rheonics

# InkSight

Autonomous ink viscosity management for printing presses

**Single click ColorLock technology**

Rheonics

Winterthur, Switzerland

SWISS MADE

# MOTIVATION for development of the Rheonics InkSight viscosity control system

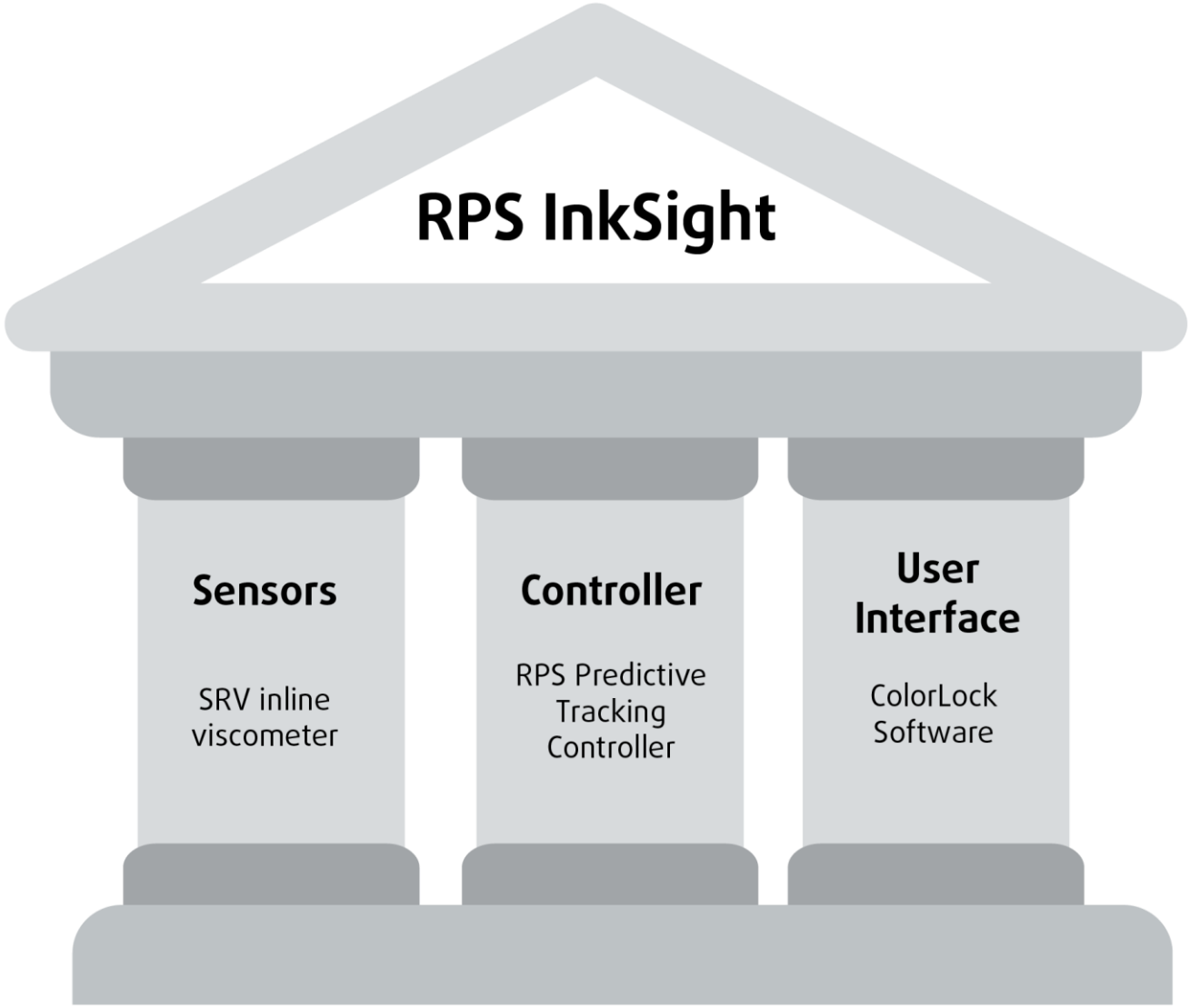
- Rheonics SRV inline viscometer technology appeared ideally suited to the needs of the printing industry for a robust, maintenance-free viscosity measurement device
- Despite the availability of several viscosity control systems on the market, many of these systems, once purchased, were taken out of service by operators, who went back to using efflux cups to measure viscosity
- Rheonics engineers' curiosity about the reasons for this fallback to old technology was the stimulus for development of the **InkSight** viscosity control system

- Discussions with operators revealed that they understood the benefit of such systems, but were eventually disappointed by the lack of reliability of existing solutions
- Reliability was revealed as *the* essential quality of a viscosity control system that was up to the challenge of modern, highly automated, high speed printing machines
- Operators saw their key responsibility as printers, not measurement specialists. A good sensor had to *stay* good, give the same readings from beginning to end of long jobs, and not need calibration or special cleaning procedures between jobs
- Rheonics had such sensors, the challenge was how to make them useful to operators

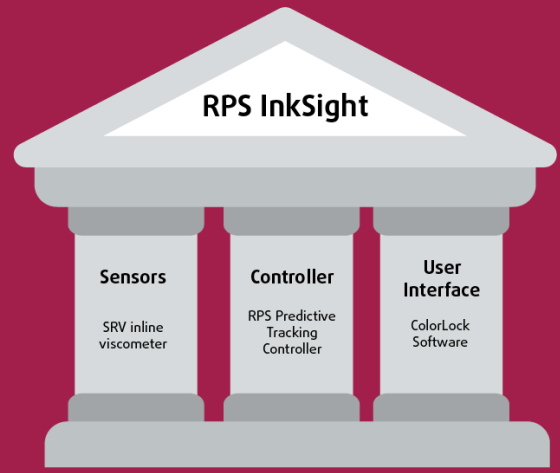
# Rheonics moves from sensors to solutions

- Rheonics had the sensors; they now had to build the control and operating systems that would make their sensors useful to operators. The sensor had to become the foundation upon which a robust, operator-friendly control system could be built. It must allow printers to print, not retrain as measurement and control engineers!
- It did this by putting the operator, rather than technology, in the center of the picture. The tech had to be so reliable that it became invisible to the operator
- Rheonics hid all that tech behind a simple, powerful and intuitive user interface. The single-click RPS (Rheonics Printing Solution) **InkSight** system was born…

# 3 pillars of Rheonics InkSight



# Description of technology



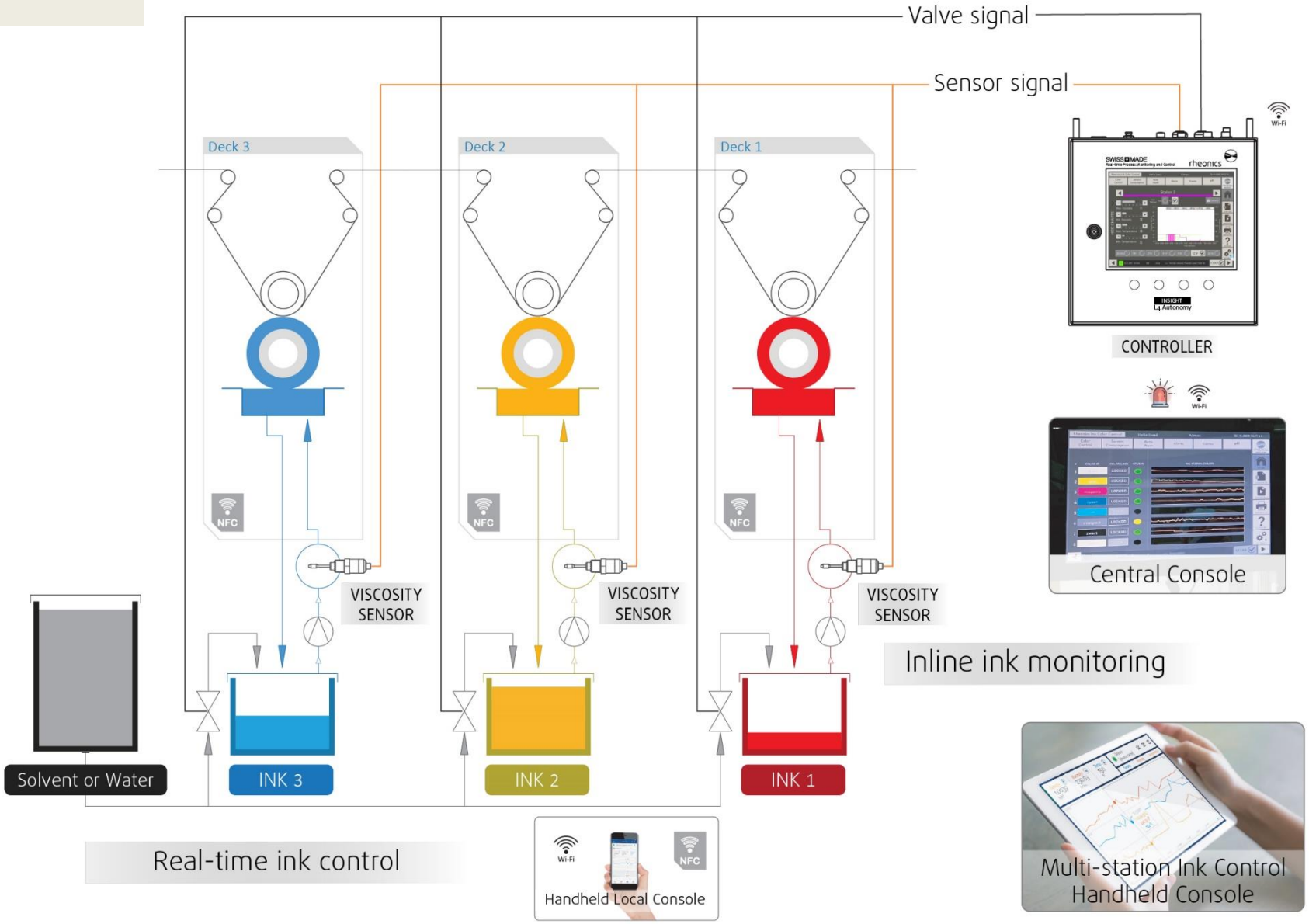
# **What** is InkSight?

## InkSight

is a highly accurate **Multi-station ink viscosity control system.**

**It consists of three subsystems, a viscosity sensor, a predictive tracking controller, and a powerful, intuitive graphical interface.**

**It delivers color excellence through tight viscosity control.**

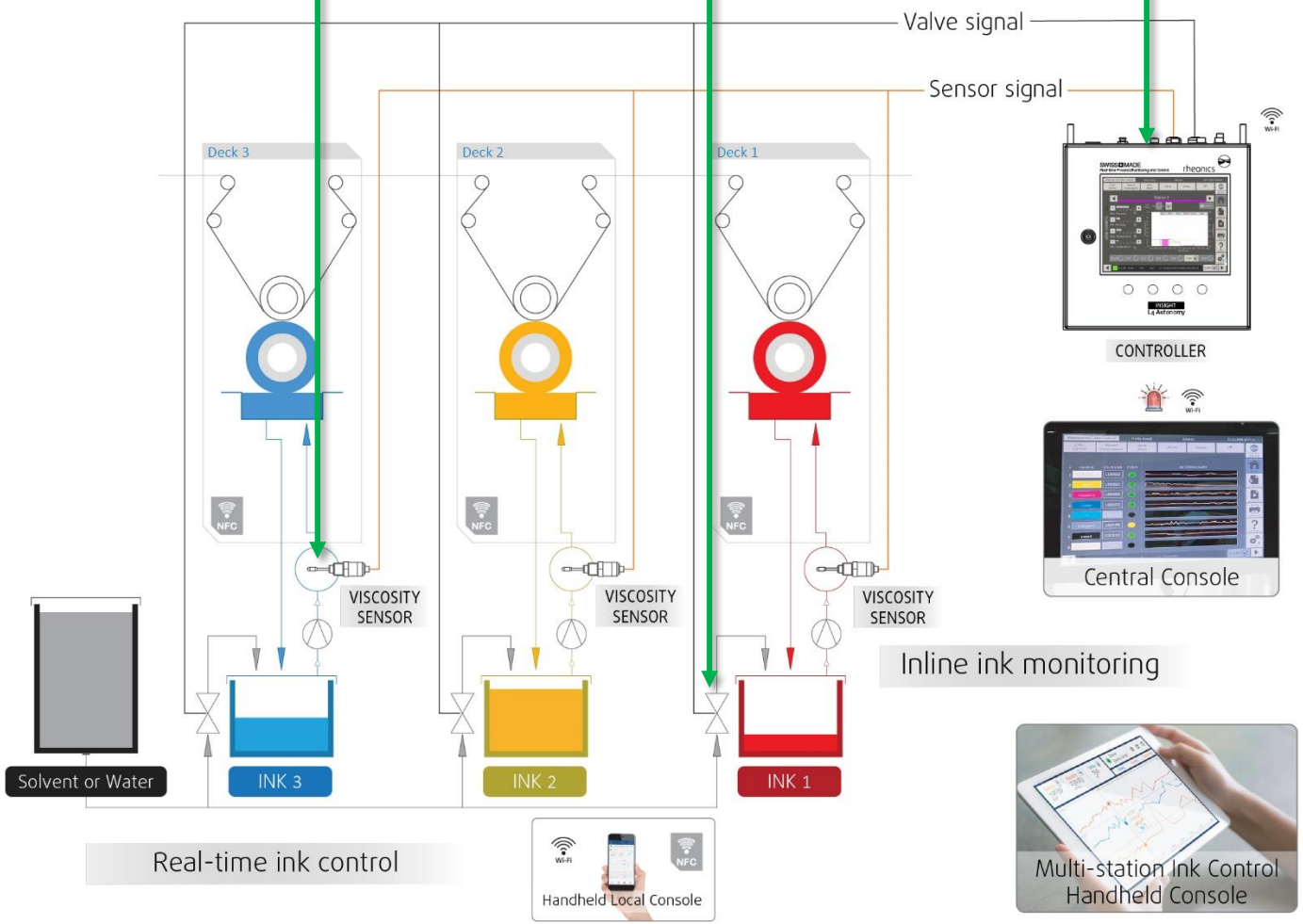


# How does InkSight work?

**1** Rheonics **SRV Sensor** is located directly in the ink line, monitoring and transmitting ink viscosity to main control cabinet in real-time.

**2** Pneumatic **solvent correction valve** connected to main control cabinet with feed line of solvent from central tank to each ink bucket.

**3** Rheonics Predictive Tracking **Controller** ensures precise control of ink viscosity on all stations. Operator HMI gives one touch ColorLock functionality.




