Synthesis and characterization of acrylic ion exchange resins and their environmental applications as sorbents

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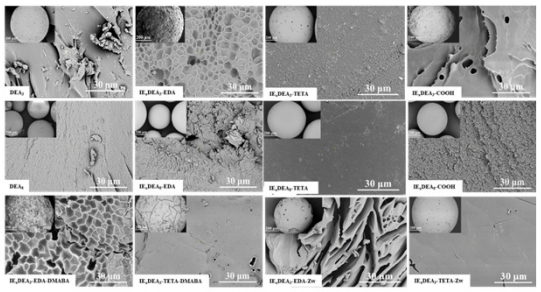
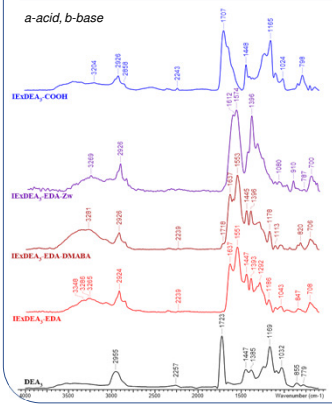
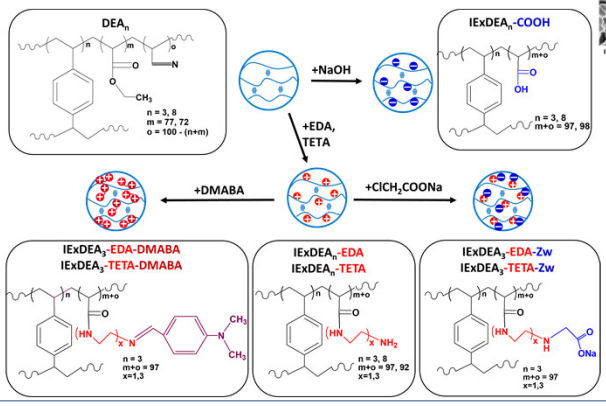
The anthropic activity generated various pollutants (heavy metal ions, dyes, residual drug etc.) and altered the environmental cycle causing a global concern linked to their eventual impact on wild life and human health.[1] The ecological rehabilitation measures undertaken so far in order to mitigate the effects of anthropic activities cover just a small part of the affected environment and are not necessarily economically efficient.[2] Various methods are currently proposed to remove pollutants which are efficient but expensive. For this purpose, ion exchange resins (IEx) are widely used in addition to other usual separation techniques, such as membrane processes. Therefore, the synthesis of inexpensive and reusable ion exchange resins based on acrylic copolymers (IExDEA$_n$), as beads, with different cross-linking degree, can be a solution for decontamination.[3]

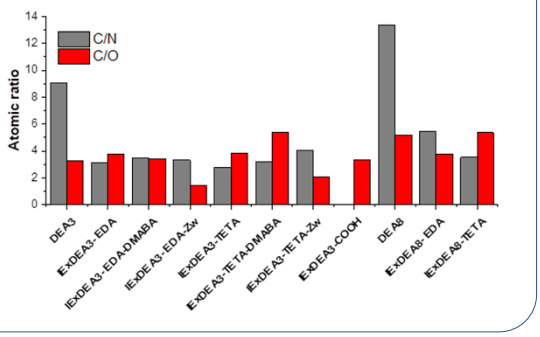
Synthesis and IExDEA$_n$ characterization

Sample code	E (mEq/mL)	E (mEq/g)	W_V (g/mL)	SC (g/g)	CD (μEq/g)	Mean diameter (mm)
IExDEA$_3$-EDA	0.33	3.50	0.094	173.03	+9.84	0.532
IExDEA$_3$-EDA-DMABA	0.47	4.57	0.102	197.28	+5.29	0.616
IExDEA$_3$-TETA-DMABA	0.85	6.84	0.131	45.79	+2.68	0.732
IExDEA$_3$-TETA	0.73	7.95	0.112	174.10	+8.22	0.638
IExDEA$_3$-EDA-Zw	3.19[a] 0.26[b]	18.21[a] 4.95[b]	0.053	239.60	-135.08	0.993
IExDEA$_3$-TETA-Zw	6.13[a] 0.51[b]	22.33[a] 6.21[b]	0.082	200.28	-73.22	1.059
IExDEA$_3$-COOH	1.39	4.63	0.23	174.17	-9.09	0.492
IExDEA$_8$-EDA	0.97	3.00	0.323	149.45	+4.01	0.358
IExDEA$_8$-TETA	1.60	6.90	0.236	132.88	+6.40	0.438
IExDEA$_8$-COOH	0.79	1.27	0.322	52.05	-7.56	0.326

