Biopolymers –Based Composites With Great Potential For Environmental Applications

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Introduction

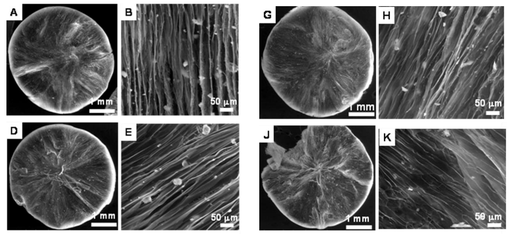
Biopolymers have received a growing scientific attention in the last decades. As a renewable, low-cost natural resource, chitosan (CS) is one of the most prominent representatives of polysaccharide biopolymers, combining in a unique manner a set of particular physiochemical and biological properties, including antimicrobial activity, non-toxicity, biocompatibility and biodegradability. CS is well-known for its sorption properties, being able to remove metal ions from dilute solutions either by electrostatic interactions or chelation [1]. We investigate here the performance of novel ion-imprinted composite cryo-beads based on naturally available components, as CS and natural zeolites for the selectively removal of Co^{2+} ions from aqueous mixtures [2]. To gain an increment in accessibility and availability of reactive groups towards water and metal ions, the ion-imprinted polymers (IIPZ) were prepared by cryogelation [3,4].

Materials and method

- CS from shrimp shells, with a relative viscosity-average molecular weight of 330,000 Da and a deacetylation degree of 85%; two types of zeolites were involved in preparation of cryo-beads: one coming from the volcanic tuffs cropped out in the Macias Area (Cluj County, Romania), containing about 60–70 wt% clinoptilolite (Z1), whereas the second one was supplied by ZeoCat Soluciones Ecológicas S.L.U., consisting of 82–86 wt% clinoptilolite (Z2).
- Ion-imprinted (IIPZ) and non-imprinted (CSZ) composites, as beads, were prepared by dropping the polymer/zeolite/cross-linker mixtures in liquid nitrogen , followed by their transfer into a cryostat at -18 ^{0}C, to complete the cross-linking reactions;
- Batch sorption experiments were performed in order to evaluate both the maximum sorption capacities of cryo-beads towards Co^{2+} ions and the selective separation of template ions (Co^{2+}) from their mixtures with Cd^{2+}, Cu^{2+}, Fe^{2+} and Ni^{2+} ions.

Results and discussions

SEM micrographs of the cryo-beads

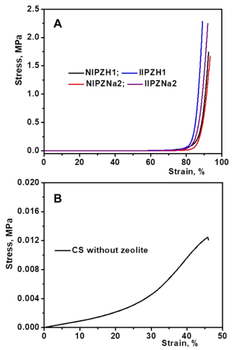


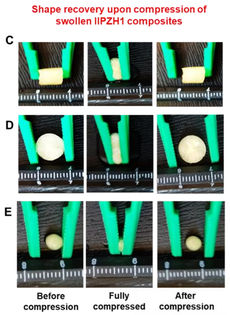
SEM micrographs of CoIIPZH1 (images A and B), of CoIIPZH2 (images D and E), of CoIIPZNa1 (images G and H), and of CoIIPZNa2 (images J and K).

Sample codes, swelling ratio (SR, g/g) of IIPZ- and NIPZ- composite cryo-beads (Table 1)

Composite cryo-beads	CS/zeolite weight ratio	NH_2/Co^{2+} weight ratio	Type of zeolites[a]	Zeolite form after the pre-treatment[b]	SR, g/g pH 4	SR, g/g pH 6
CoIIPZH1	4:1	1:8	Z1	H^+	39.14	32.18
CSZH1	4:1	1:8	Z1	H^+	30.95	27.85
CoIIPZH2	4:1	1:8	Z2	H^+	42.27	36.90
CSZH2	4:1	1:8	Z2	H^+	32.33	30.29
CoIIPZNa1	4:1	1:8	Z1	Na^+	37.22	46.73
CSZNa1	4:1	1:8	Z1	Na^+	31.19	34.17
CoIIPZNa2	4:1	1:8	Z2	Na^+	48.05	47.14
CSZNa2	4:1	1:8	Z2	Na^+	43.14	35.73

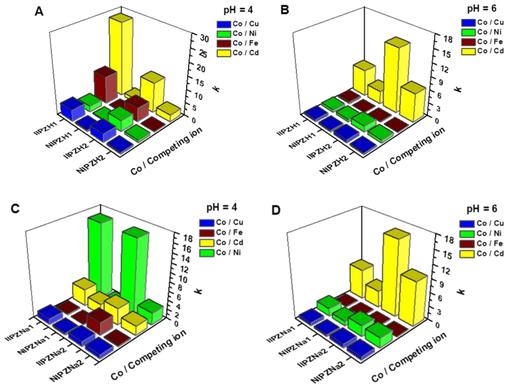
Compressive stress-strain curves of composite cryo-beads





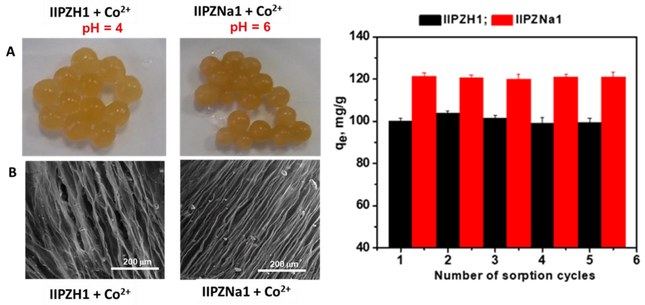
(A) Compressive stress-strain curves of NIPZH1, IIPZH1, NIPZNa2, and IIPZNa2 composite cryogels. (B) The compressive stress-strain curve of CS cryogels without zeolites. Optical images showing the shape recovery of the IIPZH1 composite as monoliths (C), disks (D), and beads (E) upon compression by plastic tweezers.

Selective sorption of Co^{2+} ions



Selective sorption of Co^{2+} ions from their five-component mixtures, at pH 4 and 6, onto the composite cryo-beads containing zeolites activated with an aqueous solution of either 1M HCl or 1M NaCl.

Optical images of composites loaded with Co^{2+} ions and the reusability of sorbents



(A) Optical images of IIPZH1 and IIPZNa1 composites loaded with Co^{2+} ions at pH 4 and pH 6; (B) SEM micrographs of IIPZH1 and IIPZNa1 sorbents loaded with Co^{2+} ions; (C) The reusability of IIPZH1 and IIPZNa1 sorbents in five consecutive sorption/desorption cycles.

Conclusions

- ✓ Novel ion-imprinted CS-based composite cryo-beads with triggered selectivity for Co^{2+} ions were successfully developed by combining the pH-dependent adsorptive features of activated zeolites with ion imprinting technology.
- ✓ The cross-section morphology is almost similar for all cryo-beads presenting a radial lamellar pattern, typical for materials prepared using this freezing procedure.
- ✓ The swelling ratio (SR) values of Co^{2+}- imprinted composites are higher than those of non-imprinted ones, regardless the pH value and zeolite pre-treatment strategy, since a larger fraction of CS amine groups participate into the chelation process.
- ✓ Typical compressive stress-strain curves were observed for all swollen cryogel samples under compression. The all zeolites-reinforced cryogels have higher compressive strengths (1.4–2.3 MPa) than the CS cryogels without zeolites (about 0.012 MPa).
- ✓ The maximum experimental sorption capacity values for Co^{2+} sorption from single-component aqueous solutions, i.e. non-competitive experiments, were achieved when the zeolites incorporated into the ion imprinted cryo-beads were conditioned with NaCl (120.4 mg/g for IIPZNa1 and 126.6 mg/g for IIPZNa2).
- ✓ Successive sorption/desorption cycles showed remarkable chemical stability of composite cryo-beads during experiments.

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The role of risk analysis in development of integrated management systems. Evidences from energy industry tle

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Introduction

At international level, it is observed the increasing complexity of phenomena and interdependency between economic, social and technological processes. According with Arthur (1999), Complexity portrays the economy not as deterministic, predictable, and mechanistic, but as process dependent, organic, and always evolving.

The managers must be able to turns constraints into opportunities and to change their perspective about their profession. They must find the proper way from "managing resources and human labor" to "managing the application of knowledge".

Materials and method

The energy field is characterized, more than any other field, by a dynamic competition:

- market dynamics - regional, Eurasian and global market - dependent mainly on the current and future energy infrastructure of each state but also on the policy of major producers in Eurasia, the Middle East, North Africa and the USA;

- dynamic due to the global strategy on mainly environmental protection as well as the seasonal nature of demand

Results and discussions

The energy industry in general and the oil and gas industry in particular are areas of activity that are constantly subject to **political, financial, social and environmental constraints**. In these circumstances, controlling the **threats to the company and possibly turning them into opportunities** can give the organization a significant competitive advantage in the market. Taking in account these considerations, managers have the opportunity to opt for the implementation of an integrated management system - a management tool that has proven its effectiveness in many practical applications. The aim of the article is the analysis of the importance of an integrated management system`s development in oil and gas enterprises.

The effectiveness of a **risk management program** is expressed by framing hazardous situations and their severity within the limits set by the security objectives.

Risk assessment requires a clear definition of them, including an assessment of the influence of risk on the process, the severity of the consequences, the sensitivity of the process to risk and the likelihood of materialization of the proposed objectives under risk conditions.

Model proposed

1. Indentification of policital factors, economic factors, social factors and environmental factors that could affect the activity of a company (**macro level).**
2. Determination of (1) management factors, organizational structure, role and responsibilities, (2) technological factors, (3) social factors , (4) environmental factors , (5) occupational safety and health factors. (**micro level**).

Conclusions

Effective management is the one that manages to design the link of short-term actions with long-term strategic objectives (Balanced Scorecard).

not all risky situations offer the possibility to identify opportunities. Recognition of opportunities depends essentially on the ability of management to accept reality and to base strategies on the results of risk analysis.

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Adsorption of Benzalkonium Chloride on Unmodified Adsorbents

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Introduction

❖ **WHY**:
- Benzalkonium chloride (**BKC**) = heavily used biocide → toxic to aquatic environments[1]
- Adsorption is an economically efficient/sustainable way of removing toxic waste from aqueous solutions

❖ **NOVELTY**:
- **Unmodified** adsorbents: more cost efficient and environmentally friendly [2]
- Adsorption on **unmodified waste** materials (sawdust, textiles, paper, etc.)

❖ **POTENTIALLY IMPORTANT** :
- Filters for BKC removal from some household grey water → reuse of water source

Materials and method

- Household and unmodified adsorbents: **sawdust**, paper towel, tea filter, viscose cloth, cotton string
- Adsorption process monitored *via* Absorbance = f(t) at 262 nm
- ε= (1.184 ± 0.011) $(g/L)^{-1}.cm^{-1}$ at 262 nm

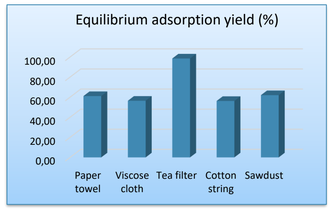
Objectives

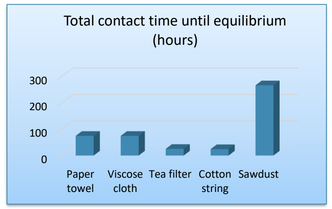
➢ Comparison among adsorbents
➢ Adsorption kinetic model (BKC on sawdust)

Results and discussions

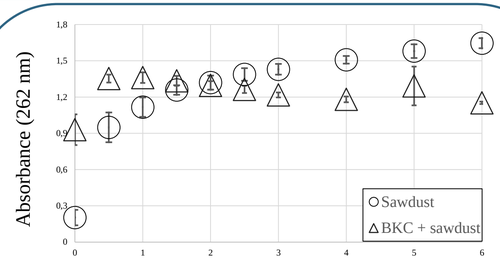
Adsorbent type	Price (EUR/kg)*	Accessibility	Standardization	A (262 nm)
Paper towel	7,53	Easy (retail)	Yes	0.015 ± 0.012
Viscose cloth	30,25	Easy (retail)	Yes	0.018 ± 0.009
Teafilter	82,24	Easy (retail)	Yes	0.018 ± 0.008
Cotton string	16,67	Easy (retail)	Yes	0.003 ± 0.003
Sawdust	0,16	Easy (retail, household, industry, etc.)	Requires processing	From 0.38 to 3.60

*currency exchange rates of August 2020





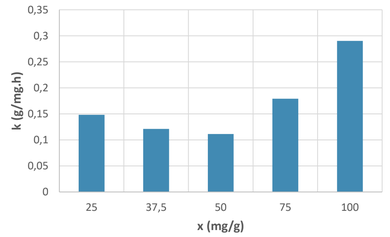
Conclusions:
(1) paper towel & sawdust → most promising
(2) sawdust → most accessible acquisition cost



Absorbance *vs* total contact time in aqueous mixtures.
Adsorption kinetics of BKC on sawdust: pseudo 2nd order kinetic law

Values at 45 °C: **k = 0,22** $g.mg^{-1}.h^{-1}$; **q_e = 12,18** $mg.g^{-1}$

Effect of temperature (18 – 45 °C) → **E_a = 28,70** $kJ.mol^{-1}$



Higher mass ratio of BKC to sawdust (x) favors process rate

Conclusions

➢ Comparison between the adsorbents → paper towel - most suitable; sawdust – most cost efficient.

➢ Overall Absorbance cumulates sawdust and BKC contributions

➢ Overall process: pseudo-second order kinetics, with Ea = 28,70 $kJ.mol^{-1}$

➢ A ratio of 100 $mg.g^{-1}$ or higher favors considerably the second order rate coefficient

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Synthesis of ZnO as an efficient photocatalyst for the elimination of organic dyes in aqueous suspension over solar light irradiation

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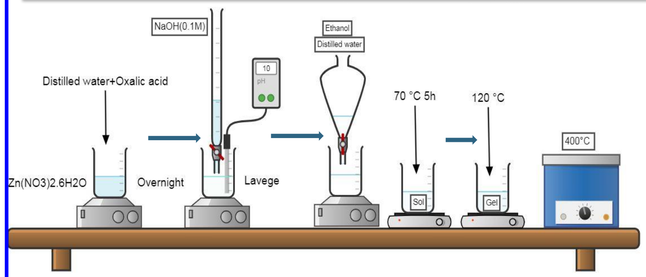
Introduction

- Wastewaters generated by textile industries are today well-known to contain large amounts of organic and inorganic hazardous pollutants [1].
- These effluents represent a real source of contamination for the aquatic environment because most of these synthetic organic molecules pose toxic, mutagenic and carcinogenic effects [2].
- Today there is a real need to developed new effective technologies to treat textile dyes effluents before their discharge to the aquatic environment.
- Solar photocatalysis was recognized during the last years, as a promising green technology for the water and wastewater purification applications [3].

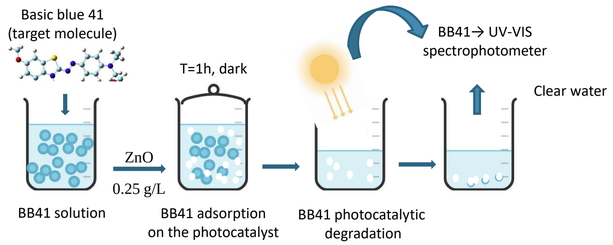
OBJECTIVE: Evaluation of the photocatalytic performance of ZnO oxide semi conductor synthesized by co-precipitation for the degradation of an azo cationic dye, named Basic blue 41 under solar light irradiation conditions.

Materials and method

Preparation of ZnO powders by co-precipitation route



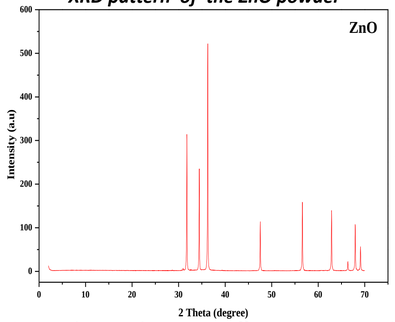
Photocatalytic process



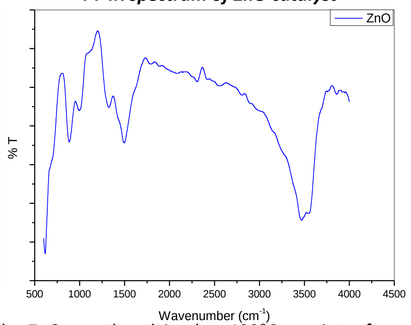
Results and discussions

Prepared material characterization

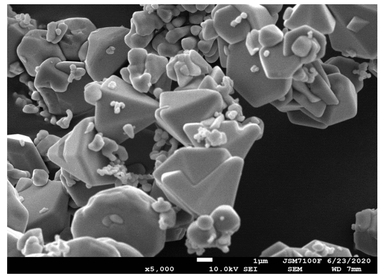
XRD pattern of the ZnO powder



FT-IR spectrum of ZnO catalyst



SEM image of ZnO sample

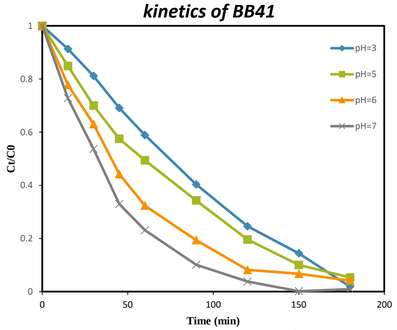


⇨According to the X-Ray Diffraction pattern, the ZnO sample calcined at 400°C consists of wurtzite (JCPDS Card No. 36-1451) as a single pure crystalline phase (planes (100), (002), (101), (102), (110), (103) and (112)).

⇨ According to the FTIR spectra, data the band observed at 611 cm^{-1} can be assigned to the Zn-O vibration, the wide band between 3200-3600 cm^{-1} is characteristic of O-H groups from hydration water molecules. The band from 1500 cm^{-1} is due to Zn hydroxo oxalate complex remaining from the oxalic acid.

Photocatalytic activity evaluation

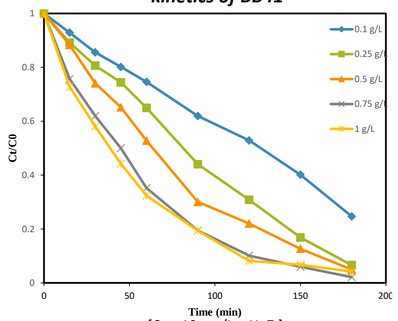
Effect of pH on the degradation kinetics of BB41



[C_o = 10 mg/L, (ZnO) = 1 g/L]

⇨ The degradation of the dye is enhanced when pH is increased from 3 to 7.
⇨ At pH 7 the maximum initial degradation rate is achieved.

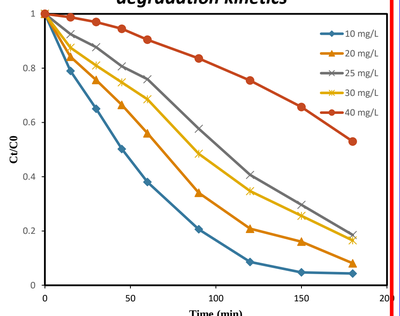
Effect of ZnO dose on the degradation kinetics of BB41



[C_o = 10 mg/L, pH=7]

⇨ BB41 degradation kinetics are faster for the highest ZnO concentration.
⇨ The limit of catalyst load is apparently reached at 0.75 g/L of ZnO.

Effect of BB41 concentration on the degradation kinetics



[(ZnO)= 0.75 g/L, pH=7]

⇨ Initial BB41 concentration effects the polluant degradation kinetics.
⇨ Dye degradation is enhanced when the concentration of BB41 is decreased from 40 to 10 mg/L.

Conclusions

- The method used for the synthesis of ZnO seems to be a promising strategy for the preparation of photocatalytic semiconductor with activity under solar light.
- The prepared ZnO nanostructures exhibit good photocatalytic activity in the removal of azo cationic dyes.
- Obtained results provide new relevant information on the degradation of Basic blue 41 dye under solar irradiation conditions.
- Collected data confirm the potential use of the prepared catalyst for future application of the detoxification of the effluents for the textile industries.

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Phase equilibria of CO_2 + organic compounds and their potential role in CCS

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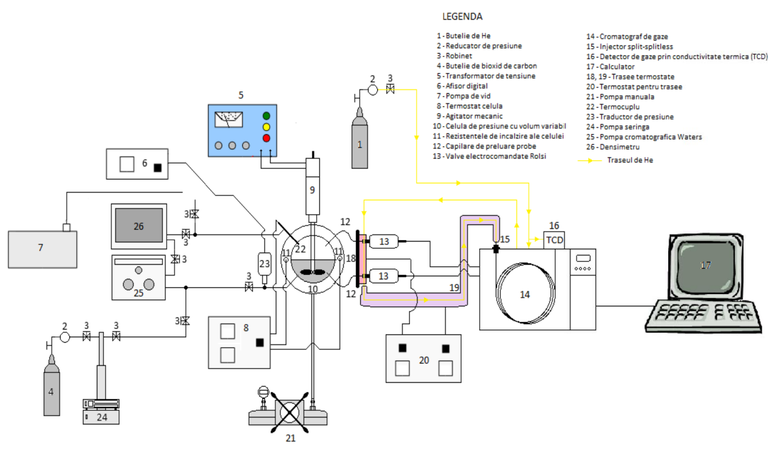
Objectives

- High-pressure phase equilibrium data were measured for binary systems containing carbon dioxide + alcohols, + ethers, + alkanes, + esters using a high-pressure installation.
- The experimental results are discussed and compared with literature data, when available.
- Measured VLE data and literature data were modeled with cubic equations of state (EoS) using classical van der Waals (two-parameter conventional mixing rule, 2PCMR) mixing rules.

Method

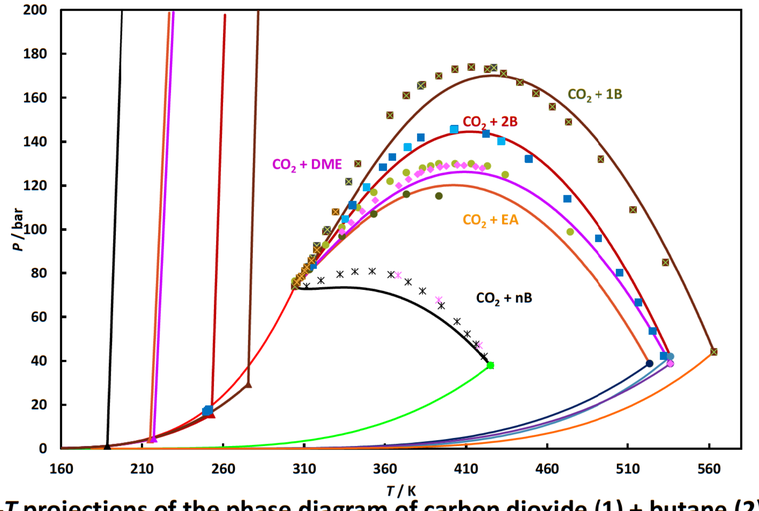
- Phase behaviour measurements were made in a high-pressure visual cell with variable volume, based on the static-analytic method with phases sampling by rapid online sample injectors (ROLSI) coupled to a gas chromatograph (GC) for analysis.



MODELLING PROCEDURE

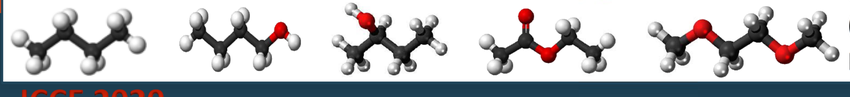
- New measured and literature data for carbon dioxide + 2-butanol system was modelled with several cubic equations of state (EoS), namely the General Equation of State (GEOS), Peng–Robinson (PR), and Soave–Redlich–Kwong (SRK), using classical van der Waals (two-parameter conventional mixing rule, 2PCMR) mixing rules.
- One unique set of binary interaction parameters tailored for the carbon dioxide + 2-butanol system was then used to predict the phase behaviour of several binary systems.
- We exemplify here the predictions of the critical behavior for the carbon dioxide + n-butane (nB), + 1-butanol (1B), + 2-butanol (2B), + ethyl acetate (EA), and + 1,2-dimethoxyethane (DME).

Results and discussions



***P-T* projections of the phase diagram of carbon dioxide (1) + butane (2), + ethyl acetate (2), + dimethoxyethane (2), + 2-butanol (2), and + 1-butanol (2)**. Symbols represent experimental literature data. Lines represent the predictions by SRK/2 PCMR (k_{12} = 0.020; l_{12} = -0.111).

nB (C_4H_{10}) 1B ($C_4H_{10}O$) 2B ($C_4H_{10}O$) EA ($C_4H_8O_2$) DME ($C_4H_{10}O_2$)



Conclusions

- All available experimental data for the CO_2 (1) + 2-butanol (2) system were modelled with SRK/2PCMR EoS. A single set of binary interaction parameters (BIPs), representing exactly the experimental critical pressure maximum (CPM) and the experimental temperature of the upper critical end point (UCEP), was calculated with the SRK/2PCMR model (k_{12} = 0.020; l_{12} = -0.111).
- This set was then used to predict successfully the phase behaviour (critical curves – PV and LL, equilibrium three-phase lines, UCEPs) of other four binary systems: CO_2 + n-butane, CO_2 + 1-butanol, CO_2 + ethyl acetate, and CO_2 + DME.
- The model predicts type II phase behavior for all systems studied.
- The predicted UCEPs are increasing in temperature in the order: $T_{nB} < T_{EA} < T_{DME} < T_{2B} < T_{1B}$.
- It can be observed that for the position isomer (1B) the CPM is well predicted, but shifted at higher temperature than the experimental one. The binaries containing in the organic molecule one additional oxygen (EA, DME) are remarkably well predicted, while the CPM of the liquid-vapor critical curve for that without oxygen (nB) is underestimated with ~10 bar.

Acknowledgments & Contact

„This work was supported by a grant of Ministry of Research and Innovation, CNCS - UEFISCDI, project number PN-III-P4-ID-PCE-2016-0629, within PNCDI III".

"The work has been funded by the Operational Programme Human Capital of the Ministry of European Funds through the Financial Agreement 51668/09.07.2019, SMIS code 124705."

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Removal Cu (II) ions and Co (II) ions from aqueous solutions using Saccharomyces cerevisiae

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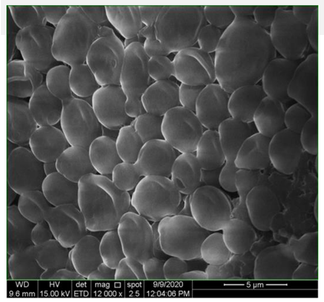
Introduction

Heavy metal pollution causes serious environmental and human health problems, as they have negative effects on the ecosystem and human health.

One technology that has proven to be promising in treating systems containing heavy metals is the biosorption that can be achieved by S. cerevisiae. This is a cheap and readily available source. Yeast cells are ideal biosorbents for the adsorption of heavy metals, they are easy to grow cheaply, thus an accessible source of biomass with high potential for biosorption of residues at low pH.

Materials and method

The biosorption experiments were performed by mixing 0.1 g of dried S. cerevisiae with 25 ml of solution of Cu (II) and Co (II) ions with known concentration and initial pH of 5.0. After a well-defined period of time (between 5 minutes and 24 hours), the phases of the biosorption systems were separated by filtration and analyzed.



S. Cerevisiae – seen under scanning electron microscopy

The concentration of Cu (II) and Co (II) ions in the solution obtained after filtration was determined by the spectrophotometric method with rubeanic acid.

All tests were performed at room temperature (21± 2 ° C).

