HACKTEX VIRTUAL TRAINING MATERIALS
ADVANCED TEXTILES MANUFACTURING INDUSTRY
Learning Unit 3 Technologies for functional and smart textiles
Lesson 2

Resource efficient textile processes for functional and smart textiles: digital printing and spray technology

Razieh Hashemi Sanatgar / University of Borås

Co-funded by the European Union

Innovative smart textiles & entrepreneurship / 2021-1-RO01-KA220-HED-000027527

HACKTEX

RESOURCE EFFICIENT TEXTILE PROCESSES FOR FUNCTIONAL AND SMART TEXTILES: DIGITAL PRINTING AND SPRAY TECHNOLOGY

LU3.2

Co-funded by the European Union

HACKTEX

Content

- Digital printing
  - Inkjet printing
    - Application of enzyme
  - Valve jet printing
  - 3D printing on fabric
- Spray technology

Co-funded by the European Union
HACKTEX

Digital printing

Co-funded by
the European Union

Inkjet printing

Co-funded by
the European Union

Inkjet printing: Introduction

- Digital inkjet printing technology offers new horizons to the advanced textile manufacturing sector, as it is a resource-efficient technology that consumes just enough materials and chemicals, with minimum waste production after the process.
- The flexibility it provides to the fashion sector plays a great role in adapting to the fast changing trends of the markets nowadays. High-resolution prints, endless color choices, high-speed production and potential of industrialization with no minimum run length are few of the outstanding characteristics of this technology.
- The designs are created digitally via software that are connected to the print heads, this allows a significant reduction of production time, as well as reduces storage space and costs related to the stamps/stencils used in rotary and screen printing methods.

