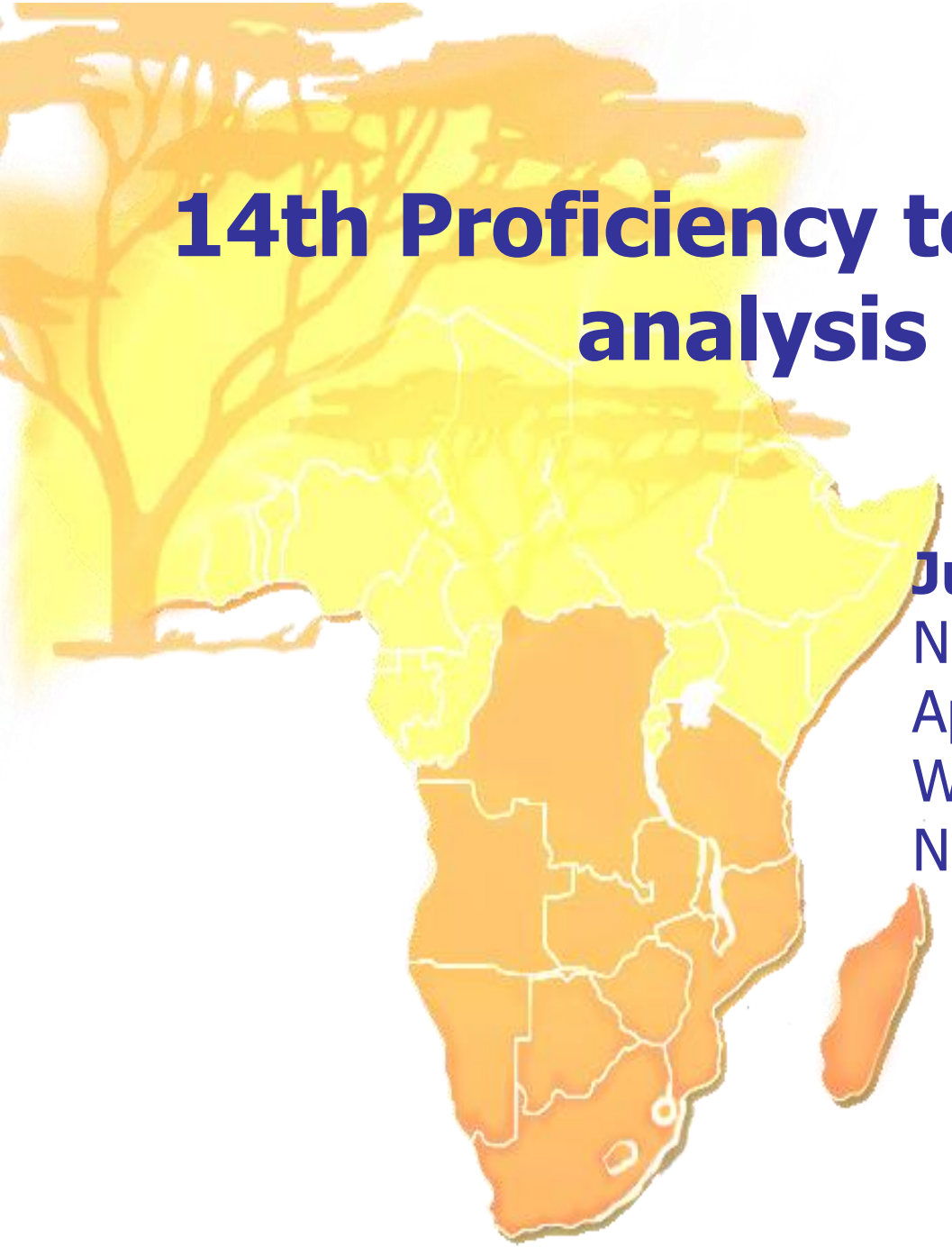

14th Proficiency testing scheme for chemical analysis of Water in Africa

Justina Endjala / Merylinda Conradie
NamWater
Applied Scientific Services
Windhoek
Namibia

