

# **Innovation ... Delivered.**

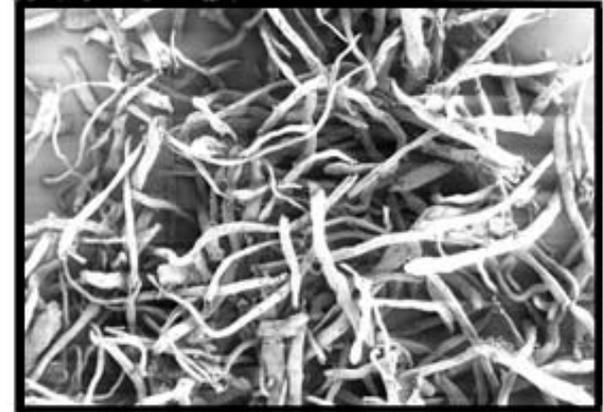
## **The Incorporation of New Refining Technologies Within the Existing Nitrocellulose Manufacturing Process at the Radford Army Ammunition Plant.**

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## Discovered in the mid-1800's

- First synthesized by Schönbein, highly unstable
- Abel perfected the purification process allowing “safe” manufacture
  - First Application: Black powder replacement
  - Celluloid – photographic film, table tennis balls, knife handles, fountain pens



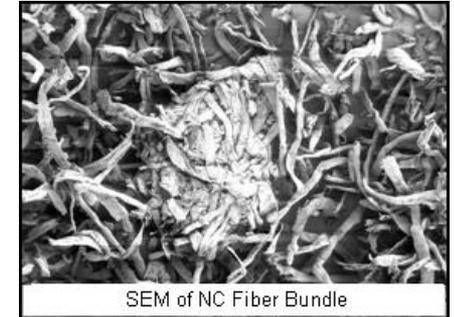
## Current Applications

- All extruded gun and small rocket propellant products across entire DoD
  - Flake and spherical powders in small caliber
  - Granular propellant in medium and large caliber (direct and indirect fire)
  - Extruded rocket motors (MK-90 Hydra 70mm, M7-TOW/SMAW, Javelin)

**RFAAP is the Sole NC Manufacturing Plant in North America**

## Problem Statement:

- Nitrocellulose (NC) fiber quality influences propellant processing/performance as well as final product ballistic properties and contributes to undesired weapon system variability.



