



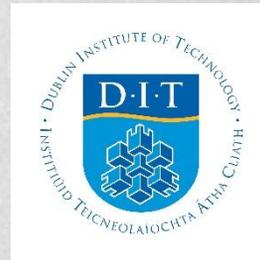
OÉ Gaillimh
NUI Galway



Development of a capture method for silver nanoparticles from the aquatic environment

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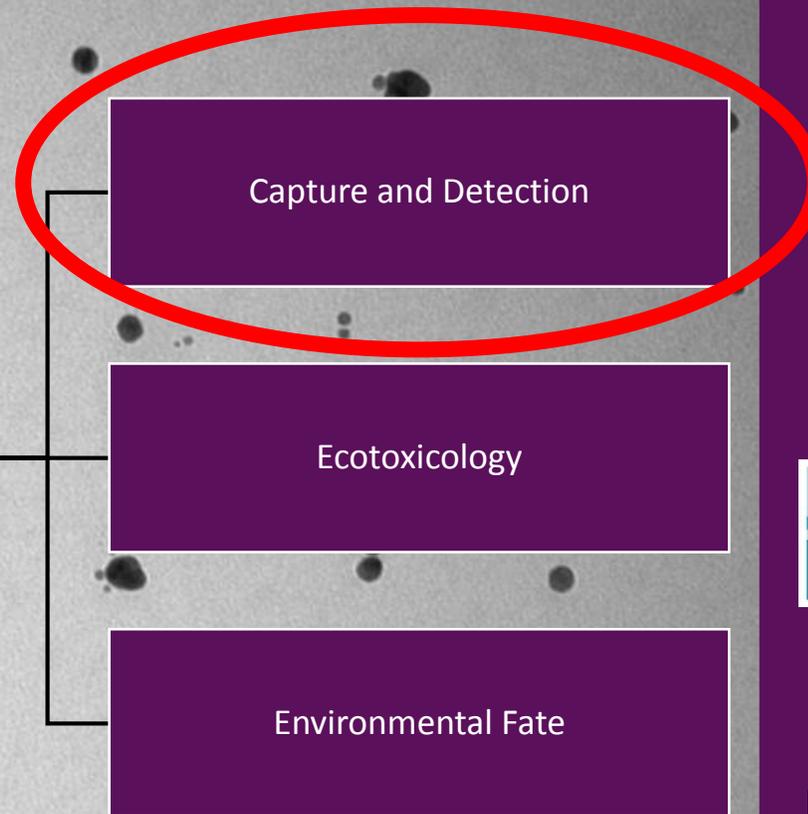


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Detection, Toxicology, Environmental fate and Risk assessment of nanoparticles in the aquatic environment



Silver nanoparticles (AgNPs)
Manufacture
Use
Disposal



Talk in a bullet point

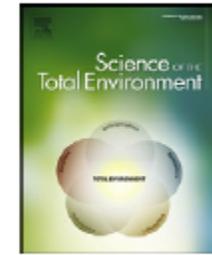
The development of a technique to successfully capture AgNPs from aqueous samples using activated charcoal as the capture material



Contents lists available at ScienceDirect

Science of the Total Environment

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Review

Silver nanoparticles in the environment: Sources, detection and ecotoxicology



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McGillicuddy, E., Murray, I., Kavanagh, S., Morrison, L., Fogarty, A., Cormican, M., Dockery, P., Prendergast, M., Rowan, N., Morris, D. 2017. Silver nanoparticles in the environment: Sources, detection and ecotoxicology. *Science of the Total Environment*. 575, 231-246.

