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NOVEL MgO-BIOCHAR COMPOSITE MATERIAL FOR NUTRIENT RECOVERY FROM WASTEWATER AND STRUVITE PRODUCTION

Alcantarini[1] A (Alma Mater Studiorum, Università di Bologna), Melandri[3] M, Primante[2] A, Contin[2] A, El Yamani[2] S, Marazza[2] D

[1] CIRSA – Centro Interdipartimentale di Ricerca per le Scienze Ambientali – Via Sant'Alberto 163, 48123 Ravenna
[2] Department of Physics and Astronomy "Augusto Righi" – DIFA, Viale Berti Pichat, 6/2 40127 Bologna
[3] CIRI-FRAME – CIRI Fonti Rinnovabili Ambiente Mare ed Energia FRAME – Viale Ciro Menotti 48, 48122 Ravenna

ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA

E-mail:
marco.melandri9@unibo.it
alessia.alcantarini2@unibo.it

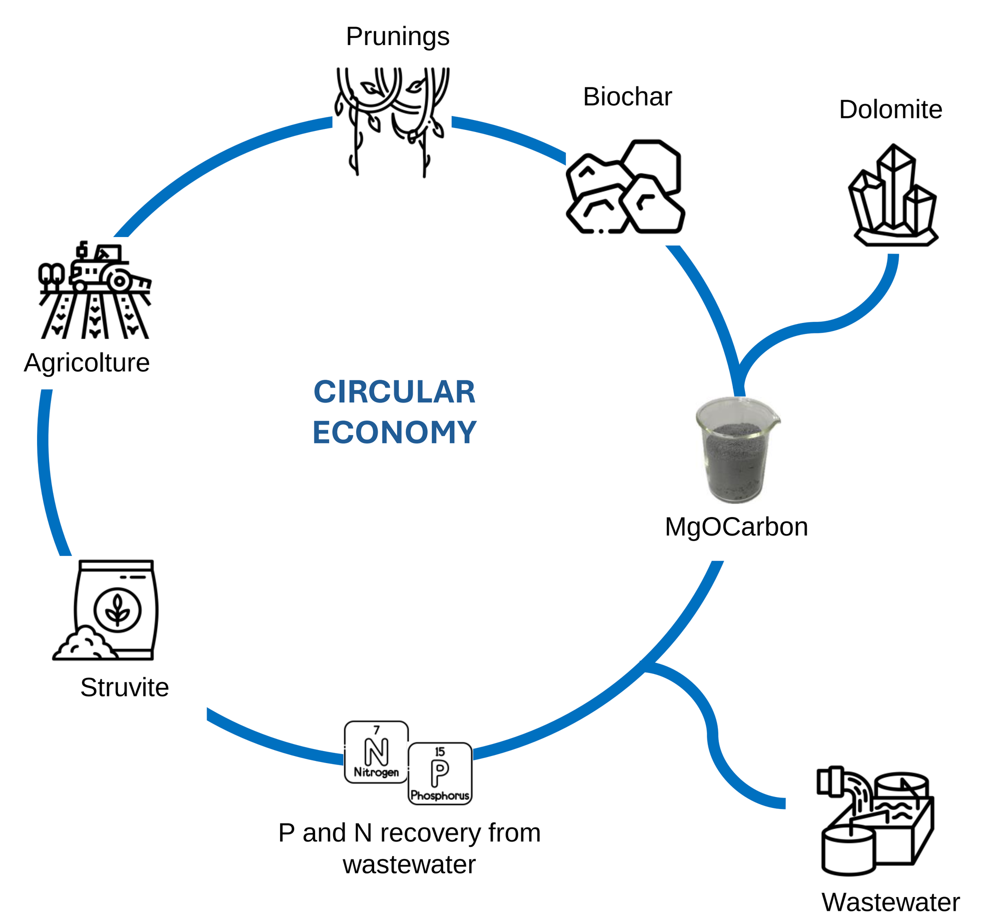
SPOKE 8 – Circular economy in agriculture through waste valorisation and recycling
WP 8.3 - Nutrient and organic matter recovery to reduce the use of agrochemicals and closing waste cycle. Produce biofertilizers to support soil fertility and mitigate climate change
TASK 8.3.2 – Valorisation and biological regeneration of wastes as resources, organic fertilizers or amendment to improve carbon storage and soil quality

