The Research on K

Linghua Guo[1], Xinhua Guo [2], Yulin Xie [3], Xing Wang [1]
[1]*ShaanXi University of Science & Technology , Xian 710021, China*
[2]*Jinan University, Zhuhai 519070, China*
[3]*Founder,Beijing 100081, China*
Email: *guolinghua*318@126.*com, xinhua*008@*sina.com*,575753738@*qq.com* ,670202998@*qq.com*

Abstract: In printing, the relative contrast (K) play an important role in controlling the solid and dot gain. According to the derivation and experimentation, Some parameters are tested and analyzed. It quantized the relationship between the K and Ds. At the same time it went step further to make clear the range of K. Therefore, it has important practical guiding significance for printing.

Keywords: relative contrast k, dot gain, solid, dot density, dot percent

1. Introduction

The printing relative contrast K is an important parameter. It can evaluate the relative contrast K and dot gain of the print products. Some books [1] and papers [2] present different explains about K. Thus, the parameter K is experimented and dis- cussed again. According to the experimentation, the conclusion is tested by the printing products. Based on "practice is the principle criterion of tr- th". Research gives new view of K. so, it can offer some references for printing industry. At the same time a new printing topic is provided .At last a reliable evaluated parameter of printing quality standardization is offered.

2. Analyzing and experimentation

2.1 Analyzing

The formula of relative contrast [3]

$$K = 1 - \frac{D_t}{D_s} \qquad (1)$$

(D_t – the density of 75%;Ds -the density of 100%)

The formula of K was put forward by FOGRA in Germany, which could reflect the relationship between the solid and dot gain. From the formula it could be seen clearly : when Ds is invariant, the D_t get smaller, then the K is got larger. It can show that the relative contrast is got larger, the dot gain is got smaller, Vice versa.
The formula of Murray-Davis [4]

a=(1-10-Dt) / (1-10-Ds) (2)
(a-the percent of dot ； Dt -density；Ds -solid）

The formula reveals the relationship between the density and dot percent. By formula(2),the dot percent is calculated, further the dot gain value is calculated.

2.2. Deriving

According to the formula of (1)(2)
Based on (1)the equation
Dt=Ds*（1-K）(3) is got
Based on (2)the equation
1- a*（1-10-Ds）=10-Dt and
lg[1- a*（1-10-Ds）]=-Dt (4) are got
Based on(1)(2) Ds*（K-1）= lg[1- a*（1-10-Ds）]
K= lg[1- a*（1-10-Ds）]/ Ds + 1
The equation K={ lg[1- a*（1-10-Ds）]+Ds} / Ds (5) is got .Then
limDs→0K= limDs→0{ lg[1- a*（1-10-Ds）]+Ds} / Ds
On the basis of rule of Robida:
limDs→0K= limDs→0 -a*10-Ds ln10 /[1- a*（1-10-Ds）]*ln10+1
limDs→0K= limDs→0 a*10-Ds / [a*（1-10-Ds）-1] + 1
When Ds→0 ,There is 10-Ds →1
a*10-Ds / [a*（1-10-Ds）-1] + 1→-a
So limDs→0K= 1 – a
When Ds→0, a=5%, There is K=0.25
When Ds=2 , K=0.70538
When Ds→∞ 时, K=1

2.3 Methods

2.3.1 Equipments and materials

DI-46 dry-offset press; X-RITE530 spectorphot- ometer; the coated paper of 157g/m^2; Newlion dry-powders made in Japan.(size 10～20um)

2.3.2Experimental conditions

With an environment of controlled relative humidity (50% RH), temperature (20℃).by adjusting pressure of printing(13si).The sequ- ence of colors are BK, C, M, Y. The screen lines is 175lines/inch; printing speed is 6000 sheets/h

2.3.3 Experimental methods

During the printing process, twelve prepare pap- ers are got. Then ten product papers are obtained on the way spaced 50 sheets in random. The sp- ectrophotometer(environment of controlled rel- ative humidity (46%RH), temperature(20℃)is used to set all

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test parameters (measurement dot gain, density,)the value can be obtained .

