Historic Manufacture of Transparent Papers

SUNY Buffalo State: Grace Walters

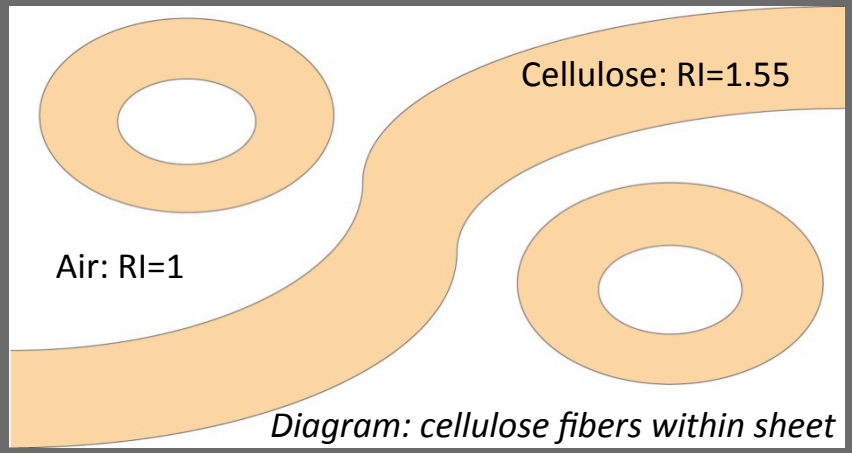


Diagram: cellulose fibers within sheet

"Prepared Papers" : ~1400 - present

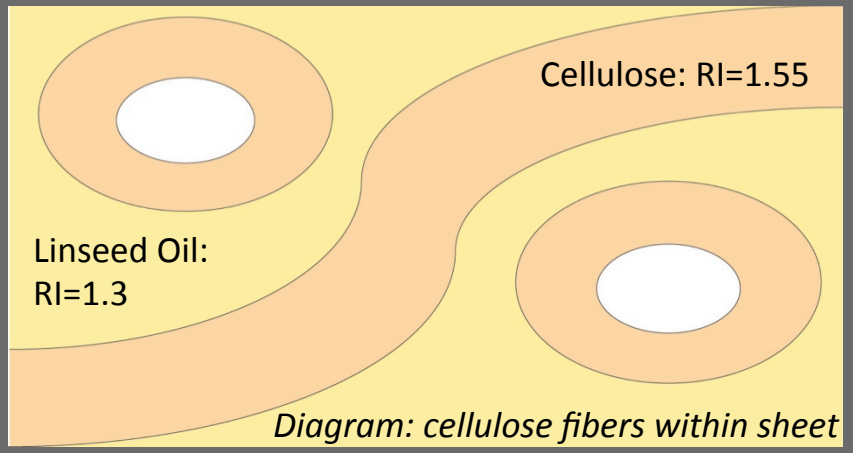
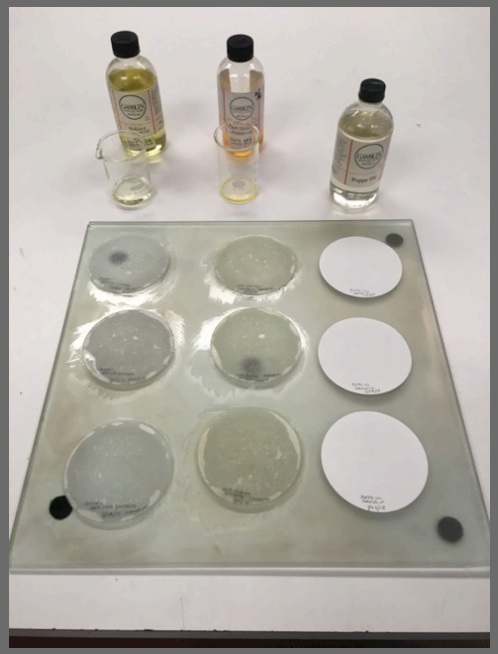


