



DEGRADATION OF CONTAMINANT ORGANIC COMPOUNDS:

A possible solution for the environment



**Think of a
river ...**



Source: <https://graphics.reuters.com/INDIA-RIVER/010081TW39P/index.html>



What do you think that have in mineral water? Is the water pure?



Mineral water label



DEPT. OF HYGIENE, PREVENTIVE MEDICINE AND PUBLIC HEALTH
AT THE UNIVERSITY OF MESSINA
CHEMICAL AND PHYSICAL ANALYSIS

WATER TEMPERATURE AT THE SOURCE	°C	7,8
HYDROGEN IONS AT THE SOURCE	PH	7,65
FIXED RESIDUE AT 180°C	mg/l	105
SPECIFIC ELECTRICAL CONDUCTIVITY AT 20°C	µS/cm	135
AMMONIACAL NITROGEN (NH ₄ ⁺)	mg/l	assente
NITRITES (NO ₂ ⁻)	mg/l	assenti
CARBON DIOXIDE AT THE SOURCE	mg/l	2,50
ARSENIC	mg/l	assente

ELEMENTS CONTAINED IN 1 LITRE OF WATER (mg /l)

CALCIUM	Ca ⁺⁺	16,8	CHLORIDE	Cl ⁻	7,3
SODIUM	Na ⁺	6,1	FLUORIDE	F ⁻	0,2
MAGNESIUM	Mg ⁺⁺	4,9	SILICON DIOXIDE	SiO ₂	16,0
POTASSIUM	K ⁺	1,7	BICARBONATE	HCO ₃ ⁻	83,6
SULPHATE	SO ₄ ⁼⁼	8,2	NITRATE	NO ₃ ⁻	2,0

Messina 17/11/2014 Prof. O. C. Grillo

BACTERIOLOGICALLY PURE AT THE SOURCE
FONTENOCE water complies with L.D. no. 176 of 08/10/11

SUITABLE FOR LOW SODIUM DIETS

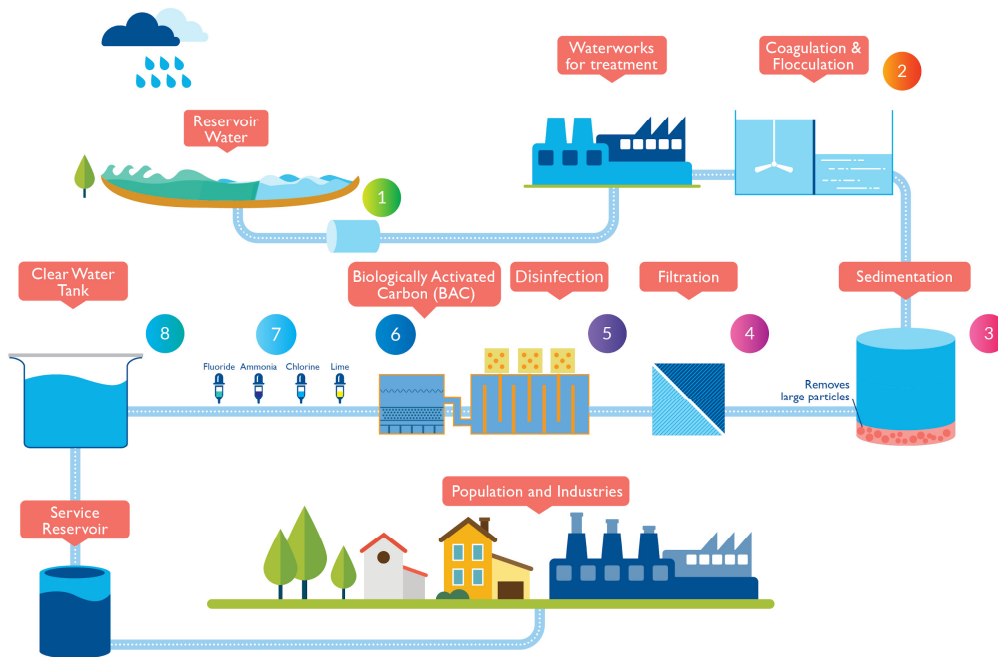
Can anyone
read what is
written here?

Source: <http://www.ibslifestylewater.com/properties-label/>

What substances do you think that have in your tap water?



