Removal of nitrate from aqueous solutions using glycerol and clay/sewage sludge carbons as adsorbents

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GRUPO DE CATÁLISE, ADSORÇÃO E SÍNTESE ORGÂNICA

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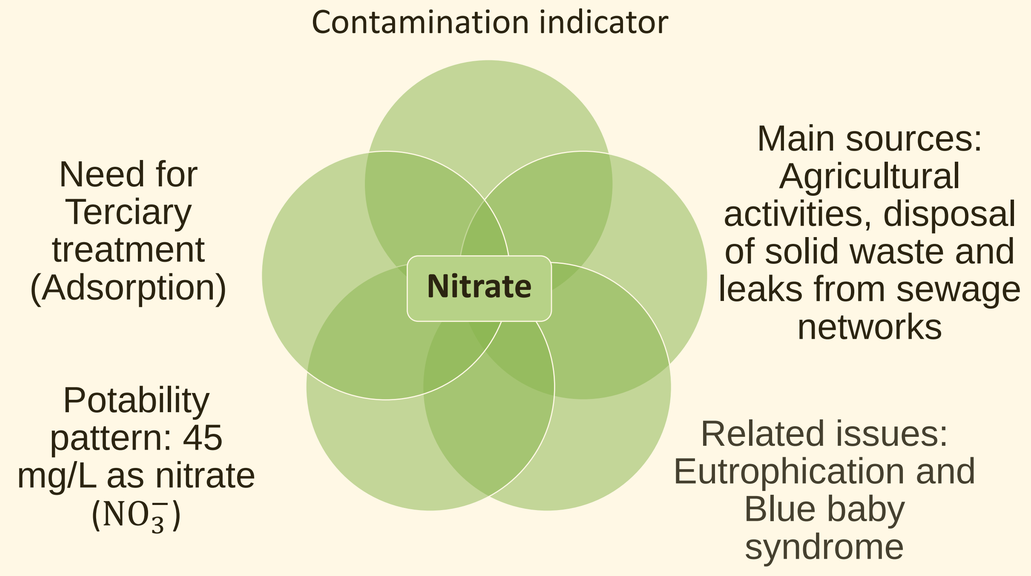
Introduction



Objectives

- Produce carbons from glycerol (CGO) and clay-sewage sludge composite (LDE_1-TechPhos);
- Functionalize the carbons surface with nitrogenous groups;
- Characterize the solids and evaluate their nitrate retention from aqueous solution behavior.

