Improving an Ink Resin-Oil Blending Process using VISIMIX™ Software

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Arizona CHEMICAL

Renewable resources. Endless possibilities.

Introduction

- Business Need: Sell Ink Resin in Solution.
- Seems simple. Mix resin with oil, filter and load a rail car.
- But….
- Mixing times exceed 4 hours!
- Filtration takes 7 hours and 20 bag changes.
- Solution: Use VISIMIX™ Software to understand the problem and point toward an effective solution.

Agenda

- Offset Lithography & Litho Ink
- Ink Solution Process Objective and Design
- Performance Problems
- Using VISIMIX™ Software to understand the situation
- Improved Process

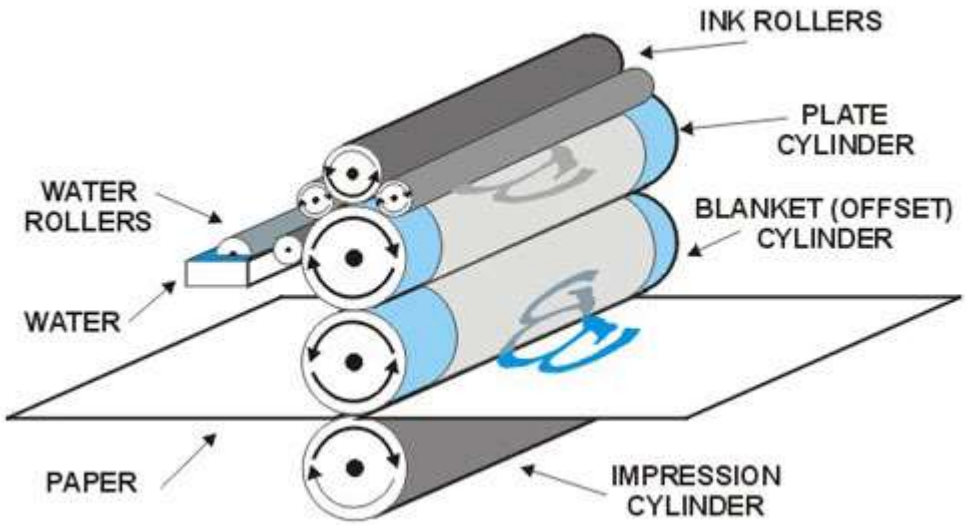
Offset Lithography

Most common printing method for brochures, magazine, catalogs, etc.

Ink consists of pigment, vehicle, and modifiers.

The vehicle is the liquid portion of the ink.

In this example, the vehicle is a solution of a psuedoplastic resin in mineral oil.



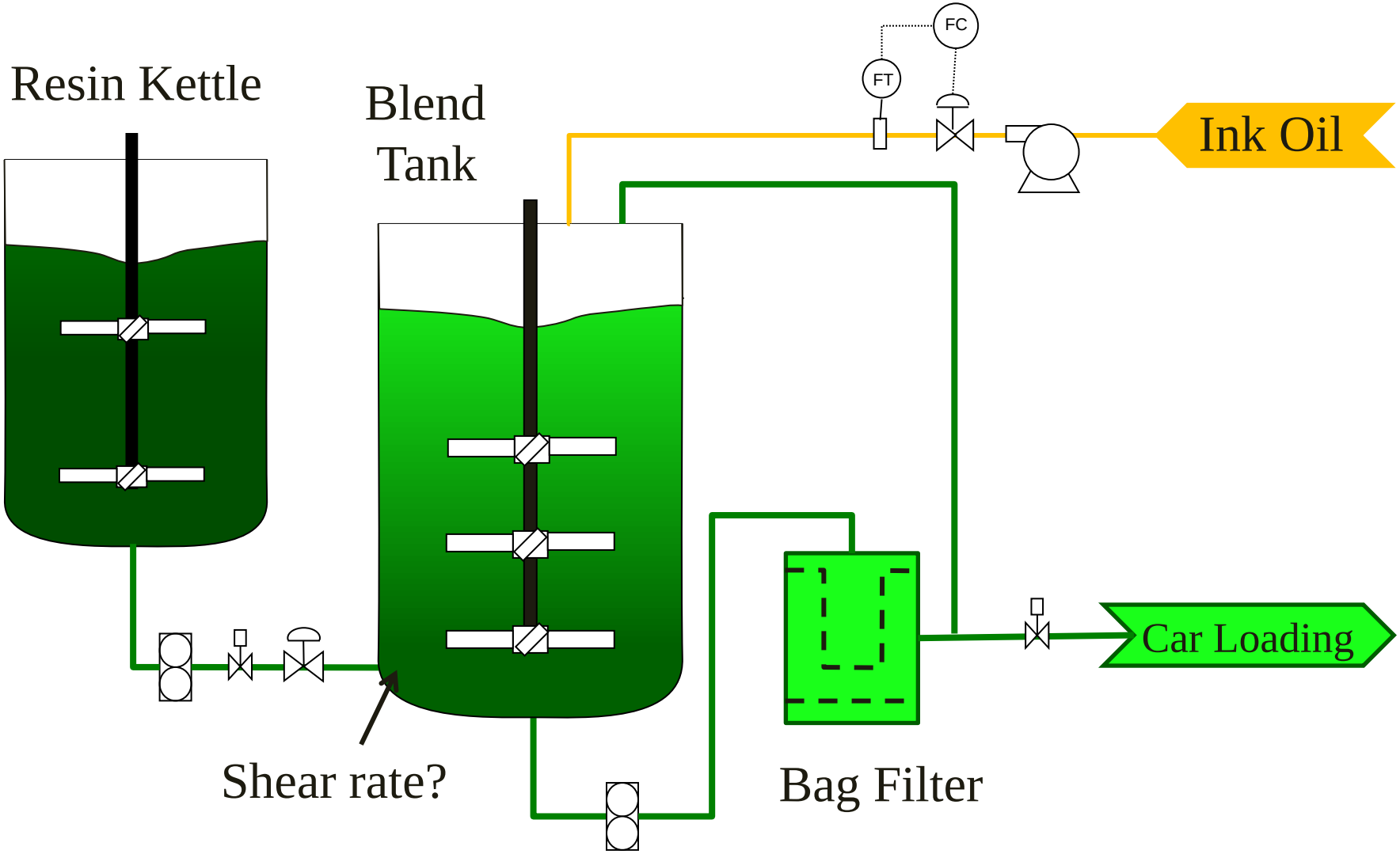
Source: www.offsetprintingtechnology.com