ABSTRACT

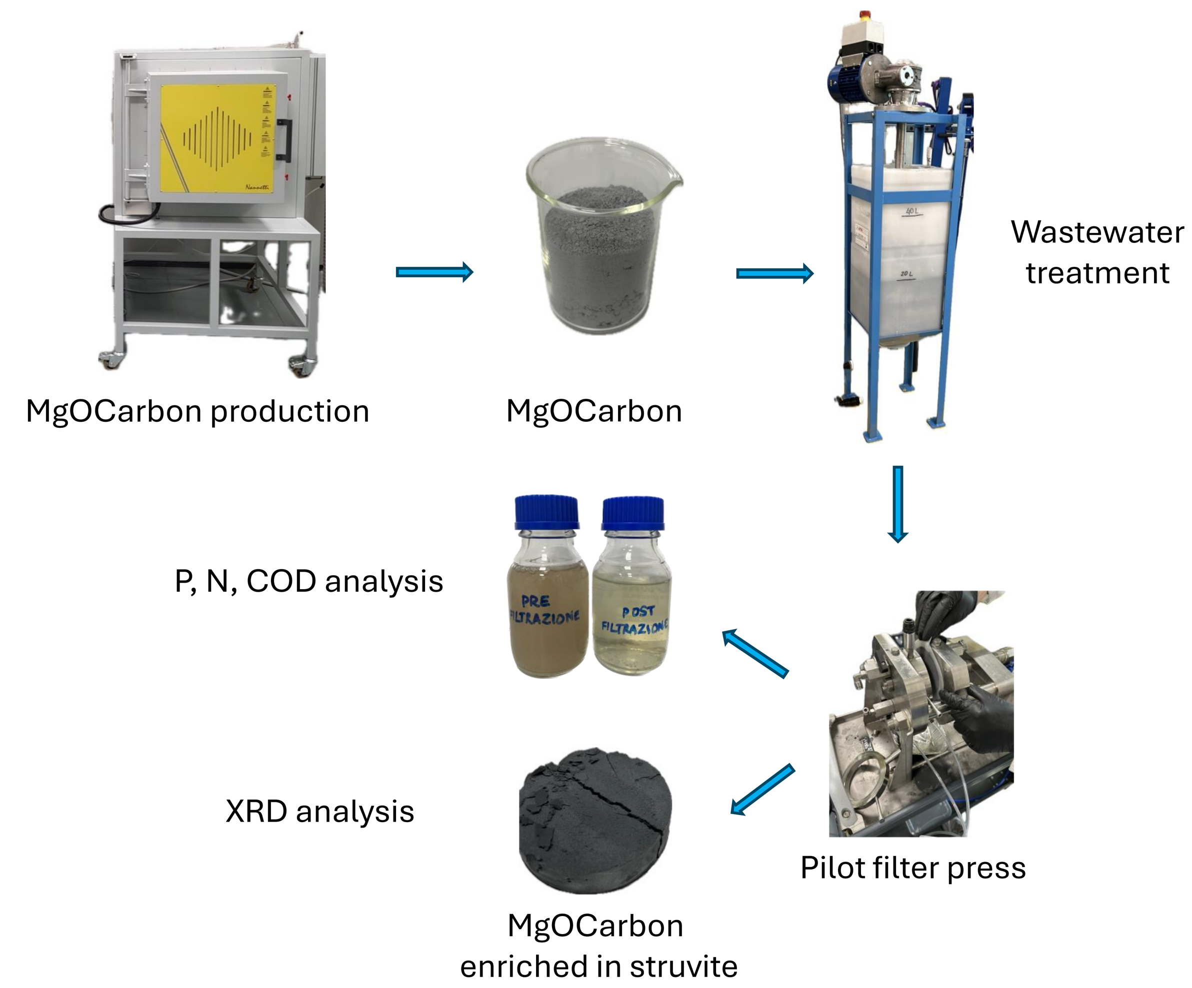
MgOCarbon is a new patented metal oxide-char blend produced from agricultural waste. It has been specifically engineered to treat agro-industrial wastewater and is now being tested as a fertiliser in line with the principles of the circular economy. Thermal treatment of dolomite and chars forms reactive sites. Metal oxides are converted into struvite when applied to N- and P-rich wastewater. This fertiliser is promoted by the new European Fertiliser Regulation 2019/1009 with the clear aim of replacing synthetic fertilisers. MgOCarbon solves two main problems. First, it removes N, P and COD from wastewater, avoiding eutrophication. Second, it recovers nutrients, producing a slow-release fertiliser. It also contains a biochar component that provides additional soil benefits, like water and nutrient retention and soil carbon storage. The main aims of the project are to scale up MgO carbon production, test wastewater treatment and investigate agronomic efficiency.