Conventional water treatment



Source: <https://www.pub.gov.sg/watersupply/watertreatment>

Evaluation

- ✓ Chlorine
- ✓ Fluorine
- ✓ Turbidity
- ✓ Color
- ✓ pH
- ✓ Coliforms

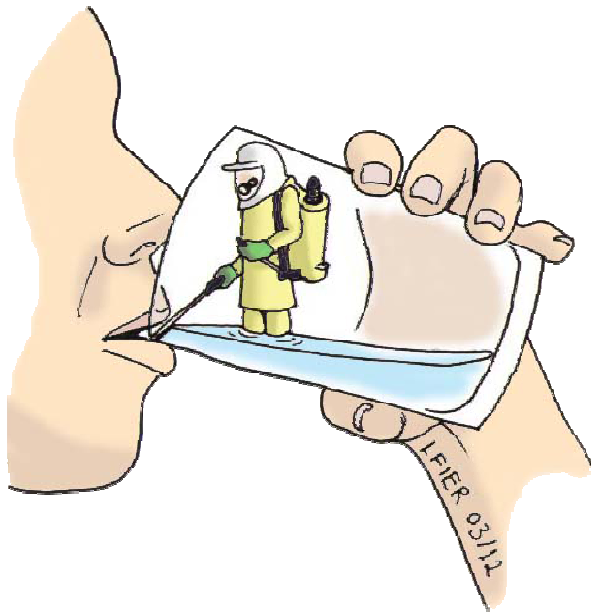
That's
enough?

Contaminant limits

Name of the Contaminant	Permissible Limit as suggested by WHO (mg/L)	Some of the Diseases/Problems Caused (if the actual concentration is more than the permissible limit)
Cadmium	0.003	Kidney dysfunction and lung impairment.
Iron	Not Given	Inflammatory problems, kidney problems, hypertension.
Arsenic	0.01	Black foot disease, arsenicosis.
Lead	0.01	Lead poisoning.
Mercury	0.006	Hydrargyria.
Chlorine	5.0	Possible artery damage, melanoma, and cancers
Nitrate (as nitrate ion)	50.0	Reduction in the oxygen-carrying capacity of blood, blue-baby syndrome
Fluoride	1.5	Dental and skeletal fluorosis
DDT	0.001	Headache, nausea, vomiting, confusion, and tremors.
Uranium	0.03	Nephritis.

Source: https://www.researchgate.net/publication/305280524_A_Sustainable_and_Economical_Approach_to_Water_Treatment_A_Review_in_Context_of_India

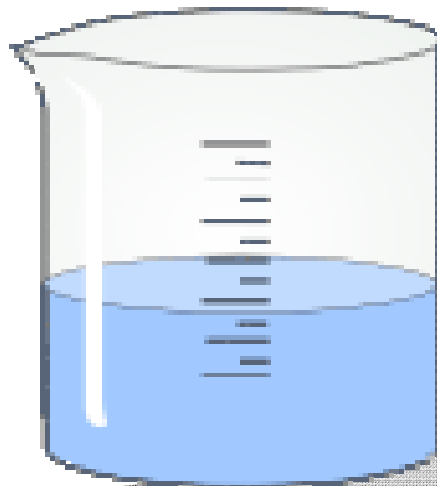
Contaminants



Do you think there is a procedure that can eliminate these contaminants, for example, dyes, from water?

Thinking about a problem situation:

Imagine that you are a chemist and collected a sample of water from a river and it had the following characteristic.



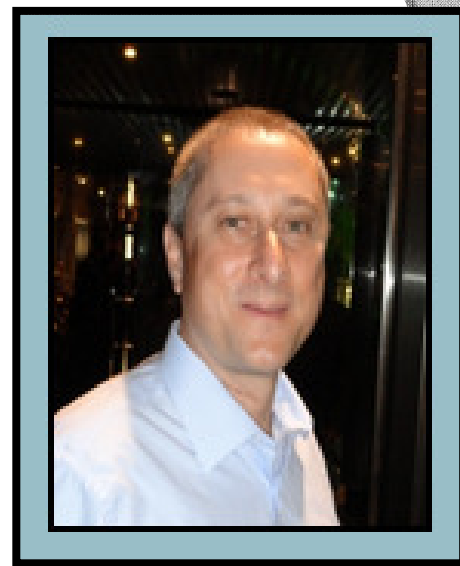
WE NEED TO ANSWER



How can we make it “decontaminated” again?

