LithoTack II

Lithographic Emulsification and Tack Analyzer

New benchmark in science and technology for the printing ink industry

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Content:

The new LithoTack II is two laboratory instruments in one. On the one hand the LithoTack is a simply to use precision tack measuring instrument on the other the LithoTack II determines water balance behavior of thin ink film under practice relevant conditions.

The LithoTack II is a pure tack measuring instrument like the AlphaTack Plus hardware has been upgraded for determination of the water balance relevant parameters such as:

- minimal water content for hydrophil surface cleaning and maximal water content for correct tack (water tolerance range)
- Interaction to hydrophil and hydrophobe surfaces (for example, hydrophil area cleaning up)
- Dynamics of water pickup and water release
- Tack as function of water content (includes a tack measurement of a dry ink)
- Quantification of free surface water and more
- Most importantly, the LithoTack II operating conditions such as speed, film thickness and temperature are similar to those found on a printing press. A test takes a few minutes – so you can characterize and optimize your products quickly, ideally for R&D and QC.

Note this brochure is focused only to the technical description of the water balance measuring functions of the LithoTack II. For detailed description of the basic instrument AlphaTack Plus please study brochure and watch video at:

http://www.novomatics.de/alphatackplus

Important questions which can be answered with LithoTack II quickly

- Is there a good interaction between fount and ink?
- How large is the water tolerance range for good print result?
- Does the change to ink B instead ink A or the change to fount Y instead fount X have an essential effect to the print quality?
- Is a bad cleaning up of the hydrophil surface more caused by the fount or more caused by the ink?
- What would be the better ink or the better fount for printing with less water?
- Can I print with less alcohol?
- Is there a higher tendency for free surface water?
- Is there a higher risk for scumming?

More can be answered with the **LithoTack II** on an early laboratory scale.
Modern sensing devices like micro wave water content sensor or high speed tack sensor are scanning the emulsion properties in roller nip – the exact position where an emulsion is created.

The instrument is addressed to R&D, QC and applications engineering. For example, customer's ink, plate and fount solution may be in same test – you may provide exact information regarding their combined water emulsification performance and so their printability. This qualifies the new LithoTack II to be a highly beneficial laboratory instrument regarding early cost savings and advanced customer loyalty.

1. Introduction

Many printing problems are associated with the ink/water balance on press. Ideally the fountain solution should keep non-image areas totally free from ink in order to obtain a clean print.

However, excessive ink/water emulsification can have a negative effect on ink properties causing loss of image sharpness and colour, reduced transfer, misting and poor setting. Good lithographic inks have a wide tolerance for these two extremes, the so called tolerance range of ink/water balance.

With a laboratory scale water balance test on open systems, real press conditions are difficult to simulate because important parameters such as water content and nip force profile have not been quantified and controlled sufficiently. The new LithoTack II measuring system offers a modern method for roller based ink/water balance tests that cannot only determine rheological properties such as tack and ink length, but also measures surface interactions with the hydrophilic and hydrophobic surface areas.

Further the LithoTack II determines the tack parameter of the dry and emulsified ink in the same test. This makes the method very efficient for controlling and optimizing the essential ink/fount solution properties on a laboratory scale.

1.1. Usual water content measurement of emulsified litho inks

Lithography is unique among printing methods in that it requires two diverse fluids – an oil- based printing ink and a water-based fountain solution to come into contact with each other.

The usual procedure in a pressroom is to let the printer correct ink and water feed control without appreciably changing the properties of either fluid. This interaction, referred to as the ink/water balance during a press run, represents the key to successful lithographic printing set points until he is satisfied with the quality of the final print. Laboratory tests to determine the water tolerance range of ink are very useful, particularly in print jobs with multicolour and metallic inks, which generally require very different water contents.

1.2. How does the LithoTack II determine water content of emulsion

Many laboratory test methods used to determine the water content of materials are not suitable for online measurements in a printing process. For example with infrared measurements only the water content at the surface can be determined, which may be different from the core water content of the material due to evaporation. Also strong dependencies on pigment type, film thickness and droplet size must be considered. As microwaves have a strong penetration into materials, this method is ideal for accurate and fast measurement of the core water content. Ideally this measurement is made within the roller nip - at the position where the ink/water emulsion is mainly created.

The LithoTack II is equipped with embedded microwave water content sensor. This sensor scans water profile of the nip in real time and so the instrument is be able determine surface on nip entry and emulsified water in the nip.

Figure 1 Microwave water content sensor embedded into brass roller

1.3. Simulation of real press conditions

Printability is generally defined as the ability of an ink/plate/substrate combination to produce high quality and quantity prints. Inks which cannot pickup any water are unsuitable for lithographic printing. On the other hand, ink dilution by water is also not desirable. The dampening system definitely has an effect on the quality of ink emulsification. In conventional damping systems large water droplets from the dampening system are thrown from the metal rollers and cannot form an ink/water emulsion. In a spraying system, small water droplets can instantly be picked up by the ink in order to form a stable ink/water micro emulsion leading to a higher degree in dot sharpness. Therefore the LithoTack tester is equipped with a spray system, that optionally can be extended with the option of a second nozzle in order to add specific chemicals to the fountain solution or to handle two different kinds of fountain solutions.

The LithoTack II can simulate real press conditions by spraying dampening and by letting emulsification take place in the nip between a hard and a soft roller, running at the same surface speed. The ink is compressed at the nip entrance, generating high shear forces in the ink, so that all water droplets are emulsified in the ink. At the nip exit the inner pressure attains negative values, so that some surface water may be found at the nip exit. Since the water content is measured directly within the roller nip the relevant of ink/water balance parameters are determined as function of water relevance with high accuracy.