Co-funded by the European Union

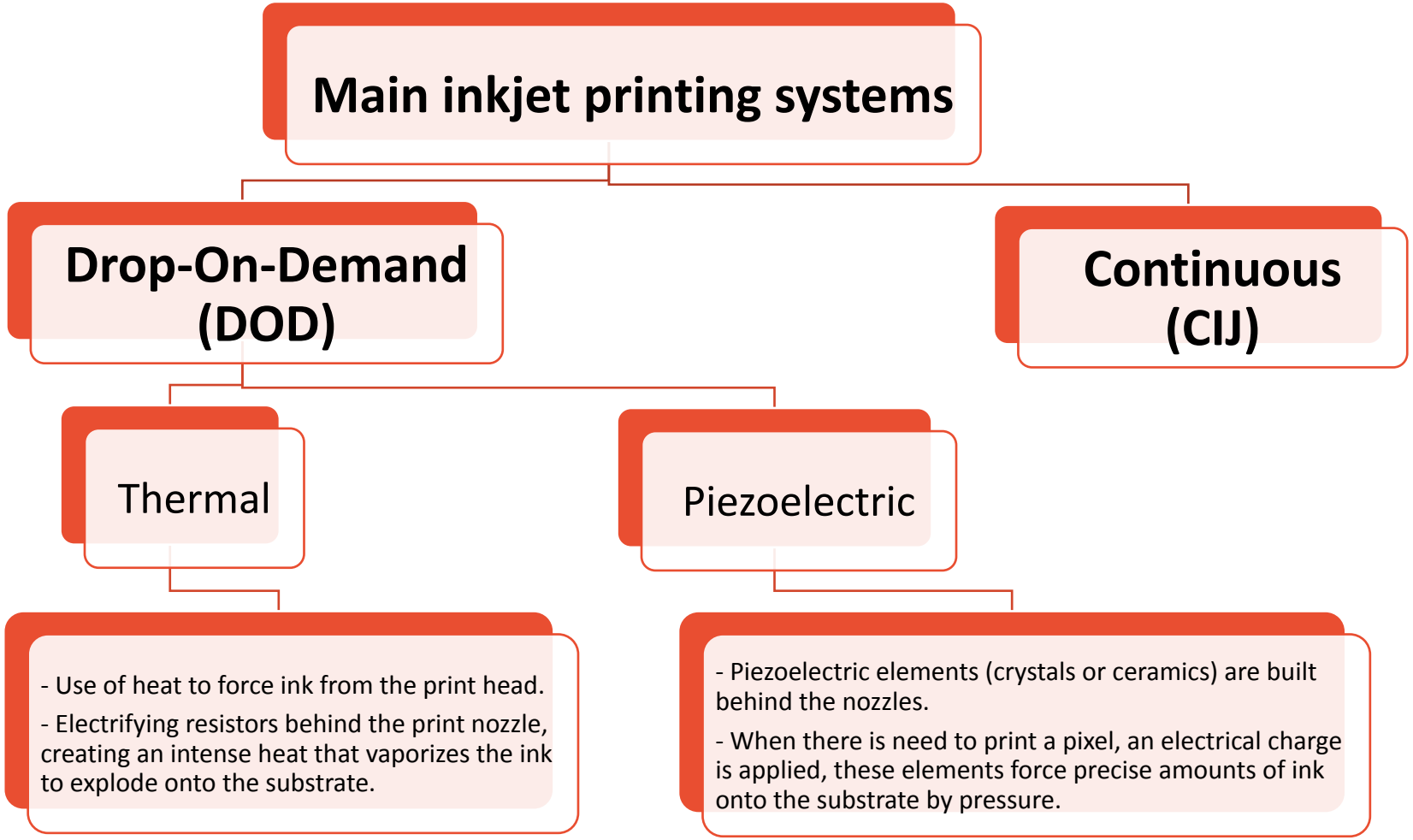
Inkjet printing: Background

- Conducting printing directly from a digital-based image onto the textile
- The technology ejects tiny drops of ink onto a substrate
- In practice, implementation of the technology is complex
- It is resource-efficient process, uses the least amount of materials, water and energy
- The (CMYK) system of subtractive colors (cyan, magenta, yellow and black) is used in digital inkjet printing
- It has seen commercial success since the 1970s
- The time required in the whole printing process with its preparation is significantly shorter than conventional printing of textiles

Image: MIMAKI TX400-1800B

Co-funded by the European Union

Main inkjet printing systems



Co-funded by the European Union
HACKTEX

Characteristics and components of DIJ printing on textiles

Variable data	• Digital • Unrestricted in size
Non-contact with substrate	• Ink is dropped onto the substrate • Printing on different surfaces
Versatile	• Compatible inks with different substrates
Multicolor	• Based on CMYK system
No moving parts	• Inherently reliable
High speed	• Depending on resolution

Co-funded by the European Union

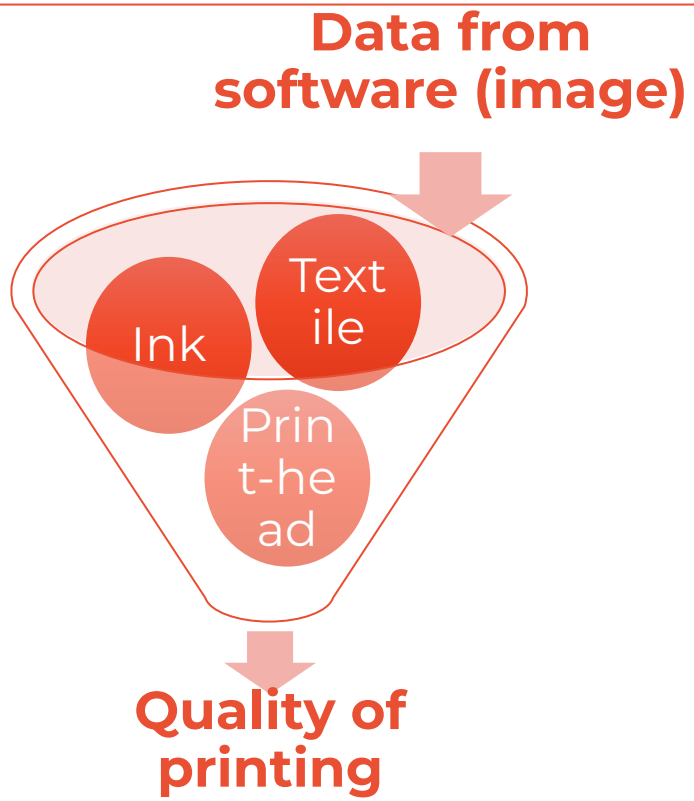
HACKTEX

Characteristics and components of DIJ printing on textiles

- **Main components of digital inkjet printing**

1. The software (controlling process and input of image)
2. The textile used (material, structure, texture…)
3. The ink used (Chemistry to suit the textile used)
4. The printhead and hardware (compatible with the ink used)