With what treatment?

CHEMISTRY

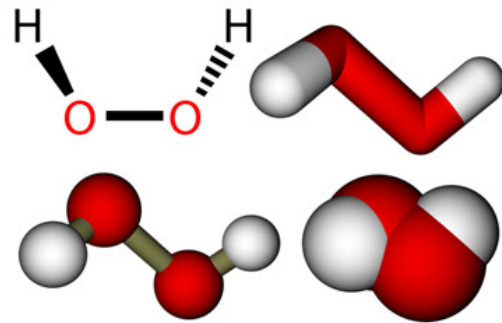


Prof. PhD Marcos Roberto de Vasconcelos Lanza and the Electrochemical and Environmental Processes Group – GPEA

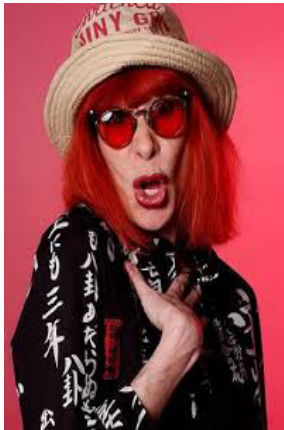
Advanced Oxidative Processes

The objective is to degrade pollutants that are not completely removed by conventional water treatment.

Advanced Oxidative Processes (POA)



In your daily life,
where do you
use hydrogen
peroxide?



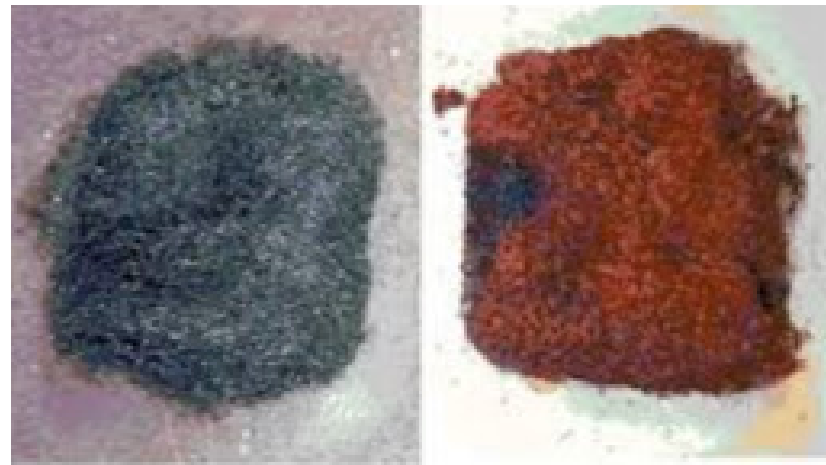
Hydrogen peroxide is commonly used to bleach hair.

Hydrogen peroxide
Hydroxyl Radical



U.V.





Before

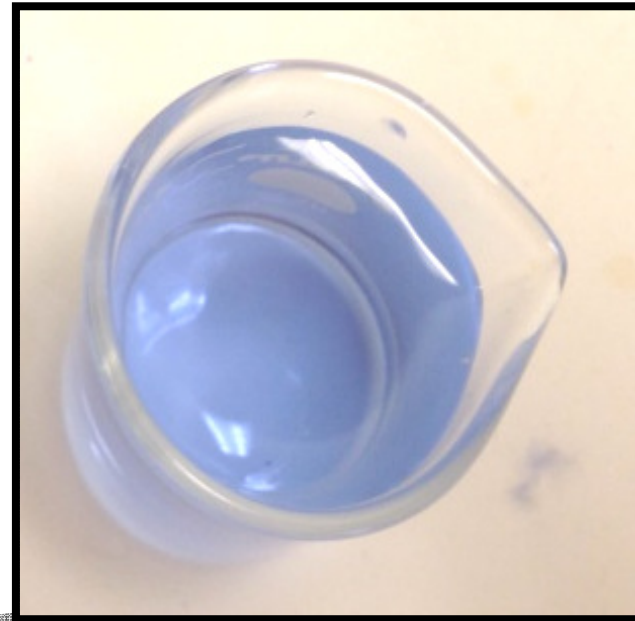
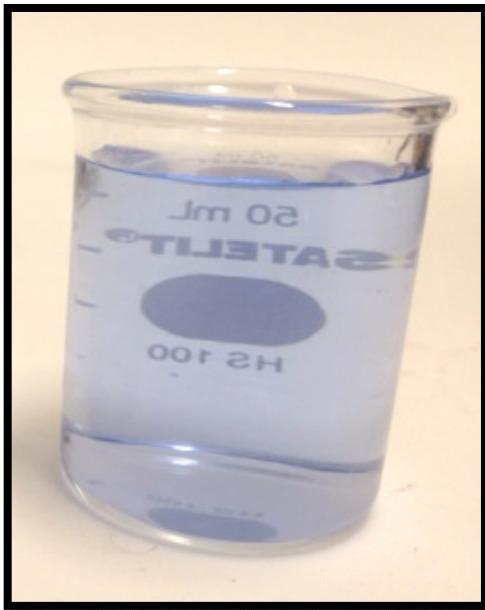
After

