



Air humidity in the printing industry

Control of ambient conditions for quality printing and no machinery stoppage

CAREL Industries S.p.A

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Topics

1. A brief insight into CAREL Industries S.p.A
2. Introduction to printing processes
3. Why humidity matters?
4. Solutions for humidity control
5. Conclusions



1. CAREL Industries S.p.A



| mission

We lead the evolution of **control technology** and **humidification** for air conditioning and refrigeration.

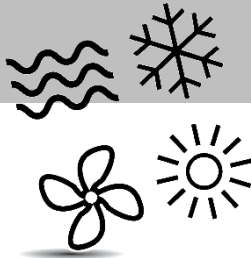
Our products support **customers** with the most **efficient energy savings** solutions.

Data-driven services through our **IoT platform** grant personalised value.



Our key strategies

We are **specialists** in **HVAC** and **Refrigeration**



We operate **globally** with the same **world-class** manufacturing standards



We want to **be close** to the customers for a **better** understanding of **their needs**



We continuously **improve** our operating performances



We **innovate** to achieve higher **energy saving**



We offer **integrated** solutions for **vertical** applications



2. Introduction to printing processes



Printing methods

Paper is mainly composed of cellulose, which is highly hygroscopic

Paper is highly affected by air temperature and relative humidity.

Ink receptivity

Ability to accept and stabilise the ink received

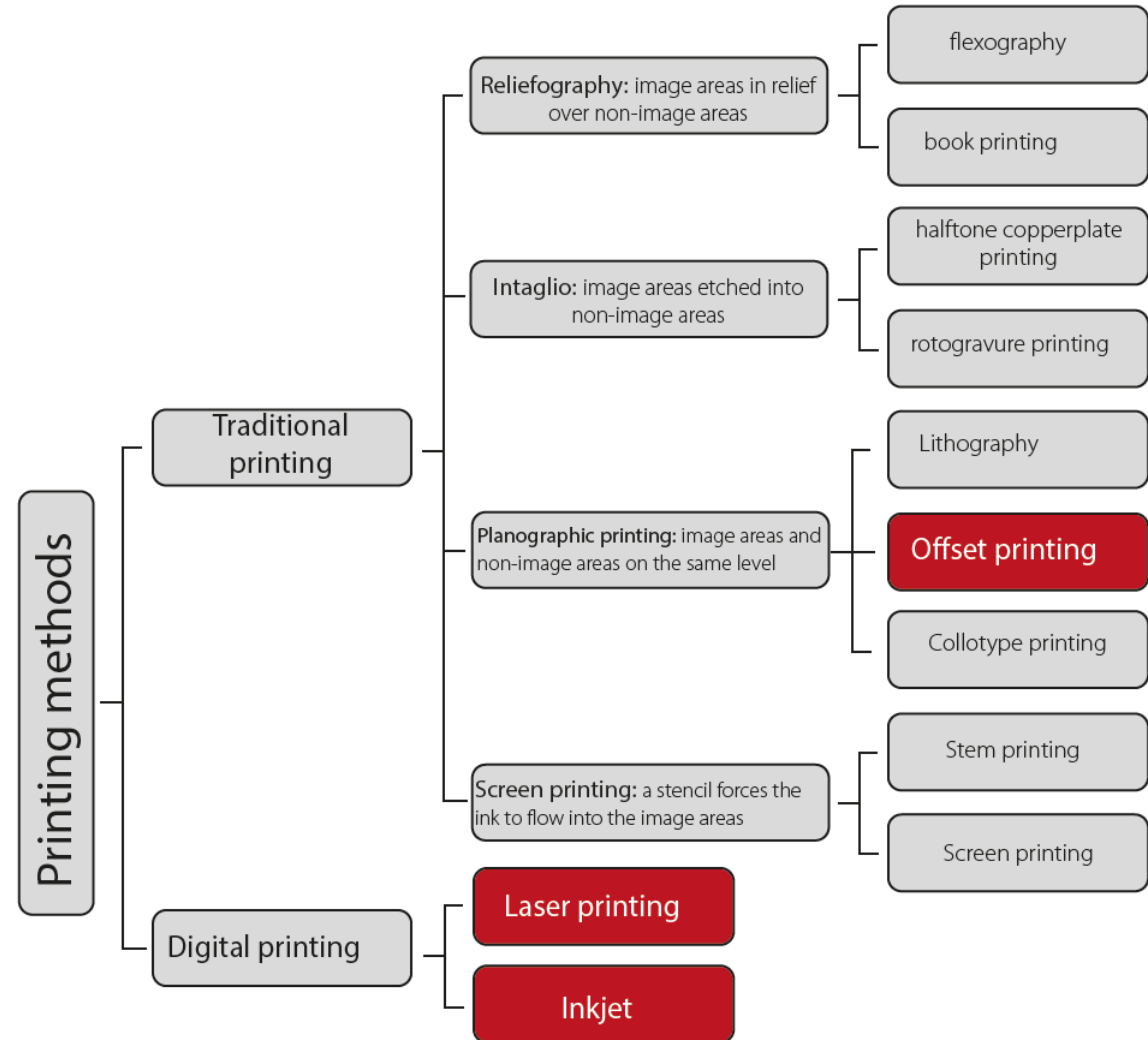
Runnability

Easy workable due to proper mechanical-physical characteristics

Printability

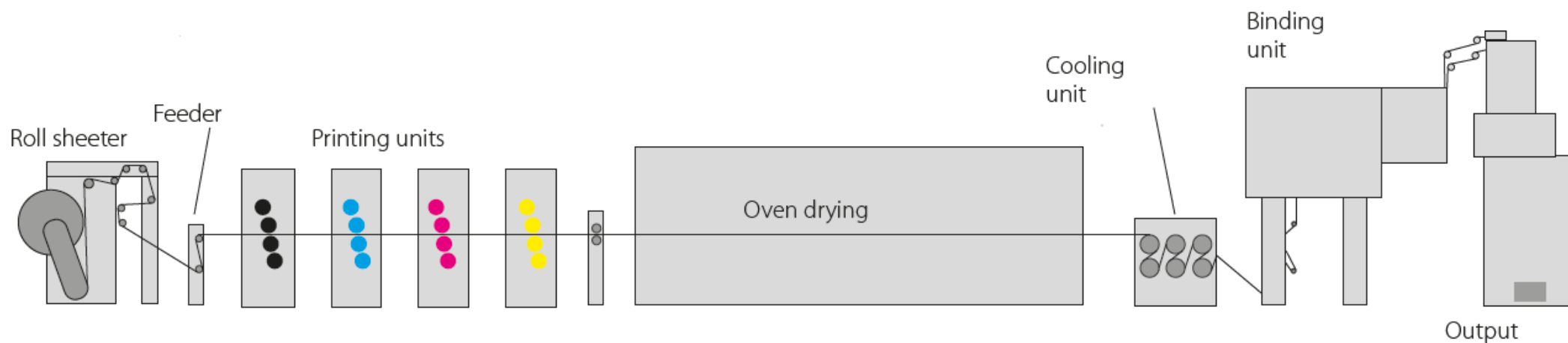
Ability to reproduce the original image

5-8% moisture content of paper is the right one

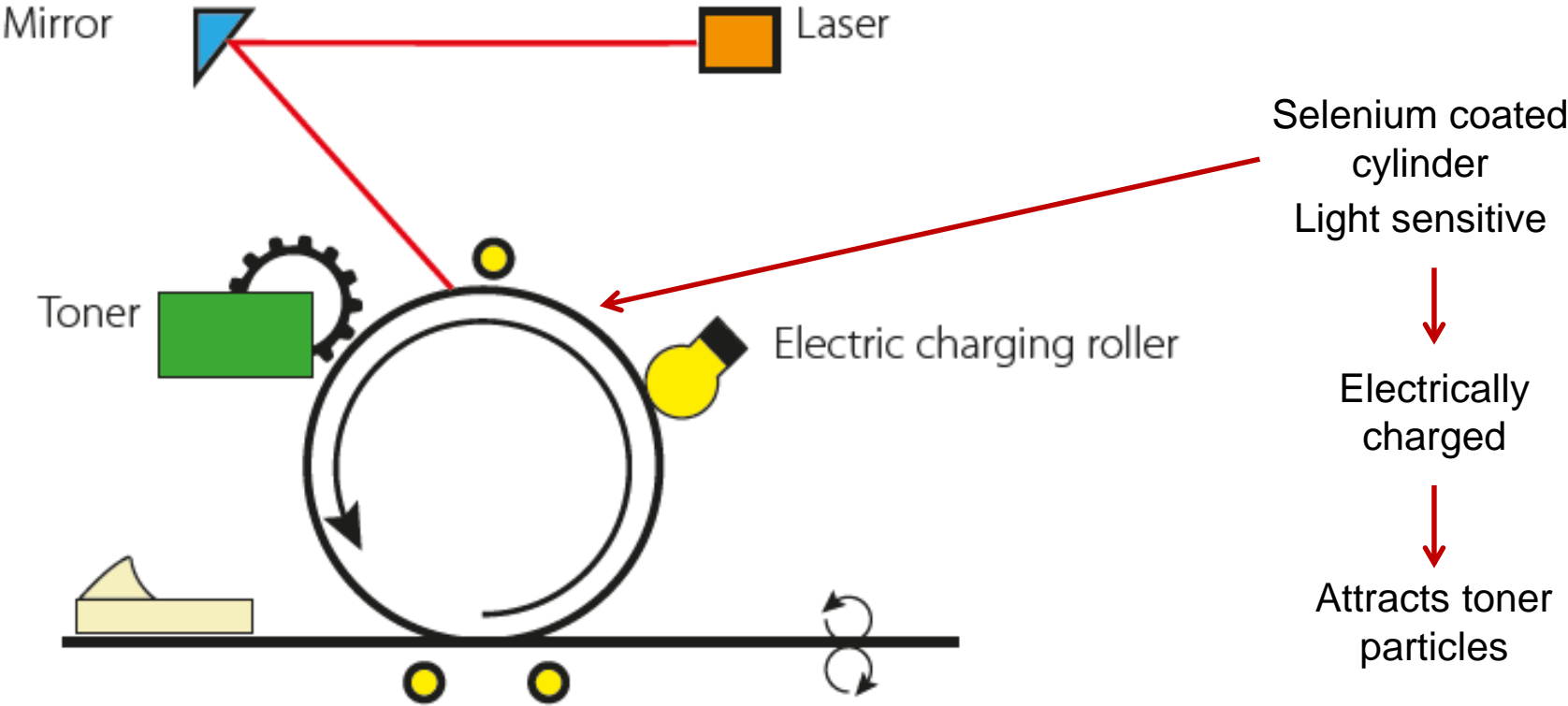


Offset printing

- Most widely used method, accounting for around 50% of printing around the world
- Low cost for > 10000 copies
- High speed
- Good quality

