Investigation to the Influence of Water-based Ink Adherence

Ling Jia Beiqing Huang Xianfu Wei Na Feng; Beijing Institute of Graphic Communication, Beijing, China

Abstract

In order to improve the adhesion of water-based ink, adopt different kinds and contents of resin, adhesion promoter and base material wetting agent to compound water-based ink. Test the contact Angle of ink on CD, and coating the ink on CD to test the adhesion of ink. The results of the study show that: the kinds of resin has a great influence on the adhesion of water-based ink; right kind of resin and adhesion promoter matching can effectively enhance the adhesion of water-based ink; the wettability and adhesion of ink has a certain relationship, wettability is necessary condition of adhesion of ink, adding appropriate contents of base material wetting agent can improve the adhesion of ink.

Key words: *water-based ink; adhesion; low-energy surface*

Introduction

At present, the environmental protection request is more and more highly in the life, demanding final zero emissions of VOCS. In printing field, the application of water-based ink in accordance with the requirements of low emissions of VOCS. There are more and more use of low-energy surface, such as plastic and CD etc. As water is the main content in water-based ink, the surface tension is high, so the adhesion of water-based ink on low-energy surface is bad, and the adhesion becomes the main factors that block the water-based ink used on low–energy surface. So, research the influence factors of adhesion that water-based ink on low-energy surface has great significance, it is also play a role in promoting the water-based ink applied to low-energy surface to our country.

Experiments

Experimental materials

Dye: Water-soluble red dye;
Disolvant: Water;
Cosolvant: Ethanol
Resin: AZR; Japan; LQ-661; WS-13-5A;
Surface active agent: Base material wetting agent245; Flatting agent Glide100; FSO; Adhesion promoters etc

Equipment

High-speed magnetic heating blender (Dongxi instrument (Beijing) technology Co., LTD); DSA100 Video optical contact Angle meter(Germany);6# Wire rod

Sample preparation

Mixing the dye and cosolvent, pre-segregation 20 min, then add water to ink, heating in 40oC to make the dye dissolve fully. Adding base material wetting agent245; flatting agent Glide100; FSO and adhesion promoters continue to stir 20 min, get water-based writing ink sample.

Adhesion tests method

Take the GB-ddT9286-1998 color paint and varnish film stroke test case as adhesion evaluation standard. Coating the ink on CD, test the adhesion of ink with 3M tape after the ink film dry.Adhesion rating: Ink film in good condition, no falls off, light lost, as 0level; if there's a little ink film fall off, the adhesion is 1 level, analogy in, Ink film completely detached, the adhesion is the worst, decide as 5 level

Contact Angle test method

Suck up 2uuL water-based ink, drop it on the CD surface, test the contact angle with automatic video optical contact Angle meter.

Results and Discussion

Influence of resin type on the adhesion

The various components of the water-based ink has different influence of adhesion, resin is the main ingredient to the adhesive force that between the base and ink film, so it is the main factors to influence the ink adhesion on low-energy surface. In order to explore the influence of resin on water-based ink adhesion, fixed other components in ink, Chose four kind of resin to prepare the ink samples respectively, then test the contact angle of the ink sample, at the same time, coating the ink on CD and test the adhesion. Test results as shown in figure 1 below.

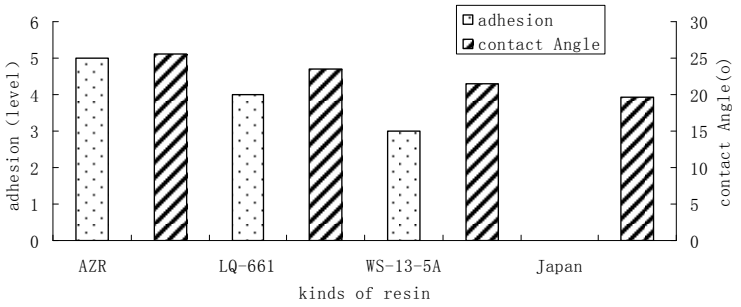

Fig.1 Influence of resin type on adhesion and contact angle

As it can be seen from figure 1, different kinds of resin have different effect on both adhesion and contact angle of ink. The ink samples prepared with the Japan resin has the best adhesion, can get to the 0 level, the other three ink samples prepared with the other resins, the adhesion of them are all poor. It is mainly due to that, the water-based ink prepared with different kinds of resins, they will form different kinds of machine integration, physical

adsorption, hydrogen bonds and chemical bonds between the base material and the ink film; also, they will form different diffusion, above all these factors, they eventually lead to the different adhesion between the ink film and the base material. It is also can be seen that the ink sample prepared with the Japan resin has the smallest contact angle, it can be explained that this ink has the best wetability, this suggests that, for the water-based ink, if it has good wetability on the material surface, the adhesion on the material surface is also well. Good wetting is the necessary condition to guarantee the adhesion of ink

