Masterclass Hands-on Lab Course in Pretreatment

Advanced Course

1. COURSE DETAILS

Date:	February 25 - February 27, 2019
Location:	at iPrint in Marly, Switzerland
Participation Fee:	EUR 1,850
Registration Deadline:	January 13, 2019
Masterclass Registration:	iprint.center/education

2. TWO-DAY PROGRAM

In this course, we cover all aspects of pretreatment relevant to inkjet printing. We will review surface tension and surface energy measurement, primers, plasma, corona and flame treatment.

3. ADMISSION REQUIREMENTS

The course is open to all participants who have:

- completed the foundation course in inkjet engineering and inkjet chemistry at the iPrint Institute and/or
- basic understanding of post-treatment

4. BACKGROUND

For inkjet printing, a key parameter for the wetting is the substrate surface energy rather than its roughness. Pretreatments are the methods to increase the wetting of inks on substrates by changing the surface energy of the substrate before printing. Common pretreatment methods are flame, plasma and corona. Additionally, primers are used to control the absorbance of inks or change the surface energy of a substrate. There is no universal pretreatment method.

Wetting depends on the molecular interaction between the ink and the substrate. The surface energy characterizes this interaction. An ink will wet a surface that has equal or higher surface tension than itself. If the surface energy of the substrate is higher than the ink, then the ink wet the substrate forming a film. If the substrate surface energy is lower than the one of the ink, then the ink will be repelled from the substrate. The surface energy is split in polar and non-polar component. Both are needed to define the wetting envelope.

Surface energy can be approximated using test inks with defined surface tensions. However, this measurement method does not give any indication on the polar and nonpolar portions of the inks. In consequence ink with the same surface tension can wet a substrate differently. Therefore, it is better to use a measurement method such as sessile drop which gives both polar and nonpolar values.

Often, contaminants such as grease, dust or solvent are present on the substrate surface, those contaminants affect the surface energy and can decrease wettability.

5. ADVANCED PRETREATMENT

Plasma is the ionized form of a gas. It contains charged particles such as ions, electrons or free radicals. Therefore, it has more electrical conductivity and chemical reactivity. Different pretreatment methods use plasma: low pressure plasma, plasma at atmospheric pressure and corona. They differ in the way the plasma is generated. Plasma can be used for the removal of organic contaminants, or for surface activation and modification. Typical times for cleaning and activation are as short as 5 seconds for atmospheric plasma and less than a minute for low pressure plasma.

In atmospheric plasma, the dioxygen becomes a mixture of oxygen ions, ozone. On an organic surface, carbonyl, carboxyl or hydroxyl groups will be formed by the action of plasma. Those groups will act as bonding points with the inks, therefore increase the wetting and adhesion.

Low pressure plasma, refers to plasma formed at pressure of 10 mbar or lower. At this pressure, plasma can be generated and maintained with less electrical energy than atmospheric pressure. The amount of gas required for a low pressure plasma system is low, typically in the range of a few hundred ml/min gas flow. The reason is that the gases expand hundred times in vacuum. Different gases can be used to generate plasma such as oxygen, nitrogen or argon. With more free path for the plasma, vacuum plasma is well suited for the treatment of three dimensional parts.

For atmospheric plasma, the distance between the plasma generator and the substrate should be as small as possible. Otherwise, the concentration of reactive species becomes insufficient as they collide with non-excited molecules in the air. Flame treatment is a plasma formed by the combustion of a flammable gas such as propane in air. Typical temperatures of 1000 °C are reached. As plasma, flame treatment can be used to remove contaminants or surface activation.

Corona, flame and atmospheric plasma are used for continuous treatment of films and foils. The gases generated contain hazardous substances such as ozone and nitrous oxide that should be extracted and treated. Corona units are constituted of two electrodes with a small gap between them. An electric potential in the order of 1 kV/mm is applied between the electrodes generating electric arcs of plasma.

Plasma is hot medium, therefore sensible substrate such as paper or plastic foil should not be exposed for too long.

6. GILBERT GUGLER

The Masterclass will be led by Gilbert Gugler and representatives from equipment providers.

Gilbert Gugler graduated in Material Science from ETH Zurich. He has over 25 years' experience in coating and process related topics. He is an expert in multilayer curtain coating technology and toll coating technologies, starting from preparation of coating fluids, characterization, to processing and drying.