



Jornada

Indústria tèxtil i sostenibilitat



UNIVERSITAT POLITÈCNICA DE CATALUNYA
BARCELONATECH

Institut d'Investigació Tèxtil
i Cooperació Industrial de Terrassa

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ECUVaI:

Degradació de colorants reactius dels efluents de tintura i acabat tèxtil

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CONTENT

The Problem

The Project

The ECUVal system

Results

Colour removal

Reuse

The Benefits

Environmental

Socio-Economic

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Additional Information



Water, treat to reuse

Electrochemical
techniques
combined with
UV irradiation
for the
treatment and
reuse of textile
dyeing
wastewaters:
Industrial
marketing

Coordinator



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Partners



www.ecuval.eu

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THE EUROPEAN UNION

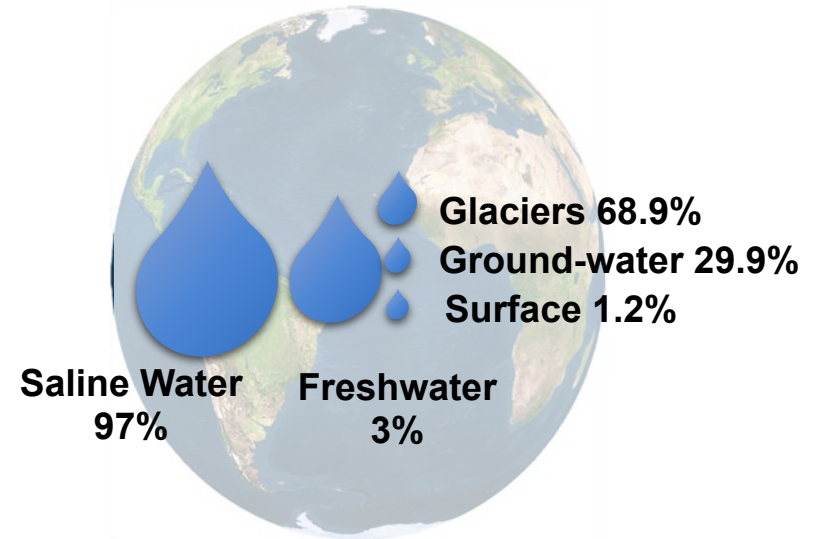


THE PROBLEM

Water scarcity



2030:
47% of the world's
population will live in
areas with water stress



- **Appropriate management of water**
- **Reduction of water consumption**
- **Water reuse**

THE PROBLEM

WHY TEXTILE INDUSTRY ?



- ❖ High water consumption
(up to 100 L/kg textile product)
- ❖ Complexity and variability of wastewater
- ❖ Deeply coloured wastewater



Discharge of textile effluent
in the biological plant

**Dyes: non
biodegradable**

**Tertiary treatments are
required to remove
colour.**

Salts are not removed.

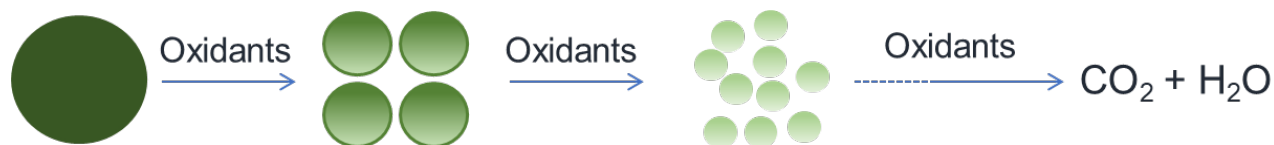
THE PROJECT

ECUVal: **electrochemical process + ultraviolet irradiation.**

ECUVal focused on the treatment of **saline effluents containing poorly biodegradable compounds**, such as dyes.

No chemicals are added and **no wastes** are produced.

Pollutants removed by **oxidants electro-generated** in situ from the salts contained in the effluent:



Subsequent irradiation with UV light:

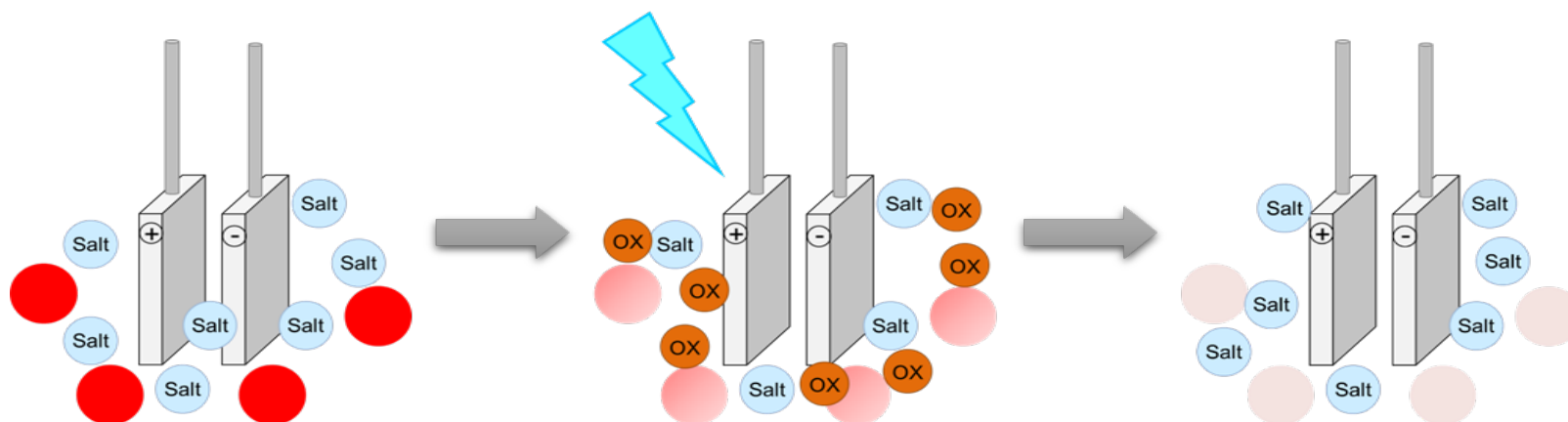
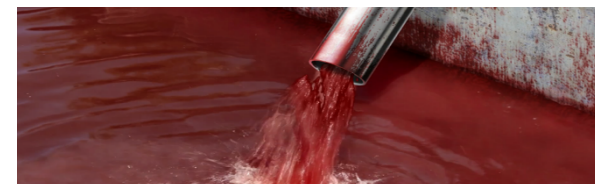
- increases the efficiency of the treatment
- removes all residual oxidants.

