

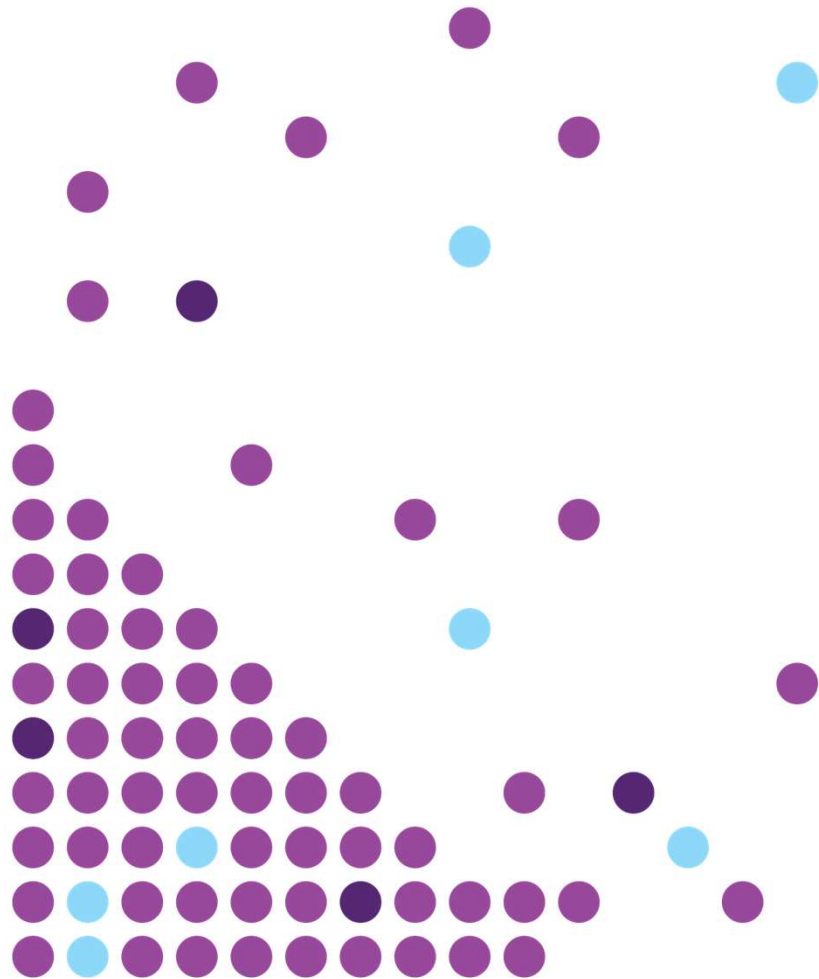
TrisKem International vUGM meeting, 24/11/20

