

Food Packaging Technology
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Package Printing Machines

Welcome everyone, to another session on packaging printing machines as part of the Food Packaging Technology course. This week we have already dealt with other packaging machineries like retort pouches, bottling and carton machines. And today we are going into the packaging printing machines. This will be dealt as a two part video. This is the first part that we will be dealing with. Now, printing exactly though it's not a part of packaging, it's a very integral part of packaging.

There are very little packages that is devoid of printing. Because that is the one that the design, the graphic is intimates, communicates to the consumer. So, the knowledge of this is essential even for packaging. Now, for effective design of packaging, there are a few knowledges that we need.

We need to have a knowledge of the product itself. We need a knowledge of the packaging material to be employed. A knowledge of the methods of distribution, the printing methods that can be employed and the quantities required per order. So, depending on your material, the printing method can also change. Depending on the product, the design as well as the content will change.

So, it's very important, though the printing is not exactly a part of packaging, it is an integral part of it. Let's look at the history before we move on to the different printing machines. In AD 594, the Chinese began to practice printing from a negative. Their method, they used to have an impression on a wooden block and that used to be transferred as a printing. Now, that method slowly moved on and by 1400, the technique of using printing with wooden blocks arrived in Europe.

Then, the invention of paper rolls was done by the Chinese. In 1450, Johann Gutenberg, he invented the printing press in Germany by adapting the wine press and in the days of the Roman Empire. And he used a recently perfected ink that was based on linseed oil and soot. And it was invented as a functional metal oil and the alloy was used as a mold and this ink was used for the printing. Now, from that time, the printing press that started, the world of information knowledge expanded and was widely disseminated.

By 1500, more than 9 million printed books were in circulation. So, we have got a lot to owe to both the Chinese and to Johann Gutenberg. Now, in all types of printing, ink is applied selectively. The ink is first applied to the printing unit and this printing unit might be either cylindrical or a plate or individual printing elements. So, depending on this, you get different types of printers.

And this ink from the printing material, is then transferred to the material that we want to print on by direct contact. So, based on the different types of method, there are different types of printing like letter press, flexography, lithography, gravure, silk screen, inkjet printing and hot-dye stamping. This may sound complex but it is easy when we take it one by one. In direct printing, what happens is the inked plate makes a direct contact on your packaging substrate or the paper on which it has to print. While in indirect printing, the engraved plate transfers the ink to another rubber stamp and then the rubber stamp or the rubber blanket then transfers the image to the packaging substrate.

So, it is not in direct contact with the packaging material. It transfers it to a rubber blanket and the rubber blanket transfers it to the packaging material. There is something called stencil printing which you have used in school days also with stencil on different forms. So, here also is the same principle. The ink is passed through a stencil to the packaging or the substrate.

In conventional method, the ink was applied to the printing unit like we said the cylinder or the plate and that is transferred to the substrate by direct contact. Now, plastics that is the packaging material that are used recently, PET, LDPE, HDPE or EVA copolymers, they cannot be printed unless the surface has to be treated. So, to obtain a satisfactory adhesion between the ink and the substrate, otherwise ink doesn't stick on to plastic. If you want that to happen, the inert non-polar surface, they don't allow any chemical or mechanical bonding between the plastics and the ink. So, various methods are used to oxidize the surface in some way.

Some of these are you can use solvent treatment, chemical treatment, flame treatment, electrical treatment. So, all plastic, the first step you remove the dust or dirt or any processing aid is the first step. The second is to make the surface activated so that it can absorb or it can receive the ink and become more polar. I will explain this term also before we move on to different printing process.

Photopolymers. Photopolymers are light sensitive plastics. Photo is light and polymers is plastic. So, photopolymers are light sensitive plastics and this is used to prepare the letterpress, the flexographic or the off-printing plates. We know how these ink is

transferred to these plates and it is the plates that makes the impression on the substrate. So, these photopolymers can be used to prepare these plates.

So, they have been available since 1974 and numerous systems that have been developed for producing these photopolymer plates. So, in this process what they do is in contrast to the photo mechanical etching, earlier we had photo mechanical etching where you make the engravings or molding system that is used on most rubber plates. Here, you expose the photopolymer to the UV light through a film negative and this is the negative that carries the image that has to be imprinted. So, each photopolymer plate is an original directly got from the negative. So, here you do not use any etching or molding system.

The photo plate is actually reacting with the UV light. Now, moving on to different printing methods. So, we have got these conventional methods and we have got the digital printing methods. The conventional methods can be divided into relief, gravure, offset and the screen printing methods. On the other hand, digital printing can be divided into the inkjet and the electrography method.

We will look at this step by step. We will start with the relief method which again is divided into the letterpress, flexography and the flexoprocess. This is the conventional method. So, in relief printing what happens is it includes only the flexographic and the letterpress. Here the image, if you can see in this picture also, the printing area or the image is actually raised above the non-printing area.

So, the non-printing area is depressed here as shown and the printed area or the impression is actually raised. Ink is supplied on the raised surface and that is brought in contact with the substrate on which it has to print. So, originally metal types were used and that is why it is called a letterpress. But later it was replaced by synthetic rubber or photopolymer printing plates. That is when the process is known as flexographic.