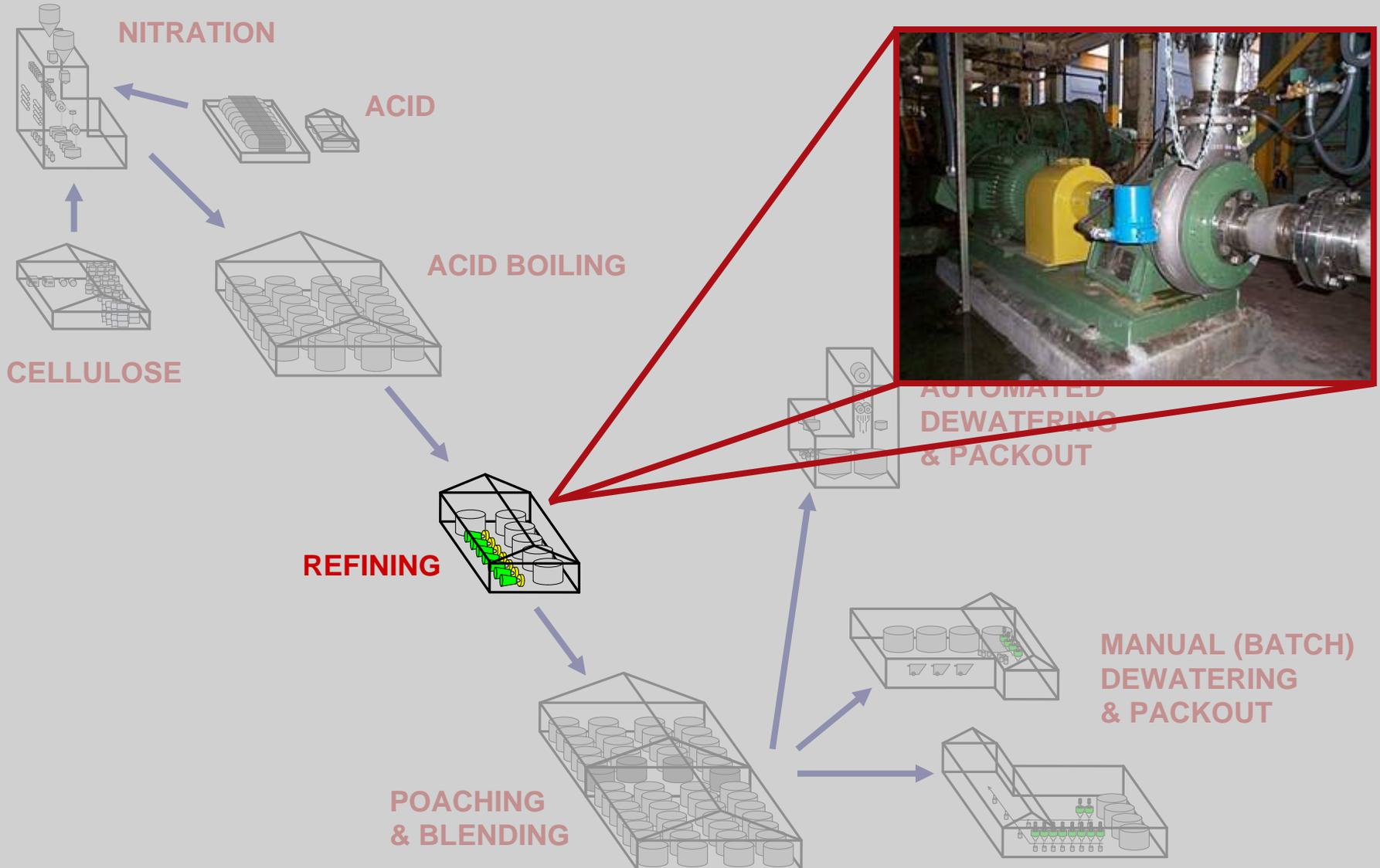
## Objective:

- Develop a process to improve fiber quality (fiber length, distribution, residual agglomerates) within the existing refining operation
  - Incorporate learnings from similar industries to “push the envelop” of NC manufacturing technology
  - Maintain existing refining process cycle time