1.4. Wetting of image areas on printing plates

Wetting can be defined as the spreading behaviour of a liquid when placed on a surface of a solid or another liquid. On a printing plate the image areas are made hydrophobic (water repellent) by surface treatment and non image areas are made hydrophilic (water-loving) in order to be covered with water instead of ink. Copper and brass are considered to be good for lithographic image areas and aluminium and chromium are very suitable for non image areas. Although wetting can be measured by contact angle measurement, it is not easy to determine wetting online under dynamic press conditions. The LithoTack II measures dynamic wetting optically using a high speed video camera and a stroboscope, providing a stable image of the wetting of a hydrophilic area on the roller surface. The cleaning parameter is measured by the ratio between the clean and covered hydrophil area, which is calculated by the application software.

Figure 2 Hydrophil surface spot embedded into brass roller

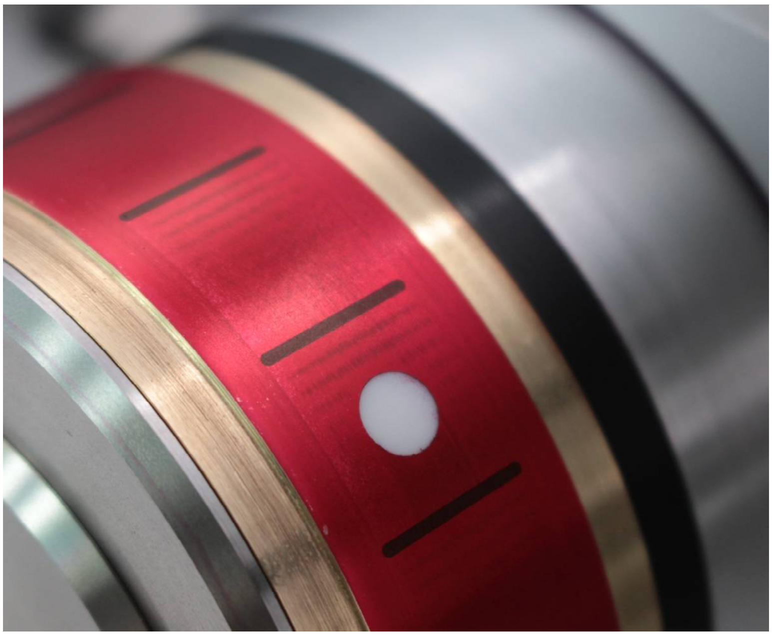

Figure 3 Cleaned hydrophil surface spot

1.5. Printability tests

It is well known that there is a relationship between press performance and physical properties of inks and fountain solutions. Viscosity mainly influences the ink transfer on a press but not printability. Printability is mainly dependent on surface adhesion of fountain solutions and ink tack. Therefore it is essential to perform tack measurements on lithographic inks under various conditions with different types of fountain solutions and at various speeds, temperatures and line forces.

Experimentation is needed to establish a full understanding of the events on a lithographic printing press. The LithoTack provides extensive computer support to perform such tests and to store and retrieve the test results.

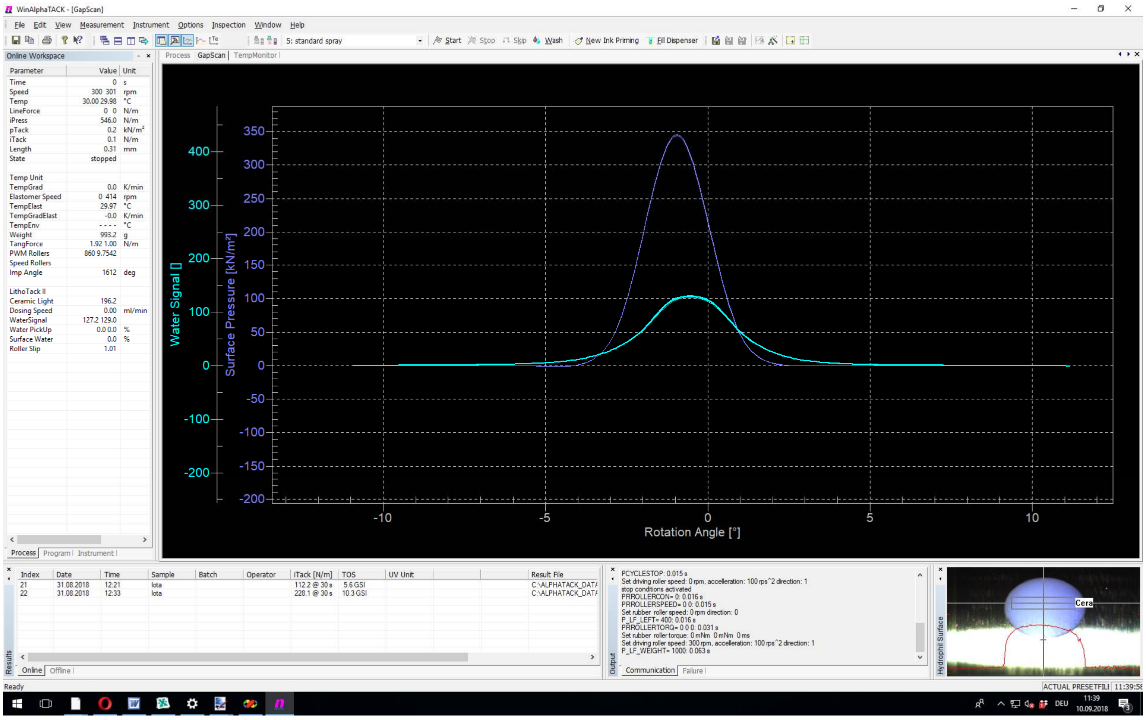

Figure 4 Modern Windows software for user friendly operation and easy data evaluation. The camera picture in the right corner down indicates a blank hydrophilic surface area.