Ink Resin Solution

Cut a Phenolic Resin into Ink Oil

- 60% Solids
- Pump Resin (250 °C) into Ink Oil (150 °C)
- The Oil has an Auto Ignition Temperature of 230 °C
- Introduce Resin to Oil subsurface
- Blend tank has two coil sets (both cooling)

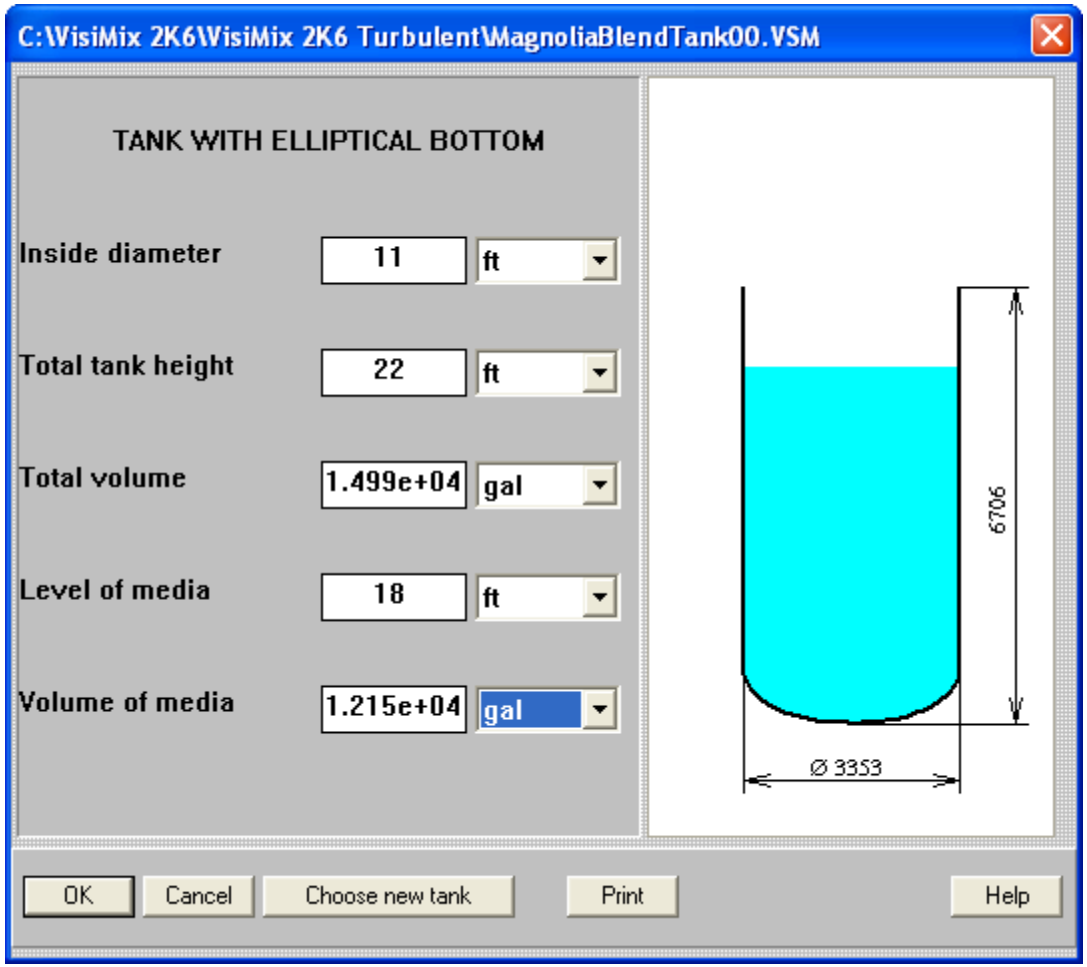
Original Process



