A New Approach to Collotype Printing

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Abstract: Through the use of modern printing technology, both novel and borrowed from other processes, the Collotype printing process is becoming more scientific and predictable. By excersising strict process control in all phases of collotype production much of the guess work previously associated with the process has been eliminated making it a more commercially desirable printing medium.

Collotype Printing

The Collotype printing process was at one time well established as a process unrivaled in its ability to create the finest reproductions. Commercially collotype, or photogelatine printing, has been used for art reproductions and for the most demanding advertising work such as fashon and point of purchase cosmetic displays where critical color matching is essential. It has also been used as a medium to print maps and medical journal illustrations because of its ability to resolve the finest details.

The main characteristic of the collotype process that allows it to produce fine reproductions is its ability to lay down on paper different thicknesses of ink in proportion to the amount of light recieved by the plate during exposure. This eliminates the need for the creation of screened halftone films and also avoids the shortcommings of the halftone process which are the inability to resolve fine detail and the creation of a greyness in the highlight densities that inhibits its ability to reproduce many colors, specifically the pastels.

Physical Shortcommings

With all its advantages the collotype process has many shortcommings as a commercial printing medium. It is a

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physically problematic process with its many variables subject to every day influences. The collotype plate in today is made from an aluminum substrate coated with bichromated gelatine. Because the plate is not commercially available it is coated in the shop on a whirler. The way in which the plate is coated greatly influences the way that it will print. Coating thichness is very critical and many factors dictate this thickness. Relative humidity, the specific gravity of the coating, whirler speed, drying rate and the grade of the gelatine must be carefully controlled. The light sensitivity of the finished plate is also dependant on many conditions. Among them are coating thichness, the bichromate, gelatine, water ratio of the plate coating solution, the relative humidity and temperature of the plate storage area, the relative humidity and temperature of the plate exposing area, the grade of gelatine used and the lapse of time between the end of exposure and the beginning of developement.

When the plate is printed there are yet another multitude of potential problems. The collotype press does not have a dampening system. The plate is initially moistened in a solution of glycerine and water. This mixture swells the gelatine and creates a moisture resevoir behind the surface of the gelatine. The glycerine, which is hygroscopic, attracts moisture from the atmosphere, which is kept at high humidity and constantly replenishes this resevoir. The moisture content of the plate directly affects the printing contrast of the reproduction. When the plate is printed the moisture is lost due to the rapidly moving air adjacent to the surface of the plate and by absorption into the printed substrate. An attempt is made to keep the press room environment sufficiently humid to keep the moisture gain and moisture loss mechanisms at equilibrium. Unfortunately the moisture loss mechanism is constantly changing due to the loss of glycerine from the moisture resevoir and errosion of the plate surface through contact with the printed substrate. Because of this the humidity level in the press room must constantly change.

Another factor is that barometric pressure influences the moisture loss rate and the typography of the gelatine relief. The collotype plate actually prints from a combination planographic, intaglio mechanism. Through rapid cooling in the developement stage a fine reticulation is introduced into the surface of the plate. The crevices of the reticulation hold the majority of the ink on the plate and represent the intaglio mechanism. When the barometric pressure changes the typography of the reticulation changes thus influencing the amount of ink held in these valleys. This in effect greatly influences the tone reproduction characteristics of the plate.

Collotype Craftsman

Another whole set of problems that make control of the process very difficult is related to the classic shop structure of the collotype industry. As with many of the trades, collotype artisans were trained under an apprentice system. When an apprentice learned how to operate a collotype press he learned from a master printer. Collotype differed however in that its techniques were carefully gaurded secrets. There was no communication between printers or between individual shops. There were no trade organizations associated with the collotype process. There was also little communication between departments within individual shops. Because of this pressman and support technicians never used standard conditions and never used a system that would allow each individual phase of the operation to produce in a way that would benifit other phases. There was virtually no standardization or control. These attitudes were self destructive as is evident in the fact that there are only three commercial collotype plants in the United States today.

