The Study of the Pigment Surface-modified Technology of Inkjet Printing Ink

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Abstract

With the extensive application of computer and network technology in the fabric printing industry, digital inkjet printing attracts more and more people. As the particle size of pigment-based inkjet printing ink requires small size. In order to ensure the particle size of the inkjet printing ink to meet the requirement, surfactant is used to modify the property of pigment surface to control the particle size. Through fixed the amount of styrene-maleic anhydride (SMA) to study the effect of grinding conditions on the particle size of ink. Through fixed grinding conditions to study the effect of the amount of styrene-maleic anhydride (SMA) on the modified pigment. The particle size of the modified pigment was tested by using Laser particle analyzer. The shape of the modified pigment and the effect of the modified are observed by using SEM. The results show that the particle size of ink was smaller when the weight of styrene-maleic anhydride (SMA) account for 12.5% of the pigment, the rotate speed of grinding is 2200 r/min and the diameter of mill medium is 1.0-1.2mm.

Key words: pigment; modifier; surface modification; particle size

Introduction

Digital inkjet printing is one of high-tech. Its appearance is another revolution of textile technology after screen printing. Digital inkjet printing could be save the complicated processes of platemaking, mix color paste, squeegee and stoving compare with traditional printing. The operation is simple and the processes have achieved digitization. Therefore, people pay more and more attention to digital inkjet printing technology.

Textile inkjet printing mainly has two kinds of ink: dye ink and pigment ink. As the particle size limitation of pigment, textile inkjet printing mainly is using the dye ink. But the generality of dye ink is poor, the dye ink has some extent environmental pollution, the printing process is complex and the light fastness is poor. Conversely, although the manufacture process of pigment ink is complex, its generality is strong. And pigment ink has no environmental pollution, the printing process is simple and the light fastness is good. So pigment ink has larger developed space [1].

In this paper styrene-maleic anhydride (SMA) is served as modifier. Study the effect of grinding conditions and SMA on the particle size of printing inkjet ink. In order to attain the ink of small particle size, a physical method was adopted to modify the surface of phthalocyanine blue.

Experiments

Experimental materials

Pigment: phthalocyanine blue;
Modifier: styrene-maleic anhydride (SMA)
Solvent: deionized water, ammonia water;
Assistant: dispersing agent, defoamer etc.

Equipment

Contact voltage regulator (Delixi corporation); 85-2 digital readout constant temperature magnetic stirring apparatus (Ronghua corporation in Jiangsu); JJ-1 style mechanical agitator (Guhua corporation in Guangzhou), GJ-2S style velocity mixing disperser (Haitongda corporation in Qingdao), Microtrac S3500 laser particle analyzer (Microtrac S3500, America), Quanta 400F field emission scanning electron microscopy (FEI, America).

The preparation of ink samples

First, the SMA was dissolved with deionized water and ammonia water under 80 ^{o}C and then cooling. Second, put phthalocyanine blue, SMA solution, deionized water and assistant together and using mechanical agitator make the compound pre-disperse. Then using grinding disperser makes the compound grinding disperse and get ink samples.

Sample characterization

Microtrac S3500 laser particle analyzer was employed to test the particle size of ink. The diluent is deionized water. The particle size appears in this paper refers to the particle size value of 95%. It means that 95% of the particle sizes of ink are below this threshold. Quanta 400F field emission scanning electron microscopy was employed to observe particle shape of ink.

Results and Discussion

The effect of grinding zirconium bead on the particle size of ink

When the rotate speed of grinding is 2200 r/min and the weight of SMA account for 12.5% of the pigment, change the diameter of bead. Study the effect of bead on particle size of ink. With laser particle analyzer test the particle size of ink. The test results as shown in Fig. 1.

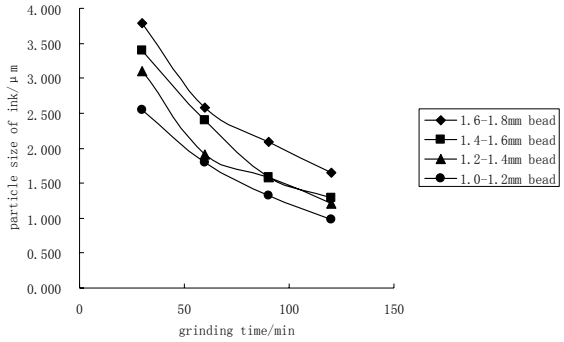

Fig. 1 the effect of zirconium bead on particle size of ink

As shown in Fig. 1, the particle size of ink decreases with increasing grinding time. The smaller diameter of zirconium beads, the smaller the particle size of the ink. As the particle size of inkjet ink should as small as possible, the effect of grinding is better when the diameter of zirconium bead is 1.0-1.2mm.