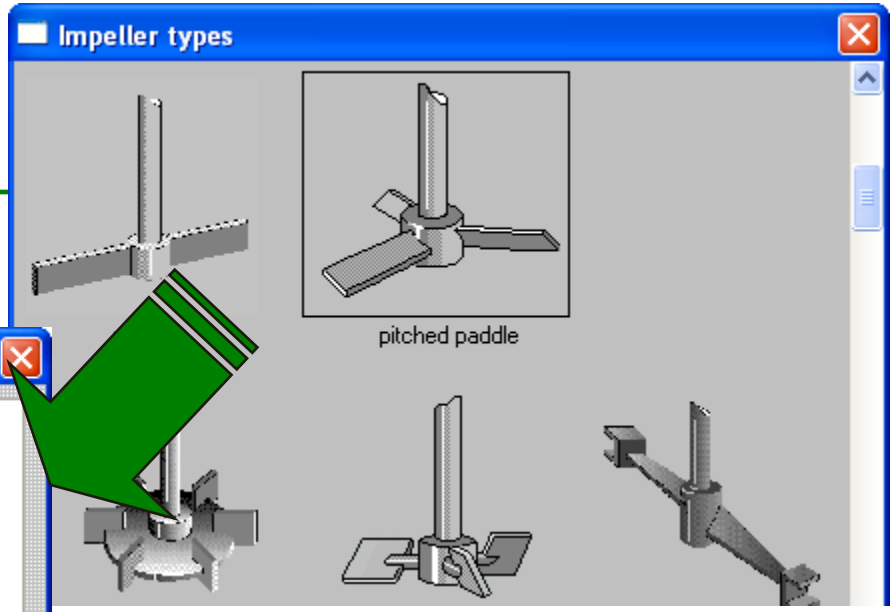
Ink Solution: Problems

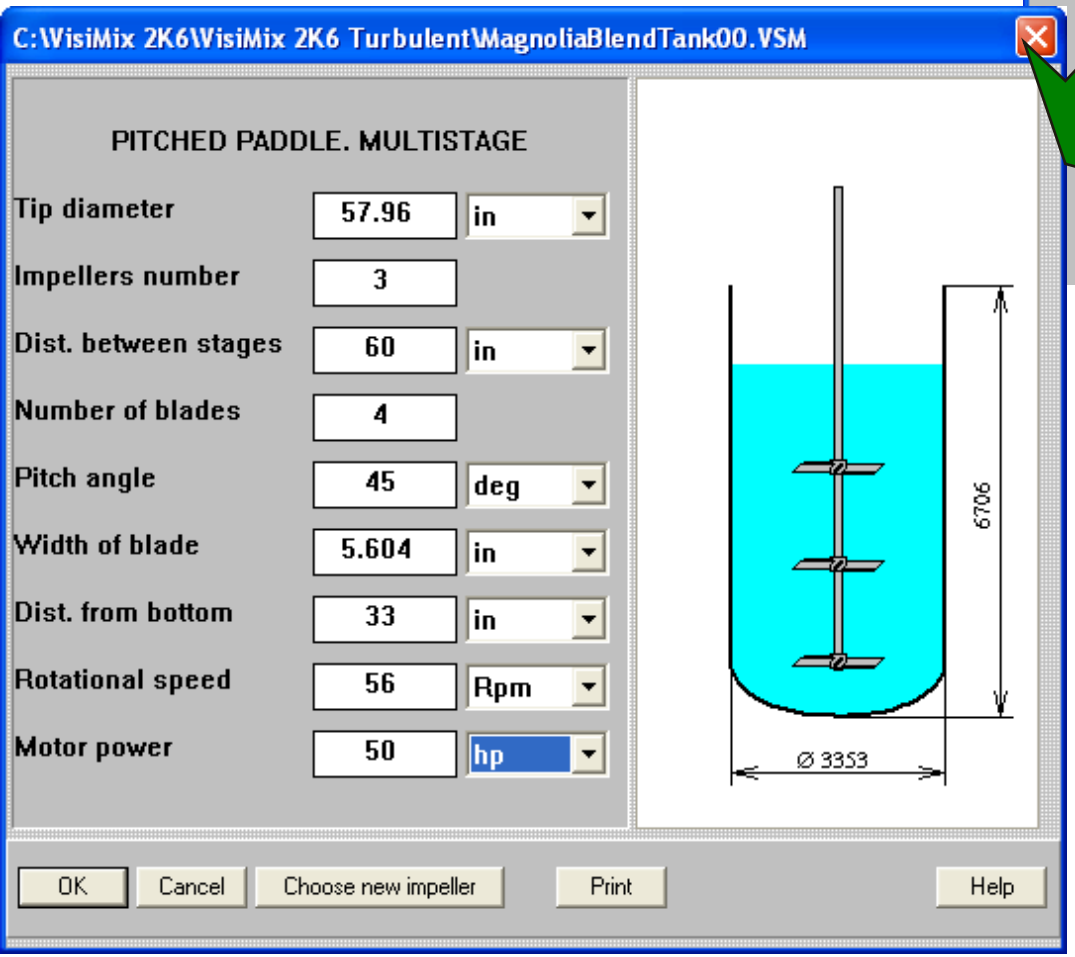
- Resin properties not stable in molten state.
- Batch needs to be circulated for 3 hours to obtain uniform properties.
- Batch Filtration requires 7 hours and 20 or more filter changes to discharge a batch.

