

Metal complex dye degradation by the fungus *Trametes versicolor* followed by metal adsorption with a low cost activated carbon derived from Tunisian olive-waste cakes.



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Plan

☀ *Introduction*

☀ *Objective*

☀ *Methodology*

☀ *Results and discussion*

☀ *Conclusions and perspectives*

Introduction

- Textiles industry effluents: characteristics contain dyes with complex molecular structure and synthetic origin



Basin for residual water from textile industry



- Treatments:**

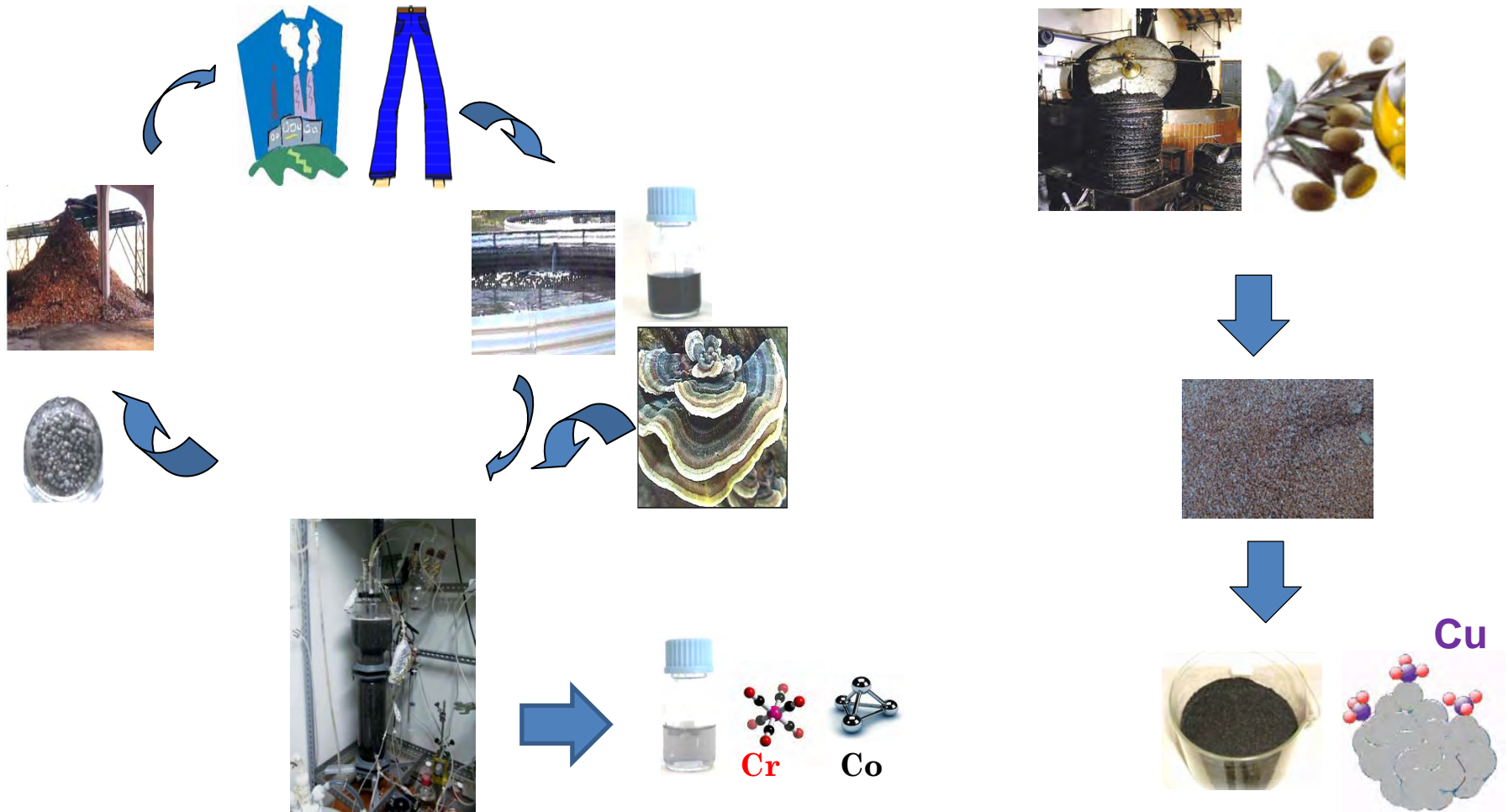
- Pysic-chemical treatment: Fenton, Ozone, Adsorption, membrane
- Biological treatments: low removal yields

