Advanced oxidation for aromatic amine mineralization after aerobic granular sludge treatment of an azo dye containing wastewater

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Textile wastewater

- negative environmental impact
- heavily loaded regarding organic carbon

and color (70% from azo dyes)

→ 2 phase biological treatment

anaerobic ↔ dye reduction (color removal)

aerobic ↔ further oxidation (COD removal)

} Aerobic Granular Sludge Sequencial Batch Reactor (AGS-SBR)

Colorless dye persisten metabolites

Aim

The aim of this work was:

- Apply advanced oxidation processes (AOP) in simple configuration, as a **post-treatment** of an AGS-bioreactor to promote the mineralization of the azo dye metabolites

  - Ozonation
  - UV irradiation

- The recirculation of the AOP treated effluent back to the AGS-bioreactor was also tested to evaluate the improvement of the overall removal of organic load (COD)

Experimental System

40 mg/L Dye (AR14)
1000 mg/L COD Emsize1

Textile Wastewater

AGS-SBR
6h cycle

Experimental System

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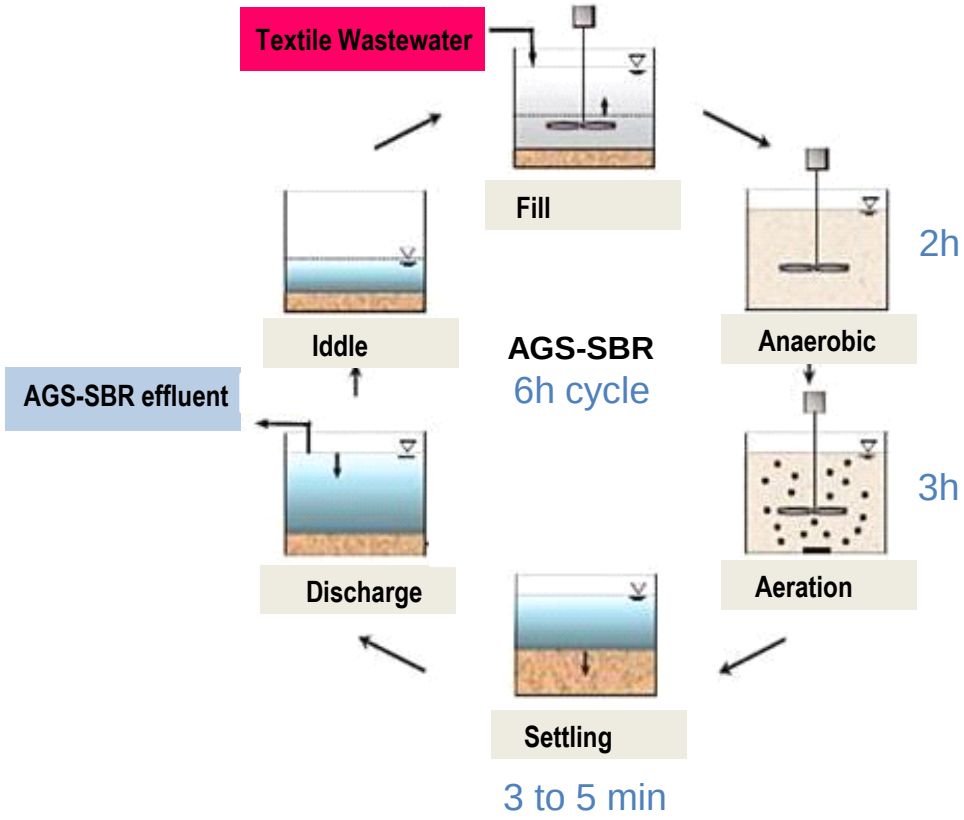
1000 mg/L COD Emsize1