## Rheonics InkSight Components

### Core:

1. Rheonics SRV viscometers
2. Pneumatic Solvent Correction Valve
3. Rheonics Predictive Tracking Controller

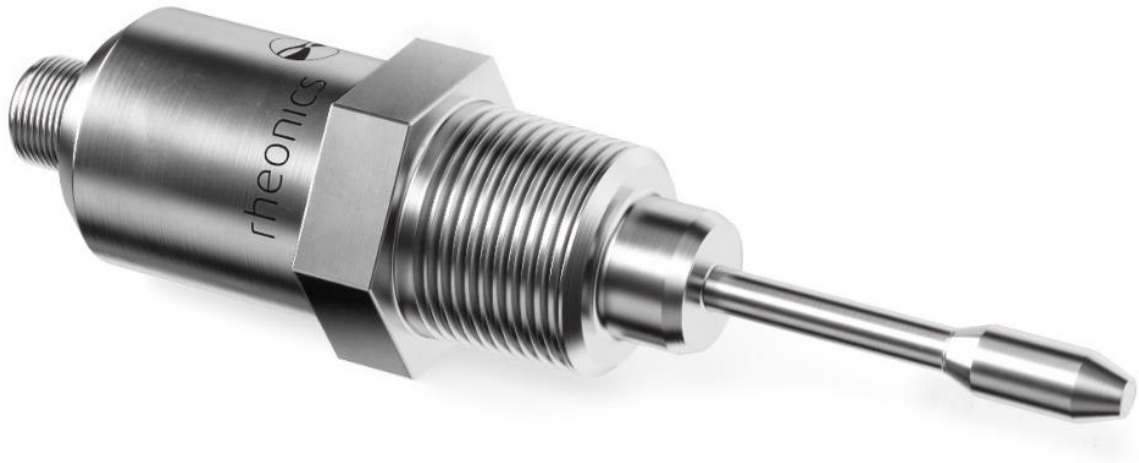
### Other components:

- SmartView Press Console
- SmartWash automated cleaning and fouling detection

# “You can’t control what you don’t measure”

1

Rheonics **SRV Sensor** is a small form-factor sensor built to insert directly in the ink lines. Extremely high accuracy and stability of viscosity measurement enables quick detection of the smallest variation.




**MEASURE**

2

Pneumatic **solvent correction valve** connected to main control cabinet that reacts fast and precisely to add exactly the amount needed.

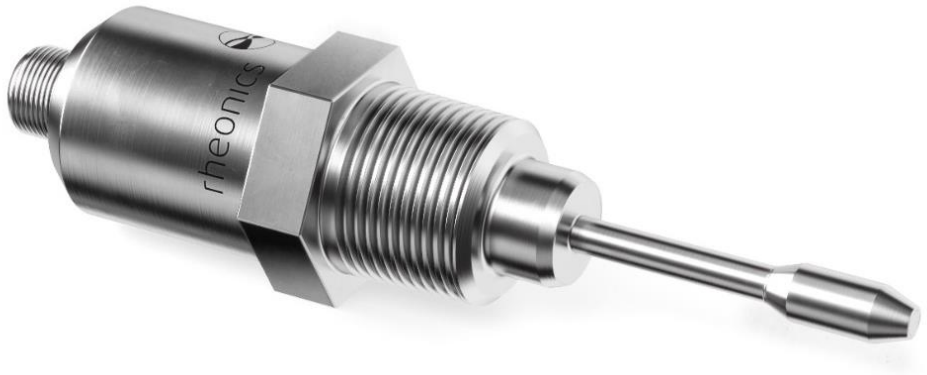
3

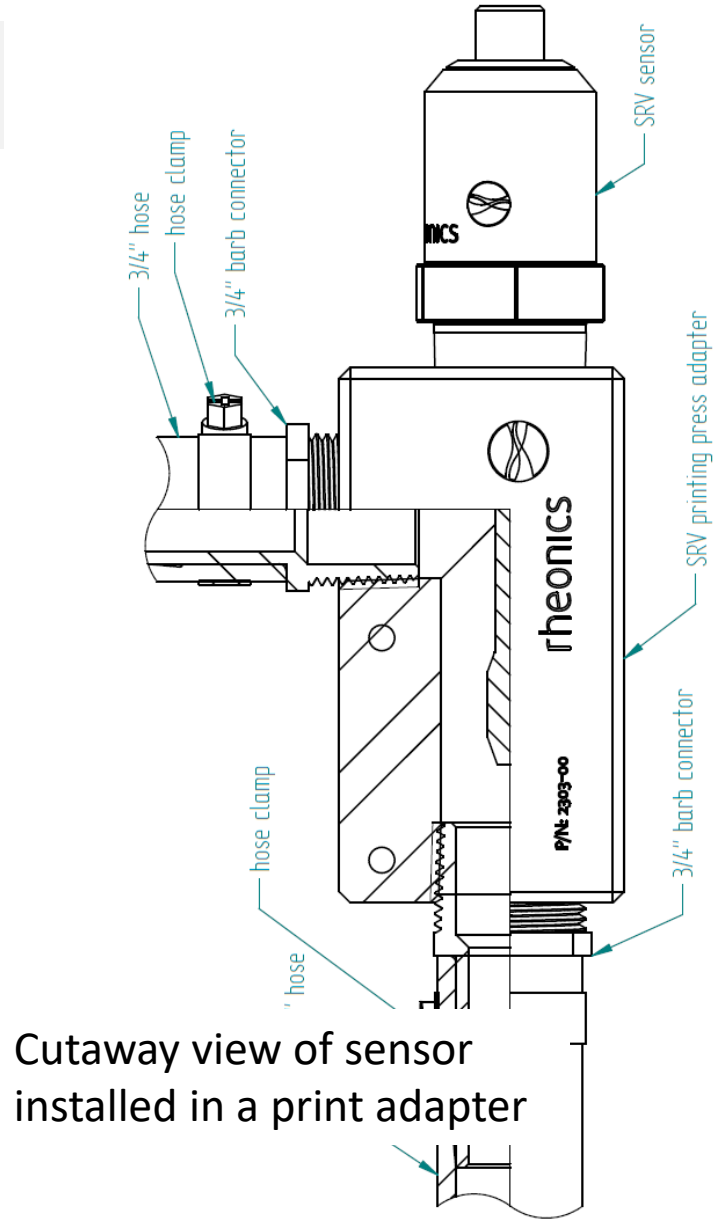
Rheonics Predictive Tracking **Controller** predicts and compensates for evaporation before the ink changes. Built on the same physics used to control NASA Mars entry guidance.

**CONTROL**

# 1. Sensor: SRV inline viscometer

- Patented **S**ymmetric **R**esonator **V**iscometer: unmatched accuracy and reproducibility
- Ultra-compact for easy installation
- Extremely repeatable measurements
- Responsive, stable measurements – not influenced by shocks or vibrations during operation




Cutaway view of sensor installed in a print adapter

# The viscometer technology revolution...

- Never needs calibration or maintenance
- FAST! Outputs viscosity readings every 1 ½ seconds.
- Stable over more than 25 years expected lifetime.

# 2. InkSight Predictive Tracking controller

- The InkSight predictive controller continually monitors the ink viscosity, and responds to changes by frequently adding small doses of solvent to the ink bucket.
- Doses solvent as often as every 20 seconds
- Solvent doses as small as several milliliters
- Best competing systems show much larger viscosity deviations

# Maintains stable ink viscosity value, in any condition…

The InkSight with SRV quickly and accurately compensates for viscosity changes due to:

- ***Differences in initial viscosity***
- ***Temperature changes***
- ***Evaporation***
- ***Fresh ink addition***

# 3. ColorLock Software and operator interface

- ColorLock lets operators achieve best possible color control without having to be measurement engineers.
- One button locks the viscosity to desired color density: *ColorLock*
- Viscosity – and color density are locked to a constant value throughout the run.

# InkSight: completely automatic, single-click viscosity control



**Operator independent measurement**

InkSIght closes the circle on perfect color density – Press speed, temperature and ink viscosity

**User focused interface**

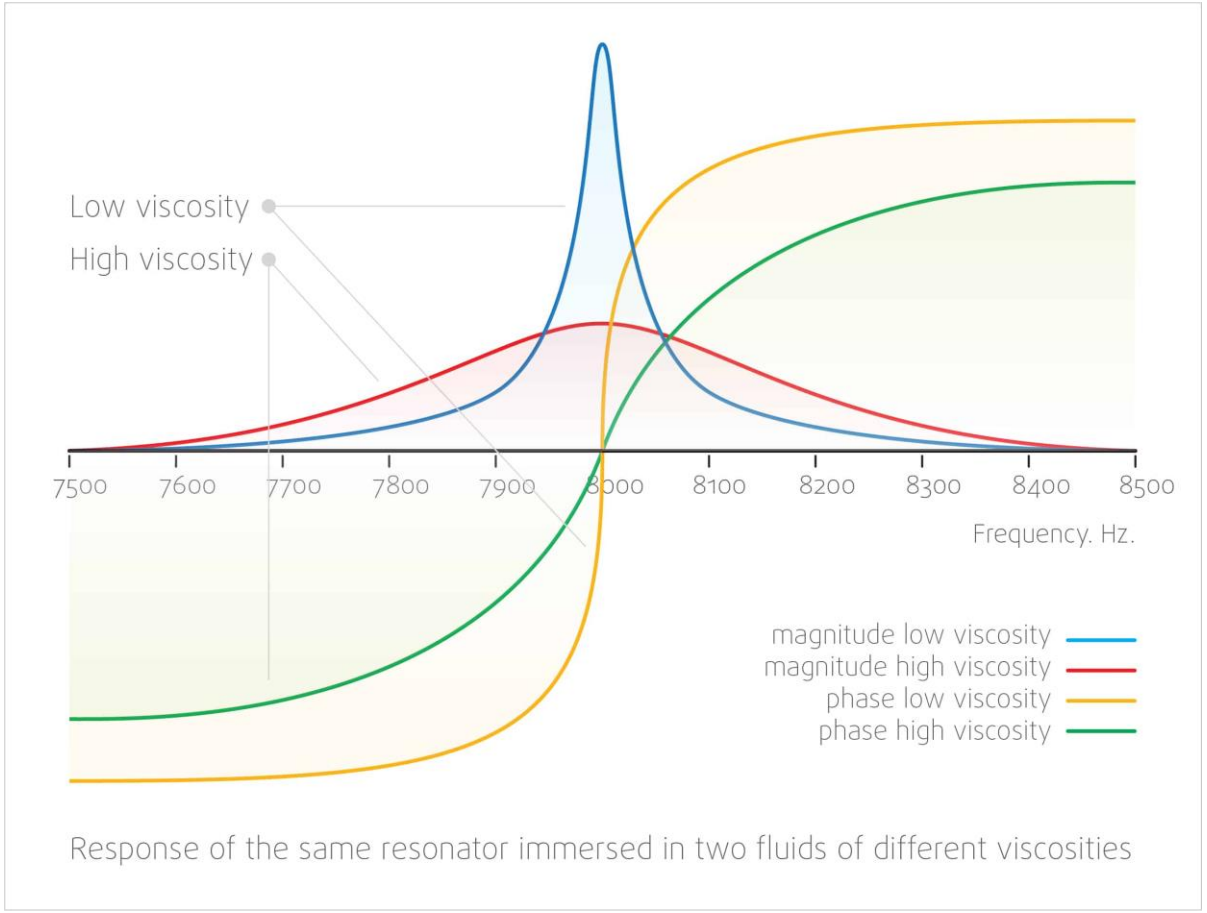
Operators worldwide told us, they wanted to “set it and forget it”. We rolled their vision into the  single-click colorlock “AUTO” control button.

**Seamless integration with machine and factory data system**

InkSight monitors, logs and analyzes every aspect of the ink system, carrying out advanced analytics, self-diagnosis, forensics to spot potential problems before they happen.

# Balanced Torsional Resonator: The game changer in viscometer technology

- Rheonics SRV viscosity technology makes use of an ultra-stable torsionally balanced mechanical resonator (US patent 9,267,872) whose oscillations are damped by the viscosity of the ink.
- The more viscous the fluid, the higher the mechanical damping of the resonator. By measuring the damping, the product of viscosity and density is estimated.
- The resonator is excited and sensed by means of an electromagnetic transducer mounted in the sensor's body.
- Damping is measured by Rheonics patented proven and patented gated phase-locked loop technology
- Based on these two key technologies, the SRV viscosity sensor delivers stable, repeatable and highly accurate measurements of the ink viscosity while being small enough to fit in the palm of your hand.