2. Principle of operation and standard test method

An ink weight of 40 mg is placed on roller surface leading to a film thickness of approx. 5 µm. The test is started. After speed setting and equalized ink distribution the initial tack is measured.

Then the LithoTack initializes a series of "water shocks". The spray dampening unit transfers fount solution at a higher pre-defined rate for a short time. As a response the LithoTack determines and records the significant ink/water balance parameters like tack, water content, excessive surface water and roller slip.

Further at every roller turn a picture of hydrophil area is taken by the camera, displayed on screen and recorded in an explicit movie file. The software processes the picture and calculates the coverage of ink on the hydrophil surface for cleaning determination.

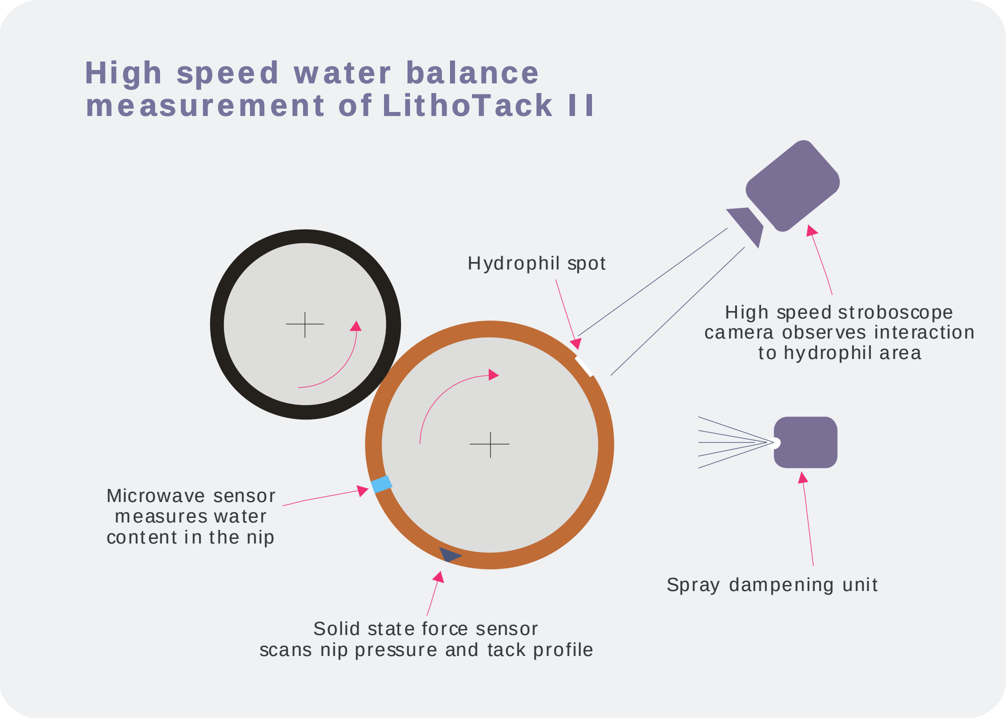

Figure 5 – Principle of high speed water balance measurement

The water shock series is followed by a final water cycle. Starting at a lower water transfer speed but applied for longer time the response of emulsion under continuous water presence is determined. Properties like cleaning point (amount of water needed for cleaning), maximal water pickup and behavior by at over-emulsification (change from water-in-ink to ink-water-emulsion) are determined.

This standard test takes just 2.5 minutes. Because of quick cleaning and ink preparation provides an opportunity for - 8-10 tests/hour can be easily performed.

2.1. Relevant parameter for water balance and measurement examples

2.1.1. Cleaning performance determined by ceramic light

The Ceramic Light parameter represents all light reflected and scattered on hydrophil ceramic spot. When the ink has no water emulsified the hydrophil ceramic spot is covered by the ink. Later during spraying the hydrophil ceramic spot is cleaned if a certain amount of free water is available. The amount of water needed for cleaning is a property of the ink but also of the water itself (fount solution).

A quick and complete cleaning at lower water content is a usually desired property of the ink emulsion. Examples below are demonstrating strong differences. When to much water is needed for keeping the hydrophil area free of ink printing problems like color density or drying may occur.

The LithoTack II software records the picture taken by camera as a movie. That movie can be watched either with a standard window movie player or used result evaluation.

For visualization load at least one result into diagram. Set the cursor of the measuring point of interest. The corresponding picture of that time is displayed. The cursor can be moved now by using right and left arrow keys on keyboard.