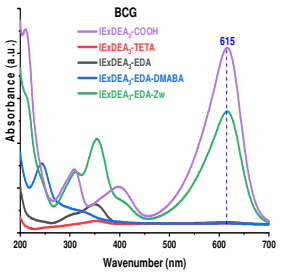


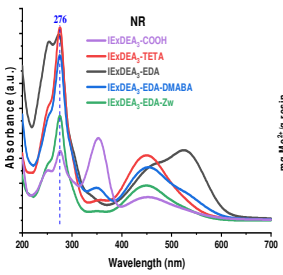




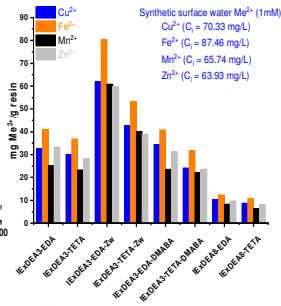


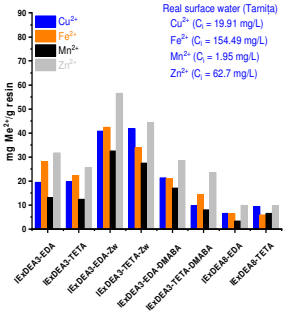
IExDEA$_n$ beads environmental applications as sorbents

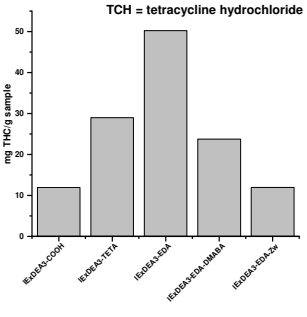


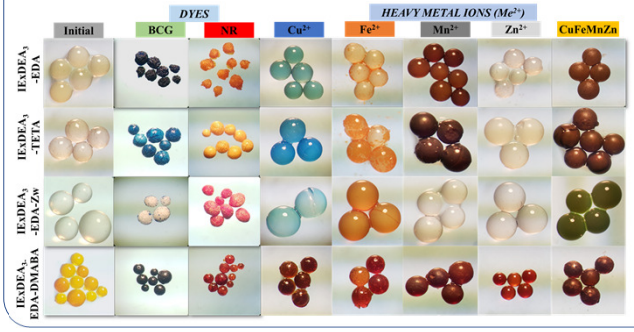


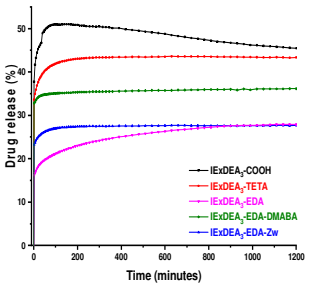
BCG = bromocresol green
NR = neutral red











Sample code	t_{max}, minutes	DR_2, %	DR_{max}, %
IExDEA$_3$-COOH	140	37.75	50.99
IExDEA$_3$-TETA	285	33.63	43.61
IExDEA$_3$-EDA	220	23.23	28.63
IExDEA$_3$-EDA-DMABA	870	16.23	27.92
IExDEA$_3$–EDA-Zw	210	32.79	36.73

T_{max}= time to reach maximum amount released; DR_2 = drug release degree after 2 minutes; DR_{max} = maximum drug release degree.

Conclusions

- Ion exchange resins based on acrylic copolymers with two crosslinking densities (3% and 8% DVB) and weak acid, basic and amphoteric functional groups were synthesized;
- The beads obtained were thoroughly characterized by specific characteristics (ion-exchange capacity, volume variation, swelling degree- and charge density), structure (FT-IR) and morphology (SEM,EDX);
- The FTIR-ATR analysis demonstrated the formation of ionic exchange resins starting from acrylic copolymers ;
- The obtained acrylic ion exchange resins were tested toward various pollutants (heavy metal ions, dyes, residual drugs, etc.), under static conditions (in batch) with good sorption results;
- The sorption capacity of the investigated samples depended on the functional groups of the polymeric matrix, the availability of functional groups and the ability to interact with small molecules.

References

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