## Investigation of the AMP-PAN resin for determination of $^{137}\text{Cs}$ in sea water samples

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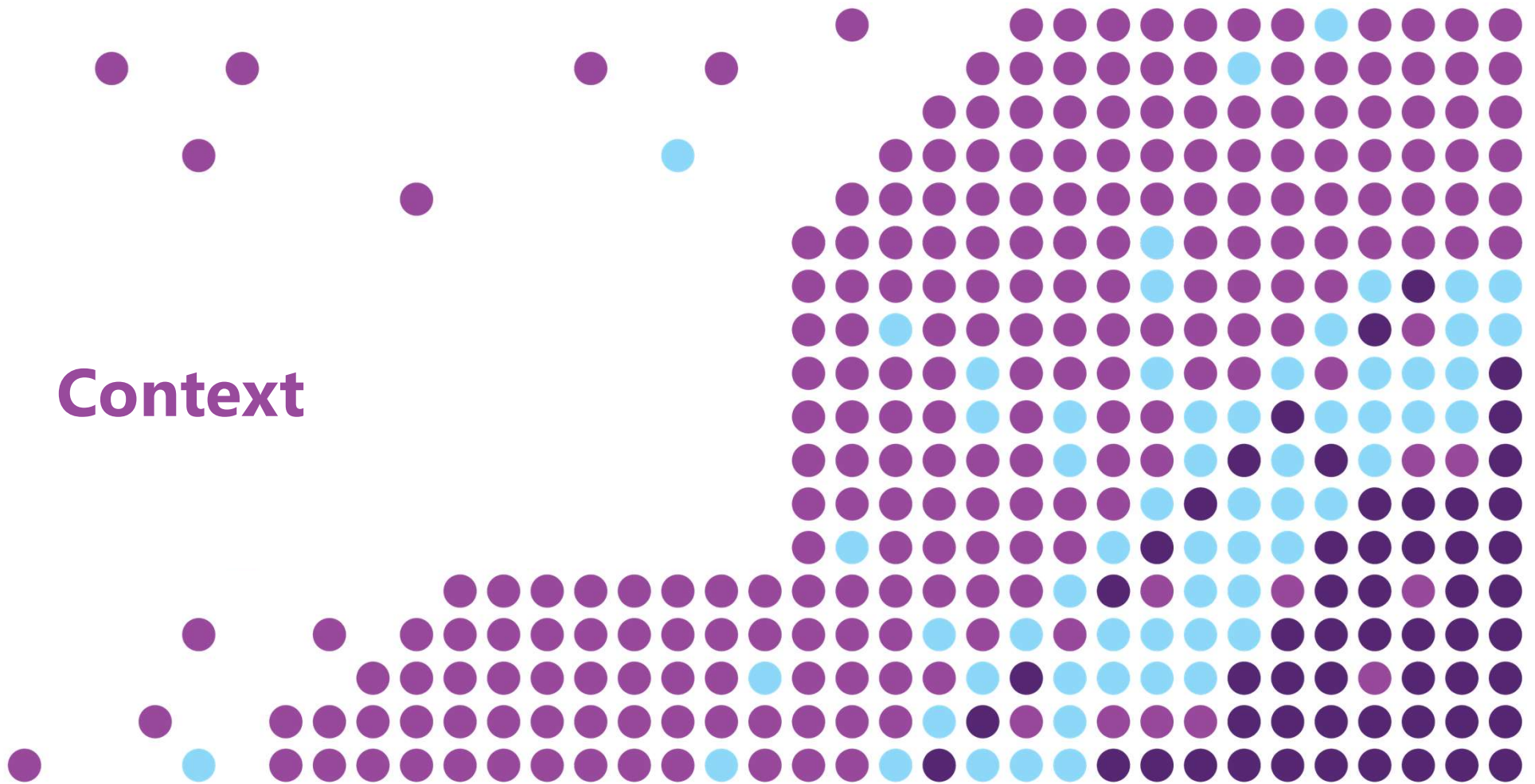
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# Context



# Radioactivity determination in different types of samples

 Accredited techniques (ISO 17025)

- ✓ Air filters
- ✓ Water samples (drinking, rain, river, **sea**)
- ✓ Soil and Sediment
- ✓ Milk
- ✓ Vegetables, Meat, Fish
- ✓ Shellfish
- ✓ Water plants
- ✓ Biological samples





# AMP co-precipitation method

- High amount of water (40 - 60 L)
- Time consuming sampling
- Complicated transport and sample treatment
- Laborious sample preparation
- In total it takes almost one week



## AMP-PAN resin: what it is?

- **A**mmonium **M**olybdo**P**hosphate, **AMP**, "embedded in an organic matrix based on polyacrylnitrile (PAN) in order to improve the mechanical characteristics" (product sheet – Cs resins)
- "**Concentration and separation of Cesium**" (product sheet – Cs resins)
- Capacity : **11 mg Cs/ml AMP-PAN resin**
- **Type of samples** (product sheet – Cs resins):
  - ✓ Acidified/non-acidified sea water
  - ✓ Liquid radioactive waste