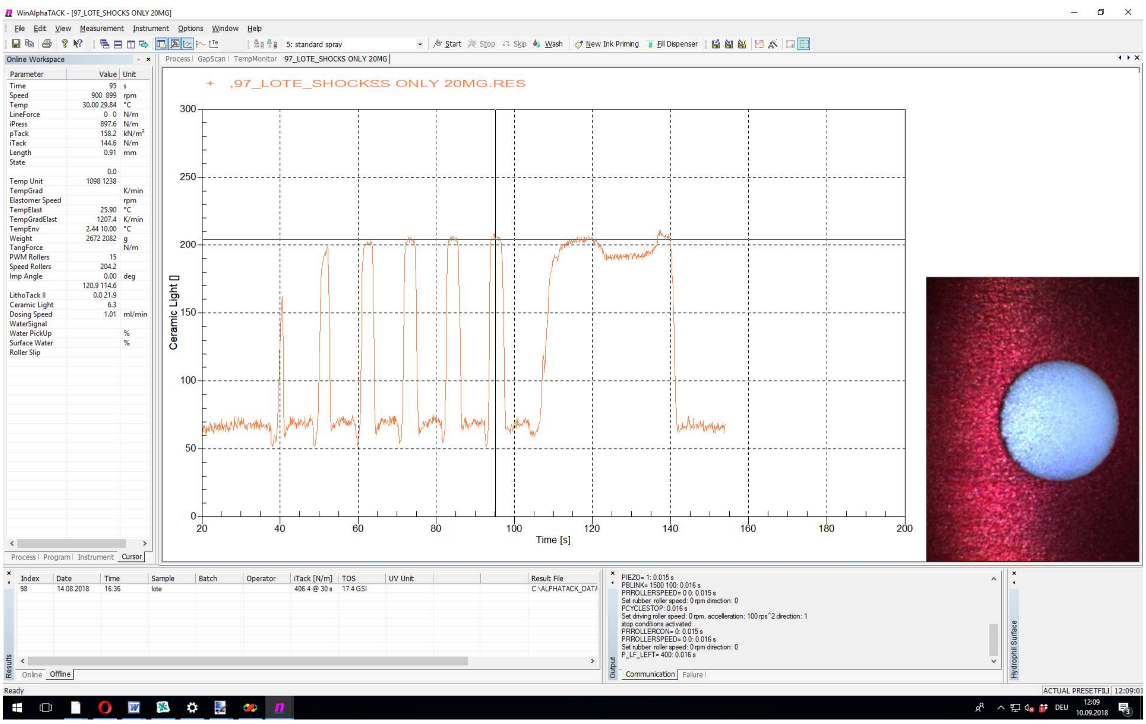

Figure 6 Good and instant cleaning of hydrophil area

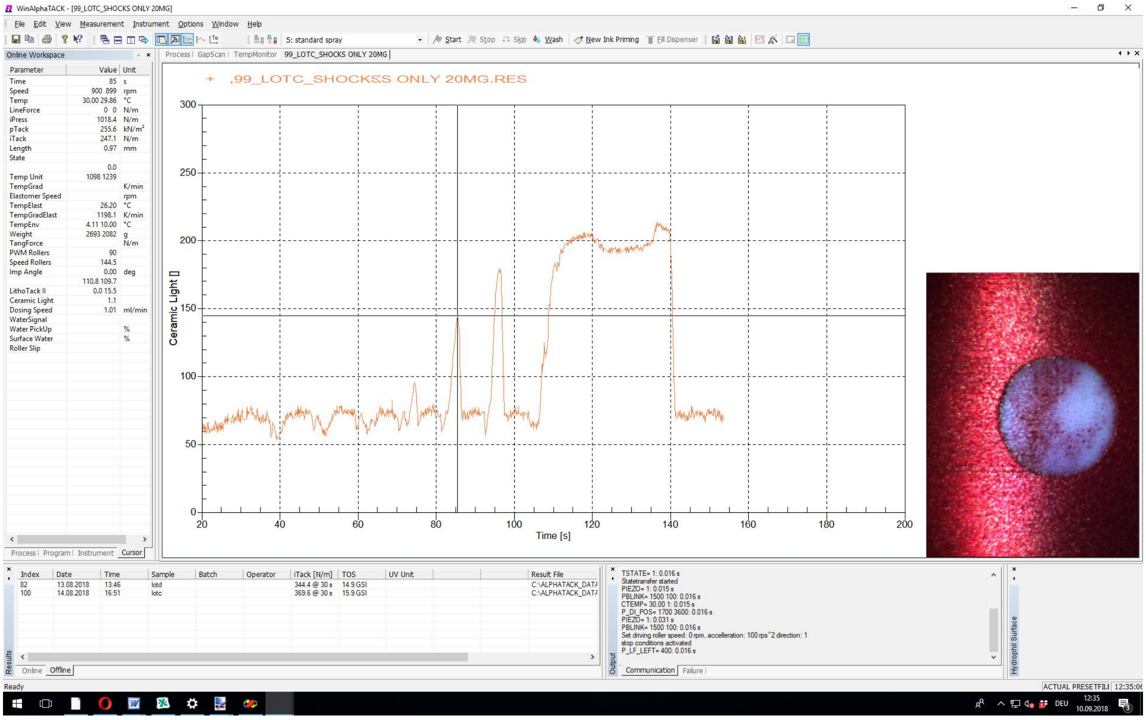

Figure 7 Late cleaning under problems

2.1.2. Water Pick Up [%]

Indicates the amount of water related to the ink. One hundred percent means the same weight of ink and water is present on rollers (equivalent to 50 % water content). The water pick up is determined in the middle of the roller nip, the place where the emulsion is created. Free water in front of the nip is not considered.