KEYWORDS: struvite, biochar, wastewater, nutrients recovery, metal-oxide, second generation carbons

MATERIALS AND METHODS

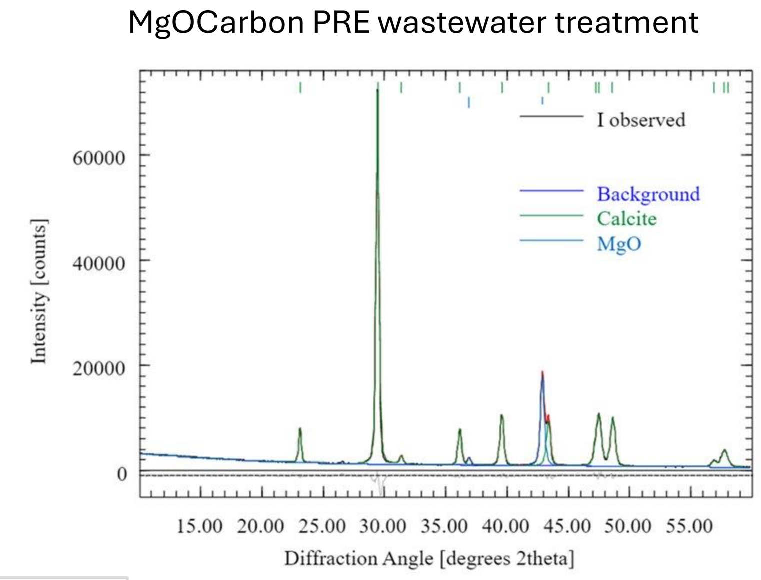


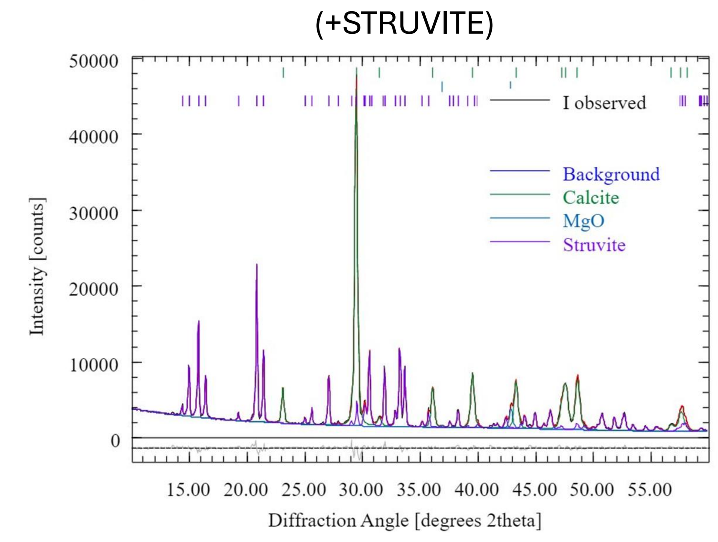
- Developing of MgOCarbon production – study of thermal process with different biochar percentage
- Batch test (100 ml) on wastewater
- Optimisation of reactives, dosage and contact time
- Scale up to 40 L wastewater treatment test with pilot filter press
- Chemical analysis on wastewater (HPLC, ICP, UV-vis)
- XRD and CHNS analysis to investigate struvite precipitation
- Study of agronomical efficency of struvite