Results and discussions

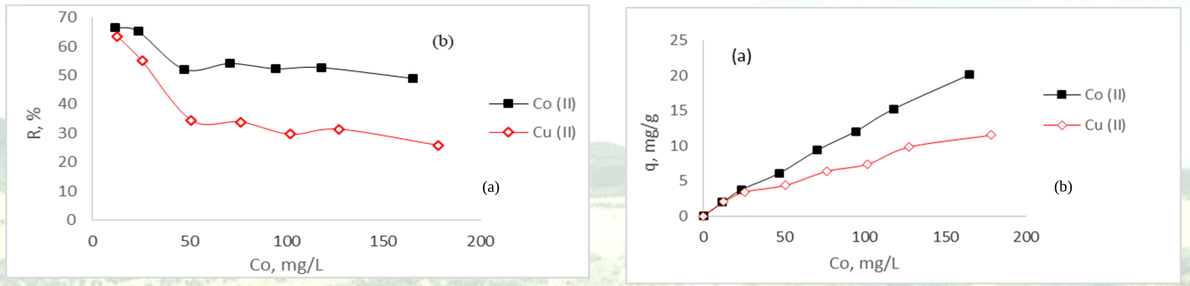


Fig.2. Influence of the initial concentration of Cu (II) and Co (II) ions on the biosorption efficiency (a) and the removal percent (b)

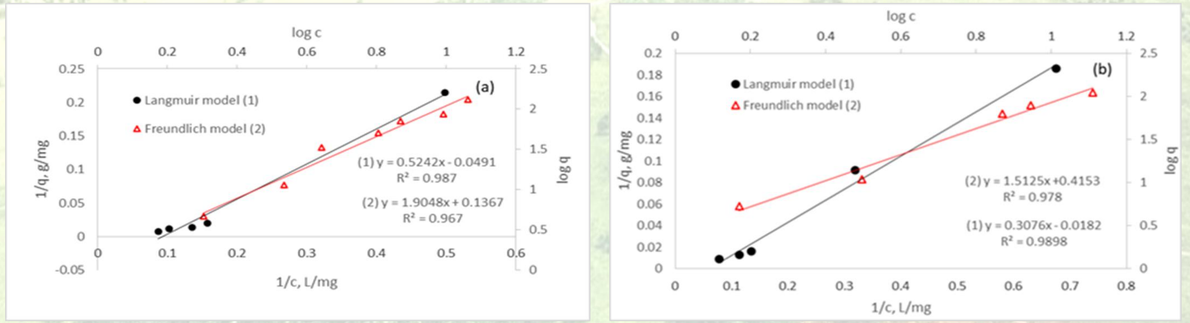


Fig. 3. Linear representations of Langmuir and Freundlich isotherm models, for Cu(II) ions biosorption and Co (II) on S. cerevisiae biomass

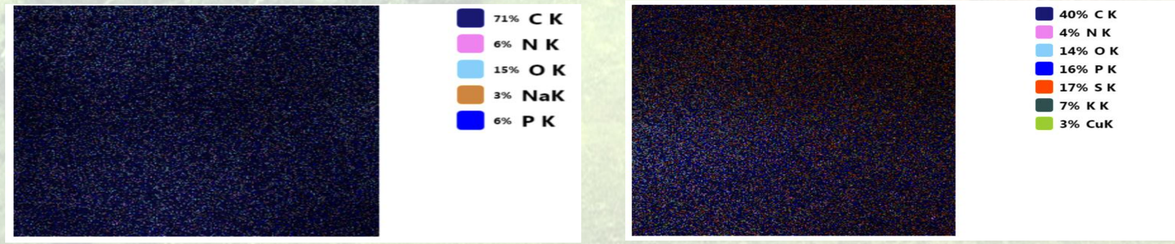


Fig.1. Distribution of elements in the S.cerevisiae sample (a) and distribution of elements in S. cerevisiae with Cu (II) ions

Conclusions

In this study it was examined the retention of Cu (II) ions and Co (II) from aqueous solutions on Saccharomyces cerevisiae biomass, trough biosorption. The experiments were performed as a function of initial Cu(II) ions and Co (II) initial ions , in batch systems and under optimum experimental conditions (pH = 5.0; 4 g yeast/L, room temperature). The isotherm modeling of the experimental data have show that the retention of Cu (II) ions and Co (II) takes place at the surface of yeast particles.

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Valorisation of woody waste for non-energetic uses: natural adsorbent in industrial wastewater treatment system

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Introduction

The application of natural woody waste - pine **sawdust** as *adsorbent* for retaining from aqueous media/industrial effluent of *textile Arancio Kemazol 3R reactive dye* (POP model) and *lead ions* (toxic metal) was studied. Certain 'batch' laboratory adsorption experiments were done for studying some operating parameters, such as: **pH**, adsorbent dose, **reactive dye** and toxic metal ions concentration, solid-effluent **contact time** and temperature. An **experimental planning** of the adsorption treatment is also discussed by using the **2^3** central compositional rotatable planning considering adsorbent concentration (X1), contact time (x2) and temperature (x3) as independent variables, while the removal of reactive dye (Y1, [%]) and lead ions (Y2, [%]) were chosen as optimization criteria.

The results of these adsorptive experiments are good and emphasize the importance of sawdust as adsorbent for retaining of polluting species from aqueous media (wastewaters/polluted waters).

Materials and method

Reactive dye: Arancio Kemazol 3R dye (λ_{max} = 492 nm); stock dye solution of 600 mg/L; working dye solutions were prepared by appropriate dilution with distilled water of the stock solution.

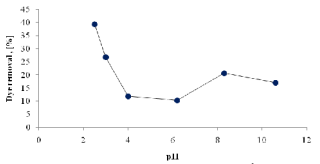
Lead ions solution: stock solution of 1000 mg/L Pb^{2+} in form of $Pb(NO_3)_2$. *Determination of lead*: spectrophotometric 530 nm-method with 0.05% PAR solution and ammonia.

Biosorbent: *Sawdust*, as production waste, resulted from conifer wood processing dried in air and sieved to obtain fractions between 1-2 mm. *Chemical composition* of conifer wood: 49.9% C, 6.4% H, 43.0% O and 1.0% N, and *caloric power* of 2035 kcal/kg (Zaharia et al., 2019; Zaharia and Gradinaru, 2020).

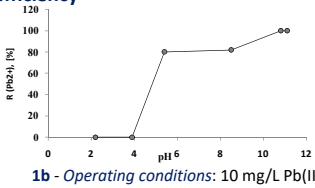
Working methodology: series of 'batch' sorption laboratory experiment for adequate operating conditions finding (solution-solid adsorbent of 0,075 – 2 g per 25 mL sample)

Results and discussions

1. Influence of initial pH on adsorption efficiency

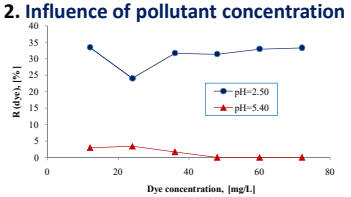


1a – *Operating conditions*: 50 mg/L dye; 50 g of sorbent /L; t=21 h; room temperature

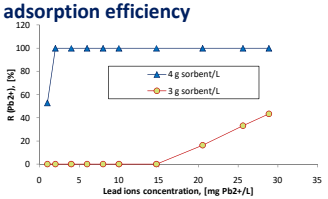


1b - *Operating conditions*: 10 mg/L Pb(II); 50 g/L of sorbent, t=21 h; room temperature

2. Influence of pollutant concentration on adsorption efficiency

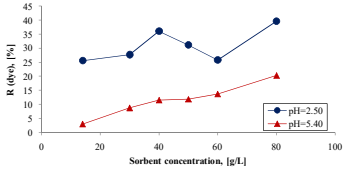


2a - *Operating conditions*: pH =2.50 and 5.40; 60 g/L of sorbent; t=22 h; room temperature

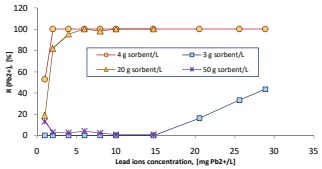


2b - *Operating conditions*: pH=5.40, 3 and 4 g/L of sorbent; t=22 h; room temperature

3. Influence of adsorbent concentration on adsorption efficiency

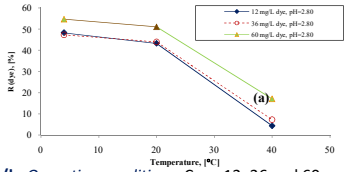


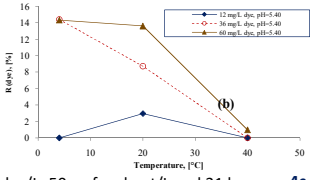
3a - *Operating conditions*: 60 mg/L of dye; pH 5.4 and pH 2.80; t=22 h; room temperature



3b - *Operating conditions*: pH=5.40, 1-30 mg/L Pb(II), 3-50 g/L of sorbent, t=22 h; room temperature

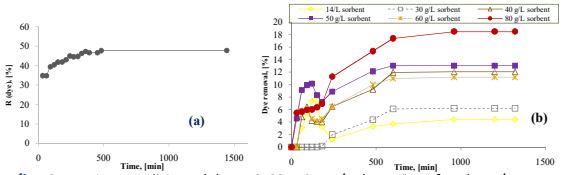
4. Influence of temperature on adsorption efficiency



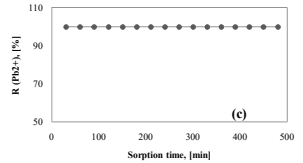


4a/b- *Operating conditions*: C_{dye}= 12, 36 and 60 mg of dye/L; 50 g of sorbent/L and 21 h of sorption. (a) pH=2.80 and (b) 5.40

5. Influence of L/S contact time on adsorption efficiency



5a/b - *Operating conditions*: (a) pH=2.60; 50 mg/L dye; 50 g of sorbent/L; room temperature; (b) pH=5.40, 50 mg/L dye, 14-80 g/L sorbent



5c - *Operating conditions*: 10 mg/L Pb(II); 50 g/L of sorbent, t=21 h; room temperature

5. Adsorption treatment modeling and best performance

❑ *Experimental treatment modeling*: central active compositional rotatable 2^3 design:

$$Y = b_0 + \Sigma b_i X_i + \Sigma b_i b_j X_i X_j$$

(2^3) Experimental matrix with independent encoded variables (pH=4.80)

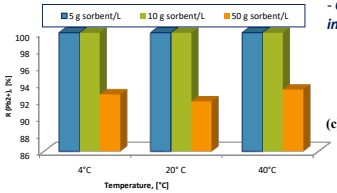
Independent variable/ value	Real variable (z_i)	Coded variable (X_i)	Real basic variable (z_{i0})	Variation step (Δz_{i0})
Adsorbent concentration, (g/L)	z_1	x_1	11	5
Contact time, (min)	z_2	x_2	480	300
Temperature, (°C)	z_3	x_3	18	5

- *Removal of reactive dye (%):*
Y_1=69.897+2.126X_1-2.965X_2-1.944X_3+0.818X_1^2+0.831X_2^2-1.165X_1X_3

- *Removal of lead ions (%)*
Y_2=50.897+6.974X_1-2.948X_2-0.269X_3+6.887X_1^2+2.001X_2^2-0.471X_3^2-4.862X_1X_2-0.854X_1X_3

- *Experimental model validation: mean deviation of 4.16% (Y1) and 3,12% (Y2)*

Fisher constant (F)	Multiple correlation coefficient (R_{Yj})	Fisher test (F_c)
F_1=28.842 F_2=32.016	R_{Y1}=0.837 R_{Y2}=0.884	F_{c1}=11.902 F_{c2}=17.606
$F=\frac{(n-1)\cdot\sum_{i=1}^{n}(Y_{ai}-\overline{Y_i})}{(k-1)\cdot\sum_{i=1}^{n}(Y_{ai}-\overline{Y_{ai}})}$	$R_{Y_c}=\sqrt{1-\frac{\sum_{i=1}^{n}(Y_{ai}-Y_{ai})^2}{\sum_{i=1}^{n}(Y_{ai}-\overline{Y_i})^2}}$	$F_C=\frac{n-b-1}{b}\cdot\frac{R^2_{Y1;2;3}}{1-R^2_{Y1;2;3}}$



4c - *Operating conditions*: 60 mg/L of dye; pH 5.4 and pH 2.80; t=22 h; room temperature

- Optimal values for removals and independent variables (pH=4.8):

X1*= 2.66 g/L
X2*= 1015.2 min → **Y1*= 65.98%**
X3*= 15.41 °C

(c) X1*= 4.68 g/L
X2*= 1161.6 min → **Y2*= 94,42%**
X3*= 22.305 °C

Conclusions

- ❑ Sawdust is an inexpensive material, easy to find, and has the necessary properties to be used for treatment of aqueous systems containing residual Arancio Kemazol 3R reactive dye and lead ions, among others.
- ❑ The adsorption performance of sawdust for the studied reactive dye is highest at very acid pH (2.5-2.8), and relative low (<20%) at neutral/low acidic pH (5.4) after 480 or 600 minutes at low (around 5°C) or room temperature (18-22°C), respectively.
- ❑ The adsorption performance of sawdust for lead ions removal is very high, even complete in specific conditions, meaning pH=5.4, room temperature and 4-20 g/L of adsorbent after no more than few minues.
- ❑ The optimal operating conditions were proposed (at pH=4.8) after an experimental **2^3** central compositional rotatable planning, considering as the main independent influencing variables the adsorbent concentration, temperature and L/S contact time.
- ❑ These adsorption tests suggested that sawdust can be used as natural alternative adsorbent for reactive dye removal.

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Environmentally friendly regional reactive sources for improving drilling fluids formulation systems

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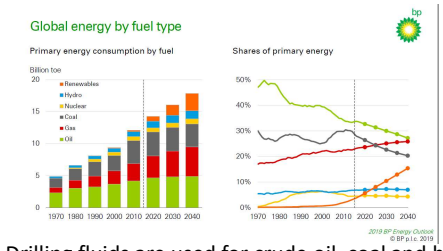
Introduction

This study follows the directive lines of EU related to European Pact for sustainable industry and European Green Deal by revealing what Romania can do as a regional hub in the European community and how EU can use its potential in order to achieve the United Nations Sustainable Development Goals (SDGs).[1]

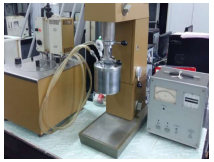
Future prediction for energy sector

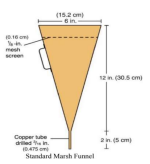


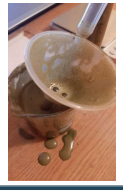
Drilling fluids are used for crude oil, coal and hydro sectors.

Materials and method

There were characterised the rheological properties for both water based drilling fluids (WBDFs) and oil based drilling fluids (OBDFs) with rheometer and Marsh funnel methods.







Results and discussions

Results for WBDFs

In this study a sets of tests to predict the rheological parameters were predicted with Marsh funnel viscosity (FV) for an WBDFs containing algae suspension.

Based on the literature, two general models were developed to evaluate the mud rheology using mud weight and Marsh funnel viscosity

- AV = D*(t-25) M. Pitt [2]
- AV = D*(t-28) Almahdawi et al. [3]

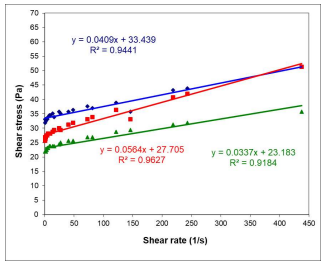


Fig. 1 Properties dependence with composition for WBDF Rheological parameters for WBDF containing bentonite at 50 ℃ and stability

Results for OBDFs

Table 1. Newpark Drilling Fluids Eastern Europe SRL tests

The literature study revealed novel types of drilling fluids including biodiesel based drilling fluids [4] and there are patents [5] for ester-containing down-hole drilling lubricates and rheological characterization of algae suspensions.

We made economical calculation for 2 plants at feed 100 kg biodiesel production from 2 different types of oils as raw materials and we obtained that is more cost effectively to produce biodiesel from soybean rather than algae.

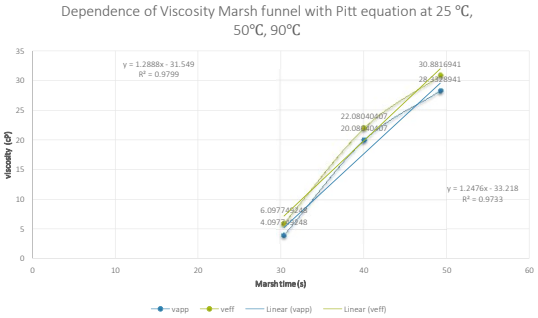


Fig. 2 Dependence of Viscosity Marsh funnel with Pitt equation at 25 ℃, 50℃, 90℃

Table 1. Properties of OBDF at 50℃ according to API Recommended Practice 13B-2, 13D

Parameters	M.U.	Results
Density	g/cm³	1.13
Electrical Stability	Volts	308
Fan 600rpm @ 49°C	/	70
Fan 300rpm @ 49°C	/	39
Fan 200rpm @ 49°C	/	29
Fan 100rpm @ 49°C	/	18
Fan 6rpm @ 49°C	/	4
Fan 3rpm @ 49°C	/	4
Gels 10" / 10'	/	7/9
Plastic Viscosity	Cps	31
Yield Point	Lbs./100ft2	8
Oil	% Vol	61
Water	% Vol	25.5
Solids	% Vol	13.5
O/W ratio	% / %	70.52/29.47
Corrected solids	%	13.14
AGS	%	2.77
LGS	%	11.38
HGS	%	1.76
Alkalinity ml H2SO4 0.1N	ml	3.10
LIME	kg/m3	11.44
CaCl2 in whole mud	mg/l	38,836
Chlorides	mg/l	37,000
Calcium	mg/l	14,000
Water phase salinity	mg/l	145098.04

Conclusions

As it can see from the rheological properties experimented in the laborator the stability of drilling fluids after 2 weeks is highly modified, so the measurements to characterise the drilling fluids properties are instantaneous values and very specific for each composition.

In this scenario the Marsh funnel viscosity is an important parameter to evaluate the rheological properties of drilling fluids.

References (if necesary)

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[5] US 20040082487, 2005-04-26, Newpark Drilling Fluids, L.L.C. (Houston, TX), Ester-containing down-hole drilling lubricating composition and processes therefor and therewith

Acknowledgment or Contact

Acknowledgments
1.The work has been funded by the Operational Programme Human Capital of the Ministry of European Funds through the Financial Agreement 51668/09.07.2019, SMIS code 124705
2.Newpark Drilling Fluids Eastern Europe SRL

Study on environmental concern: evidence for several EU countries

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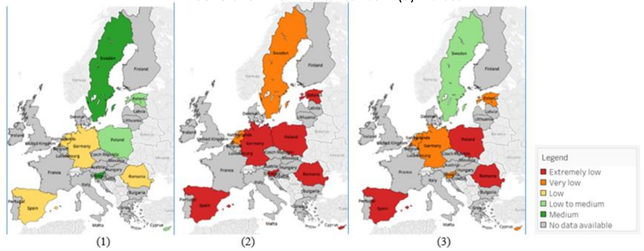
Introduction

Utilizing a particular measuring approach that divides the **environmental concern** in terms of **perceptions and active participation**, this study attempted to better understand it in selected EU countries (Cyprus, Estonia, Germany, Netherlands, Poland, Romania, Slovenia, Spain, Sweden), as even in countries from the same development stage the environmental concern levels differ.

Perceptions regarding environment (1), Action oriented to environment (2) and General environmental concern (3) indices



(1) (2) (3)

Materials and method

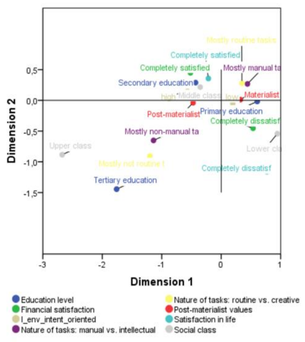
Definition of the variables

Variables	*Description*
Intent oriented to environment Index ($I_{env\_intent\text{-}oriented}$)	Analysing perceptions regarding environment and its problems ($A_{env\_intent\text{-}oriented}$, $B_{env\_intent\text{-}oriented}$, $C_{env\_intent\text{-}oriented}$) (*high, low*) = ***high*** (if the respondent gives at least two *high* responses to $A_{env\_intent\text{-}oriented}$, $B_{env\_intent\text{-}oriented}$, $C_{env\_intent\text{-}oriented}$); = ***low*** (if the respondent gives only one or none *high* response to $A_{env\_intent\text{-}oriented}$, $B_{env\_intent\text{-}oriented}$, $C_{env\_intent\text{-}oriented}$)
Care for environment ($A_{env\_intent\text{-}oriented}$)	Looking after the environment is important to this person: to care for nature and save life resources (yes = *high*; no = *low*)
Perspective on environmental pollution ($B_{env\_intent\text{-}oriented}$)	Most serious problem of the world: environmental pollution (yes = *high*; no = *low*)
Protecting environment vs. Economic growth ($C_{env\_intent\text{-}oriented}$)	Protecting the environment should be given priority, even if it causes slower economic growth and some loss of jobs (yes = *high*; no = *low*)
Action oriented to environment Index ($I_{env\_act\text{-}oriented}$)	Analysing active participation of the respondents on diverse activities for improving environmental conditions ($A_{env\_act\text{-}oriented}$, $B_{env\_act\text{-}oriented}$, $C_{env\_act\text{-}oriented}$) (*high, low*) = ***high*** (if the respondent gives at least two *high* responses to $A_{env\_act\text{-}oriented}$, $B_{env\_act\text{-}oriented}$, $C_{env\_act\text{-}oriented}$); = ***low*** (if the respondent gives only one or none *high* response to $A_{env\_act\text{-}oriented}$, $B_{env\_act\text{-}oriented}$, $C_{env\_act\text{-}oriented}$)
Member of an environmental organization ($A_{env\_act\text{-}oriented}$)	Active/Inactive membership: environmental organization (yes = *high*; no = *low*)
Given money to ecological organization ($B_{env\_act\text{-}oriented}$)	Past two years: given money to ecological organization (yes = *high*; no = *low*)
Participation in demonstration for environment ($C_{env\_act\text{-}oriented}$)	Past two years: participated in demonstration for environment (yes = *high*; no = *low*)
Environmental concern Index (I_{env})	Integrating the general concern regarding environment comprised both in perceptions and in active participation ($I_{env\_intent\text{-}oriented}$ and $I_{env\_act\text{-}oriented}$) (*high, low*) = ***high*** (if the respondent gives at least three *high* responses to $A_{env\_intent\text{-}oriented}$, $B_{env\_intent\text{-}oriented}$, $C_{env\_intent\text{-}oriented}$, $A_{env\_act\text{-}oriented}$, $B_{env\_act\text{-}oriented}$, $C_{env\_act\text{-}oriented}$); = ***low*** (if the respondent registers maximum two *high* from six possible ones)
Age	Age of the respondent
Gender	Gender of the respondent (*female, male*)
Marital status	Marital status of the respondent (*single, married, divorced*)
Number of children	Number of children of the respondent
Educational level	Highest educational level attained (*lower-secondary, secondary, tertiary*)
Employment status	Employment status (*employed, unemployed, retired*)
Sector of employment	Where the respondent is employed (*Government* or *public sector*, *private sector*)
Nature of tasks: routine vs. non-routine	If the respondent has on his job mostly *routine task* or mostly *non-routine tasks*
Nature of tasks: manual vs. intellectual	If the respondent has on his job mostly *manual* or mostly *intellectual tasks*
Scale of income	The group of income where the respondent's household is, counting all wages, salaries, pensions and other incomes that come in (*first two steps, middle steps, last two steps* - meaning the highest incomes)
Post-materialist values	Post-materialist index (*post-materialist, mixed, materialist*)
Feeling of happiness	Taking all things together, would you say you are: *very or rather happy; not very or not at all happy*

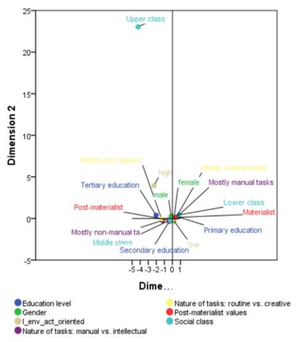
Source: Authors' indices and considered factors based on WVS, wave 6, 2010-2014

Results and discussions

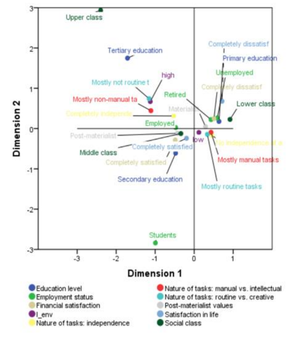
Associations between environmental indicators and socio-economic factors in Spain and Sweden, two countries with the same stage of development, but very different environmental concern levels (Joint Corresponding Analysis)



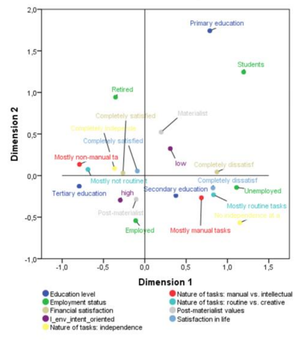
$I_{env\_intent\text{-}oriented}$ - Spain



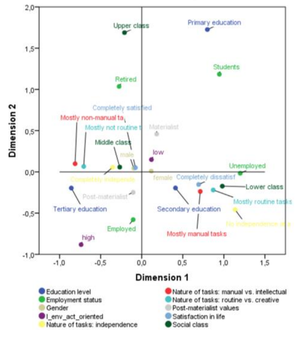
$I_{env\_act\text{-}oriented}$ – Spain



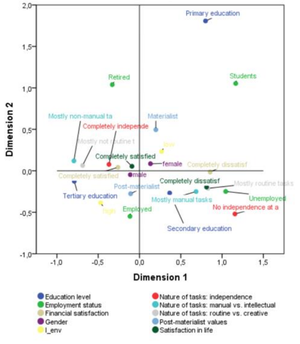
I_{env} - Spain



$I_{env\_intent\text{-}oriented}$ - Sweden



$I_{env\_act\text{-}oriented}$ - Sweden



I_{env} - Sweden

Source: Authors' indices and considered factors based on WVS, wave 6, 2010-2014

Econometrical modelling results (Binomial Logistic Regression Analysis)

Independent variables	**Spain**					
	$I_{env\_intent\text{-}oriented}$		$I_{env\_\ act\text{-}\ oriented}$		I_{env}	
	Model 1(a)	*Model 2(a)*	*Model 3(a)*	*Model 4(a)*	*Model 5(a)*	*Model 6(a)*
Age	-0.002	-	-0.014	-	0.005	-
Gender	0.131	-	1.208**	1.122**	0.284	-
Education level	-0.217	-0.313***	-1.622***	-1.680***	-0.890***	-1.117***
Employment status	0.050	-	-0.194	-	0.107	-
Social class	0.419**	0.515***	0.773	-	0.226	-
Nature of tasks: routine vs. creative	-0.085	-	-0.609	-0.985**	-0.234	-
Nature of tasks: manual vs. intellectual	-0.239	-	-0.434	-	-0.206	-
Nature of tasks: independence	0.168	-	0.879*	0.785*	0.217	-
Post-materialist values	-0.499***	-0.509***	-0.688	-	-0.410*	-0.455**
Financial satisfaction	-0.117	-	-0.153	-	-0.234	-
Satisfaction in life	-0.236	-	0.624	-	-0.286	-
Constant	1.804**	1.187**	4.748*	5.500***	4.280***	4.918***

Notes: (***) indicates the null hypothesis rejection for 1%; (**) indicates the null hypothesis rejection for 5%; (*) indicates the null hypothesis rejection for 10%; the models 1(a), 3(a), 5(a) include all the independent variables taken into consideration and the models 2(a), 4(a) and 6(a) include only the significant ones.

Independent variables	**Sweden**					
	$I_{env\_intent\text{-}oriented}$		$I_{env\_\ act\text{-}\ oriented}$		I_{env}	
	Model 1(b)	*Model 2(b)*	*Model 3(b)*	*Model 4(b)*	*Model 5(b)*	*Model 6(b)*
Age	-0.016***	-0.016***	-0.007	-	-0.019***	-0.019***
Gender	-0.122	-	-0.450**	-0.403**	-0.162	-
Education level	0.046	-	-0.380**	-0.512***	-0.126	-
Employment status	0.136*	0.133*	0.425**	0.349**	0.115	-
Social class	-0.270	-	0.368	-	-0.062	-
Nature of tasks: routine vs. creative	-0.358**	-0.317**	0.086	-	-0.241	-0.409***
Nature of tasks: manual vs. intellectual	-0.087	-	-0.310	-	-0.095	-
Nature of tasks: independence	0.028	-	-0.451	-0.604**	-0.217	-
Post-materialist values	-0.664***	-0.655***	-0.516**	-0.516**	-0.773***	-0.790***
Financial satisfaction	-0.125	-	0.590**	0.438*	-0.032	-
Satisfaction in life	-0.451**	-0.447**	-1.063**	-1.082**	-0.620**	-0.673***
Constant	4.099***	3.049***	5.501***	6.534***	5.478***	4.790***

Notes: (***) indicates the null hypothesis rejection for 1%; (**) indicates the null hypothesis rejection for 5%; (*) indicates the null hypothesis rejection for 10%; the models 1(b), 3(b), 5(b) include all the independent variables taken into consideration and the models 2(b), 4(b) and 6(b) include only the significant ones.

Conclusions

Our results showed that **Poland, Romania** and **Spain** register **the lowest levels of general environmental concern**, while **Sweden** attains **the highest level** among the analyzed EU countries. Giving the fact that, although both Spain and Sweden are advanced economies, the difference between their national general environmental concerns required a more in depth investigation.

Applying *component factor analysis*, we observed that **the common socio-economic and behavioral characteristics of an individual highly concerned with the environmental problems** in both countries are: (1) having tertiary education; (2) being employed; (3) having mostly not routine and non-manual tasks; (4) being completely independent; (5) attaining post-materialist values; (6) feeling completely satisfied with personal financial situation. In the case of **Spain**, the belonging to the middle class is added to this profile, meaning that the social class also makes a difference in the personal position regarding environment.

In addition, using the *binomial logistic regression*, we found that **this position is mainly influenced** by (1) age, nature of tasks, post-materialist values and satisfaction in life in **Sweden**, while, (2) in **Spain**, the most important determinants are educational level and post-materialist values.

In this way, our findings shaped the **national profiles of individuals according to their attitude towards environment**, **emphasized its determinants and outlined the main differences between the two nations** in this respect, as possible starting points for better targeted EU and national environmental policies.

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Analysis of the optimal bridge piers number for reducing backwater levels

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Introduction

Like much of the Vienne Valley, the area of Bouchard Island has a significant wealth in terms of environments and species. In the study area, 86 protected species are recorded, half of which are birds. In order to quantify the damping of the backwater generated by the future crossing of the Vienne, we integrated into the hydraulic modelling software (InfoWorks ICM) the 2D model of the river and using 2 solutions (3 and 4 piers) to simulate the current flow conditions generated by the future bridge for each of the two floods studied as a function the width of the piles.