➡ Effective but !! High cost, secondary products and narrow appliance



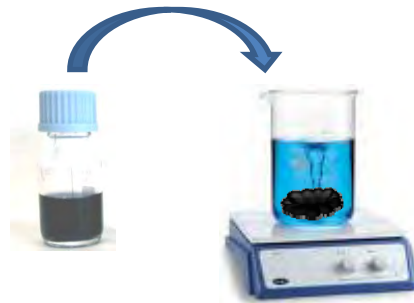
Group Biodegradation of industrial pollutants and waste valorization (UAB)

Laboratory Water, Energy and Environment (ENIS)

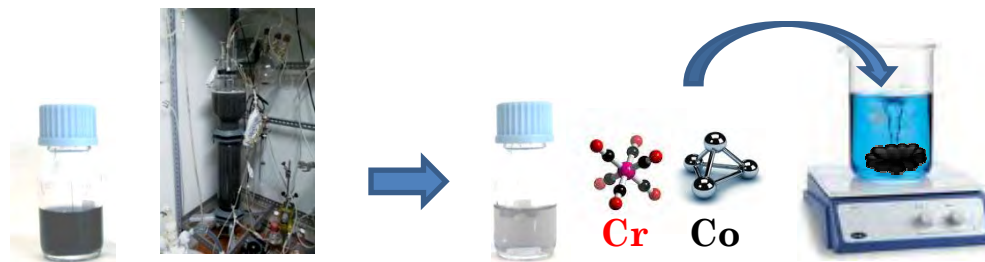


Main Objectives:

- ❖ Evaluate the adsorption potential of the AC prepared from Tunisian olive-waste cakes for metal complex dye such as GLG.



- ❖ Exploitation of the complementarity of two processes : **the biological treatment** and the **physical process of adsorption** in order to purify a textile metal complex dye: Grey Lanaset G



Biological treatment

Adsorption of metals on AC

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Methodology

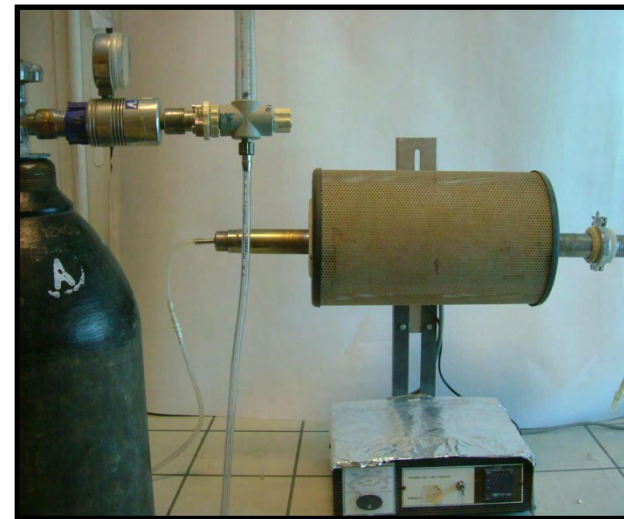
1- Preparation of AC?

