PAD PRINTING

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HISTORY

Transfer pad printing, commonly known as pad printing, is an "indirect offset gravure" printing process directly related to a process invented several hundred years ago in Europe.

It was originally used in the watchmaking industry in Switzerland to decorate watch faces. It has now developed to a point where it is one of the major methods for printing and decorating the surfaces of objects, particularly plastic.

GENERAL INDUSTRY

The founder of the Tampoprint Company in Germany built the first automatic machines used in general industry in the early 1960's. He had seen small hand operated machines that lent themselves to automation. The printing pads on these machines were made of gelatine. This was a major limiting factor in the use of the process in automatic applications. The gelatine's lack of elasticity and susceptibility to ambient changes meant that the process did not really take off in general industry until the invention of silicone rubber transfer pads.

POTTERY INDUSTRY

Before this time the Pottery Industry in Stoke on Trent had been using the same process for decorating their ceramic ware. It was generally single colour work on both flatware (plates, saucers, etc) and hollowware (cups, jugs, etc). The process was faster than applying transfers was but limited to one colour. Originally the transfer pads used by the potteries were made from an inflated pig's bladder. This was then replaced by gelatine. These pads were much bigger than those used in general industry, as they had to cover the area of a dinner plate.

PLATE EXAMPLE

The original flatware machines were developed in the late 1940's, and it was not until the 1960's that the hollowware machines were produced. These used a rotary pad and cylinder. The printing plates were hand engraved onto copper and then chromium plated. The depth of engraving was varied to give different densities of colour. Inks were thermoplastic; that is, in normal ambient conditions they were wax like and had to be heated up for printing. This meant that the ink trough, plate and sometimes the pad were kept at a temperature of approximately 60^{o} centigrade. The very nature of the process meant that high levels of skills were required to maintain constant production.

The next change in the potteries came when etched steel plates that had been developed for use in general industry were used. At the same time silicone pads took over from gelatine and inks were formulated that also used solvent evaporation to enable the transfer mechanism. At the same time the ability to use four colour process to print onto ceramics was achieved.

PRINCIPLES

The main elements of the Pad Printing process are:

- Printing plate
- The ink
- Silicone rubber printing pad
- Doctor blade or ink cup
- Machine

The image to be printed is created on the printing plate, normally by chemical etching. The plate is generally steel or a photopolymer material. There are other materials and methods of image creation that will be discussed later. Etch depth is approximately 25-30 microns. The thickness of the dried ink film varies between 2 and 20 microns. Compared to screen printing this is a thin film process.

The etching is filled with ink; the action of the silicone rubber printing pad picks up ink from the etching and transfers it to the object to be printed. Filling the etched portion of the plate can be done in various ways, but the mechanism of picking up the ink from the etched portion of the plate and transferring it to the object to be printed is always the same in conventional pad printing machines.

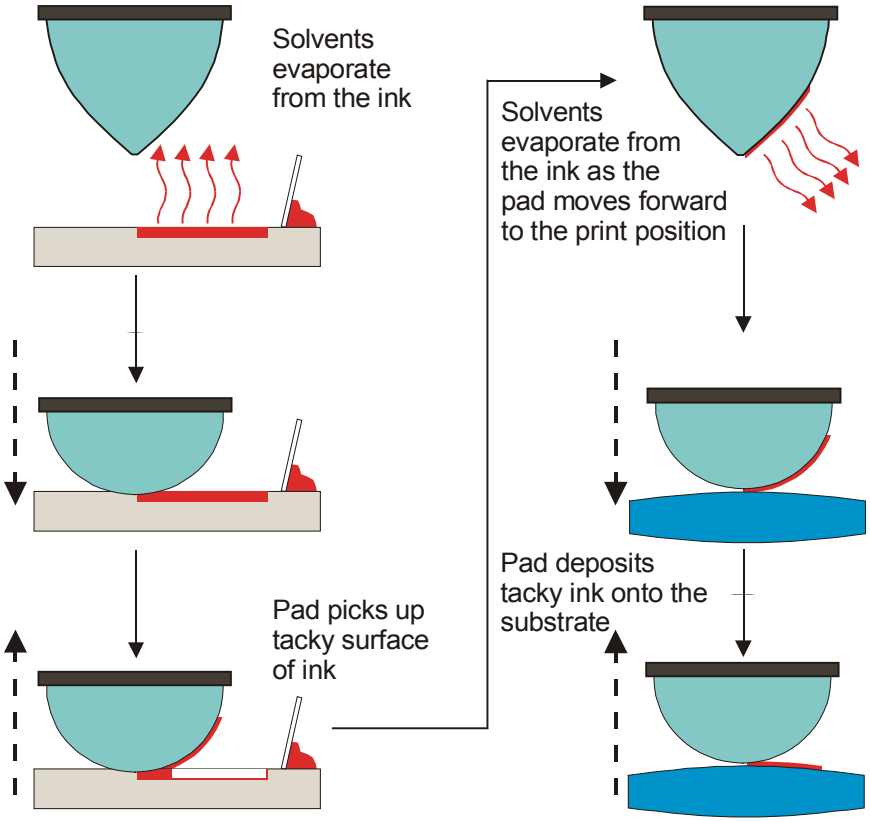
EXAMPLE OF PAD PRINTING

Pad printing inks contain solvents. The evaporation of the solvents from the ink is the main mechanism that enables the process to operate. When the ink is contained within the etched image area this evaporation of solvents causes the surface of the ink to become tacky. The shape of the pad is such that when it compresses on the plate the printing surface of the pad rolls across the plate, as it does so it comes into contact with the tacky surface of the ink. The ink sticks to the pad, as the pad lifts the printing surface rolls away from the plate and lifts up ink from the etching.

Whilst the pad moves towards the object to be printed the solvent continues to evaporate from the ink on the pad, and the outside surface of the ink becomes tacky. As the pad makes contact with the object and compresses the print surface of the pad rolls across the object and the tacky surface of the ink attaches itself to the surface of the object. The pad then lifts and the printing surface of the pad rolls away from the surface of the object and releases the ink leaving it laying on the surface. Whilst this is happening the etched portion of the plate is recharged with ink, and the pad returns to pick up another image from the plate.

The rolling motion of the pad caused by its shape is important as it squeezes out the air over the plate and the ink surface. The pad surface must come in direct contact with the surface of the ink in order to pick it up and so carry it to the component.

EVAPORATION OF THE SOLVENTS



A whole range of variables that will be examined through this manual can effect Pad Printing. Etch depth, ink condition, ambient conditions, pad shape surface finish and hardness and machine speed are the key factors. It is sometimes necessary to print an item twice or more to achieve the density of colour that is required.

Conventional pad printing machines are divided into three families.

OPEN INK TROUGH

One is known as the open ink trough, where the ink is held open to the atmosphere in a trough either behind the plate or around the plate.

CLOSED CUP

The other system known as 'closed cup', contains the ink in an inverted cup with its opening in contact with the plate. Being enclosed in the cup inhibits the evaporation of solvent from the ink. Other than the containment of ink both systems have the same operation.

ROTARY SYSTEM

The development of rotary systems stems directly from gravure printing. This system uses a rotary drum type silicone pad in conjunction with a steel cylindrical plate. The ink is either held in an open trough type system or is pumped from a sealed tank. The sealed tank normally has ink viscosity controls.

It is highly suitable for cylindrical parts and also for continuous flat printing.

More information on the pros and cons of the systems will be provided later in the chapter “Choosing a Pad Printing Machine”.

The silicone rubber pad is a very flexible material; it is this characteristic that makes the process unique. The pad can form itself onto an object with an uneven surface.