Diagram: cellulose fibers within sheet



**All refractive index values sourced from CAMEO*

Historic Manufacture of Transparent Papers: Methods

“Parchment Papers” : 1846 - present

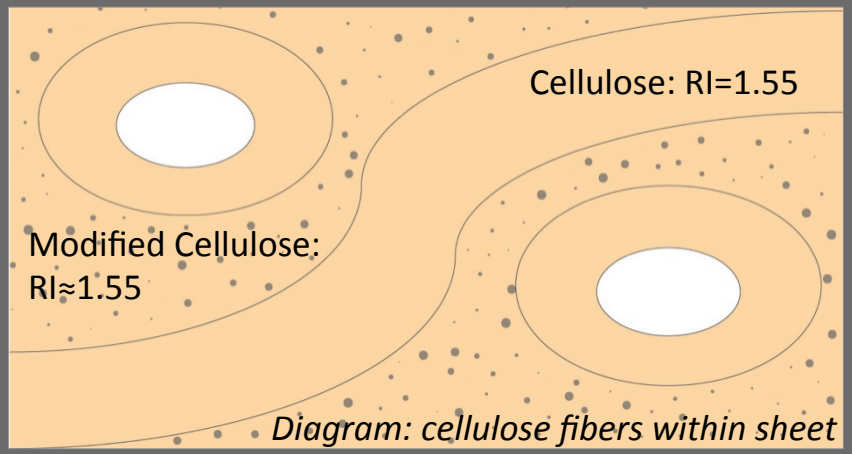


Diagram: cellulose fibers within sheet

“Natural Tracing Papers” : 1908 - present

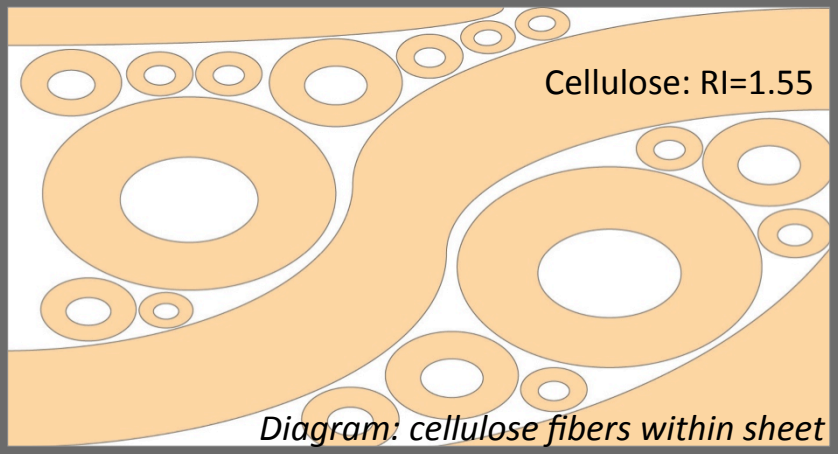


Diagram: cellulose fibers within sheet

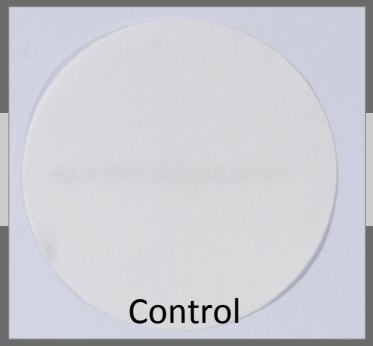
Photos by: Kaitlyn Wright and Rachel Childers