# AMP-PAN resin – how we use it

## ➤ Simple set-up:

- peristaltic pump
- sample and waste containers
- AMP-PAN resin column
- no supervision needed (once started)



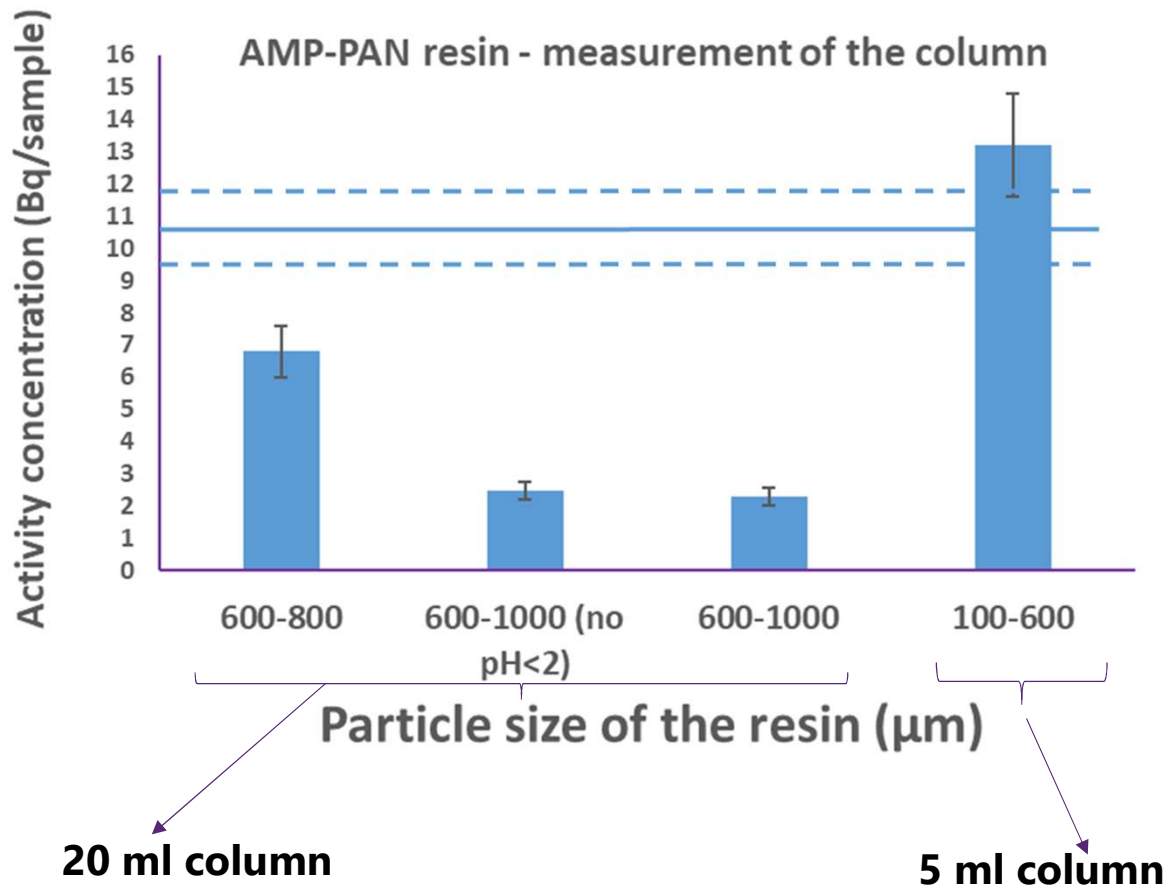
# Measurements

- ✓ **HPGe detectors**
- ✓ **Calibrated for homogeneous samples** (using efficiency transfer computations for variations in geometry, density)
- ✓ Spectrum analysis by **Genie 2000** (Mirrion) including background correction, summing correction ( $^{134}\text{Cs}$ ), interference corrections (nuclide library)
- ✓ **Low background**





