The Modern Printing Process

Trevor Ridsdale

This article looks at how printing processes for academic books and journals have evolved and how desk top publishing (manipulating text and images electronically) has led to computer to press printing and digital printing technologies.

Trevor Ridsdale is the Machine Room Manager for The Charlesworth Group, 254 Deighton Road, Huddersfield, West Yorkshire HD2 1JJ

E-mail: charlesworth@charlesworth.com

Modern printing presses use state of the art technology, are fully automated and capable of printing up to four colours on both sides of the sheet simultaneously together with a variety of varnish coatings, at speeds of up to 16,000 impressions per hour.

All the press functions are controlled from a central console using sophisticated computer technology.

Overview

An overview of how the production of text and illustrations on paper evolved, gives a clearer understanding of how ink is transferred onto paper today.

The Chinese were using wood blocks by the 6th century AD, but in Europe printing was unknown until the 14th century. A century later in Germany Johannes Gutenberg was using movable type. William Caxton introduced printing to England.

The next significant changes came in the 19th century, steam power replacing hand operated presses. Hand composition of type was replaced by machines operated by a keyboard. Linotype, a hot metal process (this produces a solid line of type known as a slug used in newspapers, magazines and books) was invented by Ottmar Mergenthaler in 1886 and commonly used until the early 1980s.

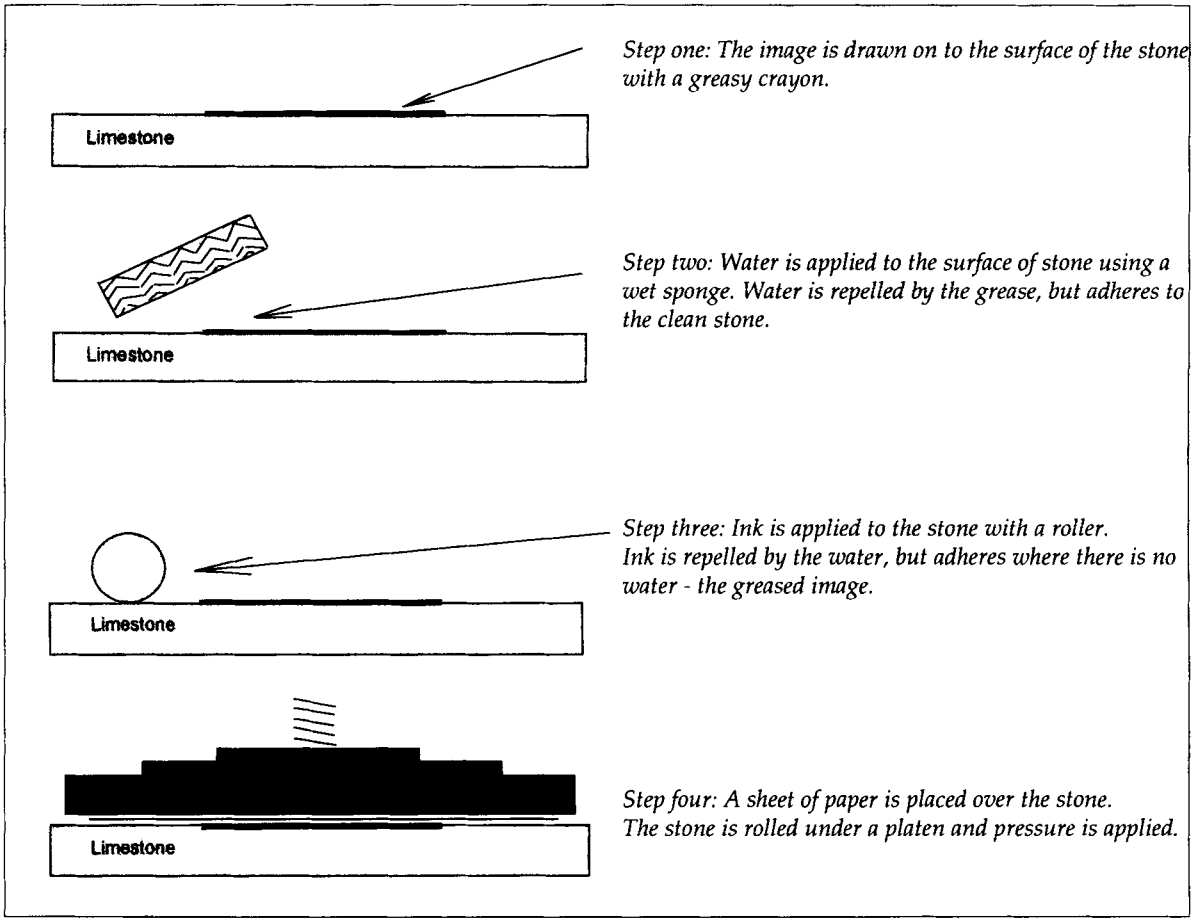
Although these advances speeded up the operation of composing forms of lead type, and steam power followed later by electricity made for longer 'runs', the actual process still involved pressing the inked type onto paper, by the process known as letterpress.