THE PROJECT

Textile effluents

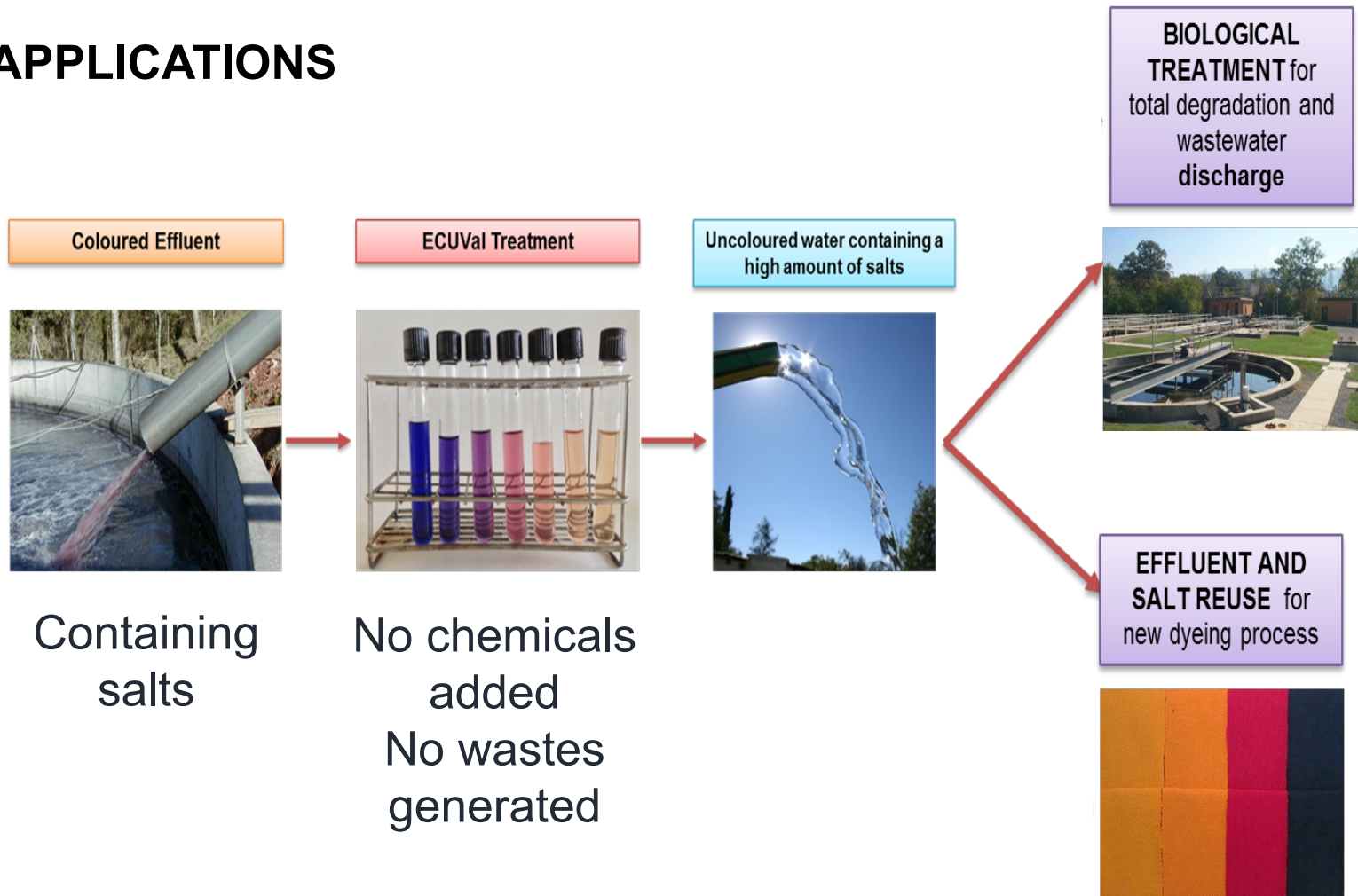
high conductivity due to the salts added during the dyeing process.

ECUVal: UV-assisted electrochemical process that **uses these residual salts as an electrolyte to generate oxidants** in the cells, thus destroying the dye molecules.



