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Plastisol vs. Water-based Ink for Textile Printing

by Mike Ukena

There are two main types of ink that are used for textile printing. Water-based ink utilizes either dyes or pigments in a suspension with water as the solvent. The evaporation of the water is necessary to set or cure the ink. This curing can take place either at room temperature or with the assist of a dryer depending upon the specific water-based ink used and the speed or volume of production.

Plastisol ink is a PVC (polyvinyl chloride) based system that essentially contains no solvent at all. Along with UV ink used in graphic screen printing, it is referred to as a 100% solid ink system. Plastisol is a thermoplastic ink in that it is necessary to heat the printed ink film to a temperature high enough to cause the molecules of PVC resin and plasticizer to cross-link and thereby solidify, or cure. The temperature at which most plastisol for textile printing cures at is in the range of 149 °C to 166 °C (300 °F to 330 °F).

Both types of ink are very popular. However, for the most part, they are used in very different applications. Plastisol is the ink of choice for printing of finished goods such as T-shirts, sweatshirts, jackets, and tote bags. Water-based ink is the ink of choice for the printing of yard goods; either in piece form or on the roll.

Both inks have technical advantages and disadvantages for use in specific applications. They also each have their own environmental impacts and these should be considered for the particular application and shop setup.

Advantages of Plastisol

Plastisol can best be described as a “user-friendly” ink because it is very easy to manage. Plastisol can be left in the screen for extended periods of time without clogging the mesh. It is ready to use right out of the container more than 90% of the time. In most applications, it can be printed wet-on-wet, which allows for increased production speeds. It comes in formulations that can be printed on light and dark fabrics. And, in most municipalities, the disposal of waste plastisol is a very simple process.

Plastisol does not “dry”. In order for a compound to dry, there must be evaporation of some kind of solvent. Since plastisol has little or no solvent, it cannot dry. Because of this characteristic, plastisol can be left in screens, the lids can be left off of the ink containers (although keeping them covered is a good practice to keep lint and dirt out of the ink). And ink left at the end of the job can be returned to the container for reuse without any adverse affects. This last practice is a great benefit in reducing waste product.

Plastisol is extremely versatile in that most printers never have to amend the ink. They are able to use it direct from the container without ever adjusting the viscosity or the strength. Plastisol comes in strengths from transparent to very opaque and most printers will have the various versions available to use, depending upon the type and color of fabric they are printing on. The various opacities of ink also vary greatly in price with the most opaque being the most expensive, mainly due to the cost of the increased pigment. So, good shop management dictates that the proper opacity be applied to each fabric in order to be cost effective.

Plastisol Disadvantages

Since Plastisol is a thermoplastic, it will remelt if it comes in contact with anything hot enough. For that reason, plastisol prints cannot be ironed. If an iron touches a print, it will smear the ink.

Plastisol ink also creates an ink film that can be felt with the hand. The higher the opacity of the ink, the greater the hand. This heavy hand is considered a disadvantage at the consumer level.

One of the most important practices when using plastisol ink is to keep the ink clean. What this statement means, is that it is very beneficial, and cost effective, to keep plastisol colors from being contaminated by dirt, lint, or even other colors of ink. By maintaining clean shop practices, there will be a great reduction in ink waste. Clean ink can be returned to the original ink container for reuse. There is no degradation in the quality of plastisol as long as it is not mixed with other colors or contaminated with foreign materials.

Plastisol that has been contaminated with other colors is can still be retained in a separate container for blending with other waste ink. Often times this waste ink can be used to create new colors or, it can be over pigmented with fresh pigment to create a dark color, such as black, for use on less critical jobs. With good plastisol ink management, waste can be reduced to a very small percentage.

Plastisol product that is unusable is not considered hazardous waste in most municipalities as long as it is solidified (cured). The best way to achieve this cure is to heat the waste container itself to 160 °C (320 °F) for a period long enough to cure the ink all the way through. In practice, a one gallon container of plastisol will cure all the way through in approximately one hour.

If the plastisol needs to be disposed of in an uncured state, then hazardous chemical regulations usually apply. For either cured or uncured disposal, it is recommended that you always check with local regulatory agencies.

The biggest environmental hazard in the use of plastisol comes in the screen and equipment cleaning steps. In order to emulsify the ink for easy removal from screens, squeegees, flood bars, spatulas, and work surfaces, it is necessary to use some type of solvent. The waste ink and the solvent must be disposed of properly in order to minimize environmental impact.

