

Sustainability in the Production of Rayon



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What is Rayon?

- Rayon is a manufactured cellulose fiber.



Rayon's Uses

- Production of Textiles
- Production of carbon fiber.



Rayon's Strengths

- Made from a renewable resource
 - Based on cellulose
 - Wood pulp
 - Cotton linters
- Carbonized rayon has low thermal conductivity
 - Excellent for products such as heat shields and rocket nozzles.



Production Issues

- Several Rayon Methods are cost prohibited in the US
- Result of hazardous production chemicals.
- Harder to acquire American made rayon based products.
- No US supplier of rocket nozzle grade carbon fiber due to EPA regulations.



Characteristics of Polyacrylonitrile(PAN) Fiber

Strengths:

- Can be used in textiles and to create carbon fiber.
- Superior tensile strength

Weaknesses:

- Carbonized PAN has higher thermal conductivity than carbonized rayon.
- Does not provide rocket nozzle or heat shield grade carbon fiber.
- Cannot replace rayon



Several Rayon Creation Methods :

Hazardous

- Viscose Rayon Method
- Acetate Method
- Cuprammonium Method

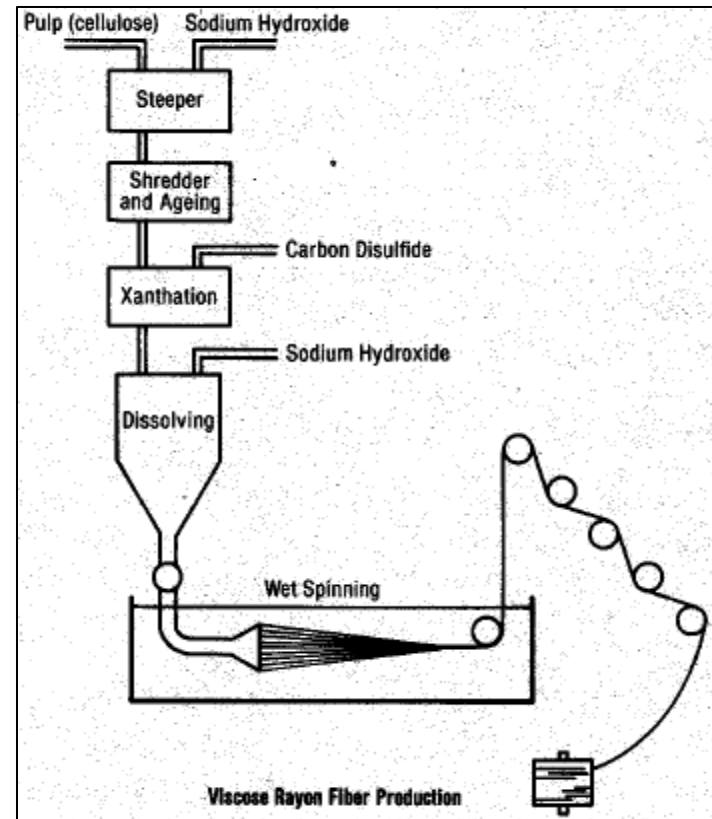
Green

- Ionic Liquid(IL) Method



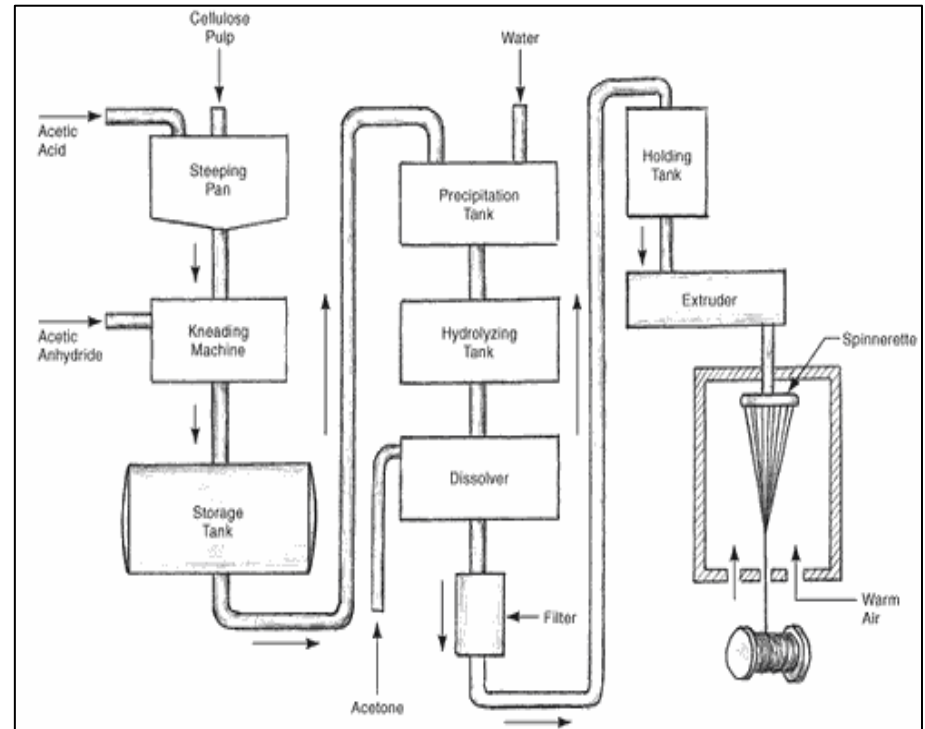
Viscose Method

- Cellulose is broken down and is eventually wet spun into a fiber.
- Caustic and acidic chemicals contaminate wash water.
- This process is cost prohibited in the United States



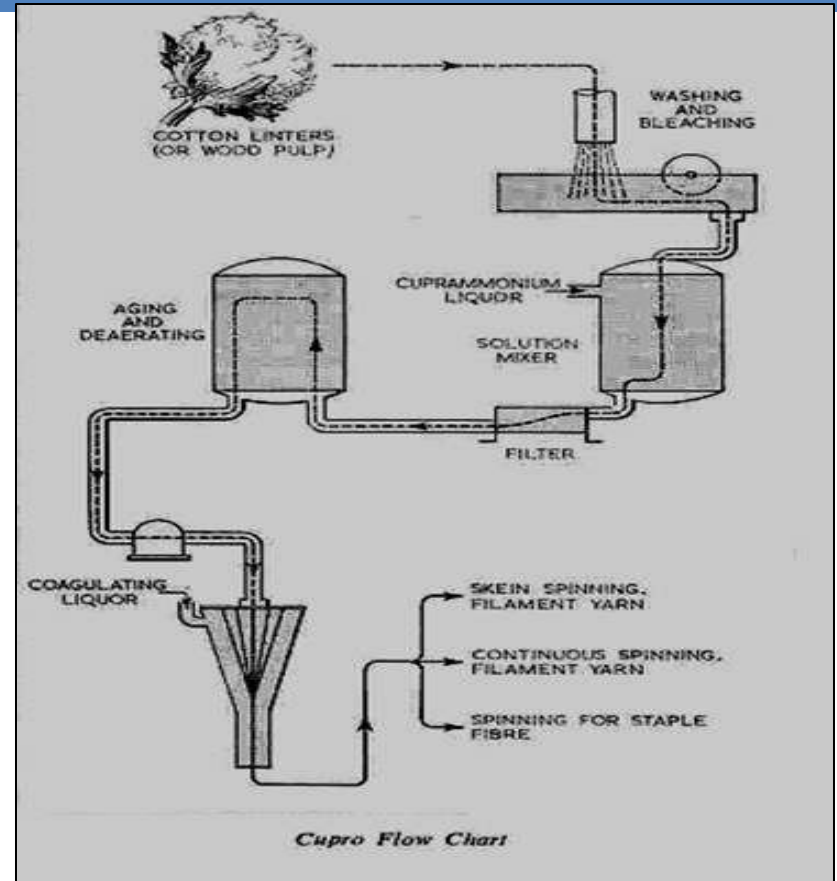
Acetate Method

- Cellulose is dissolved and dry spun into a fiber.
- Acidic & carcinogenic chemicals involved
- Some manufacturing process are cost prohibited in the United States.