What are nanoparticles

- Nanoparticle (NP): A natural, incidental or manufactured material containing particles, in an unbound state or as an aggregate or as an agglomerate and where, for 50 % or more of the particles in the number size distribution, one or more external dimensions is in the size range 1 nm - 100 nm (2011/696/EU)

1 nm = 0.000000001 m



Silver nanoparticles

Nanosilver has been observed to have antibacterial properties



To find out more:
<http://nanodb.dk/en/>

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AgNP: Environmental impacts



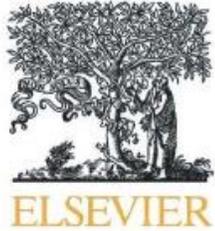
- Particles may aggregate/agglomerate, dissolve or associate with ligands present in the water, adsorb onto particulate matter in the water and/or sediment
- The ultimate fate of AgNPs in the environment will influence the bioavailability of the particles to organisms e.g. AgS compounds are insoluble and therefore may be less bioavailable

AgNP: Environmental Uncertainties

- Currently there is a lack of:
 - monitoring and detection data
 - agreed methodologies for AgNP monitoring
- To date the majority of studies on AgNP concentrations in environmental waters rely on modelling data
- It is estimated that AgNP concentration in the aquatic environment are in the ng L⁻¹ range

AgNP: Measurement

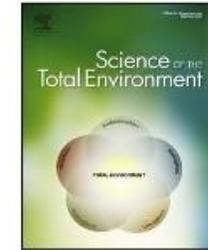
- No standard methods in place for the measurement of AgNPs in the aquatic environment
- Difficulties in measurement are associated with:
 - the reactions AgNPs can undergo in the environment
 - background Ag concentrations in the environment
 - difficulty in discriminating particulate and ionic silver
- The initial form that silver may enter the environment is not necessarily the form that it will be detected as in the environment
- Suitable methods to concentrate and quantify AgNPs in aquatic samples need to be developed



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Activated charcoal as a capture material for silver nanoparticles in environmental water samples

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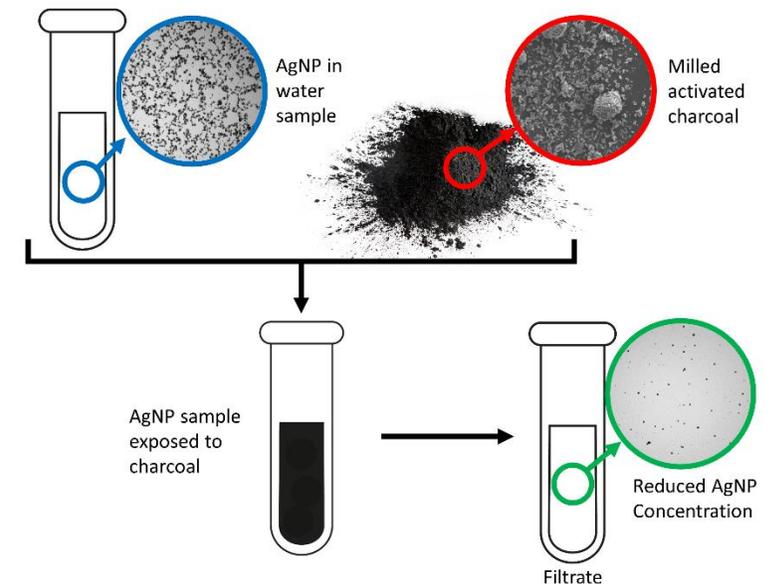
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McGillicuddy, E., Morrison, L., Cormican, M., Dockery, P., Morris, D., 2018. Activated charcoal as a capture material for silver nanoparticles in environmental water samples. *Science of the Total Environment* 645, 356–362.