# NC Manufacturing Process Flow at RFAAP

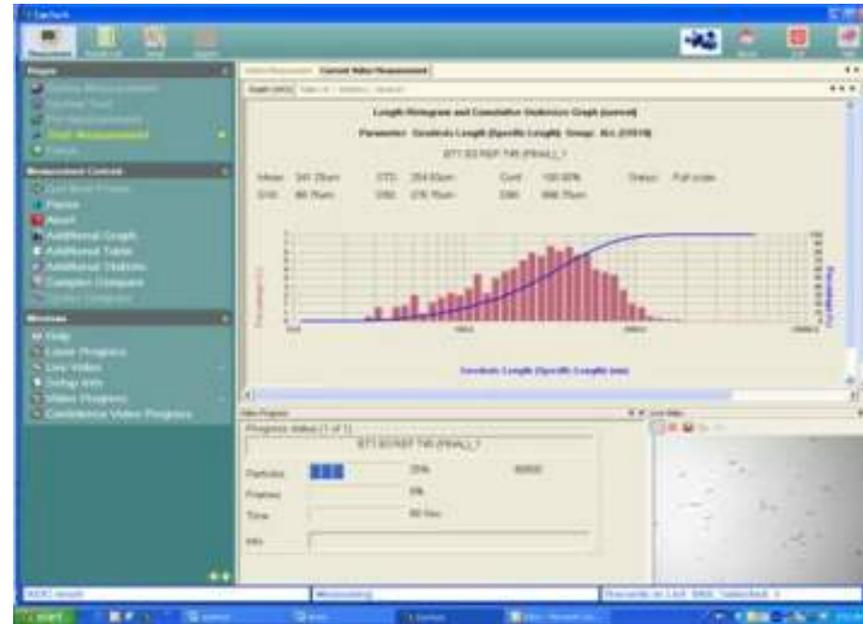


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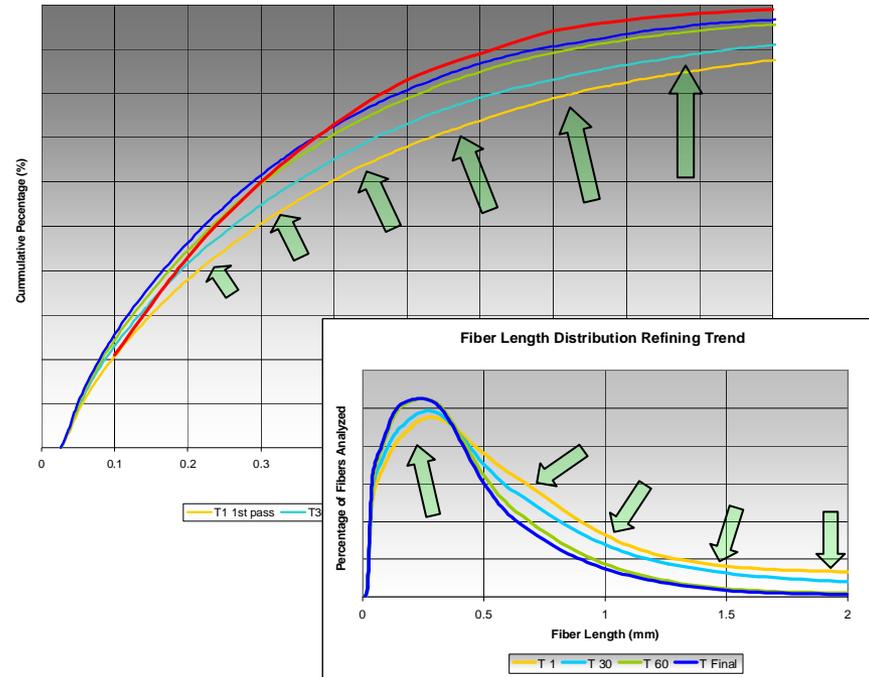
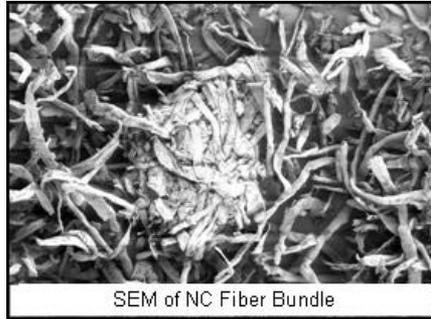
## Fiber Quality:

- Describes the relative dispersion of fibers and agglomerates during NC manufacture
- Fiber bundles are remnant unrefined particles due to an inefficient/ineffective refining process.
  - Artifact of sheeted cellulose and sheet opening/preparation technique