THE PROJECT

APPLICATIONS

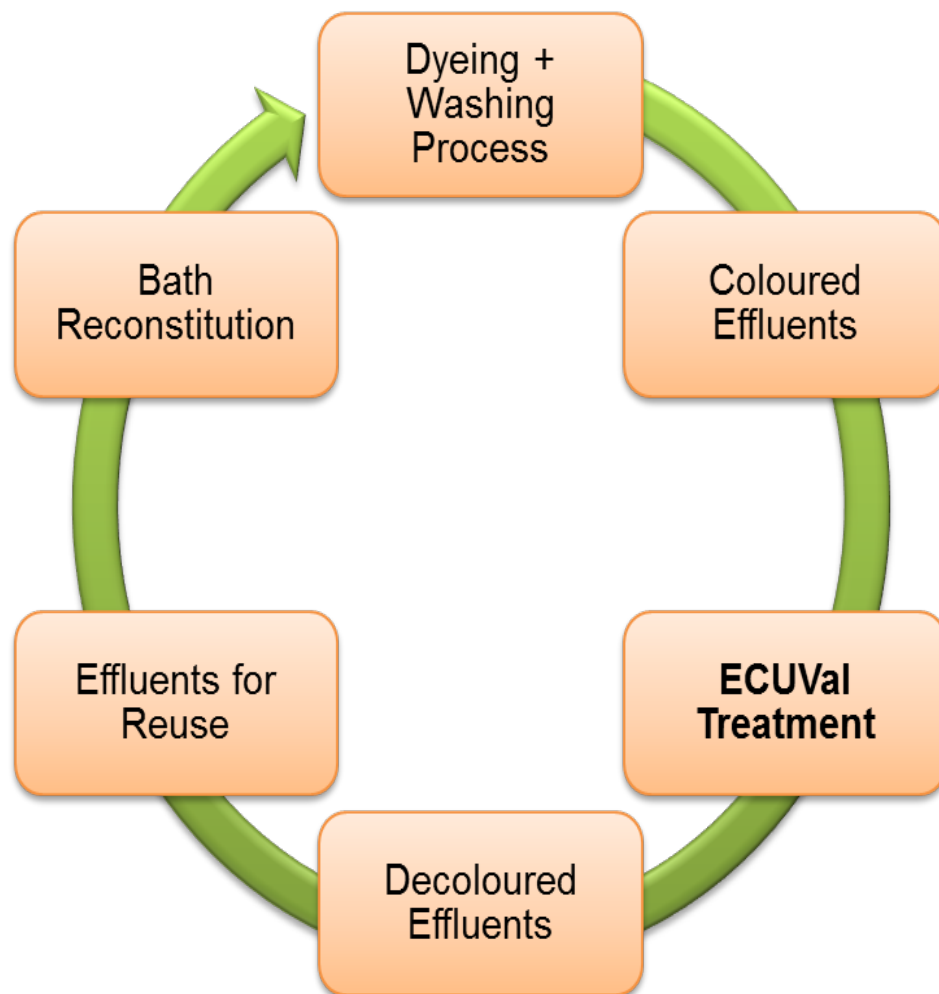


THE PROJECT

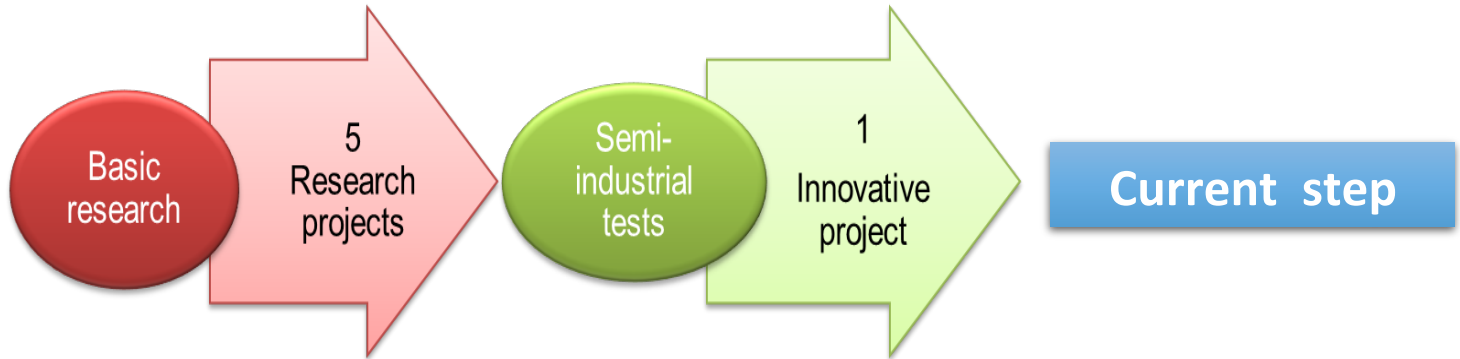
New system to **treat** textile wastewater and to **reuse** of treated effluents and salts.



- Saving water
- Saving salt
- Reduction of effluent salinity and wastewater discharge rates



THE PROJECT



ECUVal Project background



Lab. Pilot
2 L



Semi-Industrial Pilot
400 L



Industrial prototype
4m³/h

THE PROJECT

PROJECT INFORMATION

CE- EASME:
First application and
commercial replication

Execution:
36 months
(Jan 2015-Jan 2018)

UPC - INTEXTER:

Project Coordinator
Know-how, design and
development, laboratory and
in situ studies, LCA study,...

FITEX:

Business Plan,
Dissemination activities,...

ICOMATEX:

Manufacture and installation
Exploitation of technology

GRAUSA:

End-user
Validation



OBJECTIVES

Main objective

Introduce into the market an innovative eco-friendly technology for the treatment of industrial wastewater that provides an effluent able to be reused.