Raw material: Exhausted olive-waste cakes

Origine: oil factory "Agrozitex" located in Sfax Tunisia



Pyrex reactor for the impregnation step of olive-waste cakes with H_3PO_4



Cylindrical steel reactor for the step of pyrolysis of the impregnated olive-waste cakes under N_2 flow

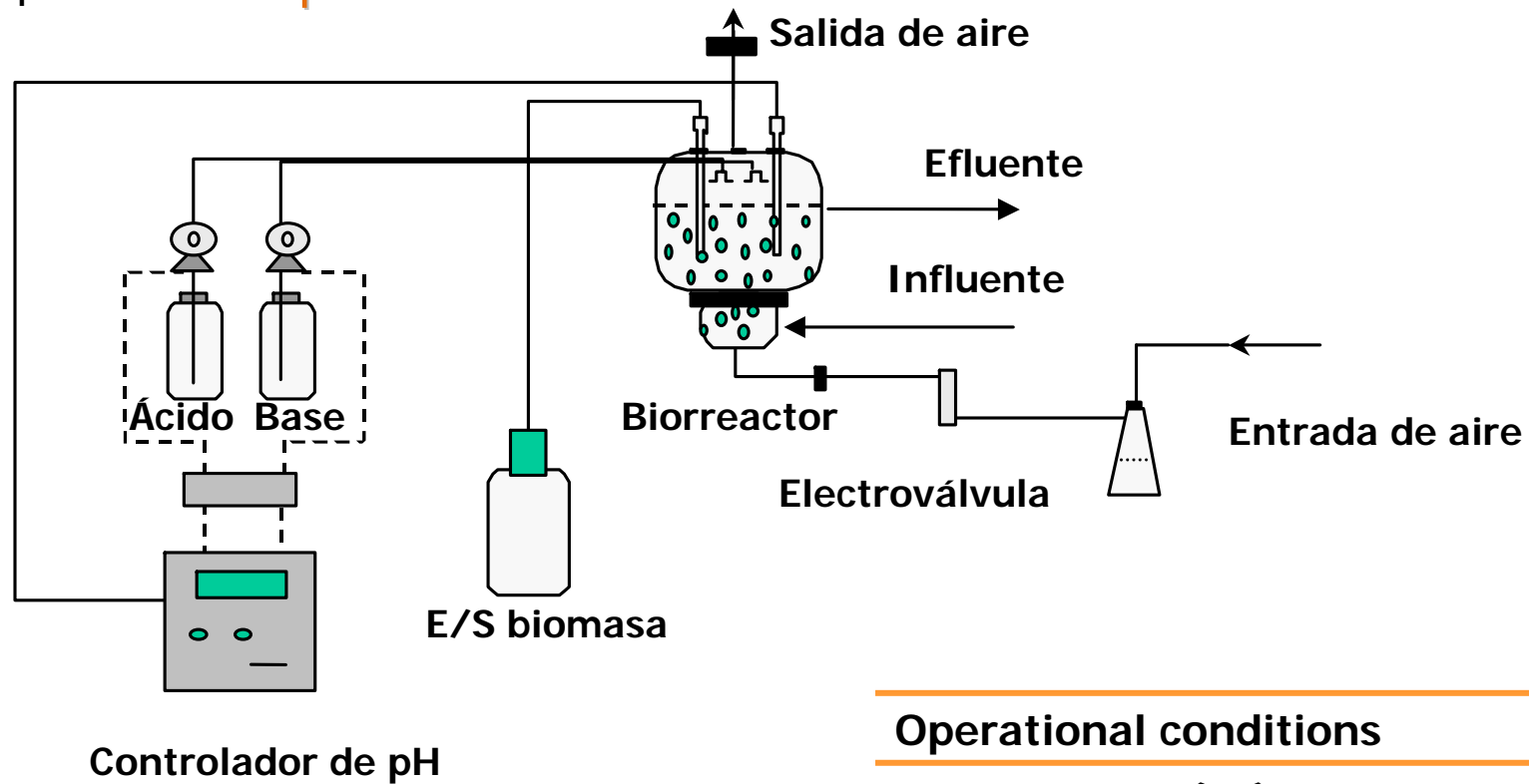
Characterization of the prepared AC: Particles size distribution, BET, I_2 and MB numbers, SEM, XR

