

As a bubble to form.  
this bubble then

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As printing evolves from one method to the next, so do the inks utilized in the machine. Inkjet printing was first developed during the 1950's. However, the technology didn't begin to produce digital images until the 1970's. It wasn't until the late 1980's that these printers hit the consumer market (Haigh, 2018). Now inkjet printers are the most commonly used type of printer throughout the world. Inkjet printers are a type of computer printing that creates a digital image by streaming drops of ink onto a substrate.

There are two different technologies of inkjet printing; continuous inkjet printers and drop on demand inkjet printers. Continuous inkjet printers contain a highly-pressurized pump which dispenses a liquid ink through a nozzle, creating a continuous stream of ink droplets. Drop on demand printers are separated into thermal and piezoelectric processes. During the thermal inkjet process tiny chambers, each containing a heater, receive a pulse of current which causes a bubble to form. This bubble then causes pressure which forces a droplet of ink onto the substrate. During the piezoelectric drop on demand process, a piezoelectric material inside the tiny chambers change shape when a current is applied, creating pressure (Woodford, 2017). Similar to the thermal process, this pressure then forces a droplet of ink to release.

So which inks do we use for each process? Which inks are best for the particular substrate being used? The three kinds of ink used for inkjet printers are solvent inks, UV-curable inks, and water based inks. Solvent inks create vibrant, beautiful prints that are fade resistant and typically waterproof.

Based on the volatile organic compounds these inks are made from, the ink is relatively inexpensive and capable of printing on all types of substrates.

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The vibrant color is a result of the use of pigment in the ink instead of dye. The pigment also contributes to the lack of fading and durability of the print. Inkjet printers that use solvent ink have generally a high print speed and utilize particular drying equipment such as heaters and blowers. Solvent inks are divided into two separate categories, hard solvent inks and mild solvent inks.

Due to the high content of volatile organic compounds in hard solvent inks, specialized ventilation is necessary to avoid the dangerous fumes. However, these inks do provide the greatest amount of durability and least amount of coatings after printing. Similar to hard solvent inks, mild solvent inks produce the same amount of durability but are safe to use in an enclosed area.

The main disadvantage of solvent inks are the hazardous vapors that are produced and the inefficient method of disposal of used solvent inks.

Based on their properties of durability and vibrancy, solvent inks are typically used for billboards and other large printed displays. Solvent inkjet inks are excellent high quality inks used for versatility in the industry. Ultra-violet curable inkjet inks provide a huge advantage in the printing industry, a practically nonexistent drying time. Due to this method, the print process for ultra-violet inks is extremely fast.

UV curable inks are composed of acrylic monomers which are cured after printing with a strong ultra-violet light. This radiation that the ink is exposed to causes the initiators within the ink to chemically react, converting the liquid ink into a solid. During this chemical reaction no ink is evaporated through heating, but cured through firmly setting into the substrate. This

results in the entirety of the ink being used, providing high quality colorization. A major disadvantage of ultra-violet cured inks is the limited number of substrates that it can be applied to.

These inks are often subject to crack when adhered to flexible substrates due to the volume of ink that remains after being cured. Because of this UV cured inks are typically only applied to rigid surfaces such as wood, plastic, or aluminum. However, companies around the world are continuously researching and expanding knowledge on these technologies. In Ink World magazine Peter Saunders states, "Over the years as lamp and ink technology have advanced, at Sun Chemical we have developed a series of graphic inks which fully cure with LED UV exposure" (Savastano, 2016). Another disadvantage to ultra-violet cured inks is the expense it requires to acquire the curing modules and ink. Overall, ultra-violet curable inks produce high quality images through the latest inkjet technology. Water based inkjet inks are commonly found in family homes with a basic desktop printer.

These inks are based on a mixture of water, glycol, and a dye or pigment. Water based inks are typically used in thermal drop on demand inkjet printers due to the need of water in the thermal heads. Although relatively inexpensive, water based inks provide a wide range of color gamut and vivid displays of images (FESPA staff, 2014). However, due to the composition of these inks they are often difficult to manage on the substrate. Unless the substrate is coated, in the presence of water the ink will begin to run. Water based inks incorporating dye instead of pigment are less durable and prone to fading.

Pigment incorporated water based inks tend to cost more but will provide better long-term wear. Although water based inks are not always portrayed as high quality, these inks are common for basic printing due to the low cost. Inkjet inks have adapted to the high pace, technology driven world we live in today.

With the extensive amount of printed materials being developed daily, the demands of printers have increased tremendously. Although the printing industry has developed many new technological advances in the past few decades, companies and organizations are still researching further ways to advance this field.