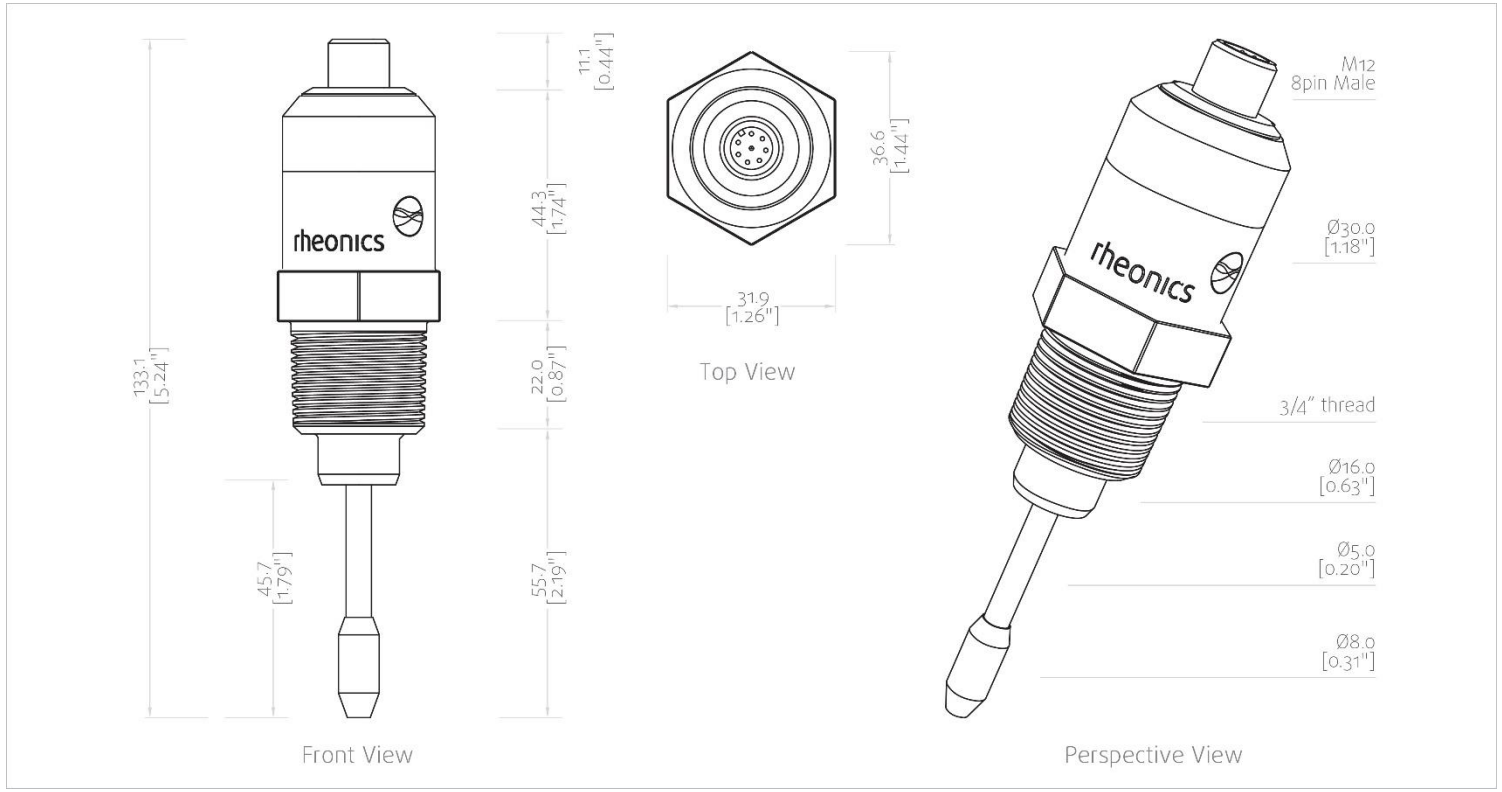


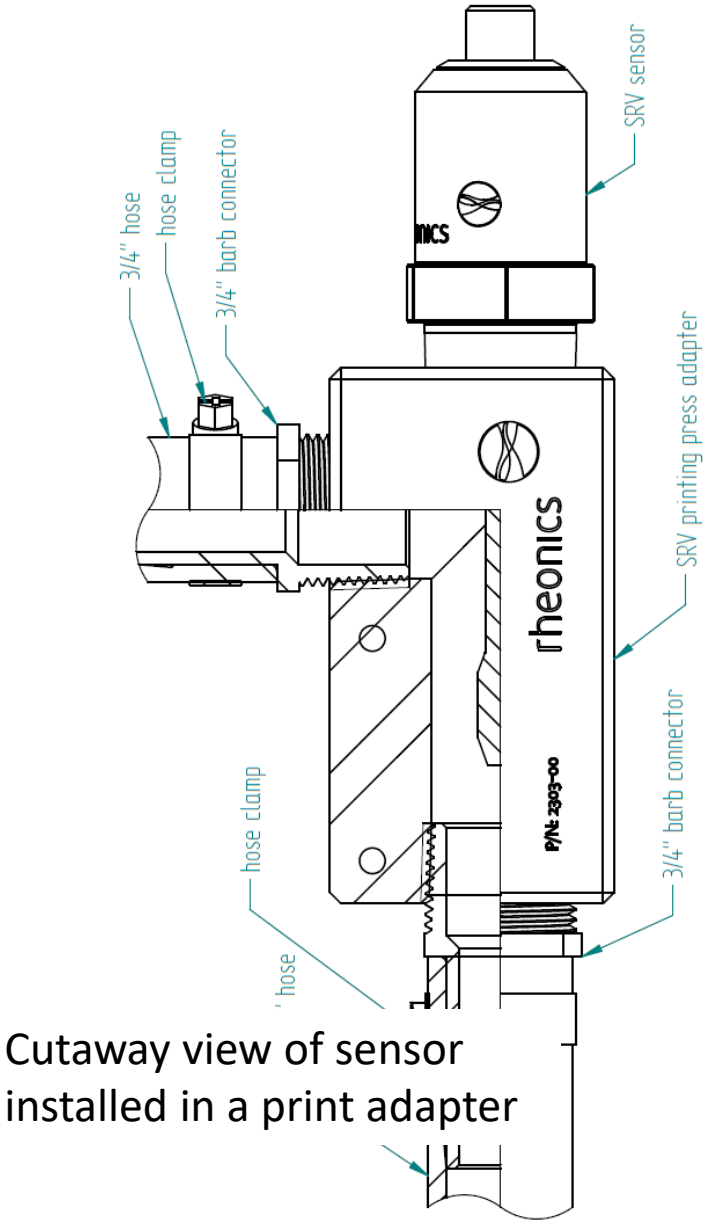

***Sensor Operating Principle***

Read more: https://rheonics.com/whitepapers/

# Rheonics SRV: The technology revolution

- Small form factor for easy installation without need for additional space in press
- Wide operational range – low to high viscosity, solvent & water –based inks
- Extremely repeatable sensor
- Ultra-precise, stable measurements – no influence of pumps or foam



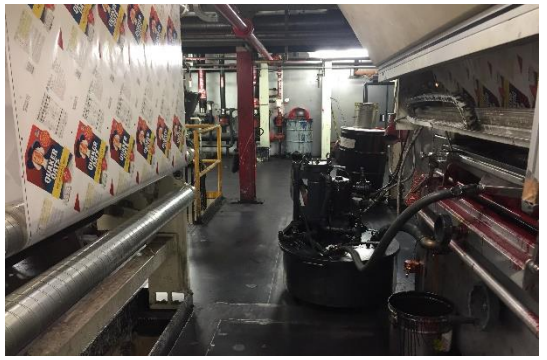




Cutaway view of sensor installed in a print adapter

# **Why** is viscosity optimization and control important in printing?

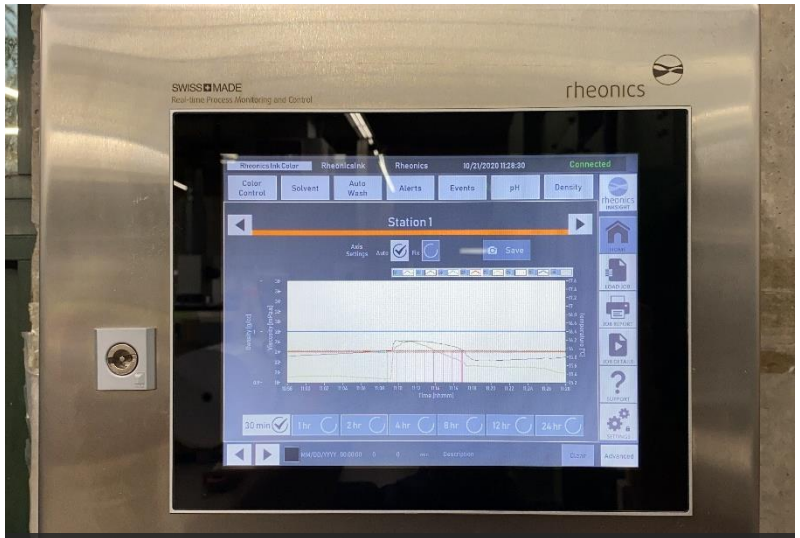
Viscosity is a very important parameter in the final print quality:

- If the viscosity is incorrect, the flow behavior and ink layer thickness will vary, leading to deterioration of print and color quality
- Poorly adjusted ink viscosity causes excessive ink and solvent consumption and drives up costs
- Optimizing ink viscosity is time-consuming, even for experienced press operators
- Viscosity automation and predictive tracking control reduces waste and improves efficiency

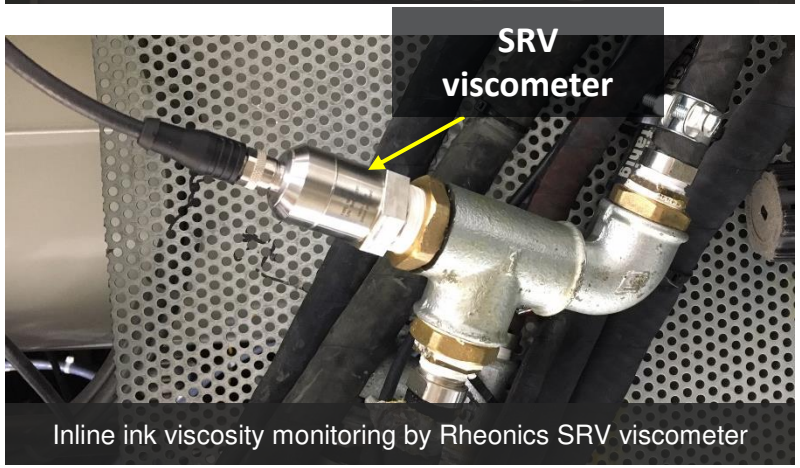


# **What** is unique about Rheonics viscosity control?

- Traditional viscosity measuring methods (like efflux cups) are inaccurate, tedious to use, and prone to errors. Continuous viscosity control with such methods is extremely inefficient and unproductive.
- Many common viscosity measuring devices do not provide fine enough viscosity control and require high maintenance and frequent calibration.
- Rheonics InkSight Predictive Tracking Controller and SRV viscometers enable tight viscosity control throughout the print job, due to the the system's ability to autonomously maintain viscosity within extremely narrow limits.
- Printers can achieve unmatched color accuracy and quality with InkSight system and **ColorLock** software – which is designed in collaboration with printers, for printers.



Predictive Tracking Controller for autonomous viscosity control



Inline ink viscosity monitoring by Rheonics SRV viscometer

# **Comparative analysis** of the Rheonics InkSight Solution

| | InkSight SRV | Falling ball (Fasnacht, W&H) | Efflux Cups (Gardener) | SAW sensor (Vectron) | Other vibrational (Hydramotion, Emerson, InkSpec, Gamma, Selectra) |
|---|---|---|---|---|---|
| Accuracy | Better than 5% absolute | Acceptable, but no temperature control | Depends on operator skill; ca. 10% | Good | Good |
| Stability | Better than 1% long-term | Acceptable | Must be continually recalibrated | Long-term drift | Long-term drift; must be periodically recalibrated |
| Ink Type | All ink types, including low-viscosity inks | All ink types | Unsuitable for low-viscosity inks | Zero-point drift with low viscosity inks. Does not work with water-based ink. | Frequent re-calibration needed for low-viscosity inks; |
| Cleaning Ease | Cleanable inline; deposits can be removed by wiping with no damage. System indicates when cleaning is required | Difficult to clean | Needs cleaning after every measurement. | Can be cleaned inline; deposit removal can damage sensor | Cleanable inline; some sensors will be damaged by mechanical removal of deposits |

**Excellent** **Good** **Bad**

# **Comparative analysis** of the Rheonics InkSight Solution

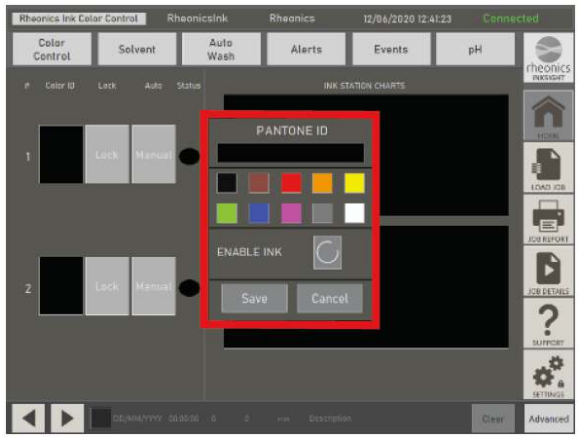
| | InkSight SRV | Falling ball (Fasnacht, W&H) | Efflux Cups (Gardener) | SAW sensor (Vectron) | Other vibrational (Hydramotion, Emerson, InkSpec, Gamma, Selectra) |
|---|---|---|---|---|---|
| Temperature | Measured by sensor, compensated in software | Not controlled or measured | Not controlled or measured | Measured | Measured |
| Installation | Compact sensor form factor for easy integration into new or existing machine. Reduces installation cost and commissioning time, and improves scalability. | Difficult installation, needs significant commisioning effort: sometimes requires rebuilding existing machines for integration, making it expensive. | Completely manual system with 100% operator dependence. Manual measurements then need interventions by operator to adjust viscosity. | Easy inline installation | Inline installation, but large size may require rebuilding ink system. |
| Calibration | No need for re-calibration: First sensor that does not need any calibration after installation. Maintenance free over the expected 25 year lifetime of the sensor. | Need frequent re-calibration. | Need frequent re-calibration. | Need frequent re-calibration. | Depends on type, but needs frequent re-calibration |

