Abstract

Over the last 25 years, curation standards have improved for fluid and dry specimens. Increased general market demand for the production of archival documents and graphics has led to a variety of innovative inks and paper stock that meets collection management needs. Museums are benefitting from these advancements, but long term studies of these media must be established to ensure the security of our specimen data. Thermal transfer labels have been in use for two decades, allowing for longitudinal study of the product’s durability in varied fluid environments. These products have performed well, but are vulnerable when exposed to certain specimen processing chemicals (e.g. surfactants). To hedge against failure of a single label product, we have been testing alternate printers and inks for back-up potential. In late 2014, the Department of Invertebrate Zoology and the Division of Fishes began testing pigment-based color inkjet printers. We replicated fluid test environments from the original thermal printer studies with the inclusion of several commonly used chemicals (e.g. DMSO, surfactants, liquid nitrogen, xylene, etc.). We present the results of the preliminary study and make recommendations for additional curation approaches using these relatively recent labeling products.

Fluid Preservation Labels: A History

For the past 170 years, the Smithsonian Institution has been labeling fluid preserved specimens using “wet stock” paper. In 1999, a Department of Invertebrate Zoology study found that many of the labels produced by computer generated printers were showing signs of instability and even hand written labels created using resilient “India Ink” were prone to abrasion and smearing. The findings validated our mid-1990’s decision to change our practice and produce primary fluid preservation labels on polyester paper with a thermal transfer printer. The only available secondary label backup option was to create simplified hand written labels with a No. 2 pencil on wet stock paper.

The search for a replacement option for this time consuming curation method led us to the burgeoning archival printer market that underpins the production of official legal documents. The problem was that these archival inks were only tested for minimal fluid exposure and not for solvents. Fortunately, we found a company that allowed us to demo a full color pigment ink printer against the full suite of fluids and solvents present in our wet collections. Testing of the HP Officejet Pro 476dn commenced in the fall of 2014.

Multipurpose Printer Trials

The Officejet Pro 476dn inks were vetted by several archival product research labs for legal documents and have an excellent price/performance ratio. We replicated fluid test environments from our collection and labs were also tested. The test labels were printed with basic CMYK color and expanded color palettes using a variety of fonts and test sizes. Dry control labels were maintained in neutral environments for later comparison. At three months and twelve months we attempted to distress the test labels and smudge the inks via mild to moderate abrasion.

To assess the long term resiliency or degradation of these products, all test samples will be maintained in collection conditions indefinitely. Labels will be periodically removed from each fluid medium and checked for fading and smudging under mild to moderate abrasion.

Test Results

Labels maintained in standard and full concentrations of fixative and preservative chemicals (Ethanol, Isopropanol, Formalin) performed remarkably well, with the black, red, and blue inks showing almost no signs of fading and exhibiting extreme resistance to smudging. Minor label smudges only occurred when excessive friction was applied.

Yellow inks were the least reliable pigment, with signs of fading present in some trials. Yellow inks completely failed after a year submerged in the whale and whale lice alcohol.

The stability of black, red, and blue inks was consistent across almost all fluids, as was the unreliability of yellow inks in all fluid testing conditions.

The majority of surfactants did not impact the integrity of the label. Only one fluid, bleach, caused the paper to disintegrate.

The expanded combination color palettes were only tested in standard curation concentrations of our three main fluids and performed as well as the standard CMYK palette on the original test labels.

The labels on dry archival, sticky and magnetic paper have shown little to no fading after over a year of exposure to lab lighting and direct sunlight. Wet stock label paper began to degrade when exposed continuously to direct sunlight.

Conclusions

The findings of this study are preliminary, but the printer has performed better than any other traditional pigment ink printer we have used to date. The increased stability of the inks negates the need to frequently replace labels, saving valuable staff time. An added benefit of archival ink printers is they can be applied to a multitude of museum lab needs, both wet and dry labels as well as production of archival museum documents and color coded specialty labels used for types or HazMat information.

The print speed is fast and the ink sets quickly. If dust accumulation becomes a problem, the multi-phase cleaning features allow the user to quickly re-establish print quality. Pigment ink printers are at or below the market price of thermal transfer printers. The ink cartridges are very stable in long term storage, so cost saving bulk purchases are an option.

Based on the results of our short term study, we recommend these units for production of archival dry labels and backup labels for fluid collections. We will continue to use the thermal transfer printers as our primary specimen labels for fluid preserved specimens, but will explore expanded practical uses of these printers and archival inks in collections management.

Control Label

Color Palette

In September 2014, a call was put out to departments and labs to provide samples of chemicals used in the fixation, preservation and study of biological specimens. Sample labels were printed to test light and fluid exposure on the preferred museum paper stock. Below are the label exposure conditions and fluids tested in this study.

Labels Printed on Resistall Paper (Standard for curation of wet specimens)

<table>
<thead>
<tr>
<th>Chemical/Surfactant</th>
<th>Exposure Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethanol 70% Clean</td>
<td>Office Lights</td>
</tr>
<tr>
<td>Ethanol 55%Clean</td>
<td>Direct Sunlight</td>
</tr>
<tr>
<td>Ethanol 70% (Reptile jar with picric acid)</td>
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<td>Ethanol 70% (Crocodylentank)</td>
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<td>Ethanol 70% (Whale with Sea Lice Tank)</td>
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<td>Ethanol 70% (Tuna Jar)</td>
<td>Direct Sunlight</td>
</tr>
<tr>
<td>Ethanol 70% (Cocktail of various Herb Specimens)</td>
<td>Direct Sunlight</td>
</tr>
<tr>
<td>Isopropanol 70% Clean</td>
<td>Direct Sunlight</td>
</tr>
<tr>
<td>Isopropanol 59% Clean</td>
<td>Direct Sunlight</td>
</tr>
<tr>
<td>Formalin 10%</td>
<td>Direct Sunlight</td>
</tr>
<tr>
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*After preliminary study, a more complex color sample was added to this jar to assess adding a color component to label formats in standard collection preservatives.

Labels Printed on Archival Paper (Standard for curation of dry specimens)

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Labels Printed on Sticky Label Paper and Magnetic Sheets (Standard for Slide Labels and HazMat Labelling for Collection Rooms)

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