Materials and method

Channels have been modelled as 1D river reaches where bathymetry data is available, with the remaining wetland area modelled using a 2D mesh.

Bank lines were created along the left and right banks of the Vienne river for the areas represented using 1D channels. A global Manning's n roughness of 0.055 was used for river. Tidal areas may in general be expected to exhibit lower roughness than fluvial reaches due to the finer sediments in the channels.

A coarse mesh element size of 0000m2 is applied on the floodplain. This capture the detail of small channels and other floodplain features such as banks, it allows fast simulation of long time series events whilst maintaining the volume of tidal flows onto the floodplain.

Flow-time boundary was applied on Vienne River as the upstream inflow hydrographs.

Results and discussions

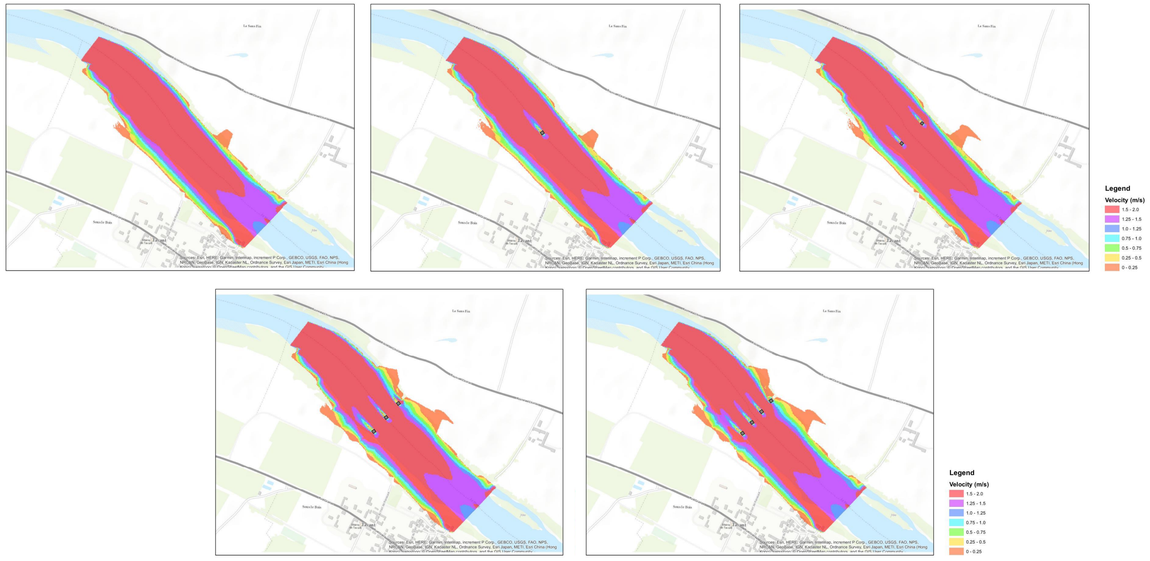
The differences in water levels with and without bridge piers for a flow of 1300 m^3/s were obtained by subtracting the water levels when there are no piers from the water levels when there are.

In the below figures is presented the distribution of computed velocity near the piers and the locations of the piers. Can be clearly seen that there were clear backwater effects due to the presence of bridge piers upstream of the bridge, and the maximum water level rise was about 1 m.

Flow velocity fields during floods are also important because high velocity flow will cause the erosion of river beds and the destruction of banks and bridges.

Quantitative analysis indicated that the maximum flow velocities near to the bridge were 1.74 m/s and 2.58 m/s without and with piers, respectively, which is an increase of 1.44%. The highest depth in the situation without piles reach a value of 4.97m, while in the case of the 4 piers this value decreases to 4.93m.

The maximum flow was reduced with 0.99% which likely leads to sediment deposition in this section.



Conclusions

In this study an 2D model was created in order to assign the optimal bridge piers number for reducing backwater levels.

Backwater effects and flow velocity fields due to the presence of piers were analyzed in detail.

The flow field structure near piers and the resulting sediment erosion are critical to the safety of bridges and are an issue of interest to engineers, and thus this subject deserves further study.

References (if necesarly)

Acknowledgment or Contact

Efficient remediation of environmental hazardous using a carbon rich material from biomass waste conversion

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"Gheorghe Asachi" Technical University, "Cristofor Simionescu" Faculty of Chemical Engineering and Environmental Protection, Iași, Romania

Introduction

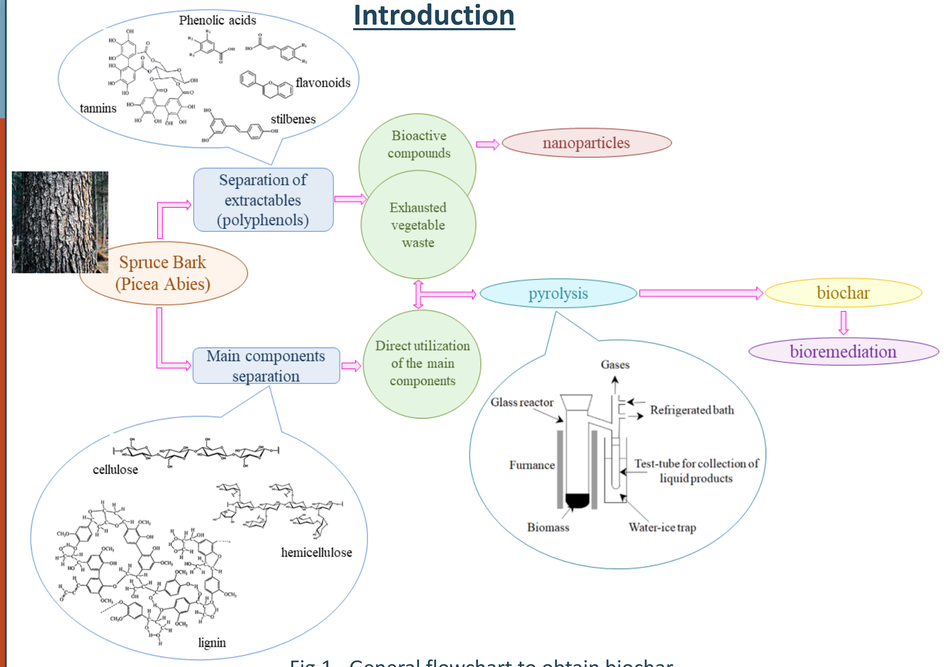

Fig.1 - General flowchart to obtain biochar

Materials and method

- Physical and chemical characterization of row material and the resulting biochar by AAS, FTIR and BET
- In order to establish the most favorable experimental conditions, preliminary pH tests were completed in a range pH 2 - 8 with synthetic effluent in single component system, perfectly mixed batch, at constant temperature, in duplicate, 5g/L biochar mass and 50mg/L Pb and the results were analyzed by AAS.
- Kinetic experiments were conducted in duplicate in continuously mixed batch adsorbers using biochar accurately weighed 5g/L added to a synthetic effluent 50g/L Pb in single component system.
- Adsorption isotherms were performed in duplicate, using initial Pb concentration between 2 to 50 mg/L, 5g/L biochar, at constant values of pH and temperature.

Results and discussions

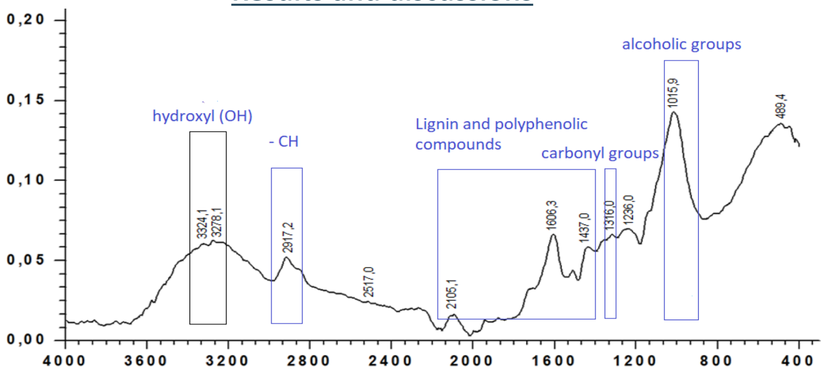

Fig.2 - FTIR spectrum obtained for spruce bark

Tabel 1 - Concentration of heavy metal ions identified in spruce bark

Metal ions	Determined values (mg / L)	WASTEWATER - Maximum allowable concentration (mg / L) Low no. 188/2002
Arsenic	ND	0.1
Cadmium	0.000125	0.2
Chromium	ND	1.0
Copper	0.000120	0.1
Iron	0.001735	-
Lead	ND	0.2
Selenium	ND	0.1
Zinc	ND	0.5

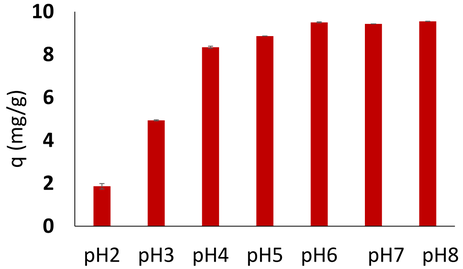

Fig. 3 – Effect of pH on Pb (II) biosorption, C_0=50 mg L^{-1}, C_s=5 g L^{-1}, ; T=23 ºC, 4h contact time

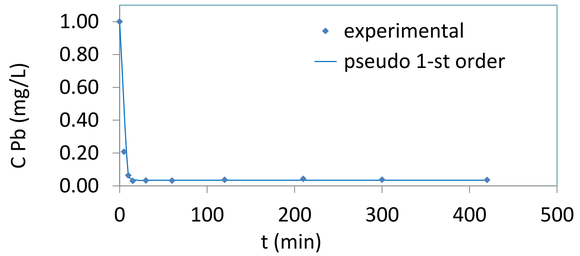

Fig.4 – Biosorption kinetics for Pb(II) (pH 5.5) at 23 ºC C_0=25 mg/L, Cs=10g/L; (b) C0=50 mg/L, Cs=5g/L. Experimental data and pseudo-first model

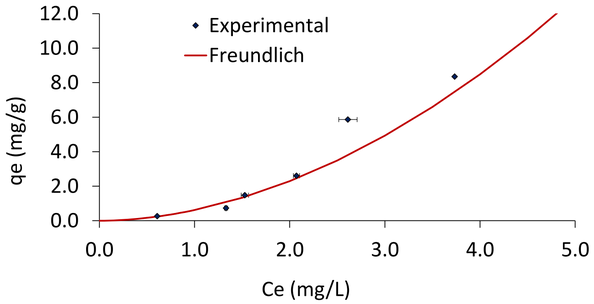

Fig.5 – Equilibrium isotherms at 23 ºC, for Pb(II) biosorption on *Picea abies biochar*, experimental data and Langmuir model

Conclusions

Biochar must be considered a low-cost sorbent. The biochar under study present considerable sorption ability for Pb(II) and a weak influence of pH which are positive indicators for its practical use on the remediation of contaminated waters.

References

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Studies regarding the tolerance of *Amaranthus retroflexus* L. growing on nickel polluted soil

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Introduction

***Amaranthus retroflexus* L. (redroot pigweed)** is one of the most widespread plant in the world with a high adaptability under different environmental conditions

It may growth until 3 m height providing a tall aerial biomass which gives it efficient capacities for biosorption and bioaccumulation of toxic pollutants.

It is a suitable plant for phytoremediation of soils polluted with heavy metals.

Materials and method

Soil sterilized at 105^{0}C for 12 hours.

The experiments were carried out in triplicate in Falcon tubes containing 35 g of soil.

35 g of soil + 25 mL solutions of different nickel ions concentrations kept in contact for 7 days for a proper stabilization.

After 7 day, 2 mL of sterile deionized water and 2 seeds of redroot pigweed was added in each sample. After sowing, one single plant was kept for analysis.

Different concentrations of nickel in soil were tested: 59 mg/kg, 131 mg/kg, 177 mg/kg, 233 mg/kg, 292mg/kg, 462 mg/kg.

Different contact time was considered: 30 days, 37 days, 47 days, 54 days, 60 days.

The plants were grown during 11th of July until 9th of September 2019.

Photosynthetic Pigments Determination

The photosynthetic pigments in plant were extracted with 96% ethanol and quantification of chlorophyll a, chlorophyll b and carotenoid pigments in leaf tissue were performed according to the method described by Welburn (1994).

Results and discussions

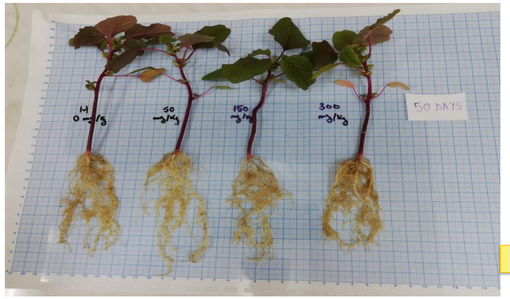

Figure 1. Growth of the *Amaranthus retroflexus* L. in the presence of Ni(II) after 50 days

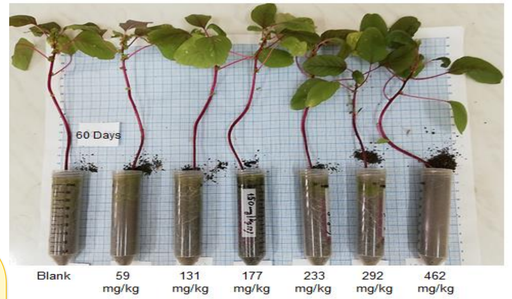

Figure 2. Tolerance index of the *Amaranthus retroflexus* L. in the presence of Ni(II) after 60 days

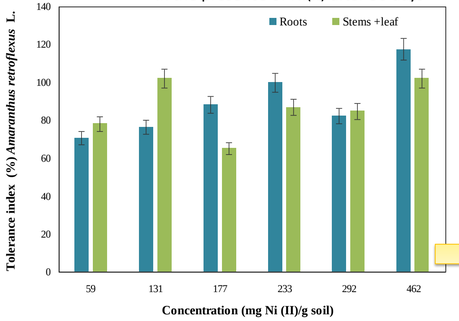

Figure 3. Tolerance index of the *Amaranthus retroflexus* L. in the presence of Ni(II) after 60 days

No significant changes in roots and shoots morphology was observed (e.g. for blank the length of stems+leaf was 240 mm compared with the stems+leaf at concentration of 462 mg/kg where the length of stems+leaf was 235 mm). Also, the tolerance index indicates that for all tested concentration, the tolerance was over 76 % for roots, stems with leaf.

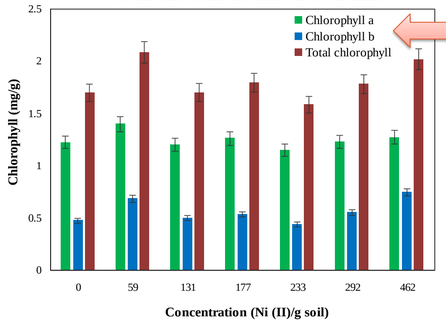

Figure 4. Chlorophyll content *of Amaranthus retroflexus* L. in the presence of Ni(II) after 60 days

Nickel ions have beneficial influence in the range of concentrations between **0-59 mg/kg** (chlorophyll a and b was stimulated with **15%**, respectively **43%**, while carotenoids with **4%**). For concentrations between **131-462 mg/kg,** the nickel ions determined a slight decrease in chlorophyll and carotenoids content.

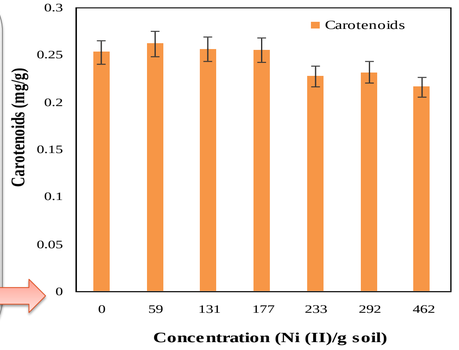

Figure 5. Carotenoids content *of Amaranthus retroflexus* L. in the presence of Ni(II) after 60 days

Conclusions

- *Amaranthus retroflexus* L. developed a good nickel tolerance in the range of Ni(II) concentrations of 0-462 mgNi(II)/kg soil, with no significant effects on morphological and physiological state.
- Determination of chlorophyll pigments and carotenoid showed that nickel did not affect the physiology of *Amaranthus retroflexus* L. plant.
- Further studies will investigate the morphological changes, as well as the behavior of other plants in terms of tolerance on nickel.

References

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Acknowledgment

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Synthesis and characterization of lanthanum doped titanium dioxide for the enhanced photocatalytic elimination of an emergent water contaminant

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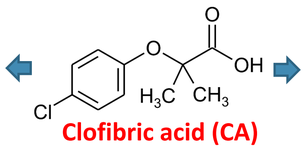
Introduction

Water pollution with pharmaceutical active compounds is nowadays one of the major environmental concerns.

Fibrates, a group of lipid lowering agents, typically used in high therapeutic dosages (1-2g/d) leading to their excretion in large amounts.

Highly stable ←  → Non-biodegradable

Clofibric acid (CA)

The most frequently found pharmaceutical residue in ground, surface and drinking waters because of its incomplete removal during the conventional wastewater treatment.

The problem:

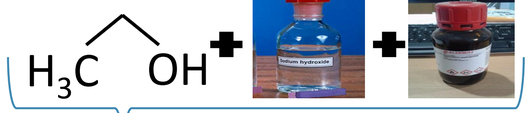
- **Techniques such as physicochemical (coagulation, filtration, adsorption,…) or conventional biological treatments show significant limitation in CA degradation.**
- **To date, increased need in developing efficient technologies and systems to enhance its elimination from the polluted waters.**

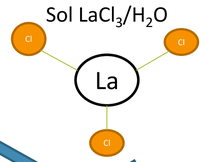
Objectives:

- Synthesize La doped titanium dioxide ($La@TiO_2$) via a facile synthesis approach and investigate its photocatalytic activity in the degradation of CA.
- Evaluate the influence of some key process parameters in order to enhance the photocatalytic elimination of this molecule.

Materials and method

Catalyst preparation

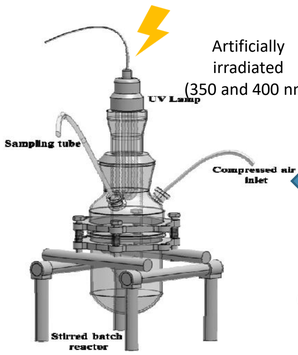




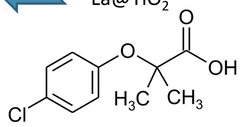
The gel was homogenized with the lanthanum solution before the hydrothermal treatment.

Hydrothermal treatment 150°C, 24h

Photocatalytic experiments



$La@TiO_2$

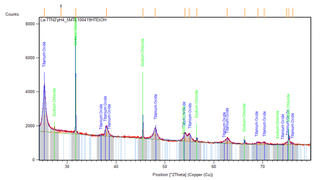


Stirred in the dark 60 minutes to ensure adsorption-desorption equilibrium, before starting the photocatalytic experiment.

Results and discussions

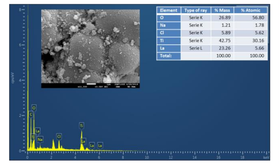
Powder X-ray diffraction (P-XRD)

- Strong peaks are attributed to anatase phase.
- Formation of sodium chloride (NaCl) by the reaction between used precursors.

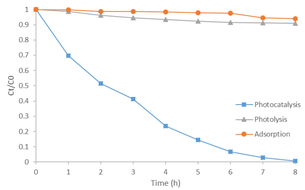


SEM-EDX

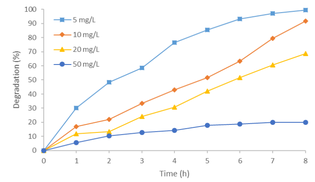
- Agglomerate micro-powder without a specific shape.
- The presence of La was confirmed by (EDX).



Photocatalytic activity

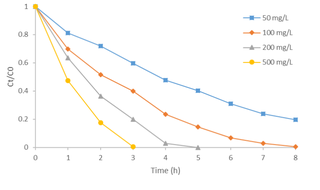


5 mg/L of pollutant, 100 mg/L $La@TiO_2$ and UV intensity of 6.3 mW/cm²

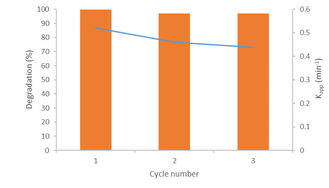


5-50 mg/L of pollutant, 100 mg/L $La@TiO_2$ and UV intensity of 6.3 mW/cm²

- Negligible pollutant elimination observed for the photolytic (9%) and adsorption (6%) processes after a contact time of 8h.
- 100% of CA elimination obtained for the photocatalytic process after 8h of irradiation.
- The degradation yield ↘ with the increase of CA initial concentration. Moreover, the elimination efficiency of CA was enhanced by ↗ the catalyst concentration.
- The photocatalytic degradation efficiency remains unchanged after 3 successive cycles.



5 mg/L of pollutant, 50-500 mg/L $La@TiO_2$ and UV intensity of 6.3 mW/cm²



5 mg/L of pollutant, 200 mg/L $La@TiO_2$ and UV intensity of 6.3 mW/cm²

Conclusions

- ✓ $La@TiO_2$ was successfully synthesized via a facile synthesis methodology and displays an efficient photocatalytic activity for the degradation of the clofibric acid under UV-A irradiation.
- ✓ An efficient degradation of CA (**99%**) and mineralization **(63%)** under the following operating conditions: a catalyst loading of 500 mg/L, an initial pollutant concentration of 5 mg/L and a maximal irradiation flux, after 3h of irradiation.
- ✓ Present work provides a new insight on the use of $La@TiO_2$ catalyst for the photocatalytic water purification.
- ✗ Extend the study to industrial or to wastewater effluents in order to investigate the CA photodegradation efficiency under real conditions.

Bioremediation of aqueous solutions polluted with Cd^{2+} ions by *Bacillus megaterium* in a stirred tank bioreactor

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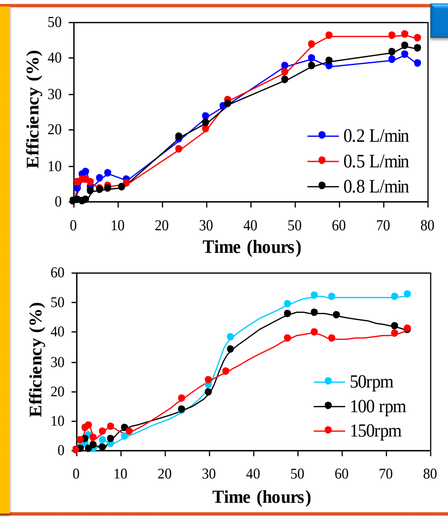
INTRODUCTION

In stirred tank aerobic bioreactors the mixing of phases necessary for aerobic microorganisms growth is performed mainly by mechanical agitation, but also by aeration of the culture medium. The stirrer has to ensure an adequate degree of homogeneity inside the bioreactor without damaging the microbial cells.

Cadmium is a heavy metal classified as carcinogenic for humans by IARC. Short-term exposure to high amounts of cadmium causes nausea, vomiting, abdominal pain, muscle cramps, sensory disturbances, liver damage, shock and kidney failure. The main **objective of the present paper is to investigate the influence of mixing rate, air flow rate and initial cadmium concentration on pollutant removal efficiency from aqueous solutions by *Bacillus megaterium* living biomass.**

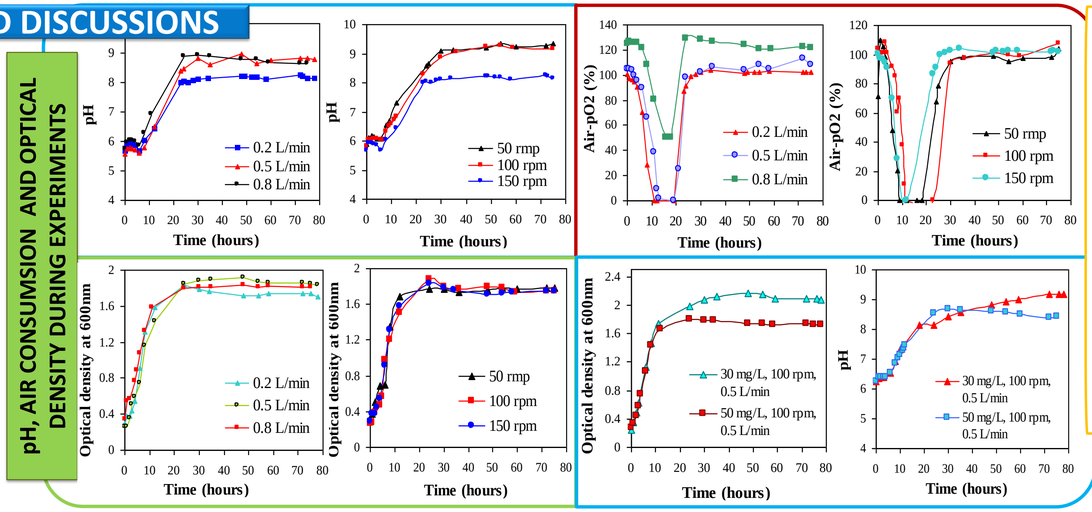
INFLUENCE OF AIR FLOW AND AGITATION SPEED



RESULTS AND DISCUSSIONS

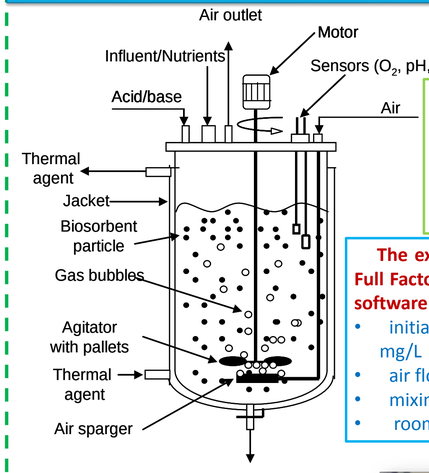
- **The highest efficiency was obtained for air flow rate of 0.5 L/min after 72 hours (46.57%). Under the same conditions and considering 0.2 L/min and 0.8 L/min air flow rates, the efficiency was 40.97%, and respectively 44.35%.**
- **The process efficiency decreases from 52.60% to 40.73% by increasing the mixing rate from 50 to 150 rpm (Ci = 50 mgCd/L and air flow rate 0.2 L/min).**

pH, AIR CONSUMSION AND OPTICAL DENSITY DURING EXPERIMENTS



pH, oxygen consumption and biomass growth monitoring throughout the experiments shows that the variation of air flow rate, mixing rate and initial concentration of cadmium affect the normal activity of the microorganism.

MATERIALS AND METHOD



Sartorius bioreactor
(BIOSTAT B plus control panel with UniVessel 2L)

- working volume of 1.5 L
- equipped with pH, oxygen and temperature sensors
- sterile olive oil as antifoaming agent
- 0.2 µm PTFE filters to keep the sterility inside the bioreactor

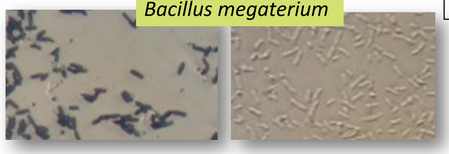
The experiments were performed according to a Full Factorial Design matrix generated by Minitab17 software considering:

- initial concentration of Cd^{2+} between 10 and 50 mg/L
- air flow rate between 0.2 and 0.8 L/min
- mixing rate between 50 and 150 rpm.
- room temperature of 25 ± 2°C

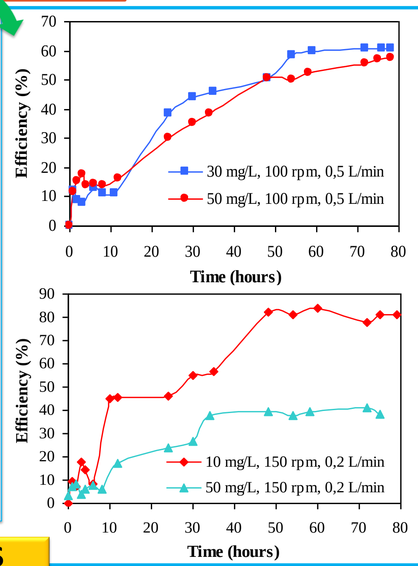
Table 1. Experimental matrix

No. expt.	Parameters value		
	Initial conc. (mg/L)	*Air flow rate (L/min)*	*Mixing rate (rpm)*
1	50	0.8	50
2	50	0.2	50
3	30	0.5	100
4	10	0.2	50
5	10	0.2	150
6	10	0.8	50
7	50	0.8	150
8	50	0.2	100
9	10	0.8	150
10	50	0.5	100
11	50	0.2	150
12	50	0.5	150

Bacillus megaterium



INFLUENCE OF CADMIUM CONCENTRATION



- **At an air flow rate of 0.5 L/min and a stirrer rotation speed of 100 rpm, the maximum efficiency at a concentration of 30 mg/L was 60.97% after 76 hours.**
- **Under the same operating conditions, at approximately 50 mg/L, the efficiency was 57.21%.**
- **At 0.2 L/min air flow rate, 150 rpm and initial concentrations of 10 mg/L and 50 mg/L, the maximum efficiency was 82.83% and respectively, 40.97%.**

CONCLUSIONS

- The results show that, the process efficiency decreases from 52.60% to 40.73% with increasing the mixing rate from 50 to 150 rpm, at initial concentration 50 mgCd/L and air flow rate of 0.2 L/min.
- Also, at initial concentration of 50 mgCd/L and 150 rpm, the best results were obtained at 0.5 L/min air flow rate, both in terms of process efficiency and biomass growth.
- Variation of air flow rate and mixing rate does not significantly affect the development of biomass, but it seems that the increase of air flow rate and decrease of mixing rate stimulate the synthesis of ammonia which leads to the increase of pH.
- The increase of the initial concentration of Cd^{2+} ions in solution leads to the decrease of process efficiency, as well as to the inhibition of the biomass development and ammonia synthesis by *B. megaterium*.
- In conclusion, for the removal of Cd^{2+} by *B. megaterium* living biomass in stirred tank bioreactor, 0.5 L/min and 50 rpm are the adequate values for air flow rate and mixing rate.