These problems have been addressed with three methods of solution, standardization, education and experimentation. The first and foremost is standardization. By instituting a system of process control very similar to that in the offset industry in combination with quality control techniques used in the photographic industry much of the guesswork can be removed from the process. Standardization of pressroom conditions, proper control mechanisms such as color bars, grey scales and color guides have to be instituted. Quality control in the plate coating and exposing operation will greatly improve productivity.

Up to now this type of system was impossible because of the attitudes present in the industry. It is only through the reeducation of craftsman and technicians that such a system can be instituted. Collotype which has been approached as an art process in the past needs to be viewed as a science. As an art many of the problems associated with the process were taken as givens and little was done to try to eliminate them. As a science collotype becomes a controlable predictable process.

Experimental Areas

A great deal of the problems associated with the process could be eliminated it a commercial collotype plate was available. As the probability of this happening is very low I have been attempting to adapt redily made materials to our needs. Two areas of experimentation hold promise.

Bromoil Matrix Collotype

The ideal collotype plate would be a thick crosslinkable gelatine layer on a stable base that is projection speed. Such a material does exist and is called Matrix film, an Eastman Kodak product used for dye transfer photography. This film when coupled with the near ancient technology of the Bromoil process yields a fine collotype plate. The materials are available off the shelf and the resulting plate is projection speed as an added bonus. The Bromoil process is a 19th century printmaking process that converted a silver bromide black and white print into an inked image. First a silver bromide print was exposed and developed in a low fog developer such as amidol, fixed, and washed in the conventional way. The print was then immersed in a special bleach that removed the silver image. A gelatine relief was formed that represented hardening of the emulsion in direct proportion to the amount of silver present. Ink was then pounded into the surface of the print through the use of special brushes. The ink adhered in proportion to the hardening of the emulsion and resulted in a positive image in ink of the original silver print. The resulting print was either used as is or passed through an etching press in contact with another substrate to yield multiples. When matrix film is subject to similar treatment the gelatine relief may be substituted for a conventional collotype plate. Initial tests have yielded very good quality but more work needs to be done to make a more durable relief.

Example

A sheet of matrix film was exposed from a separation negative with a density range of 1.20 and then developed in Kodak HC-110 developer (dilution A) at 68°F for 3 minutes. The film was then immersed in an acid stop bath for 30 seconds followed by fixing in a non-hardening fixing bath. The film was then washed in running water at 68°F for 15 minutes. After washing the matrix is hung to dry without heat for a period of 24 hours.

The dry matrix was pre-soaked in water at 68°F for 1 minute and then immersed in a Bromoil bleach bath for 6 minutes. Next the film was washed in running water at 68°F for 5 minutes followed by a 15 second treatment in a 1% sulfuric acid bath. The film was then washed again in running water for 3 minutes at 68°F and fixed in a non-hardening fixing bath for 2 minutes. The finished matrix was then washed in running water at 68°F. After 5 minutes of washing the temperature of the water was raised at a rate of 5°F per minute until the bath reached a temperature of 85°F. At this point the matrix was carefully and swiftly immersed in a chill bath at a temperature of 45°F to induce reticulation. The matrix was then hung to dry again without heat for 24 hours.

To print the matrix it is first soaked in a 50% solution of glycerine in water for 20 minutes. The wet matrix was clamped on a press and the excess moisture blotted from the surface with clean newsprint. The matrix was then surface hardened with a formaldehyde solution until the tackiness of the surface was eliminated. The matrix was then printed with normal collotype inks to yield fine reproductions. Several hundred impressions were made before degradation of the image prevented further printing.

Comments

The collotype plate described above has several distinct advantages over the conventional plate. Obviously a projection speed plate eliminates the need for full size separation negatives which are necessary when plate making by contact. The matrix plate can be exposed in the camera room from small separations. There is even the possibility of working directly from the original by using the panchromatic version of the matrix film. A greater advantage, however , is in the ability to control the tone reproduction characteristics of the plate by using either different types of developer in the first stage of platemaking or by varying the developement time to change contrast. This is especially useful when correction is needed after the separations have been made and are found to be incorrect in range or curve shape. With the conventional plate there is no means of changing contrast in the platemaking operation.