- Compatibility in interactions between the components is crucial to obtain good quality prints



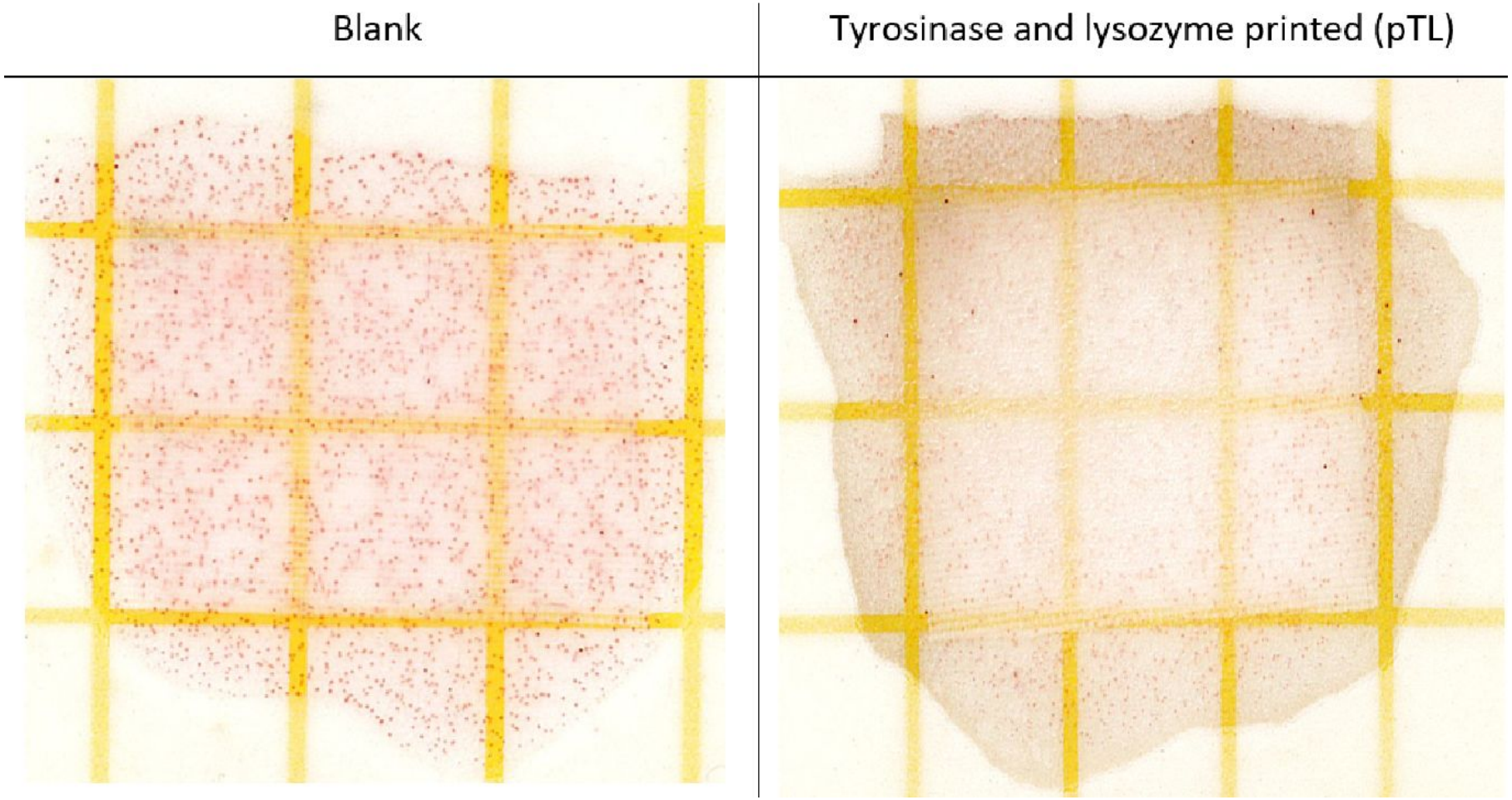
Co-funded by the European Union
HACKTEX

Inkjet printing of Enzymes

Co-funded by
the European Union

Enzyme Printed Fabrics: Bio-functionalisation of synthetic textiles by digital inkjet printing

Bacterial growth on lysozyme and tyrosinase printed PA6,6 fabric