**Excellent** **Good** **Bad**

# **How** is it used?

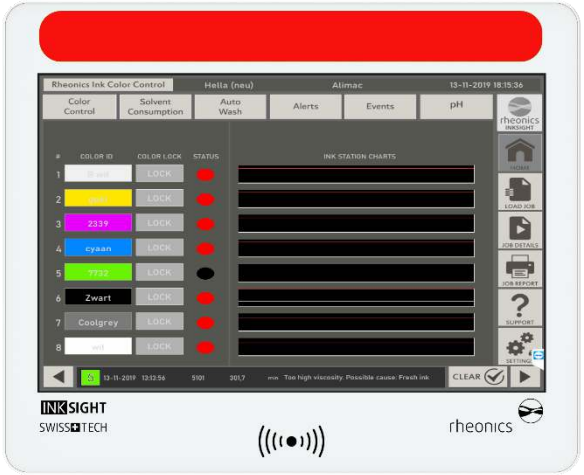
3 steps to autonomous viscosity control

1. Enable ink station in USE




2. Click AUTO button when print is accepted to MASTER


3. System informs operator when intervention is needed




**No need for constant monitoring**

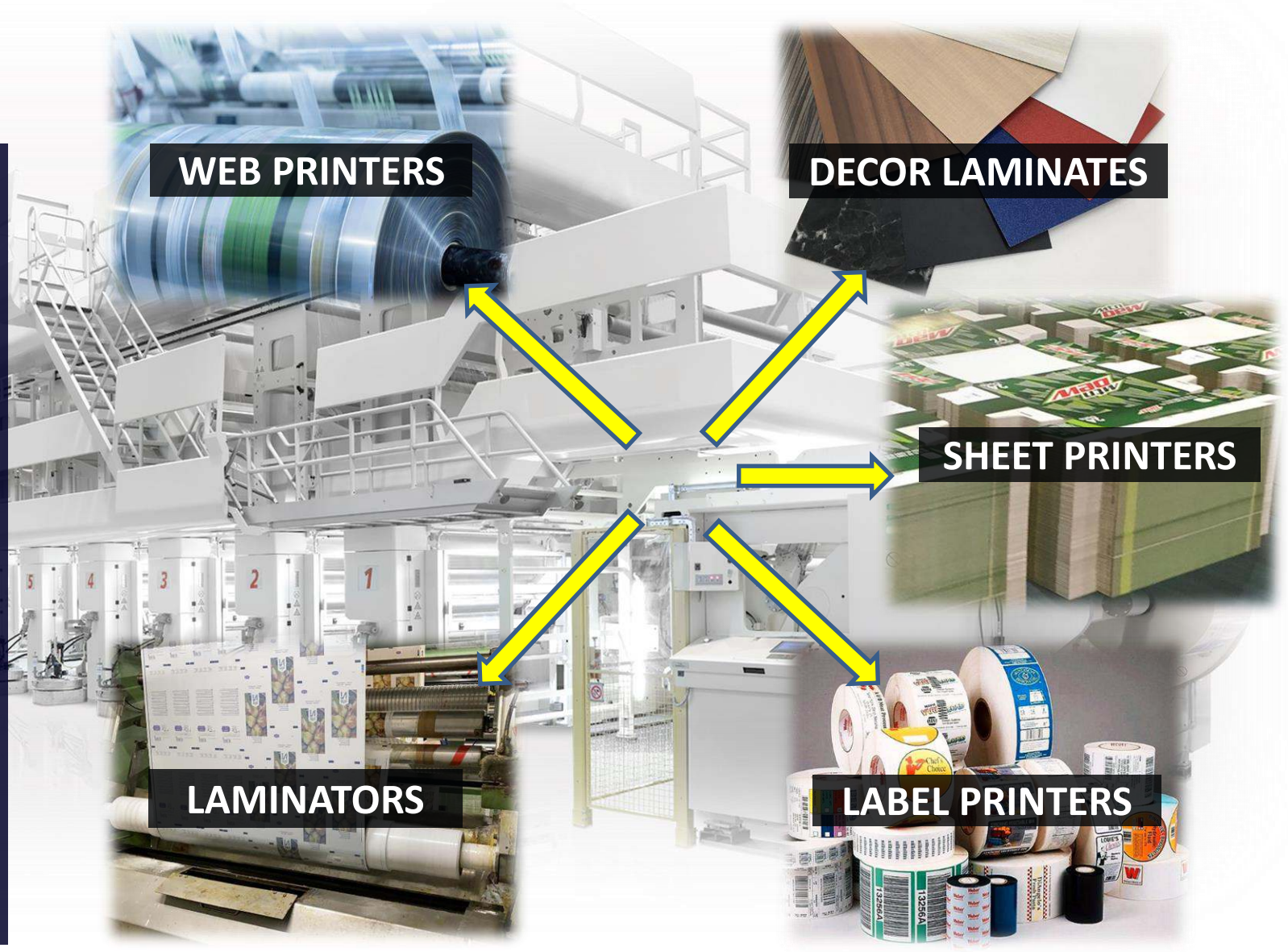
*Level 5 autonomy on Rheonics InkSight means the system will seek intervention only when needed*

# **Who** uses it?

Printing press companies deploy the Rheonics InkSight to achieve excellent reproduction accuracy, print quality and color brilliance.

It is ideally suited for the production of film packaging for food, snacks, confectionery and pharmaceuticals, and also decorative paper for laminate flooring and furniture in addition to the high-gloss magazines, catalogues, advertising flyers and supplements of retail chains.

**Printing press manufacturers**, **machine builders** and **system integrators** easily integrate the modular InkSight system into new and existing machines to give **single click** ink viscosity control to operators.



# **Who** uses it?

## Flexo presses where Rheonics InkSight is deployed


| | |
|---|---|
| Company | **Maasmond Papier Industrie B.V. Netherlands** |
| Application | **Packaging printing (web)** |
| Machine | **W&H Primaflex 8-station** |
| Installation Type | **Integrated in their press HMI** |

# **Who** uses it?

## Flexo presses where Rheonics InkSight is deployed

| | |
|---|---|
| Company | **BCI – Buckeye Converting Inc., USA** |
| Application | **Corrugated printing** |
| Machine | **Bobst NT** |
| Installation Type | **Integrated in their press HMI** |

# **Who** uses it?

## Flexo presses where Rheonics InkSight is deployed

| | |
|---|---|
| Company | **CGT – Canadian General Tower, USA** |
| Application | **Seat leather/textile coating** |
| Machine | **KBA coating line** |
| Installation Type | **Integrated in their press HMI** |

# **Who** uses it?

## Gravure presses where Rheonics InkSight is deployed

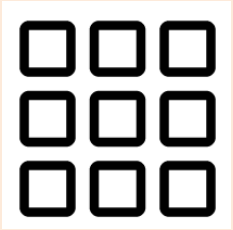

| | |
|---|---|
| Company | **Interprint, Inc. (Toppan)<br>Pittsfield, MA, USA** |
| Application | **Decor laminates printing** |
| Machine | **Faustel** |
| Installation Type | **Integrated in their press HMI** |

# **Who** uses it?

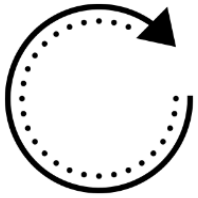
## Gravure presses where Rheonics InkSight is deployed


| | |
|---|---|
| Company | **American Packaging Company Columbus, WI, USA** |
| Application | **Packaging printing** |
| Machine | **Comexi** |
| Installation Type | **Retrofit - standalone integration** |

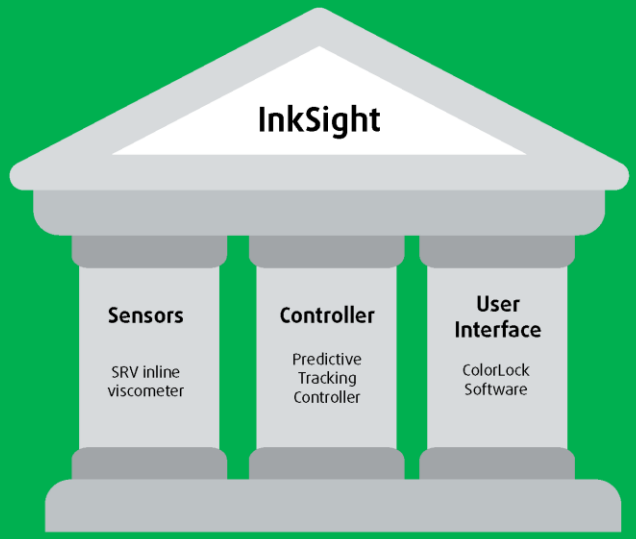
# **Summary** of InkSight features and benefits

| | | |
|---|---|---|
|  | Menu-driven electronic controls are powerful and easy to use | Operators can put InkSight to work right after installation. No extensive retraining, no previous measurement and control knowledge necessary. |
|  | Built-in temperature measurement | Allows automatic control of temperature-compensated viscosity of inks, allowing for tight color control regardless of press temperature. |
|  | Repeatable, reproducible & highly accurate | Once a job has been set up, it can be saved and recalled when repeat orders are printed. |
|  | Smart wash and CIP optimizations | No need to remove sensors from the system to clean up between runs. Informs the operator when line is clean. |

# **Summary** of InkSight features and benefits

| | | |
|---|---|---|
|  | Automatic viscosity control for saved jobs | Changing settings for repeat jobs is as easy as pushing a button |
|  | Security and alerts - Prevents unauthorized changes, alerts operators at setpoints | Protects job integrity from unauthorized and accidental changes |
|  | Data logging - date and time-code are automatically logged, creating an audit trail | Makes support easy and accurate. Logs can be made internet-accessible for quick and specific remote diagnosis and correction. |
|  | Quick-change memory settings | Simplifies changing ink viscosity control settings in multi-station presses. |

# InkSight in Action



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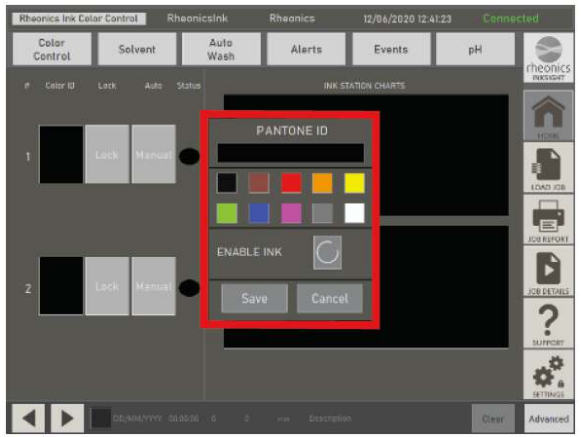


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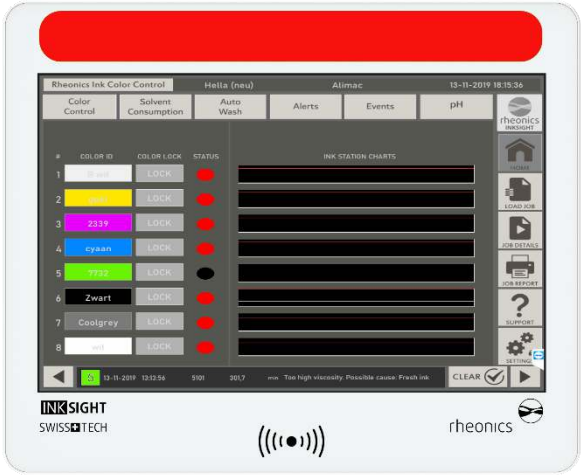
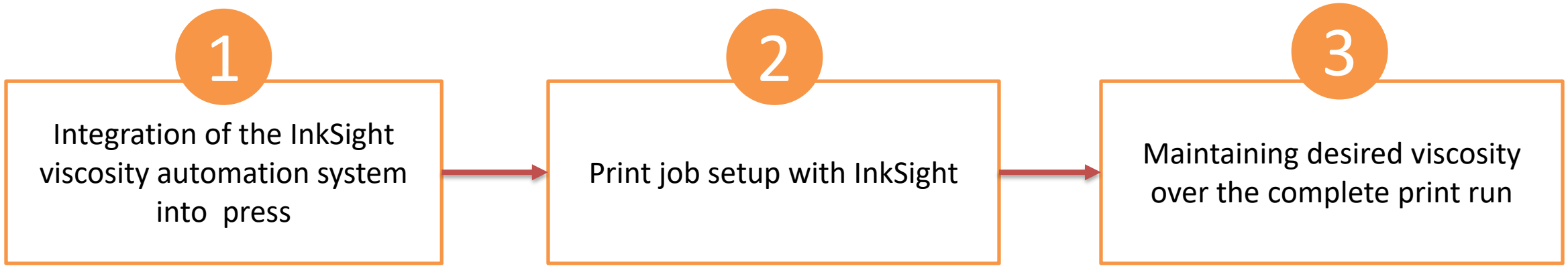



**No need for constant monitoring**

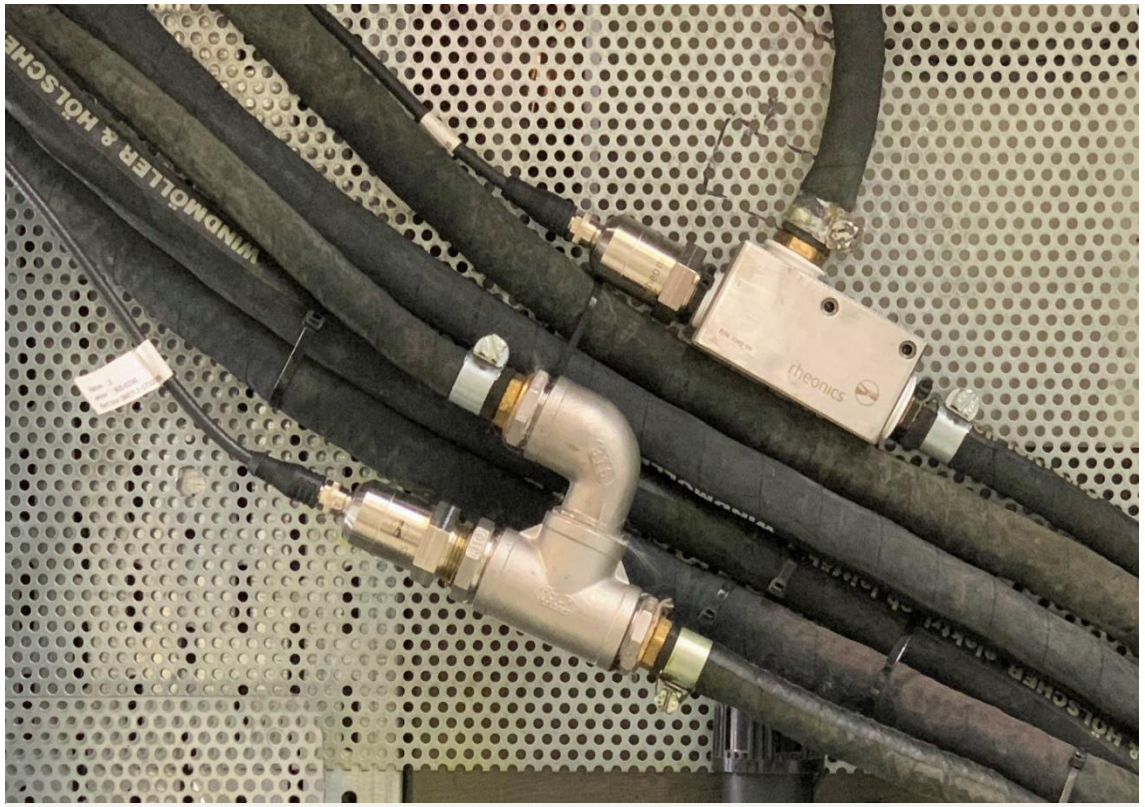
*Level 5 autonomy on InkSight means the system will seek intervention when needed*

# InkSight from installation to operation




Let’s see this in action on a Windmoeller primaflex CS 8 station press used by Bert Verweel’s company, Maasmond.

# 1. Installation of the InkSight into press




Two SRV inline viscometers installed on the ink hoses from pump to the doctor chamber


InkSight predictive tracking controller installed on machine


W&H Primaflex CS 8-station with InkSight system integrated in the press as a modular unit


Inksight Colorlock user interface located on the main press console

# 2. Print job setup with InkSight

1. **To start a job**, the operator premixes the ink recipe, either according to the manufacturer's recommendations, or from a recipe that was used on a previous job of which this is a repeat order.