Methods

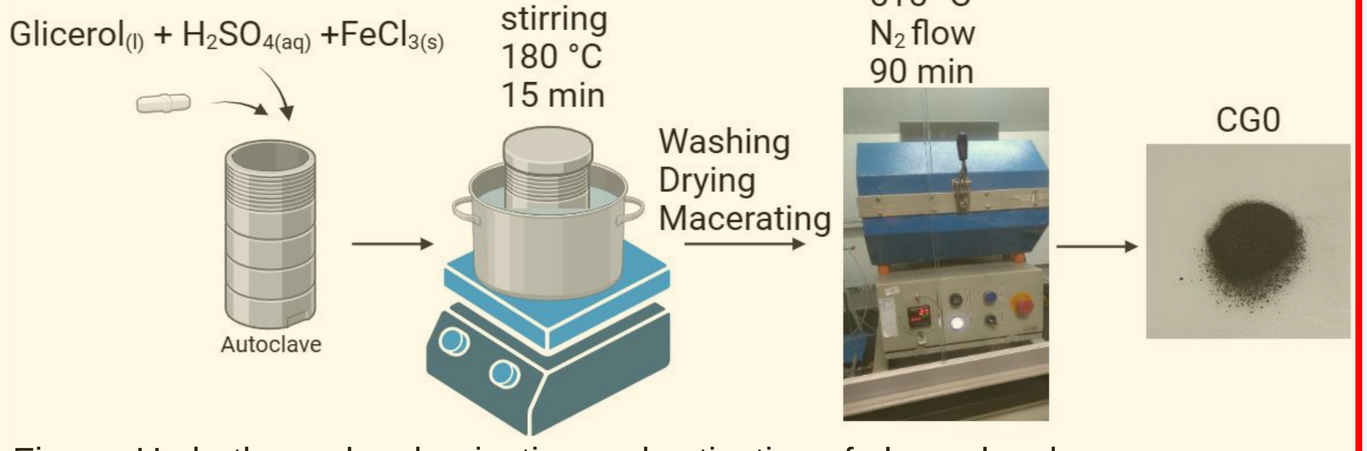


Figure: Hydrothermal carbonization and activation of glycerol carbon

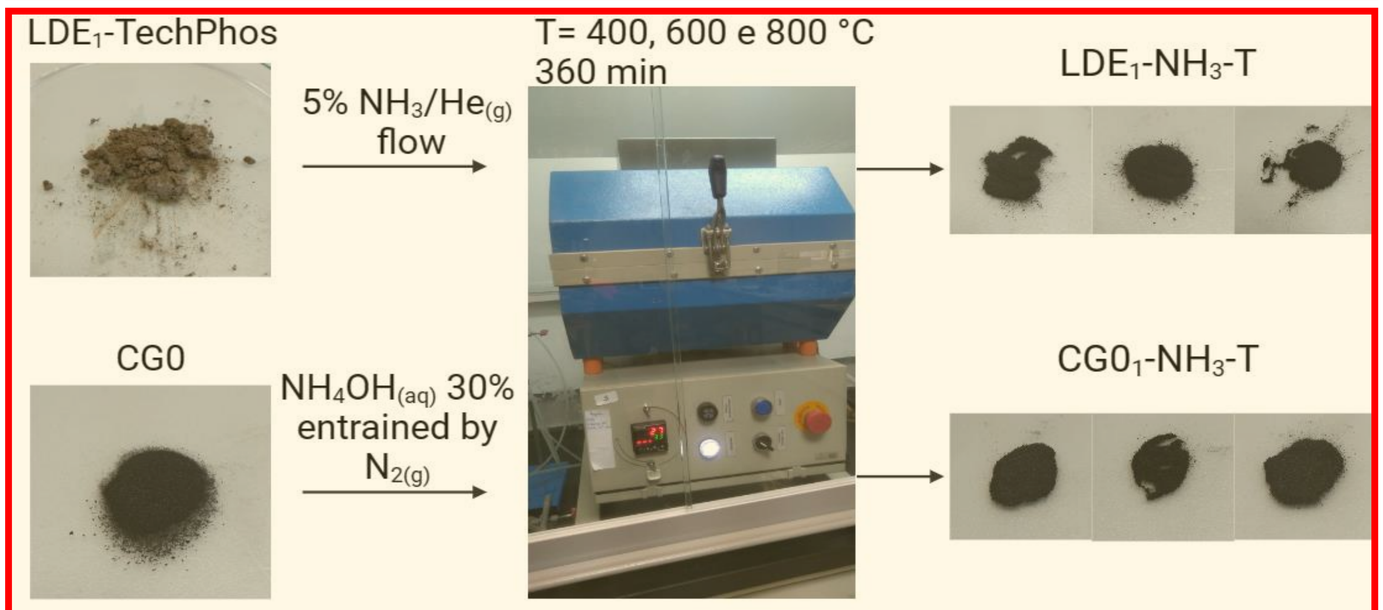


Figure: Thermal treatment under NH_3 flow (Ammonization)

Results and Discussion

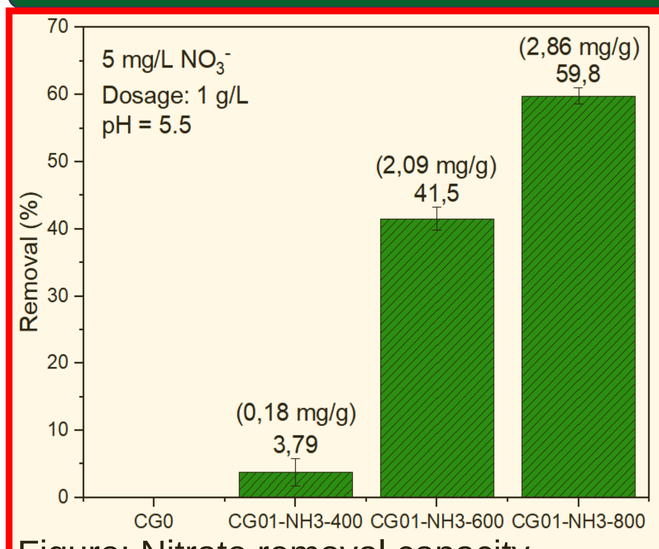
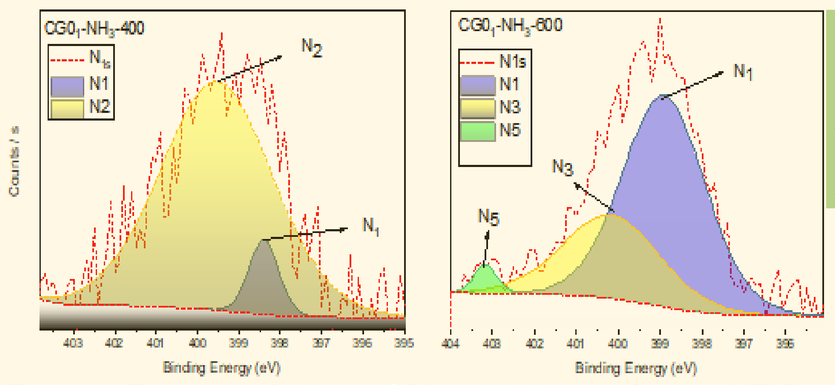