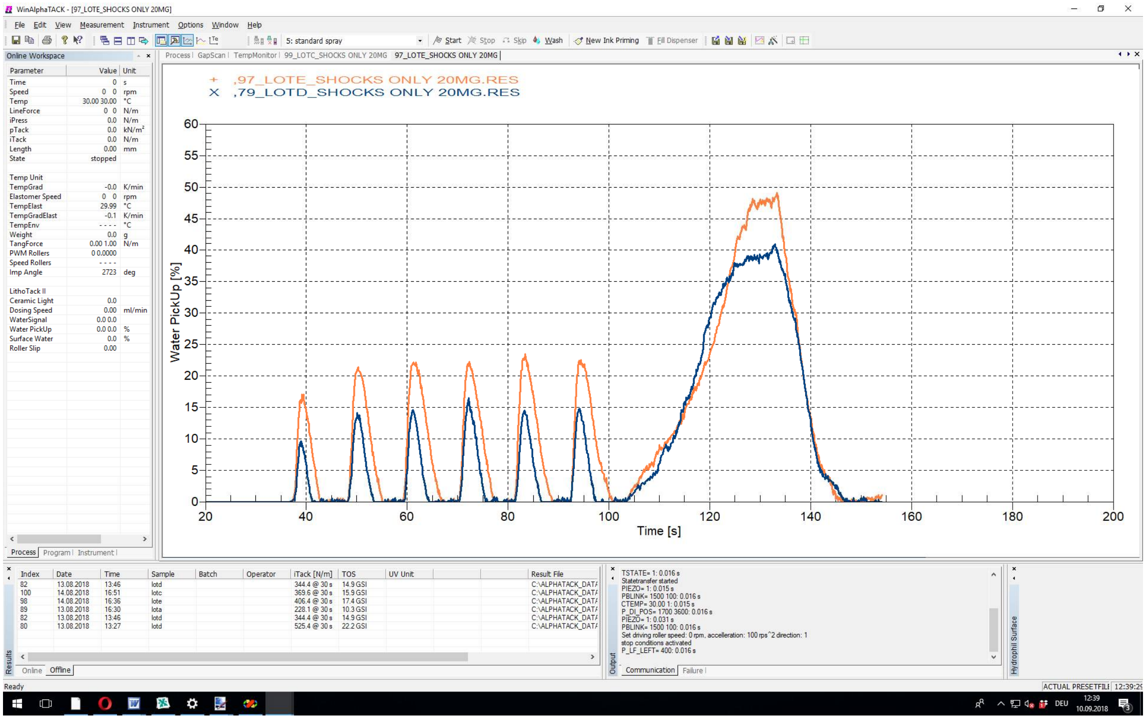

Figure 8 Differences in water pick up, ink 97 uptakes much more water than ink 79

2.1.3. Integral Tack [N/m]

The integral tack denotes the complete vertical force that is needed to split the ink film after leaving the nip. The integral tack is expressed in relation to roller length. It is the force moving apart inks covered measurement and elastomer under the applied conditions.

The integral tack is a property of a ink but also strongly related to the amount of emulsified water. As the film splitting is along the weakest volume parts in the emulsion the splitting is within the water droplets. The integral tack of emulsion is based on the integral tack of the “dry ink” but than mainly up from droplet size and density of emulsified water.

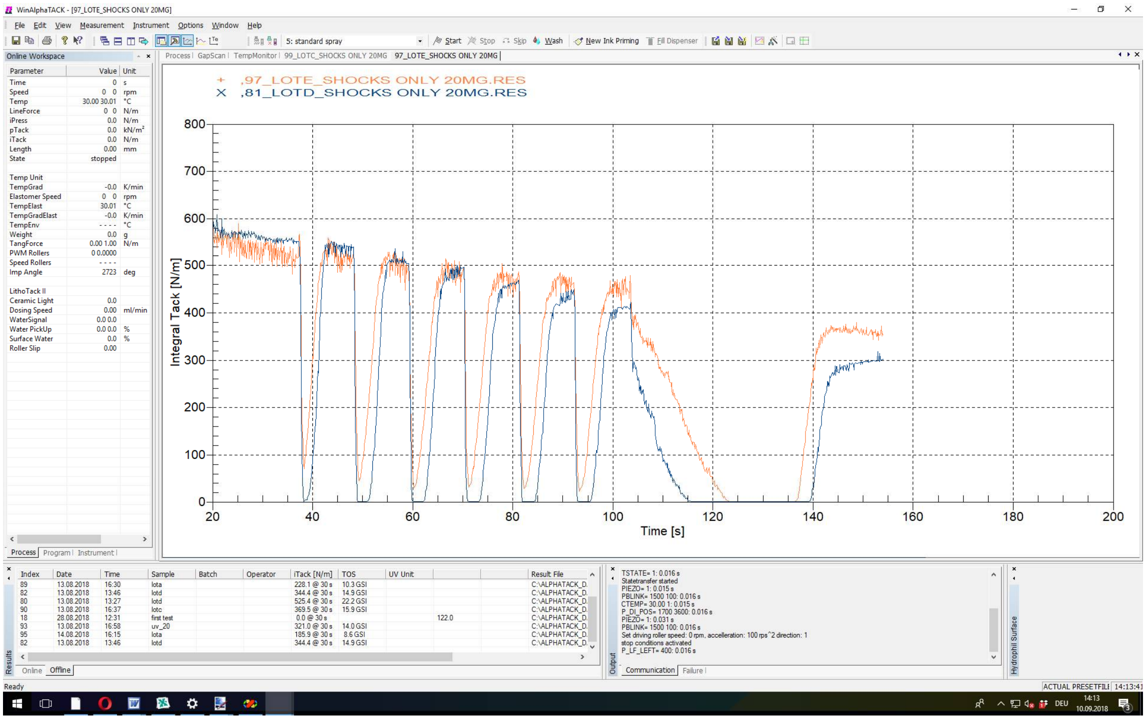

Figure 9 Different tack development during water shocks and cycle, ink 97 is essentially more stable unlike ink 81 under presence of water

2.1.4. Roller Slip []

Indicates the relative difference between rubber and metal roller in speed. During water tests both rollers are driven but the rubber roller with slightly reduced speed. This causes tangential forces in the roller nip. But nevertheless as long as the contact between rubber and metal roller is high enough both rollers are moving with same surface speed.

When water is transferred and emulsion is created the contact between rubber and metal can be weakened resulting in a roller slip.

The roller slip parameter is an indication of the change in viscosity of the emulsion under test.