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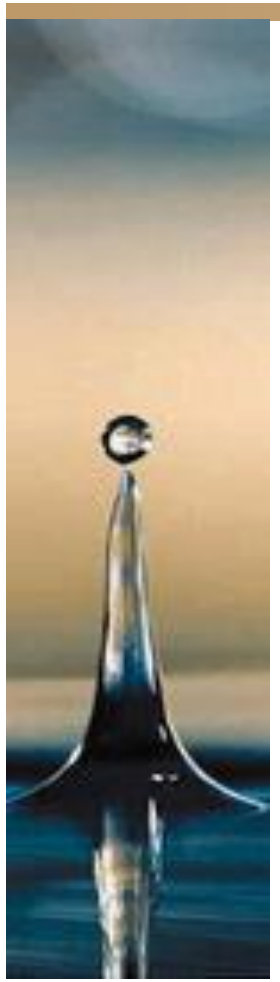
NamWater



- The bulk water supplier for Namibia
- Established in 1997 from MAWF
- 100% GRN owned
- +/- 80 million m^3 potable water per annum
- 28 000 customers
- Asset base N$4 billion
- 670 employees
- Supplies all towns except 5
- Operating on cost recovery basis since establishment

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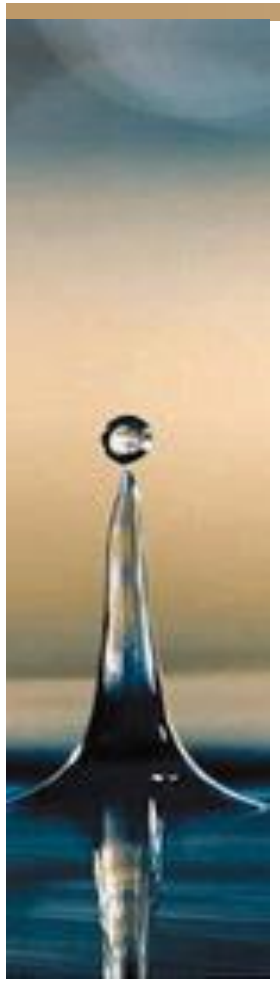
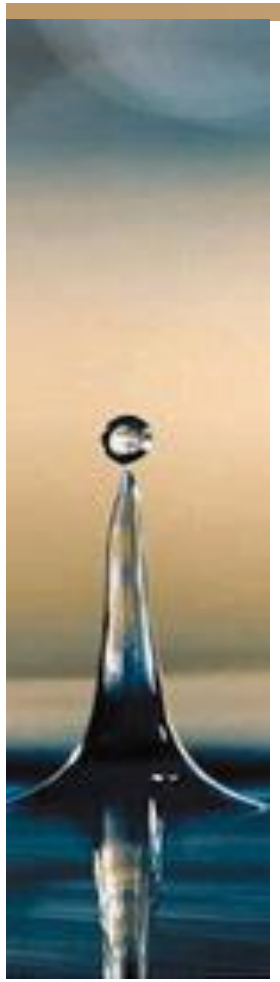
Outline



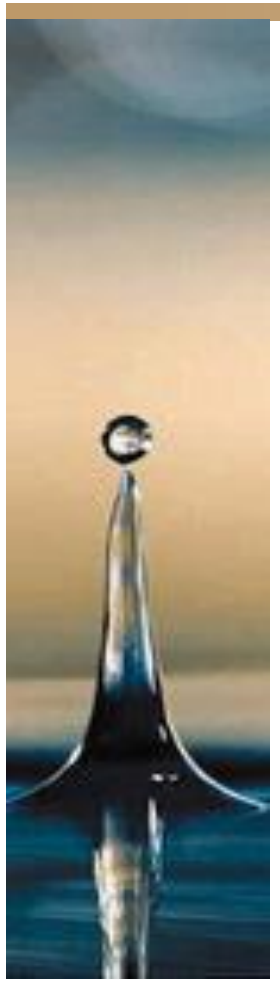
- Background of the SADCMET PT scheme
- Participation
- Growth of the SADCMET PT Scheme
- Overview of a PT round
- Details of the PT process
- Evaluation & Assessment
- Performance scoring
- Changes and Progress of Parameters
- Summary of the Parameters
- Overall Success
- Challenges 2018
- Conclusion