ACKNOWLEDGMENTS

This work was supported by a grant of the Romanian National Authority for Scientific Research, CNCS –UEFISCDI, project number PN-III-P4-ID-PCE-2016-0683, Contract no. 65/2017, and a grant of the Romanian Ministry of Education and Research, CCCDI - UEFISCDI, project number PN-III-P2-2.1-PED-2019-5239, Contract no. 269PED/2020, within PNCDI III.

Researches regarding the monitoring of underground water quality in vulnerable communities to nitrate pollution from agricultural sources in Botoşani County, Romania

Alina Agafiței, Vasile Lucian Pavel, Valentin Boboc

"Gheorghe Asachi" Technical University of Yassy, Faculty of Hydrotechnics, Geodesy and Environmental Engineering, Romania

Introduction

The object of the national water monitoring programs is the evaluation and control of their quality. Monitoring data can be used to establish initial conditions, final pollutant concentrations, but most of the time they cannot be used to identify the stages and processes that occur during pollution. The purpose of groundwater monitoring is a long-term research of the distribution area for pollutants, and of their concentrations in the underground. For the groundwater monitoring, we follow both chemical and quantitative stage. The investigation environments are represented by water, sediments, and biota, with qualitative elements, parameters, and minimum monitoring frequencies, in accordance with requirements of the Water Framework Directive, depending on the type of program.

Areas vulnerable to nitrates from agricultural sources represent 8.64% of our country's surface, and 13.93% of the total agricultural area of Romania. In order to determine the vulnerable areas, they were delimited following the analysis of each subsystem (soil, climate, water bodies, sources of nitrates from agricultural activities), from the perspective of the production and/or transmission of nitrates from the agricultural sources to water bodies.

The vulnerable areas were differentiated according to the type of nitrate sources: current sources (present agricultural activities, which produce a surplus of nitrates due to the high density of animals from individual households and/or zoo-technical complexes), and historical sources (zoo-technical complexes that have worked in the past and are decommissioned now).

In Botoşani County, a number of four communes were diagnosed as vulnerable areas: Corni, Prăjești, Ştefăneşti and Truşeşti. Depending on the characteristic of each municipality, the action programs have been established to lead to the prevention of pollution with nitrates from the agricultural sources.

Materials and method

In order to prevent the pollution of groundwater with nitrates, a monitoring program for the physical – chemical indicators of the water collected from hydro-geological wells located in Botoşani County was prepared. This paper presents the results of the groundwater quality monitoring in the period 2012 – 2019, in a number of 37 wells, located both in vulnerable areas, and in zones diagnosed as not being vulnerable. The selected parameters for the monitoring are the indicators of the nutrient regime: concentrations of nitrate, nitrite, phosphate, and ammonium ions, From the analysis of the nitrate ions concentration of the water samples from 20 wells, we found very large exceeding of the maximum allowed limit (50 mg/l). From the nitrite loading point of view, the groundwater in monitored wells falls within the maximum permissible limits (0.5 mg/l), with two drilling exceptions, where exceeding of the maximum concentration allowed for the nitrite parameter are recorded, achieving values of 1.54 mg/l (at Sadoveni F1), respectively 1.37 mg/l (at Ştefăneşti F3).

Fig. 1. Geographical location and map of Botoșani County, Romania

After monitoring of rural settlements, we detected deficient areas regarding water supply in terms of both quantity and quality.

These waters quality monitoring was performed in laboratories from the Environmental Pollution Agency, also of economic units, data have been processed with respect of actual standards.

Important sources of nitrogen pollution by agricultural activities are runoff and leaching, as well as deposition of ammonia upon its volatilisation.

Results and discussions

Groundwater quality

Drilling No.	Sampling section	Outdated indicators
F1	Stefăneşti	Ammonium, manganese
F1	Dorohoi	Ammonium,
F1	Săveni	Ammonium, sulphates
F1	Bălușeni	Nitrogen
F2	Stefăneşti	Manganese,
F2	Măşcăteni	Ammonium, manganese
F3	Dângeni	Nitrogen, manganese
F3	Sadoveni	Nitrogen
F3	Stefînești	Nitrogen, sulphates
F3	Dracșani	Sulphates, manganese

Three treatment plants were monitored: from Dorohoi, Darabani, and Saveni. A special situation is represented by localities where the water supply system is built, but there is no sewerage – treatment system. In these cases, all wastewater is discharged in natural receptors, diffuse, without prior treatment.

Due to different pollutants concentrations (suspensions, organic substances, petroleum products, detergents, metal ions, ammonium, nitrites etc.) of untreated or insufficiently treated wastewater, the impact produced on surface waters is appreciable and manifested by negative effects on the aquatic biotope and biocenosis, through the physical, chemical and bacteriological changes they cause. In most cases, this leads to a modification of the quality category of the receptor or in an increase of the indicators values within the same quality category.

Out of 1,216 physico-chemical and bacteriological analysis performed in the Bucecea and Cătămărăşti water stations, only 0.02% of the samples did not correspond to the drinking parameters. There were recorded twenty-five physical-chemical and seven bacteriological unsuitable samples.

Conclusions

The probable causes for which in most cases groundwater does not meet the requirements to be used for drinking purposes are the following:

- surface water pollution;
- natural hydro-geochemical conditions and processes that favours the passage into solution of various anions and cations;
- the intensive development of agriculture in recent decades with the excessive use of chemical fertilizers based on nitrogen and phosphorus, also pesticides has led to the accumulation in the soil of some of these substances (or their degradation products);
- the negligence effect of the former high-capacity of zoo-technical complexes, regarding the measures for the conservation of environmental factors;
- climatic, hydro-geological features and the exploitation of irrigation systems that contributes to the mineralization of organic matter in the soil and the migration of substances resulting from these processes.

Our researches show that significant improvements can be achieved (reduced fertilizer inputs, for example) while maintaining crop yields, and thus maintaining the economical potential of agriculture.

References

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Leclerc, H., *Nitrates de l'eau d'alimentation et risques pour la santé.* Acad Agric Fr. 4p. (2008).

Fixed-Bed Column Adsorption of Acid orange 7 onto Soil

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5th International Conference on Chemical Engineering
Innovative Materials and Processes for a Sustainable Development
ICCE 2020
Iași, October 28 - 30

INTRODUCTION

Synthetic dyes are used in various industries such as textile, printing, paper, food, leather, cosmetic industries and a representative percent of produced dyes are discharged in the environment, generating hazards in water, soil, sediments and to human health.

The main objective of present work is to assess the **transport and mobility** of Acid Orange 7 (AO7) dye onto soil layers. In order to achieve this objective, the experiments were performed in dynamic mode. The analysis of breakthrough curves was done using Thomas, Adams–Bohart, Wolborska, Yoon–Nelson and bed-depth service time (BDST) models.

MATERIALS AND METHOD

Soil

- The soil used in this study was sampled in the surface layer (0-25 cm) from Splai Bahlui – Iasi county located in the North-Eastern of Romania. The soil was classified by Romanian System of Soil Taxonomy, as **protisoil** with the subtype entiantrosoil urbic associated with aluviosoil molic-gleic/pelic.

Chemicals - Acid Orange 7 (AO7) azo dye was used as a model contaminant in this study (*Fig. 1*).

Experimental procedure

- Continuous flow sorption experiments (*Fig. 2*) were performed in a borosilicate column of 1.0 cm inner diameter and 25 cm high. The influent dye solution with initial concentration (C_0) of 10, 50 and 100 mg AO7 mg/L was pumped through the packed column, with the height of soil bed (Z) of 5, 10 and 20 cm respectively, at different flow rates (Q) (2.5, 5, 7 mL min^{-1}). The column was saturated over 24 h using a 0.01 mol L^{-1} $CaCl_2$ solution. Samples were collected at the exit of the column at regular time intervals and analyzed for the remained pollutant concentration. The studies were conducted at room temperature (20 ± 2°C) and natural pH of solution.

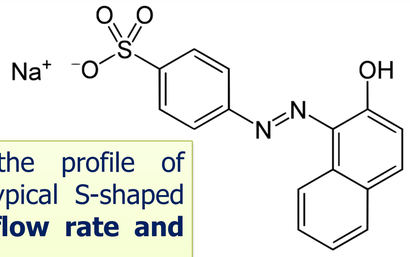

Fig. 1. Molecular structure of Acid Orange 7

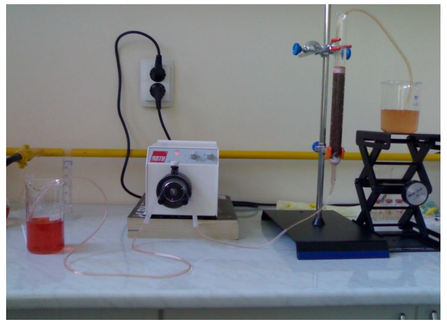

Fig. 2. Experimental setup

RESULTS AND DISCUSSIONS

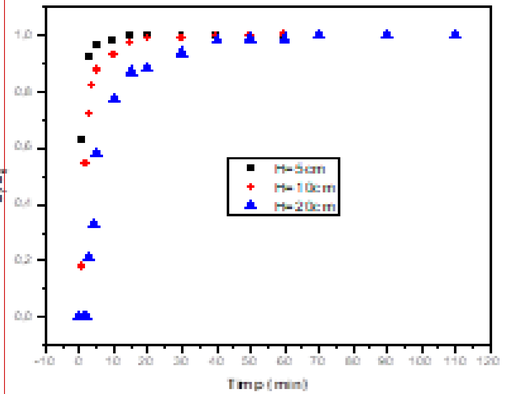

Fig. 1. Breakthrough curves of AO7 sorption on soil for different soil bed height (C_0=50 mg L^{-1}; Q= 7 mL min^{-1}; soil particles diameter 0.8-2 mm)

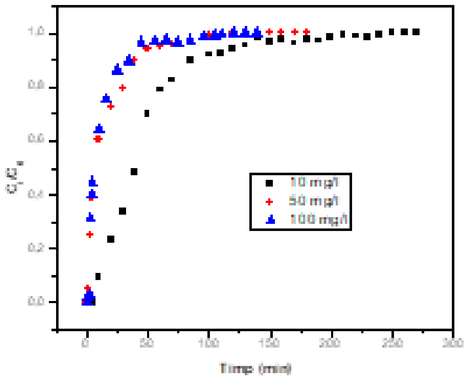

Fig. 2. Breakthrough curves of AO7 sorption on soil column for different influent concentration (C_0=10-100 mg L^{-1}; Q= 7 mL min^{-1}; soil particles diameter 0.8-2 mm)

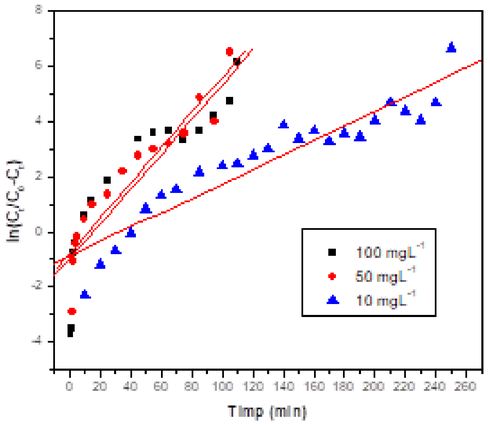

Fig. 3. Linear regression analysis for breakthrough curve modeling by Yoon-Nelson model, obtained at different CR concentration (H = 10 cm, Q = 7 mL min^{-1})

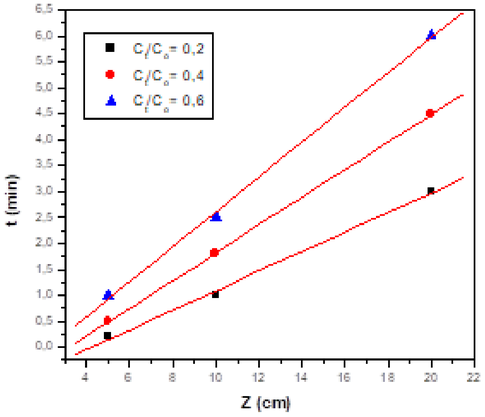

Fig. 4. BDST model applied for AO7 sorption at diferent soil soil bed height (C_{AO7}=50 mg L^{-1}; Q=7 mL min^{-1})

CONCLUSIONS

- The results of this study show that the profile of breakthrough curves is not described by typical S-shaped curve, and **varies with soil depth, the flow rate and initial pollutants concentration**.
- The modeling of the breakthrough curves using the Thomas, Adams-Bohart, Wolborska, Yoon-Nelson and BDST models highlighted that **the BDST model offers the best correlation of the experimental data,** followed by the Wolborska and Adams-Bohart model.
- The breakthrough time, exhaustion time, uptake capacity and the percent of AO7 sorbed became higher with the increase of soil column height from 5 to 20 cm. This displacement of the front of sorption with soil column depth can be explained by the different conditions for mass transfer.

ACKNOWLEDGMENT

This work was supported by a grant of the Romanian Ministry of Education and Research, CCCDI – UEFISCDI, project number PN-III-P2-2.1-PED-2019-5239, Contract no. 269PED/2020, within PNCDI III.

Kinetic and isotherm studies of metal ion biosorption on alkaline treated peat

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Technical University Gheorghe Asachi of Iasi, "Cristofor Simioneacu" Faculty of Chemical Engineering and Environmental Protection, Department of Environmental Engineering and Management, Bvd. Prof. Dimitrie Mangeron, no. 73, 700050 – Iasi, Romania

Introduction

The rapid increase in the pollution of metal ions in the aquatic environment as a result of anthropogenic activities has become an important issue, due to their accumulation tendency and toxic effect on human health. Among metal ions, copper(II), cobalt(II) and zinc(II) ions are most common contaminants of industrial wastewater, mainly due to their numerous uses in industrial processes. Biosorption has been identified as more attractive due to economic feasibility, simple operation, efficient and cost effectiveness. The cheapest and easiest to obtain are natural materials, which are available in large quantities and require only a few steps of preparation. One such example is peat. In order to increase the biosorption capacity of peat for metal ions, a simple alkaline treatment was used, in this study.

Materials and method

The adsorbent used in this study was peat, sampled from Poiana Stampei (Romania) at a depth below 1.0 m. The alkaline treatment was done by treating the peat samples with an aqueous solution of NaOH. Thus, 2.0 g of peat was mechanically shaken with 50mL of 0.1 mol= L NaOH solution, for 30 min. After 24 hours, the alkaline treated peat samples were filtrated, washed with double-distilled water, dried in air, and then mortared. The adsorption experiments were performed for a single component, by batch technique, at room temperature, mixing samples of 0.125 g of adsorbent with a volume of 25mL of known heavy metals concentration (6.4 – 127 mg/L). For kinetics experiments a constant adsorbent (dose of 5 g=L was mixed with 25mL of 25 mg M(II)/L heavy metals solution at various time intervals between 5 and 180 min.

Results and discussions

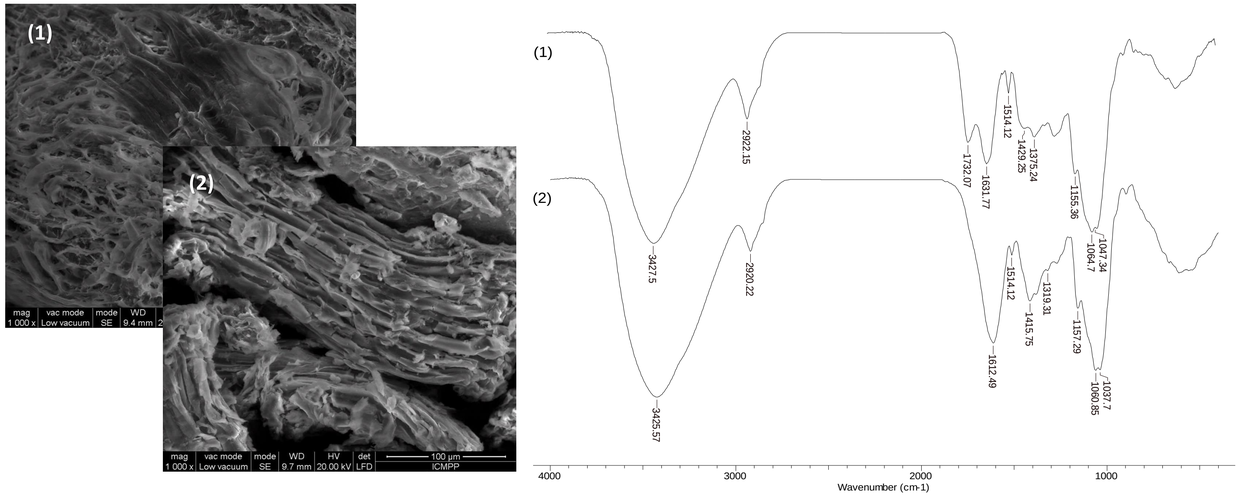

Fig. 1. SEM images and FTIR spectra of peat (1) and alkaline treated peat (2)

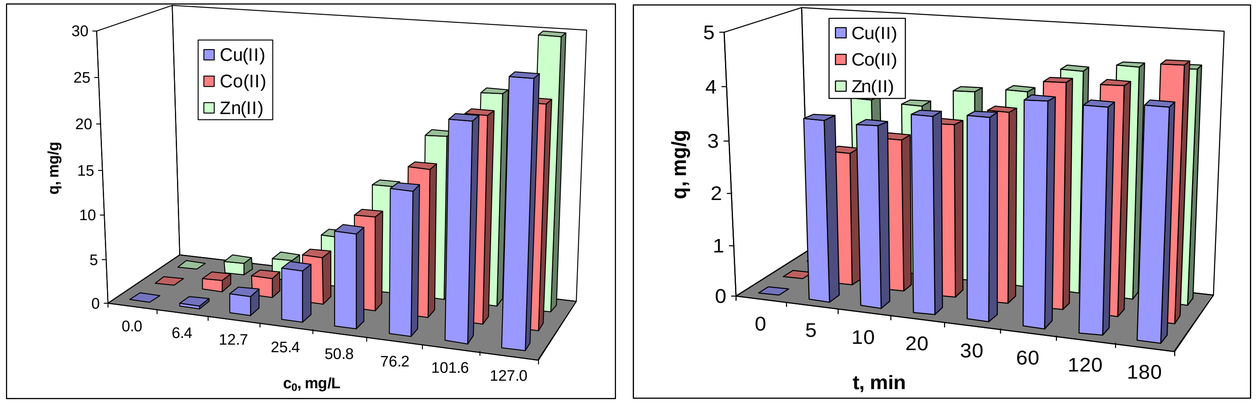

Fig. 2. Influence of initial metal ions concentration (a) and contact time (b) for the studied biosorption processes.

Conclusions

In this study, the adsorptive performances of alkaline treated peat have been investigated for the removal of Cu(II), Co(II), and Zn(II) ions from aqueous solutions. The influence of metal ions concentration and equilibrium contact time was studied at room temperature, in batch-adsorption experiments. The experimental data have shown that after alkaline treatment the biosorption capacity increase with 25–27% for studied metal ions (Cu(II), Co(II), Zn(II)), while the required contact time decreases significantly. All the biosorption processes follow the Langmuir isotherm model and pseudo-second order kinetic model. This indicate that the efficiency is mainly dependent on the number of superficial functional groups.

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Toxic effects of lead and cadmium on lettuce (*Lactuca Sativa Attraction*)

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Introduction

Presently, heavy metals are considered a serious environmental problem.

- **Cu, Ni and Zn** in low concentration are **essential elements** for the growth rate of plants
- **Cd, Cr, Pb, Co, Ag, Se, Hg (toxic metals)** are part of non-essential metals which in the end could affect the plant developmnt even in lower concentration.

Goal

Extend the knowledge of plant reactions under different concentrations of heavy metals

Objectives

Evaluate the ability of lettuce (*Lactuca sativa Attraction*) seeds to grow and develop under Pb(II) and Cd(II) stress

Materials and method

Lead chloride
$PbCl_2$
M = 278.1 g/mole

Cadmium chloride
$CdCl_2$
M = 202.539 g/mole

1. Toxicity tests

Petri dishes with filter paper → Add 3 mL of heavy metal solution for each sample → Add 10 lettuce seeds → Cover petri dishes and left at room temperature → 7 days of incubation

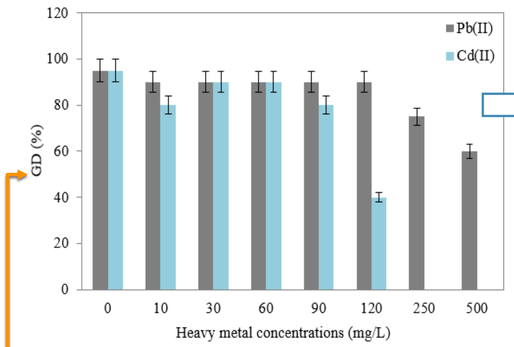
2. Control test

Perfomed following the same procedure as in toxicity test but using distilled water as control without adding the pollutant.

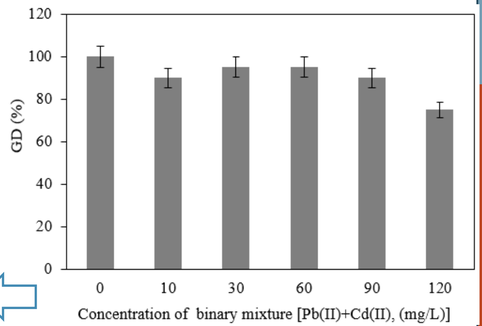
1. The rate of seed germination (germination degree - GD)

2. Plant elongation (roots, leaf and stems length of each seed)

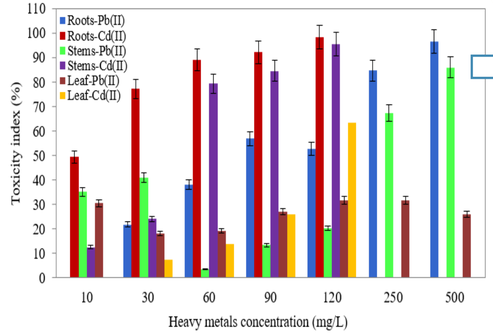
Results and discussions



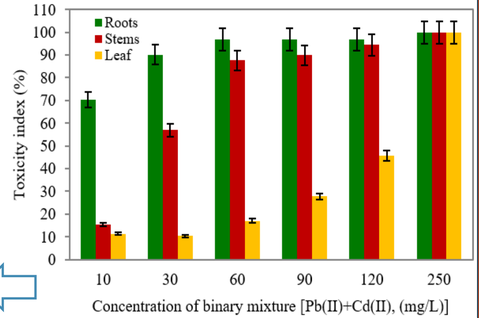
- In the control sample (M) the lettuce seeds germinated in a proportion of 95% for both metals;
- The concentration of 250 and 500 mg/L solution of Cd(II) can be considered lethal for lettuce seeds given that the seeds did not germinate, while the concentration of 250 and 500 mg/L solution of Pb(II) has a germination percentage of 80% , respectively 60%.



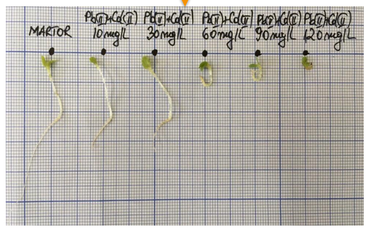
The lowest concentration of Pb(II) + Cd(II) had a slight influence on seed germination, while higher concentrations were lethal for lettuce seed germination.



- The concentration of 10 mg / L Pb (II) has a toxicity index of 0% for the root, while the concentration of 10 mg / L Cd (II) has a toxicity index of 50%
- The concentration of 120 mg/L Pb(II) has a toxicity index about 50%, while the concentration of 120 mg/L Cd(II) has a toxicity index about 100%



Exposure of lettuce to binary mixture of these two heavy metals (Pb(II) +Cd(II)) by increasing the concentration of metals from 10 mg/L to 500 mg/L has led to a decrease in seed germination efficiency and plant growth dynamics



Conclusions

Cadmium ions are more toxic than lead ions for lettuce.

A pronounced toxic effect was observed on root growth, compared to the other components of the plant (stem or leaf).

The leaves of the seedlings are the least affected compared to the other components of the lettuce both in the case of Pb (II) and Cd (II) ions and in the case of Pb(II)+Cd(II) ions.

Acknowledgment

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This work was supported by the Romanian National Authority for Scientific Research, CNCS - UEFISCDI, project number PN-III-P1-1.1-TE-2019-1200.

IDENTIFICATION AND EVALUATION OF FOOD WASTE MANAGEMENT ALTERNATIVE- LIFE CYCLE ASSESSMENT ASSESSMENT METHODOLOGY

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INTRODUCTION

Food production and consumption have a high impact on the environment, since three quarters of food produced for human consumption is lost or wasted globally, which amounts to about 1.3 billion tonnes per year.

Main sources which generate food waste are represented by following sectors: residential, commercial, institutional and industrial (Katajajuuri et al., 2014) (Fig. 1)

Considering the complexity of the consequences of food waste products it was concluded that the solving solutions can be obtained only in an Integrated Waste Management which must consider all the factors involved.

A number of treatment processes and technologies are used to generate usable forms of materials and energy and which also reduce the volume of food waste. Among these mentioned: pretreatment processes which include: mechanical biological treatment (MBT) - anaerobic digestion (AD) energy conversion process; mechanical heat treatment (MHT) – autoclaving and conversion treatments which include: incineration, gasification, anaerobic digestion (from mixed residual waste, often as part of an MBT process (Fig. 2) (USEPA, 2016).

In this context, **the goal of this study is twofold: (i)** provide an overview of sources and categories of food waste and their impact on the environment, economy and society, **(ii)** applied Life Cycle Assessment (LCA) methodology to compare the best alternative management for reduce the environment impact of food waste.

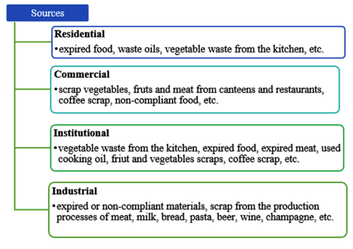


Fig. 1. Food waste generating sources

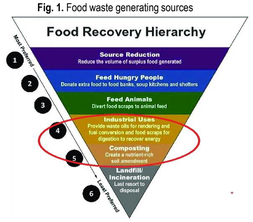
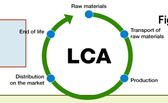


Fig. 2. Hierarchy of food waste management

MATERIALS AND METHOD



Environmental impacts were assessed based on Life Cycle Assessment (LCA) methodology (ISO 14040).
LCA is a complex methodology because: (i) is oriented toward processes and products and applies the principles of sustainable development; (ii) is an integrative method (incorporates altogether environmental problems occurring during the life cycle of process or product); (iii) is a scientific and quantitative method.
Two food waste management alternatives were considered in applying the LCA methodology:

(•) obtaining bioenergy by anaerobic fermentation of food waste and
(••) obtaining compost with a high level of nutrients.

In order to evaluate the environmental impacts for the studied processes we have applied ReCiPe and Eco-Indicator 99 methods. The impact categories considered in our evaluation were as follows: *Climate change, Human health (CcHh), Human toxicity (HT), Human health, Carcinogenic effects (CcCe), Ecosystem ecotoxicity (Ee)*, *Ozone layer depletion (Old), etc.*
All four phases of LCA were accomplished. The functional unit is the amount of food waste at national level. Input and output data were processed by GaBi software to determine the environmental and human health impacts of both alternatives studied.

The limits of the system are shown in Fig. 3.

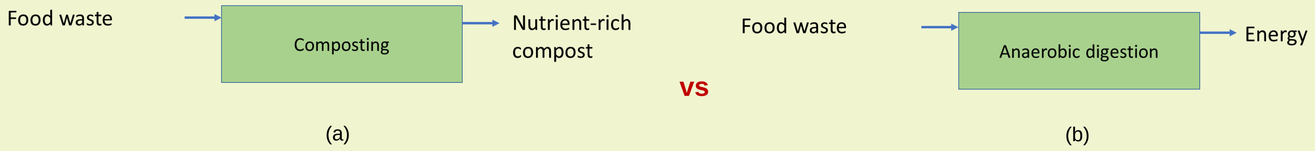


Fig. 3. System boundaries for (a) composting and (b) anaerobic digestion processes

RESULTS AND DISCUSSIONS

-Applying the LCA methodology showed that the results obtained by applying the ReCiPe (Fig. 4) and Eco-Indicator 99 (Fig. 5)methods, specific to the GaBi software environment, several categories of impact are negative, each of them being more severe than the last, in the following order:

-**ReCiP: (i) composting** - CcHh> HT;
-**(ii) anaerobic processes** - HT> CcHh;
-**Eco-Indicator 99: (i) composting** - Ee> CcCe> Old;
-**(ii) anaerobic processes** - Ee> CcCe> Old.