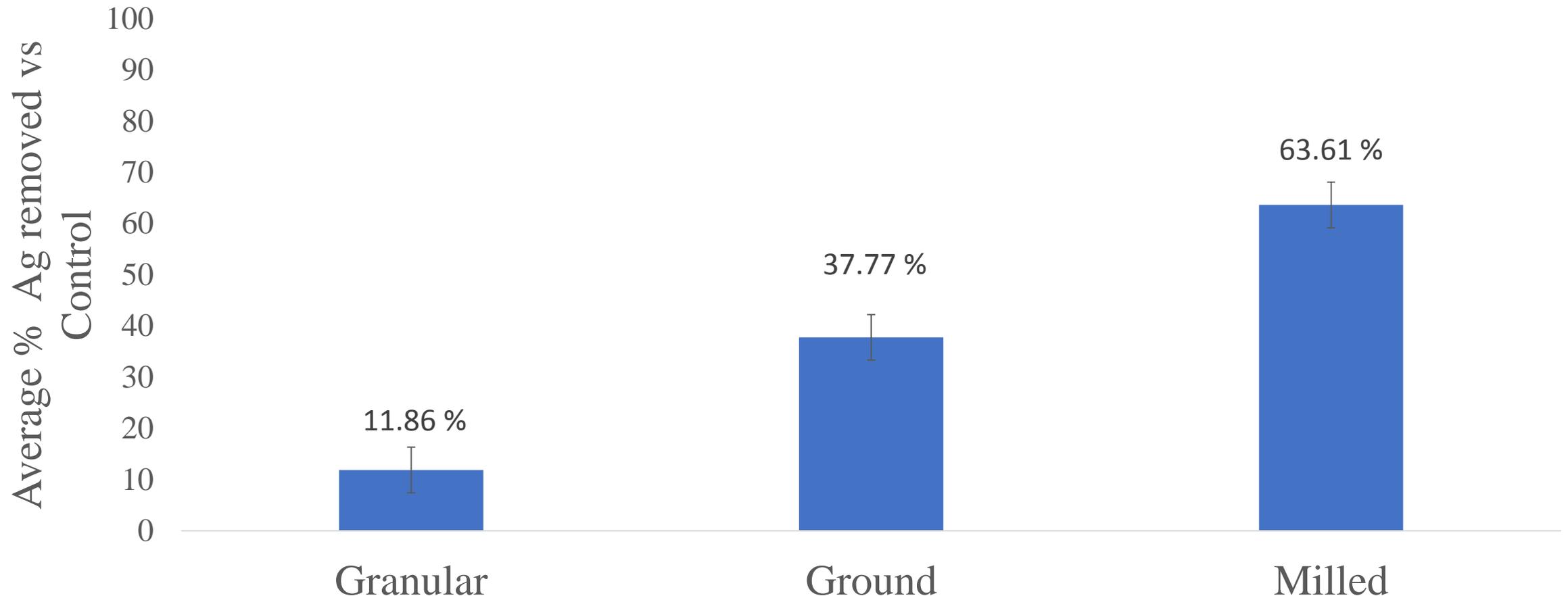
Charcoal as a capture material

- Charcoal is a commonly used material in water purification where it is used as an adsorbant
- Previous study successfully used charcoal as an adsorbant for 60 nm citrate coated nanoparticles (Gicheva and Yordanov, 2013)
 - This study added electrolytes in order to improve AgNP removal
- Charcoal used for our study was Norit CA1 activated charcoal which is used in water purification