Specific objectives:

- Recycling 70-100% process water
- Recycling up to 100 % salt in the industrial processes.
- Removal of poorly biodegradable compounds.
- In the case of dyes, up to 100 % colour removal.
- Wastewater purification without the addition of chemical reagents.
- Green technology that does not produce wastes.
- Flexible system, operating at smooth conditions.
- High durability, minimal maintenance.
- Sustainable industrial processes: reduction of carbon footprint and environmental impact.
- Industrial viability to introduce the system into the market

THE ECUVaI SYSTEM

1. Decolouration function

4m³/h

Especially suitable
for effluents of
reactive dyeing

2. Reuse function

Reconstitution steps:

- Removal of carbonates and bicarbonates with an **acid** and **stripping**.
- Neutralization with **alkali**.
- Removal of residual oxidants with **UV** and **reducing agent**.

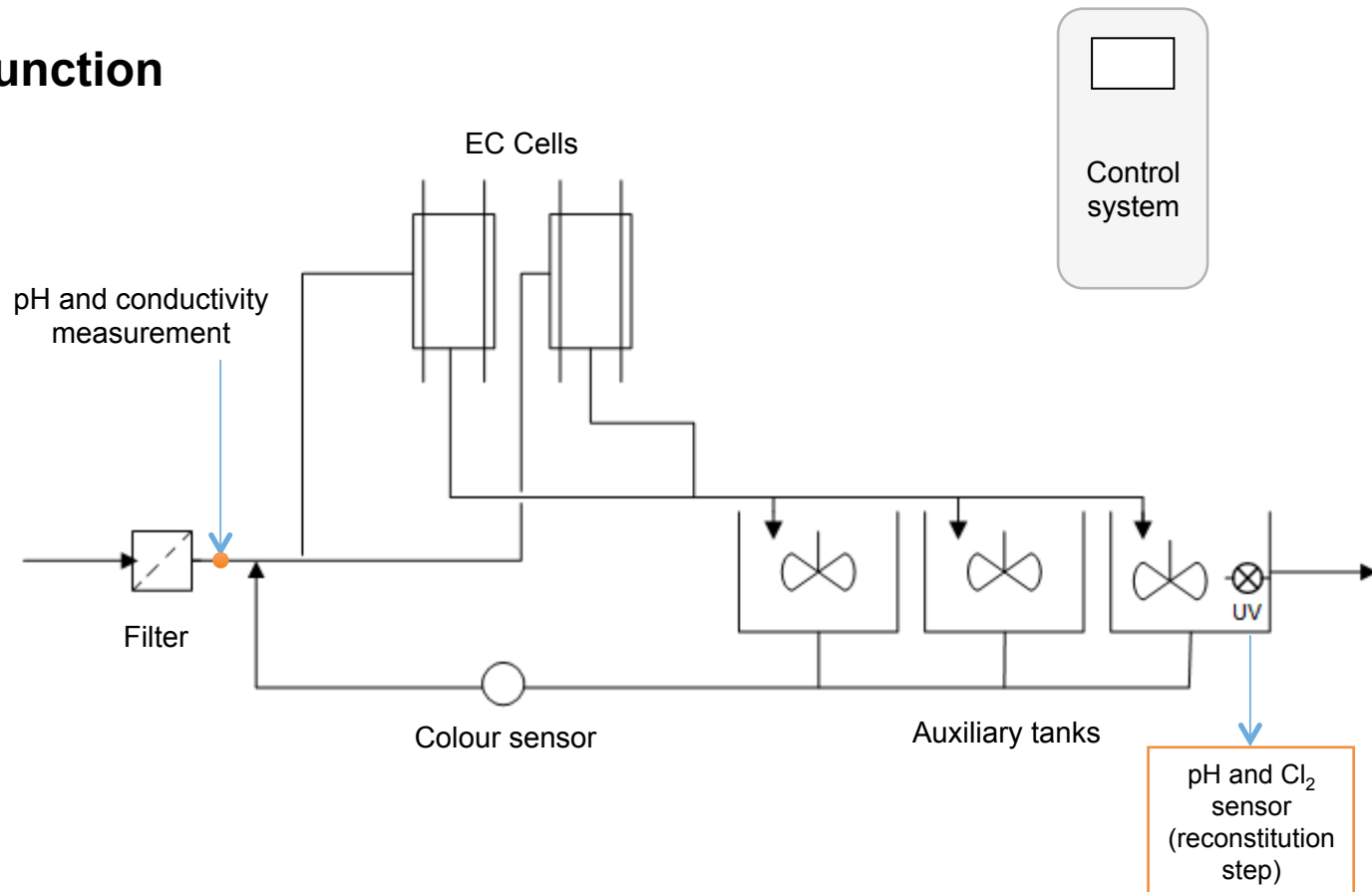


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THE ECUVaI SYSTEM

1. Decolouration function

2. Reuse function



WHY REACTIVE DYEING EFFLUENTS?

The most used dyes in the dyeing of cellulosic fibre.

Advantages

- Dyes react chemically with fibres
dye-X + Cel-O⁻ → dye-O-Cel + X⁻
- Water soluble
- High wash and light fastness
- Wide range of shades

Disadvantages

- Dyes also react with water → hydrolysis
dye-X + H₂O → dye-OH + HX
- Low exhaustion level
- Alkaline conditions and high amount of salt are required to fix dyes on the fibre

Main characteristics of reactive dyeing effluents

Organic
matter

Alkaline
pH

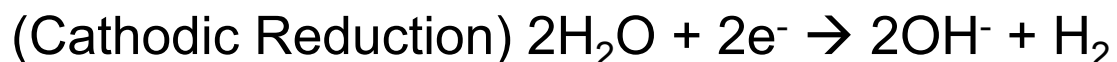
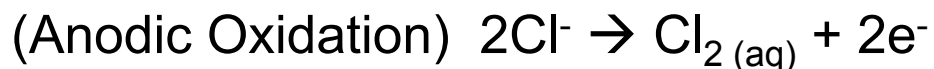
High
salinity