Figure: Nitrate removal capacity

Adsorbents	$S_{B.E.T}$ (m^2/g)	%N	pH_{PCZ}
CG0	652	-	~1.0
$CG0_1$-NH_3-400	558	1,5	~1.0
$CG0_1$-NH_3-600	600	2,2	~3.2
$CG0_1$-NH_3-800	1034	0,3	~3.4

Table: N_2 adsorption/desorption and XPS analysis



N1 → Pyridine

At 400 °C = 7.9% N1

At 600 °C = 66.8% N1

Figure: Deconvolution of N_1 s high-resolution XPS peaks from $CG0_1$-NH_1-400 and $CG0_1$-NH_3 -600

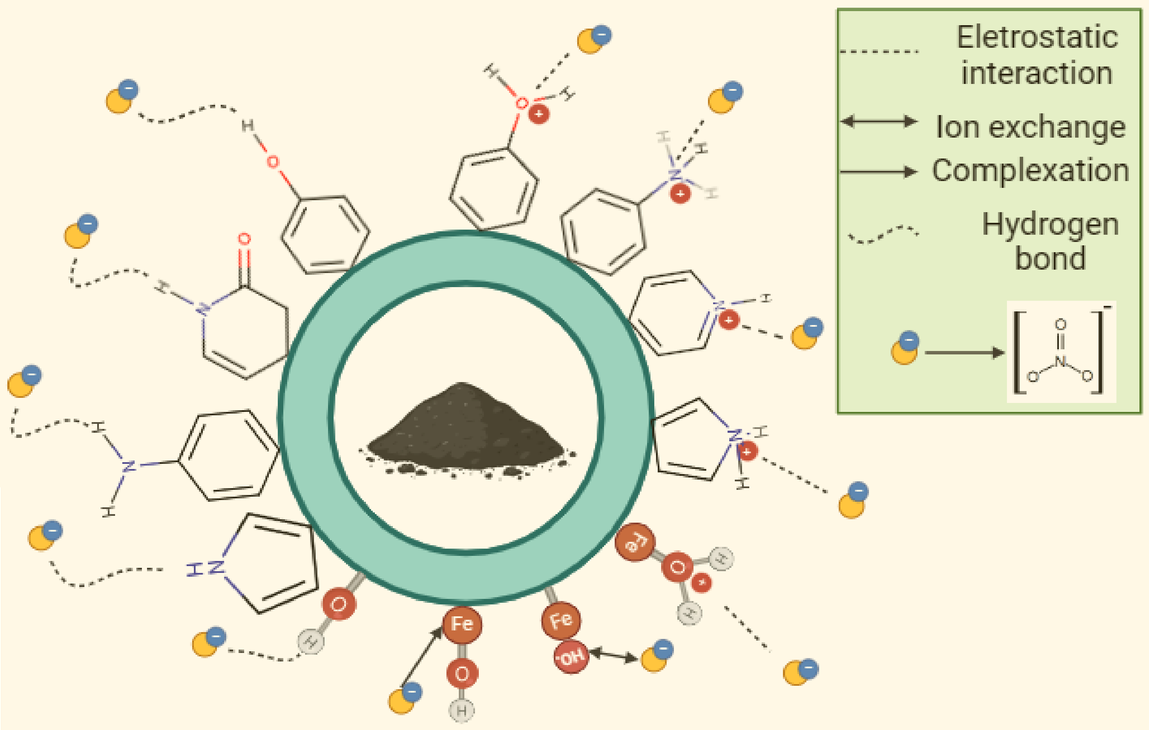


Figure: Possible adsorption mechanisms involved in nitrate retention for $CG0_1$-NH_3-600 and/or $CG0_1$-NH_3-800.

Conclusions

- LDE_1-NH_3-T had no adsorption capacity, which is related to the low carbon content of the solid;
- The ammonization of glycerol's carbon considerably altered its behavior, allowing it to reach from 0.18 to 2.86 mg/g of removal capacity (400-800 °C);
- The increase in the amount of pyridine groups led to a higher adsorption capacity of nitrate;
- Multiple mechanisms must be involved: electrostatic interaction, hydrogen bond, ion exchange, and complexation.

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Acknowledgments

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