Tank Geometry



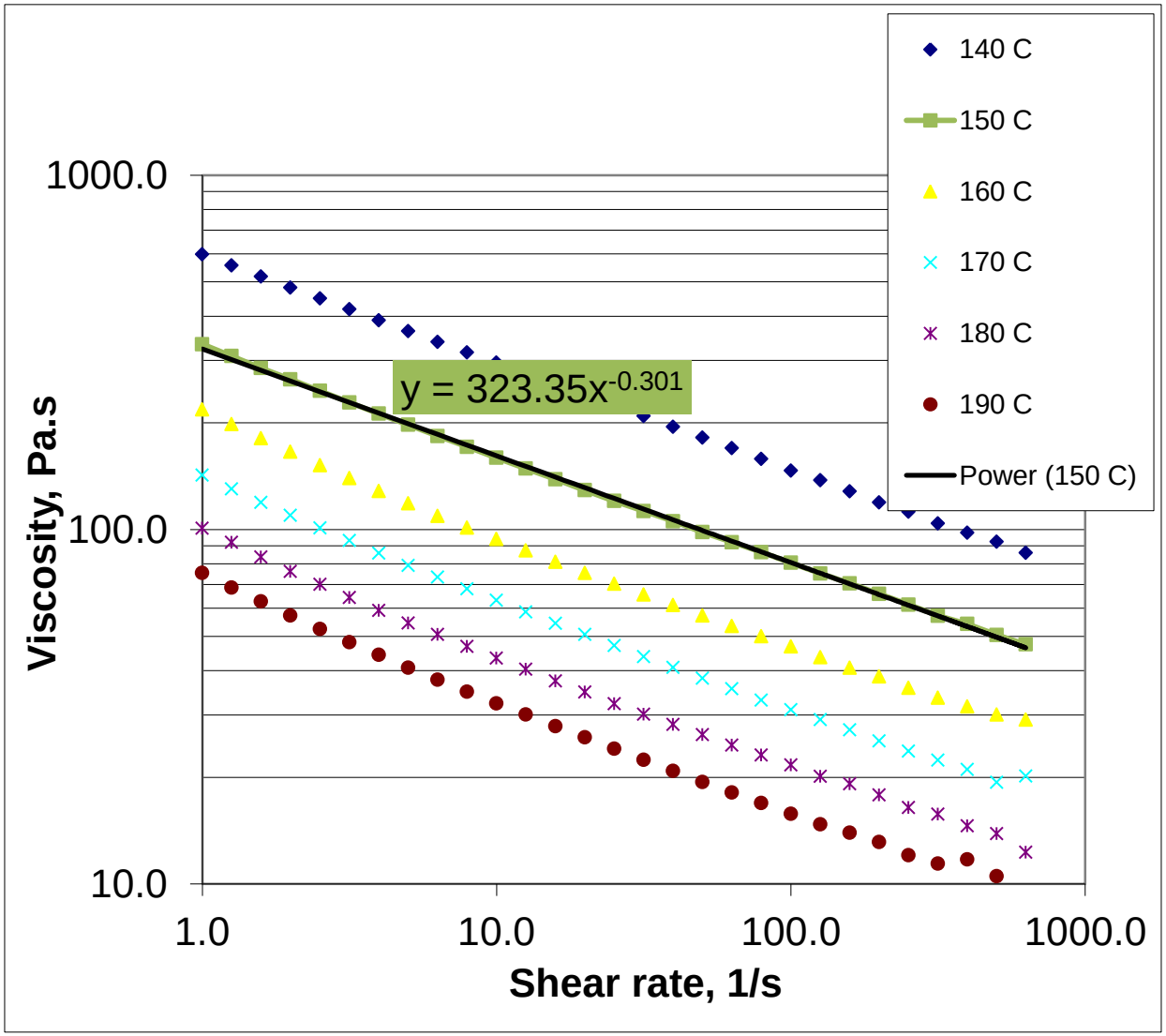
Impeller Definition



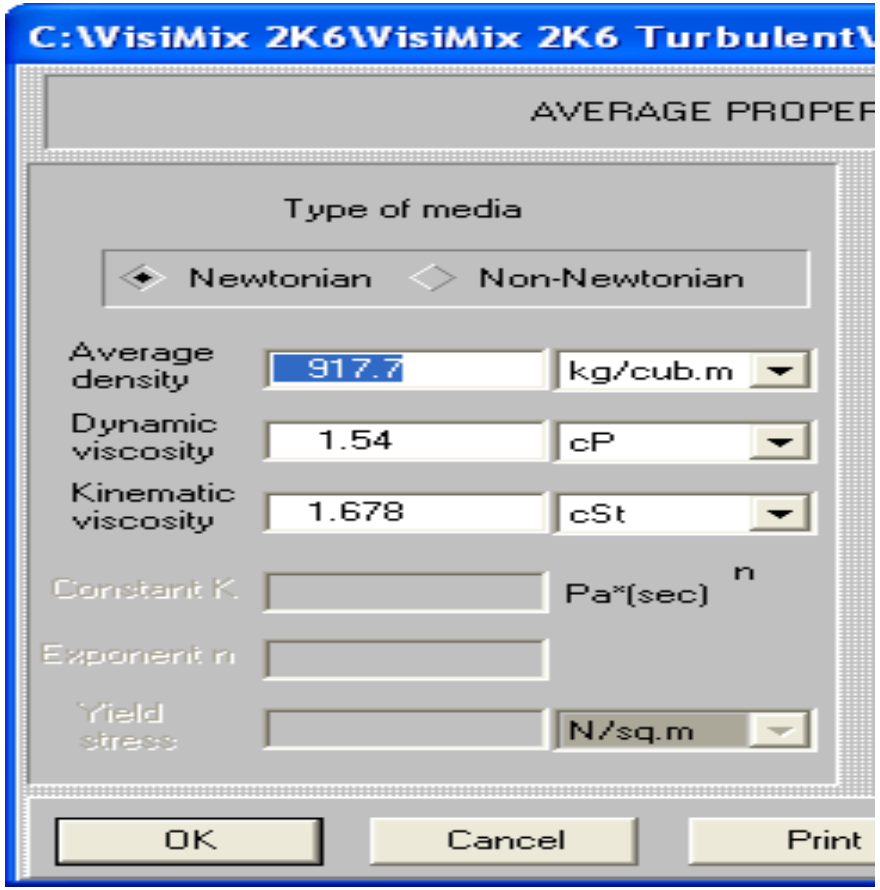


Similar screens for Baffles and Jacket definition

Ink Resin Melt Rheology



Material Properties: Ink Oil @150C



- For Non-Newtonian Fluids use a power-law equation:

$$\mu = \tau_o * \gamma^{-1} + K * \gamma^{n-1}$$

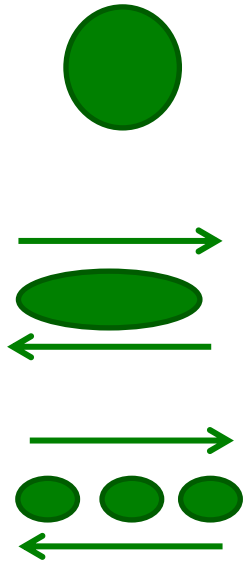
$[\mu]$ = Pa S $[\gamma] = s^{-1}$

Resin (150C):

