A Defect Analysis of Rotary Screen vs. Digital Textile Printing

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While most printers say that they love a 10-20,000 yard run, ask them again when they are looking at the percentage of seconds generated during that run. Print seconds, or printed fabric with one or more defects, are very common to textile printers. Industry wide, a textile printing plant will average between 2 – 10 % seconds. What causes these seconds, and how can printers reduce the total number of yards ruined?

Arguably, the three main causes of print seconds in rotary screen printing are misfits\(^1\), stick-ins\(^2\), and scrimps\(^3\). In addition to the main three, add screen stoppage due to chemical incompatibility, wicking\(^4\), loss of color, color contamination, smears / streaks, and edge rounding due to screen buildup and you have Excedrin headache number 29. Some may argue that color matching is one of the biggest causes of defects, but for the sake of sanity, we won’t discuss that in this article. Fortunately, some of these defects can be minimized or prevented. For example, stick-ins are a result of poor singeing or lint removal prior to printing. Scrimp defects are a result of cloth wrinkles or creasing they receive due to bleaching in rope form. As the cloth passes under the screen, it often regains these wrinkles and leaves a large unprinted area. In addition, streamlining the chemical system and removing excess print paste components can minimize screen stoppage. Unfortunately, the majority of these defects have one major thing in common – screens. All of the defects described above are inherent problems associated with the use of rotary screens.

Fortunately for the textile printer, the future has a bright outlook. Digital Printing, the newest method of fabric printing, bypasses the need for screens. With a digital printer, textile manufacturers can uses their existing screen files to print a pattern directly onto fabric. The elimination of screens provides a huge benefit in sampling and print orders of 1000 yards or less. In addition, digital printing allows the user to scan in pictures, artwork, and just about anything else and print an image onto fabric. The overall process from sampling to production is greatly shortened, and total costs are reduced. However, as with any type of printing, digital textile printing has its own set of defects.

Digital printing of textiles is very new and with the exception of sampling, is not widely used. Therefore, the defects are not easy to classify and even harder to rate in order of frequency. However, one of the most common defects inherent in digital printing is “banding.” Banding is a slang term given to a defect created by the print head’s movement over the substrate. Most all of the digital printers on the market use a scanning print head, or to put it simply, a print head that moves back and forth across the substrate. This scanning head prints across the substrate in straight lines, placing drops of ink at precise locations along the line. If the head is not properly aligned, or if the substrate advances unevenly, the result is a slight horizontal “band” or line of unprinted area. Banding can be reduced or prevented with nozzle redundancy and multiple passes by the scanning print head. In addition, banding is naturally reduced by most fabric substrates. The three-dimensional textile fibers in woven and knit fabrics help to mask the effects of digital print banding.

Another common defect in digital printing is called a “misfire.” A misfire occurs when the inkjet nozzle fails to send a drop of ink onto the fabric. Similar to a stick-in, the result is a small, unprinted area. In addition to misfires, nozzle clogging also plays a big role in digital defects. When an inkjet nozzle clogs, the pattern may lose some or all of one color. Fortunately, the inkjet drop is tiny, and most misfires and clogs are not seen if the printer has been designed with nozzle redundancy.

Fabric handling also plays a role in the creation of defects with digital printing. Because most digital printers use a scanning head to print across the width of the fabric, the fabric must remain perfectly still or the image can be distorted. One of the biggest fabric handling related defects occurs when the fabric buckles or gets wrinkled, causing the scanning inkjet head to come in contact with the fabric. The result is a nasty ink smear and possibly a damaged print head.

Last but not least, color reproduction, repetition, and side-to-side shading cause many digital printing headaches.
Colors are created in digital printing by using a series of dots or drops of varying color to shade an area of the design. The result can be a beautiful design with heavenly tone or a spotty mess, depending on the design software, ink choice, printer, and the individual colors. For example, medium to dark colors are often easily reproduced with a digital printer with good results. Unfortunately, we cannot say the same about light colors, especially pastels. Pastel colors often end up as the spotty mess talked about above. This phenomenon is known as dither, and is an inherent characteristic of digital printing. Dithering can be reduced or prevented in some cases by using lighter inks and choosing the correct design software, but it will never go away. While not a true defect, dithering has proven to be a main resistance to the adoption of digital printing in the Textile industry.

Color repetition defects occur when the digital printer is asked to print the same pattern a second time. Without a strong calibration feature in the printing software, the apparent color of dot shading can vary from side to side and from batch to batch. These defects are often associated with poor ink standardization, and sometimes occur when the printer changes ink cartridges or ink suppliers. As mentioned above, repetition defects can be minimized or reduced with the proper software and ink.

As you can see, digital printing does eliminate many of the defects associated with textile printing. However, it is very important to realize that digital printing brings with it a different set of defects. As mentioned above, these defects can be reduced and / or eliminated by the proper combination of ink, printer, and design software. Indeed, the future looks bright for the textile printer, but I guess it depends on which lightsource you are using. (Sorry, a textile joke).

Footnotes:
1. Misfits – A misfit is a print defect caused by improper alignment of the screens. Also known as “out of registration,” misfits leave unprinted areas in the design. For example, a green leaf may overlap its black outline or print over another color. Up to 10 % of printed goods designated as first quality contain some level of misfit.
2. Stick-ins – A stick-in occurs when a small fiber or piece of lint gets stuck in the screen opening. The result is a small pen tip sized unprinted circle in the design. A stick-in is very difficult to see and often goes unnoticed during a long run.
3. Scrimps – A scrimp defect occurs when the fabric creases underneath one of the screens during the printing process. The pattern is then printed on top of the crease, leaving a large unprinted area when the fabric returns to its relaxed state.
4. Wicking – Wicking, also known as flushing, occurs when the printed area bleeds out into the unprinted area. The result is a “haloing” or shadowing effect around the outline of the pattern design. Residual salts left in the fabric during resin finishing and / or poor fabric preparation often cause wicking.

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