# AMP-PAN results

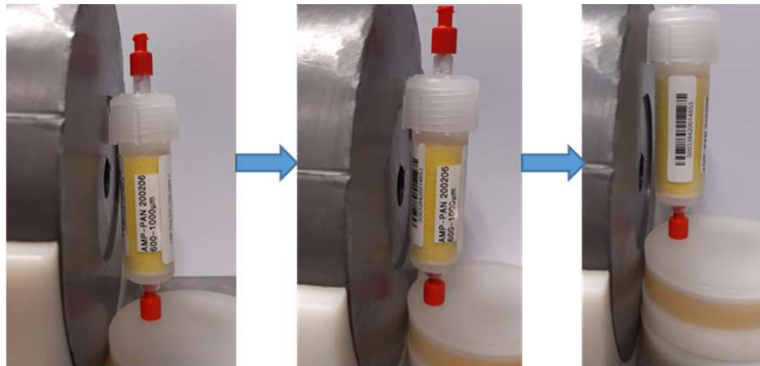
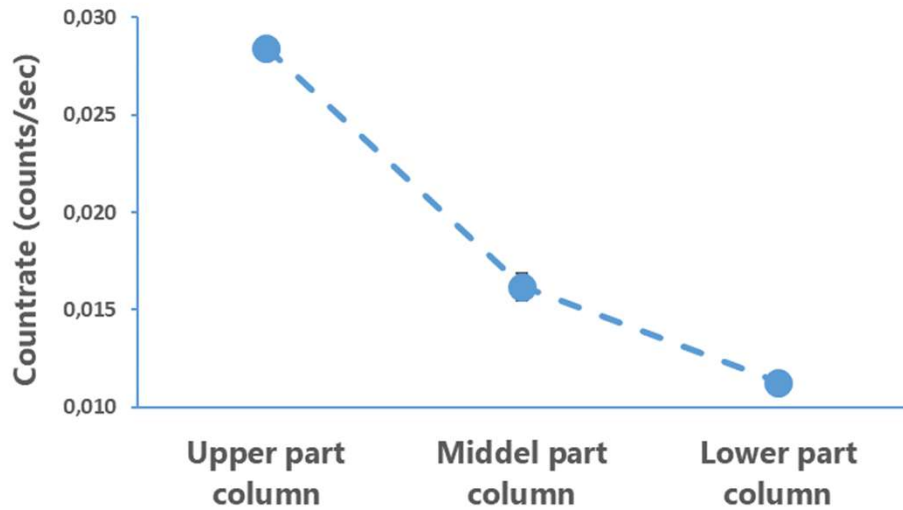


- ✓ 2.4 L sea water sample
- ✓ pH < 2 with HNO<sub>3</sub>
- ✓ 5 L/h (by mistake) flow rate