It is because that the smash of pigment is finished through extrusion force and shear force which caused by grinding mediums. The smaller the diameter of zirconium bead, the more the contact points between zirconium beads. The bead with small diameter has high odds of collision shearing action than the bead with big diameter in the sand mill barrel. The second reason is that the bigger the beads, the larger the gap between beads. So a part of aggregates of pigment may be dissociated in the gap. It may be form "dead angle". If so, the fineness of products will fail of requirement. The mill efficiency will decrease [2]. So, in general, if the products dispersion require finer, the diameter of the grinding media relative to a little bit small.

The effect of the rotate speed of grinding on particle size of ink

When the diameter of bead is 1.0-1.2mm and the weight of SMA account for 12.5% of the pigment, change the rotate speed of grinding. Study the effect of the rotate speed of grinding on particle size of ink. With laser particle analyzer test the particle size of ink. The test results as shown in Fig. 2.

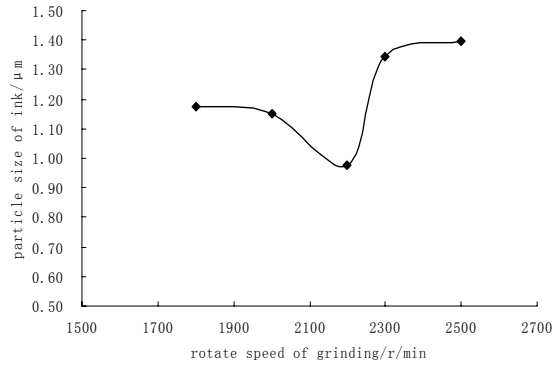

Fig. 2 the effect of rotate speed of grinding on particle size of ink

It can be seen from Fig. 2 that the particle size of ink decrease firstly and then increase with increasing rotate speed of grinding. The particle size of ink is smaller when the rotate speed of grinding is 2200 r/min. The dispersion of pigment refers to the aggregates and condensates are crashed into primary particles [3]. As there is strong van der waals' force between pigment particles, pigment could be crashed into primary particles only when shear force is greater than van der waals' force between pigment particles. Besides, the dispersion of pigment is also a process of energy consumption. The aggregates of pigment could be smashed only when they obtain enough energy [4]. The higher the rotate speed of grinding, the higher the shear force and the more the energy pigment particles obtained per unit time. Therefore, the particle size of ink decrease gradually with increasing rotate speed of grinding when the rotate speed of grinding among 1800 r/min-2200 r/min.

The effect of the amount of SMA on the particle size of ink

When the diameter of bead is 1.0-1.2mm and the rotate speed of grinding is 2200 r/min, change the amount of SMA. Study the effect of the amount of SMA on particle size of ink. With laser particle analyzer test the particle size of ink. The test results as shown in Fig. 3.

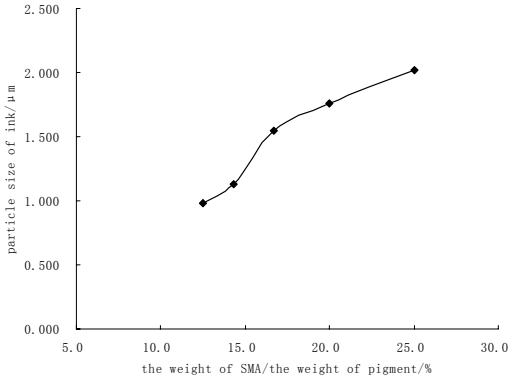

Fig.3 the effect of the amount of SMA on the particle size of ink

It can be seen form Fig.3 that particle size of ink increases gradually with increasing the content of SMA. The increase range of particle size becomes decline when the amount of SMA increases to 16.7% of the weight of pigment. The probably reason is that the SMA deposited and adsorbed the surface of pigment increases with increasing the amount of SMA. So the particle size of ink increases with increasing the amount of SMA [5].