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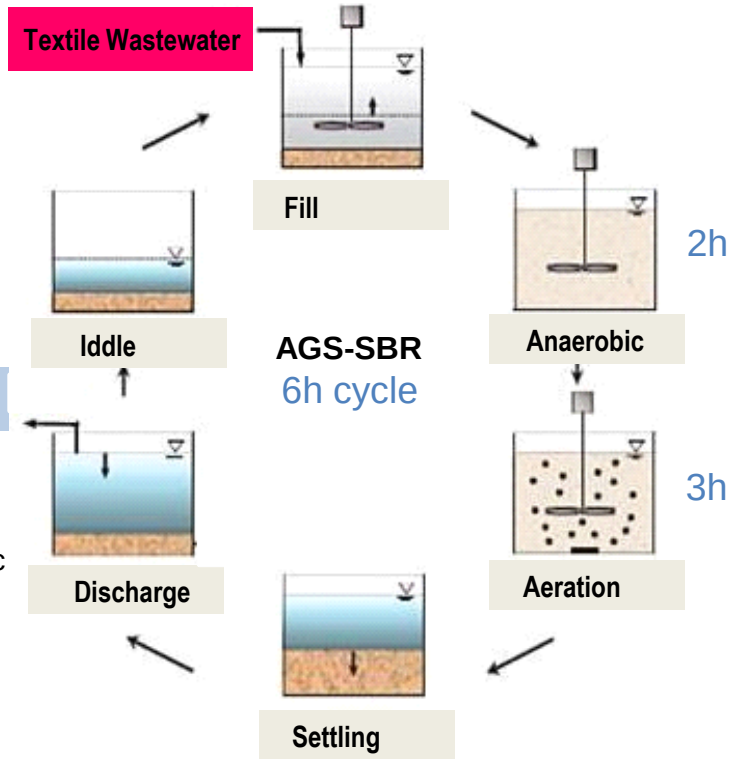

Color and COD removal > 80%
but
Recalcitrant aromatic amine (41ANS)

AGS-SBR effluent collected along a period of 2 days for following experiments

Experimental System

AGS-SBR effluent

Color and COD removal > 80%

but

Recalcitrant aromatic amine (41ANS)

Ozonation

post-treatment

60-watt Electronic Ozonizer
5 L/min
Sample: 800 mL in an 1L cylinder

Ozone fed for 60 minutes

samples collected at
0, 5, 10, 20, 30, 45 and 60 min

Followed by

HPLC
UV-vis
COD

Experimental System

AGS-SBR effluent

Color and COD removal > 80%
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post-treatment

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Sample: 800 mL in an 1L cylinder

Ozone fed for 60 minutes

samples collected at
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Followed by

HPLC
UV-vis
COD

UV irradiation

post-treatment

150-watt, medium pressure mercury lamp (200-600 nm)
Sample: 600 mL in a 850-mL photoreactor

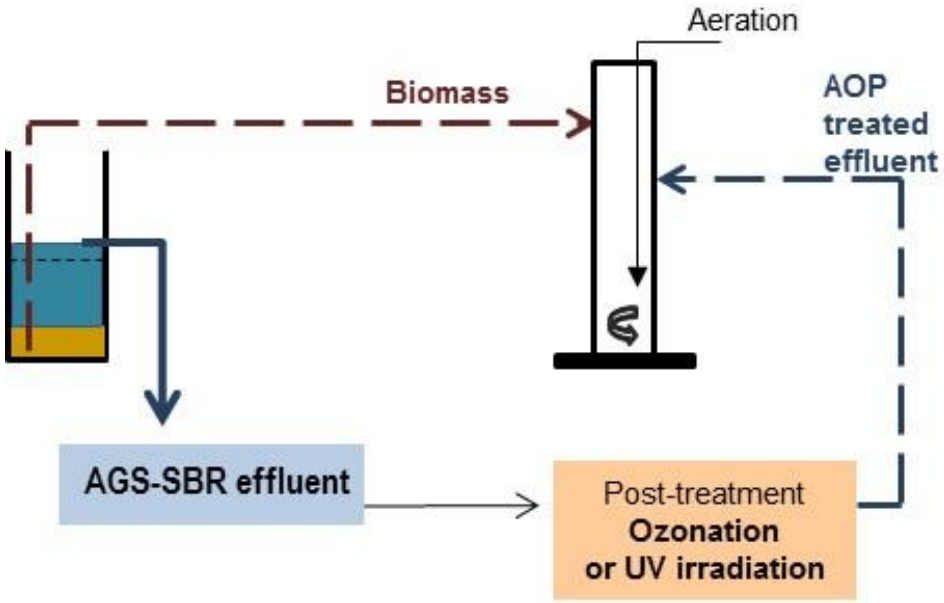
30 min irradiation

samples collected at
0, 5, 10, 20 and 30 min

Followed by

HPLC
UV-vis
COD

Recirculation of the AOP treated effluent back to the AGS-bioreactor was also studied

