



University of Turin
Department of Chemistry



**USE OF NANO-STRUCTURAL MATERIALS FOR ABATEMENT OF
NITRATES IN NATURAL AND WASTE WATER**

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Teamwork:

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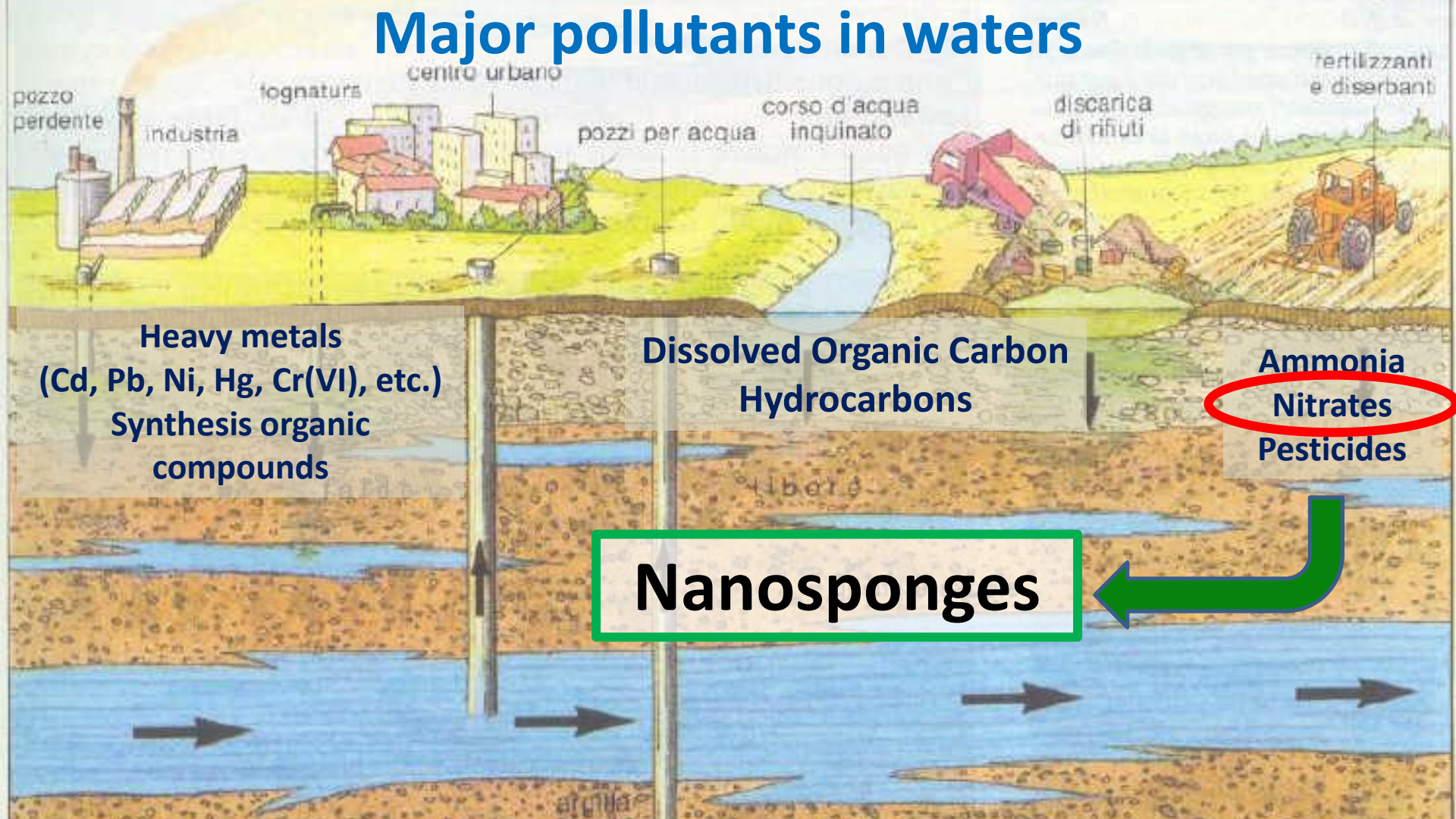
Prof. F. Trotta, Dr. C. Cecone²

