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RESEARCH ARTICLE

EFFECT OF PARTICLE SIZE ON HYDRATED CALCIUM SILICATEFILLER INK PRINTING SUITABILITY

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ABSTRACT

Ink is a kind of pigment particles evenly dispersed in the connection material and a certain viscosity of the fluid material, in the production of life plays a very important role. In this experiment, based on the preparation of ordinary calcium carbonate inks, modified calcium silicate (particle size smaller than that of ordinary calcium silicate fillers) was used to replace ordinary calcium carbonate, in order to explore whether the particle size of calcium silicate has any effect on the ink printing suitability, and to find out the most suitable replacement rate of modified calcium silicate inks.

INTRODUCTION

Ink as an essential element in life, with the role of weightlifting. The ink prepared with calcium silicate filler has better printing performance than traditional calcium carbonate ink (Li Tao et al., 2016). In which the, The chemical combination of calcium silicate filler and volatile organic compounds in the ink can reduce the amount of volatiles into the atmosphere, and achieve the effect of controlling the emission reduction of ink VOC, so as to realize the theme of green and environmental protection printing with low production cost and simple process (Zhang Quanli, 2017). But in our country, calcium silicate filler used in the process of ink production projects are still less, so it is still in the area of continuous research and development (Yi Hailing, 1990).

The experiment

Experimental drugs and equipment: The experimental drug are as follows. Phenolic resin oils, nano active calcium carbonate, hydrated calcium silicate, modified hydrated calcium silicatesodium tripolymetaphosphate with concentration of 1% and addition of 2% was used for modification, pigment, antioxidants, red dryness oil, ink oil；Laboratory equipment, such as beakers, measuringcylinder, glassrod, electronic analytical balance, NDJ-8S digital viscometer, fineness scraper, IGT printing fitter, X-rite spectrophotometer made by

METTLER TOLEODO

The experimental steps: Use a pallet scale to weigh certain grams of ink components, add it to the beaker in proportion to the weight，add a liquid substance and then add a powdered substance. Stir well with a glass rod (DiaoRunli, 2017). Adjust the level of the NDJ-8S digital viscometer so that the bubbles on the instrument are in the center position (5). After ensuring the instrument is in the horizontal state, select the appropriate speed and rotor (6).Screw the fitting drill into the drill connector and place the measured ink in the measuring cylinder, adjust the lifting knob to make the ink liquid height and the liquid mark on the rotor (the middle of the groove) phase. Click measure, get the viscosity data, move the position, measure the viscosity data again.

Will be tested with a spoon out a few drops of ink, drop into the deepest part of the Groove, that is, the largest part of the scale value (Chen Saiyan, 2010). With both hands to hold the scraper, so that the scraper and scraper surface is 45 degrees angle contact, the scraper from the largest part of the scale to the smallest part scrape. Then, the particles in the groove were evenly exposed and the corresponding calibration values were recorded.

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Table 1. Properties of calcium silicate filling ink

	Group	Ink printing suitability		Ink print suitability			
	Replace rate	viscosity	fineness	Color density	Chroma	Tonal errors	Gray
Ordinary calcium silicate ink	0	2980.87	21.00	1.22	98.19	20.33%	24.00%
	20%	3009.03	27.67	1.10	98.46	20.50%	23.00%
	40%	4277.40	24.67	1.01	95.43	20.50%	24.00%
	60%	4672.47	22.00	0.92	94.83	19.50%	23.50%
	80%	6818.63	21.67	0.86	91.65	18.50%	25.00%
	100%	8097.60	21.33	0.78	91.63	18.50%	25.00%
Modified calcium silicate ink	0	2980.87	21.00	1.22	98.19	20.33%	24.00%
	20%	3158.33	25.00	1.33	97.37	20.50%	26.50%
	40%	5816.73	24.00	1.16	98.40	21.00%	25.00%
	60%	5447.30	22.67	1.10	98.17	19.50%	24.00%
	80%	5269.97	16.33	1.06	97.96	19.00%	23.50%
	100%	4917.27	13.67	1.11	97.21	19.50%	26.00%