In the 1960s offset printing became a more cost effective alternative, both through lithography which uses the inked surface of a flat metal plate, and from gravure (used for high circulation magazines) where the surface of the cylinder is etched.

Lithography

Today lithography is the most commonly used printing process. Invented in 1798 by Alois Senefelder in Bavaria, he discovered that when the local limestone (Calhiem) is ground to produce a flat surface, it is porous and very smooth. He applied the image onto the surface using a greasy crayon.

Lithographic principle

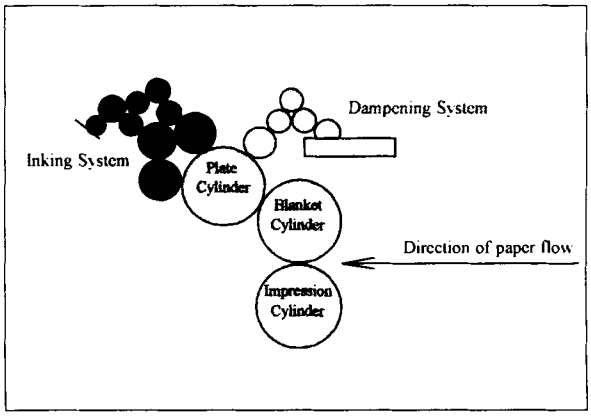


This early form of lithography was still in use in the 1920s. Producing high quality printing from stone required skilled craftsman, as the image had to be drawn the wrong way round so that it appeared the correct way round when applied to the paper.

Over the next twenty years this form of printing was transformed as mechanisation and electricity speeded up the process. A sheet of aluminium plate replaced the stone and the image was prepared using a photographic process. The plate was wrapped around a cylinder on the press. Here it rotated under a set of rollers which moistened and inked the plate in turn. This is the basis of most modern lithographic presses today.

The technique was improved still further by rolling the image from the aluminium plate (plate cylinder), directly on to a rubber covered cylinder (blanket cylinder), which in turn transferred the image on to the paper. This improved the print quality, as moisture on the plate evaporates whilst being transferred to the rubber covered cylinder.

The image on the plate is now produced the correct way round, transfers to the blanket cylinder the wrong way round, which in turn prints the image onto the paper the correct way round, the paper passes between the blanket cylinder and a third cylinder (impression cylinder) under pressure. This is called offset printing.



Typical lithographic offset configuration

The aluminium plate

The aluminium plate used today utilises Alois Senefelder's original process, with a number of refinements which have speeded up the operation of imaging the plate, extended the run life of the plate from a few dozen copies to hundreds of thousands, and improved print quality.

The surface of the plate looks smooth but is manufactured with micro pores which are designed to hold the film of water and prevent it evaporating too quickly. The image is applied to the plate using a photographic technique. During manufacture the surface receives a pre-sensitised light sensitive material based on either diazo compounds, or polymers.

The plate is dispatched to the printer in light protective packaging. The printer prepares the image (typically pages of text at a journal printer) which is exposed onto photographic film. This is given to the plate maker who, whilst working in a room which is protected by safe light, positions the film over the plate in an exposure frame. From a high output UV lamp the image on the film is exposed onto the light sensitive surface of the plate. When using positive film, the light passes through the clear background, but its held back by the image area. The film is removed from the plate which is then developed in a plate processor.