**Goal: Achieve customer desired fiber length with minimum bundles**

## Improved NC Fiber Quality



Deflaking Process Complete



Refining Process Complete

### Results:

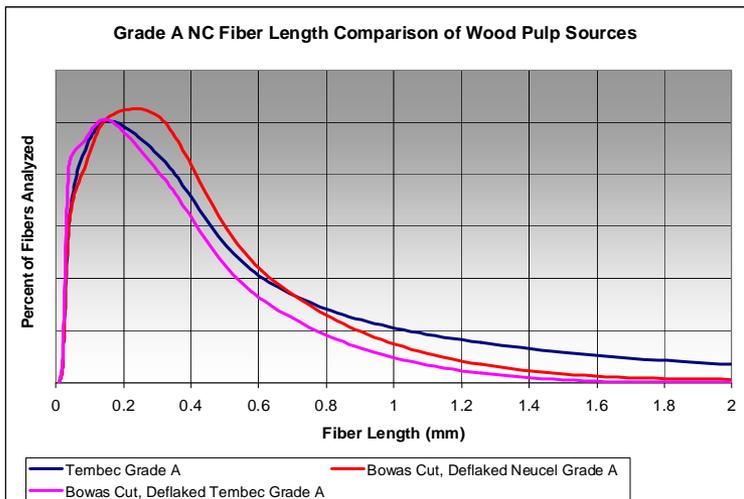
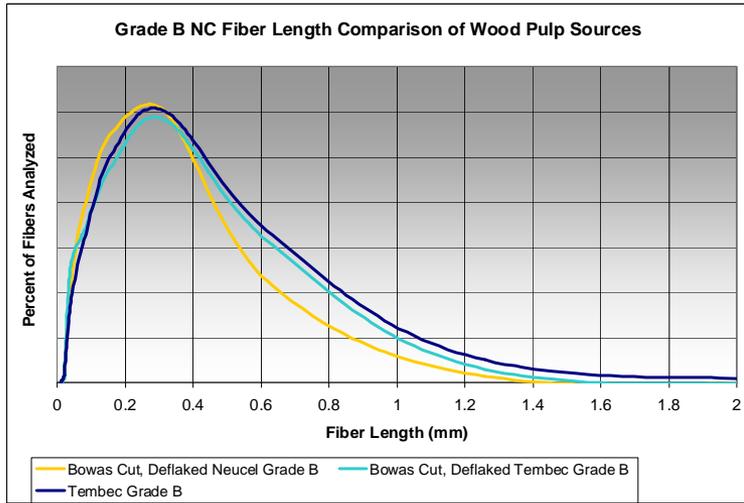
- Real-time fiber analysis developed characterizing processing effects
- Deflakers provide free fibers from NC with multiple cellulose sources
  - Minimizes residual agglomerates (fiber bundles)
- New process controls optimize and control to target requirements

# Deflaked NC Fiber Quality Characterized



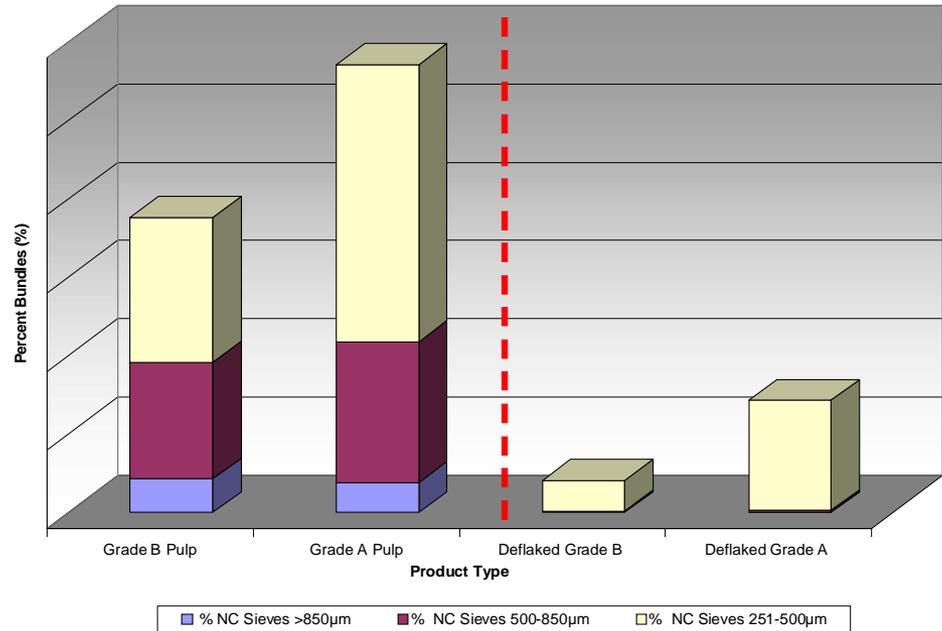
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- New processing methods maintain long fiber lengths, narrows fiber distribution, and minimizes bundles



**Before → After**

Fiber Bundle Comparison of NC Processing Incorporating Deflaking Technology



**Significant Improvements in Fiber Quality Realized**

## Successful Incorporation of New Pilot Equipment

- Deflaking technology proven in NC manufacture
  - Adapted from recycled fiber market segment

## Improved NC quality from sheeted cellulose

- Single base propellant manufacturer qualified on new process
- Improved process robustness and product attributes towards cellulose source



## Where Next?

- Currently executing a US government process improvement program installing full sized deflaking process at RFAAP
  - Leverage product quality improvement on entire NTIB NC base
  - Project to be complete summer of CY2009

**Cutting Edge Process Improvement and Characterization**

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