2- Biological treatment

- Microorganism: Pellets of *Trametes versicolor*

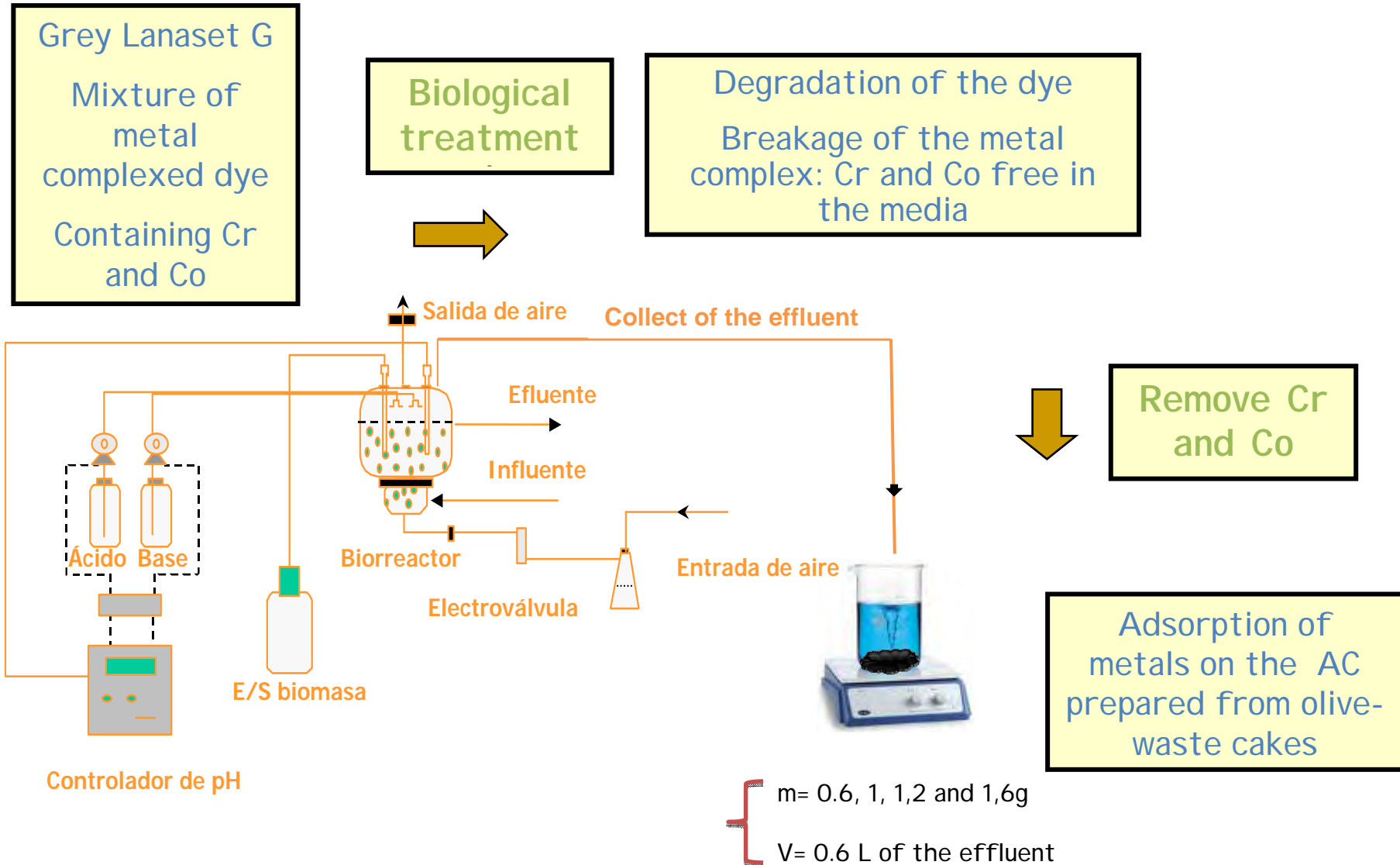


- Equipement: Air pulsed fluidized bioreactor



Operational conditions	
Temperature (°C)	25
pH	4.5

3- Combination of two processes for the treatment of GLG:



