Erasable Ink for Inkjet Printers

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1 MOTIVATION

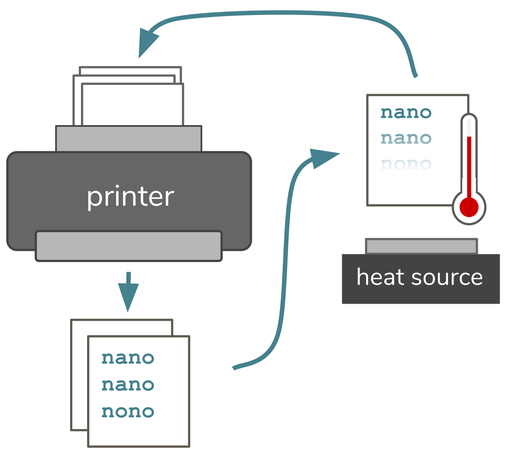
- Printed documents are discarded after just a single use.
- Documents are reprinted entirely because of typos or small changes.
- Wasted paper leads to increased deforestation.

2 OBJECTIVES

- Develop an ink with an irreversible colour changing effect.
- Print designed ink from a standard household inkjet printer.
- Ensure ink withstands everyday conditions without going clear.
- Minimize time required to erase the ink.

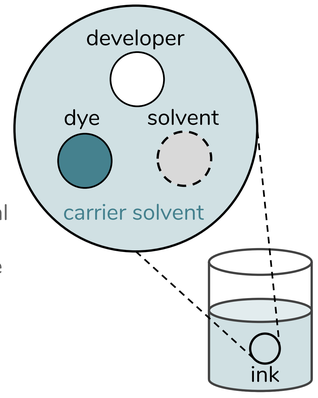
3 APPROACH

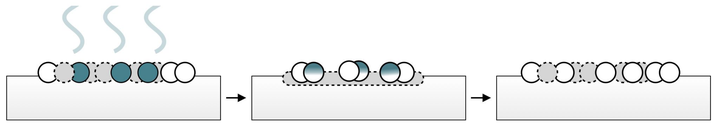
- A thermochromic dye system allows the ink to transition from coloured to clear upon heating.
- Incorporate the dye system into an ink formulated to print from a selected inkjet printer (Brother MFC-J480DW).
- Documents printed from the inkjet printer can be heated to erase part or all of the document and then reprinted from the same printer.



4 DESIGN

- The three-part dye system is carried in a volatile solvent mixture of ethanol and isopropanol to allow for printing.
- The dye system is composed of a dye (crystal violet lactone), a developer (3-nitrobenzoic acid), and a dye solvent (1-octadecanol). The optimal dye system mass ratio was found to be 1:15:40.
- A viscous agent is used to increase the viscosity of the ink for effective printing.





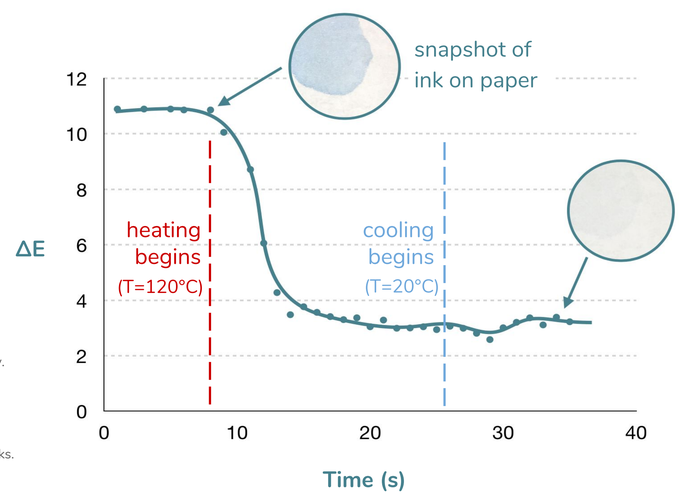
On paper: Carrier solvent evaporates away at room temperature.

When heated: Solvent melts allowing developer and dye to interact.

When cooled: System solidifies into clear state.

5 RESULTS

- The designed ink was tested by heating a sample to 120°C and measuring its colour (ΔE) over time, relative to a controlled spot on the paper. The colour data was analyzed using MATLAB.
- The ink did not change colour when heated to 60°C or lower.
- Viscosity and surface tension of the designed ink was tuned to closely match the branded printer ink. This allowed for the successful printing of the ink using the Brother inkjet printer.
  - Viscosity of ink: 2.36 cP (target of 2.36 cP)
  - Surface tension of ink: ~43 mN/m^2 (target of 31 mN/m^2)

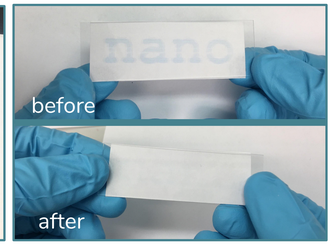


designed ink

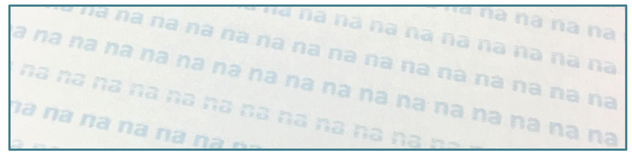
6 PROTOTYPE RESULTS

- Printing of the designed ink was successful. Multiple printing passes can be used to obtain more vibrant documents.
- The printed ink transitioned permanently to clear when heated at 120°C for ~1 minute.

Printed “nano” text



Erasing of printed text



Sample text printed with size 14pt font

7 CONCLUSIONS

- The synthesized ink successfully transitioned from coloured to clear irreversibly with applied heat in roughly a minute.
- Printing of the ink was achieved by tuning viscosity and surface tension to roughly match the branded ink’s properties.
- Ink did not fade when exposed to temperatures up to 60°C.

8 RECOMMENDATIONS

- Tune the designed ink to work in other printers by matching it to their respective branded ink properties.
- Develop other colours that can be printed and irreversibly erased with heat. This would allow for printing of more complex documents.
- Investigate the use of aprotic viscous agents to increase the viscosity of the ink while maintaining the full thermochromic effect.

REFERENCES

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