The screen printing industry has been very proactive in the creation of products that can minimize the impact of these cleaning processes. Solvents are available that are "more" environmentally sensitive than the traditional petroleum based solvents. In addition, there are many types of filtration and cleaning systems available to capture inks and solvent residues to minimize the solids that are discharged into the sewer system.

Water-based Ink Systems

Water-based inks are defined as those that utilize water as the main solvent. That does not mean, however that water is the only solvent. It is significant to note that many water base inks contain "co-solvents" which may even be petroleum based solvents. The reason these co-solvents are used varies, but one of the key reasons is to decrease the time and heat necessary to cure the ink film on the fabric.

Advantages of Water-based Inks

Water-based inks are a good choice when a "soft hand" is desirable. A soft hand is the condition where the ink film cannot easily be felt with the hand when passed across the surface of the fabric. This affect is often used as an argument for why water-based is preferable to plastisol as plastisol has more of a hand than water-based.

Water-based ink also has the advantage of being an excellent ink system for high speed roll-to-roll yardage printing. Such printing is done on large sophisticated equipment that has very large drying (curing) capacity.

Water-based ink also is a good choice where ink penetration is desirable, such as in towel printing. Towels have a high nap fabric that must be printed in a manner where the ink penetrates or wicks through to the base fabric for adequate coverage. Water-based inks that are designed to wick into the fabric are excellent for this application. Ink wicking is not a desirable affect in most other fabric printing as it will destroy the design and registration of multiple colors.

Disadvantages of Water-based Ink

Water-based ink is much more difficult to cure than plastisol. A shop that is interested in printing water-based ink must have the drying capacity to remove the water. The dryers used for water-based printing tend to be larger than those needed for plastisol. In plastisol printing, the ink film must only reach the cure temperature for a brief moment. With water-based ink, the temperature must be reached and then held until all of the solvent (water) is removed.

There are water-based ink that will air dry but they are usually only acceptable for craft level printing as the room required for curing greatly reduces productivity. Many water-based inks can also be more quickly cured with the addition of a catalyst that will assist the heat in the curing of the ink by continuing the cure even if all of the water is not removed in the dryer.

The disadvantage of a catalyst is that once it is added to a water-based ink, it creates a time limit or “pot life” where the ink must be all used in a certain time or be discarded. Most catalyzed water-based ink pot life’s are between four and twelve hours.

Since water-based inks contain water as an evaporative solvent, care must be taken to prevent the ink from drying in the screen. If water-based ink is left in open mesh for even a short period of time, it can clog the mesh and ruin the screen. Practiced water-based ink printers must always be conscious of how long a screen sits between prints to prevent the ink from “drying in”. While modern water-based inks are less prone to this phenomenon, it is still a concern.

In addition, when a water-based print job will take more than one day, the ink must be removed and the screen cleaned with to prevent drying. The ink is then put back in the screen on the next work day and the job is continued.

Water-based ink is also much more aggressive than plastisol towards the emulsion that is used to create the screen stencil. Emulsion manufacturers all make “water-resistant” emulsions that must be used for water-based printing. If standard emulsion is used, the water-based ink will destroy the stencil by melting the emulsion is as little as a few minutes. Even when the proper emulsion is used, screen life tends to be much less with water-based printing than it is for plastisol printing.

Water-based Ink Cleanup

There is a common misconception that because water can be used for cleaning screens, squeegees and tools, that the waste water can just be discharged in the sewer. However, the water-based ink is not just water. There are pigments, binders, thickeners, and sometimes, even co-solvents in the ink residue. Screen cleaning systems that can at least capture the solids are still recommended.

In addition, water-based that has not been catalyzed can be returned to its container for reuse. If the ink has been catalyzed, it should be considered hazardous waste unless it can be dried out (all water and solvent removed) before discarding. If it cannot be dried, it should be disposed of as hazardous waste.

Summary

Whether printing with plastisol or a water-based ink system, you are still printing a chemical compound. Therefore, it is essential that proper handling and disposal methods be practiced. As stated above, there are advantages and disadvantages to each ink system. The key is to use the proper ink for the application, minimizing waste product, and always dispose of waste properly.

	Curing	Ease of Printing	Opacity	Hand	Cost	Waste Ink Recovery
Plastisol	Easy	Fair	Low-High	Med-Hvy	Mod-High	Excellent
Water-based	Hard	Easy	Low-Med	Soft	Low-Mod	Fair

	Plastisol	Water-based
T-Shirts, light colored	Excellent	Excellent
T-Shirts, dark colored	Good	Poor
Nylon Jackets	Good	Fair
Towels	Poor	Excellent
Yardage	Poor	Excellent