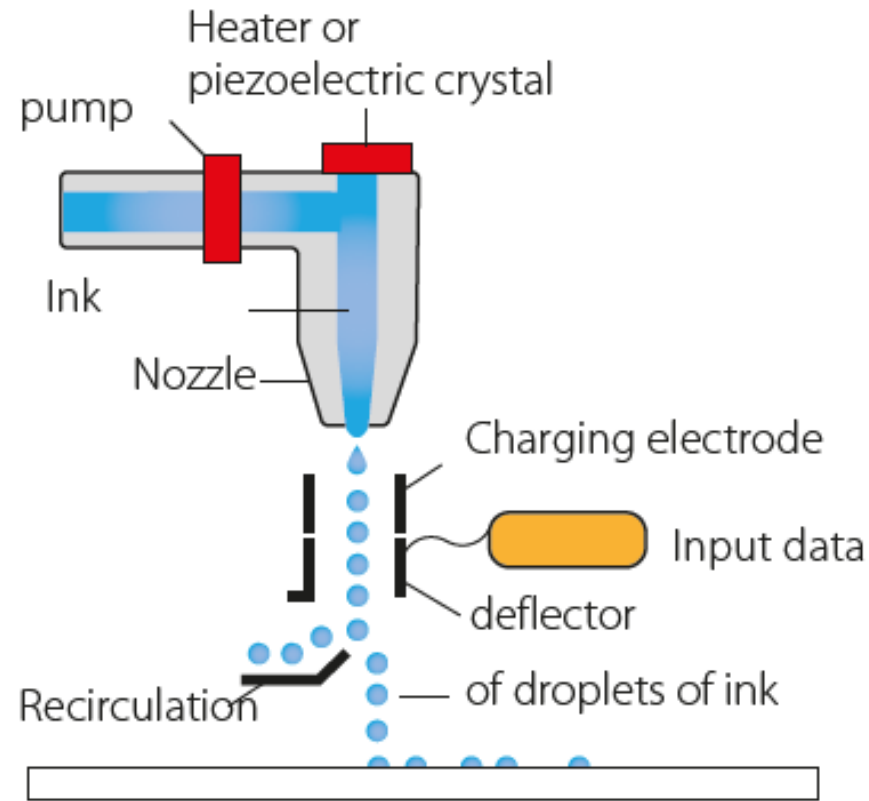


Digital laser printing



Digital inkjet printing

In inkjet technology, tiny droplets of ink are sprayed directly onto the substrate.



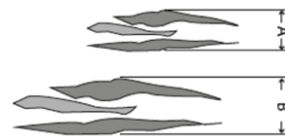
3. Why humidity matters?



Why humidity matters?

Paper runnability \longleftrightarrow Dimensional stability and ESD

- Dimensional variations

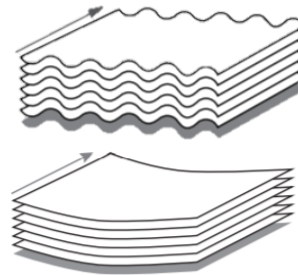


$$\Delta RH_{\text{room}} = 10\% \rightarrow \Delta L = 0.1 - 0.2 \%$$

- Machine stoppages

- Loss of flatness

Incorrect paper feed
Wrinkles
Creases
Tears



$$RH_{\text{room}} > RH_{\text{paper}}$$



$$RH_{\text{room}} < RH_{\text{paper}}$$



- ESD (Electrostatic discharges)

Paper jam
Printing defects (setoff)
Dangerous with flammable ink solvents

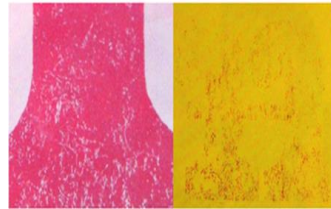


Print Defects

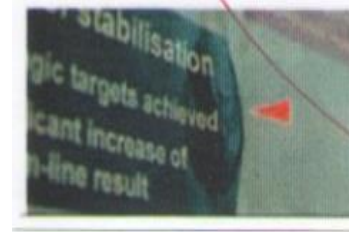
- **Misregister**
Causes: Loss of flatness, dimensional variations



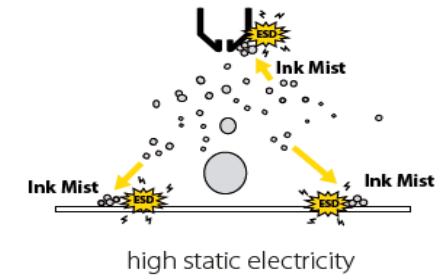
- **Blocking (setoff)**
Causes: Abnormal adhesion of printed sheets