Cuprammonium Method

- Cellulose is treated to remove impurities.
- Cellulose is converted to copper cellulose and dissolved in ammonia
- Acidic chemicals contaminate wash water
- Cost prohibited in the United States



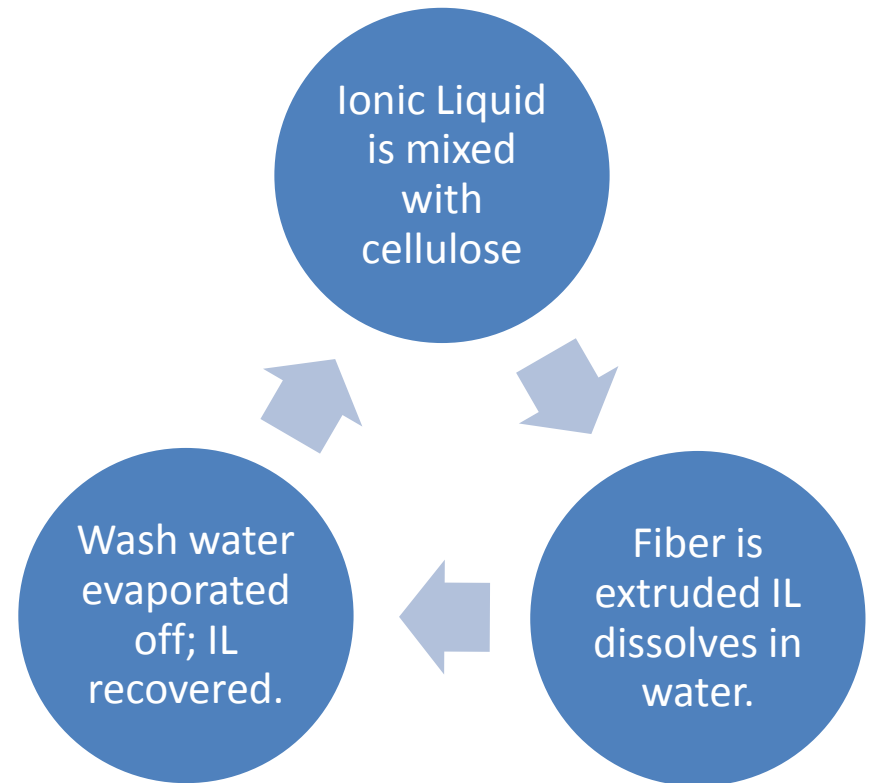
What Are Ionic Liquids?

- Organic salts in a liquid state at room temperature
- Almost no vapor pressure
- Very good solvents



IL Fiber Creation Process

- Cellulose is dissolved in IL
- Ionic liquid/cellulose mix is extruded into a water bath
- IL is recovered