The high values obtained in the case of the composting process, in the case of both methods, are the cause of the emissions resulting from the fermentation stage.

A comparison shows that the values of CcHh are different considering the three LCA methods applied (Fig. 6). The higher value is provided by ReCiPe method for composting process.

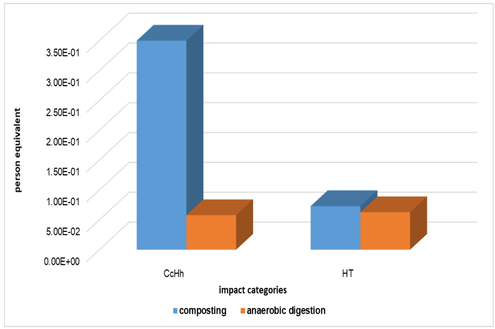


Fig. 4. Impacts on the environment resulting from the application of the composting and anaerobic processes , ReCiPe method

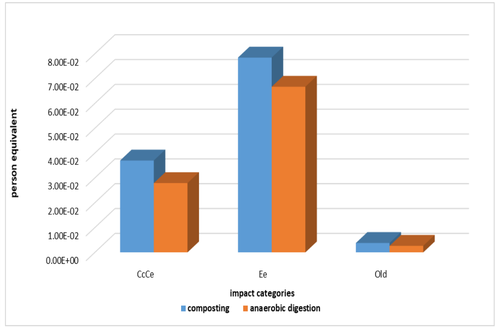


Fig. 5. Impacts on the environment resulting from the application of the composting and anaerobic processes , Eco-Indicator 99 method

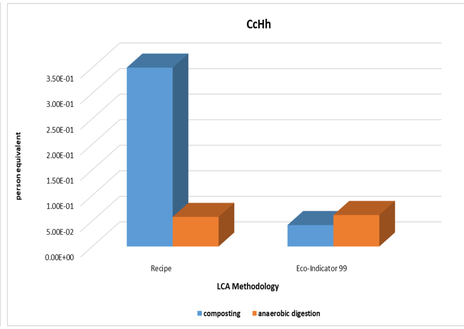


Fig. 6. Climate change, Human health (CcHh)

CONCLUSIONS

In conclusion, the application of the LCA methodology was able to provide the decision support for the analysis of the two food waste management alternatives and selection of the best and sustainable method of food waste management.
The results of the study can help us in a better understanding the harmonization of circular economy with the priorities of sustainable development, and the measure the overall environmental benefits and impacts in energy and compost production from food waste.
Future studies will focus on environmental impacts assessment of bioproducts production from recyclable organic materials and food waste.

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Quantitative evaluation of biochars performances obtained from algae biomass in metal ions biosorption processes

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Introduction

Nowadays, heavy metal pollution has become an acute problem. Due to toxic toxicity, persistence and accumulation tendency, high concentrations of heavy metals are found in the environment, becoming an important factor in the degradation of the ecosystem. Various conventional methods (chemical precipitation, ion exchange, electrochemical processes, membrane processes, etc.) are commonly used to treat industrial effluents. However, the use of such methods is often limited for economic or technical reasons. Heavy metal ion adsorption is an alternative technology that can be widely applied to remove toxic heavy metals using low-cost adsorbents. In this study, algae biomass (*Ulva lactuca sp.*) was transformed into biochar by a slow pyrolysis process and used as adsorbents for the removal of Zn(II) ions from aqueous media.

Materials and method

The green algae biomass was pyrolyzed at two temperatures (320 and 550 °C), for 8 hours, and under oxygen-limited conditions. The obtained biochars (320-BAB and 550-BAB) were then used as biosorbents for the removal of Zn(II) ions from aqueous solution, in optimal experimental conditions (initial solution pH of 5.0; biochar dose of 4.0 g/L, contact time of 60 min.). The adsorption experiments were performed, in batch system, at room temperature (21 ± 1 °C) In all cases, constant quantity of biochars (0.2 g) were mixed with 25 mL of aqueous solution of Zn(II) ions (initial concentration = 10 - 180 mg/L), The adsorption capacity (q, mg/g) of these materials for Zn(II) ions was calculated from the experimental results.

Results and discussions

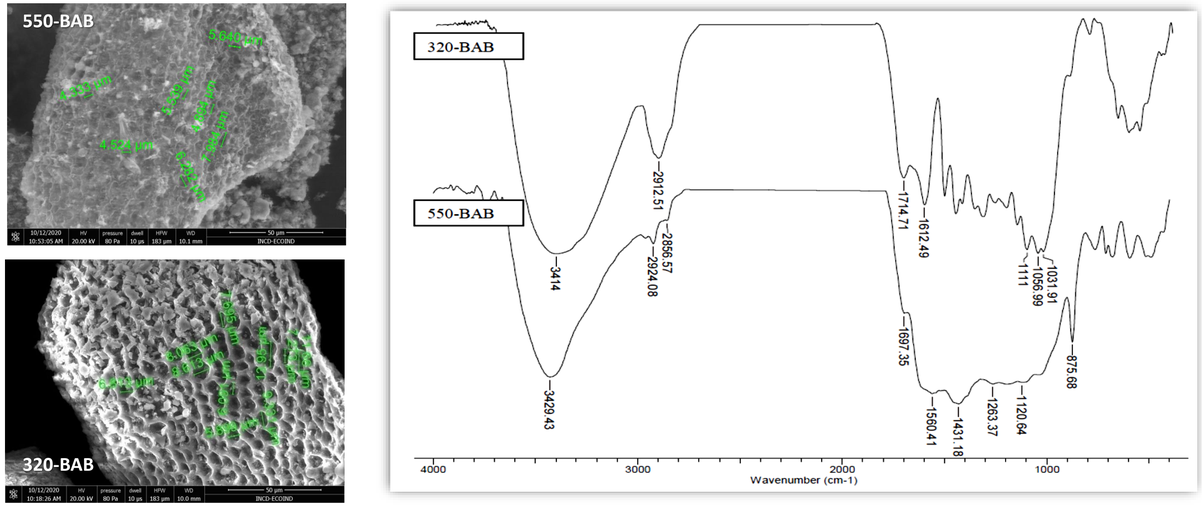
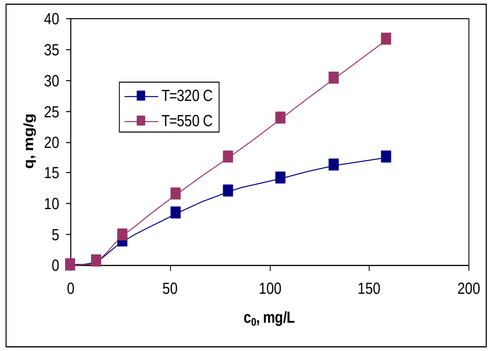


Figure 1. SEM images and FTIR spectra of biochars obtained at 320 C and 550 C.



q_{max} (320-BAB) = 24.45 mg/g

q_{max} (550-BAB) = 38.61 mg/g

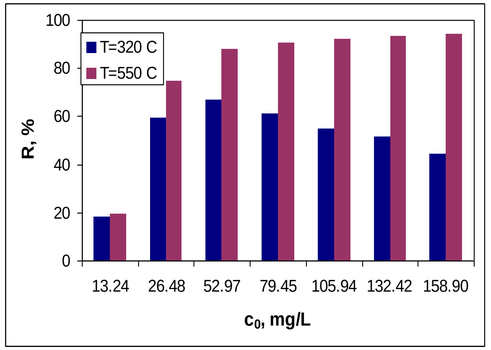


Figure 2. Adsorptive performances of biochars obtained at 320 C and 550 C for Zn(II) ions.

Conclusions

Biochar obtained from seaweed has demonstrated a good adsorption capacity of Zn (II) ions, which depends by the temperature of pyrolysis. The obtained experimental results have indicate that the 550-BAB is more efficient in the removal of Zn(II) ions from aqueous media than 320-BAB. To explain these differences, the elemental analysis of these two types of biochars was performed, as well as their morphological characterization. Thus it was observed that even though 550-BAB has a smaller number of functional groups than 320-BAB, its specific surface area is much larger and its basic character is much more pronounced, making this biosorbent much more efficient in biosorption processes of Zn(II) ions. The quantitative evaluation of the biosorptive performances of these two biochars in the Zn (II) ion removal processes sustain all these observations.

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Removal of Chromium (III) from tannery effluent using *Tamarindus indica* L. bark powder

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Introduction

- Water pollution by toxic metals through industrial effluents is a burning environmental problem worldwide.
- Chromium is the most carcinogenic of all metals despite its extensive industrial applications.
- Tanneries are the largest user of Cr to tan putrescible animal hides/skins.
- The amount of Cr(III) in tannery effluent is 2656-5420mg/L which is beyond than acceptable limit (0.1mg/L)

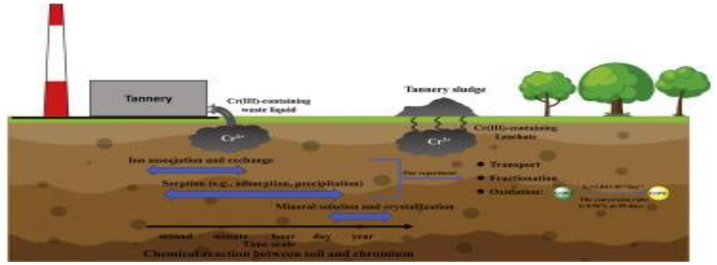


Fig. 1: Adverse effect of discharged Cr on environment

Research Purpose

- Prepare and characterize adsorbent of *T. indica* L. bark powder
- Monitor adsorption process
- Describe sorption mechanism
- Evaluate removal potency of secondary pollutants

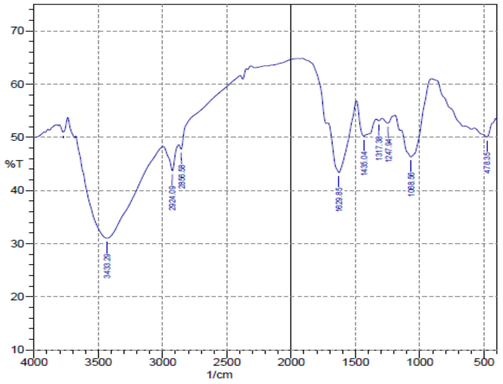
Features of *T. indica* L. bark powder

- ✓ Contains natural coagulants
- ✓ Biodegradable
- ✓ Abundant, low-cost and nontoxic

Fig. 2: *Tamarindus indica* L. bark powder

Materials and method

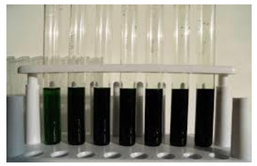
Adsorbent Characterization by IR Spectrum



Wavenumber (cm^{-1})	Tentative functional groups
478	-NH bending vibration for primary and secondary amines
1069	C=O stretch
1248	Amide III bend
1317	C-N Stretching
1435	C=C vibration in the aromatic ring
1630	bending in primary amine
2857, 2924	SP^3 C-H stretching
3433	(-OH) and amine group (-NH)

Adsorption experiment

Batch experiment at 25˚C and 300rpm



After treatment

Results and discussions

Batch study

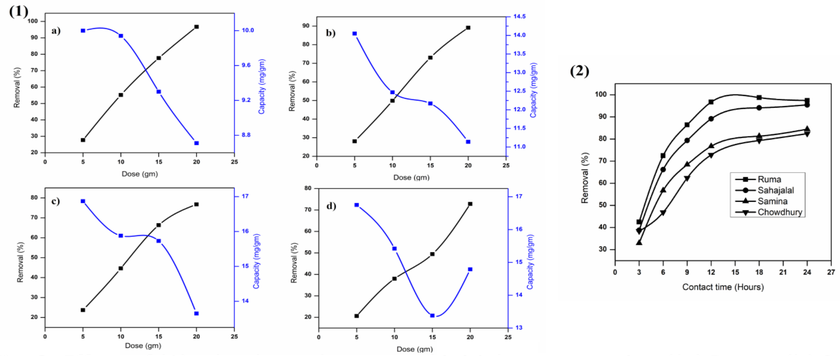


Fig. 3: Effect of (1) adsorbent dosage and initial concentration ((a) Ruma, (b) Sahajalal, (c) Samina and (d) Chowdhury) and (2) contact time

Secondary pollutant removal

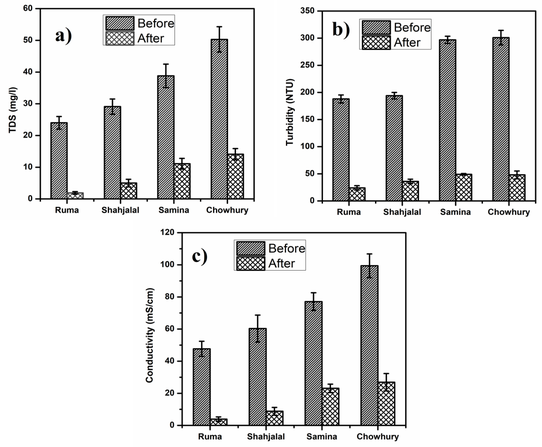


Fig. 4: Secondary pollutant (a) TDS, (b) turbidity and (c) conductivity value before and after treatment.

Conclusions

- Highest Cr removal 96.71%
- Maximum adsorption capacity (q_e) 31.1mg/g
- Optimum pH 3, dose 20g/L, for contact time 12hrs at chrome concentration 1423mg/L
- Reduction in other physicochemical parameters are remarkable

Acknowledgement

- Affiliated institutes

Estimation of the energy consumption at separate stages during wastewater treatment in a municipal treatment plant

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Introduction

In recent years, we are increasingly talking about reducing the consumption of fossil fuels and the search for new innovative technologies for the recovery of energy resources. One of the ways to reduce energy consumption is to optimize the operation and improve the energy efficiency of production systems, as well as the demand for new renewable resources. Wastewater treatment plants are considered to be one of the largest consumers of energy managed by municipalities. This is due to their main function aimed at reaching legal norms regarding the quality of treated water. The notion of WWTPs has changed over the last decade and wastewater has been seen as an energy resource for energy recovery. The improvement of the energy efficiency of the plants is related to modernizations and assessment of the separate stages of WWTP operation. Energy consumption depends on many constantly changing factors such as: volume, amount of pollutants in the incoming water, climatic conditions, seasonal load and others. All these factors affect the amount of energy consumed. This requires a thorough review of the individual stages of the technological treatment scheme in order to determine the specific costs of the facilities.

Goal

The purpose of the present study is to analyze the energy consumption at different stages of the municipal wastewater treatment plant, (see Figure 1) and to propose measures to improve energy efficiency. Several indicators are used to assess the energy efficiency of WWTPs. The most common of them are related to the total consumption of electricity EE relative to the volume of treated wastewater.

Main stages in wastewater treatment

- Mechanical treatment;
- Biological treatment;
- Sludge treatment

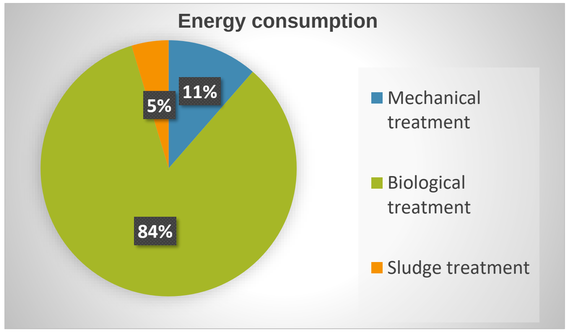

Figure 1. Energy consumption at different stages of treatment

Results and discussions

Energy generation approaches:

- Generation of energy by burning sludge;
- Generation of energy through biogas production;
- Reduction of energy consumption by utilization of heat energy.

Generation of energy by burning sludge:

- Specific energy capacity of sludge – 3.5 MJ/kg dry substance = 0.972 kWh/kg.

Generation of energy through biogas production:

- Anaerobic digestion produces methane and carbon dioxide as the final product. The approximate energy released during the conversion of 1 g of COD. decomposed into a methane tank is 0.35 Nm^3 methane.
- 1m^3 of methane has a calorific value of about 40MJ.

Reduction of energy consumption by utilization of heat energy:

This could improve the energy efficiency and sustainability of a wastewater treatment system. This approach is used in autothermal thermophilic aerobic digestion systems.

Conclusions

The performed analysis allows to make an assessment of the possibilities for energy recovery, assessment of the installation and possibilities for its reconstruction. This would lead to a reduction in energy consumption as well as a reduction in greenhouse gas emissions. The energy balance made of the facilities appears the basis for decision making for appropriate reducing the energy consumption.

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Effects of Feeding Solution and Flow Rate in a Sequential reductive/oxidative process for perchloroethylene (PCE) removal

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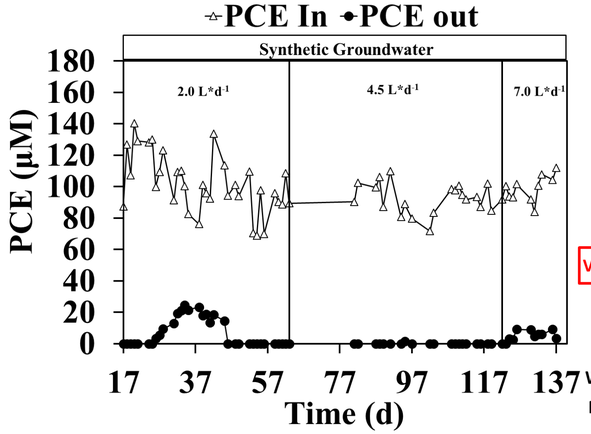
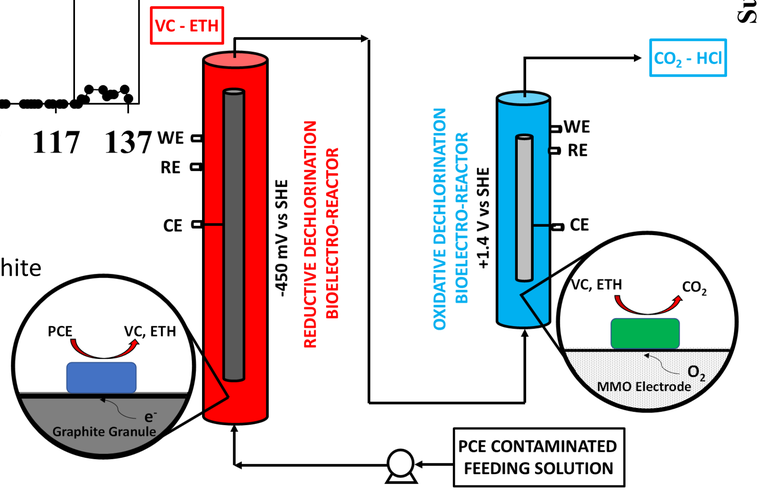
Introduction

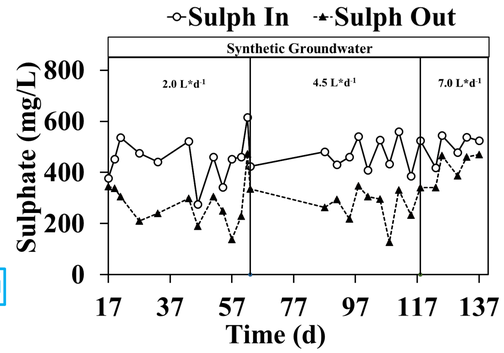
Chlorinated aliphatic hydrocarbons (CAHs) as perchloroethylene (PCE) are a common groundwater contaminant. Specialized microorganisms, are able to couple the reductive dechlorination (RD) of CAHs with growth in a process called organohalide respiration. The low chlorinated ethenes such as cis dichloroethylene (cisDCE) and vinyl chloride (VC) are more susceptible to oxidative mechanisms performed by aerobic dechlorinating microorganisms. In bioelectrochemical systems (BES) an electroactive biomass interact with an electrode by a direct or indirect mechanisms. BES can be used as an innovative strategy for the stimulation of both anaerobic and aerobic microbial pathways. A sequential reductive/oxidative bioelectrochemical process has been developed for the complete mineralization of PCE contaminated solutions by the use of two microbial electrolysis cell named reductive and oxidative reactor, respectively.

Results and discussions

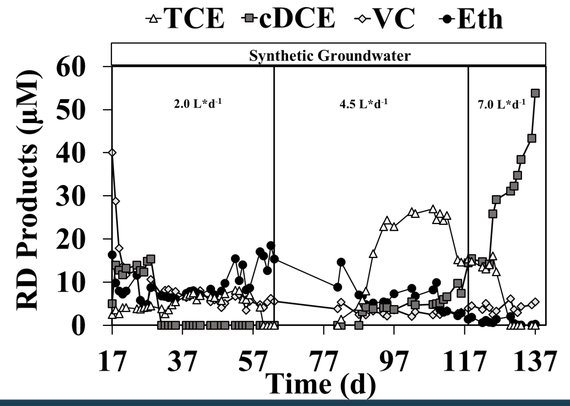


- **Reactor Volume:** 8.24 L
- **Working Electrode:** Granular Graphite
- **Internal Counterelectrode:** 1.7 L





- **Reactor Volume:** 3.14 L
- **Working electrode:** Titanium mesh with MMO
- **Internal Counterelectrode:** 0.18 L



Reductive reactor Condition	-450 mV vs SHE Mineral Medium	-450 mV vs SHE Synthetic Groundwater
Flow rate (L/d)	2.2 ± 0.7	2.0 ± 0.1
PCE removal rate (µmol/d)	216 ± 8	181 ± 7
PCE removal efficiency (%)	100 ± 1	100 ± 1
Reductive Dechlorination rate (meq/d)	1.1 ± 0.1	0.4 ± 0.1
Flowing Current (mA)	-19.3 ± 0.8	-64.6 ± 2.9
Coulombic Efficiency RD (%)	6.2 ± 0.7	0.8 ± 0.2
Coulombic Efficiency SR (%)	X	74 ± 12

Reductive reactor Condition	-450 mV vs SHE Synthetic Groundwater	-450 mV vs SHE Synthetic Groundwater
Flow rate (L/d)	4.7 ± 0.2	6.5 ± 0.1
PCE removal rate (µmol/d)	434 ± 10	608 ± 19
PCE removal efficiency (%)	100 ± 1	95 ± 1
Reductive Dechlorination rate (meq/d)	0.6 ± 0.1	1.0 ± 0.1
Flowing Current (mA)	-98.2 ± 2.9	-54.3 ± 5.3
Coulombic Efficiency RD (%)	1.0 ± 0.1	2.5 ± 0.4
Coulombic Efficiency SR (%)	70 ± 7	76 ± 6

Conclusions

- the feeding solution shift caused a loss of PCE removal In the reductive reactor probably due to a temporary biomass shock.
- Even if the PCE removal capacity was restored, the RD by-products distribution resulted in the presence of high chlorinated compounds like TCE and cis DCE.
- The sulphate presence in the reductive reactor resulted in the current control by sulphate reduction.
- The flow rate increase promoted the sulphate reduction inhibition under the higher flow rate.

Acknowledgment

This project has received funding from the European Union's Horizon 2020 project GA 826244 ELECTRA -Electricity driven Low Energy and Chemical input Technology foR Accelerated bioremediation".

ELECTRA 生物电 www.electra.site

An environmentally route of surface texturing polyimide films for proper light management in solar cells

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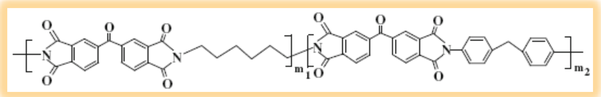
Introduction

The alarming diminishment of planet resources for energy production have led to development of alternative technologies. These are working on the principles of sustainable and clean energy. In this context, photovoltaic devices have gained a huge attention in scientific community. However there are still some issues that must be solved in order to enhance the conversion efficiency (Kim et al., 2013). For instance, adequate light management can be attained by specific processing of the components in a solar cell device (Singh et al., 2013; Mustafa et al., 2019). This work is devoted to application of an environmentally route of surface texturing of a polyimide film. The proposed surface designing could be useful to control scattering and thus to harvest a greater amount of solar radiation.

Materials and method

Polyimide (PI) was synthesized starting from a pair of diamines 4,4'diaminodiphenylmethane (DDM) and 1,6diaminohexane (HMDA), and benzophenone-3,3',4,4'tetracarboxylic dianhydride (BTDA) as dianhydride (in equimolar ratio), by the ring-opening polyaddition at room temperature to poly (amic acid) (PAA).

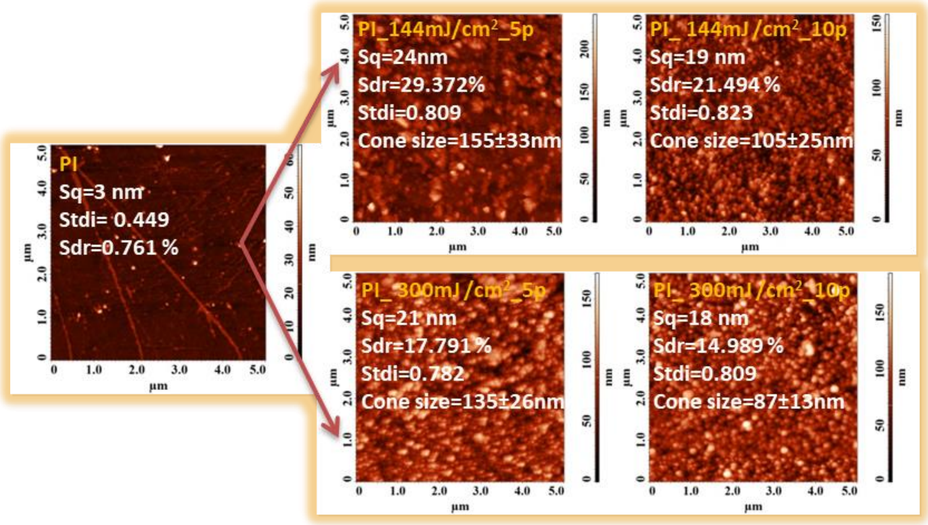
PI film was prepared through imidization of PAA film cast on a glass substrate, by sequentially heating process (via thermal cyclodehydration method).



Methods

- Static ablation of polyimide samples was made on a LPX 220 excimer LASER operating at 308 nm (XeCl), with pulse duration of 25 ns and an energetic stability of laser beam of minimum 1%. The experiments were performed after 5 and 10 pulses at two laser fluences of 144 mJ/cm2 and 300 mJ/cm2.
- AFM measurements were performed on a scanning probe microscope Solver Pro-M (NT-MDT, Russia), in air, at room temperature, in tapping mode. A rectangular a high-resolution gold-coated silicon cantilever NSG10 (NT-MDT, Russia), with a 305 kHz resonance frequency was used.

Results and discussions



The 3D parameters were calculated using Image Analysis 3.5.0.19892 software.

Sq - root mean square roughness,
Stdi - surface texture direction index,
Sdr - surface area ratio

The average cone sizes were also calculated for textured samples.

- The surface topography and roughness of the pristine PI film derive from the characteristics of the polymer chains that govern aggregation and molecular ordering, which occur during the thermal imidization processes.
- After laser irradiation, the roughness (Sq) and surface morphology complexity (Sdr) significantly increases, due to the occurrence of the cone-type formations. At 5 pulses of irradiation, the cones tend to agglomerate, organizing themselves like mountain ridges. As the number of pulses increases, the cones individualize and become smaller. Also, increasing the fluency the cones were smaller.
- The pristine PI was slightly anisotropic , but all textured surfaces had random/isotropic morphology, with Stdi close to 1, the best results being obtained when 10 pulses of irradiation were used.

Conclusions

- The dimensions of the cones influence the values of the 3D texture parameters. All textured surfaces had random/isotropic morphology, with texture direction index (Stdi) close to 1, the best results being obtained when 10 pulses of irradiation were used.
- The laser induced texture, due to its increased randomness and roughness parameters could improve the light propagation among the layers of the solar cell devices. In this way, if the proper amount of light reaches the active region of the photovoltaic device one may attain a higher conversion efficiency. The surface morphology features are in strong relation with light propagation among the layers of the device and this might lead to new insights on surface processing of polymer material for upgraded energy conversion.

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Acknowledgment

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The assessment of human health effects of particulate air pollution ($PM_{2.5}$ and PM_{10}) in Romania

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Introduction

Air pollution plays an important role in increased morbidity and mortality around the world. According to the World Health Organization (WHO), air pollution causes seven million people's death worldwide every year. $PM_{2.5}$ and PM_{10} have a different physical-chemical property, hence the $PM_{2.5}/PM_{10}$ ratio can supply detailed information about particulate origin, formation process, and their implied human health effects. Due to its smaller size, the fine particulate can pass via the respiratory tract and accumulate in the lungs causing lung cancer. The present study aims to analyze the temporal and spatial distribution of airborne particulate matter and to calculate the relative risk, excess risk, and attributable death in eight different regions in Romania.

