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Water recycling in leather wet-end process

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Introduction

Leather industry is one of the oldest and most traditional industries but is also a source of concern regarding its environmental impact, mainly because of the high amount of wastewater and solid waste. From an economical and environmental point of view, there is a great interest in the process water reduction.

The present work has as main objective the improvement of the treated wastewater quality for its recycling reducing the global water consumption.

Methods

The raw and treated water was supplied by Aveneda and both were initially characterized (Table 1)

Before being introduced into the processes, the waters were submitted to treatments. The raw water was treated by Fenton's reagent (Figure 1 left) and then by activated carbon (Figure 1 right). The original treated water was divided and one part was submitted to Fenton's reagent and the other part to activated carbon.

Table 1 -Initial characterization of treated water and raw water

Parameter	Raw water	Treated water
Total Nitrogen	40 mg/L N	39 mg/L N
BOD	0,65 g/L O_2	0,40 g/L O_2
COD	1,2 g/L O_2	0,99 g/L O_2
Chromium	2,9 mg/L Cr	1,2 mg/L Cr
Total Phosphorus	0,82 mg/L P	0,41 mg/L P
pH	8,6	7,7
TSS	0,12 g/L	16 mg/L
Sulphides	<0,20 mg/L S	<0,20 mg/L S

Treated water → Activated Carbon → Fenton's Reagent (ratio Fe^{2+}:H_2O_2 = 1:5)

Raw water → Fenton's Reagent (ratio Fe^{2+}:H_2O_2 = 1:5) → Activated Carbon

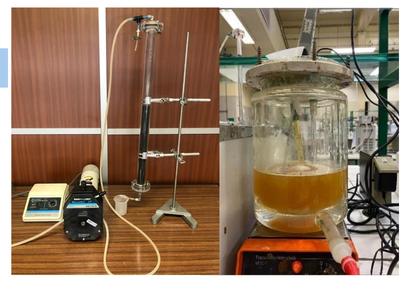

Figure 1- Activated Carbon (left) and Fenton's Reagent (right)

After the treatments, the resultant waters were characterized (Table 2) and seven wet-end processes (retanning, dyeing and fatliquoring) were carried out, one standard and six processes with recycled water using the treated waters (Table 3).

Table 2 –Characterization of raw and treated water after treatments

Parameter	Raw water after treatment with Fenton's reagent and activated carbon	Treated water after treatment with Fenton´s reagent	Treated water after treatment with activated Carbon
Total Nitrogen	21 mg/L N	34 mg/L N	22 mg/L N
BOD	73 mg/L O2	0,27 g/L O2	0,23 g/L O2
COD	0,10 g/L O2	0,41 g/L O2	0,30 g/L O2
Chromium	<0,10mg/L Cr	1,3 mg/L Cr	0,13 mg/L Cr
Iron	2,3 mg/L Fe	0,40 g/L Fe	0,20 mg/L Fe
pH	5,9	2,9	7,4
TSS	<25 mg/L	0,62 g/L	<10 mg/L
TS	2,1 g/L	3,2 g/L	1,8 g/L
Sulphides	<0,50 mg/L S	<0,20 mg/L S	<0,20 mg/L S

Table 3 –Description of wet-wnd processes

Wet-end Process	1	2	3	4	5	6	7
Used Water	municipal water	Treated water after treatment with Fenton´s reagent		Raw water after treatment with Fenton's reagent and activated carbon		Treated water after treatment with activated Carbon	
Observations	Standard	recycled water in the 1st wash	recycled water in the 1st and 2nd wash	recycled water in the 1st wash	recycled water in the 1st and 2nd wash	recycled water in the 1st wash	recycled water in the 1st and 2nd wash
pH of the water before the process	-	6,42		6,24		6,55	
% water reduction	-	21,7	43,5	21,7	43,5	21,7	43,5

Results

In each process, a composite sample (from the various baths resulted from the process) was collected and characterized with the results shown in Table 4. The crust leather obtained from the retanning processes was evaluated (Table 5) in terms of grain cracking (ISO 3379:2015), tear strength (ISO 3377-2: 2016) and ashes.

Table 4 – Characterization of composites samples

Composite Sample	1	2	3	4	5	6	7
pH	3,98	4,05	4,08	4,1	4,16	4,11	4,03
TS (%)	0,86±0,07	0,94±0,16	1,24±0,13	1,15±0,13	1,25±0,19	1,23±0,09	1,24±0,07
TDS (%)	9,9	11	11	11	11	11	11
COD (g/L)	6,8	8,9	7,6	7,8	8,8	8,0	6,5

Table 5 - Results of the crust obtained from retanning processes

Test	Ashes		Grain cracking		Tear strength
	%	dry base %	Distension (mm)	Load (N)	Load (N)
1(Standard)	5,16	6,05	6,88	158,34	72,68
2	5,03	5,89	6,33	114,33	53,52
3	5,52	6,47	6,42	145,91	72,91
4	5,60	6,56	6,69	154,57	70,57
5	5,70	6,71	7,67	174,69	54,60
6	5,38	6,28	6,90	101,14	47,47
7	5,67	6,62	8,52	293,27	70,21
Minimum values required for footwear			7,0	200	50

Conclusions

Treated wastewater from tanneries working wet-blue and wet-white, was refined by activated carbon and Fenton oxidation for recycling in the wet-end process. The treatment efficiency was good in both ways, resulting in a chemical oxygen demand reduction of about 92% to raw water and 75% to normal treated water, and allowing greater water quality for recycling when compared with the normal treated wastewater. The water obtained was applied in the first and second washes of the wet-end process and the leather obtained was evaluated.

Organoleptic properties, physical-mechanical resistances and ashes of the leather obtained were evaluated with good results when compared with the standard process. Pilot recycling trials were done at Aveneda and Dias Ruivo with good results.

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