As the plate travels through the processor it is washed by the developer. This cleans away the surface coating of the plate which was exposed to light, leaving the image area intact. The plate then passes through chemicals which desensitise the non-image area and a sensitiser which causes the image area to become ink attracting.

Press systems

Lithographic presses fall into two system types, web offset and sheetfed. Web offset presses print a continuous strip of paper which is fed from a reel. This passes through the press and is cut and slit into separate sheets before passing into the delivery. Web offset presses are used mainly for high volume magazine and brochure work.

The sheetfed press feeds separate sheets from a paper stack, registering, printing and delivering the sheets individually. Sheetfed presses are used for most journals, monographs and academic books.

Multicolour printing (halftones)

This technique is used in printing to reproduce the full range of tones in a photograph or illustration. The range of tones are varied from full strength shadows to the lightest shades. The picture being reproduced is photographed through a screen ruled with a rectangular mesh of fine lines. This breaks up the tones of the original into areas of dots that vary in frequency according to the intensity of the tone. In the darker areas the dots run together, in the lighter areas they have more space between them.

Colour pictures are broken down into a pattern of dots in the same way, but first the original has to be scanned, this separates the colours which are output on film as four colour separations. From these separations plates are made and printed in sequence, black, cyan (blue), magenta (red), and yellow. The printer uses four colour process inks which combine to give the full range of colours.

Waterless offset printing

Printing from a plate which is produced in the same way as a lithographic plate, but requires rolling with ink only (no damping rollers), has many advantages. With conventional lithographic printing, several impressions are required at the start of the print run before the ink/water balance settles down, this can waste as many as thirty sheets. Correct ink/water balance is essential to print quality and can change during the run, this requires the skills of an experienced operator who must make the necessary adjustments.

The waterless printing plate relies on a different kind of surface to repel the ink from the non image area, a much smoother synthetic coating. Temperature stability of the printing unit is essential to waterless printing. Most of the leading press manufacturers now offer the option of regulated temperature control and although the setting up costs are high, it offers an attractive option to the printer who is producing high quality work on non-absorbent substrates.

Digital technology

Printing press manufacturers continue to build faster and more complex machines. Press technology is gathering speed rapidly, enabling the printer to produce high quality print,

satisfying the growing demands of the design agent and customer alike. Improved press technology creates problems in pre-press. Traditional methods of shooting colour separations by camera, imposing film and exposing plates cannot satisfy the demands of a high speed press. This demand naturally drove pre-press equipment manufacturers to develop their products.

With the introduction of desk top publishing, transporting copy on digitally encoded disk led the way to manipulating images and text electronically. Components such as Apple-Mac computers and postscript software were linked to filmsetters, which could output on film imposed text and graphics. High speed RIPs (software which drives a component, such as an imagesetter or a colour retouching station) make it possible for all systems to talk to each other. This means that digitally encoded copy can now pass between components.

Computer to plate

Imaging plates direct from the computer has proved difficult. The imagesetter is a low cost solution, producing polyester plates which are suitable for short run, on-demand printing of medium to good quality.

Large format, high quality, multicolour lithographic printing relies on a metal plate. Few filmsetters can handle metal plates, so generally a platesetter is required using laser light for imaging, either argon ion or Yag, while the plates can be silver halide, photopolymer or a hybrid. Systems available today include automatic plate loading and unloading which reduce the plate making process still further.

Mixed media workflow (part film/bromide, part digital), is a problem for a journal printer, the solution may be to scan the films and incorporate the digital information into the workflow sent to the platesetter.

Computer to press

Though still in its infancy, there are systems available today which accept the image directly to the press, Indigo E-print 1000+, Xeikon DCP or Heidelberg Quickmaster DI, and are suitable for short run work up to A3 size, where speed of turnround can justify the cost. This technology is limited for the moment to some high street copy shops and in-plant users.

The future role of lithography

Lithography is still the most cost effective system for the production of high quality, multicolour journal printing. Equipment manufacturers continue to develop their equipment around this principle.

Digital printing presses which can image plate cylinders from within the machine are set to become the press of tomorrow, but this new concept is still based on the lithographic process.