Materials and method

The main objective of this study was to decipher the temporal and spatial distribution of airborne particulate matter and to calculate the relative risk, excess risk, and attributable death in eight different regions in Romania. The daily course (PM_{10}) and fine ($PM_{2.5}$) particulate matter concentration were followed up in eight different regions (B-Bucharest, C-Central, NE, NW, S, SE, SW, W) between 2009 January to 2018 December, excepting $PM_{2.5}$ data in Bucharest region, where the data are available only from 2016. The data were provided by the National Environmental Protection Agency, in total 33 and 122 monitoring station's data were processed for $PM_{2.5}$, PM_{10}, respectively. In order to determine the pollutant concentration variation, temporal and spatial distribution, descriptive statistics, and time series analysis were used.

- **Health Risk Assessment Methodology for short term effect of PM_{10}**

The relative risk associated with $PM_{10,}$ $PM_{2.5}$ was calculated:

$RR = \exp[\beta(X - X_0)]$ (1),

$RR = [(X + 1)/(X_0 + 1)]\beta$ (2),

Where: X is the annual mean concentration of PM ($\mu g/m^3$), X_0 is the background concentration of PM_s and β is the coefficient of the risk function. After that, using the determined relative risk (RR), the attributable fraction (AF) was calculated (Equation 3,4).

$AF = (RR - 1)/RR$ (3)

$(ER = RR - 1)$ (4)

Results and discussions

During the period of observation, the average concentration of fine and coarse particulate matter in the eight studied regions varied between 17.01 - 22.91 $\mu g/m^3$ and 23.02 - 33.29 $\mu g/m^3$, respectively, which is 1.82 and 1.35 times higher than the annually acceptable limit for $PM_{2.5}$ and PM_{10}, according to National Ambient Air Quality Standard. The multiannual mean concentration of the $PM_{2.5}$ and PM_{10} concentration were the highest in Bucharest region (22.91 $\mu g/m^3$ and 33.29 $\mu g/m^3$) followed by SW (20.40 $\mu g/m^3$ and 30.85 $\mu g/m^3$). The mass percentage for coarse particles is higher than the fine particles for all regions. The proportion of fine particles in PM_{10} also shows wide variability varying between 0.52 - 0.76. The maximum ratio (0.76) is found in the most polluted region (B), indicating the high $PM_{2.5}$ contributions from industrial emissions, which has also been found in the well-developed industrialized region (NW, W) with higher $PM_{2.5}/PM_{10}$ ratio (0.73) (Fig.1).

Relative risk calculation

The relative risk caused by the PM_{10} for all-cause mortality varied between 1.017 (W) and 1.025 (B), with an average 1.020 (Figure 2). The results demonstrate a positive relative risk of cardiopulmonary and lung cancer disease due to exposure to $PM_{2.5}$ for the national average 1.26 (±0.023) and 1.42 (±0.037), respectively (Figure 3).

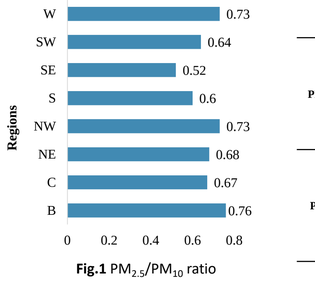

Fig.1 $PM_{2.5}/PM_{10}$ ratio

	Regio n	min	25 P	med	75 P	max	mean	stdev	count	95% CI	CV
$PM_{2.5}$	B*	0.94	13.76	19.21	28.39	128.95	22.91	14.70	917	21.95-23.86	0.64
	C	0.36	9.06	13.30	19.62	138.73	17.01	13.73	3502	16.56- 17.47	0.81
	NE	2.00	11.79	16.37	23.12	119.54	19.24	11.47	3567	18.86-19.61	0.60
	NW	0.00	10.08	14.99	23.21	107.49	18.04	11.23	3533	17.67-18.41	0.62
	S	1.60	11.24	14.90	20.95	81.02	17.51	9.59	3564	17.19-17.82	0.55
	SE	0.58	8.30	11.34	15.66	143.57	13.38	8.88	3319	13.08-13.68	0.66
	SW	0.91	11.90	16.99	24.69	118.37	20.40	13.51	3392	19.95-20.85	0.66
	W	1.00	8.99	13.93	21.59	132.62	17.21	12.46	3330	16.79-17.64	0.72
PM_{10}	B	3.00	22.12	29.75	39.67	230.29	33.29	17.72	3562	32.70-33.87	0.53
	C	3.66	14.82	21.15	30.21	174.10	24.57	15.01	3651	24.08-25.05	0.61
	NE	5.57	19.62	25.71	33.28	120.80	27.69	11.99	3651	27.30-28.08	0.43
	NW	3.45	15.28	21.48	30.46	127.62	24.29	12.27	3649	23.90-24.69	0.51
	S	5.97	20.31	26.28	34.37	92.61	28.57	11.65	3651	28.20-28.95	0.41
	SE	2.00	18.76	22.99	28.10	93.38	23.95	7.61	3648	23.70-24.20	0.32
	SW	3.55	20.16	27.22	37.07	171.81	30.85	16.33	3631	30.32-31.38	0.53
	W	5.04	15.34	20.94	28.09	99.52	23.02	10.63	3647	22.68-23.37	0.46

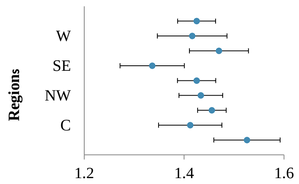

Fig.2. Relative risk of PM_{10} for all-cause mortality

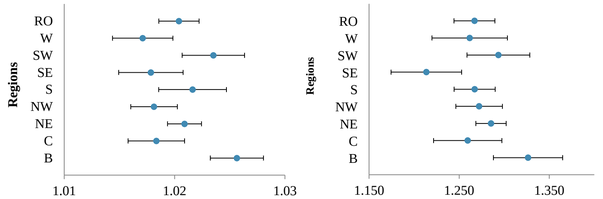

Fig.3. Relative risk of $PM_{2.5}$ – for cardiopulmonary disease(left) $PM_{2.5}$ - lung cancer(right)

Conclusions

During the period of observation (2009-2018), the average concentration of fine and coarse particulate matter in the eight studied Romanian regions was 1.82 and 1.35 times higher than the annually acceptable limit for $PM_{2.5}$ and $PM_{10,}$ respectively. The temporal distribution of PMs is significant, with higher concentration in the cold period, and lower concentration in the warm period. According to the results, significant differences were found between regions, the highest in the Bucharest region, and the lowest in the South-Est and West regions. Human health risks associated with exposure to $PM_{2.5}$ and PM_{10} were estimated in the current study. The ratio between the fine and coarse particulate matter in Romania was 0.66. The relative risk calculated for the $PM_{2.5}$ (cardiopulmonary and lung cancer) was significantly higher than the relative risk caused by the PM_{10} all-cause mortality. The relative risk calculated from the $PM_{2.5}$ concentrations (1.26) was more than one order of magnitude higher than for the PM_{10} (1.020).

Acknowledgement or Contact

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Polyimide films for solar cell applications

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Introduction

Global energy demands impose research of new materials that upgrade the performance of current devices that use natural resources to produce electricity [1]. Among them, solar cells have received special attention since solar radiation is one of the most abundant source of energy on our planet [2]. Shielding solar cells with lightweight materials that resist in harsh conditions (sun heating, wind erosion, etc), but also induce low optical losses is a hot topic in this domain [3].

The present work is devoted to the study of some polyimides from the point of view of their optical, morphological and surface properties. These aspects affect the device reliability and provide perspectives on designing photovoltaics.

Materials

Polyimides were prepared by polycondensation reaction using alicyclic dianhidrides (5-(2,5-dioxotetrahydrofuryl) -3-methyl-3-cyclohexenyl-1,2-dicarboxylic acid anhydride, EPI, or cyclobutane-1,2,3,4-tetracarboxylic dianhydride CBDA) and aromatic diamines (bis[4-(4-aminophenoxy)phenyl] sulfone, pBAPS, or 4,4'-ethylenedianiline, DDE).

Methods

Light dispersion was determined on a multiwavelength Abbe refractometer.

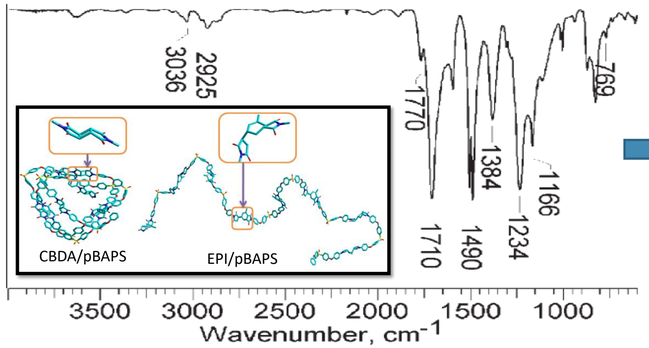
Transmittance data were collected on SPECORD 210 PLUS Analytik Jena spectrophotometer.

Morphology was analyzed using a Bresser optical microscope.

Surface properties were evaluated via contact angle method using a lab-made device.

Results and discussions

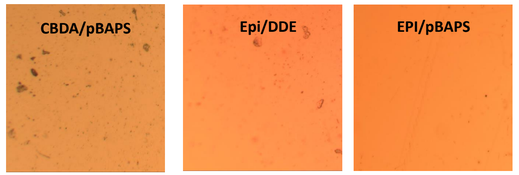
FTIR spectra and molecular modeling



FTIR spectrum of EPI/pBAPS sample. Molecular modeling of CBDA/pBAPS and EPI/pBAPS.

- FTIR spectra: 1770 cm-1 peaks ascribed to the C=O asymmetrical and symmetrical stretching vibrations of imide rings ; 1384 cm-1 and 769 cm-1 bands are assigned to CN stretching and CN bending, respectively, in imide groups; 1320 or 1166 cm–1 are attributed to the SO2 asymmetrical and symmetrical stretching vibrations in the p-BAPS
- The broad absorption band at 3350–3450 cm–1 and the narrow absorption peak at 1650–1660 cm–1, specific to amidic NH and C=O groups from the amide linkage, have disappeared entirely, indicating the completion of thermal imidization of the intermediate poly(amic acid) into final polyimide
- Molecular modeling shows the impact of dianhydride moiety on polyimide conformation. It can be noted that the distinct flexibility of EPI or CBDA sequences affects chain packing

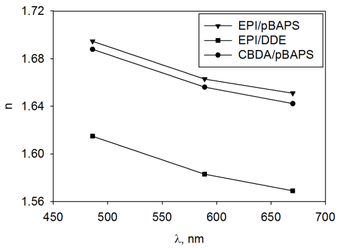
Morphological analyses



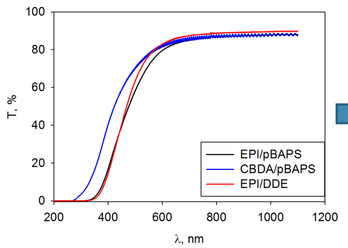
Micrographs of studied polyimide films.

- The surface of polyimide films is characterized by isotropic features.
- The observed morphology is similar to that of amorphous materials
- All samples display flat surface and no porous architecture.
- The type of diamine structure and dianhydride structure is slightly influencing the surface features at macroscopic level

Optical analyses



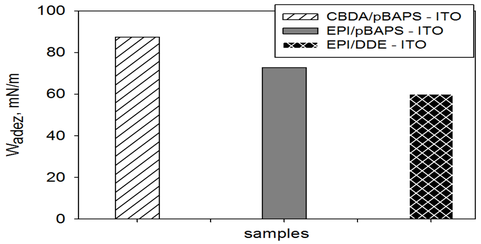
Light dispersion curves of studied polyimide films.



Transmittance curves of studied polyimide films.

- For all films the refractive index decreases as the wavelength decreases
- Polyimide structure affects the magnitude of refractive index
- The cutt-off wavelength is lowest for CBDA/pBAPS film, followed by EPI/pBAPS and EPI/DDE
- The prepared polymer films are transparent in visible and infrared domains
- This aspect is positive for propagation of sunlight in the studied materials

Surface properties and adhesion



Work of adhesion of Indium Tin Oxide (ITO) to polyimide film surface.

- The polar and dispersive contributions to surface tension of polyimide samples reflect the influence of structure polarity
- Work of adhesion was assessed based on polyimide and ITO surface properties, as follows:

$$W_a = 2\cdot[(\gamma_{sv}^{d}\cdot\gamma_{mv}^{d})^{0.5} + (\gamma_{sv}^{p}\cdot\gamma_{mv}^{p})^{0.5}]$$

where the subscript "m" denotes the metallic phase, while the "s" index denotes the polymeric phase.

- Work of adhesion to ITO was found to be highest for CBDA/pBAPS perhaps owing to its small CBDA moiety which allows a higher density of imide rings along the main chain

Conclusions

The studied polyimides containing BPDA sequence are more transparent, have higher refractive index and better adhesion to ITO – all these being favorable for solar cells applications.

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Acknowledgment or Contact

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Novel heavy metal tolerant bacterial strains with PGPR potential, isolated from heavy metal polluted soils

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Introduction

The soil is a natural source of heavy metals (HM), but anthropogenic activities increase the HM concentrations of soils, thus becoming harmful to plants, animals and human (Tirry et al., 2018). The plant growth promoting microbes (PGPM) can protect the plant from HM stress. The rhizospheric microbes have metabolic capabilities to adapt and live even in presence of high concentration of HM (Mishra et al., 2017).

Purpose

Cd, Zn, Cd+Zn → ? →

- phosphate (organic, inorganic) mobilization
- exopolisacharide (EPS)
- indole-3-acetic acid (IAA)
- siderophore

} production

Materials and methods

Each medium/broth was supplemented with different HM concentrations (1 mM Zn, 0.5 mM Cd, 0.5 mM Zn + 0.1 mM Cd). Overnight grown bacterial cultures were point inoculated (10 µL, OD=0.3) in 3 replicates. The plates were incubated at 28 °C, for 3 days.

Inorganic P mobilization: Detection and measurement of a clear (halo) zone around the bacterial colony.

Organic P mobilization: Bacterial strains with phytase enzyme degraded the phytate and a clear zone was formed around the colony.

Siderophore production: The diameter of the halo orange zone formed around the colonies indicated the siderophore production.

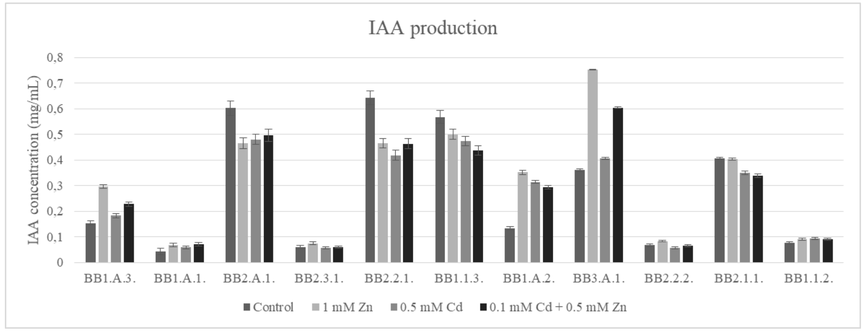
IAA production:

- Bacterial strains grown in 5 mL TSB broth (28 °C, 150 rpm, 72 hours)
- 1 mL culture supernatant + 2 mL of Salkowsky reagent (incubation: 30 min, dark, room temperature)
- absorbance at 570 nm (standard curve)

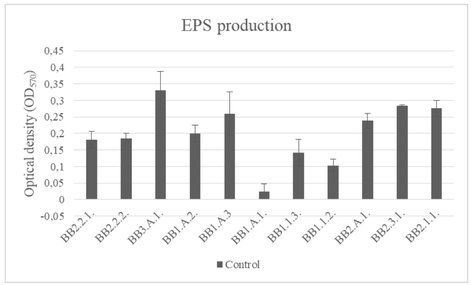
EPS production:

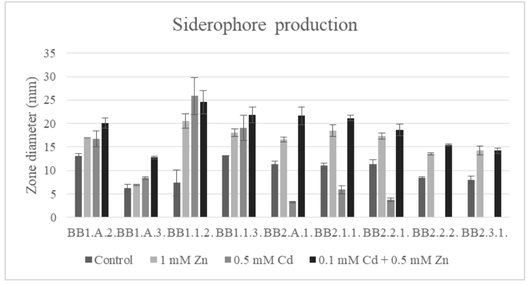
- Bacterial culture: 200 µL Nutrient broth for 24 hours at 28°C (absorbance at 595 nm)
- 0.01% crystal violet (20 min), than 3 washing steps (distilled water), 96% ethanol (10 min), absorbance at 570 nm.

Results and discussions

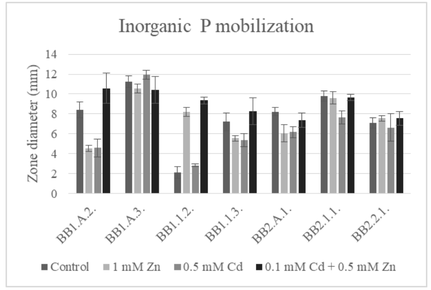


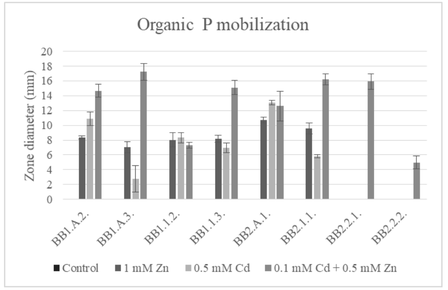
91.66 % of strains can produce **EPS** in control conditions, and also 91.66 % of bacterial strains were able to produce **IAA** in case of HM concentrations.





The **siderophore** production of bacterial strains was detected at 75 % of isolated bacterial strains.





58.3 % of isolated bacterial strains mobilized the **inorganic phosphate**, and only half (50 %) was able to mobilize the **organic phosphate** in presence of used HM concentrations

Conclusions

- ✓ The presence of HM improved the **organic P mobilization**. There was no P mobilization observed for bacterial strains in control conditions.
- ✓ 50 % of examined bacterial strains **maintained their PGP traits in presence of HMs**, making them suitable for plant experiments.
- ✓ Thus, our goal in future is to test the PGP potential and effect on HM uptake of selected bacterial on **plants** under controlled conditions.

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Acknowledgment

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Comparison of adsorption efficiency of the fly ash for heavy metals removal

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Introduction

Why fly ash as adsorbent?

It has alkaline property and its surface is negatively charged, the matter that can be used as a potential adsorbent.

The aim of this study was to compare the adsorption efficiency of a locally available fly ash as a low cost adsorbent material for removal of nine heavy metals ions from aqueous solution. Removal of heavy metals from wastewater is one of the most important environmental issues studied (Harja et al., 2013). The adsorption process has gained attention due to some advantages: there are not used expensive chemicals, and it has a low capital and operating cost, etc (Buema et al.,2014).

Materials and method

Fly ash used in the present study was collected from CET II Holboca power plant, located near Iasi, Romania. The batch study was undertaken for the removal of heavy metals. The stock solution of each heavy metal was prepared in the laboratory. The filtrates of the remaining heavy metal ion (C_t) were analyzed by atomic absorption spectroscopy for Ni, spectrophotometrically (Cd, Ni, Cu, U), respectively using γ-ray spectroscopy (Ba, Cr, Eu, Cs). The adsorption efficiency of the process was determined using Eq. 1. All the experiments were carried out triplicate and the average values are presented in Figure 1.

Adsorption efficiency, % = $(1 - C_t/C_o)$ 100 (1)

Results and discussions

The chemical composition of this fly ash was determined by XPS technique and it contains the following chemical constituents by weight SiO_2: 53.8%, Al_2O_3: 21.9%, Fe_2O_3: 8.2%, Na_2O: 2.9%, K_2O: 2.1%, TiO_2:1.9%, CaO: 6.2%, (classified as class F). The mineralogical characterization of fly ash (determined through XRD method) revealed that the fly ash contains: Quartz, Mullite, Hematite, Rutile, etc. Regarding the particle size of fly ash it was found that about 25 wt. % of the particles are finer than 0.050 mm. In order to study the morphology of fly ash, SEM analysis using JEOL JSM 840A microscope was carried out at an accelerating voltage of 10 kV. FTIR spectrometer (Thermo Scientific Nicolet 6700 Model) was used to identify the functional groups.

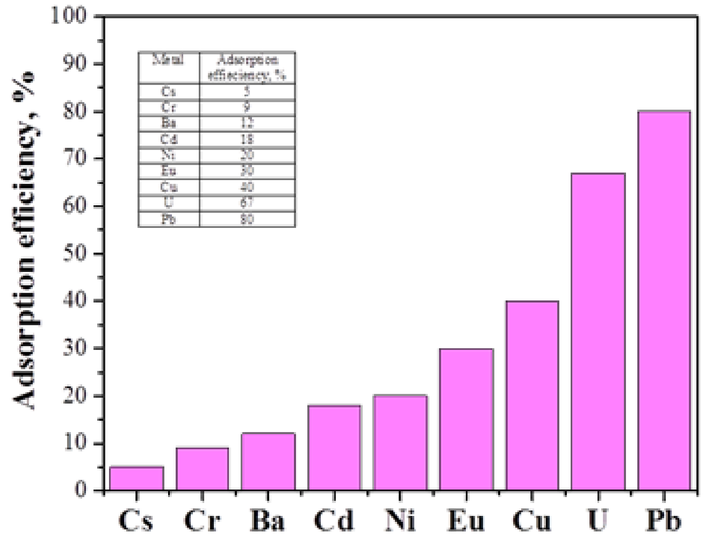

Figure 1. Comparison of adsorption efficiency of the fly ash: Cs (pH 4), Cr (pH 5), Ba (pH 5), Cd (pH 5), Ni (pH 6), Eu (pH 4), Cu (pH 5), U (pH 3), Pb (pH 9)

Conclusions

In this research, fly ash from CET II Holboca Iasi, Romania was involved as low cost adsorbent.

The basic properties of fly ash, such as: SEM, XPS, XRD, and FTIR were evaluated.

The adsorption efficiency on different heavy metals: Cs, Cr, Ba, Cd, Ni, Eu, Cu, U, Pb was assessed. These harmful heavy metals represent the greatest threat to the environment.

The results obtained during this investigation provide useful information for the recycling of fly ash and the adsorption of various heavy metals from aqueous solution.

Therefore, the utilization of fly ash can considerably help in the reduction of environmental pollution.

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F. Noli, G. Buema, P. Misaelides, M. Harja, J. Radioanal. Nucl. Chem. 303(3), 2303, (2015).

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E-Service Quality and Customer Loyalty and the moderating role of consumer demographics- An empirical relationship with specific reference to the Indian Organic Online Stores.

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PSG Institute of Management, Coimbatore, India

Introduction

- The rapid growth of worldwide information and technology communication (ICT) has rendered the extensive internet usage and different kinds of connecting devices in networks such as tablets and smartphones more and more common.
- Downing and Lu have underlined e-commerce as the current and normal mode of carrying out business; together with the growth of social trust, this combination will result in the growth of the national economy.
- Pandey and Chawla have pointed out that customers should be perceptive of the importance of online activities and electronic marketing, as well as enhancing the element of website security.
- Repeated buying intention is driven by various elements, such as website reputation, reliability, trust, guarantee of reputation, information safety, reliability of transaction, and price advantage.
- In the marketing landscape, the loyalty of a customer is considered as the most significant factors influencing one's business.

Materials and method

This particular study made use of the positivism paradigm due to it proposing the factors driving the repeated purchase of customers in online stores and their impact towards loyalty.

- ***Research Design:*** *Descriptive Research Design*
- ***Sample Size:*** *290*
- ***Sampling Method:*** *Simple Random Sampling*

Results and discussions

In general it was noted that 20.5 per cent of the respondents were below 20 years of age, while 25.3 per cent of them were between the age range of 20-30 years. Similarly, 27.6 per cent of the respondents were in the age range of 30-40 years, whereas 26.6 per cent of them were 40 years and older.

In general, 3.1 per cent of the respondents made online purchases once within 0-6 months. Meanwhile, 32.4 per cent of them made online purchases once within 6 months to 1 year, 34.1 per cent of them made online purchases once in 1.3 years, and 30.4 per cent of them made online purchases once within 3 years and more.

Also 1.7 per cent of the respondents strongly disagreed that saying positive things about the organisation to other people, while a larger proportion of 13.7 per cent disagreed that saying positive things about the organisation to other people. Contrastingly, 31.1 per cent of the respondents were neutral that saying positive things about the organisation to other people, whereas a majority or 42.7 per cent agreed about saying positive things about the organisation to other people. Meanwhile, the remaining 10.9 per cent of respondents strongly agreed about saying positive things about the organisation to other people.

Here 0.3 per cent of the respondents were very satisfied, while merely 2.0 per cent were satisfied. In contrast, 16.7 per cent of the respondents were neutral, whereas a whopping majority or 59.4 per cent were unsatisfied. The remaining large proportion of 21.5 per cent were also very unsatisfied.

A Relationship was found between information security and confidentiality and loyalty, as well as a correlation between information security and confidentiality and website performance.

Meanwhile, the parameters of age, income, and gender all strengthened the respective relationships between informational security and confidentiality, website performance, and loyalty accordingly.

Many factors could be attributed towards influencing a customer to repeatedly purchase from online stores, as well as the information they had given to the website were kept securely.

Website must simplify the process of identifying any products on its interface and should allow the customers to quickly carry out their transaction. Moreover, the customers should feel that the website facilitated them to easily browse information about their products or goods.

Besides, it was noted that these customers would encourage their relatives and friends to use the particular online store and post positive comments and messages about it on internet message boards online for loyalty purpose.

Conclusions

This article aims to examine the factors driving repeated purchase of customers in online stores and their impact on loyalty, which consist of information security, information confidentiality, website performance, customer loyalty, and satisfaction of a transaction.

Finally, this study may further assist practitioners and academicians of the field to understand the importance of factors driving the repeated purchase of customers in online stores and their subsequent impact on loyalty.

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Optimization of experimental parameters for retention of Hg (II) ions from aqueous solution on clay adsorbent

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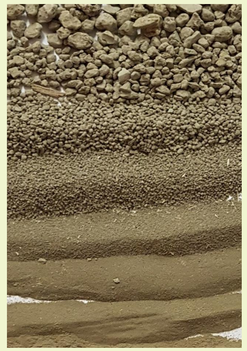
Introduction

Research on decontamination of water resources has led to an extraordinary boost in finding new and cheap materials that are able to remove pollutants. Pollution of water sources caused by Hg (II) ions has raised global environmental problems around the world because they cannot be destroyed or degraded, have a tendency to accumulate in the environment and affect the quality of ecosystems.

Materials and method

The method used for removal of mercury ions from aqueous media is **adsorption** due to its advantages:

Clay materials have received increased attention because they are available in large quantities and the are cheap which make adsorption a economical process, and they are easy to prepare, the main process is based on grounding, mortaring and sieving.



Results and discussions

Adsorption experiments onto clay material were conducted in batch systems, at room temperature (20˚C). The influence of initial solutions pH (2-7), adsorbent dosage (4-20 g/L), contact time (5-180 min) and initial metal ions concentration (0.1 – 2.8 mmol/L) were examined in single component systems, analyzing each factor one by one.

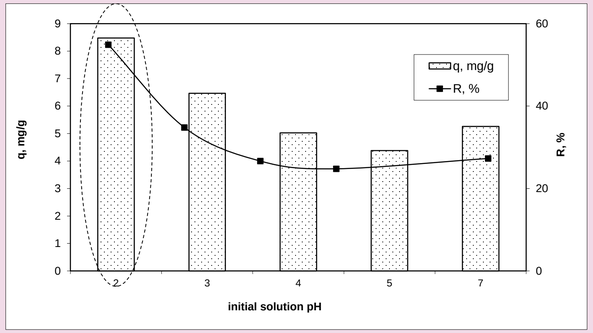


Fig.1 Effect of initial solution

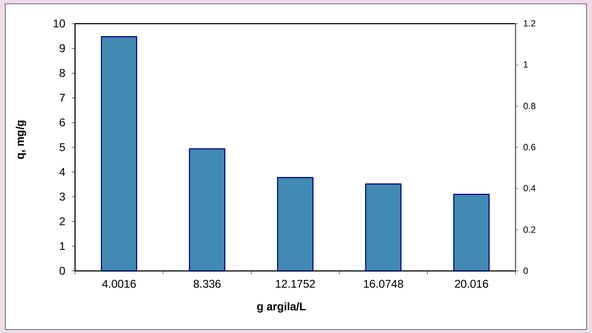


Fig. 2 Effect of adsorbent dosage

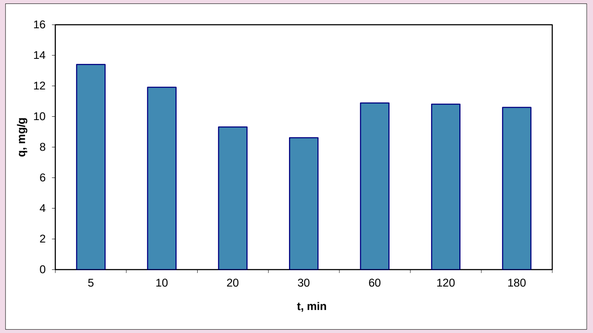


Fig. 3 Effect of contact time

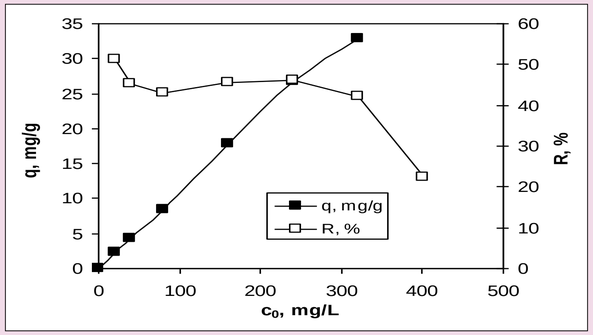


Fig. 4 Effect of initial ion concentration

Experimental parameters and optimal conditions	pH	Adsorbent dosage g /L	Contact time, min	Hg (II) concentration
	2	40	10	320.32
q	8.48	9.48	11.91	32.91
R	54.87	47.37	61.47	42.17

Conclusions

In this study, a local natural clay material was used for the efficient removal of Hg (II) ion from aqueous solution. The highest adsorption efficiency of clay material was found at initial pH=2(Fig.1), the adsorbent dosage of 4g/L (Fig.2), contact time 10 minutes (Fig.3), when the adsorption capacity of clay material for Hg(II) ions is 32.91 mg/g (Fig. 4).