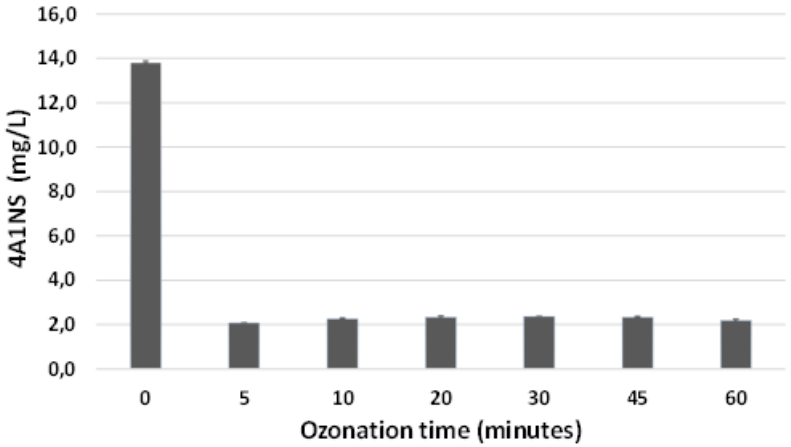


Followed by

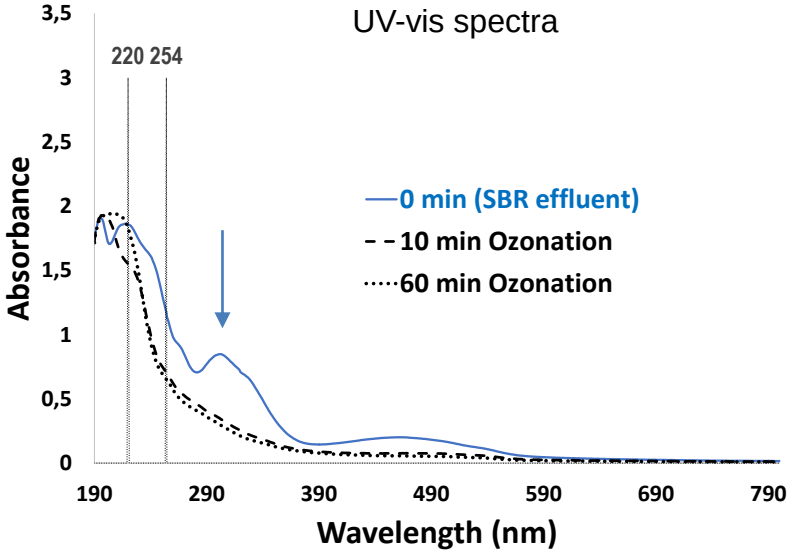
HPLC
UV-vis
COD
TSS

Results Ozonation post-treatment

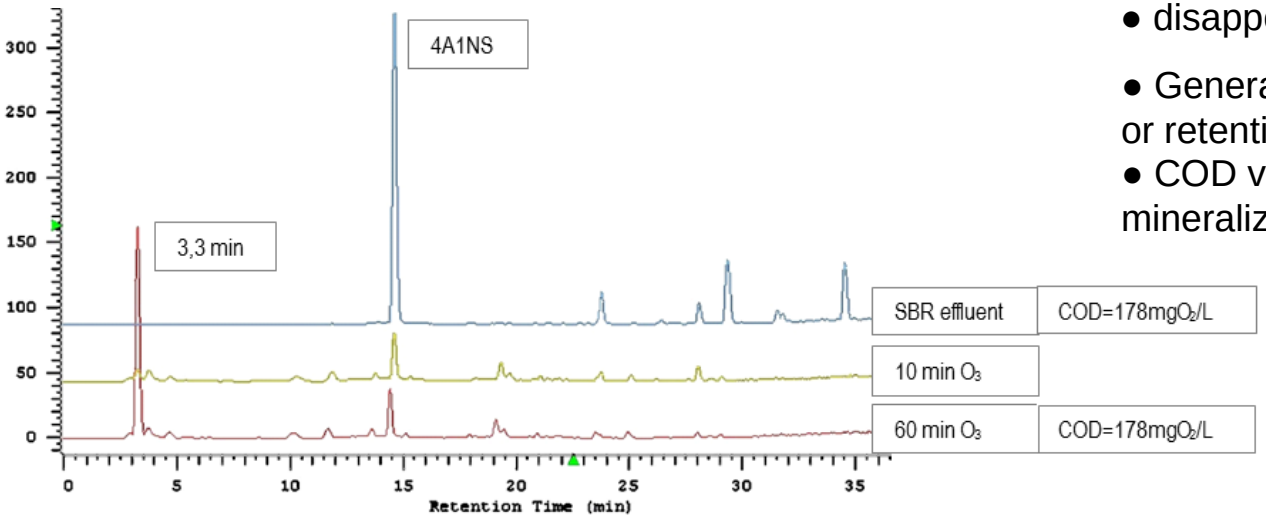
4A1NS concentracion by HPLC



UV-vis spectra



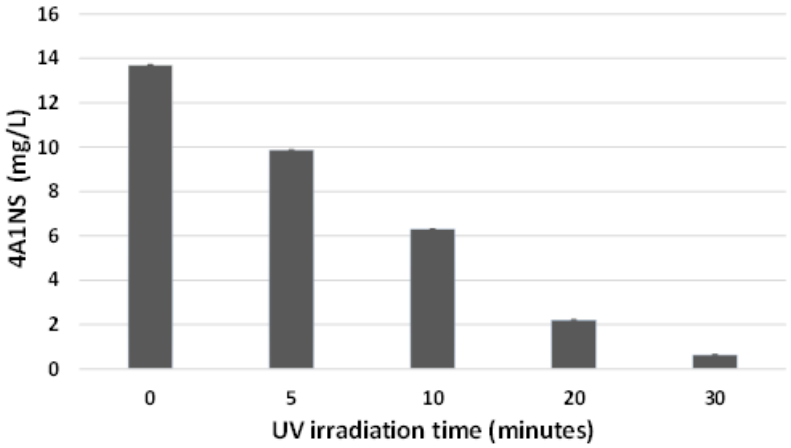