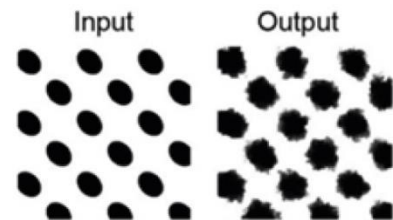
- **Blistering**
Causes: High rH, insufficient coating porosity



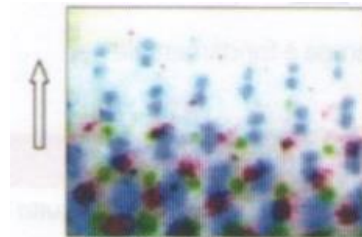
- **Ink Mist**
Causes: Static electricity



- **Dot gain**
Causes: High relative humidity



- **Doubling**
Causes: Dry environment



- **Cover brackage**
Causes: High T, low rH



Print Defects

	Offset printing	Laser printing	Inkjet printing
Misregister	X		
Dot gain	X		X
Setoff	X	X	X
Doubling	X		
Blistering	X		
Cover breakage	X	X	X
Ink Mist		X	X



4. Solutions for humidity control



Humidity control systems

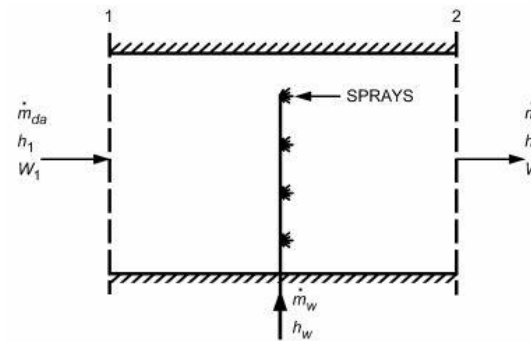
Feedwater treatment system
(not always mandatory)

Humidifier

Distribution system

DUCT HUMIDIFICATION

The boundary conditions are only related to the HVAC system

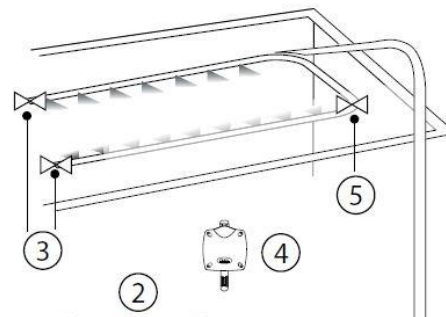


ISOTHERMAL

ADIABATIC

DIRECT HUMIDIFICATION

The boundary conditions are related to the HVAC system, application, workers, machines, natural airflow, doors and gates