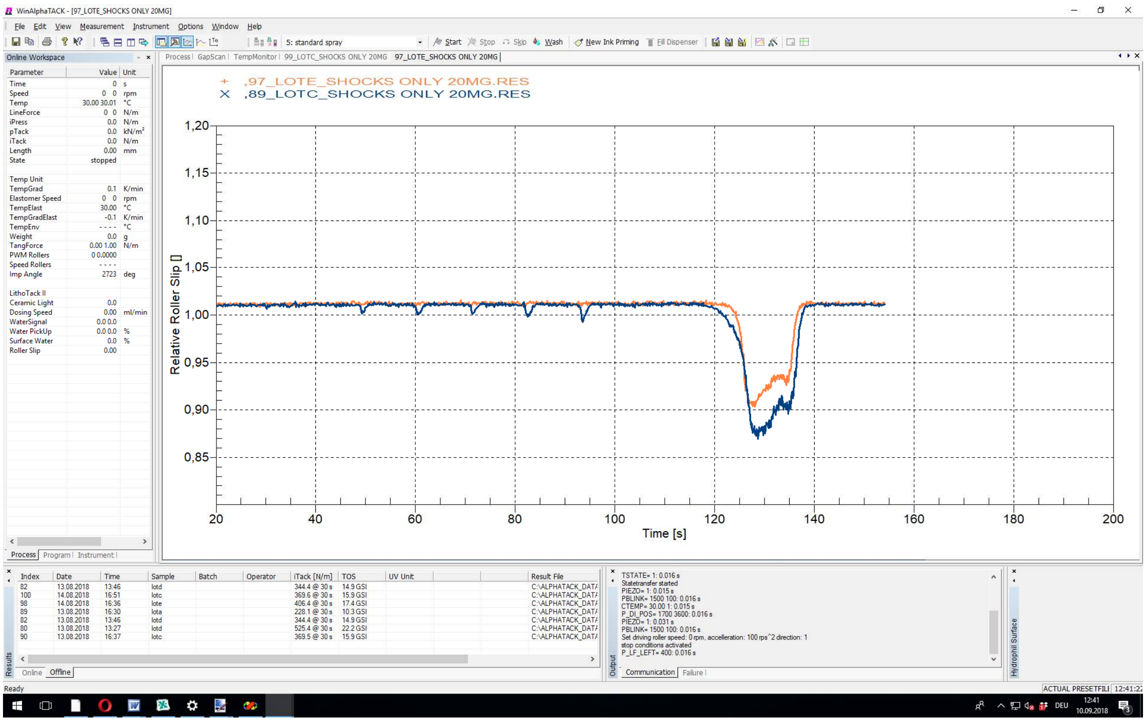

Figure **10** Different viscosity development during water shocks and cycle, ink 97 is essentially more stable unlike ink 89 under presence of water

2.1.5. Excessive Surface water [%]

Indicates the difference of water between front of nip and within the nip. When there is more water in front than in the nip that parameter is larger than zero.

Usually it takes a certain time till the water transferred to the rollers is taken up by the ink or emulsion. Meanwhile the water is buffered in front of the nip. As higher the excessive surface water is the longer the time the ink needs emulsifying water under applied conditions (water pick up speed).

From experience it is known that emulsions with higher levels in excessive surface water have a higher tendency for scrumming – an undesired property of emulsion.

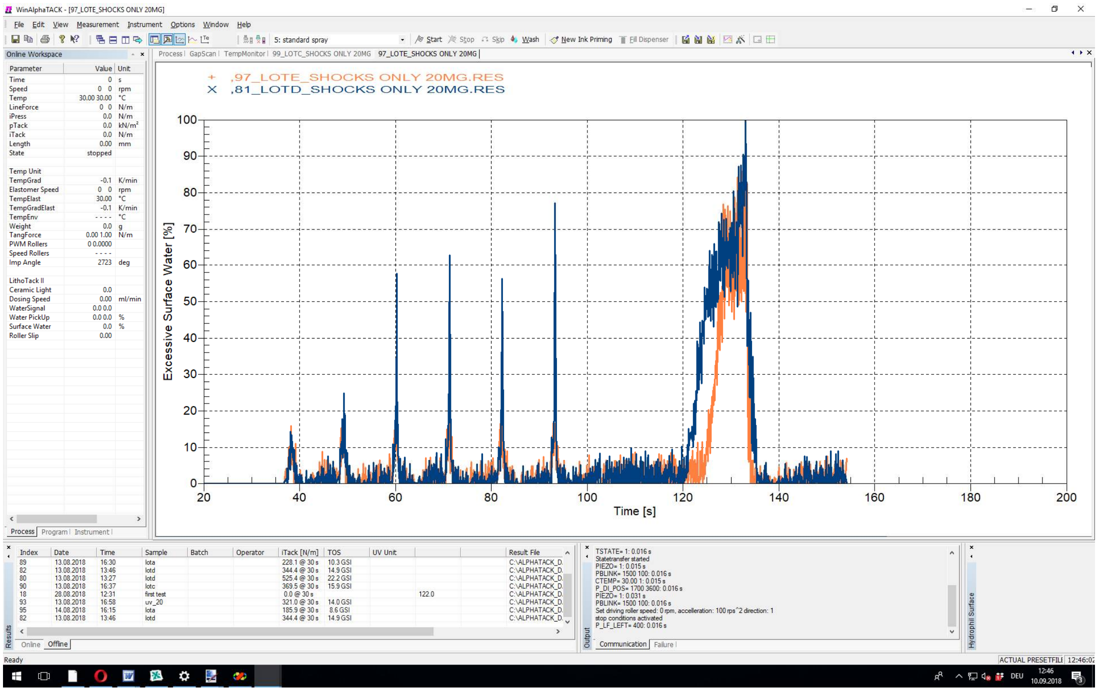

Figure 11 Different amount of excessive surface water during water shocks and cycle, ink 97 shows nearly no surface water when “shocked” compared to ink 89