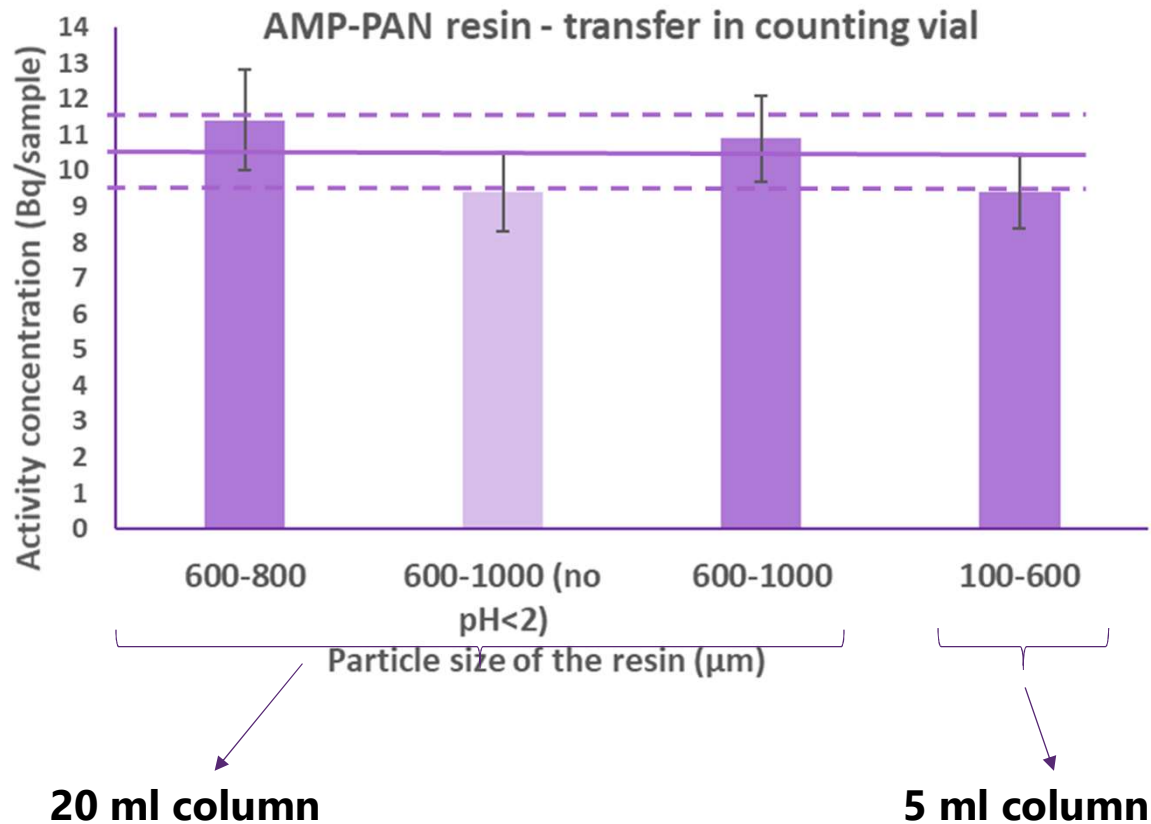
- ✓ **Underestimated** results directly measuring the **20 ml column**
- ✓ **Slightly overestimation** of the activity using **5 ml column**

# AMP-PAN results: inhomogeneity of activity concentration in cartridge



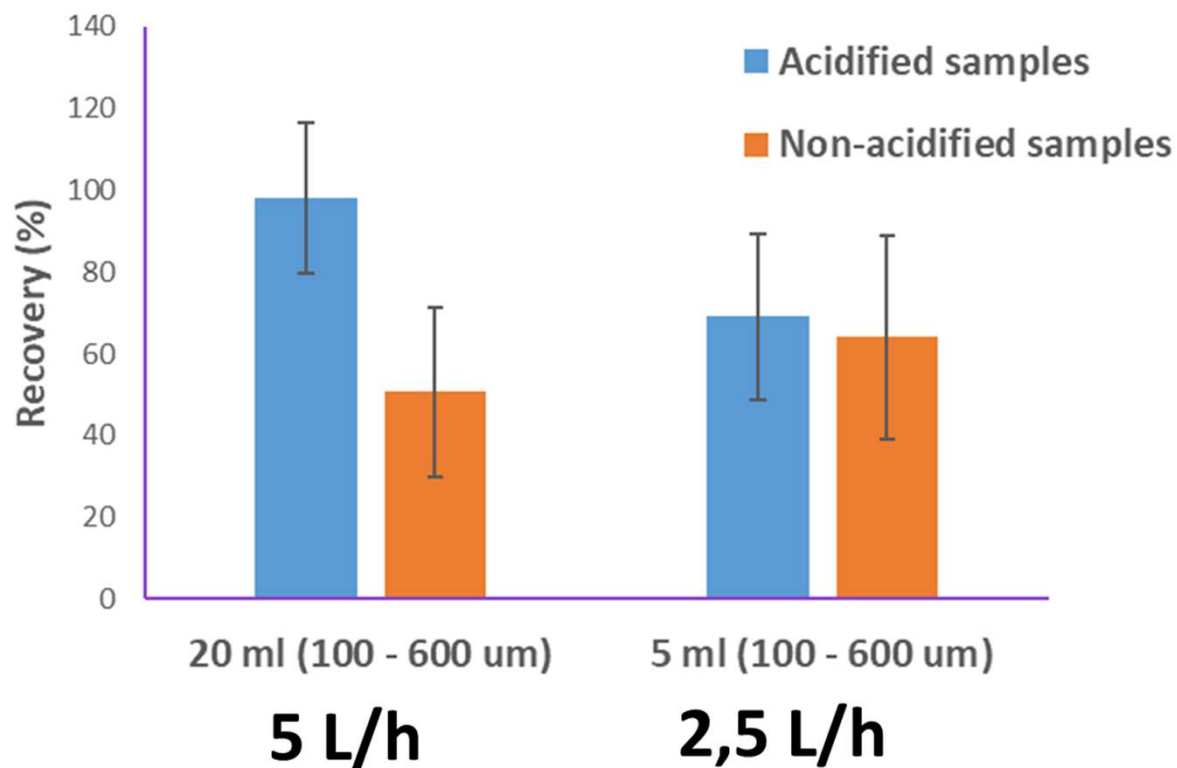
- ✓ **vertical scan** with **collimated HPGe detector**
- ✓ scan made by measuring at **3 positions** along the axis of the cartridge
- ✓ **Counts in the  $^{137}\text{Cs}$  gamma peak** reflect the concentration in the cartridge