Collotype by Imbibition

Many substrates will alter the printing characteristics of the collotype plate. Pressmen use a variety of solutions to either locally or generally change the printing densities of the plate. These solutions include ammonia, formaldehyde, triethanolamine, and various metal salts. Certain acid dyes have recently been found that have the ability to crosslink the gelatine layer in collotype plates. This brings about another novel method of producing collotype plates ; namely collotype by imbibition. Again matrix film is an integral part of the process. If a piece of matrix film is exposed and processed to yield a conventional Dye transfer matrix, dyed up with the acid dye and then transfered to a conventional collotype plate which has the bichromate component removed, the dye as it transfers into the plate coating will crosslink the gelatine. The resulting plate also has a visual image, which the conventional collotype plate lacks. When the plate was locked onto a collotype press the resulting image was directly proportional to the dye image on the plate. This proceedure has many advantages. First of all the image is visual and can be evaluated prior to printing. Secondly it is correctable. The plate can be hand retouched by adding dye manually or subsequent transfers can be made from locally dyed matricies to build up isolated areas.

Example

A conventional dye transfer matrix is prepared by exposing a sheet of matrix film through the base to a separation negative with a range of 1.20 . The film is then processed in Kodak Tanning Developer at 68°F for 2 minutes and fixed in a non-hardening fixer for 2 minutes. The unhardened gelatine is then removed from the matricies by agitating them one at a time in 120°F water for 2 minutes. The matricies are then chilled in 68°F water for 30 seconds and hung to dry.

The dry matrix is immersed in 90°F water for 1 minute to swell the gelatine prior to a 10 minute dye up in the proper dye bath. After dye up is completed the matrix is soaked in a 1% acetic acid bath for 1 minute. The matrix is now ready for transfer.

A conventional collotype plate is washed for 20 minutes in cold water to remove the bichromate sensitiser. It is then hung to dry overnight. Prior to use as a substrate for transfer it is surface treated with a 50% solution of ethylene glycol. The surface of the gelatine coated plate is then gently squeegeed to remove excess liquid. The plate is now ready to recieve the prepared matrix.

The matrix is placed in contact with the prepared plate and firm contact is affected by rolling it out in one pass with a rubber roller. The matrix is left in position for 5 minutes and then removed. The dyed plate is immediately dried with rapidly moving air.

Prior to printing the plate is soaked in a 50% solution of glycerine in water for 30 minutes. The plate is then locked onto the press and the excess liquid is blotted off with clean newsprint. The surface of the plate is hardened with a formaldehyde solution and then printed in the normal manner. The resulting plate handles similarly to a conventional plate and prints from 1500 to 3000 impressions.

Comments

The mechanism present in this method of platemaking is unknown. Obviously the acid dye alone is not responsible for the crosslinking of the gelatine. If this were so the matrix film would be hardened to the point that it would not be capable of releasing the dye. Further experimentation is necessary to determine if possibly the dye is reacting with some small amount of bichromate left in the washed printing plate or with the formaldehyde hardening treatment.

Conclusion

The Collotype process when approached as a science rather than an art can be made controllable and predictable. Many of the shortcommings of the process that are responsible for its infrequent use today can be eliminated making it a practacle commercial printing medium. Through strict process control, reeducation of existing craftsman and experimentation into novel collotype technology the process is very much alive and growing at Pho-Gelco Reproductions.

Appendix

Formulas

Bromoil Bleach (Wall 1924)

Potassium Bromide...............10 grams
Copper Sulfate..................15 grams
Potassium Dichromate.............5 grams
Distilled Water..................1 litre

Dissolve in the above order and add hydrochloric acid to form a clear solution.

Non-Hardening Fixer

Sodium Thiosulfate............150 grams
Distilled Water...............900 ml.

Acid Dye Bath for Collotype By Imbibition

Acid Blue 27....................1 gram
Glacial Acetic Acid.............9 ml.
Triethanolamine................10 grams
Distilled Water.................1 litre

Literature Cited

Wall, E. J.
1924. "Photographic Facts and Formulas" (American Publishing Co., Boston), pp 312 -313.