HPLC chromatogram



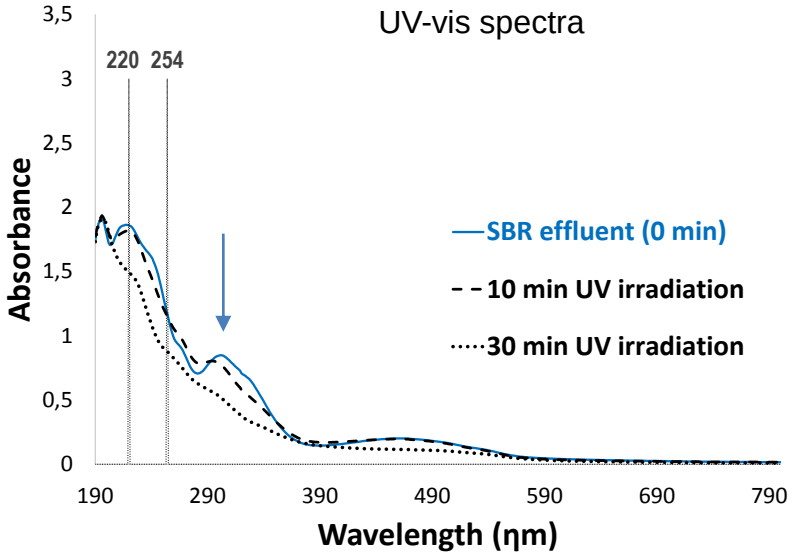
- 5 min O_3 -> 85% conversion of 4A1NS
- disappearance amine peak at 320 nm
- General disappearance of residual peaks or retention time reduction
- COD value was unchanged (no mineralization)