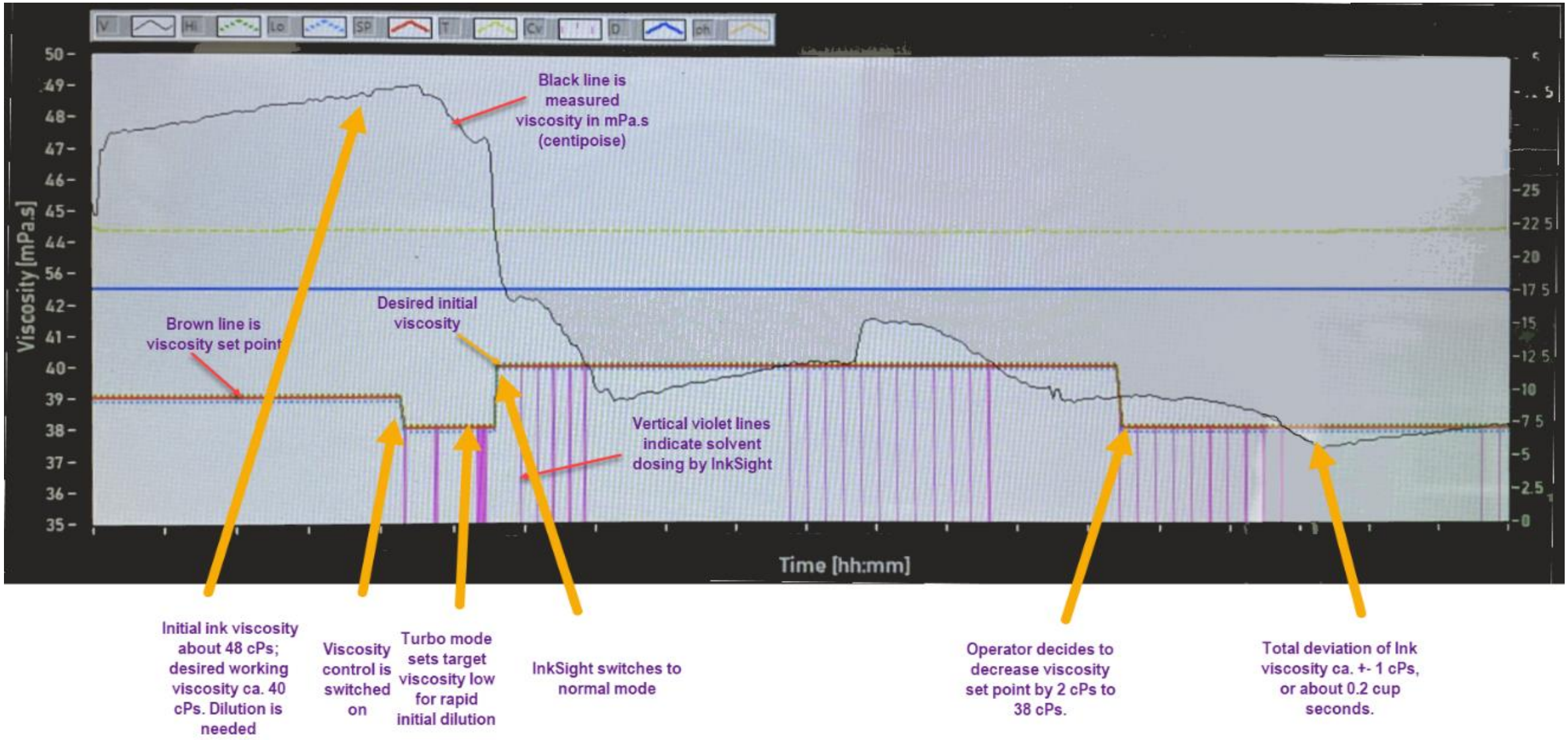
2. **Starting from a slightly higher viscosity**, the operator can make small adjustments to the viscosity until the optimum color density is reached.

3. The operator then **pushes a button on the screen** (ColorLock button) that locks the viscosity setpoint to that required for the density of the particular color.



## The Result

Viscosity drops out of the picture. Control is taken over by InkSight, freeing operator to focus on the printing process



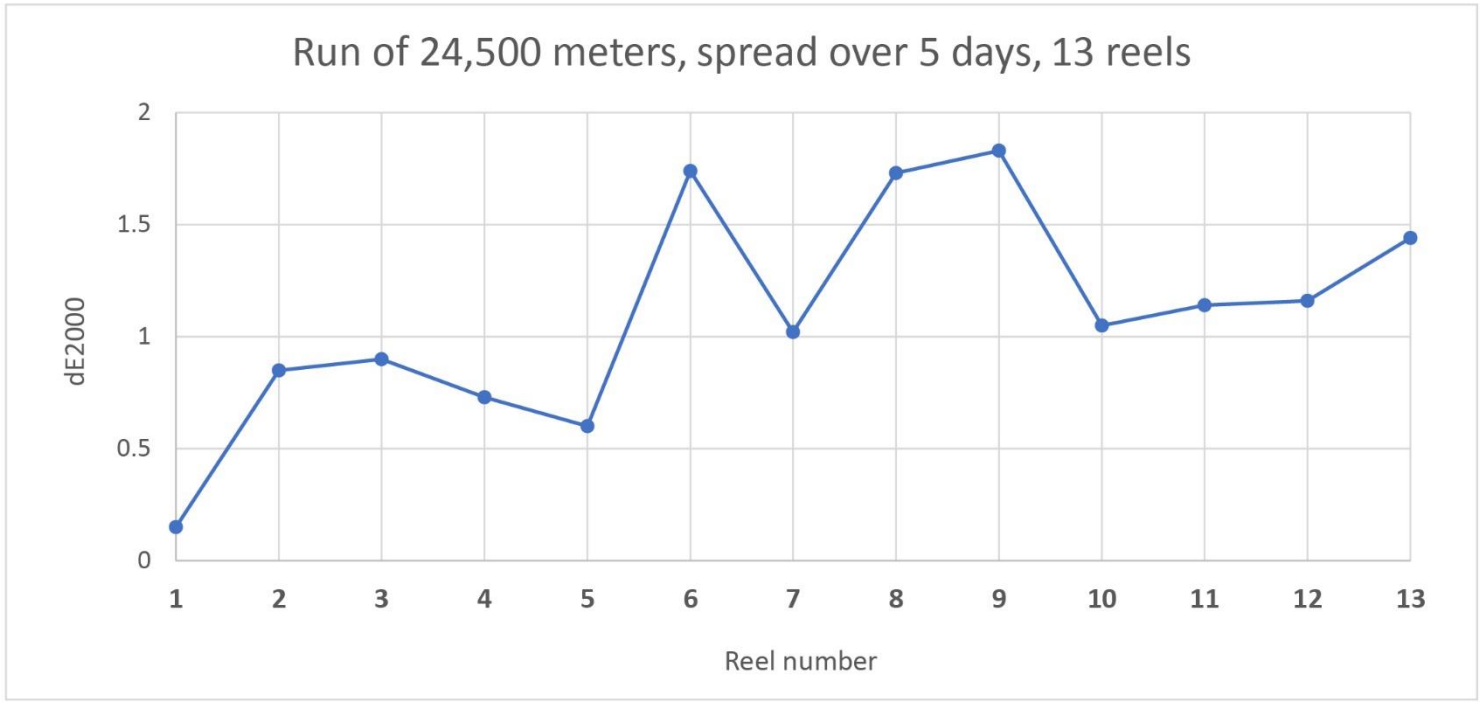

Start-up process showing fast, autonomous stabilization of ink viscosity to set point

# 3. Maintaining set viscosity over the complete print run

- During the actual print run, the InkSight system locks the viscosity at the preset optimal value.
- The InkSight system ensures color accuracy and control even during a long print run regardless of external conditions, such as evaporation, temperature changes or fresh ink addition.

*In the next slide, let's look at a series of measurements taken from a print job of 24,500 meters, and 13 reels. The run was interrupted several times, and so was printed on 5 different days, and in part at different speeds...*

# dE values in a long print run

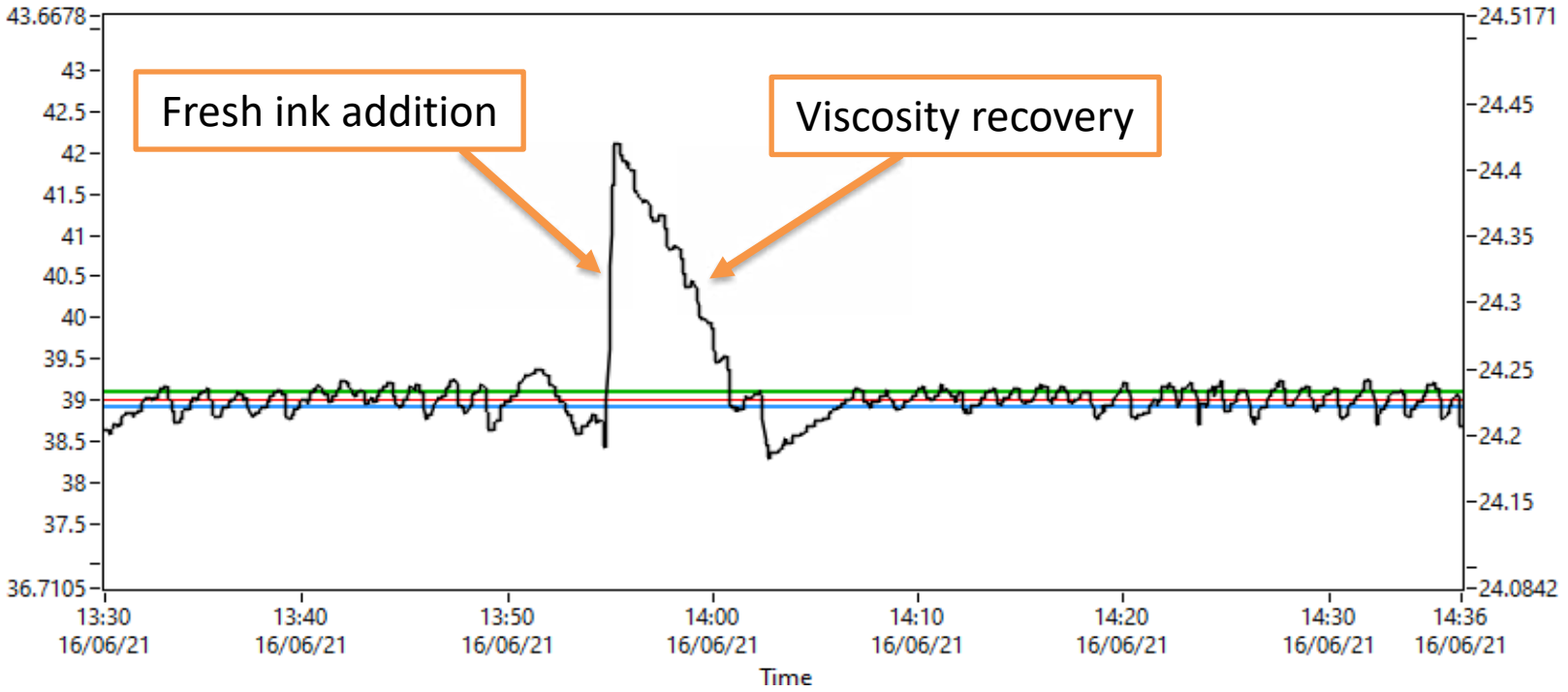



(a) dE2000 for a run of 24,500 meters spread over 5 days and 13 reels (b) sample of print

**Key findings:**

- **Tight dE control:** Despite the long time span and the interruptions, the dE2000 value never exceeded 1.8
- Over the run, SRV viscometers were never re-calibrated, nor were they cleaned. The individual runs were simply loaded from the ColorLock screen, and continued from where it last left off.

# System’s response to fresh ink addition




**Key findings:**

- **System responsiveness:** Rapid recovery of viscosity within less than 5 minutes
- **Control Precision:** Viscosity fluctuates between about 38.7 and 39.2, or +- 0.5 cP before and after ink is added. This corresponds to a viscosity of about +- 0.1 cup seconds, impossible to measure with cups.

# User benefits and outcomes of technology

# Key **user benefits** of InkSight

**INKSIGHT places the focus on print quality instead of measurement skills.**

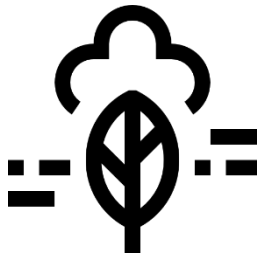
Achieve best in class print quality, dramatically reduce setup time and optimise use of pigments and solvents. Improve productivity and efficiency through complete automation of color control on your press.

- Takes out all manual steps and enables fully autonomous ink viscosity control: Single click, intuitive automatic viscosity control up to the standards of today's and future highly automated presses
- Reduces setup time and eliminates setup scrap by loading previously saved job configurations, enabling consistent print quality in repeat jobs with minimal efforts for production
- Robust, maintenance free viscosity sensor eliminates need for re-calibration or cleaning by operators.
- Better print quality: Tighter, more accurate color density and dE control across the complete run
- Edge over competitors by undertaking higher margin – higher quality print jobs made possible with the Rheonics InkSight system
- Accurate dosing of solvents ensures minimal, precise amounts of solvents are consumed, leading to reduced emissions

# Outcomes | InkSight Technology lets the operator ….

**ENVIRONMENT**

## Reduce Solvent Emissions



Optimized automatic solvent dosing compensates exactly for solvent evaporation, eliminating excess solvent consumption. InkSight technology enables building ‘greener’ printing presses. Software keeps track of all events such as setpoint violations, alarms averages per-color solvent consumption and the number of doses.

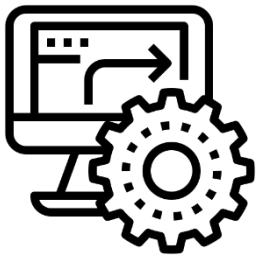
**SAFETY**

## Achieve better operator safety

With InkSight, operators do not need to make manual measurements eliminating all contact with ink and solvent vapours. Furthermore, any new addition of ink does not need pre-dilution, as InkSight system automatically and rapidly brings fresh ink to the proper viscosity.

**PRODUCTIVITY**

## Completely Automate operations



Most all systems in printing machines are automated except ink control. InkSight completes the circle by bringing fully automating ink viscosity control – one of the most crucial factors in achieving highest print quality and lowest environmental impact with minimal operator intervention.

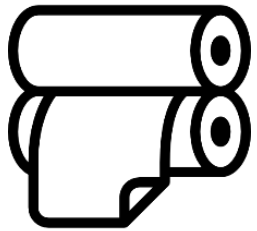
**RESPONSIVENESS**

## Make data-driven decisions

Collected print job data is available for process optimization, quality control and proactive maintenance. Data allows detecting process deviations and facilitates root cause analysis. Rheonics solutions are designed to empower printers with maximum actionable data.

# Outcomes | InkSight Technology gives the operator ….

## Highest Print Quality



Viscosity is the single most important variable for printing color quality. InkSight system helps maintain the highest color quality standards through tight and accurate viscosity control.