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1- Characteristics of the AC

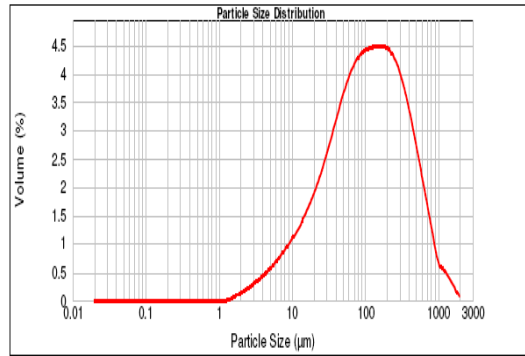
2- Adsorption of Grey Lanaset G

3- Biological treatment with *Trametes versicolor* followed by the adsorption

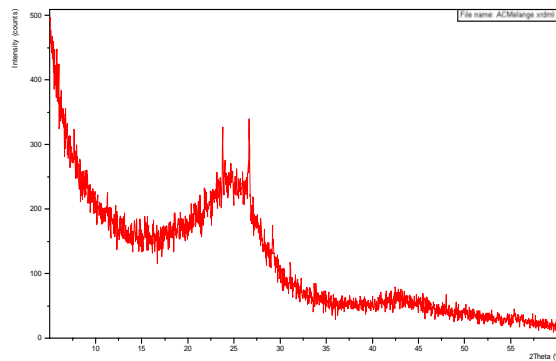
☀ *Conclusion and perspectives*

Preliminary results

1- Characteristics of the AC



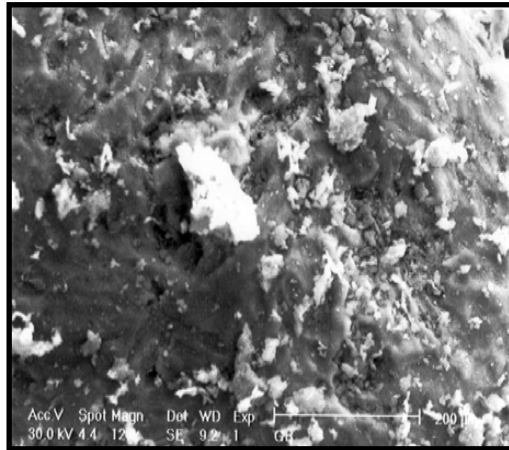
The particles size of the AC varied from 110 and 500 µm



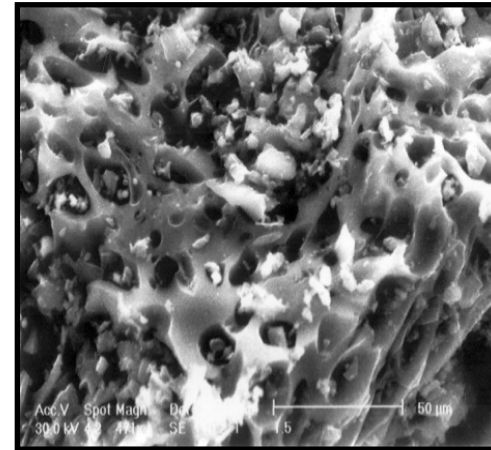
The X-ray diffraction analysis of activated carbon did not show any peak indicating amorphous nature of the carbon prepared from olive-waste cakes.