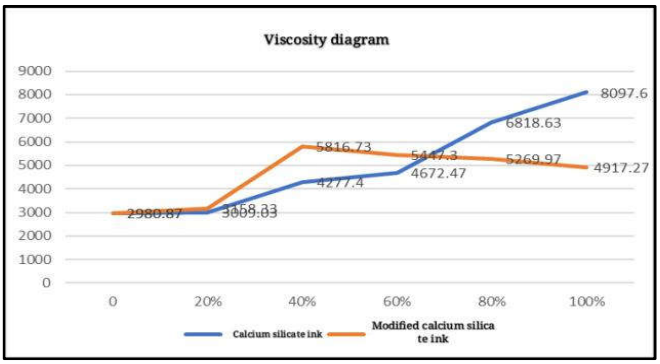

Fig.1 Viscosity diagram

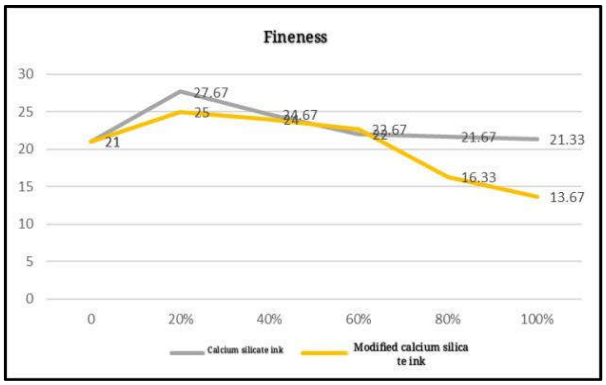

Fig.2 Fineness diagram

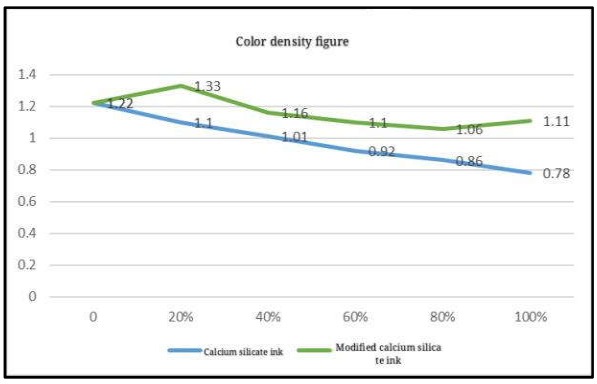

Fig.3 Color density figure

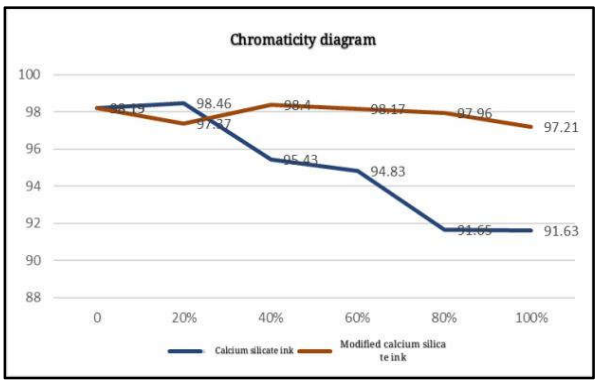

Fig.4 Chromaticity diagram

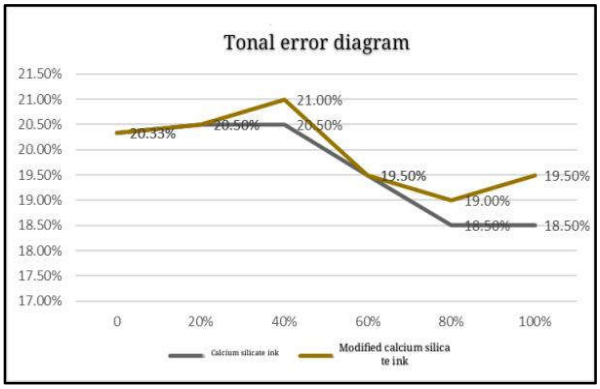

Fig.5 Tonal error diagram

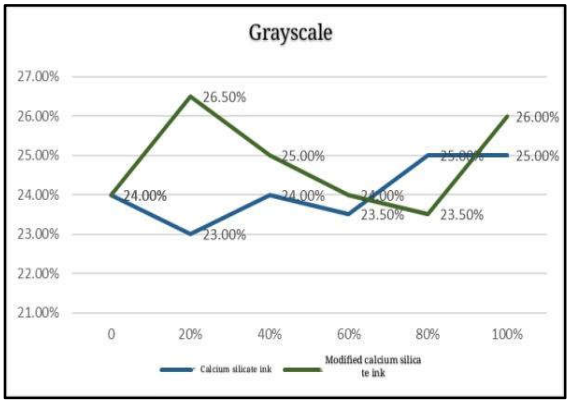

Fig.6 Grayscale

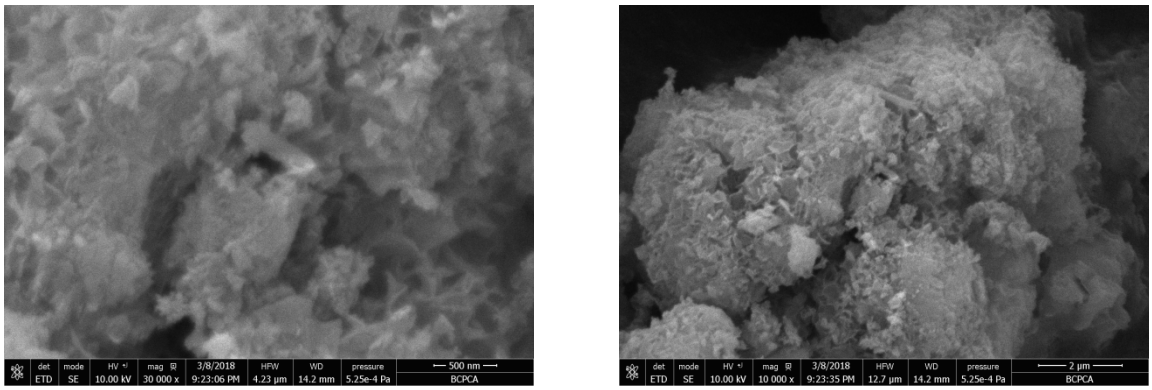

Fig.7. Common Calcium silicate filler

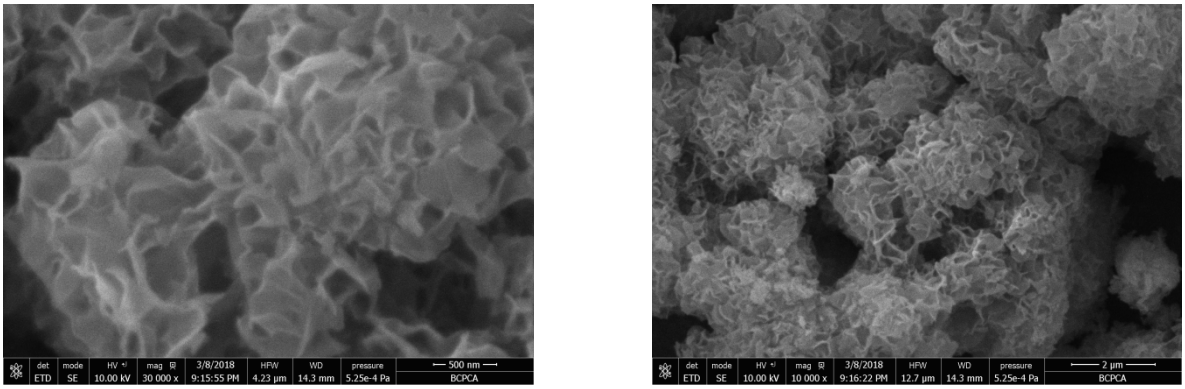

Fig. 8. Modified Calcium silicate filler

Stick the Strip to the rectangular strip on the printability meter, place it in the proper position of the printability meter, put the ink on the printing drum, the ink rollers rotate and touch each other, when the ink is evenly distributed on each drum, both hands at the same time press the buttons on both sides of the machine, printing drum press on the printing wheel to complete printing. The printed paper samples were taken off to dry, and the surface film layer of the paper samples was completely dried. The chromaticity and color density were measured with a spectrophotometer, and each group of data was measured three times and averaged.

Experimental data analysis: The ink in a certain proportion of calcium carbonate with ordinary calcium silicate and modified calcium silicate to replace the preparation of calcium silicate inks, the data as shown in Table.1.