The experimental results included in this study highlight the practical applicability and increased potential of this clay material as adsorbent in the decontamination processes of the aqueous effluents.

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TOXIC EFFECTS OF LEAD IN EARLY GROWTH OF WHEAT AND ITS TOLERANCE

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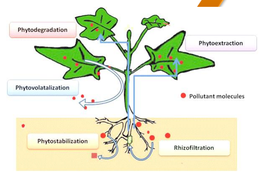
Introduction

Environmental pollution with heavy metals is considered a serious problem internationally. The accumulation of these contaminants in agricultural land and crops can cause major production losses worldwide, through their toxicity, mobility and non-biodegradability. ***Lead*** has been classified as one of the most significant soil contaminants, which once in the soil, can be transferred to groundwater, surface water, absorbed by plants and transferred to herbivores and humans, affecting the entire food chain. It is therefore necessary to investigate the relationship between metal toxicity and plant tolerance, and the ***phytoremediation*** process can be applied for this purpose.

Objectives:

Removal of Pb(II) ions by phytoremediation processes

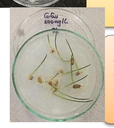


Establishing the potential of wheat hybrids (*Triticum aestivum* L.) (variety *Glossa*) to tolerate different concentrations of lead

- Sterile laboratory conditions
- Room temperature: 24±2°C
- Germination time: 5 days

Materials and method

- **Wheat seeds were subjected to synthetic contamination with $PbCl_2$ solutions of different concentrations: 50-400 mgPb(II)/L. Experiment was made in sterile conditions.**
- **10 wheat seeds were evenly distributed in Petri dishes containing one layer of Whatman filter paper with 10 mL of $PbCl_2$ solution of known concentration to create metallic stress, or 10 mL of distilled water for the control samples.**
- **After 5 days of growth the roots and stems of plants were measured for determinations of inhibitions degree on plants lengths.**
- **For each concentration, the roots and stems were separated for determination of fresh and dry biomass quantities.**
- **Before drying at 105° C for 15 hours, the fresh biomass was washed with distilled water for removal of heavy metal from the surface of the plant.**



Results and discussions

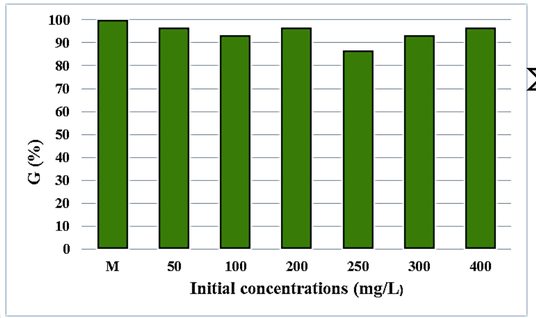


Fig. 1. Influence of heavy metal Pb(II) on the degree of germination of wheat seeds (*Triticum aestivum*, *Glossa* variety)

The germination rate of wheat seeds was not significantly affected by the different concentrations of Pb(II) compared to the control sample.

The growth rate of the roots is significantly lower than the growth rate of the stems. With the increase of metal concentrations, a decrease of the plant parts is observed. At a concentration of 50 mg/L Pb(II), a better evolution of the roots was found compared to the control sample.

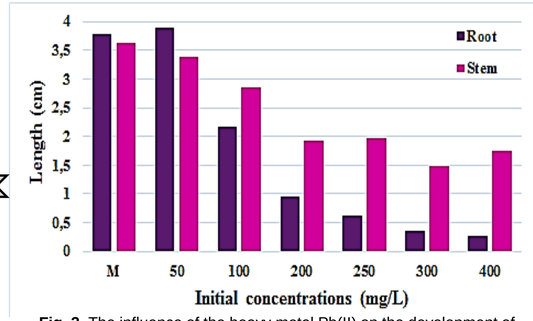


Fig. 2. The influence of the heavy metal Pb(II) on the development of wheat roots and stems (*Triticum aestivum*, *Glossa* variety)

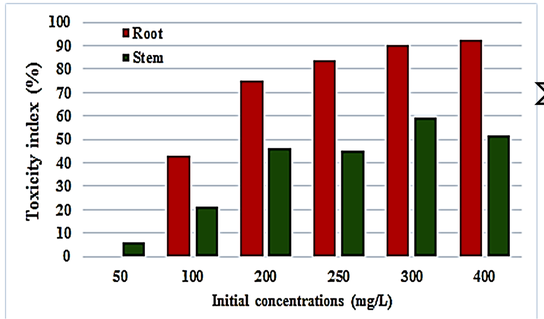


Fig. 3. Toxicity index of wheat root and stem (*Triticum aestivum*, *Glossa* variety) at different concentrations of Pb(II)

The concentration of 50 mg/L Pb(II) has no toxic effects on the root system. It has been found that the toxicity of the metal Pb(II) affects over 90% the development of the roots and up to 60% the growth of the aerial part.

The tolerance of wheat strains is higher at the concentration of 400 mg/L Pb(II) solution than at the concentration of 300 mg/L, which shows that the increase in metal concentration does not significantly influence the growth of the plant.

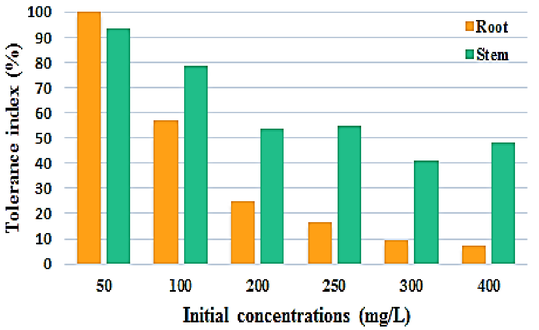


Fig. 4. Tolerance index of wheat root and stem (*Triticum aestivum*, *Glossa* variety) at different concentrations of Pb(II)

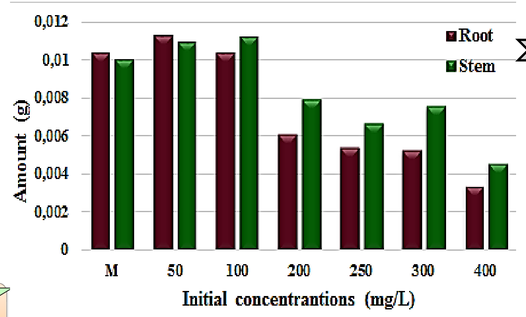


Fig. 5. The influence of the concentration of Pb(II) ions on the dry biomass of wheat (*Triticum aestivum*, *Glossa* variety)

Regarding the dry biomass, a higher amount of stems was highlighted than of the root system. A significant decrease in biomass was observed in the range of 200-400 mg/L Pb(II).

Conclusions

- Following phytotoxicity tests, the Glossa wheat hybrid proved to be a potential phytoremediating agent of the heavy metal Pb(II), but with the mention that, after harvesting the crop, it should not be intended for human consumption or animal feed. Biomass can be processed as a secondary source of raw materials for Pb(II) extraction by chemical and thermal methods.
- The inhibitory effect was more pronounced at higher concentrations and the root system proved to be more affected than the stems.

Acknowledgment

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Assessment of human health risk associated with pesticides residues in fruits and vegetables

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5th International Conference on Chemical Engineering Innovative Materials and Processes for a Sustainable Development ICCE 2020 Iași, October 28 - 30

Introduction

Population growth is directly associated with an increased demand for food, sustaining thus, the agricultural progress in human society. To ensure a proper food production, the development of agricultural production needs first of all, the protection of plants against diseases and pests. In this sense, different categories of pesticide are developed and applied, the majority of them belonging to persistent organics pollutants (POPs) class.

These pesticides can be very toxic for humans and animals and may further contaminate the surface waters, groundwater, soils, and atmosphere. In this demand, food security should be treated as a serious public concern worldwide.

In this context, the major objective of our paper is to provide a dietary risk assessment of the population from Romania exposed to pesticides residues in fruits and vegetables based on PRIMo EFSA model (version 3).

Materials and method

Input data:

- ***Residual pesticides concentrations*** (data collected from the Romanian *National Plan for Pesticide Residues Monitoring in Fruit, Vegetables and Cereals*) detected in: **3 types of fruits** (apples, strawberries, cherries) and **2 types of vegetables** (green onions, lettuce);
- ***ARfD*** (**Acute Reference Dose**) and ***ADI*** (**Acceptable Daily Intake**) values for each type of detected pesticides;
- Different ***categories of population*** (toddler, childern, adults, the whole population, general population) in EU countries, according to European Food Safety Authority (EFSA) recommendations, taking into account **short and long term exposure**.

Pesticide Residue Consumption Model (PRIMo) developed by the European Food Safety Authority (EFSA)

1
- **Developed since 2007**, being a spreadsheet performed in the Excel program.
- **Aims to estimate the acute and chronic risk associated with the consumption of vegetable products contaminated with pesticides.**
- **Performing scientific opinions and recommendations underlying European policies and legislation for:** food and feed safety, animal health and welfare, plant protection

2
- **Considers the possible impact of the food chain on:** biodiversity, plant and animal habit.

Final results expressed as:

- ***%ARfD* and *%ADI* < 100%:** the pesticide residues do not present a risk to human health;
- ***%ARfD* and *%ADI* > 100%:** the pesticide residues pose a risk to human health

Results and discussions

❑ ***Short term-exposure***

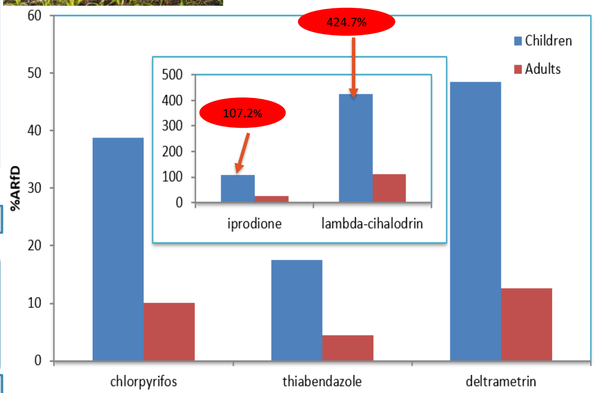

Fig. 1. Acute exposure of the European population to pesticide residues in **apples** in the Galati area expressed as% ARfD

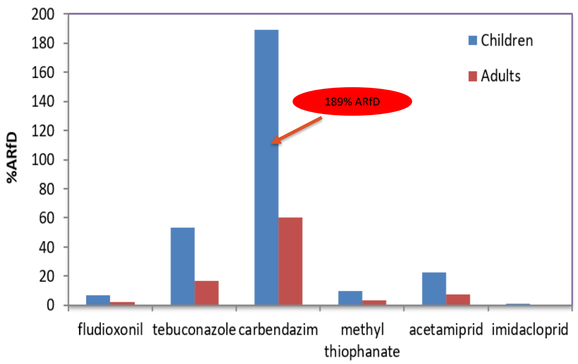

Fig. 2. Acute exposure of the population to pesticide residues present in **lettuce** in the Galati area expressed as% ARfD

❑ ***Long term-exposure***

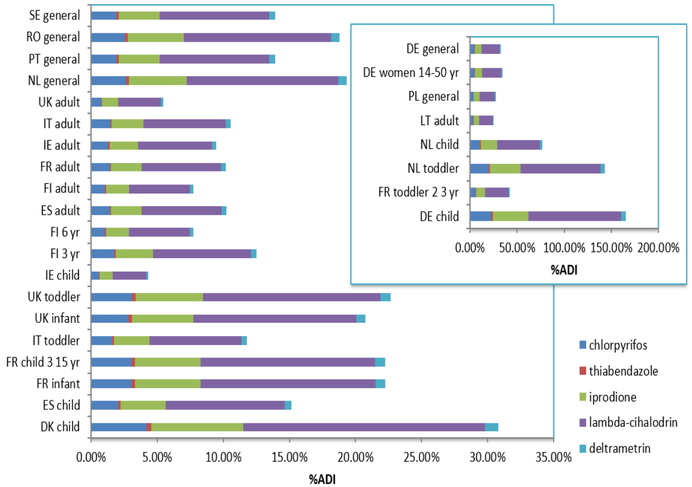

Fig. 3. Estimation of long-term exposure to pesticide residues in **apples** in the Galati area expressed in% ADI

Conclusions

Following the analysis on the content of pesticides residues detected in apples, there were exceedances in case of **acute exposure**, in **apples from the Galati** area for **lambda-cyhalothrin** pesticide, which exceeded the corresponding limit for children (424.7% of *ARfD*). Also in the case of children, an excess was observed in the case of **iprodion** pesticide (107.2% of *ARfD*). While the **long-term exposure** assessment showed that the risk is acceptable.

In case of **lettuce** (Galati area), an acute risk was obtained for children, regarding **carbendazim** pesticide with the value of 189% of *ARfD*. While the long-term exposure of the lettuce consumers can be excluded for all age groups, since there were no exceedances of pesticide residue.

The results of this study confirm that residue levels in vegetable products could pose a threat to consumers health (especially**, children**).

Acknowledgment

This work was supported by a grant of the Romanian Ministry of Education and Research, CCCDI - UEFISCDI, project number PN-III-P2-2.1-PED-2019-5239, Contract no. 269PED/2020, within PNCDI III.

Comparative study of Pb(II) ions adsorption on PET waste fibers and flakes

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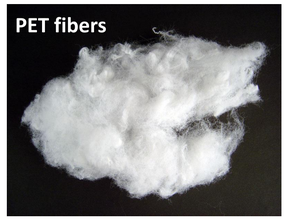
Introduction

The use of polyethylene terephtalate (PET) for the manufacture of food packaging and beverage containers has led to the discharge of huge amounts of such waste into the environment, causing its pollution. In addition, as the degradation of PET waste requires a very long period of time (Mendoza-Carrasco et al., 2016), environmental pollution with this waste can be considered permanent (Shukla et al., 2008). In order to found some practical applications in environmental remediation, PET waste fibers and flasks have been tested as adsorbent materials for the removal of Pb(II) ions from aqueous media.

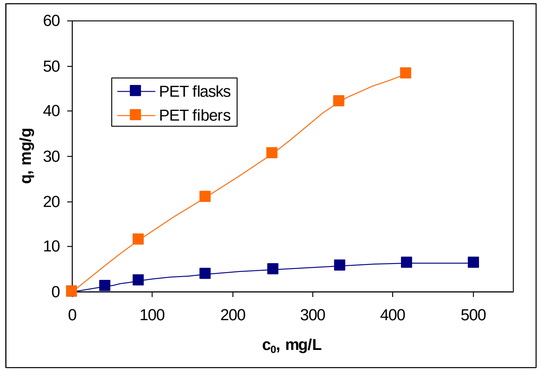
Materials and method

PET waste (fibers and flasks) were purchased GreenFiber Company (Iaşi, Romania). Both materials were washed and cut into pieces of 0.2 cm^2.



The adsorption experiments were performed, in batch system, at room temperature (22 ± 1 °C) and at constant contact time (24 hours). In all cases, a constant quantity of adsorbent material (0.2 g) was mixed with 25 mL of aqueous solution of Pb(II) ions (initial concentration = 42 - 500 mg/L), The adsorption capacity (q, mg/g) of these materials for Pb(II) ions was calculated from the experimental results.

Results and discussions



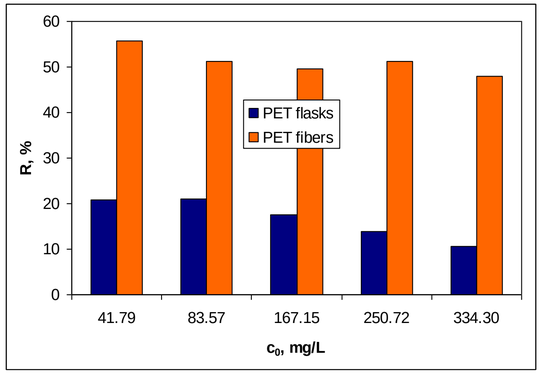


Fig. 1. Variation of adsorption capacity (q, mg/g) and removal percent (R, %) for the adsorption of Pb(II) ions on PET flasks and fibers

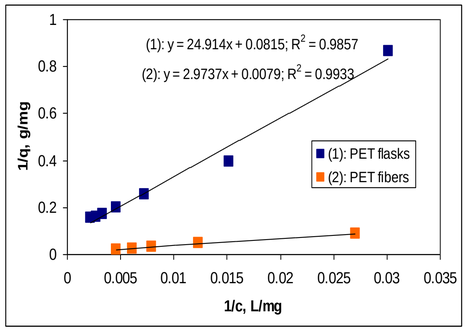


Fig. 2. Langmuir representations for Pb(II) ions adsorption on PET waste

Table 1. Langmuir parameters obtained by calculation

PET	R^2	q_{max}, mg/g	K_L, L/g
Flasks	0.9857	12.27	0.0033
Fibers	0.9933	126.58	0.0027

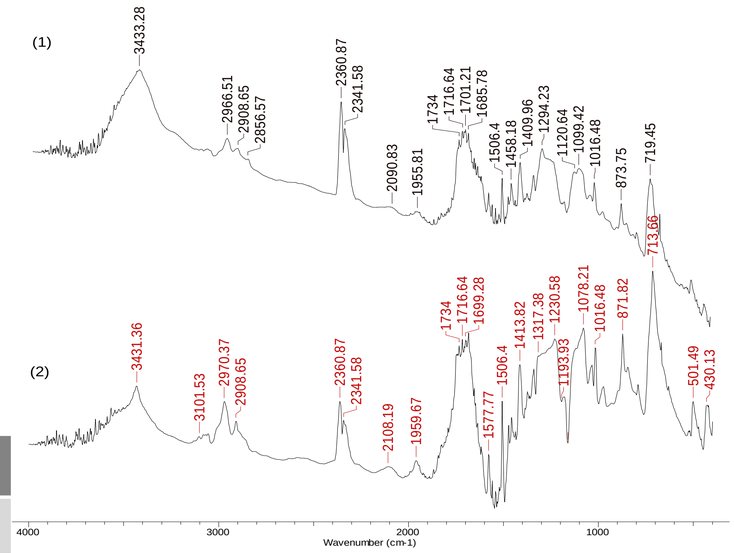


Fig. 3. FTIR spectra of (1) PET flasks and (2) PET fibers.

Conclusions

In this study, PET waste (fibers and flasks) were tested for the removal of Pb(II) ions from aqueous solution. The adsorption capacity (q, mg/g) of these two PET-based materials, calculated after 24 hours of contact time increases with the variation of initial Pb(II) ions concentration, on entire studied interval. The obtained results show that the adsorption capacity of PET waste fibers is clearly superior to that obtained when using PET waste flakes as adsorbent material. This is mainly due to the clearly superior morphological characteristics of the fibers compared to those of flakes. However, in both cases the removal percent does not exceed 57 %, which is an important drawback of these materials. Therefore, the possibilities of functionalization of these wastes should be considered in order to obtain high-performance adsorbent materials.

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Insights into toxicity and risks caused by heavy metals found in medicinal plants

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Introduction

Humanity has been using plants in different types of therapies for centuries. The use of plants as alternative to conventional medicine is considered by many people more safe, available and affordable. However, due to the continuous increase of environmental pollution caused by our demand in consumption, major concerns have been raised by researchers on safety and quality issues related to the use of herbal plants (Ozyigit et al., 2018). On the other side, heavy metals are of special concern since they cannot be degraded and are the subject of plant and animal bioaccumulation causing toxicity (Hlihor et al., 2017). Given this context, a possible contamination with heavy metals of plants used in phytotherapy and cosmetology for specific preparations, could cause risks to human health even in low concentrations. For example, metals found in cosmetic products can act locally on the skin or accumulate in the body after absorption and cause systemic toxic effects (Fischer et al., 2017).

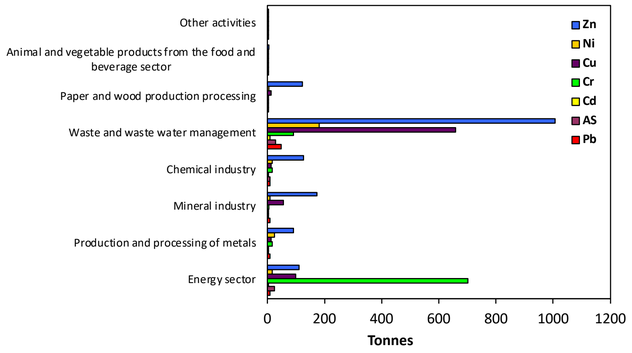

Fig. 1. Discharges of heavy metals through different activities

Objectives

The aim of our paper is to investigate the complexity of human health risks generated by the exposure to herbal plants contaminated with heavy metals used in phytotherapy and cosmetology according to the state of the art, given the following objectives:

i) defining key issues at national and international levels related to the risks generated by the use of herbal ingredients exposed to different amounts of heavy metals in holistic medicine and cosmetology;

ii) to provide insights into the mechanisms by which plants take up metals and their detoxification/antioxidative pathways.

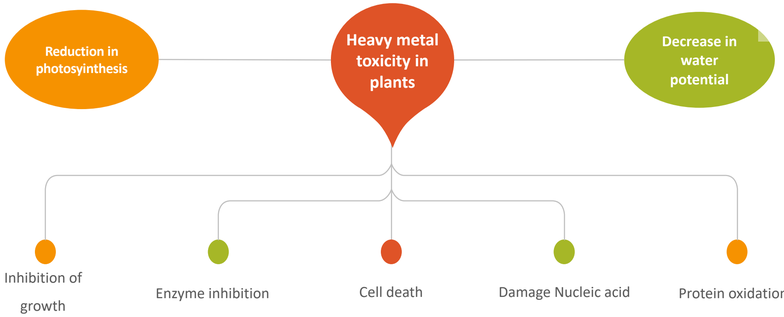

Fig. 2. Heavy metals toxicity in plants

Conclusions

The limitations of current approaches within the toxicity to human health caused by herbal based products containing heavy metals, provide us the opportunity to further investigate this complex field and to provide solutions to improve the quality of life by underlining appropriate recommendations for safety levels of metals contained in medicinal plants used for phytotherapy and cosmetology.

Results and discussions

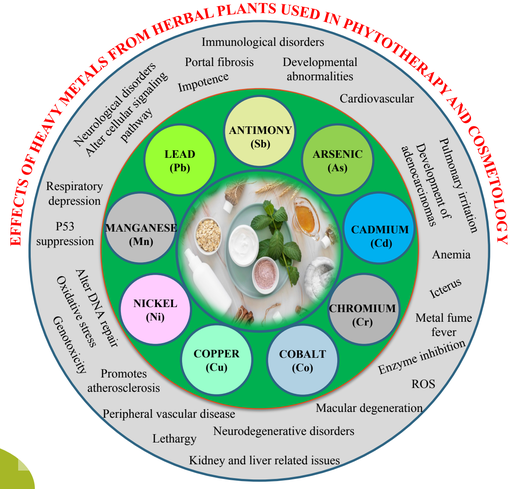

Fig. 3. Human health effects induced by different heavy metals

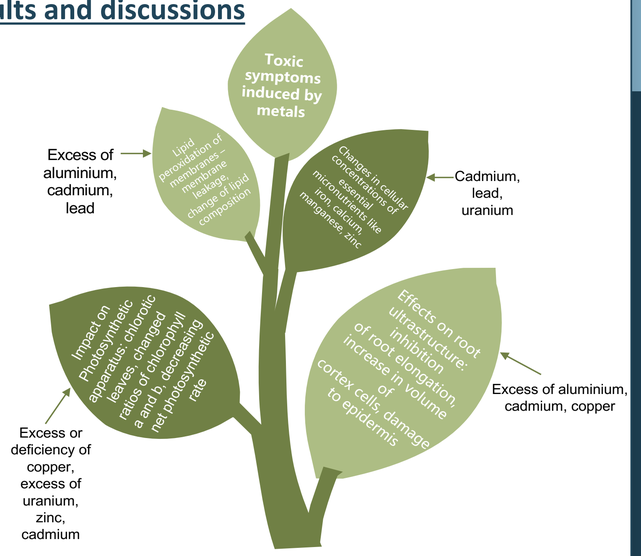

Fig. 4. Toxic symptoms induced by different heavy metals in plants

In the current national and international context, the assessment of the human health risk generated due to plants which are exposed to heavy metals and used for different purposes is a challenge for researchers, assessors and risk managers, especially considering the limitations of current methodologies in terms of the relationship between terminology and problem formulation, uptake mechanisms, the toxicological profile and human exposure conditions.

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Acknowledgments

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Impact of beet sugar manufacturing activity within S.C. AGRANA Romania S.A. – Roman, Neamț County on the environment

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Introduction

The industrial activities have a major impact on all environmental factors, thus it is necessary to monitoring them, to ensure compliance with existent legislation in the field of environmental protection. Sugar beet production has gained momentum and reached approx. 30% of today's world beet sugar production. Also called "white gold", sugar came to be taxed with astronomical sums due to growing demand for it. Since 2005, the company S.C. AGRANA Romania S.A. is one of the largest suppliers of sugar for both sweeteners and soft drink industry, for the retail sale of sugar internationally, but it it especially a supplier for retailers who sell sugar in small towns and villages across the country. This paper analysis the impact of beet sugar manufacturing activity on the main environmental factors, starting with technological wastewater, domestic water, purified and directed through pipes in the natural emissary, studying the concentrations of nitrites, nitrates, iron and nickel ions, in three different analysis period, calculating the retention yields at the station for the most important chemical indicators.

Materials and method

Founded in 2005, the company SC AGRANA Romania SA produces sugar, both from imported raw sugar, and sugar beet and supplies retail sugar for small towns and villages across the country. The factory in Roman, Neamț County is a partner for thousands of sugar beet growers and owners of agricultural land in eastern Romania, from the border with Ukraine to the South of Galați City.

Fig. 1: Location of the sugar factory SC AGRANA Romania SA -Roman, Neamt county

By continuously equipping with new production lines and packaging machines for each type of sugar product, it was possible to diversify the assortment range to over 100 types of products, using various packaging from the country and imported, with its own laboratory for creating new sugar products, at a high quality standards, with low prices. The raw materials for making sugar are sugar beet and sugar cane. Sugar factories in Europe do not work with sugar cane, but with brown cane sugar imported from cane sugar producing countries (Cuba, Brazil). The factors that influence the quality of beets are: genetical (seed quality, hybrid characteristics), pedo-climatic (soil, climate), phyto-technical (cultivation and maintenance technology), factors regarding the harvesting method, and storage conditions (alteration, wilting, degradation). The sugar beet quality indicators concern the external appearance and technological quality, and were calculated with mathematical relations.

External appearance indicators are: package indicator, shape indicator and diameter indicator. Technological quality beets indicators are: sugar content, purity of cell juice, beet pulp content, reducing substance content, distillated content of beets, molasses quantity, and theoretical crystal sugar yield. The beet is stored in the factory: - on the platform, with a 10-15 ° slope of the side walls; - in deep channels, with a triangular section, and the side walls slope of 45 °. Below the storage channel is the transport channel with a drainage slope. From the storage platforms or channels, the beets are sent to the washing-cutting section. The beet is transported with water, which represents 600- 1000 l / 100 kg of beets. The water has a temperature of ~ 20 ° C and a speed of 0.6- 0.7 m / s.

In order to ensure the efficiency of the sugar factory's operation, it is necessary to clean the beet of impurities (organic and mineral) in the field, load it in transport machines, and transport the beet to the factory without impurities. A Maguin installation type is used to separate the mineral and vegetable impurities from the beet mass. Washing sugar beet in special machines is necessary for:

- remove the adherent soil on the surface of the beet that would cause wear of the washing machine;
- stones, sand, straw removal for those which have not been removed on the route of the transport channel;
- microorganisms removal from the surface of beets with impurities.

The amount of water for washing is about 40 kg / 100 kg beets.