Example of an oxidized rock in a museum

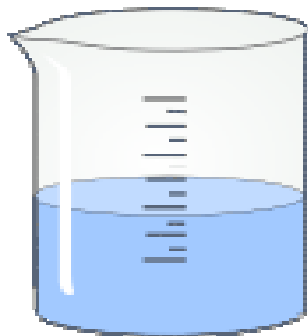


Returning to the problematic

**How can we decontaminate water?
Let's see how advanced oxidation
processes work?**



THE EXPERIMENT



Laboratory materials used



Beaker



Beaker



Pipette



Magnetic bar



Balance

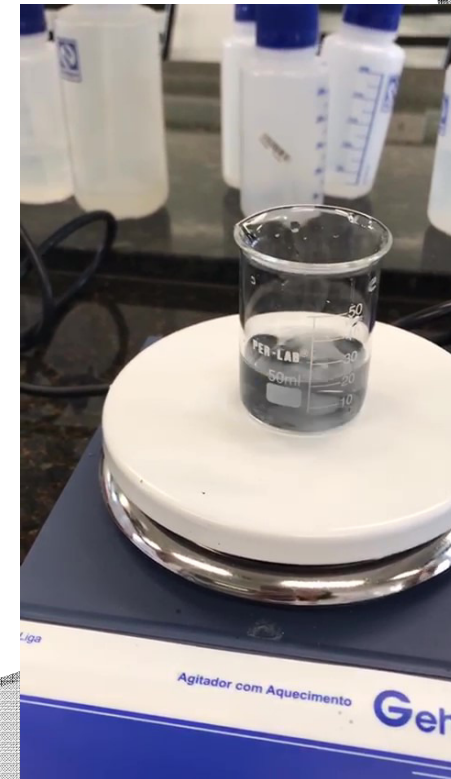
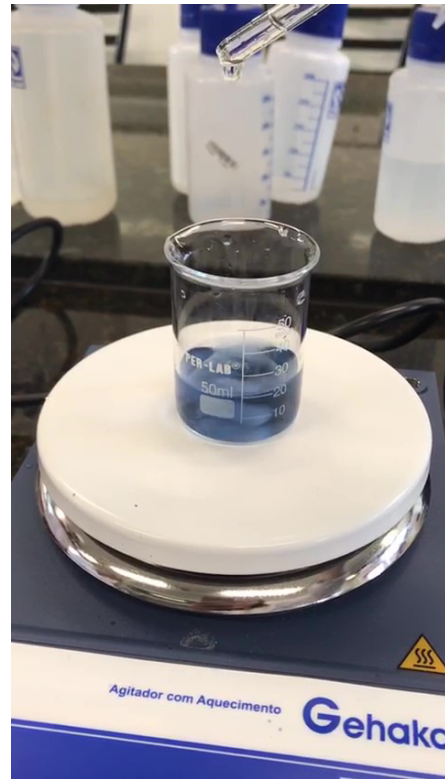
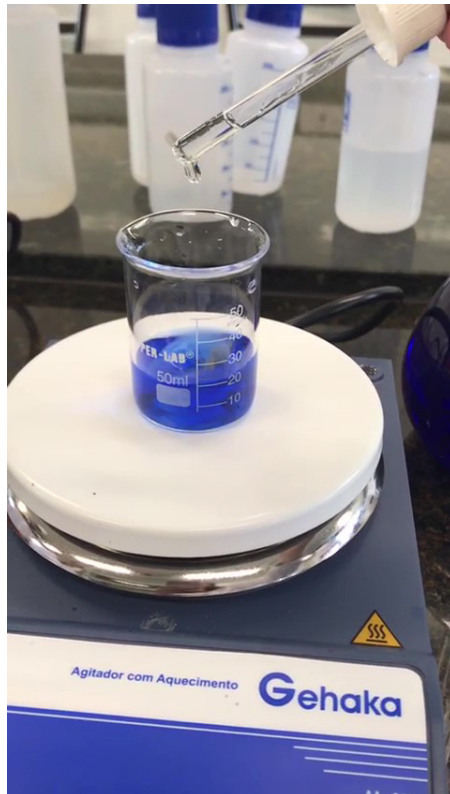