Influence of adhesion promoter type on the adhesion

Adding adhesion promoter to ink is an effective method to improve the adhesion between ink film and base material. Because the adhesion promoter has different structure and nature, so it will have different effects if it effected with different kinds of resin. Fixed the other components in ink, Chose four kind of resin and the four kinds of adhesion promoter, and match them respectively, prepared the water-based ink samples. Test the adhesion of the ink sample on CD. Test results as shown in figure 2 below

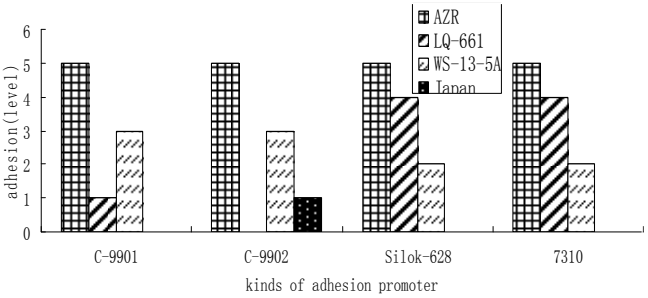

Fig.2 *Influence of adhesion promoter on ink*

It is can be seen from the figure 2, different kinds of adhesion promoter prepared with the same resin, the ink samples will have different adhesion on the material surface, also if different kinds of resin prepared with the same adhesion promoter, they also have different adhesion result. As it can be seen from the figure 2, the adhesion promoter C-9901 matching with the Japan resin, the ink sample have the best adhesion, achieve to 0 level, the LQ-661 resin take the second place, and matching with the other two kinds resins, the ink's adhesion is bad. The adhesion promoter C-9902 matching with the LQ-661 resin, the ink sample has the best adhesion, achieve 0 level, the Japan resin take the second place, matching with the other two kinds resins, the ink's adhesion is bad. The adhesion promoter Silok-628 and 7310 matching with the Japan resin, both the ink samples have the best adhesion, achieve to 0 level, but if they matching with the other three kinds of resin, the ink all have bad adhesion. This is mainly because that, the adhesion promoter matching with the different kinds of resin or the resin matching with different kinds of adhesion promoter, the adhesion promoter and the resin will have different function, occur different reaction, so the production is different, so the adhesion of the ink film on CD surface is different

Influence of wetting agent content to the adhesion

From the previous test data, it is can be seen that, the adhesion of ink and wettability have particular concern on the same base material surface. In order to research the relationship between the content of material wetting agent and the adhesion, fixed the other components in ink, prepared the ink with different content of wetting agent 245, test the adhesion of ink sample on CD surface, Test results as shown in figure 3 below.

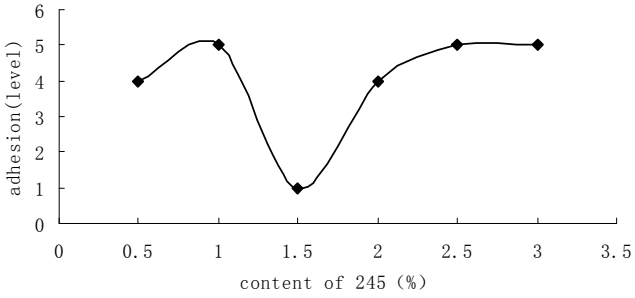

Fig.3 Influence of wetting agent content to the adhesion

It is can be seen from figure 3, the adhesion of ink samples is different as the ink prepared with different content of wetting agent 245. When the 245 content in 1.5%, the adhesion of ink is best, with the increase of the content of 245 the adhesion reduced. This is mainly because as the base material wetting agent content is low, the role of base material wetting agent played between the ink film and substrate surface, can improve the wetting effect of the ink film on the material surface, and then improve the adhesion of ink on the material surface. Along with the increase of base material wetting agent content, it form micelle structure in ink, Can't completely play the role on the contact layer, Reduce the adhesion of ink on the substrate surface. So, adding appropriate amount of base material wetting agent can improve ink adhesion.

Conclusions

(1)The ink adhesion have differences while they prepared with different kinds of resin, the ink have good adhesion on CD surface if it is prepared with the Japan resin.

(2)Adhesion promoter matching with the suitable resin can improve the adhesion of ink. C-9901, Silok-628 and 7310 matching with the Japan resin to prepare the ink will have good adhesion, while C-9902 matching with the LQ-661 to prepare the ink has good adhesion.

(3)The ink has good wettability on the material surface is the prerequisite to the good adhesion of the ink on low-energy surface.

(4) Adding appropriate amount of base material wetting agent can improve ink adhesion. When the 245 content in 1.5%, the adhesion of ink is best.

References

[1]Deping Zhao Water resistant to scratch light oil development

[2]Xiaofang Wang, 2010 China printing and packaging academic journal meeting [J]362-364

[3] http://www.wcoat.com/club/thread-140972-1-1.html

[4] http://bbs.coatu.com/thread-59815-1-1.html

[5] http://info.pf.hc360.com/2006/08/22094346294.shtml]