¹Analytical Chemistry

²Organic Chemistry

Bologna, September 17th2018

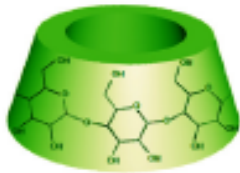
Major pollutants in waters



Nanosponges: definition

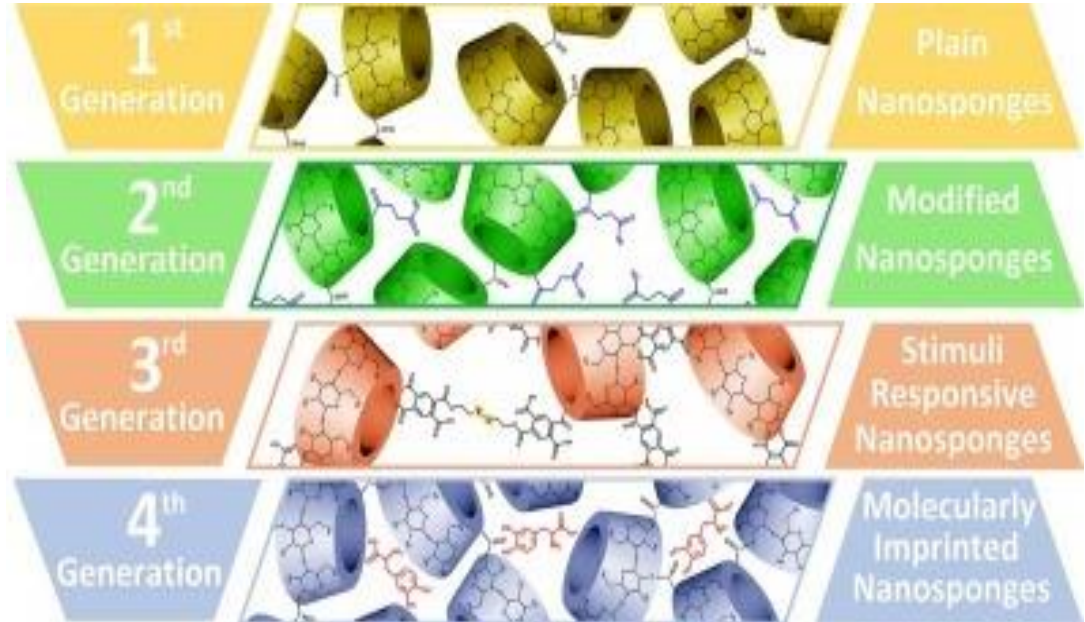
The term Nanosponge (NS) refers to a class of insoluble materials with distinctive nanometric porosity and superior absorption/ complexation properties

- Cyclodextrin based NS



β -cyclodextrin

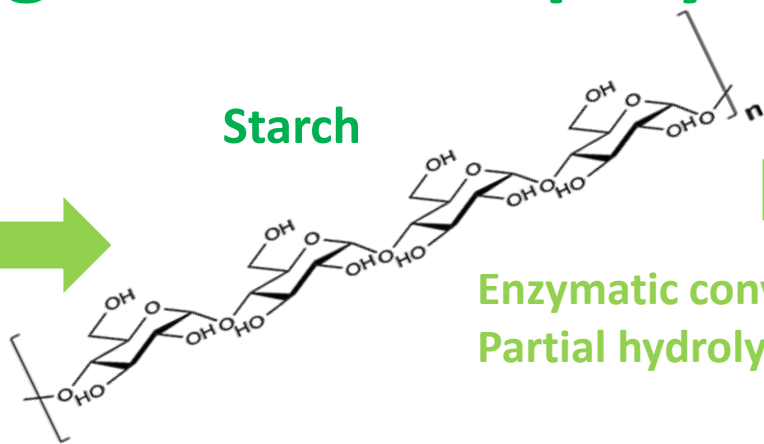
- Maltodextrin based NS



Nanosponges based biopolymers



Starch

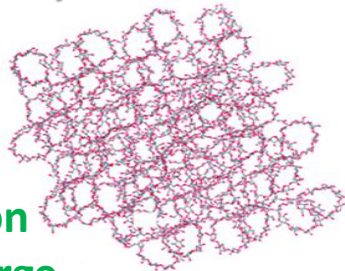


Enzymatic conversion/
Partial hydrolysis

This NEW type of synthesis is under patent process.