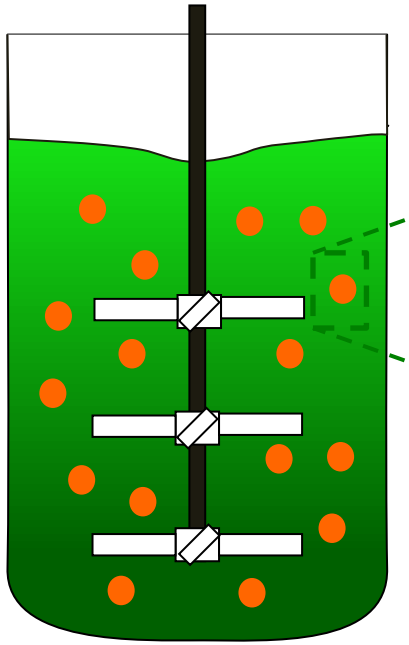
K = 323.35

n-1 = -0.3013

The Physical Picture

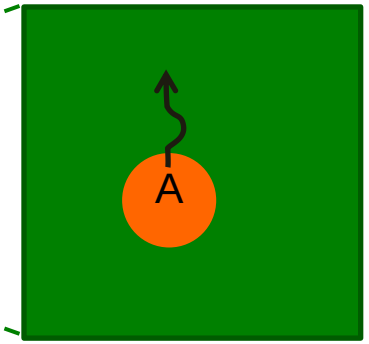


Droplet Formation



Droplet Dispersion

$$N_{A0} = k_c(C_{A0} - C_{Af})$$



Dissolution

Analysis Approach*

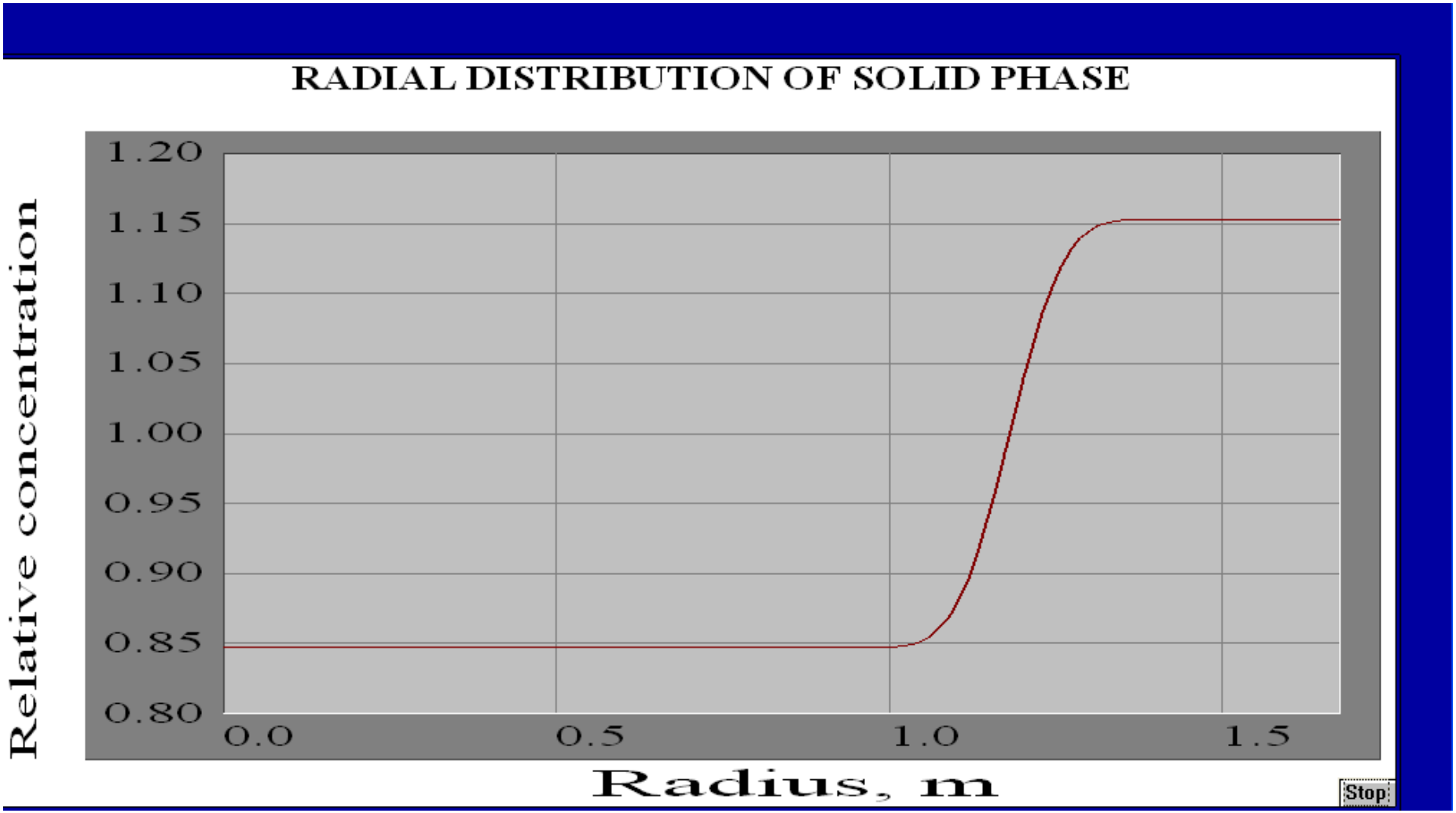
- Determine the max. local shear rate
- Calculate the effective viscosity at the given shear rate
- Evaluate the average drop size
- Evaluate radial distribution using the Liquid-Solid mixing option (use drop size for particle size)
- Explore parameters to maximize radial uniformity.