A red dot in the figure shows the growth of one gram-positive bacterial colony

Co-funded by the European Union

HACKTEX

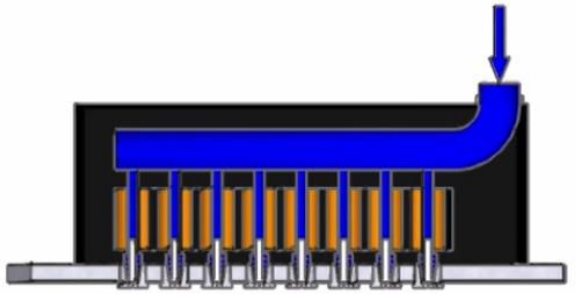
Valve jet printing

Co-funded by
the European Union

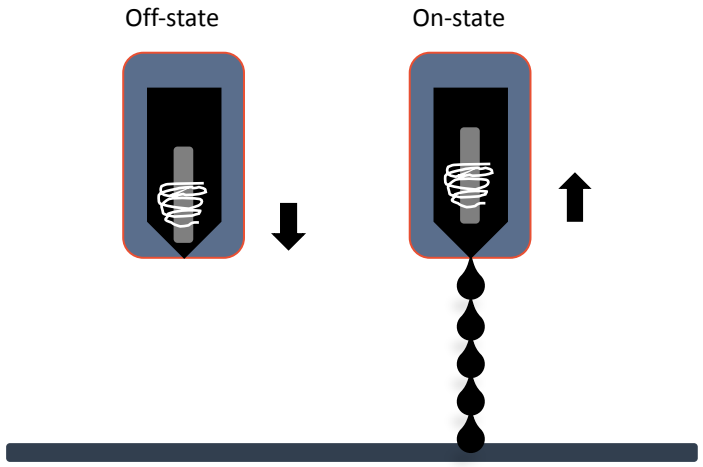
Valve jet printing system

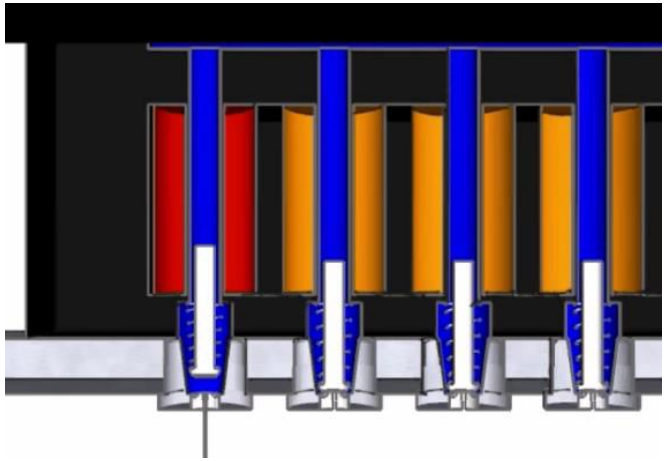
Drop-on-Demand (DOD) — Electromagnetic

(Valve jetting)



An electromagnet activates a plunger which is opening and closing a nozzle.