# Measurement after transferring cartridge content to measurement vial and homogenization



- ✓ measurements in the vial in **good agreement** with the spiked value
- ✓ **good results** independent of particle size
- ✓ **good results** even using **5 L/h flow rate**
- ✓ non-acidified samples slightly lower results – but maybe only due to the transfer of the sample some resin was still in the column?

# AMP-PAN results: acidification vs non-acidification



- ✓ 14 L sea water
- ✓ 10 mBq/L
- ✓ **only one sample per result**
- ✓ lower recovery for non-acidified sample (and 20 ml column)
- ✓ lower recoveries using 5 ml column –we have to investigate the reason (fresh results)
- ✓ repeatability needs to be investigated

# Results: AMP-PAN resin vs co-precipitation

Parameter	Classic AMP	AMP-PAN resin (20 ml column – 100-600 µm)
Volume sample (L) sea water	40	<b>14</b>
Final high of sample (mm)	~100	<b>16 – 20</b>
Flow rate (L/h)	-	<b>2.5</b>
Time of the procedure	4-5 days	<b>6 hours</b>
Counting time	Over week-end	<b>Over week-end</b>
<b>Detection Limit (mBq/L)</b>	<b>2</b>	<b>1.8</b>

- ✓ real samples – North Sea water
- ✓ apply both methods



**Good agreement of the results**



# Comparison of measurement geometry

## Co-precipitation



## Detection limits

## AMP-PAN resin



❑ average source-detector distance larger

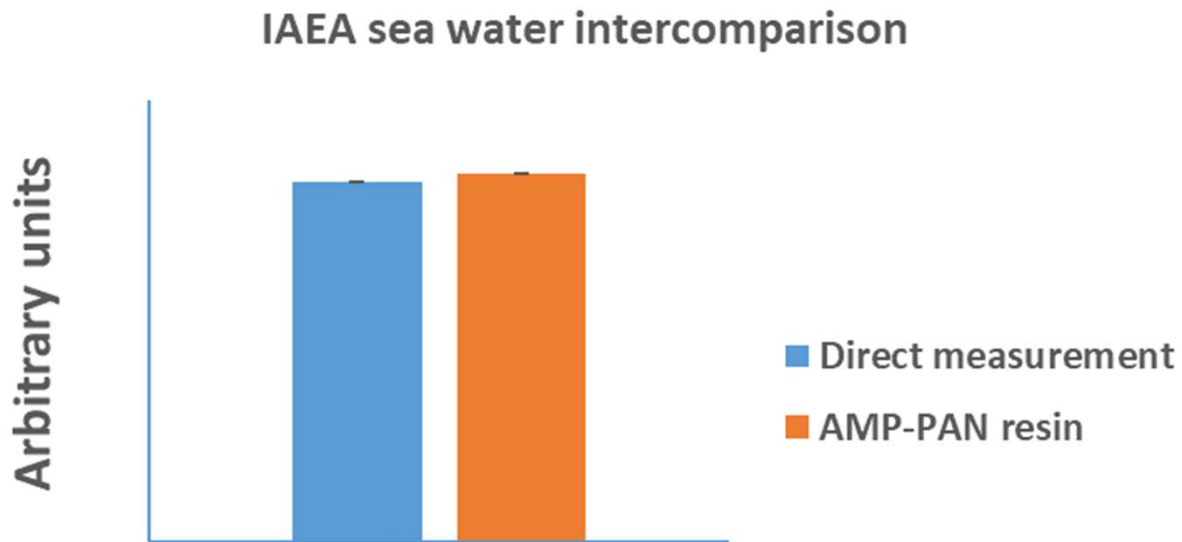
- ✓ lower detection efficiency
- ✓ higher detection limit

versus

❑ average source-detector distance shorter

- ✓ higher detection efficiency
- ✓ lower detection limit

# AMP-PAN resin vs direct measurement



- ✓ 2.4 L sample
- ✓ 2.5 L/h flow rate
- ✓ acidified sample (pH < 2)
- ✓ 20 ml column



**Good agreement of the results**



# Conclusions and Perspectives

# Conclusions

## □ Using AMP-PAN resin:

- ✓ **Faster and easier method (few hours comparing with few days)**
- ✓ **Good recoveries (~ 100 % for 20 ml column)**
  - ✓ the 5 ml column needs to be investigated further
- ✓ **Good agreements with the classical method**

# Perspectives

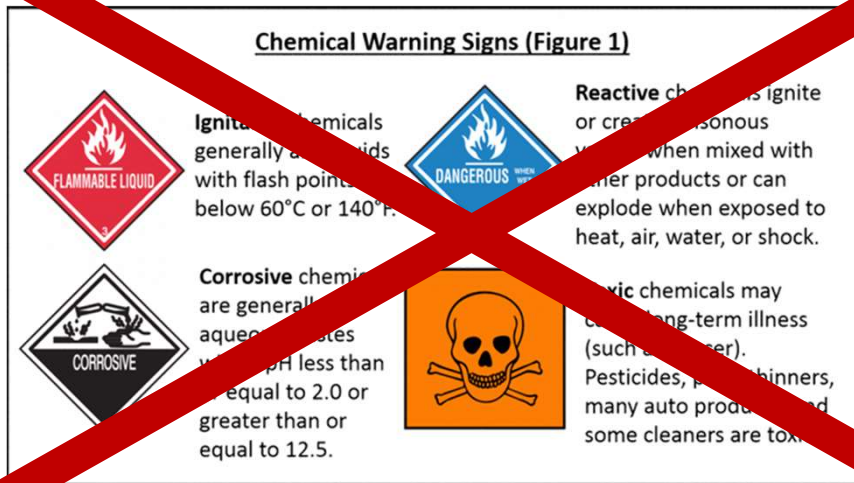
- ❑ Implementation in the routine analyses and replace the classical method
  
- ❑ Validation of the procedure
  - ✓ **decide on the type of column (20 or 5 ml pre-packed columns)**
  - ✓ **decide if the sample should be acidified or not**
  - ✓ **reproducibility and repeatability**



# Perspectives

- ✓ No acidification of the sample – **no wastes**

- ✓ **in-situ treatment** of sample avoiding transport of huge amounts of sample material



Taken from: <https://odnature.naturalsciences.be/belgica/nl/image-gallery>

**Thank you for your attention!**

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