Deep
colour

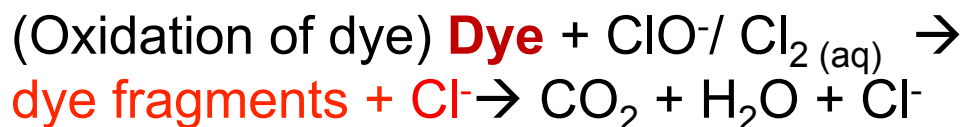
THE ECUVaI SYSTEM

DECOLOURATION MODE:

Electrochemical reactions:

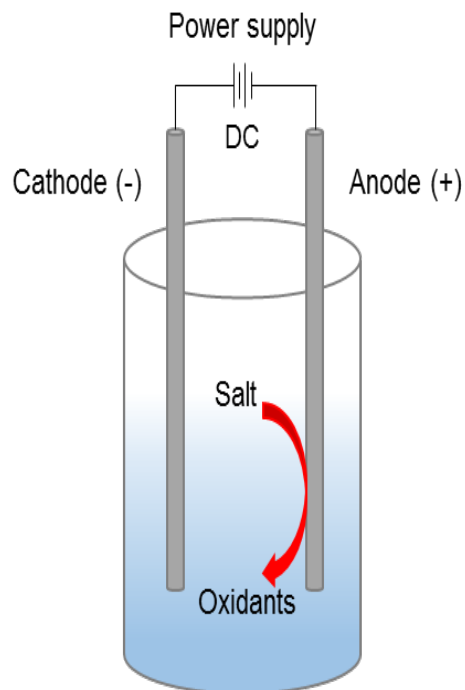


Subsequent reactions:



(decoloration)

(mineralization)



THE ECUVaI SYSTEM

REUSE MODE

Reactions:

1. **Removal of carbonates** and bicarbonates with acid:



HCl is added until pH 5 to ensure the complete removal

2. **Neutralization** of acid in excess by adding alkali:



3. **Removal of residual oxidants** with:

- UV irradiation and
- a reducing agent (only if required)

RESULTS

**Colour removal:
up to 100%**

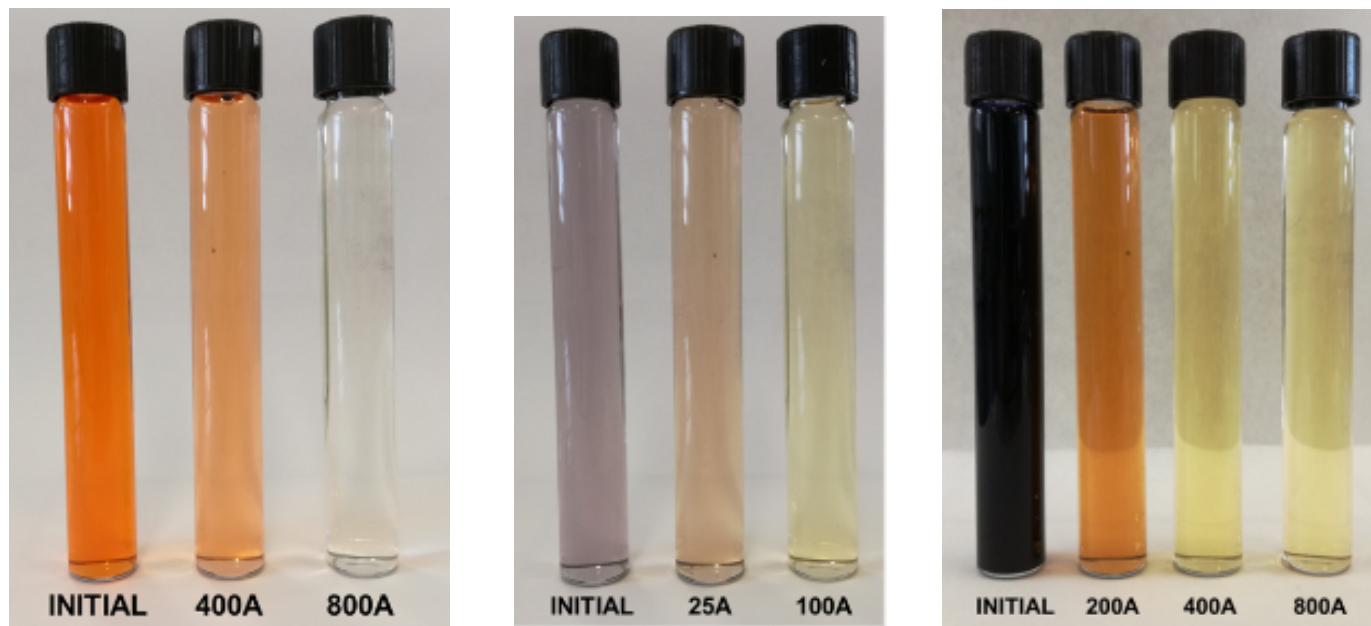
**No chemicals added
No wastes generated**



Exhausted reactive dyebaths (Jet)

RESULTS

Colour removal:



depends on:

- the **current intensity** and
- the **effluent conductivity**

The higher the intensity and the conductivity, the higher the amount of generated oxidants and the more efficient the decolouration.

RESULTS



Electric consumption

INTENSITY (A)	CONSUMPTION (kWh/m ³)
25	0.5
100	2.1
200	4.2
400	8.5

* Cost kWh = 0.092€

Decolouration:

- The electricity is the only cost
- No reagents are required
- No wastes are generated
- The wastewater treatment is more efficient

RESULTS

Reuse :

The clarified effluents still contain high levels of salts.

