ECUVAL PROJECT: a feasible system to recover salts and reduce water consumption in textile industry
Introduction

WATER DISTRIBUTION

- Saline Water: 97%
- Freshwater: 3%
  - Glaciers: 68.9%
  - Ground-water: 29.9%
  - Surface: 1.2%

**Drawback**

- + 80 millions/year
- + 64 millions m³/year

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

USES OF WATER

For cooling, steam generation, as raw material or as part of the final product

World: 69%
Spain: 75%
Catalonia: 72%

World: 19%
Spain: 10%
Catalonia: 9%

World: 12%
Spain: 15%
Catalonia: 19%

Water consumption in Spain by industrial sectors
TEXTILE INDUSTRY

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

Main characteristics of dye effluents

- Organic matter
- Alkaline pH
- High salinity
- Strong colouration

Between 1 and 15% of the dyes are discharged in the wastewater
Introduction

REACTIVE DYES

The most used dye in the dyeing of cellulosic fibre. It reacts chemically with cellulosic fibre.

**Advantages**
- Water soluble
- High wash and light fastness
- Wide range of shades

**Disadvantages**
- Low fixation
- Alkaline conditions and high amount of salt are required to fix the dye on the fibre
- Dye react with water $\rightarrow$ hydrolysis

\[
\text{dye-X} + \text{Cel-O}^- \rightarrow \text{dye-O-Cel} + X^- \quad \text{\textit{(Reaction with fibre)}}
\]

\[
\text{dye-X} + \text{H}_2\text{O} \rightarrow \text{dye-OH} + \text{HX} \quad \text{\textit{(Hydrolysis)}}
\]
TEXTILE WASTEWATER TREATMENT

Current method: Biological process

Discharge of textile effluent in the biological plant

Dyes: non biodegradable

Tertiary treatments are required
COLOUR REMOVAL METHODS

Treatment of coloured effluents

Physico-chemical methods
- Sludge production
- Additional treatment required
- Regeneration of adsorbent

Chemical oxidation methods
- Expensive
- Operational trouble

Enzymatic methods
- Under research

Electrochemical methods
- Operate at smooth conditions
- Simple and clean
- The electron is the only reagent
**Introduction**

**ELECTROCHEMICAL TREATMENT**

- Electrocoagulation
- Reduction
- Oxidation
- Indirect oxidation
- Photo-Fenton
- Heterogeneous photo-catalysis
- Direct
- With active chlorine
- Electro-Fenton
- Without UV radiation
- With UV radiation: posterior

**Diagram:**
- Power supply
- DC
- Cathode (-)
- Anode (+)
- Self
- Oxidants
ECUVal Project

OBJECTIVES

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

- 100% colour removal
- Reuse of 70% treated effluent
- Reuse between 20-75% of salt
- Reduction of effluent salinity and wastewater discharge rates
Good correlation between lab and semi-industrial pilots

- 2 patents
- UPC
CURRENT STATUS OF THE PROJECT

- An industrial prototype (4m³/h) has been built and installed in a mill.
- The optimisation of wastewater treatment conditions in the textile industry are being carried out to demonstrate the viability of the technique.
Results

INITIAL TESTS AT LABORATORY SCALE

• 100% colour removal after 10 min. of treatment
• Dyeings with reuse of treated effluents into the acceptance criteria

On basis initial tests

ECUVaI system design

Lab. Pilot 2L
Results

TESTS AT INDUSTRIAL SCALE

• Tests at different intensities
• Colour removal between 65-100%
• Reuse up to 75% of salt
• Dyeings (monochromies and trichromies) with reuse of treated effluents into the acceptance criteria ($\Delta_{\text{cmc}(2:1)} < 1$)
MARKET: POTENTIAL USERS

INDUSTRIAL SECTORS:
- Generation of non degradable compounds
- Receptors of green technologies (reuse of water…)

Validated
- Textile Sector
- Chemical Sector
- Pharma Sector
- Paper Sector

Market potential users
- Leather Sector
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 70% dyeing water.
- Saving 20-75% dyeing electrolyte.
- Lower salinity of wastewater.
- Lower cost of the wastewater discharge.
THANK YOU FOR YOUR ATTENTION!!

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