1- Characteristics of the AC

Morphology analysis



Raw olive- waste cakes



Optimal AC




The surface of the olive waste cakes was quite smooth without any porous structure \neq the sorbent surface exhibits a clear porous structure and a predominately microporous character.

1- Characteristics of the AC

Comparison of the characteristics of the prepared AC and those for AC mentioned in the literature

Raw material	Activation process (activation agent)	Adsorbent characteristics				
		I ₂ (mg.g ⁻¹)	BM (mg.g ⁻¹)	SBET (m ² .g ⁻¹)	Total pore volume (m ³ .g ⁻¹)	Average pore diameter (nm)
Olive-waste cakes (this work)	Chemical (H ₃ PO ₄)	583	312.5	793.93	0.4927	4.1994
Grain sorghum	Chemical (H ₃ PO ₄)	-	-	182-508	-	-
Peach stones	Chemical (H ₃ PO ₄)	-	-	632	-	-
Olive-seed waste	Chemical (KOH)	-	190-262	367-506	-	-
Olive-waste cakes	Physical (steam)	-	-	514-1271	-	-
Olive stones	Physical (steam and N ₂ gas mixture)	574	-	-	-	-



The characteristics of the AC obtained in this work compare well and sometimes even favourably with those of the other sorbents.

2- Adsorption of Grey Lanaset G

Table 1: Langmuir and Freundlich isotherm constants for Grey Lanaset G at 25°C.



Langmuir isotherm		Freundlich isotherm	
R^2	0,9986	R^2	0,837
q_{\max}	108,69	n	5,767
R_L	0,0452	K_F	48,337

Langmuir equation provides the best fit.

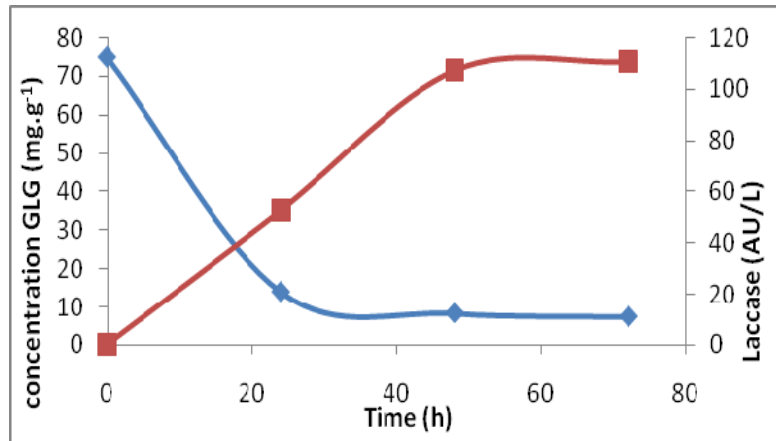
$0 < R_L < 1$
favorable isotherm

Comparison of the maximum capacity adsorption of the AC prepared from olive-waste cakes and the commercial AC F400 and CAL (Chemviron Carbons)

Type of AC	AC prepared from olive-waste cakes	Commercial ACs	
		F400	CAL
q_{\max} (mg.g ⁻¹)	108.69	454.54	56.82

➡ The maximum adsorption capacity of the carbon obtained in this work is less than the commercial activated carbon F400 but it is almost the double of the other commercial sorbent CAL.

3- BIOLOGICAL TREATMENT WITH *TRAMETES VERSICOLOR* FOLLOWED BY THE ADSORPTION:



Laccase activity and colour time course during the biological process

Fig shows that the most substantial color reduction occurred within the first 24 hours. However, low enzyme activity was noticed in the first day.