Magnetic shaker

EXPERIMENT

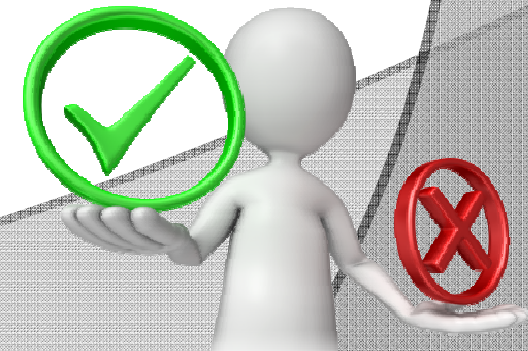
- ✓ Add to a beaker with 40mL of distilled water and 10mL of dye;
- ✓ Then place a piece of steel wool (~ 0.05g) (releasing the iron in the reaction);
- ✓ Leave under constant agitation;
- ✓ Add 1 ml hydrogen peroxide (3% hydrogen peroxide), and observe.

What happened in the experiment?

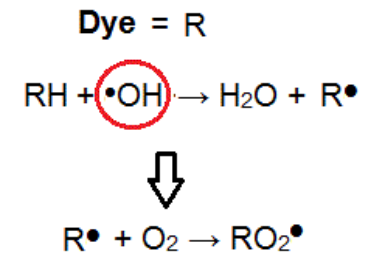
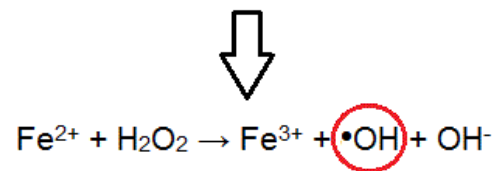
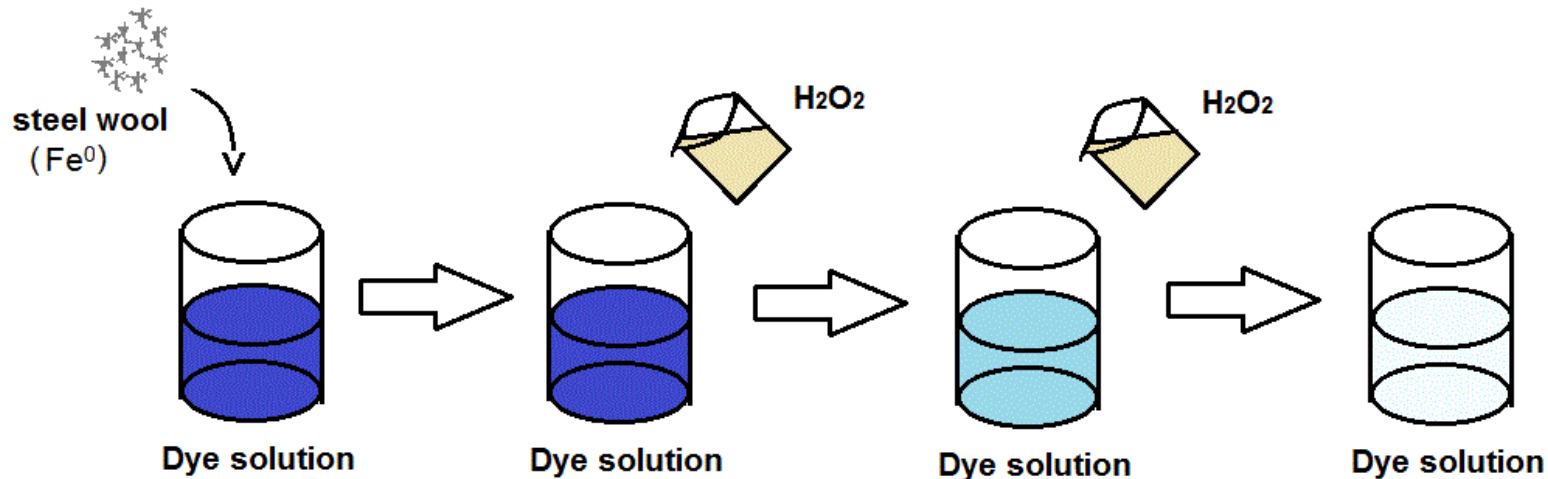