Humidity control systems

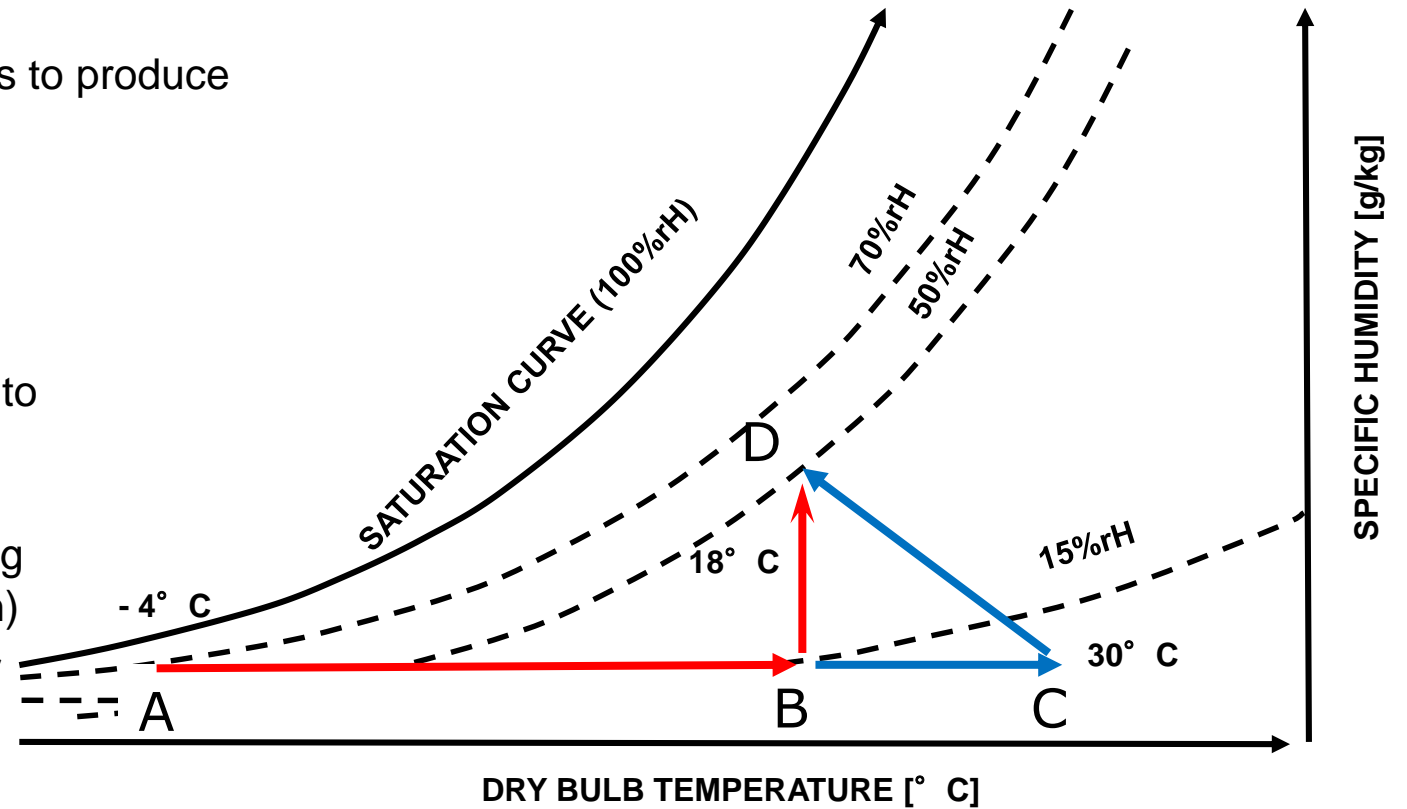
Humidifier types: psychrometric chart

ISOTHERMAL H. (ABD):

- The goal of isothermal humidifiers is to produce steam
- temperature is almost constant

ADIABATIC H. (ACD):

- The goal of adiabatic humidifiers is to produce tiny water droplets
- temperature decreases because sprayed water evaporates absorbing heat from the air: about 686W/(kg/h)
- Evaporative cooling during summer



Humidity control systems

Isothermal or adiabatic?

It depends on the scenario! It is always a trade off between:

- Hygiene
- Capacity
- Power consumption
- Free space
- Type of water



5. Conclusions



Conclusions

- Temperature and relative humidity must be controlled to ensure an efficient process
- Changes in relative humidity can cause dimensional variations and loss of flatness



Misregistered reproductions, printing defects and machines stoppages

- A humidification system that keeps the relative humidity at 55-60%(offset printing) and 50-55%(digital printing) brings significant savings and increased productivity
- Adiabatic humidification partially contrast the internal heating loads due to the evaporative cooling effect.
- A professional support is necessary from the beginning to correctly choose and size the most suitable humidification system





Thank you!