2.3.4 Experimental value

The values of Y and M are in the **table 1**;

Table 1 the values of relative contrast K and dot gain on the yellow and magenta prints of the prepare papers

Prepare papers	*Dot gain(Y)*	*K*	*Dot gain(M)*	*K*
1	23.7%	0.078	23.2%	0.182
2	23.2%	0.072	23.1%	0.229
3	22.8%	0.096	21.9%	0.301
4	20.1%	0.150	21.1%	0.339
5	17.3%	0.220	20.6%	0.369
6	13.4%	0.289	19.3%	0.340
7	11.2%	0.334	18.8%	0.385
8	7.3%	0.370	18.1%	0.414
9	7.0%	0.386	16.8%	0.401
10	5.4%	0.391	15.9%	0.470
11	5.4%	0.395	14.9%	0.476
12	4.8%	0.410	11.9%	0.516

3. Results and discussion

3.1 The theoretical value of K

According to the frontal analysis in this paper, the theoretical value of K is [0.25，1]. But previous studies[5] of others have shown that the value of K is[0，1]. The reasons that I think when the ink layer is thin ,the solid is Ds→0，the dot of 75% can be printed. Thus, based on the formula(3), K=0.25 can be got. When Ds→∞，Based on the formula (3), then, K=1 can be got； But the mathematics value is no physics meaning. The reason is the dot of 75% is tinting. It is useless in the printing products. Under the conditions, the parameters "a" is dynamic changes ,the relationship between K and Ds got dynamic. We must consider the change of parameter "a", when the solid density is adding.

According to the situation of the practical printing products, when Ds=2,the printing reaches ultimate state. By substitution of the data solid density 2 into the derived formula (3),then, the K=0.70538 is got. When the density Ds≥2, the ink layer is too thickness to print the dot density. The speed in the dot area is faster than the solid area. The result is the value K is declining. The curve 4 of the K and Ds is expressed the relationship. The functional relation is complex .The real function is

$$K=\{\lg[1-a*(1-10^{-Ds})]+Ds\}/Ds \quad (Ds\leq 2)$$

3.2 The relationship between K and dot gain

The curve between K and dot gain of the Y prepare papers is shown in **Figure 1.**

The curve between K and dot gain of the M prepare papers is shown in **Figure 2.**

In printing, in order to get the best value solid density,the factors both dot gain and K are considered.

We conducted an experiment and analysis. When the dot gain[6] is less than ≤ 15%,The K of weak color Y is between 0.3 to 0.4; When the dot gain less than ≤ 15%,The K of strong color M is between 0.45 to 0.6.It is consistent with the practice of print products.

