25	20.65	8.5	73.5	7.92
31.03.2018	9h	738.5	21.5	10	72	4.05
31.03.2018	11h	596.87	21.65	17.5	51	4.06
2.04.2018	15h	447	21.55	16	38.5	1.6
2.04.2018	17h	400.12	20.55	15.5	35.5	2.82
2.04.2018	20h	385.37	20.4	14.5	39.5	1.57
3.04.2018	14h	499.6	22.2	19.5	34	4.31
3.04.2018	17h	404.6	21.7	19	37.5	4.73
3.04.2018	19h	397.12	21.4	15.5	48	4.98
4.04.2018	14h	510	23.25	23	32	4.07
4.04.2018	18h	397.25	22.75	20	51	4.95
4.04.2018	20h	385.12	22.4	16.5	60.5	4.68
5.04.2018	18h	405.25	22.4	18.5	63.5	6.02
5.04.2018	19h	387.375	22.2	16.5	72	6.19

VII. FURTHER WORK

In addition to the microclimate on the printing process, there is also a lot of noise. The impact of the noise will be our next examination. There are instructions for noise risk for printing machinery in Europe [11].

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