*Leonid Braginsky personal communication May 9, 2007

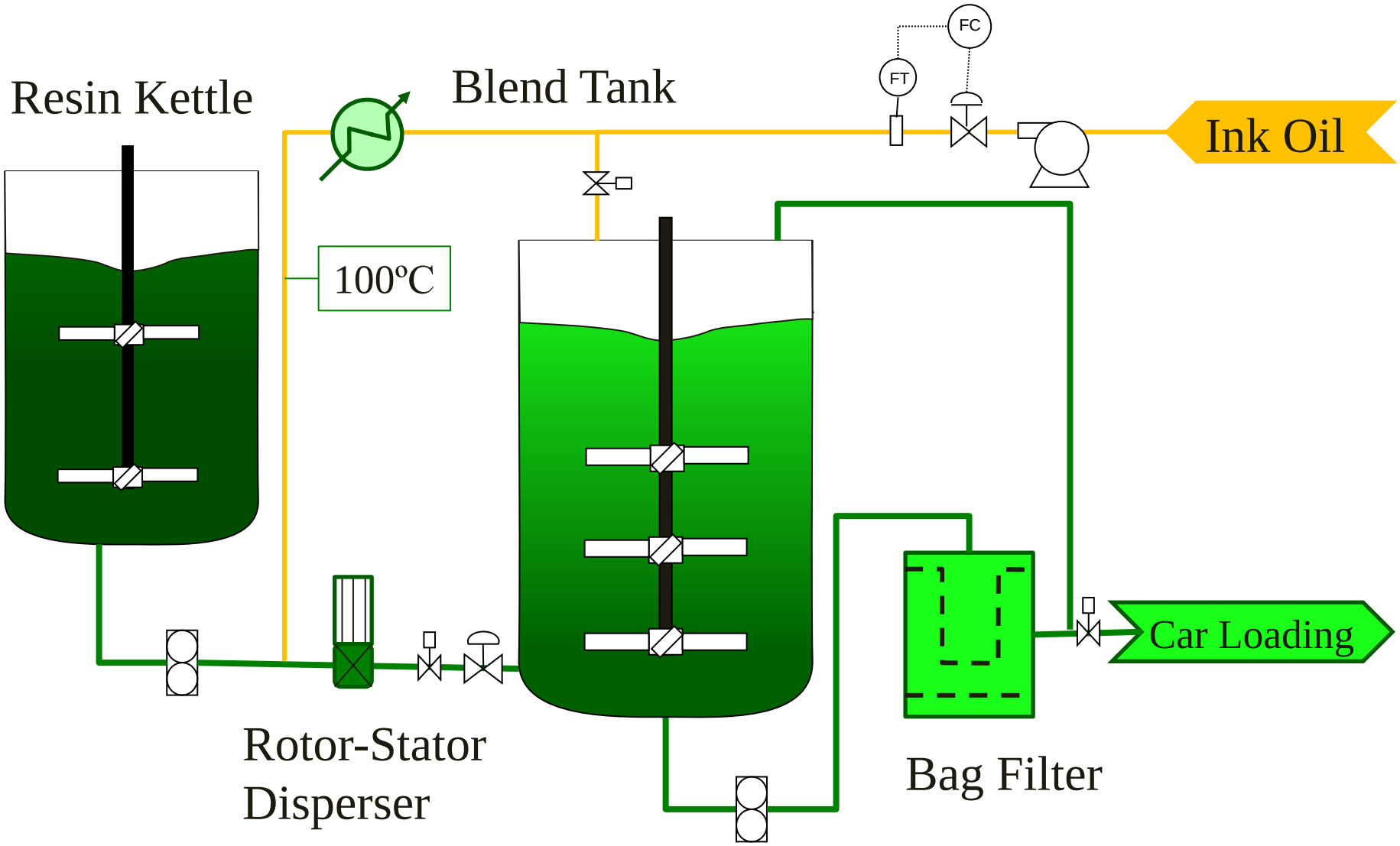
Results

Location	shear rate. [s-1]	Resin Viscosity, [Pa s]	Drop Size, [mm]	Radial Distribution		
150 C						
Baffle	504	49.6	No Data			
Bulk	269	59.9	No Data			
Blade	3950	26.7	No Data			
180C						
Baffle	596	12.4	70.6 (*)			
Bulk	319	15.1	84.2 (*)	+/-15%		
Blade	4670	6.5	39.4 (*)	+/-12%		