3. Appendix

4. Importance of water content measurement

During spraying or a similar dispension method to an ink film the water droplets pass in several ways

- Not all the water droplets arrive the fast running roller surface and are evaporating in air environment
- Droplets which are in first contact with ink film are not emulsified instantly
- Droplets are usually collected in front of the roller nip
- Since the dynamic pressure situation in a roller nip the droplets are passing the nip ideally embedded into the in ink film layer
- Water is evaporating permanently and because of the large surface it can be out within a few seconds

The **technical solution**: Measuring the water content in the roller nip, the exact place where the ink-fount emulsion is created.

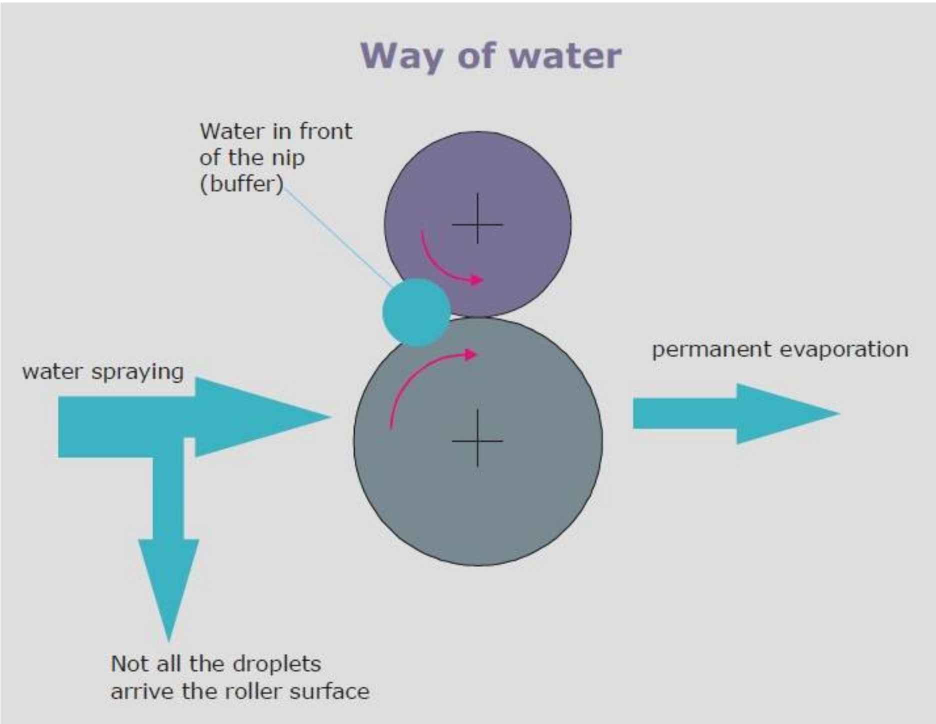

Figure 12 Way of water during a LithoTack II spray cycle

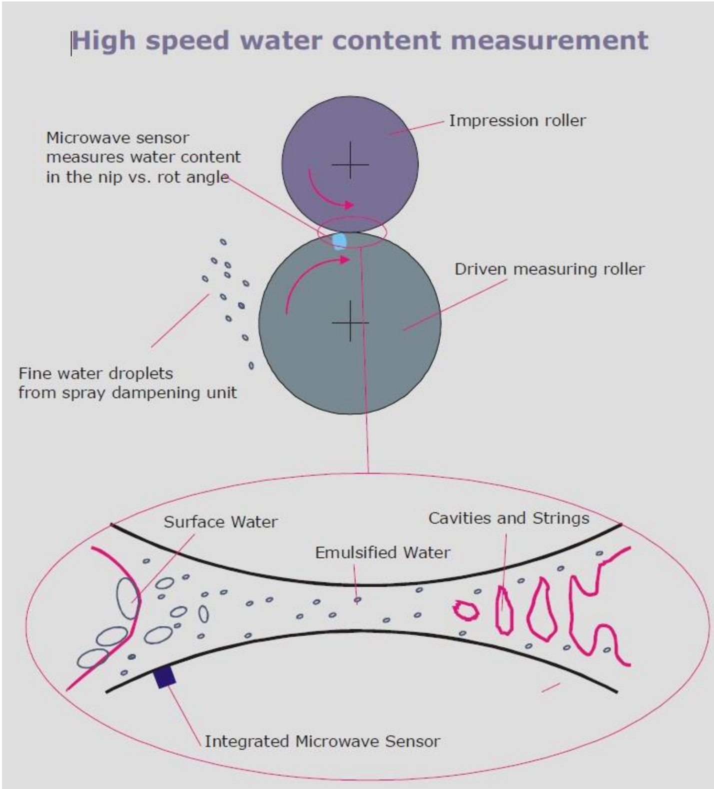

Figure 123 Schematic cross section of nip with emulsion under test

4.1. Tack measurement of Emulsion

The higher the water content the lower the forces are needed for splitting the ink film on the nip outlet. Statistically splitting happens into the water droplets, the volume parts of nearly no tack. At a certain water level the tack is reduced approx. to zero, the ink transfer is stopped at the latest, the emulsion is saturated and the definitive end of printability range is achieved.

4.2. Surface interaction of emulsion

A minimum of free available water has to be present for cleaning a hydrophil surface (non-image area). The exact amount of water is up from ink, fount solution and hydrophil surface.