## More efficient operations

InkSight enables setting up a job to spectrophotometer standards. It offers 100 times greater viscosity resolution than average efflux cups. Operators do not need to make time-intensive and error prone manual measurements of viscosity.

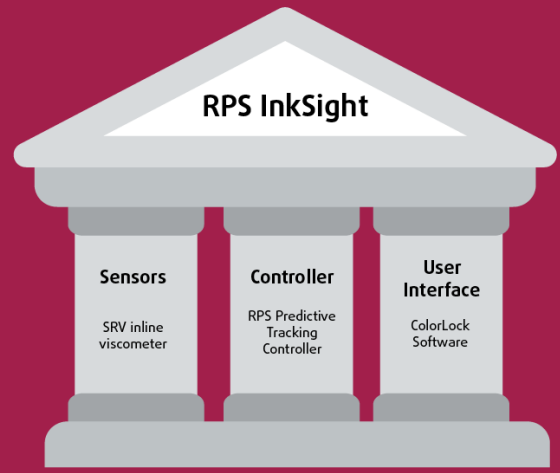
## Reduced printing costs

By ensuring correct ink properties throughout a run, tight viscosity control reduces printing errors, paper waste and rejects. Solvent consumption is significantly reduced while improving productivity

## Easy scalability

Reduce and eliminate setup times and scrap by loading saved jobs for repeat orders.

# Technical Achievement



# What did we **achieve** with InkSight?

| | |
|---|---|
| **User Benefits reported by our customers** | • Superior Print Quality<br>• Efficient Operations<br>• Improved productivity<br>• Higher Profitability<br>• Reduced printing costs<br>• Easy scalability of operations |
| **Technology Outcomes for Printing Industry** | • Reduced scrap, rejects, solvent consumption and emission<br>• Reduction in setup times and significantly easier cleaning procedures<br>• Tight color control: dE < 1<br>• Safer workplace<br>• Completely automated operations<br>• Industry 4.0 connectivity enabling data-driven decision making and fault analysis |

# What did we achieve with InkSight?

Let our customers speak for themselves …

“ The following are some key advantages of the Rheonics systems:

- Ease of use
- Do not need to calibrate for every use as our other system requires
- Temperature compensation for predictive logic precise dosing
- **Set it and forget it operation** - The operators have full confidence in this system, we have had several occasions where we did not have a press crew to run the press at night so instead of shutting the press down and washing up we opted to leave the viscosity control system on with the cylinders in the press spinning and the ink circulating through the system. We came in the next morning and we were able to start right back up.
- Another key feature is the reporting and event tracking, this is key for us to monitor and see how the system performed over the run.

INTERPRINT
A TOPPAN COMPANY

Todd Luman,
Laser Engraving Manager
Interprint, Inc.

# What did we achieve with InkSight?

Let our customers speak for themselves …

"

Since installing the new InkSight viscosity control system on one of our rotogravure lines, we've seen some impressive results. The PID control is phenomenal, and we could control almost any valve style with success. It can maintain an extremely tight setpoint tolerance. The built-in data logger is an excellent feature that our process engineering team finds very useful. Also, Rheonics ability to service us remotely in a timely manner has been instrumental in the successful commissioning of this system. We are looking forward to installing our second system soon and we thank Rheonics team for their commitment to our success.

American Packaging CORPORATION

Randy Buchholz,
Maintenance Engineer
American Packaging Corporation

# **How** did we achieve ?

## 1 Put the operator first

- **InkSight** system has been developed by Rheonics in very close collaboration with printing press engineers and operators.
- Their inputs have been taken in every stage of the ColorLock software development cycles.
- ***Rheonics InkSight is a system by the printers for the printers***.

## 2 *Rock solid sensor technology*

- The Rheonics SRV viscometer is a technologically superior, best-in-market viscometer. It uses patented and proprietary, ultra-stable resonator technology that add up to the industry's most robust, repeatable and accurate sensor.
- It has capability to detect the smallest of ink variations. Coupled with predictive tracking control, it ensures extremely agile ink control.

# Achieved: robust, repeatable, no-calibration sensor


Showing the inline installation of the Rheonics SRV viscometer in an ink delivery system

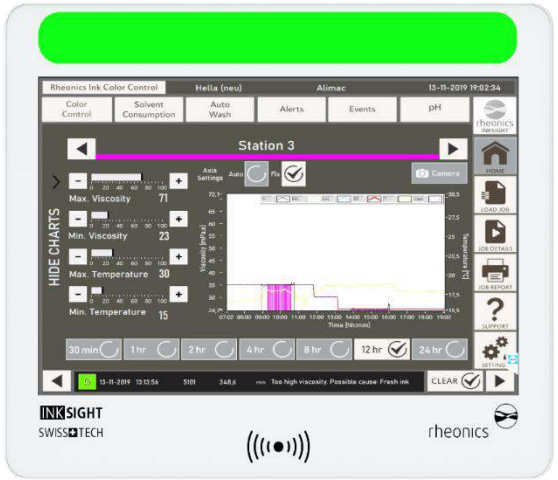
The Rheonics' SRV Viscometer is the essential foundation upon which InkSight system is built:

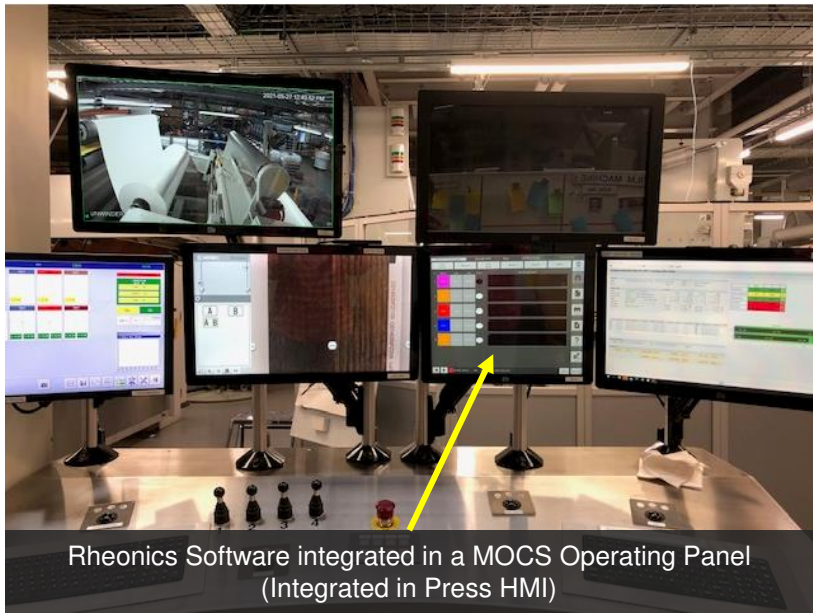
**Robustness construction**
Rheonics balanced torsional resonators together with proprietary 3rd generation electronics and algorithms makes the SRV accurate, reliable and repeatable under all printing conditions. It is free of the rotating parts and narrow gaps that are typical of conventional viscometers.

**Zero maintenance, no recalibration**
The SRV viscometer exposes only hermetically sealed, mechanically robust sensor elements to the ink. it is free of gaps and cavities, and is cleaned in place (CIP). The sensor monitors cleanliness of the line, and informs the operator of any fouling.

**Built-in temperature monitoring for effective temperature compensation of viscosity**
The SRV sensor has temperature measurement integrated into the sensing element. This enables characterization of the ink at the point of viscosity measurement, and allows calculation of temperature compensated viscosity – critical for uniform print quality even under daily and seasonal variations.

# Achieved: completely automatic, single-click viscosity control



Rheonics Software integrated in a MOCS Operating Panel
(Integrated in Press HMI)

### Operator independent measurement

Conventional viscosity measurement systems require intensive operator intervention distracting operators from their core mission. InkSight takes over measurement and control functions placing the full power of todays highly sophisticated printing machines in the hands of the operator. It removes the last hurdle to producing the best possible printed materials.

### User focused interface

Operators worldwide told us, they wanted to “set it and forget it”. We rolled their vision into the  single-click colorlock “AUTO” control button. That single button places the full power of InkSight in the hands of the operator.

### Seamless integration with machine and factory data system

InkSight monitors, logs and analyzes every aspect of the ink system, carrying out advanced analytics, self-diagnosis, forensics to spot potential problems before they happen. All these data and analytics is shared with machine PLC and factory data acquisition systems in industry standard protocols. Rheonics InkSight can communicate bi-directionally with machine and factory AI systems, enabling plant managers, quality assurance specialists and production supervisors to not only monitor but actively guide the production in their plants.

# **Why** we believe it's an achievement?

"In my professional opinion, there is not another viscosity control system in the market place today that can match the results we have experienced to date with the Rheonics InkSight. It is a new technology that separates itself from the others. In stating this, I am not saying the other viscosity controllers in the market place are bad by any means, they do work and work well. However I have not had the same level of performance as displayed by the Rheonics InkSight controller due to their technology product advancements.

INTERPRINT
A TOPPAN COMPANY

Todd Luman,
Laser Engraving Manager
Interprint, Inc.

# **Why** we believe it's an achievement?

## Competitive Edge of InkSight & SRV System (1/2)

**Major advancements as compared with other ink viscosity measuring devices.**

- ***Build it in the machine instead of building the machine around it:*** Compact sensor form factor means lower footprint and easy integration into new or existing machine. Simple sensor integration reduces installation cost. Measurements are unaffected by environmental disturbance whether vibrations, temperature variations or presence of motors and other large machinery.
- ***Provides a direct, stable link between ink viscosity and print quality:*** Operators can focus on the printing job instead of measurement techniques.
- ***Works with all types of inks, primers, adhesives:*** The Rheonics SRV viscometers work reliably with all types of inks whether solvent-based, water-base, metallic or UV as well as adhesives, varnishes and other coatings. They maintain the same accuracy and repeatability with low viscosity materials, such as gravure inks as with high viscosity coatings.
- ***Reliable Temperature Compensated Viscosity:*** Controls the viscosity parameter that reflects pigment loading, taking out variations due to daily and seasonal ambient temperature fluctuations.
- ***Intrinsically safe sensor:*** SRV comes with fully certified with ATEX, IECEx, CE and others pending. It can be used in any solvent based environment.

# **Why** we believe it's an achievement?

## Competitive Edge of InkSight & SRV System (2/2)

**Major advancements as compared with other ink viscosity measuring devices.**

- ***Operator focused interface:*** User interface was designed with consultation of operators, so it addresses the day-to-day needs rather than requiring extensive re-training. Operator acceptance was first and foremost in our design process. InkSight gives the full power of the system at the click of a single button in ColorLock software GUI.

- ***No need of any sensor re-calibration, cleaning or maintenance:*** First sensor that does not need any calibration and is maintenance free over the expected 25 years lifetime of the sensor. Trust in the sensor through InkSight ensures operators move away from using cup to calibrate an ultra-precise, accurate sensor helping achieve consistency during and between print jobs.

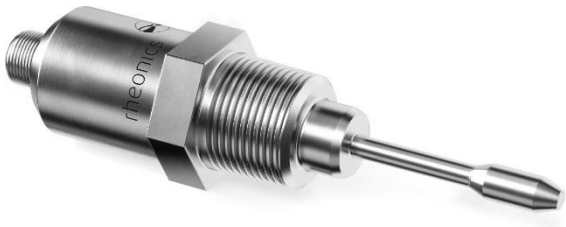
- ***Printing 4.0 ready - Equipped to enable printing presses achieve full automation:*** InkSight ColorLock software keeps track of every process variable during a print run. The print data is stored on the system as well as is made available to the machine PLC and factory data acquisition systems. Bi-directional communication between machine, job servers and InkSight makes loading and running job easy. Plant managers, quality personnel and production supervisors get powerful interface to directly review print job report on InkSight ColorLock webservers or evaluate performance on job dashboards.

# Major **advances in printing** by Rheonics Technology

## Thinking beyond cup seconds

### Revolutionising the way printers control ink quality

Measuring viscosity with cups is unreliable, inaccurate, time-intensive even with experienced operators. It's a huge bottle neck for scaling up printing volumes by continuous processes.

Inline ink viscosity monitoring by Rheonics SRV viscometer

"Due to the knowledge gained and the behaviour of the ink on the substrates on which we print, we know which values for the viscosity must be adhered to- this saves a lot of time, reduces scraps and wastage. We have eliminated setup scraps and reduced setup times because of the ability to load previously run jobs. It has significantly boosted our productivity and profitability by increasing our ability to deliver more print jobs.

**Bert Verweel**
Owner, Maasmond Paperindustrie BV, Netherlands

# Precise viscosity control

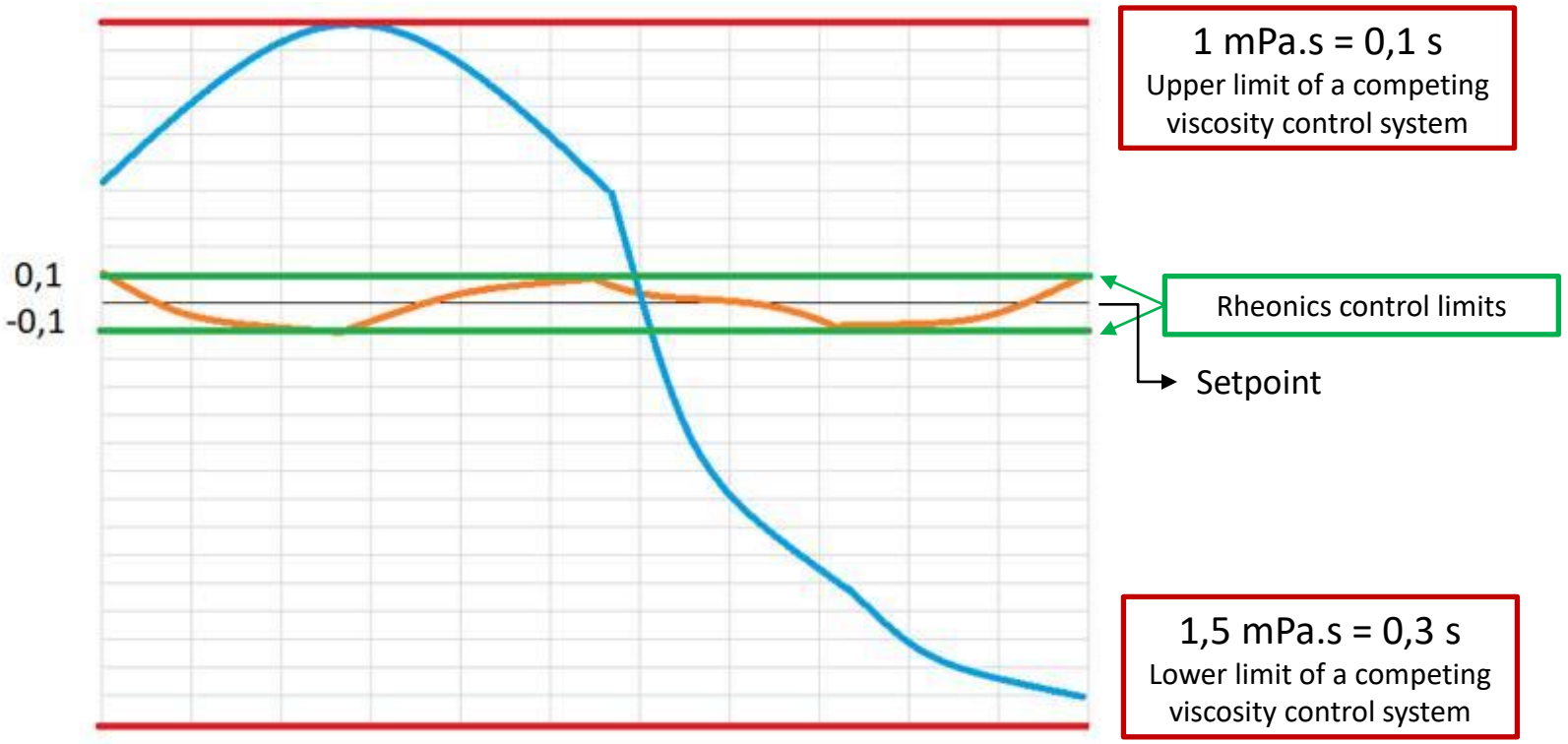



Exhibit – 1. Viscosity control accuracy, Rheonics InkSight Vs. Competitor

**Note:**
Orange line shows ***ink viscosity control with Rheonics InkSight***
Blue line shows ink viscosity control of a competing, industry leading solution