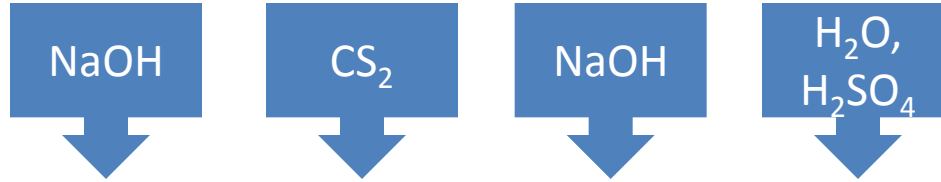


Viscose Process

versus

Ionic Liquid Process

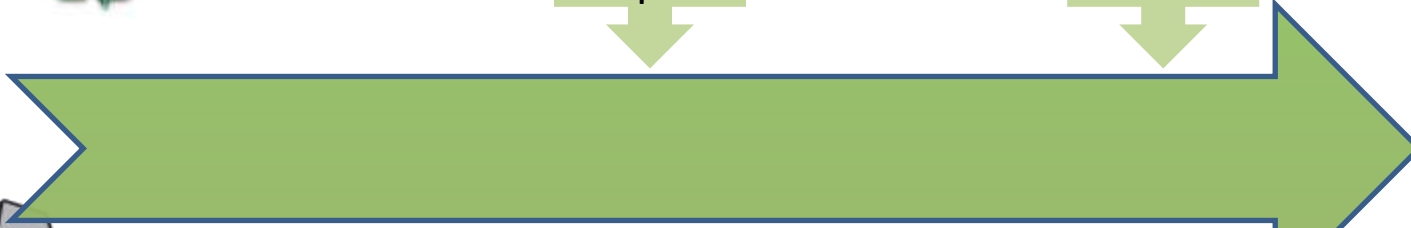
Viscose Process



Products

Derivation Dissolution Spinning

Ionic Liquid Process



Products

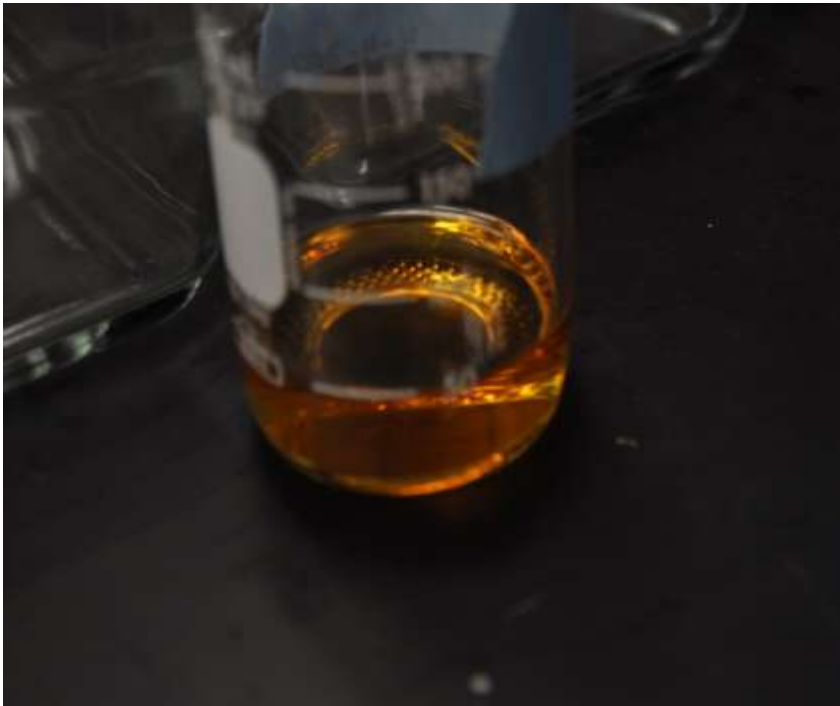
Direct Dissolution Spinning

Ionic Liquid

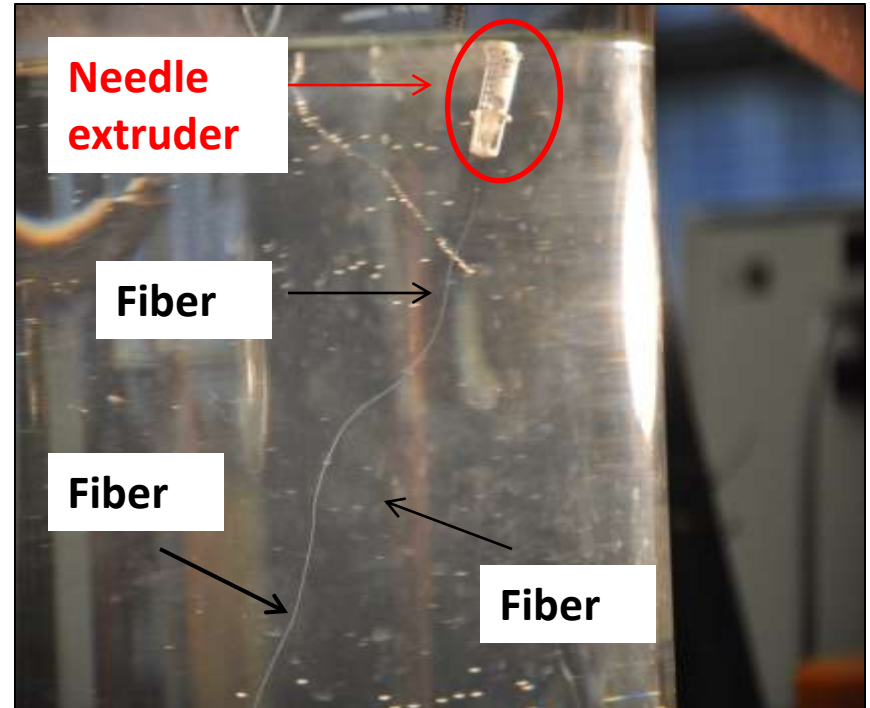


IL Creation Process (cont.)