Effect of calcium silicate filler on the suitability of ink printing: Ink printing properties mainly include viscosity, fineness, drying speed and a variety of tolerance, this experiment is mainly to measure the ordinary calcium silicate ink and modified calcium silicate ink viscosity and fineness. According to the Fig.1 and Fig.2. Ordinary calcium silicate ink with the increase of replacement rate, the viscosity increases gradually, when the substitution rate reaches 100%, the viscosity reaches the maximum. But in the modified calcium silicate experimental group, the viscosity increased first and then decreased with the increase of the substitution rate. When the substitution rate was 20%-65%, the viscosity of the modified calcium silicate experimental group was greater than that of the ordinary calcium silicate experimental group. When the substitution rate was about 65%, the viscosity of the modified calcium silicate experimental group was the same as that of the modified calcium silicate experimental group, and after that was always lower than that of the ordinary calcium silicate experimental group. From the Fig.2 we can see that The fineness of ordinary calcium silicate ink is consistent with the change of experimental data after modification, which is increased first and then decreased when the substitution rate is 20%, the fineness reaches a maximum value of 27.67 and 25, respectively, and then decreases continuously. During this period, the two experimental curves have intersected twice, with the first point between 40% and 50% and the second point between 60% and 70%.Overall, ordinary calcium silicate fineness of experimental group were greater than that of calcium silicate modified group fineness, and in the replace rate of 60% to 100%, calcium silicate modified experimental data fell sharply, get the minimum value of 13.67.

Effect of calcium silicate filler on the suitability of printing ink: According to Fig.3 and Fig.4, the modified calcium silicate ink color density data are greater than ordinary calcium silicate ink color density, the numerical difference between 0.15 to 0.33，So using modified calcium silicate filler of ink printing color density effect is better, and its value has been above the value of 1.The change of chroma data is consistent with the change of color density data, The difference is that when the substitution rate is between 0-30%, the data of ordinary calcium silicate ink is greater than that of modified calcium silicate ink. When the substitution rate was about 25%, the experimental data of the two groups were the same, and the data of the experimental group of calcium silicate was always smaller than that of the experimental group. The experimental data decreased greatly, and when the substitution rate was 100%, it was reduced to the minimum value of 91.63. As we

can see Fig.5 of the tonal error chart, the experimental data of both groups were increased first and then decreased, and the replacement rates were 20% and 60%.Overall, the tonal error of modified calcium silicate experimental group is larger than that of ordinary calcium silicate experimental group, but the range of phase difference is small, about 0.5%. From the Grayscale data in Fig.6, When the substitution rate is about 60%-90%, the experimental data of modified calcium silicate is smaller than that of ordinary calcium silicate, and the other ratios are larger than that of ordinary calcium silicate. In general, the color error and gray scale of the modified calcium silicate experimental group were larger than that of the ordinary calcium silicate experimental group, which may cause certain printing color error, but the difference was not large, which could not be detected by naked eye.

Analysis of experimental results: It can be seen from the figure that the modified calcium silicate filler has the same crystal structure as the ordinary calcium silicate filler, which belongs to the honeycomb sheet. However, after the modification, the crystal structure is clearer and the whole structure distribution can be seen clearly. The ordinary calcium silicate in Fig.7 can only be seen as a lumpy, cotton-like substance with powder covering the surface, while in Fig.8 it can be clearly seen that the substance is in honeycomb sheets, the crystal surface is loose and porous, and the structure is distinct between layers. This shows that the modified calcium silicate material has better adsorption characteristics than the ordinary calcium silicate material, its water content is more than the ordinary calcium silicate material, and the hydrogen bond binding capacity, and ink filler binding capacity is greater. Therefore, the use of modified calcium silicate fillers prepared ink performance is better than the ordinary calcium silicate fillers prepared ink performance.

Conclusion

This experiment is mainly for exploration, particle size on the ink printing suitability of the impact. The experimental results show that the experimental data of modified calcium silicate ink are generally larger than that of the experimental group of ordinary calcium silicate ink, indicating that the particle size has an impact on the ink printing adaptability, of course, it is inevitable that some substances in the ink due to the presence of sodium tripolymetaphosphate in the modified drug may react with some substances.

If it can be widely used in the printing industry, this will be a major breakthrough in the history of ink, not only for the printing industry, for those of us who use printing products, is undoubtedly a big step forward.

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