Samples taken at the beginning and the end of decolourisation process

Table: Concentration of Cr and Co in the medium at the beginning and the end of the biological process

	Dye solution(A)	End process (B)
Chromuim (mg/L)	1.87	1.19
Cobalt (mg/L)	0.59	0.38

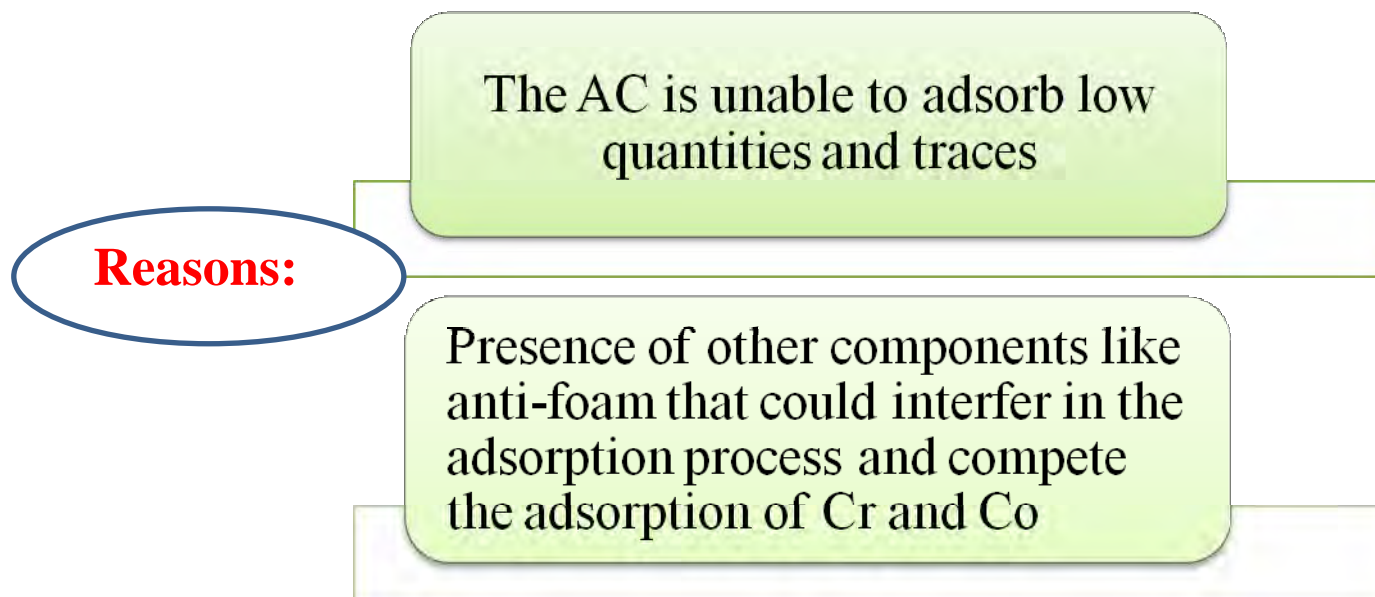
3- BIOLOGICAL TREATMENT WITH *TRAMETES VERSICOLOR* FOLLOWED BY THE ADSORPTION

Table: Variation of the adsorption capacity of Cr on AC at 25°C

Time (min)	10	20	40	60	90	120	180
q_{Cr} (mg.g ⁻¹)	0.11	0.11	0.11	0.13	0.12	0.13	0.13

➔ Low capacities of adsorption of Cr , same results for Co

≠ Cu (previous work) ?



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Conclusions and perspective

- The metal complex dye is **successfully biodegraded** in a **fluidized pulsed bioreactor** filled with pellets of *Trametes versicolor*. The dye is first adsorbed onto the biomass, followed by its transfer into cells. Then degradation occurs within cells and the resulting metals are finally released in the medium.
- **The prepared activated carbon** from Tunisian olive-waste cakes presented a **good capacity of adsorption** of the metal complex dye: Grey Lanaset G **comparing to commercial ACs**.
- The results, found from the application of biological treatment followed by the adsorption on the AC, in order to purify the Grey Lanaset G, show low capacities of adsorption of Cr and Co. These, led us to **modify the AC** in order to ameliorate its adsorption capacity.

Thanks for your
attention