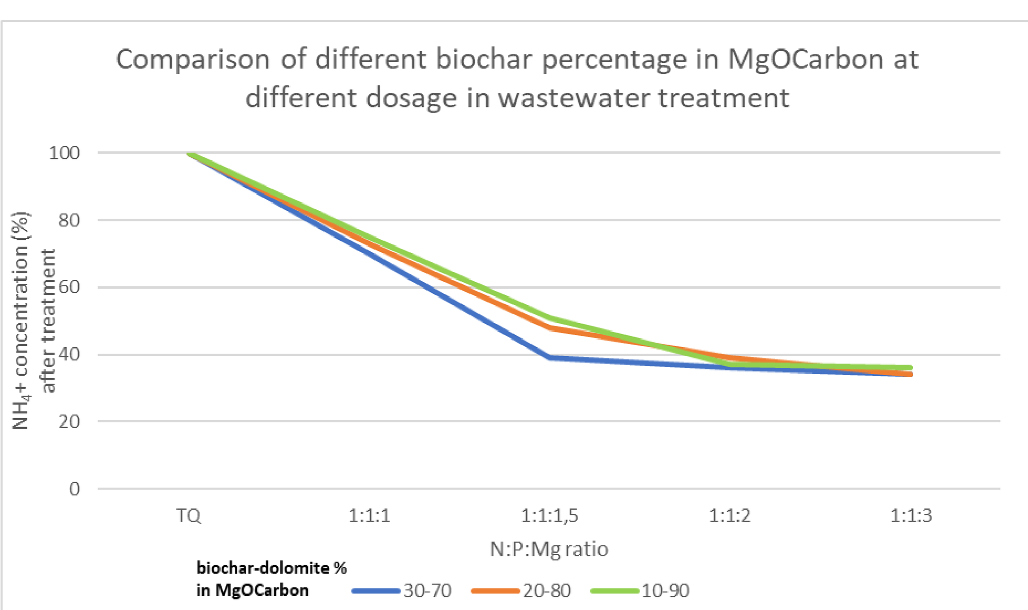


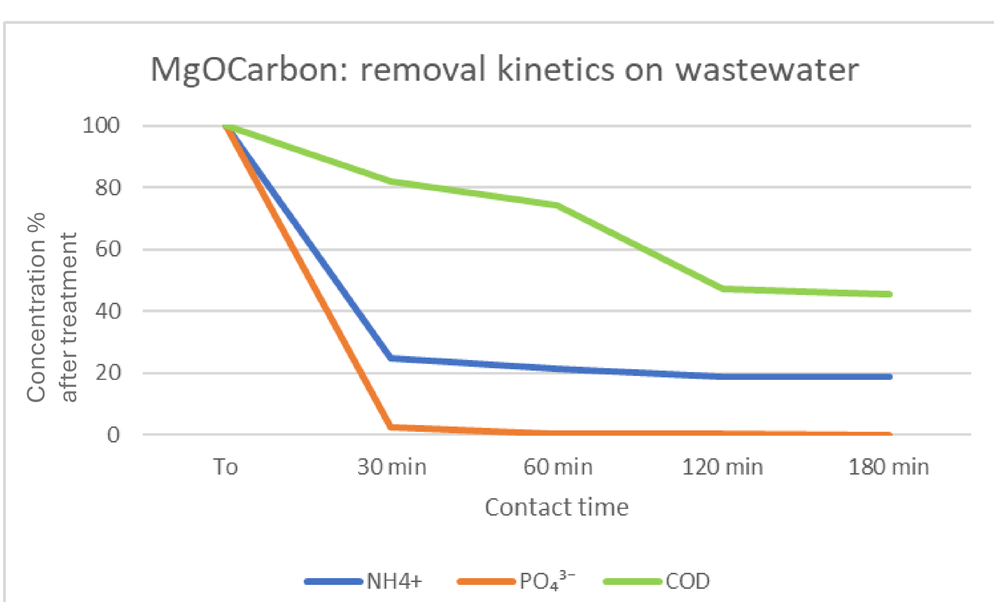
RESULTS

- ✓ Upscaling production MgOCarbon from grams to kilos
- ✓ Upscaling water tratment to batch test to 40 L pilot
- ✓ N, P and COD removal on wastewater treated
- ✓ We identified the best performance 10-90 (biochar-dolomite) MgOCarbon
- ✓ XRD analysis confirmed struvite precipitation









	MgO	Struvite	N [%]	C [%]	H [%]	S [%]
10/90 PRE	24	0	0,15	15,99	0,14	0,05
10/90 POST	3	50	1,93	10,78	2,57	0,09
30/70 PRE	23	0	0,29	30,81	0,51	0,08
30/70 POST	6	50	1,72	23,64	2,35	0,05
50/50 PRE	23	0	0,61	46,47	0,41	0,07
50/50 POST	4	53	1,83	33,98	2,32	0,08

REFERENCES

Bianchi, L., Kirwan, K., Alibardi, L., Pidou, M., & Coles, S. R. (2020). Recovery of ammonia from wastewater through chemical precipitation: Investigating the kinetic mechanism and reactions pathway of struvite decomposition. *Journal of Thermal Analysis and Calorimetry*, *142*(3), 1303–1314.

He, Q., Li, X., & Ren, Y. (2022). Analysis of the simultaneous adsorption mechanism of ammonium and phosphate on magnesium-modified biochar and the slow release effect of fertiliser. *Biochar*, *4*(1), 1–16.

Hu, P., Zhang, Y., Liu, L., Wang, X., Luan, X., Ma, X., Chu, P. K., Zhou, J., & Zhao, P. (2019). Biochar/struvite composite as a novel potential material for slow release of N and P. *Environmental Science and Pollution Research*, *26*(17), 17152–17162.

Siciliano, A., Limonti, C., Stillitano, M. A., Panico, S., & Garuti, G. (2017). Trattamento dei digestati per il recupero dell'azoto ammoniacale sottoforma di struvite. *Ingegneria Dell'Ambiente*, *4*(2), 142–151. www.smart-plant.eu

Stolzenburg, P., Capdevielle, A., Teychené, S., & Biscans, B. (2015). Struvite precipitation with MgO as a precursor: Application to wastewater treatment. *Chemical Engineering Science*, *133*, 9–15. https://doi.org/10.1016/j.ces.2015.03.008

Wang, S., Sun, K., Xiang, H., Zhao, Z., Shi, Y., Su, L., Tan, C., & Zhang, L. (2022). Biochar-seeded struvite precipitation for simultaneous nutrient recovery and chemical oxygen demand removal in leachate: From laboratory to pilot scale. *Frontiers in Chemistry*, *10*(August), 1–14.

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