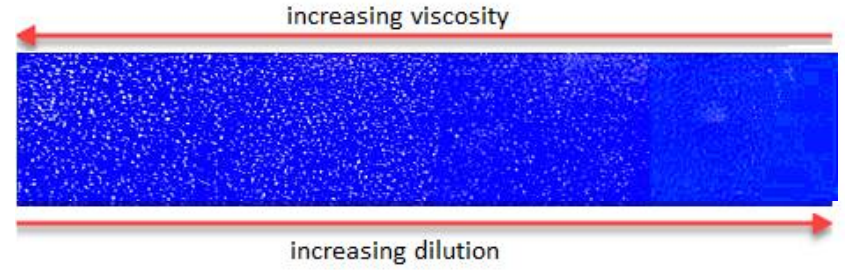
> “ InkSight is at least 10-15 times more accurate than competing viscosity systems with repeatable setpoints.

**Bert Verweel**
Owner, Maasmond Paperindustrie BV, Netherlands

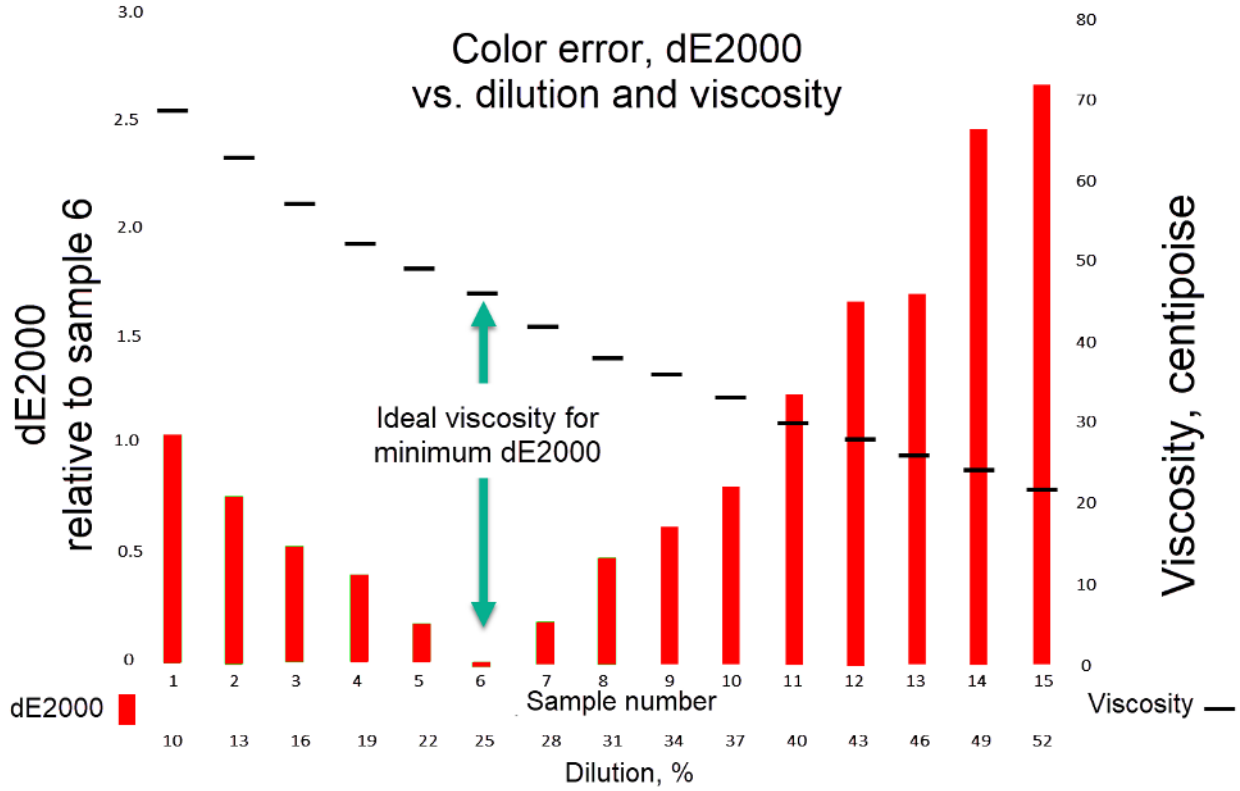
# Viscosity control = color quality control

| sample | Viscosity (mPa.sec) | din cup | dilution | dE | colour strength |
|---|---|---|---|---|---|
| 1 | 69 | 26.2 | 10% | 1.07 | 94.20% |
| 2 | 63 | 24.8 | 13% | 0.79 | 97.80% |
| 3 | 57 | 23.4 | 16% | 0.55 | 96.40% |
| 4 | 52 | 22.3 | 19% | 0.41 | 98.80% |
| 5 | 49 | 21.6 | 22% | 0.19 | 98.80% |
| 6 | 46 | 20.9 | 25% | 0 | 100.00% |
| 7 | 42 | 20 | 28% | 0.2 | 98.90% |
| 8 | 38 | 19 | 31% | 0.5 | 98.00% |
| 9 | 36 | 18.6 | 34% | 0.64 | 98.00% |
| 10 | 33 | 17.9 | 37% | 0.83 | 97.20% |
| 11 | 30 | 17.2 | 40% | 1.26 | 96.80% |
| 12 | 28 | 16.7 | 43% | 1.69 | 95.00% |
| 13 | 26 | 16.3 | 46% | 1.73 | 95.00% |
| 14 | 24 | 15.8 | 49% | 2.49 | 92.30% |
| 15 | 22 | 15.4 | 52% | 2.7 | 91.60% |

Numerical values of dE2000 and color strength vs. dilution.

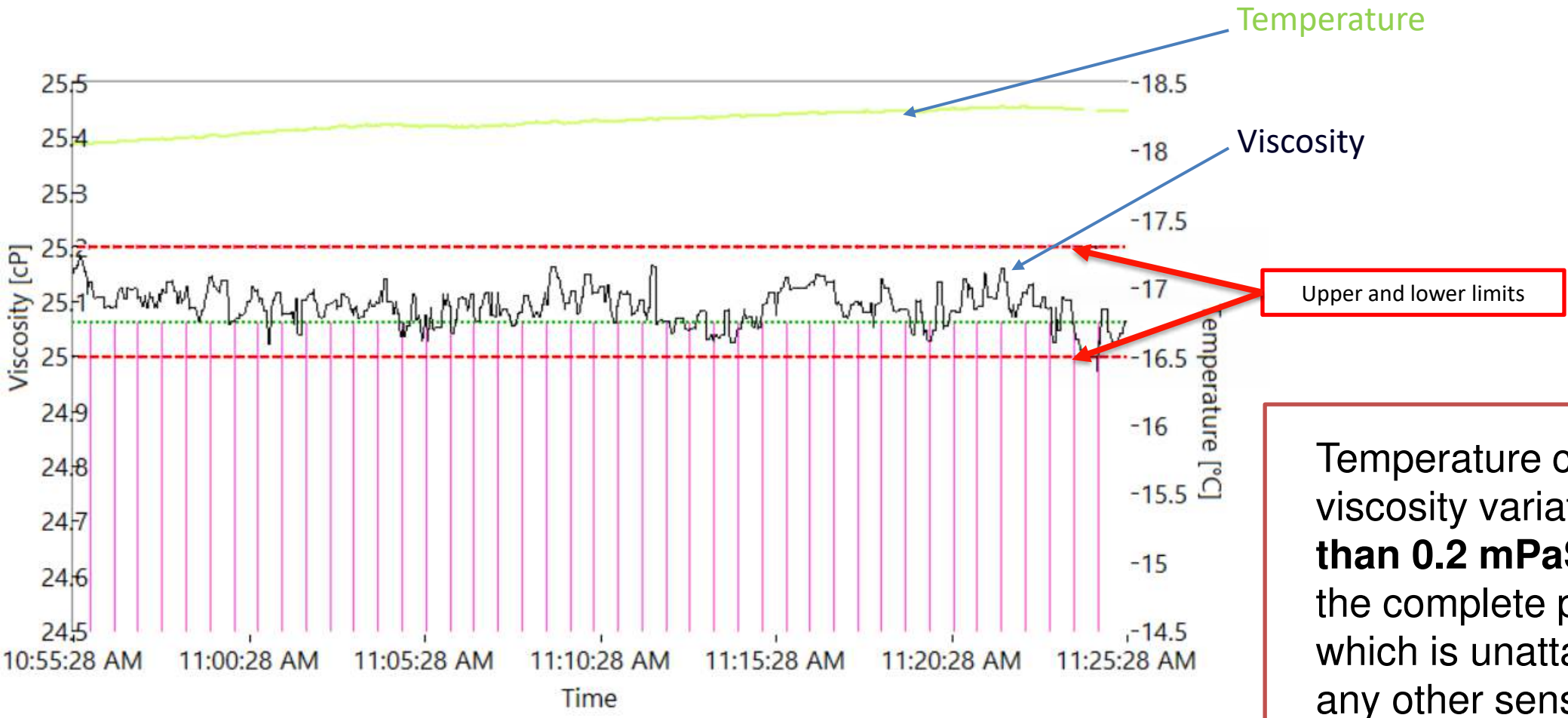



Color density variation with ink dilution and viscosity




Ink was diluted in steps. Viscosity and color strength were measured. Dilution of 25% gave minimum dE2000, at a viscosity of 46 cPs. Using a setpoint of 46cPs for InkSight will give a constant minimum color error throughout the print run.

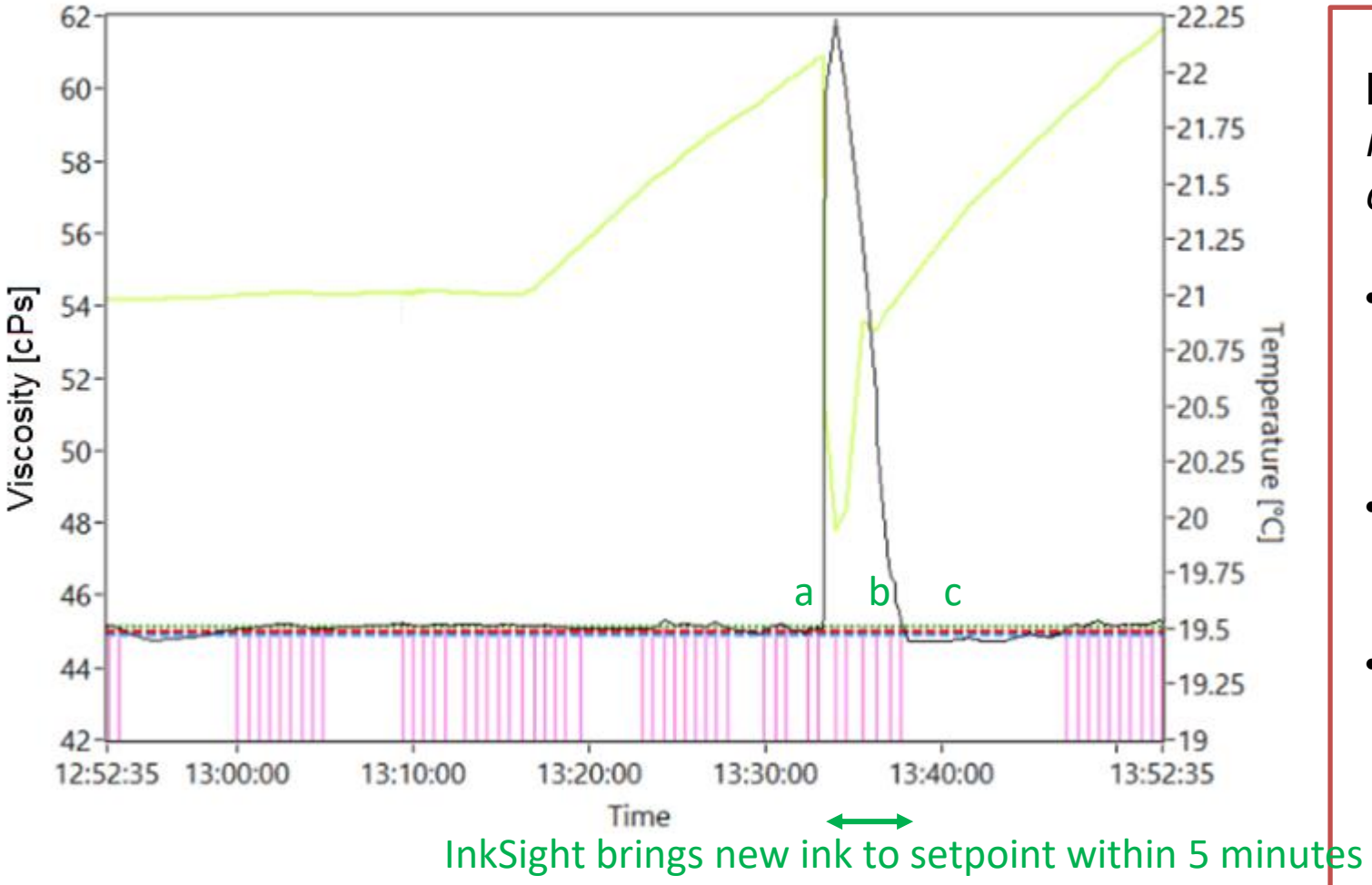
# Control stability




Temperature Compensated Viscosity Vs Time. Software screenshots collected from a press using InkSight for Viscosity Management.