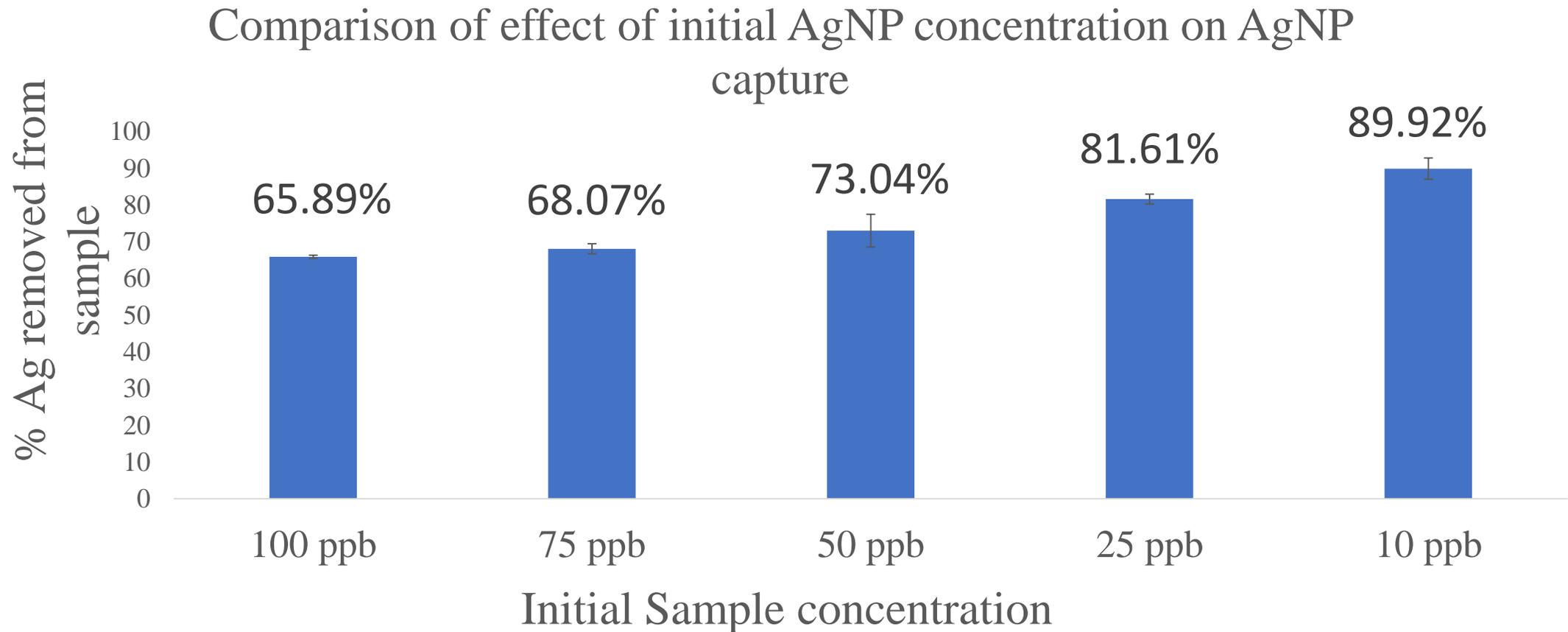


Charcoal Grade Comparison

Comparison of AgNP removal using different grades of charcoal

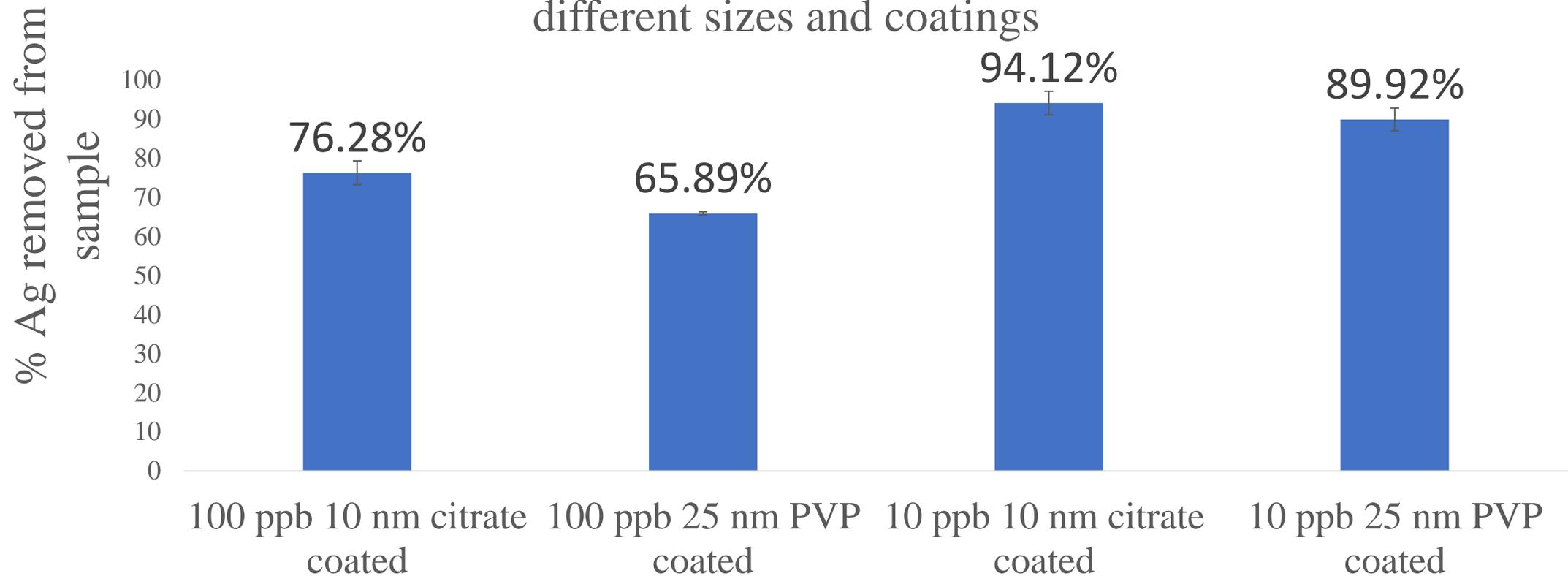


Concentration Variation



Size/Coating effect

Comparison of AgNP capture by charcoal using AgNPs with different sizes and coatings



Removal of AgNP from Charcoal (HCl)

- Samples of charcoal filtered from sample and freeze dried
- 0.1 g of dried sample weighed out and added to 2 ml of 30 % HCl
- Samples shaken for 48 hours at 200 rpm
- Samples filtered to remove charcoal
- Filtrate diluted to 1% HNO₃ and analysed using ICPMS to determine the AgNP removal from the charcoal

- The HCl extraction recovered an average of 94.83% of the Ag captured (std. dev. = 5.51) varying from 86.67% to 101.93%

AgNP: Conclusions

- Inventories of AgNP containing products at national and international levels should be developed
- AgNPs likely to be emitted into the environment however, levels are difficult to determine as they are present at low concentrations
- Suitable methods must be developed to successfully remove AgNPs (and possibly other nanowastes) from environmental waters
- Charcoal (commonly used in water purification) shows some promise as a nanoparticle capture material
- Increasing surface area of the charcoal increases the capture of AgNPs from the sample

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<http://www.nuigalway.ie/medicine-nursing-and-health-sciences/medicine/disciplines/bacteriology/research/deter/>