ADVANGES of POA

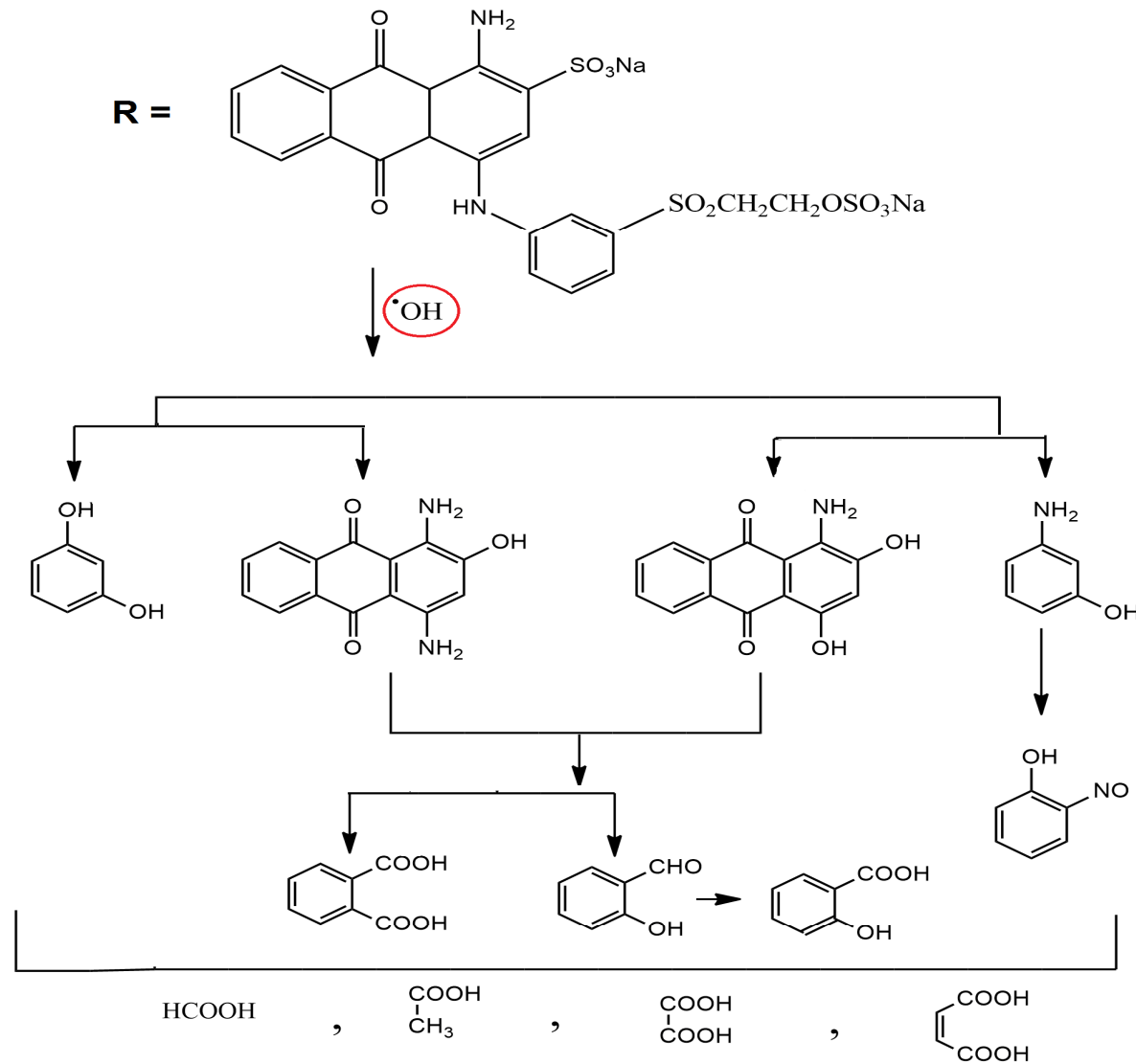
- It has strong oxidizing power.
- It promotes the oxidation of complex compounds until they convert to CO_2 , H_2O and inorganic compounds, such as gases.
- They don't need post-treatment;
- Consume less energy;
- Enable *in situ* sorting.