Radial Distribution



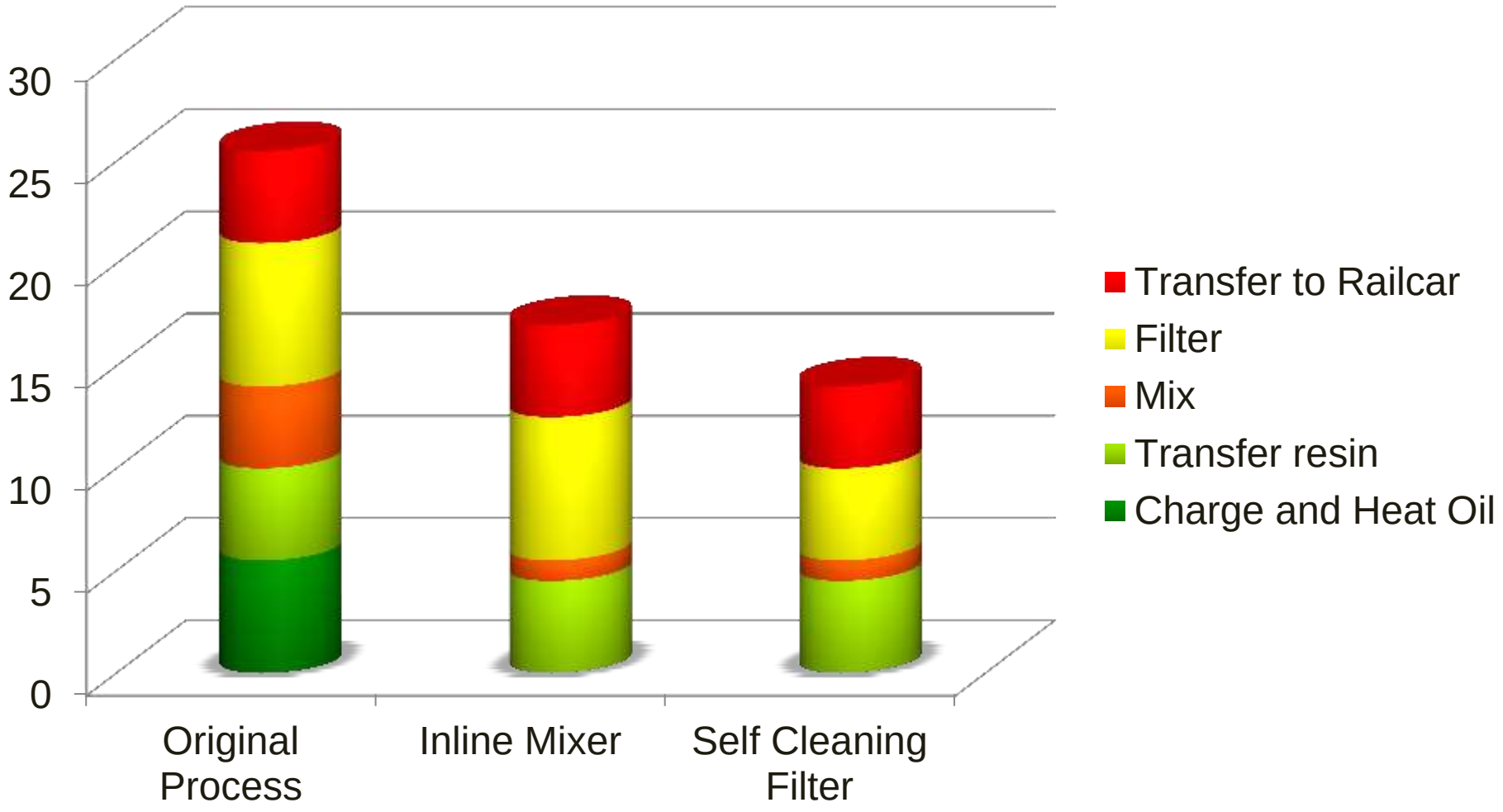
Improved Process



Improved Results

	Old Process	New Process
Cycle Time, Hrs	26	17.5
Filtration Time, Hrs (2 turnovers)	7	7
Filter Changes	20	6

Cycle Time Improvements



Summary

- An Ink Resin Solution Blending process was exhibiting long cycle times and excessive exposure risk to personnel.
- Analysis with VISIMIX™ Software elucidated the underlying causes, pointing the way to an improved process.
- A low capital cost solution was implemented, which reduced cycle time by 33% and filter bag changes by 70%.
- The blend tank mixer is over designed for the modified process.

Acknowledgements

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