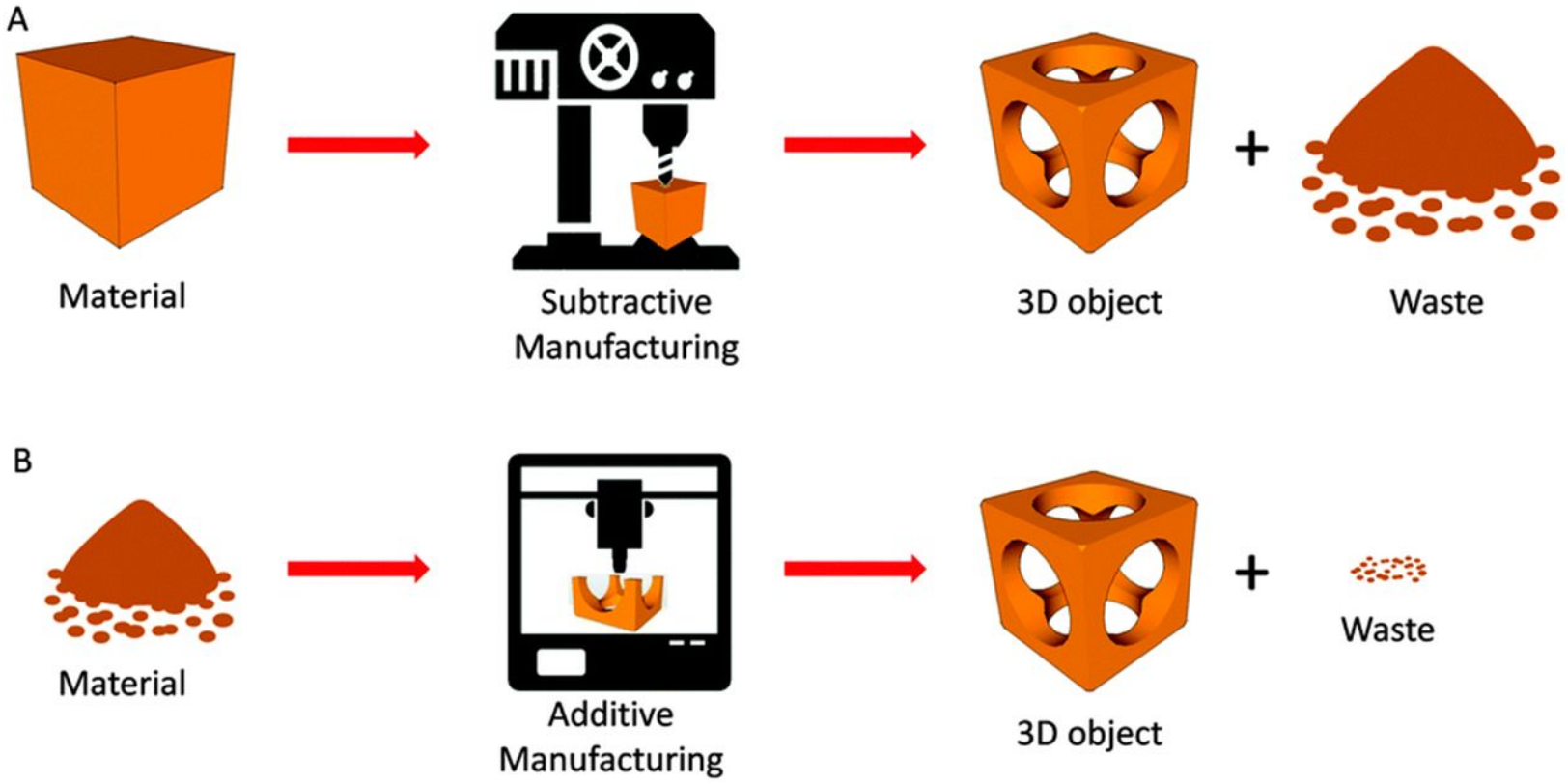


Co-funded by the European Union
HACKTEX

3D printing on textiles

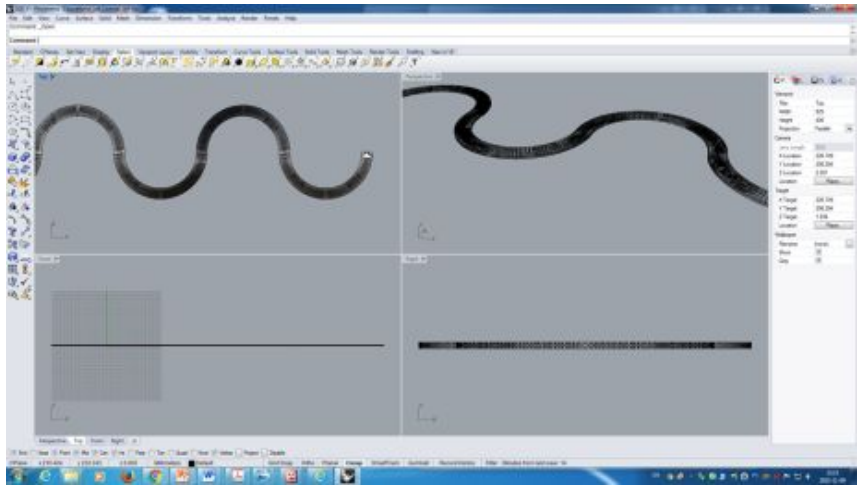
Co-funded by
the European Union

3D printing

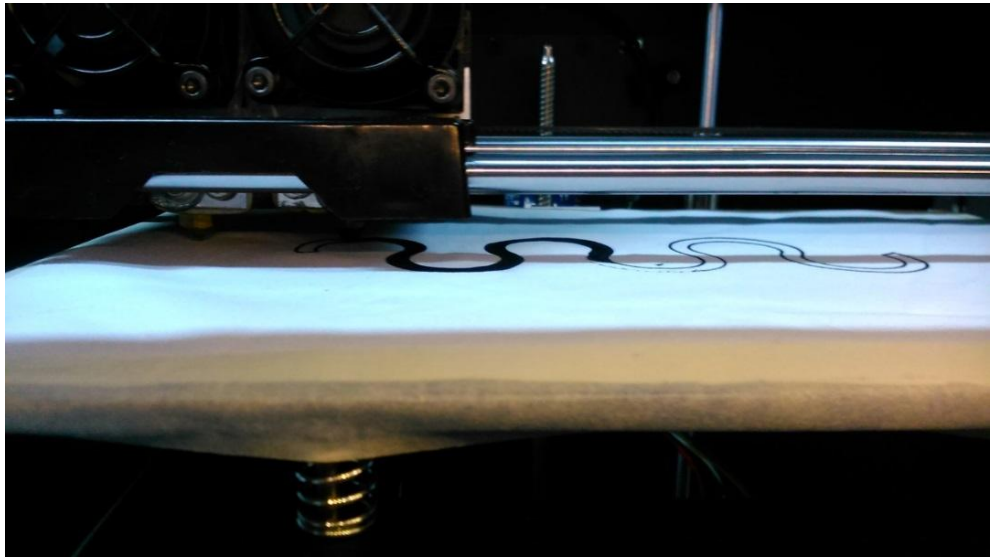


Co-funded by the European Union
HACKTEX

3D printing on Textile



CAD modeling



It is believed 3D printing on textiles can be one of the solutions to open up opportunities and fulfill the requirements of functional and smart textiles such as cost and flexibility as a more flexible technique.

The workflow of the method begin with a CAD modeling and then the design is given to 3D printer and as you can see in the figure you can have polymeric patterns on certain places of fabrics for example to integrate printed sensors and interconnections.

Co-funded by the European Union
HACKTEX

Benefits and Challenges of 3D printing on textiles

Potential Benefits of 3D Printing on Textile

- The technology can be applied where patterned and water and solvent-free functionalization is needed.
- The technology enables to improve the ecological footprint by minimization of textile waste as well as reduced consumption of energy, water and chemicals.
- The technology is high productive, flexible and cost effective
- It has short time to market for textile innovations.
- It is adaptable to quick changes of customer demands.
- It is possible to develop innovative products for functional and smart textiles

Main challenges of 3D Printed Textiles

- Durability,
- Flexibility
- Comfort

Affecting factors on 3D printed textile properties

- Adhesion
- Tensile properties
- Bending and drape properties
- Washability
- Abrasion