4.3. Principle of operation

The interaction between microwaves and water is based on the principle that the water molecules are strong dipoles and they re-orientate when an electric field is applied on them. Their orientation alternates with the frequency of the applied electric field. At low frequencies the water dipoles instantly follow the electric field. But at higher frequencies their orientation lags behind the applied electric field (inertia effect). The angle difference between field and orientation is called tan (δ) (similar to rheology). The higher the tan (δ) the more microwave energy is converted to thermal energy. The LithoTack II microwave sensor transmits the microwave to the ink film and measures the reflected wave part. The higher the water content the smaller the value of the reflected wave part. The microwave sensor is seamlessly embedded into measuring roller and doesn't affect the ink film flow.

5. Water dielectrics and the microwave sensor

The interaction between microwaves and water is based on the principle that the water molecules are strong dipoles and they re-orientate when an electric field is applied on them. Their orientation alternates with the frequency of the applied electric field.

At low frequencies the water dipoles instantly follow the electric field. But at higher frequencies their orientation lags behind the applied electric field (inertia effect). The angle difference between field and orientation is called tan (δ) (similar to rheology). The higher the tan (δ) the more microwave energy is converted to thermal energy.

The LithoTack water content sensor uses this principle. It operates at 9.35 GHz near to the maximal dielectric loss of water molecules at 20 GHz (25℃). the more water that is present on the roller surface the lower the reflected microwave signal.

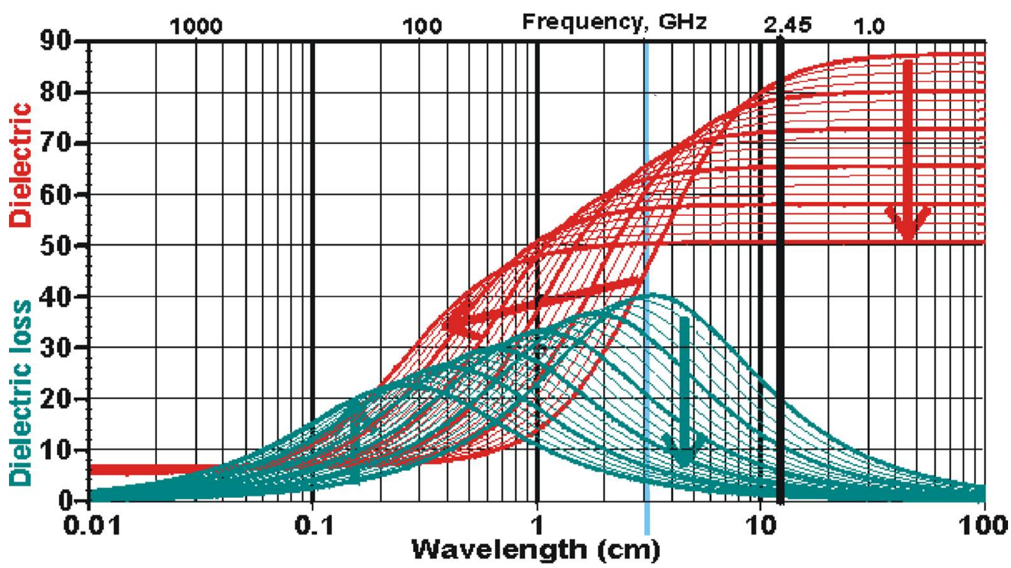

Figure 14 Dielectric permittivity and dielectric loss of water between 0℃ and 100℃, the arrows showing the effect of increasing temperature, the blue line indicates the operation point of the LithoTack sensor

The LithoTack microwave sensor operates in reflection mode. It compares the emitted wave with the received wave from roller surface when the sensor passes the roller nip. After signal amplification and linearization the sensor outputs the amount of water present on roller surface.

Water content measurements could be theoretically made at lower frequencies but the ion- conductivity of water, solved and surrounded compounds may essentially affect the measurement results.

1 Martin Chaplin, "Water dielectric and microwave radiation", London South Bank University, 2004

6. Technical Specification

Full automated lithographic emulsification and tack measuring system comprising the following two main items.

6.1. AlphaTack Plus

High precision, operator independent, tack measuring instrument. Refer to brochure of AlphaTack Plus.

6.2. Water balance unit

2.2.1. Spray dampening unit

binary nozzle spray unit
precision piston pump,
chemically inert

Dampening rates:	0,5 to 2 ml/min
Air entrance pressure:	3 to 8 Bar

2.2.2. Water content measurement

Equivalent water film thickness:	0 to 20 µm
Resolution:	50 nm
Accuracy:	1 % of measurement range
Sensing principle:	based on de-polarization loss of water dipole molecules, operates in reflection mode
Operation frequency:	9.35 GHz
Radiation power2:	1 mW
Calibration:	factory calibrated, auto-zeroing

2.2.3. Hydrophilic Area Blanking Detection

Sensing Principle:	A position-triggered high speed camera sends a surface photo to WinLithoTACK software for instant image processing
Exposure time:	10 µs

Software extension with different picture procession functions for simultaneous evaluation of standard ceramic hydrophil surface, modular instrument conception

2.2.4. Power supply

Operation voltage	100 - 250 V, 50 – 60 Hz
Power consumption	< 200 VA

2.2.5. Dimensions and weight

L x W x H	36 x 45 x 29 ccm
Weight	22 kgs

2.2.6. Computer

Interface to AlphaTackPlus	2 x USB 2.0
Operating system	Win 10
Software	WinLithoTACK provided with the measuring system

7. Contacting Novomatics

Please don't hesitate to contact your local distributor or Novomatics for any further information.

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