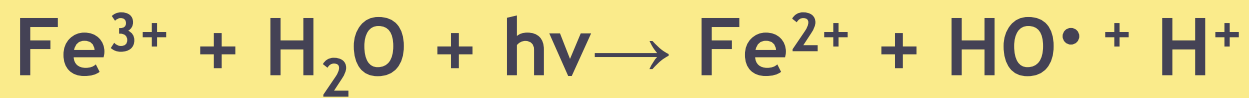
Degradation reaction of blue dye 19



Blue 19 Reactive Dye Molecule



Cicle $\text{Fe}^{2+}/\text{Fe}^{3+}$

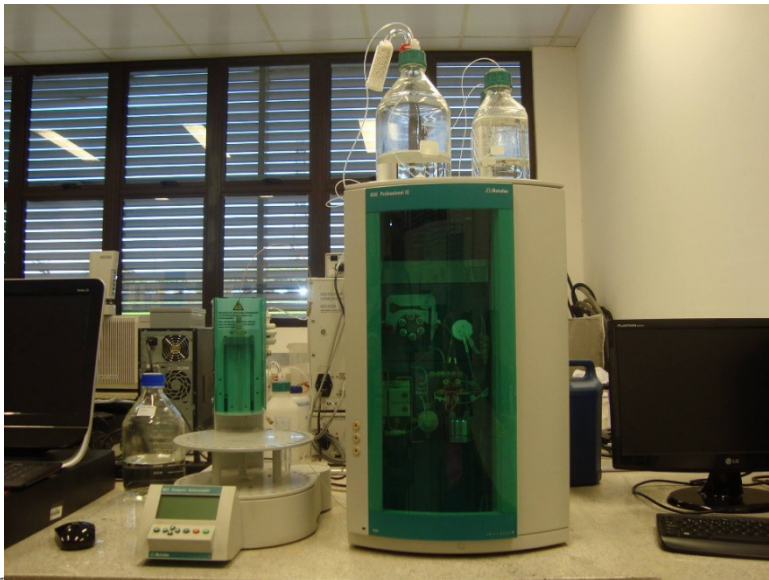


**As we know what is in
the treated solution?**

Chemical analysis



To find out what is in the treated solution, we can use different types of chemical analysis, such as chromatography.



Research Lab



● The research lines are:

1) Development and evaluation of processes / materials for the electrosynthesis of hydrogen peroxide in-situ;

2) Development and evaluation of electrode materials for electrochemical synthesis processes and / or for the treatment of effluents;

3) Development and evaluation (POA);

4) Development and evaluation of electrochemical sensors and / or biosensors for online analysis.

Is this process applied?



Group of electrochemical and environmental processes:



Scientific research
Master's
PhD
Post doctoral

Partnerships

The Paulista State University - UNESP
Araraquara

Federal University of São Paulo - UNIFESP

São Carlos School of Engineering - EESC

University in Canada

Thanks!

Scholarship students involved:

Ana Carolina Steola

Ariane Carolina da Rocha

Caio Nunes

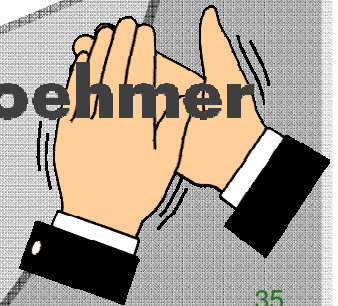
Daniel Matheus da Silva

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Fábio Gullo

Coordenation: Kenia Naara Parra

Supervision: Prof.^a Dr.^a Ana Cláudia Kasseboehmer



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