Savings:

- 70-100 % dyeing water
- up to 100% salt



ECUVal

- solves the problem of effluent colouration
- and enables the reuse of water and salts in new dyeing processes
- with a low energy consumption.

BENEFITS

ENVIRONMENTAL: life cycle assessment

LCA 1: environmental impact in the dyeing process (unit: kg textile)

Three scenarios:

Current process



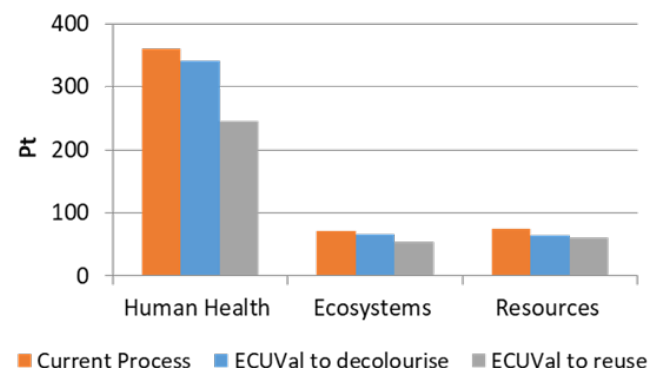
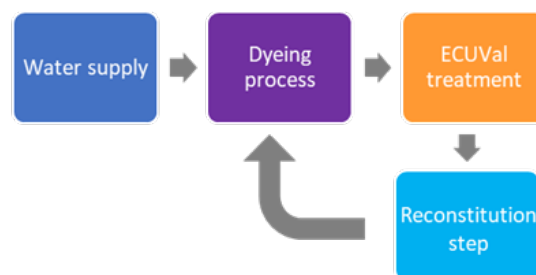
ECUVal to decolourise

The environmental impact decreases in 5%



ECUVal to reuse

The environmental impact is reduced in 30%



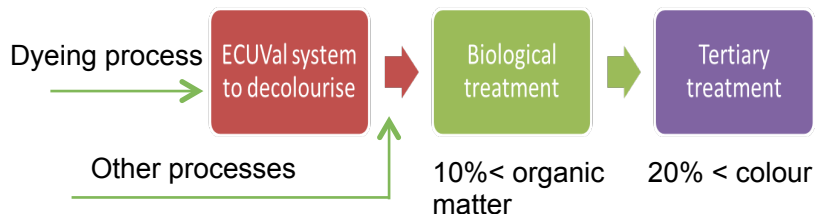
BENEFITS

Life cycle assessment 2: Environmental impact in the wastewater (unit: m3 wastewater)