Co-funded by the European Union

Spray Technology

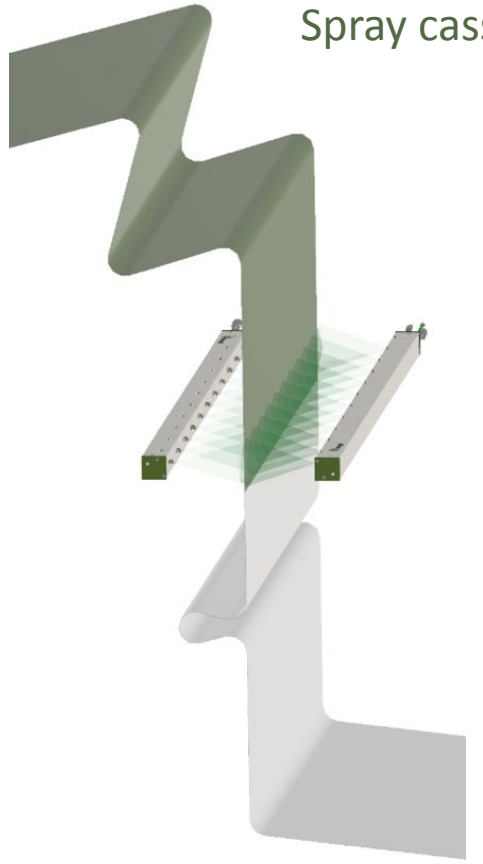
Co-funded by
the European Union

Spray technology

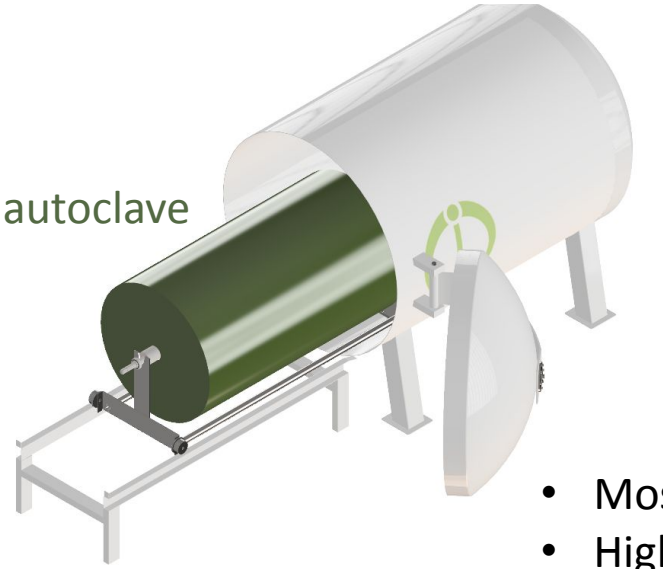
The combination of high-speed spray application with the special imogo autoclave fixation step enables high output

(Flex Dyer® process)

Spray cassettes



Fixation autoclave



- Most types of traditional dye classes
- High range of fibre types

Co-funded by the European Union

HACKTEX

Summary

- Digital printing and spray technology are resource-efficient technologies for textile printing and functionalization with minimum consumption of water and chemicals, and minimum waste production.
- These technologies overcomes many disadvantages of the conventional methods of textile dyeing, printing and functionalization with reduction of time and endless flexibility of designs to adopt to the changing fashion trends, and developing innovative smart and functional textiles.
- The elimination of metallic stencils used in conventional printing process reduces cost, time and storage needed in the digital printing process.
- The interest in these technologies is rapidly increasing due to their great potential in advanced textile manufacturing, and their capacity of overcoming many disadvantages of conventional printing and functionalization techniques.

Co-funded by the European Union
HACKTEX

Project:

Innovative smart textiles & entrepreneurship
2021-1-RO01-KA220-HED-000027527

Financial support:

Co-funded by
the European Union

Partners:

HACKTEX

Innovative smart textiles & entrepreneurship
Project 2021-1-RO01-KA220-HED-000027527

Co-funded by
the European Union