Results UV irradiation post treatment

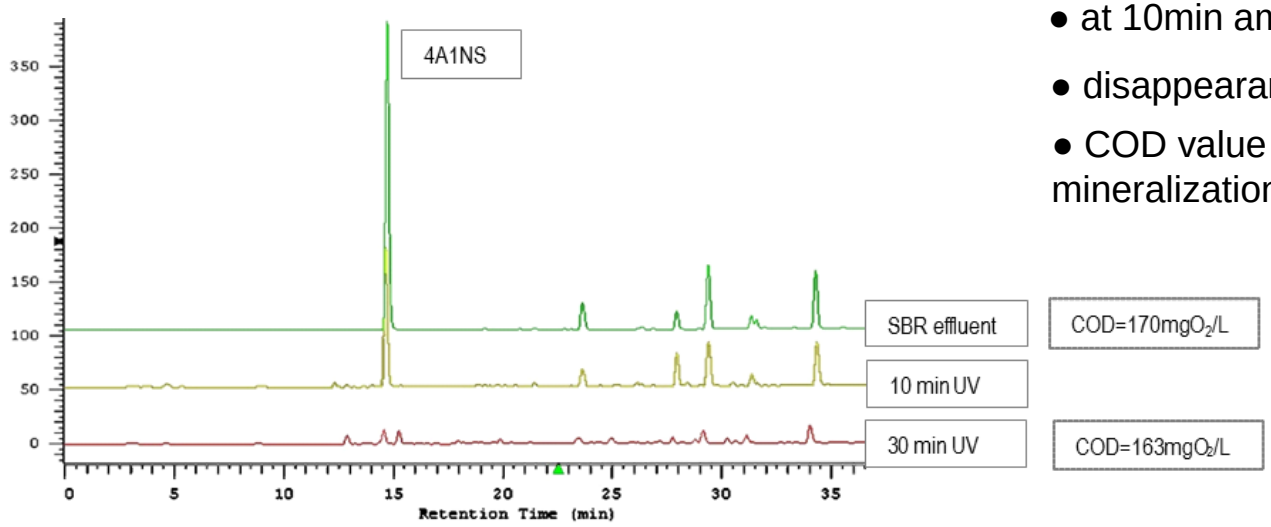
4A1NS concentracion by HPLC



UV-vis spectra



HPLC chromatogram



- need 20min UV -> 85% conversion of 4A1NS
- at 10min amine peak at 320 nm still remains
- disappearance of all residual metabolites
- COD value almost unchanged (no mineralization)

Results Recirculation to bioreactor after AOP

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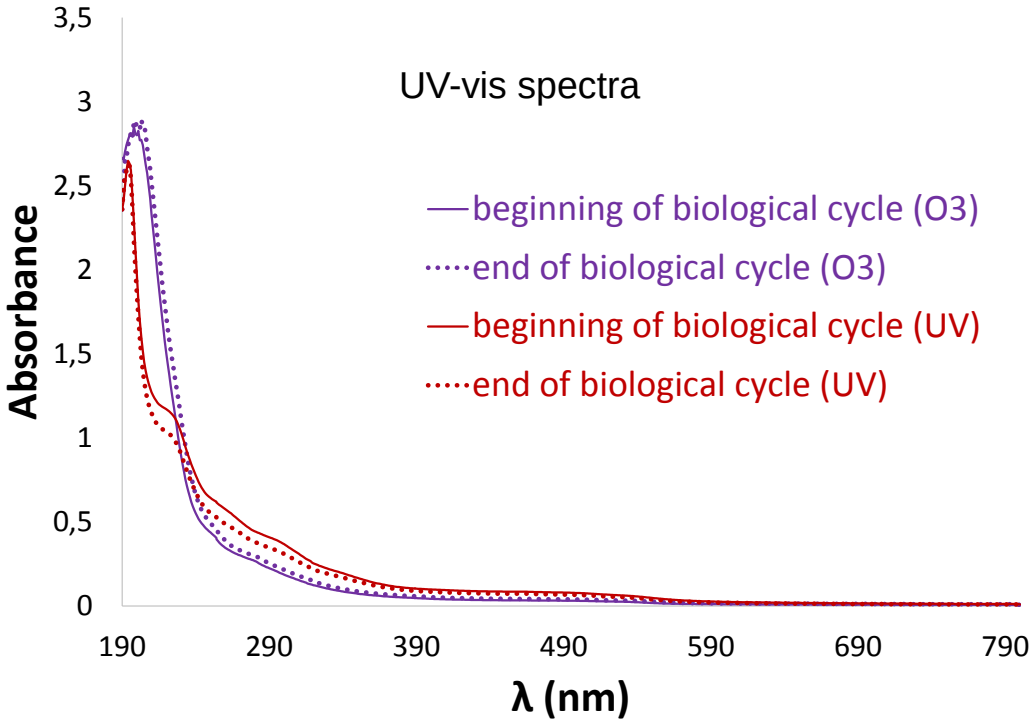

- no change of the ozonised effluent
- a slight absorbance decrease of UV-irradiated effluent
- HPLC essentially unchanged both for Ozone an UV-irradiated effluent
- recirculation to bioreactor increments COD removal by
  20% - ozonised effluent
  15% - UV-irradiated effluent

Conclusions

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- The conversion of the recalcitrant 4A1NS amine was successfully achieved using the two AOP tested as post-treatments
- A removal efficiency of 85% for the recalcitrant amine could be obtained with either 5 min of ozonation or 20 min of UV irradiation.
- COD removal in both AOP treatments was insignificant, but a simulated recirculation of these effluents back to the biological treatment achieved removal yields of 15 to 20%.
- It can be concluded that ozonation and UV irradiation are promising options as polishing treatments for the effluents coming from AGS-SBR treatment of textile wastewaters, aiming to eliminate recalcitrant aromatic amines resulting from azo dye bioreduction.

Acknowledgements

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Thank you for your attention!

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