So, it is the same thing. Both letterpress and flexographic comes under the relief conventional method, where the portion to be printed is raised in the metal. In the letterpress, the metal type is used while in the flexography the synthetic rubber is used. Let's look at the letterpress. Like I told you, the letterpress is made of the metal type and they are divided into the platen machines, flatbed cylinder machines and the rotary machine. Rotary machine as the name suggests, the plates are supposed to be curved for mounting on that rotary press.

The ink that you use in the letterpress are usually oil based and slow drying. So, they have a pasty consistency and it makes the process a little difficult to apply on plastic

films. Unless the plastic films are not too susceptible and high pressure can be given. It is not easy to apply these oils or these oil based inks onto the plastic. By pressure you can apply it onto the plastic.

Now a distinctive feature, how do you recognize if it is a letterpress is that the letterpress printing, it has a 'ghost-like' image. Because around each character, the ink slightly spreads because of the pressure that the plate applies onto the substrate. So, you can recognize if it is a letterpress if you see those ghostly images around each of the characters. And sometimes a slight embossing or denting will appear on the reverse side. I told you, there is a pressure applied on the metal plate that presses onto the substrate and so it leaves a denting on the reverse side of the substrate.

And also, letterpress is still used for printing folded cartons, labels and all types of bags for dry goods. So, we talked about the letterpress, which is divided into the platen machine. The platen machine, this is a picture of the platen machine. You have the frame and the substrate that is impressed together with overall contact. So, you can see here this is the ink rollers, this is the type onto which the ink flows and this is pressed onto your substrate.

So, hand felt type will usually operate at speeds of 800 impressions per hour while the automated ones at 3000 impressions per hour. That's the first type under letterpress. The second type under the letterpress is the flatbed machine. Here, the bed reciprocates on the forward stroke. So, when you give a forward stroke the bed will reciprocate.

The printing element will pass under a series of inking rolls. So, they take up the ink and then that is impressed onto the impression cylinder and the paper is around the impression cylinder and it is printed onto the paper. The paper will be squeezed between the cylinder and the form and the ink is transferred to the paper from the printing areas. Now, this can operate at speeds of 1200 to 4500 impressions per hour. So, here is a pictographic represent of a letterpress flatbed.

Again you have the rollers which will take up the inks. It goes onto the impression, the relief form is there and that impression cylinder passes it onto the paper on the substrate. The third type of letterpress is the Rotary sheet fed machine. Now, this has speeds of up to 6000 impressions per hour. Here as I said, the printing press is a curved place and the substrate is print at the nip between the printing plate and the impression cylinder.

This pictographic representation will make it clear. So, you have the rollers will take up the ink and the plate cylinders. Impression is made at the nip between the impression cylinder and the plate cylinder. Coming back to the classification; we discussed the

conventional methods. We talked about the relief method and the first one we talked about was the letterpress which was again divided into three.

We will move on to flexograph. Flexograph is again a relief printing method where the printing area is raised. The printing material on the reel uses flexible plates. Now unlike the letterpress which uses metal types, here they use flexible plates and evaporating drying inks. So, they have these rubber plates which are more flexible than your metal plates. This is a high speed method primarily for printing packaging material.

Earlier, this was known as an 'aniline' printer because at that time they used to use coal tar dye stuffs. This coal tar dye was derived from aniline oil and that's why the name came as aniline printing. In 1952, the name changed to flexography. This is defined as a method of direct rotary printer using resilient raised image printing plates affixed to a plate cylinder. This is again inked by a roll carrying fluid to virtually any substrate.

So, basically it's the same like the letterpress except, you have a flexible plate instead of a metal plate here. And again, the printing plates are raised, points are raised. So, here generally, they have four rollers or cylinders that are used. The number one is the rubber inking roller or the fountain roller, as you can see in this picture. A is the rubber fountain roller or the inking roller which actually supplies the ink to the next roller which is called anilox roller, B So, some cases they do have this doctor blade which will remove the excess ink and then it is passed on to C roller which is the printing cylinder.

Now, the C roller and the D roller. The D roller is the impression cylinder. The substrate is passed between the C and the D roller and it makes the impression on to the substrate of the printing material. Now, the cost of producing the plates are relatively low. When you come to this, flexographic printing is cost effective especially for short runs. Moreover, thin fast drying solvent based things are used.

So, this helps in multi-colored printing also, which can be done in one pass. Like we said high speed is possible. There is a major disadvantage, where the ink has a low viscosity and so, it is difficult to get sharp image. That is the only one disadvantage. However, with the introduction of photopolymers, this disadvantage has been overcome.

So, we talked about letterpress, flexography and this is another picture of flexography. Again the four different rollers and how the impression is made on to the substrate. The third type of relief printing is flexo process. Now, for the flexo process, a double chamber doctor blade is used which delivers the ink to the analogues. So, instead of the earlier method, it is just a simple modification of the flexography method.

In the flexo process printing, this blade, which is the doctor blade and that delivers the ink to B, which is the analogues rubber. Now, this is distributed in metered amount of ink. So it doesn't spread too much and that is taken to the printing cylinder C. Now, the impression of D, which is the impression cylinder that presses on to the package material or any substrate on which you want to print. So, the flexo process is just a modification of the flexography process.

So, quick recap. We have gone into the conventional methods of printing. We talked about the relief printing under which you have the letterpress which uses a metal type plate or the flexography method which uses a flexible printing plate and the flexo process which is a slight modification. Now, in the next video, we will go on into details of the next few printing presses. We will start with the gravure in the next session. Take care till then. Thank you!