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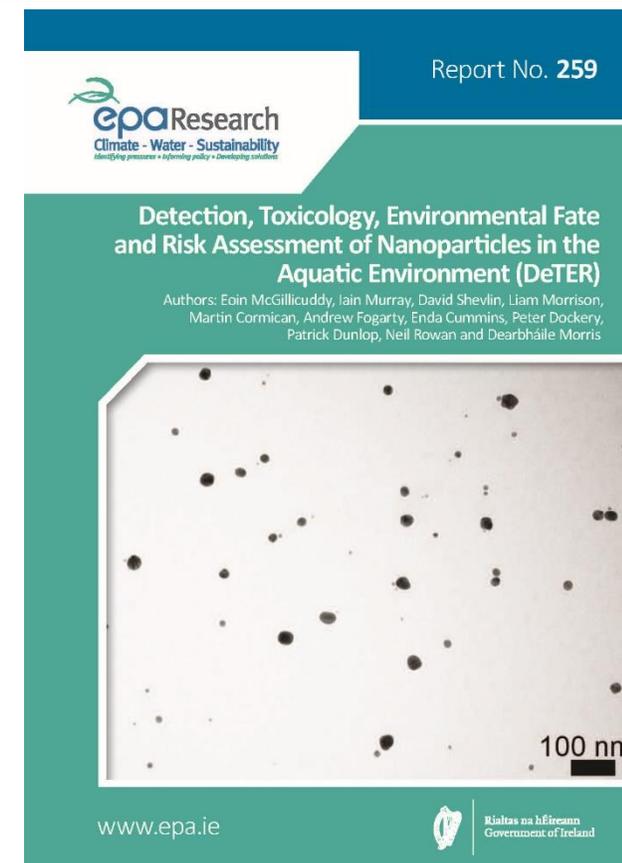
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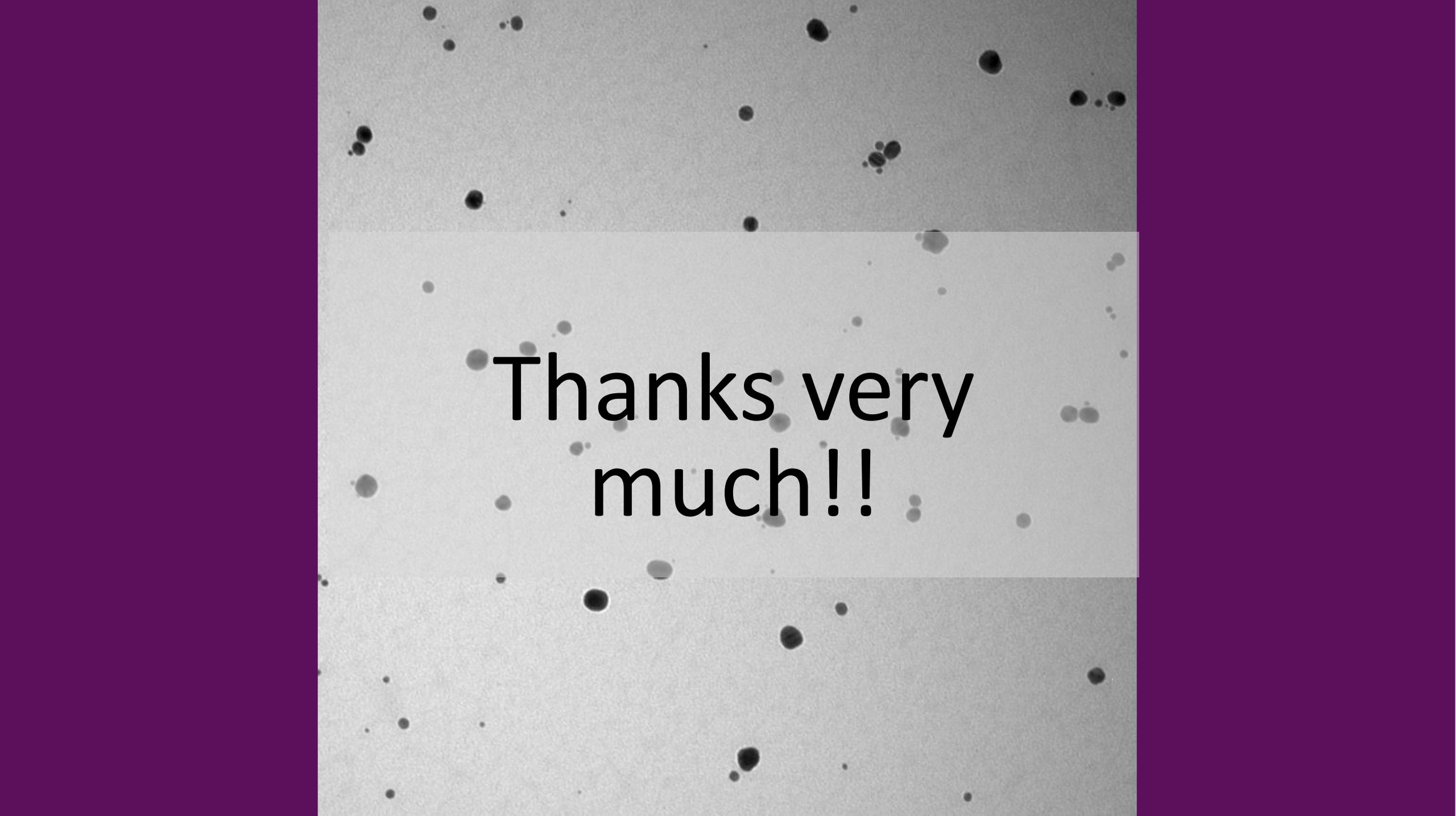


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Thanks very
much!!