When wastewater is re-circulated in the cold state, there is a gradual transformation of sugar into organic acids, a change due to fermentation bacteria. In this case, more acetic acid and less butyric acid are formed. We estimated sugar losses in the hydraulic transport, also at sugar beet washing process.

The diffusion juice is subjected to the purification process, which consists in the following operations: pre-defecation, defecation, 1st saturation, 2nd saturation, boiling thin juice of 2nd saturation, sulphite of thin juice, precipitate separation, decantation and use of concentrating filters. We analyzed, step by step, the physical-chemical processes from technological stages. We inventoried the most important sources of microbiological infections from AGRANA factory (*Streptococcus, Pseudomonas, Aerobacter aerogenes* etc.). By monitoring the quality of main environmental factors, we evaluated the impact of sugar production on the environment.

Results and discussions

Impact on the environmental factor WATER. The departments activities results in technological wastewater and domestic water, which, after purification, are directed through pipes in the natural emissary. Inside AGRANA were drilled two wells to observe the groundwater chemistry: F1 in the oil fuel storage, and F4 in the fuel storage area - diesel. At Cordun Pond, there is another F2 drilling, where samples were taken in September 2016. The reference sample was taken from an F3 well, located in the village of Cordun, on the road. No drilling was found in the landfill. The pH value is in the range of 6.5 to 8.5, for all samples ranging from 6.97 to 7.37. A pH of 7.37 was determined for water from the Cordun village well, which falls within the allowed limit value -AVL, corresponding to the second class of surface water quality. The filterable residue was within the concentration limits 644 - 902 mg / l for F1, F2 and F4, with values falling within the AVL of the fourth class of surface water quality, values higher than the measured one for well F3 from the village of Cordun, of 340 mg / l, a value that falls into second class of surface water quality. The value of organic substances, measured as CCOCr indicator for samples from F1, F2 and F4, falls within the limits of 49.2 - 81 mg / l, which exceed the maximum allowable concentration of 25 mg / l, corresponding to 2nd class quality for drinking surface water and the value of 9.6 mg / l was obtained from a well in Cordun - F3.A high concentration of CCOCr of 532 mg / l was obtained for the drilling in the Cordun Pond - F2, which corresponds to the 5th quality class. Nitrates recorded values of concentrations lower than the MAC of 50 mg / l. In sample F4, the nitrate concentration was between 48.5 - 86.4 mg / l, the maximum value exceeding by 72% MAC. Groundwater samples have non-nitrite concentrations in the range 0.189 - 0.465 mg / l, all being below the MAC of 0.5 mg / l. The concentrations of iron ions in the boreholes related to the fuel oil storage - F1, the diesel storage - F4, the Cordun Pond - F2 and the well - F3, exceed the MAC for drinking water of 0.2 mg / l. Exceedances are 75% in the case of iron ion concentrations from F3 and 60 - 284 times higher than MAC for other boreholes.

Impact on the environmental factor AIR. Emissions into atmosphere are provided from technological sources and from electrical thermo-central CET4000.

Emissions of sugar dust do not contain pollutants and in this case, the losses in the atmosphere are only technological losses, losses that reduce the yield of white sugar from raw sugar, or to obtain white sugar from sugar beet. The results of direct physical measurements of the pollutants analyzed were reported at the reference value of 3% O2 in the flue gases. During the analysis periods, the boilers in CET 4000 operated in normal parameters. The quantities of dust discharged with the flue gases to the chimney of the energy boilers are exceeded. One of the major causes of dust entrainment is excess combustion air.

The impact produced on the environmental factor SOIL. The nature and degree of soil pollution was established based on the results of physical and chemical analysis of soil samples, collected from the main premises of the company, the area of functional and non-functional installations, of industrial waste landfill, as well as from outside the company. We considered: - areas that have served and are serving for the temporary storage of raw materials, auxiliary materials and fuels containing hazardous substances and / or hazardous waste - distribution in all cardinal directions nearby sources of pollution, including sources of air pollution. Soil samples at both depths showed the presence of chemical elements in soils, sulphates, chlorides, nitrates and nitrites as follows: pH values of aqueous solutions, register the analyzed soils in low alkaline soil types (7.21 - 8 , 4) and moderately alkaline (8,4 - 9) according to the reaction classes provided by the pedological norms (the presence of carbonates in soils.) Concentrations in chemical elements - sulphates, on the site of the company and the land for industrial use ranged from 4 to 756 mg / kg dry matter. The highest value - 756 was determined in the area of the fuel storage, but all values were below the alert threshold.

Conclusions

Based on the average values of the wastewater pollution indicators at the entrance and exit of the treatment, for three considered periods of determination, the detention yields at the station were calculated for the main indicators: TSM, CBO5, CCO-Cr, total nitrogen and total phosphorus.

Following the researches carried out, after the analyze of the degree of pollution made on each environmental factor, we recommended the correlation of fuel flow with combustion air for loading within the limits provided by norms.

Also, to check flue gas circuits to reduce air infiltrations at the common basket of three energy boilers, especially since two of them are permanently operating energy and the third one is off.

The amounts of dust discharged with the flue gases to the boiler basket energy exceeds. One of the major causes of powder entrainment is excess combustion air, also the lack of specific dust containment equipment (electrical filter etc.).

We also compared resulted measurements with conclusions of the „Reference Document on Best Available Techniques for Large Combustion Plants ", and we observed that emissions of recording pollutants are within normal limits or higher, depending on the pollutant emitted (SO2, CO, NO2).

No areas of local pollution were identified. Pollutants concentrations are below the alert value.

The soil from the factory surface is not affected by current activity or previous operation.

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IDENTIFICATION OF ECONOMIC AND ENVIRONMENTAL CRITERIA FOR EVALUATING THE SOIL REMEDIATION PROCESSES PERFORMANCES

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INTRODUCTION

- Due to the intensification of industrial activities and technological evolution, environmental pollution with inorganic and organic pollutants is becoming an increasingly worrying issue.
- Contamination of soils with heavy metals as a result of anthropogenic activities is quite common in Europe with an undesirable impact on the quality of life and the environment. As it is known, metals can last in soils for thousands of years, being non-biodegradable and usually immobile compared to inorganic pollutants.
- In the literature, we often find several types of remediation processes, but in order to choose the appropriate remediation alternative for sites contaminated with heavy metals, decision makers must consider aspects economic and environmental.
- Currently, there are a number of tools for (i) assessing the economic and environmental performances of alternatives for the removal of heavy metals ions from contaminated sites, or to (ii) choose hyperaccumulator plants for decontamination of soils polluted with heavy metals: Cost-Benefit Analysis (CBA), Life Cycle Assessment (LCA), Multi-criteria Decision Analysis (MCDA) etc. (Comanita et al., 2018).
- The goal of this paper is to identify economic and environmental criteria for to apply the three mentioned economic and environmental assessment tools in order to find the most viable soil remediation processes.

PROPOSED FRAMEWORK

- This study present a framework for assessing the remediation processes sustainability of soil and for incorporating sustainable development criteria in soil decontamination management strategies. It helps assessors to identify the optimum soil remediation strategy and/or technique.

- The criteria used in evaluating the performance of a remediation process express the views of decision makers which aim to establish comparisons of products/ processes/ technologies by applying decision models. A number of principles are used to determine the set of criteria, which reflects the ways of constructing a problem.

- In general, for all types of processes it was identified a set of criteria in the literature for assessing the economic and environmental performance (Cipullo, 2013): (i) environmental quality; (ii) approach/ logic; (iii) transparency; (iv) ease of applicability; (v) correlating data with the importance of the problem; (vi) the policy of adapting to the importance of the problem; (vii) time and human resource requirements for analysis; (viii);) economically viable processes; (ix) software availability, where required.

RESULTS AND DISCUSSIONS

To determine the optimum remediation alternatives scientifically, a technology determination and evaluation model is developed based on a decision method (shown as Fig. 1) involving the consideration of a set of criteria, which were identified in this study. In Table. 1 it is presented a set of identified and applicable criteria for to evaluate the performance of soil remediation processes applicable to the model shown in Fig. 1. Also, in Table 1 are presented the methodologies in which these criteria are used. These criteria will provide a solid database and will facilitate the making of the best decisions as a consequence of the results obtained from the application of environmental and economic performance assessment tools for the soil remediation alternatives to be analyzed.

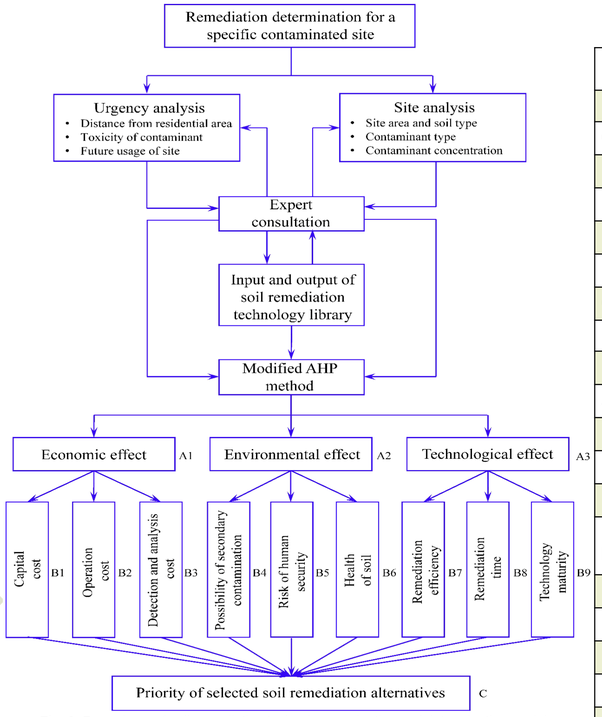

Fig. 1. Procedures of soil remediation technology evaluation and determination model

Table 1. Criteria for evaluating the performance of soil remediation processes

Criteria	References	Evaluation method used
Environmental criteria		
Germination index (GI)	Gomez et al. (2020)	MCDA, CBA
Biomass production	Gomez et al. (2020)	MCDA, CBA
Microorganisms removal	Gomez et al. (2020)	MCDA, CBA
CO_2 emissions	Gomez et al. (2020)	MCDA, CBA
Human toxicity	CL:AIRE (2010)	LCA, MCDA
Climate change effect on ecosystem	CL:AIRE (2010)	LCA, MCDA
Economic criteria		
Drying energy cost	Gomez et al. (2020)	MCDA, CBA
Adjuvant transport costs	Gomez et al. (2020)	MCDA, CBA
Residues management cost	Gomez et al. (2020)	MCDA, CBA
Project flexibility.	CL:AIRE (2010)	MCDA, CBA
Life-span and 'project risks';	CL:AIRE (2010)	MCDA, CBA
Direct and indirect economic costs and benefits	CL:AIRE (2010)	MCDA, CBA
Technical criteria		
Drying rate (DR)	Gomez et al. (2020)	MCDA, CBA
Diffusion coefficient (Deff)	Gomez et al. (2020)	MCDA, CBA
Kinetic constant (k)	Gomez et al. (2020)	MCDA, CBA
Acid neutralization capacity (ANC)	Gomez et al. (2020)	MCDA, CBA

Cost-Benefit Analysis (CBA), Life Cycle Assessment (LCA), Multi-criteria Decision Analysis (MCDA)

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CONCLUSIONS

In conclusion, the identification of the applicable criteria, based on the decision-making instruments, was undertaken to make the evaluation of alternatives for remediation of soils contaminated with heavy metals, more sustainable, adequate and robust, from an economic and environmental point of view.

ACKNOWLEDGMENT

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Carbon biocapture in the frame of the climate change and air quality issues: a preliminary microbiota screening

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Introduction

In recent years, research has intensified on the study of the interactions between algae and bacteria not only due to their ecological significance, but also their biotechnological potential. Algae and bacteria are known to affect each other's physiological processes and metabolism. In natural ecosystems, algae-bacterial interactions cover a whole range of relationships such as: mutualism, commensalism and parasitism, depending on the species and living requirements. These microorganisms can work together to remove pollutants such as volatile organic compounds (VOCs) from the environment. The system of immobilized cells involves microbial strains (algae and bacteria) capable of degrading certain pollutants, including VOC. The goal of this work is to study the ability of some microbial strains free or immobilised, to grow in the presence of volatile organic compounds and consume toxic organic compounds in the context of their application in biological air purification devices.

Materials and methods

Microorganisms and initial growth conditions:

The microalga *Arthrospira platensis* PCC 8005 (Figure 1- I.a) and a consortium of two bacterial strains (*Arthrobacter sp.* and *Bacillus subtilis*) (Figure 1 – I.b) isolated from compost were used. Before immobilization in alginate beads, the microalga was cultured in sterile Zarrouk medium for 15 days. *Arthrobacter sp.* and *Bacillus subtilis species* was grown in nutrient broth (Sigma) at 30±2 °C for 24 h in a rotary shaker at 120 rpm, using standard techniques for these genres.

Immobilization of microorganisms in alginate beads:

- Immobilization of *Arthrospira platensis* PCC 8005 microalgae in sodium alginate.
- Immobilization of the bacterial consortium on sodium alginate.
- co-immobilization the microalgae and the bacteria consortium.

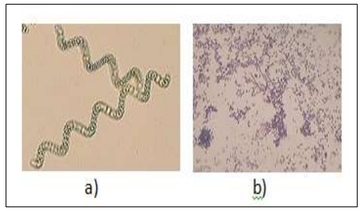
Experiments with free and immobilized cultures for pollutant removal

Species of free or immobilized microorganisms alone or in common were grown in batch conditions for 8 days in a synthetic medium (Fig. 1-IV) with and without (control) the addition of ethyl alcohol 1% as a carbon source. The cultures were incubated in 150mL, Erlenmeyer flasks (50 mL medium containing 30 beads or 3 mL cellular suspension) at 28±2 °C, agitated at 120 rpm under constant light (Fig. 1-III). After 8 days of growth, the microorganisms were harvested by sedimentation and resuspended in 10 ml of sterile water. Dry biomass was measured gravimetrically using Whatman filters and dried at 95°C for 24 h.

Growth and biomass were determined at the end of the submerged cultivation period for different scenarios in terms of beads number, type and rapport configuration.

Results and discussions

Experimental highlights



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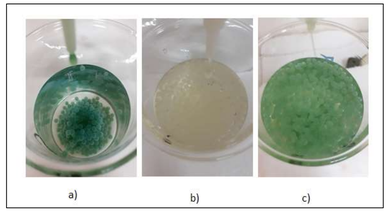

II

Figure 1. Experimental highlights:
I. Microscopic appearance of microbial strains
II. Formation of microorganism beads:
a) immobilization of *A. platensis* microalgae;
b)immobilization of the bacterial consortium;
c) co-immobilization of microalgae and bacterial species
III. Batch experiment with free and immobilized microorganisms
IV. Composition of grow medium for development of free or immobilized microorganisms

III

Compound	Concentration of deionized water (mg L^{-1})
Macronutrients	
NH_4NO_3	500
K_2HPO_4	30
$MgSO_4 \times 7H_2O$	50
$CaCl_2 \times 2H_2O$	50
$FeSO_4 \times 7H_2O$	50
$MnCl_2 \times 4H_2O$	25
Micronutrients	
$ZnSO_4 \times 7H_2O$	6.3
$Co(NO_3) \times 6H_2O$	1.0
$CuSO_4 \times 5H_2O$	1.0
H_3BO_3	1.0
$(NH_4)_6Mo_7O_{24} \times 4H_2O$	0.9

IV

Biological system behaviour

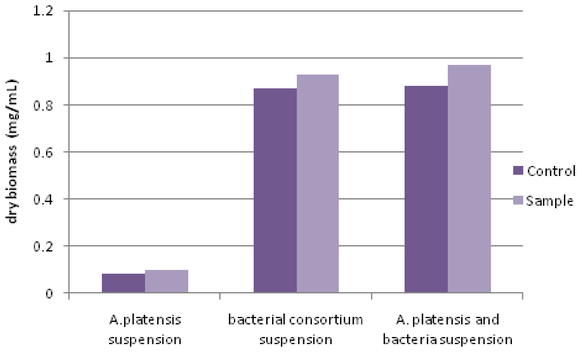

Figure 2. Dry biomass obtained by submerged cultivation of cell suspensions

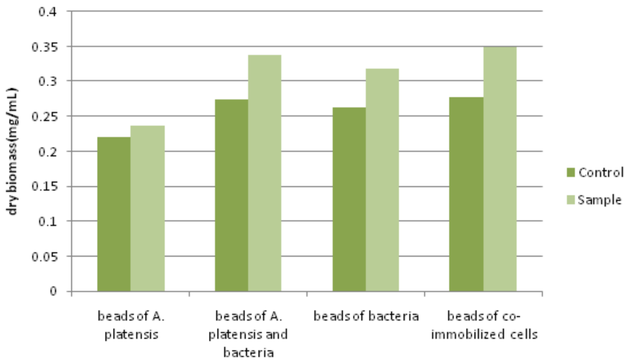

Figure 3. Dry biomass obtained by submerged cultivation of immobilized microorganisms

The following process aspects have been drawn:

- immobilized microorganisms were much better developed during the cultivation than with suspended-cells, so that dry biomass yield is about 2.5 - 3.0 times higher in variants with beads compared to free culture;
- when the ethyl alcohol was introduced as a source of carbon and energy for microbiota, the amount of dry biomass obtained is about 1.0 – 1.25 times higher compared to the control (without ethyl alcohol) thus demonstrating the ability of the immobilized microorganisms to tolerate and consume this compound;
- the amount of developed biomass depends on the involved scenario in terms of beads number, type and rapport configuration; for instance, the highest amount of dry biomass was obtained with immobilized microalgae and bacteria, either separately (but in the same culture) or co-immobilized in the same bead, thus demonstrating the beneficial relationship between algae and bacteria.

Conclusion

The results reveal new opportunities for mitigation of volatile organic compounds by co-immobilised microorganisms, as a tool of carbon capture in the frame of environmental policies. Future research needs refer to exploring this potential for further increasing the microbiota performance in such systems, contributing to the biological removal of volatile organic compounds and thus purification of air from toxic substances, with diminished carbon emissions and associated benefits related to climate change and air quality issues.

Acknowledgments

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Vegetable wastes – environmentally friendly and low-cost adsorbents

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Introduction

In many developed countries, urban and rural areas, disposal wastes are a stinging and widespread problem. A new trend regarding food and vegetable waste recycling is starting to become an important topic among researchers. In order to eliminate various pollutants from the environment, a wide variety of potential adsorbents were tested, following their retention capacity and the costs involved in this process. Vegetable wastes proved to have the capacity to adsorb and desorb pollutants from wastewater, quantify the environmental impacts generated during the process life cycle and useful potential for energy production. The most popular adsorbent used for the adsorption process is the activated carbon. This adsorbent is very expensive by comparison with ***vegetable wastes*** and there is a need for its regeneration after each adsorption experiment (Saka et al., 2012).

Objective

The aim of the study was to revise the current literature concerning the application of low-cost adsorbents for wastewater treatment highlighting, systematically, both adsorbents characteristics and adsorption capacities. For this scope, low-cost sorbents have been divided into five groups represented in Fig. 1.

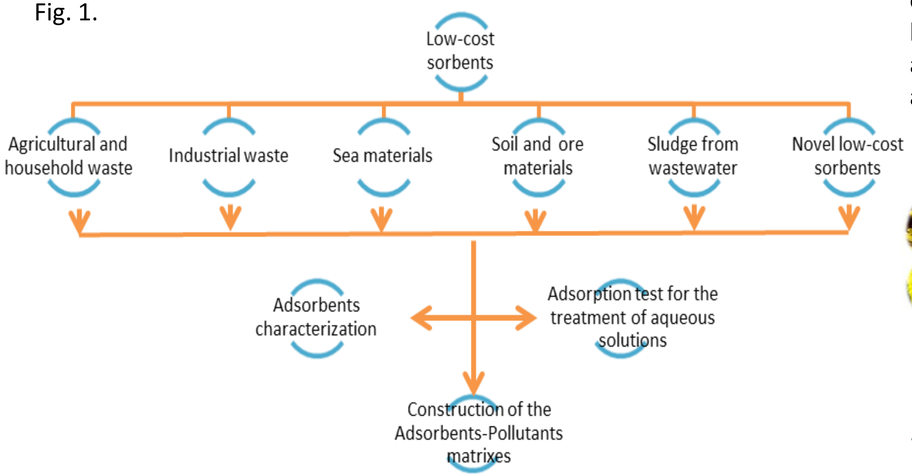

Fig. 1. Low-cost sorbents classification

Results and discussions

An important source of vegetable waste is represented by plants used in phytoremediation already containing heavy metals, which can further be loaded by metals during adsorption. Then, the waste can be used as secondary source for (critical) raw metals, being processed by chemical treatment and/or extraction. Fig. 2 shows the most used low cost sorbents and the parameters that influence their capacity of sorption.

The rate of metal removal is of greatest significance for developing a natural adsorbent-based water-treatment technology. Based on the extensive literature reviewed, the optimum pH for removal was found to be in the range from 4.5-6.5, at which Pb(II) removal for example, reaches 99% for the three investigated adsorbents.

Table 1. Vegetable adsorbents properties

Adsorbent	Uptake capacity (mg/g)	Removal (%)	Optimum pH	Sorbent dose (g)	Concentration (mg/L)	Temperature (^{0}C)
Banana peels	72.79	-	5	1	200	25 ± 2
Cereal chaff	12.5	-	5.5	0.1–0.6	8 g/L	20
Onion skins	200	93	6	0.15	25–200	30
Seed hull of the palm tree	3.77	-	4	6	100	60
Sunflower seed peel	-	99	6	-	-	60
Sunflower waste	33.2	-	4.0	-	10	-

In Table 1 are shown the properties of vegetable adsorbent for Pb(II) removal, which have been reported to show high removal efficiencies. The review indicate that the use of commercially available activated carbon for the removal of the Pb ions can be replaced by the utilization of inexpensive, effective and readily available agricultural by-products as adsorbents. Thus, the sources of agro-based inexpensive adsorbents were explored and their feasibility for the removal of the Pb(II) ions should be studied in detail.

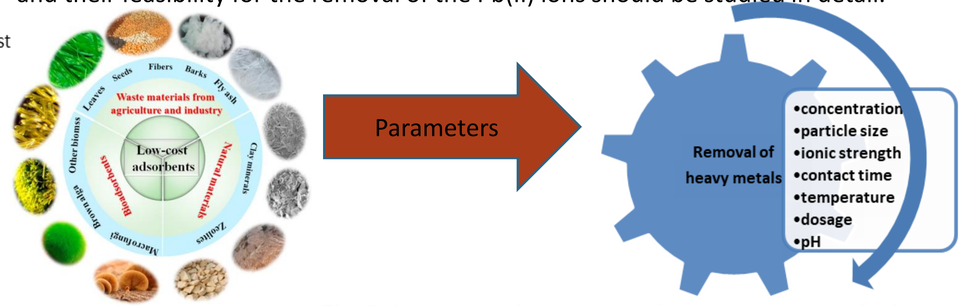

Fig. 2. Low-cost adsorbents and the parameters of adsorption

Conclusions

Adsorbent materials derived from low-cost agricultural wastes can be used for the effective removal and recovery of metals from wastewater. In subsequent cycles with low costs, the removal occurs in a relatively short operating time and no other toxic compounds are released at the end of the process.

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Improvement of the water management on the Sulina Chanel by implementation of an automated water quality monitoring system on the passenger ship

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Introduction

In the frame of "Water Harmony" project, the Romanian partner offers a demo site focused on water management improvement, located in the Danube Delta, actually on the Sulina Chanel, which is the main arm of the Danube that is discharged into the Black Sea. Based on both the available historical data and own data base for the last 2 years, related to the water quality in 22 monitoring points distributed along the Chanel from Tulcea to Sulina, it was proposed in the frame of an workshop organized together with the main important stock holders and the local authorities, ***the implementation of an automated monitoring system for the surface water quality on a passenger ship (ferry)***. This can scan (with a sampling frequency of 5 minute) the water from the Sulina Chanel along the distance from Tulcea to Sulina and respectively back from Sulina to Tulcea, performing automated measurements. The obtained data will be transmitted to the water management authorities Administration of Biosphere Reserve of Danube Delta, National Research Institute for Danube Delta and Water Company "Aquaserve" Tulcea (responsible with preparation of drinking water for inhabitants of small communities located between Tulcea and Sulina, using water from Sulina Chanel and respectively with the treated wastewater that is discharged in the same Sulina Chanel).

The main objectives of the automated monitoring system implemented on the ship are:

- from the scientific point of view: to establish a correlation between the algae development (algae blooming) and the concentration of nutrients in terms of nitrate/nitrite, COD and phosphate (the last one being the Polish partner contribution);

- from the practical point of view: to transmit an early warning message to the water authorities and water stockholders in the case of overcoming the Maximum Allowable Concentration of each water quality indicators (nitrate/nitrite, COD, and phosphate), along with the location of the polluted area (through the geographical coordinates detected by the GPS system from the ship) and the moment when the pollution was found.

Methodology

The water from the river naturally enters into a tank for storing the cooling water for the engines. Due to the positioning of the tank below the river water level, its circulation is ensured by the ship movement. The access to fresh water is correlated with the position of the ship, the system automatically determining the location from which the water was collected.

Fig.1. The passenger ship with the automated online monitoring system

Results and discussions

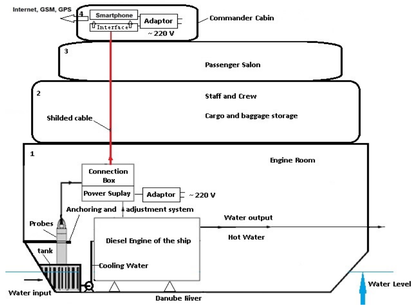

Fig. 2. The construction of the passenger ship with details related to the installed components of the automated online monitoring system

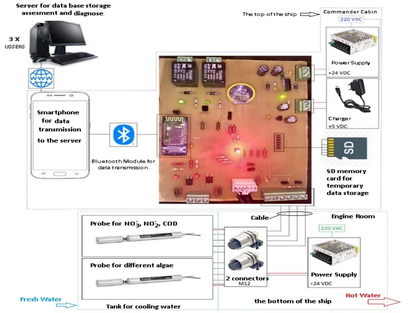

Fig. 3. Schematic diagram of the monitoring system as a whole



Fig. 4 Pictures from the Commander cabin and respectively from the Engine Room

- A power supply of +24 VDC (connected to 220 VAC) is used to power the probes in the engine room.
- A power supply +5 VDC or +24 VDC (connected to 220 VAC) is used to power the interface (motherboard).
- A box with 2 connectors M12 (female) is used to connect and power the probes.

The Connector Box powers the probes through the connection to the power supply mentioned above, facilitating the communication between the probes and the interface (motherboard), through a special, multi-wire and shielded cable. The probes connected in parallel provide the possibility to use only 4 wires from the multi-wire cable that connects the engine room and the commander cabin.

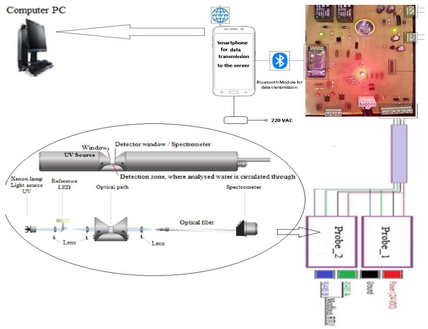

Fig 5.The main components of the monitoring system

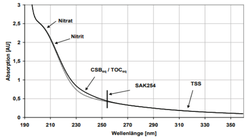

Fig.6. Variation of the water sample absorbance as a function of wavelength, allowing the monitoring of different dissolved compounds

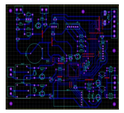

Fig.7. The designed circuit of the interface (motherboard)

Design of the monitoring system and the progress of implementation

The probes:

There are 2 optical probes envisaged for the automated monitoring system; one of them is dedicated to measure the concentrations of some contaminants in water, such as nitrates / nitrites and, respectively, compounds with carbon content, i.e. organic substances; the another one is designed to determine the content of algae in water based on the Chlorophyll A measurement.

The probes are provided with a specific cable to be connected to the interface, allowing the acquisition of data from the probe and their transmission to the smartphone.

The spectral sensors make up a spectrometer that records the spectra in the UV field at certain time intervals, automatically correcting the temperature and the turbidity of the water to be analyzed.

The interface based microprocessor (motherboard) located in the commander cabin is responsible for the following automatic functions:

- requesting the transmission of data read by the probes;
- processing the answers coming from the probes;
- data storing on the SD memory card;
- data transmitting via Bluetooth to the smartphone, from where they are transmitted to the three users, in charge of water resources management.

The reading of the data from the probes is done through the RS-485 interface and the Modbus RTU protocol, while the communication with the smartphone is done through Bluetooth and an interface converter, from Bluetooth to UART.

The interface (motherboard) also have digital inputs and outputs to interact with the existing systems on the ship (as can be seen on the designed circuit in Fig. 7), for example to be able to detect when the ship's diesel engine is running, or when the water pump is running.

Conclusions

The implementation of an such automatic monitoring system will allow achieving the proposed objectives, while supporting the authorities in charge of water resources management (by preventing the accidental pollution) as well as the civil society through a better information and ensuring of necessary water resources, without neglecting the protection of the natural habitat of the Delta by avoiding the eutrophication phenomenon.

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Acknowledgments

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