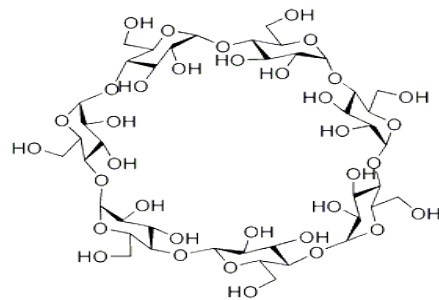
Functionalisation
with positive charge



Hyper
Cross-Linked
Biopolymer



Cross-Linker



Cyclic
Maltodextrins



Linear
Maltodextrins

Nanosponges: Analytical Tests

Batch tests: nitrates solution

- For NS characterisation several batch tests were performed.
- Some NS with different positive charge ratio were tested.
- ✓ 1 gr NS.+ 100 ml of Nitrate synthetic solution 100 mg/l

Abatement around 85-95%

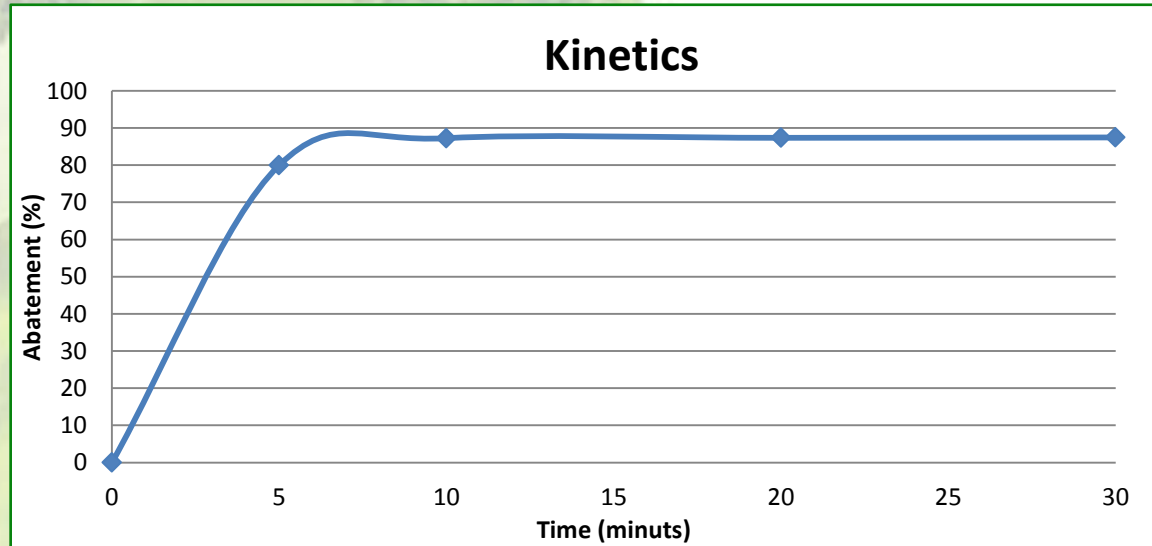
Different abatement values are due to different quantity of exchange groups inside the structure



Nanosponges: Analytical Tests

Kinetics (24 h):

- Kinetics was performed to point out the time in which there is the maximum % of abatement.
- After 10 minutes the equilibrium is reached. In the diagram there is a focus of the kinetics until 30 minutes.



Nanosponges: Analytical Tests

Batch tests: real samples

Several batch tests were performed using waste waters (100 ml) with different amount of nitrates. These are the results:

Nitrates Abatement (%)	1 g	0,5 g	0,25 g
100 ppm	78%	77%	76%
75 ppm	77%	75%	73%
50 ppm	77%	73%	72%
25 ppm	76%	73%	70%

Abatement around 70-78%

The real samples show a little decrease of the NS efficiency, because of the matrix complexity and non-heterogeneity of NS

Other batch tests were performed using a seawater to algae production with 500 ppm of nitrates.

Maximum abatement showed is around 30%. This low abatement is due to the high amount of chlorides (20000 ppm) into the solution that are competing with nitrates.

Conclusions

NS advantages in agricultural field:

- ✓ **Innovative, biodegradable, eco-compatible materials (sugar based)**
- ✓ **Good abatement of nitrates in waters**
- ✓ **Possible re-use as slow-release fertilizers, also degradable from soil bacteria**
- ✓ **Soil enrichment of N and C**

THANK YOU FOR YOUR ATTENTION!



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