The SEM pictures when the amount of SMA difference

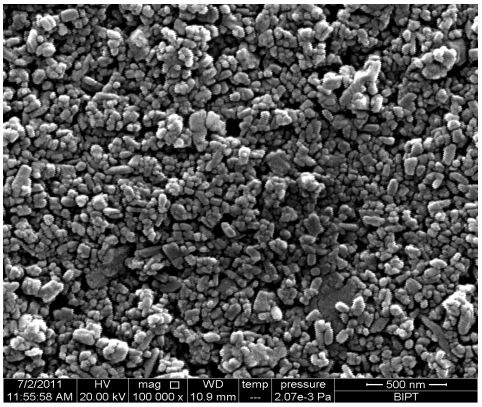

Fig. 3.4.1 the weight of SMA/the weight of pigment=12.5%

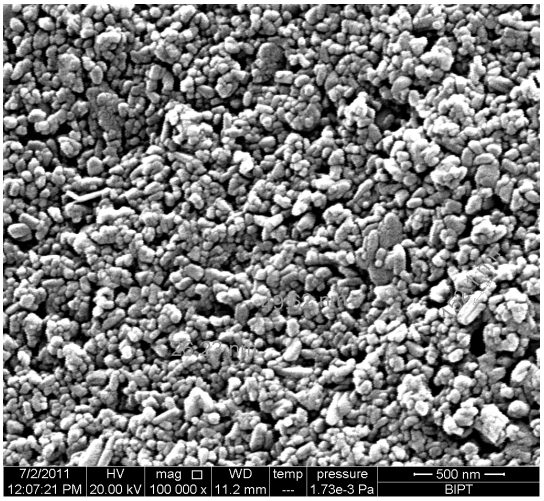

Fig.3.4.2 the weight of SMA/the weight of pigment=14.3%

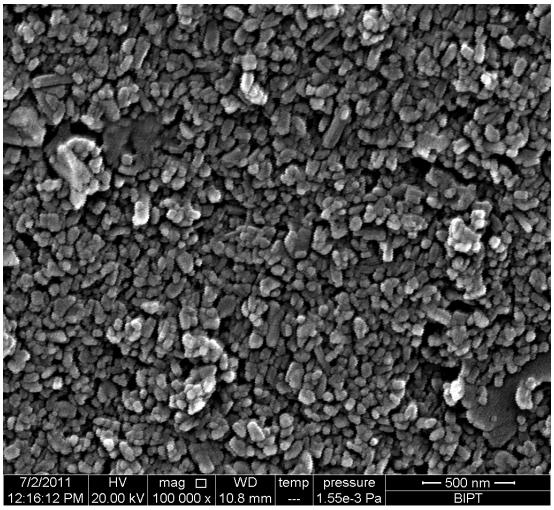

Fig. 3.4.3 the weight of SMA/the weight of pigment=16.7%

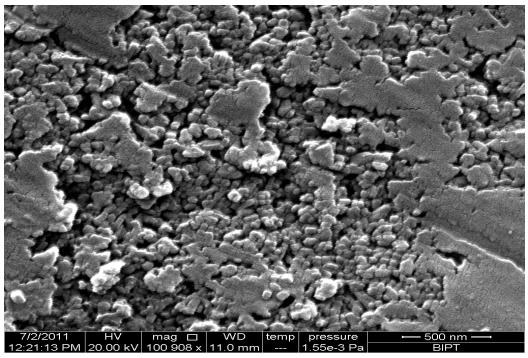

Fig. 3.4.4 the weight of SMA/the weight of pigment=20%

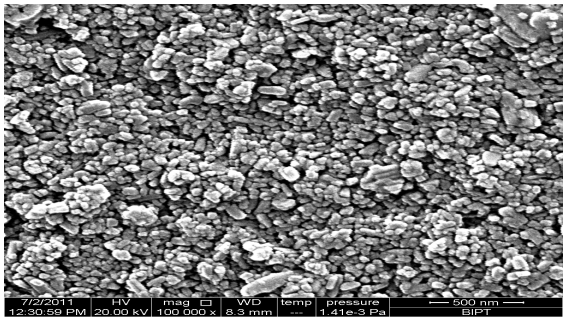

Fig. 3.4.5 the weight of SMA/the weight of pigment=25%

The samples were dropped in conductive adhesive, drying in oven under 50^{o}C and then the samples were metalized by spraying. Quanta 400F field emission scanning electron microscopy was employed to characterize the morphology. As the samples have been drying, the ink particles were observed. But the particle size was tested in wet environment. Due to the ink particles are still condensates, the particle size of ink is bigger. This suggests that the dispersion of ink is not good. It needs continue study. It can be seen from Fig. 3.4.1 to Fig. 3.4.5 that the particle size of ink increases with increasing the amount of SMA. The particle size of ink is smallest when the weight of SMA account for 12.5% of the weight of pigment.

Conclusions

The process conditions of sand mill have great effect on the particle size of ink. The particle size of ink is smaller when the rotate speed of grinding is 2200 r/min and the diameter of bead is 1.0-1.2mm. The particle size of ink increases with increasing the amount of SMA.

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