Temperature compensated viscosity variation is **less than 0.2 mPaS** throughout the complete print run; which is unattainable with any other sensor or traditional instruments.

# System responsiveness




Response of the system to adding a large volume of cool ink to a system running at 21 deg. C. The spike in viscosity is because of cool ink addition.

InkSight viscosity control system ensures *rapid recovery of the temperature compensated viscosity to the setpoints*.

- On addition of new, cool ink (a), InkSight brings the ink viscosity to the setpoint quickly (b), with minimal overshoot and without overdilution (c).
- The dosing of solvent to make viscosity adjustment is completely autonomous: no manual intervention is required.
- The operator does not need to worry about ink's viscosity prior to addition, since the system can automatically adjust the viscosity very fast and accurately.

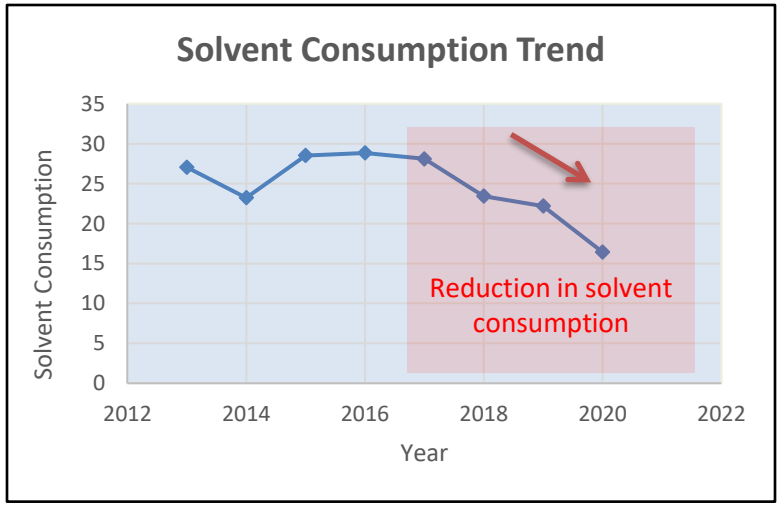
# Reduction in solvent consumption and emissions

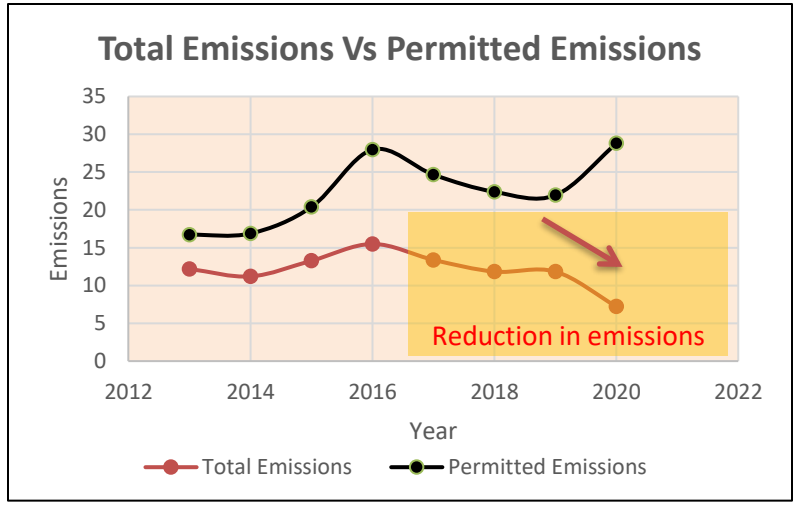
InkSight introduced in Maasmond B.V. Operations – June 2018

| | 2013 | 2014 | 2015 | 2016 | 2017 | 2018[1] | 2019 | 2020[2] |
|---|---|---|---|---|---|---|---|---|
| Solvents consumption | 27.045 | 23.239 | 28.532 | 28.848 | 28.112 | 23.442 | 22.197 | 16.420 |
| Total emission | 12.193 | 11.214 | 13.281 | 15.487 | 13.389 | 11.841 | 11.841 | 7.240 |
| Permitted emission | 16.727 | 16.896 | 20.400 | 27.971 | 24.655 | 22.388 | 21.954 | 28.798 |

**Notes:**

1. InkSight Commissioned on printing press ink stations in June 2018
2. The second InkSight system commissioned on the laminator units in April 2020

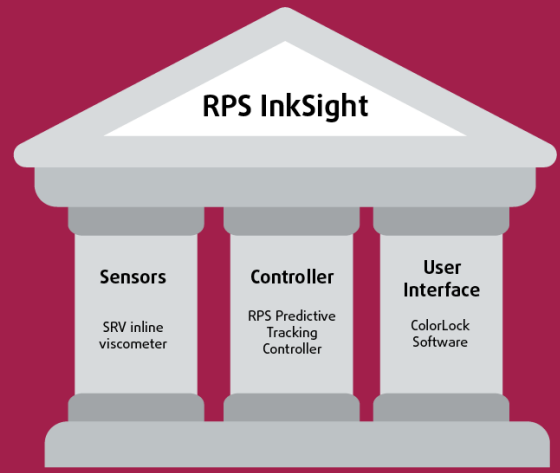



Solvent consumption and emissions data reported by a customer after commissioning of InkSight (Source – Maasmond B.V.)

# Technical Impact on Industry's Future

## "Stretching the envelope" of Printing Technology



# Future of printing – “ Streching the envelope”

## Goals of the printing companies

1. ***Higher print speeds, reduced setup times and increase throughput:*** Shorter time to finish a job and to shorten job times. Ability to complete more jobs. Reduction of setup times becomes more critical, especially for short-run work which is expected due to changes in consumer behaviours and marketing approach by brand owners.

2. ***Highest print product quality:*** Achieving color accuracy reliably, repeatably, and complying with brand owners’ changing quality expectations.

3. ***Higher profitability:*** Using technology and data to optimize scale, volumes, quality and product differentiation. Increasing the lifetime of expensive printing machines using data.

4. ***Sustainability:*** Reduced wastage and setup scrap; improve savings in solvent and ink consumption

5. ***Compliance:*** Meet increasingly stringent environmental norms in terms of solvent consumption, CIP requirements, emissions as well as operators’ safety.

6. ***Embrace, adopt and reap benefits of Industry 4.0 & Digitalization:*** Maximize utility of acquired printing process data combined with full traceability and information transparency.

# How does InkSight help operators reach their goals?

| Future & Present Goals of Printers | How does InkSight help reach those goals? |
|---|---|
| 1. Higher Printing Speeds, reduce setup times and increase throughput | • Reduces setup time and scrap – operators can re-run a previously loaded job using the 'Save job' and 'Load job' functionality<br>• Reduces operator time to maintain ink viscosity and auto wash eliminates any need for operator to clear the measurement system<br>• Autonomous viscosity control means no delay between viscosity measurement and corrective action |
| 2. Accurate print quality control | • Tight viscosity control gives tight color control and color brilliance. InkSight allows operators to bring viscosity control up to the standards of today's highly automated press controls<br>• Temperature compensation of viscosity puts the focus on correct pigment loading of ink regardless of seasonal or daily temperature variations<br>• Compensation for evaporation: tight control and 'fine resolution' of solvent addition in small steps means less variation in print quality during a run |
| 3. Higher Profitability | • Savings in solvent and ink consumption (also record keeping of solvent consumption)due to frequent measurement and precise solvent dosing<br>• Reduced setup time means higher press utilization<br>• Precise color control reduces waste and rejects, leading to higher margins<br>• Increased color precision and uniformity enables operators to confidently take on more-demanding, higher value jobs with larger profit margins |

# How does InkSight help operators reach their goals?

| Future & Present Goals of Printers | How does InkSight help reach those goals? |
|---|---|
| 4. Sustainability | • Reduced wastage and setup scrap leads to lower environmental impact<br>• Precise, targeted solvent dosing<br>• Ability of the SRV viscometers to work reliably and repeatably *at low viscosities,* enabling a smooth transition to water-based inks for more environmentally sustainable operations |
| 5. Compliance | • Accurate dosing of solvents ensures minimal, precise amounts of solvents are consumed, leading to reduced emissions<br>• Less scrap, waste and rejects to dispose of |
| 6. Embrace, adopt and reap benefits of Industry 4.0 and Digitalization | • Brings automatic viscosity control up to the standards of today's and future highly automated presses<br>• Enables higher degree of integration of press instrumentation. Tight, frequent, autonomous viscosity control produces synergy with other automation features, such as online spectrophotometric analysis. Paves the way toward tighter integration of systems in tomorrow's printing machines |

# Future of printing: need for reliable **autonomy**

**Todd Luman, Interprint, comments on the accuracy and reliability of InkSight**

"The InkSight sensor held the viscosity over the duration of the entire order within **0.5 cP.** The other print stations that were not being controlled the operator had to chase the color and adjust the ink thorough out the run while the print unit the InkSight controller was in ran flawlessly. We were fortunate enough to be able to hold onto the sensor for several months to allow us the ability to run the gamut of our testing across our different product/ink segments. Time and time again the result were outstanding!"

INTERPRINT
A TOPPAN COMPANY

Todd Luman,
Laser Engraving Manager
Interprint, Inc.

# How does InkSight facilitate **automation goals**?

| Printers expectations from automation | How does InkSight facilitate? |
|---|---|
| Transferring skilled operator's expertise, knowhow and legacy into a robust, intelligent viscosity control system for sustained quality & reputation over decades. | • InkSight system can take the knowledge and skills of ink viscosity control experts and make them available, on demand, to future generations of operators.<br>• Advanced functionalities such as 'Save Job', 'Load Job' are used for print re-runs - these can be repeatably deployed over decades of the press operation. InkSight enables complete track and trace of every job! |
| Not just any viscosity automation, but there's a need for reliable viscosity automation technologies. | • Ease of use, no need to calibrate for every use as other systems require<br>• Temperature Compensation, Event tracking, Smooth print re-runs, Unparalleled accuracy of the sensor. |
| Full autonomy | • InkSight system supports seamless integration with machine and factory data systems ensuring full traceability for production and quality control.<br>• It monitors, logs and analyzes every aspect of the ink system, carrying out advanced analytics, self-diagnosis, forensics to spot potential problems before they happen. |

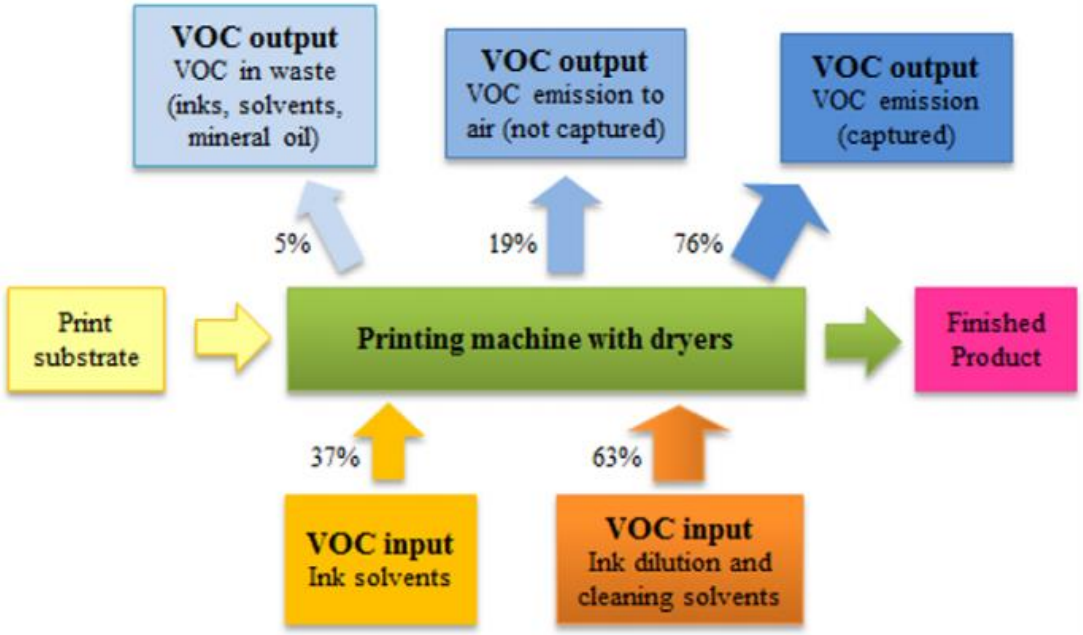
# Future of printing: Focus on the **environment**

**Roadmap of printing companies calls for safer, environment friendly, sustainable operations.**

1. Continuous improvement cycles to ***minimize solvent consumption*** in printing operations to reduce volatile organic compounds (VOCs) and air pollutants (HAPs)
2. ***Transitioning away from solvent-based inks to water-based inks***, since solvent-based inks contain high concentration of VOC and require higher energy in application(drying).

**Environmental hazards of VOCs and HAPs**

- Soil, air and water pollution
- Ozone layer depletion
- Negative health effects on exposure




**VOC input and output during the printing process**

**Source:** Environmental impact of printing inks and printing process, Journal of Graphic Engineering and Design, Volume 11 (2), 2020. http://doi.org/10.24867/JGED-2020-2-011

# How does InkSight facilitate these environmental goals?

| Environmental goal of printers | How does InkSight facilitate? |
|---|---|
| 1. Solvent consumption and emissions minimization | • InkSight ensures only minimal and extremely precise amounts of solvents are used up in ink viscosity adjustments, while maintaining high print quality. The software also keeps records of all solvent additions for to enable evaluation and optimization of solvent consumption patterns.<br>• Customers using InkSight have reported about 40% reduction in solvent consumtion and total emissions. |
| 2. Transitioning away from solvent-based to water-based inks | • The Rheonics SRV viscometers work reliably with all ink types: solvent-based, water-based inks, glues, metallic inks, UV inks etc. It works extremely well with water-based inks and gravure inks which is a major challenge for other competing viscosity measuring instruments.<br>• The SRV viscometers are accurate, reliable and repeatable even with very low viscosity inks. |

RPS
InkSight

SWISS MADE

rheonics

inline process
density and viscosity
monitoring

# CONTACT

**Rheonics GmbH**
Klosterstrasse. 19
8406 Winterthur Switzerland
Tel: +41 52 511 32 00

Website: https://rheonics.com
E-Mail: info@rheonics.com