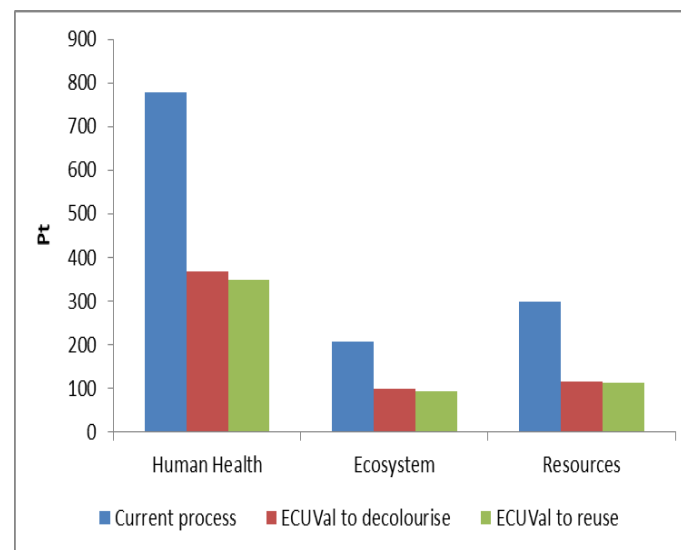
Current WW treatment



ECUVal to decolourise



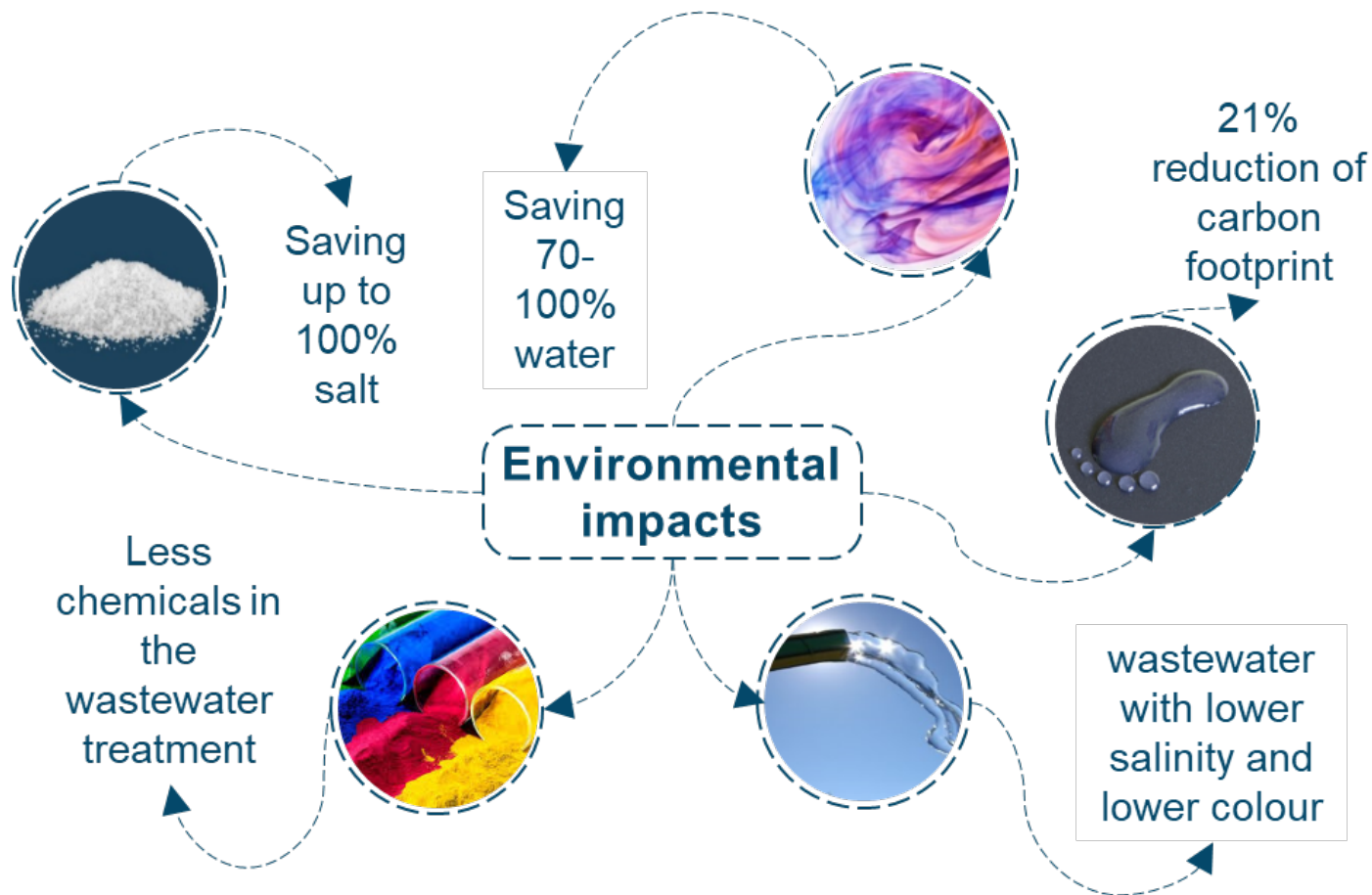
ECUVal to reuse



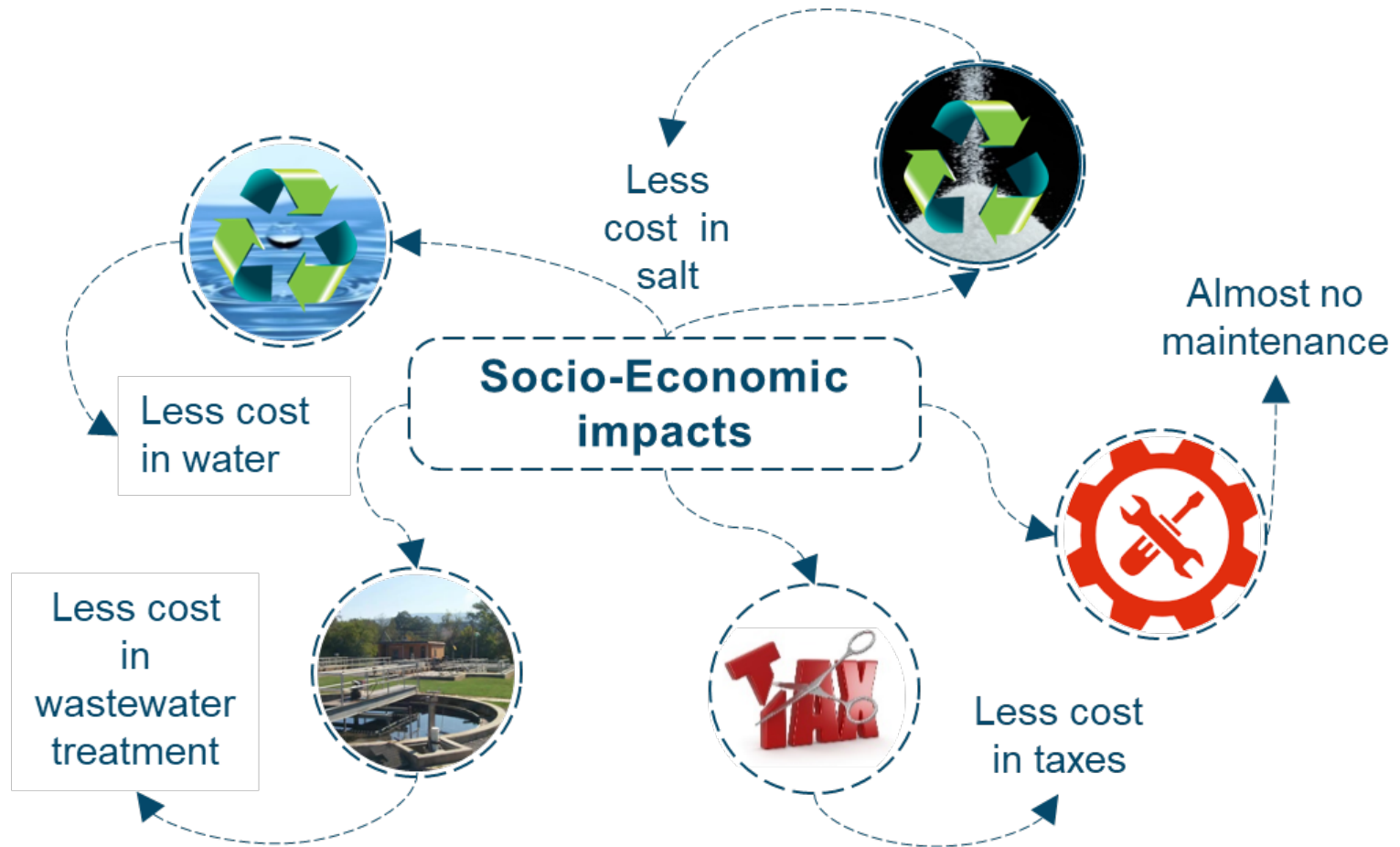
Reduction of the environmental impact: **55%**