Ionic Liquid/Cellulose Mix



Fiber Extrusion



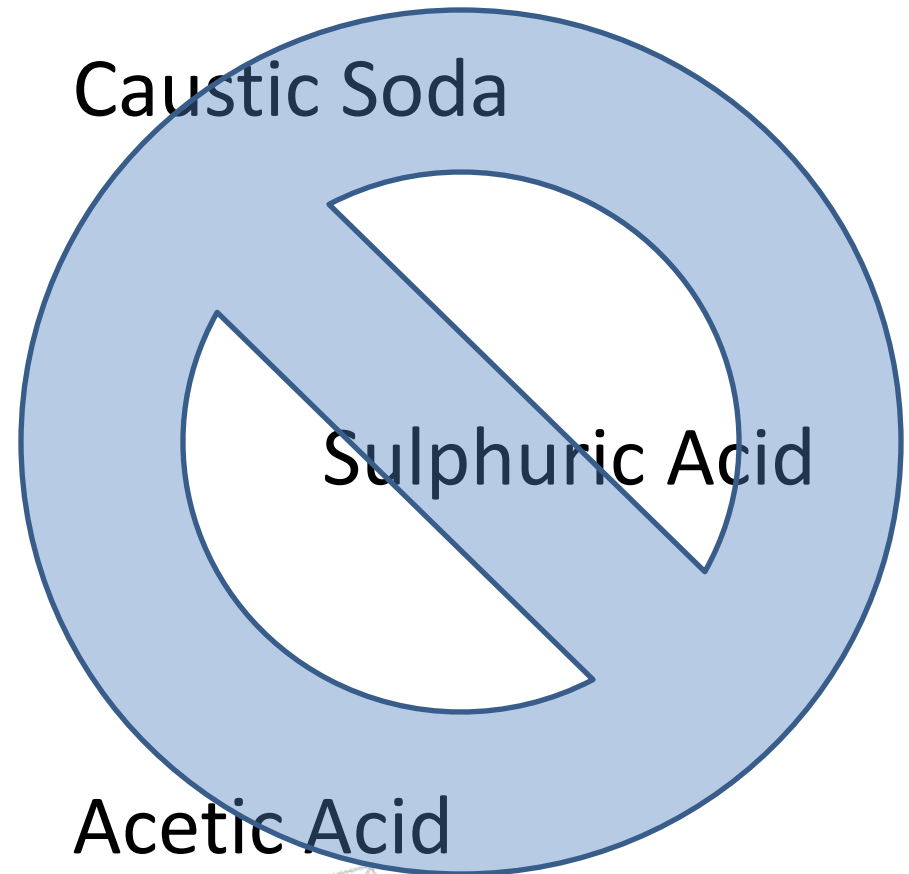
Our Work at RFAL

- Created fibers from Ionic liquid
- Successfully carbonized fibers
- Recovered Ionic liquid after extruding fibers
- Attempting to produce mass amounts of fiber



Why the IL Process is Better For the Environment

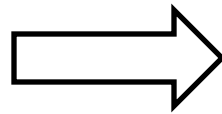
- No extremely harmful chemicals involved
- Water is the only required wash solution
- Waste water is evaporated off
- IL is reusable
- No need for disposal



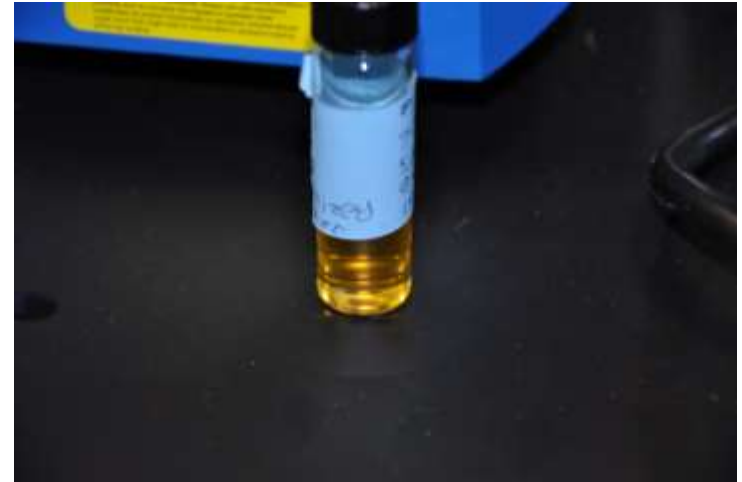
Why the IL Process is More Sustainable

- Only two chemicals involved
- IL is recoverable

IL dissolved in water



Recovered IL



Questions?

UAHuntsville

RFAL

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