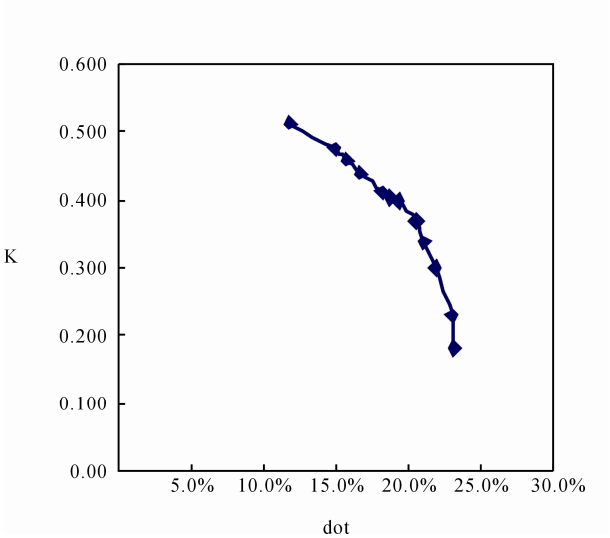

Figure 1. the relationship between K and dot gain of Y

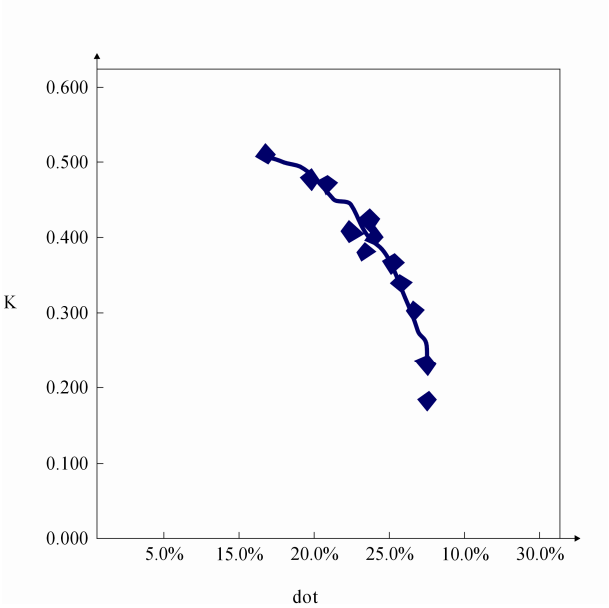

Figure 2 the relationship between K and dot gain of M.

3.3. the curve of K and Ds

At present ,in some books and papers the curve of K and Ds is shown in **Figure 3** . Recently, it is considered that when the value K is got the Maximum[7] ,the color solid density value is the best. By means of the earlier derivation and the measured data in the productive practice, We draw the curve of K_{max}-Ds which is shown in **Figure 4**. The correct solid density value is not corresponding to the Maximum value K., because the value of dot gain is must considered.

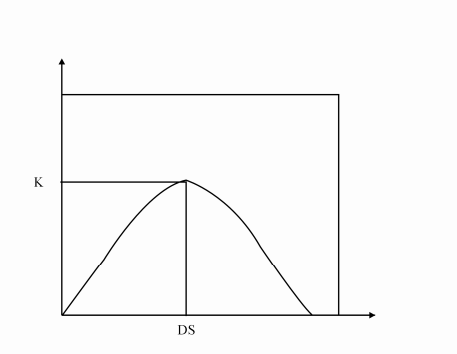

Figure 3. the curve of K and Ds.

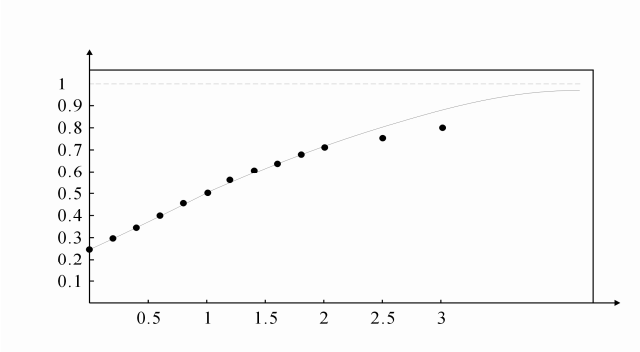

Figure 4. the curve of K and Ds.

4. Conclusion

A new curve of K-Ds is got. The function is K={ lg[1- a*（1-10-Ds）]+Ds} / Ds (Ds≤2);

It quantized and corrected the curve of K-Ds in the previous papers.

when Ds≤2，K= [0.25，0.7], It corrected K=[0，1] in the previous papers.

When dot gain ≤15%，The perfect solid is determined according to the K. It corrected the view that the solid density is got when the K is max.

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References

[1] Zhao,W. L.; Testing the presswork quality M.Beijing: Chemical Industry Press, 2008,2, 39-44.

[2] He,X.H.; controling and testing the presswork quality, M.Beijing: printing industry publishing house, 2008, 6, 100-105.

[3] Liu, S.C.controling and testing the presswork quality, M.Beijing: printing industry publishing house, 2000, 5, 67-78.

[4] Wang,Z.L.; Printing Color Science, M.Shanghai: Shanghai Jiaotong University press, 1991, 12, 223-232.

[5] Zheng, Y.; LV, X.G; Song, B.; Study on the Relationship Between Printing Ink Thickness and Density. J. Packaging engineering . 2004, 3, 161-163.

[6] Wang, X.M; Tang, W.Y; Chen, J.; Study of the Relationship between Ink Thickness and Solid Density. J. Packaging engineering . 2009, 3, 93-95.

[7] WANG X.F. Study on Controlling Principles and Methods of Halftone Dot Accretion and Relative Contrast Control. J. 2008.12, 78-81.HuBei vocational &Technological college academic journal 2008, 12, 78-81

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