Reduction in CO₂ generation: **56%**

BENEFITS



BENEFITS



BENEFITS

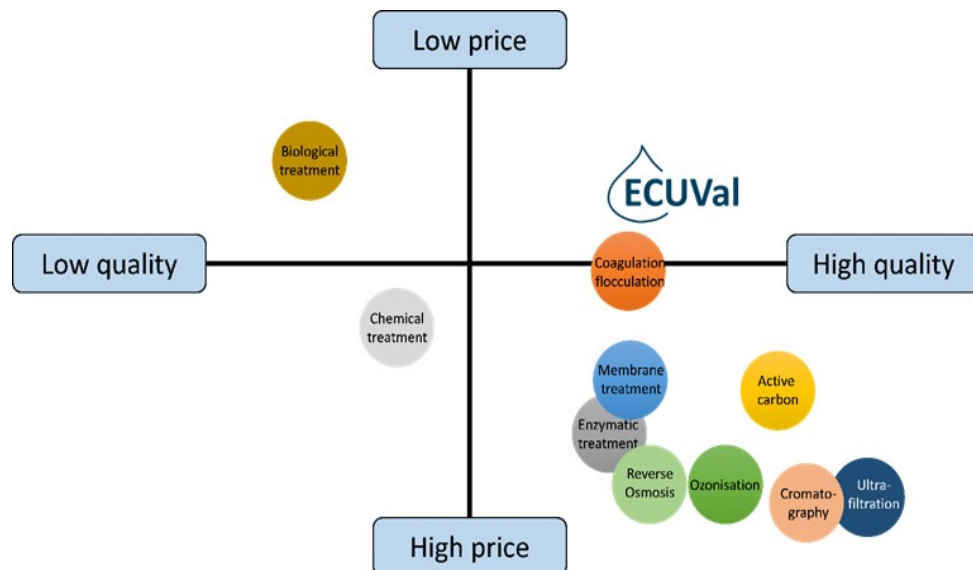
Economic benefits of ECUVal:

- No chemicals added
- No wastes are generated.
- Only cost: electric power supply.
- Only a part of wastewater is treated,
- Significant reduction of reagents and sludge disposal costs.
- Discharge taxes are lowered due to the reduction of wastewater salinity.
- No maintenance. Electrodes stable over 5-10 years.
- Less cost in water and salt.

ECUVal investment
will be depreciated
in 4-5 years.

BENEFITS

**Market segmentation
of ECUVal
with respect
to other technologies**



Method	Colour removal	Rate	Cost	Other specifications
Active carbon	Very good	Low	High	Regeneration
Membranes	Good	High	High	Maintenance and cleaning
Ozonization	Good	Medium	Very high	By-products
Coagulation– flocculation	Good	Medium–High	Medium	Sludge generation
ECUVal	Good	High	Medium	Clean and recycle option

MARKET REPLICATION

MARKET: POTENTIAL USERS

INDUSTRIAL SECTORS:

- Generation of non degradable compounds
- Receptors of green technologies (reuse of water...)

Validated



Textile
Sector

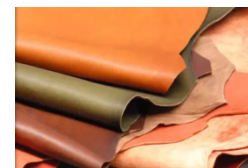


Chemical
Sector

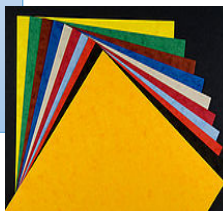
Other potential users



Pharma
Sector



Leather
Sector



Paper
Sector

NEW PROJECT

Validated



Textile
Sector

A flexible smaller pilot

SPECIFIC OBJECTIVES:

- Demonstrations in fairs
- Companies could use the technology in situ and verify its efficiency
- Evaluate other applications of the technology such as direct dyes removal

FINAL OBJECTIVE:
to achieve the introduction of the
technology into the market

MARKET REPLICATION



Paper
Sector

NEW PROJECT:

ELDE

**ELECTRO-DEPURACIÓ D'AIGÜES RESIDUALS INDUSTRIALS:
VIABILITAT TÈCNICA, AMBIENTAL I ECONÒMICA**



Chemical
Sector



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lavola
cosostenibilitat



Leather
Sector

RIS3CAT – COMUNITAT AIGÜES (ACCIÓ)

CONCLUSIONS

ECUVal is particularly efficient in the treatment and reuse of reactive dyeing and washing effluents.



Environmental and economic benefits

- No chemicals are required to remove colour.
- No residues are generated.
- Saving water.
- Saving salt.
- Lower salinity of wastewater.
- Lower cost of the wastewater discharge.
- Low maintenance

CONCLUSIONS

ECUVal is addressed mainly to companies that generate effluents with high salinity and low biodegradability.

This new technology will reduce the environmental impact associated to the removal the poorly biodegradable compounds from wastewater.

ECUVal will also contribute to reduce the salinity of effluents (very important in low flow rivers)

Currently, there is no other wastewater treatment available for this purpose, economically feasible.



Additional information on ECUVal project:

- Website (English, Spanish and Catalan): www.ecuval.eu
- Papers in water and textile journals
- Fairs
- Conferences and congresses
- Demonstrations and workshops
- Video on ECUVal project





THANK YOU !!

www.ecuval.eu