Photo by: Peter Sowiski

**All refractive index values sourced from CAMEO*

Historic Manufacture of Transparent Papers: Results

Prepared



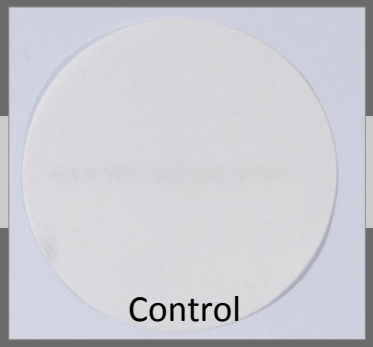
Control

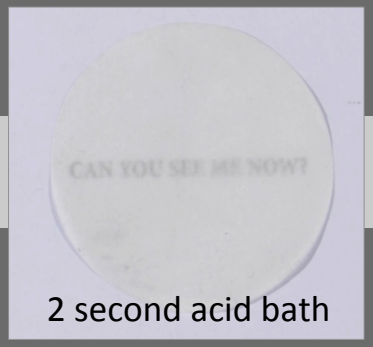
Cold pressed linseed

Poppy seed oil

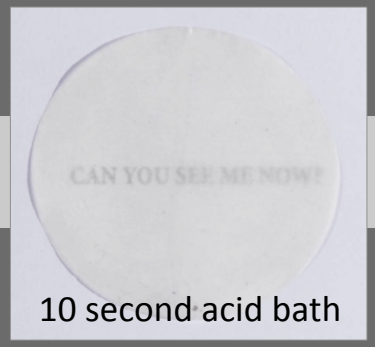
Alkali-refined linseed

Parchment


Control

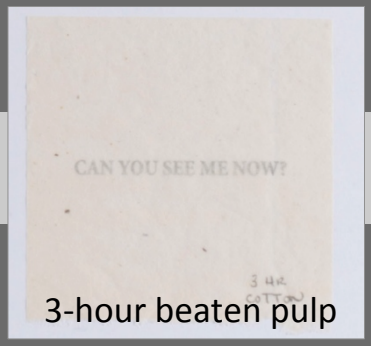


2 second acid bath

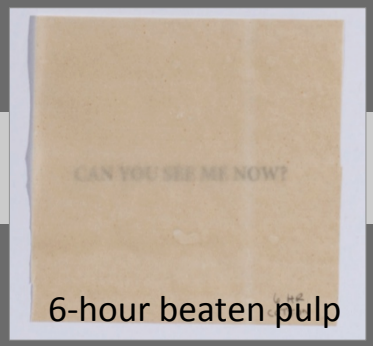


10 second acid bath

Natural



3-hour beaten pulp



6-hour beaten pulp

Many thanks to: ANAGPIC 2018, Queen's University, Peter Sowiski, Jonathan Thornton, Dr. Aaron Shugar, Dr. Rebecca Ploeger, Fiona Beckett, Theresa J. Smith, JJ Chen, and the classes of 2019 and 2020

**All photos and diagrams by author unless stated*

Grace Walters
Patricia H. and Richard E. Garman Art Conservation Department
SUNY Buffalo State
Advisors: Peter Sowiski, Jonathan Thornton, Theresa J. Smith, Jiuan Jiuan Chen, Dr. Rebecca Ploeger, Fiona Beckett, Dr. Aaron Shugar

HISTORIC MANUFACTURE OF TRANSPARENT PAPERS

Slide 1:

Hello to you all. For a project investigating a historical method of manufacture, I chose to recreate transparent papers, having been introduced to them in architecture school. Cellulose fibers are a naturally transparent material. The difference in the refractive index of the fibers and the air trapped between them is enough to register a normal sheet of paper as opaque to our eye. The overarching method of transparentizing a sheet of paper is to displace the air between the fibers, replacing it with a material that more closely matches the refractive index of cellulose. As the material fills the interstitial space it also saturates the uneven and irregular surface of the cellulose fibers themselves. These two things allow the light to pass through the sheet relatively uninterrupted, which our eye registers as transparent. This has been done over the years in three ways. The first and oldest method of making prepared papers is to brush a sheet of paper with a drying oil. Artists commonly made these papers from materials found in the studio for the purpose of copying paintings. I brushed three different drying oils on Whatman filter papers to observe the difference between them once the surface had polymerized. Prepared papers made in this way have a tendency to strongly yellow and become brittle as the impregnated oil crosslinks over time.

Slide 2:

The second method of making parchment paper, involves using a strong acid to break down part of the cellulose chain into shorter lengths, which forms a gel-like substance. This is forced between the fibers during manufacture, as well as the calendaring process, matching the refractive index of the sheet with part of itself! If done properly, this

process yields a strong flexible paper. However, residual acids were common, which I found through pH testing my sheets after I pulled them through an acid and several neutralizing baths. To make natural tracing paper, you must increase the amount of time the pulp is beaten before initial sheet formation. Overfibrillating the cellulose fibers increases the number of reactive sites, reduces the air space between the fibers, and creates a more homogenous sheet. Not only do the fibers want to bond with themselves, but they also have an increased affinity for the water in the pulp, which leads to longer drainage times. I found a one minute forty second difference in drainage times between the three hour and six hour pulps when pulling sheets! While the acidic component of parchment papers is absent in this method, the extra fibrillation shortens the cellulose chains making them more susceptible to environmental attack and mechanical failure.

Slide 3:

In the end, I was able to make transparent papers using all three of the methods. Each contributes their own degradation factors to consider when thinking about preserving transparent papers. And of course, keep in mind that contemporary transparent papers are made with combinations of all three of these methods, which are often, if not always, undisclosed by the manufacturer. Thank you for all your time and attention.