Backgound & history of the scheme



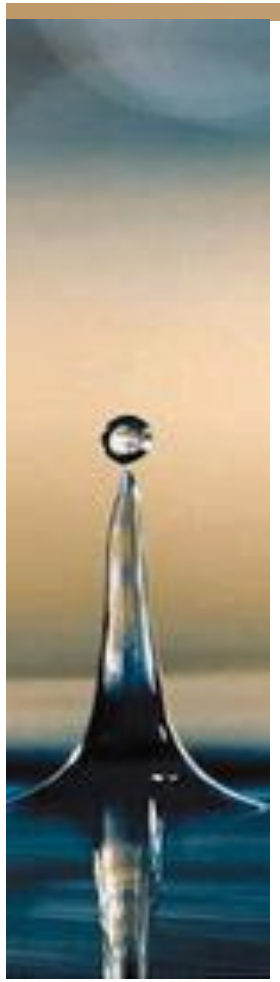
2004	The first workshop was held in February in Windhoek, Namibia, with participants from 16 countries where the need for a PT scheme was identified. Training on basic issues of quality in analytical laboratories was also addressed at this workshop.
2004	1st PT round; Evaluation workshop in Pretoria, South Africa
2005	2nd PT round; Evaluation workshop in Dar es Salaam, Tanzania Training session on measurement uncertainty
2006	3rd PT round; Evaluation workshop in Gaborone, Botswana Training session on method validation and control charts
2007	4th PT round; Evaluation workshop in Dar es Salaam, Tanzania Training session on validation and measurement uncertainty October: Poster presentation at the **Eurachem** workshop in Proficiency testing in analytical chemistry, microbiology and medicine in Rome, Italy

Backgound & history of the scheme



2008	5th PT round; Evaluation workshop in Kampala, Uganda Training session on the Management requirements of the ISO17025
2009	6th PT round; Evaluation workshop in Mahé, Seychelles Test & Measurement conference: Presentation of Chemical analyses of water in Africa, South Africa
2010	7th PT round; Evaluation workshop in Windhoek, Namibia Training session on estimation of measurement uncertainty using validation and quality control October: Poster presentation at the **Eurachem** Workshop in Proficiency testing in analytical chemistry, microbiology and laboratory medicine in Istanbul, Turkey
2011	8th PT round; Evaluation workshop in Port Louise, Mauritius Training session on ensuring the quality of analytical results – Trueness and Precision

Backgound & history of the scheme



2013	10th PT round; Evaluation workshop in Nairobi, Kenya Training session on control charts
2014	11th PT round; Evaluation workshop in Lusaka, Zambia Training session on measurement uncertainty October: Poster presentation at the Eurachem workshop in Proficiency testing in analytical chemistry, microbiology and laboratory medicine in Berlin, Germany
2015	12th PT round; Evaluation workshop in Gaborone, Botswana. Training session on Inter-laboratory tests, basic statistics and control charts
2016	13th PT round; Evaluation workshop in Dar Es Salaam, Tanzania. Training session the update on the revision of ISO/IEC 17025ion on Inter-laboratory tests, Root cause analysis and Estimation of Uncertainties

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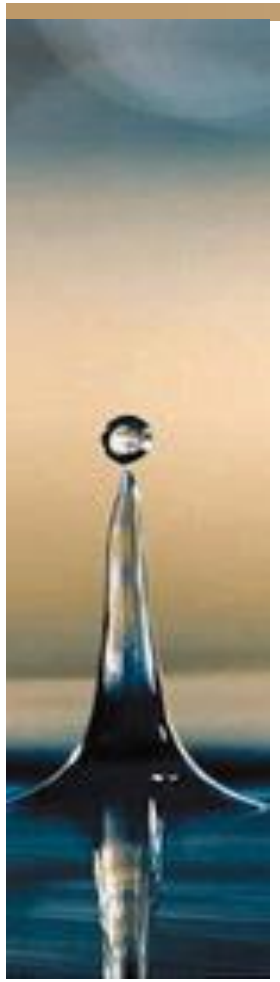
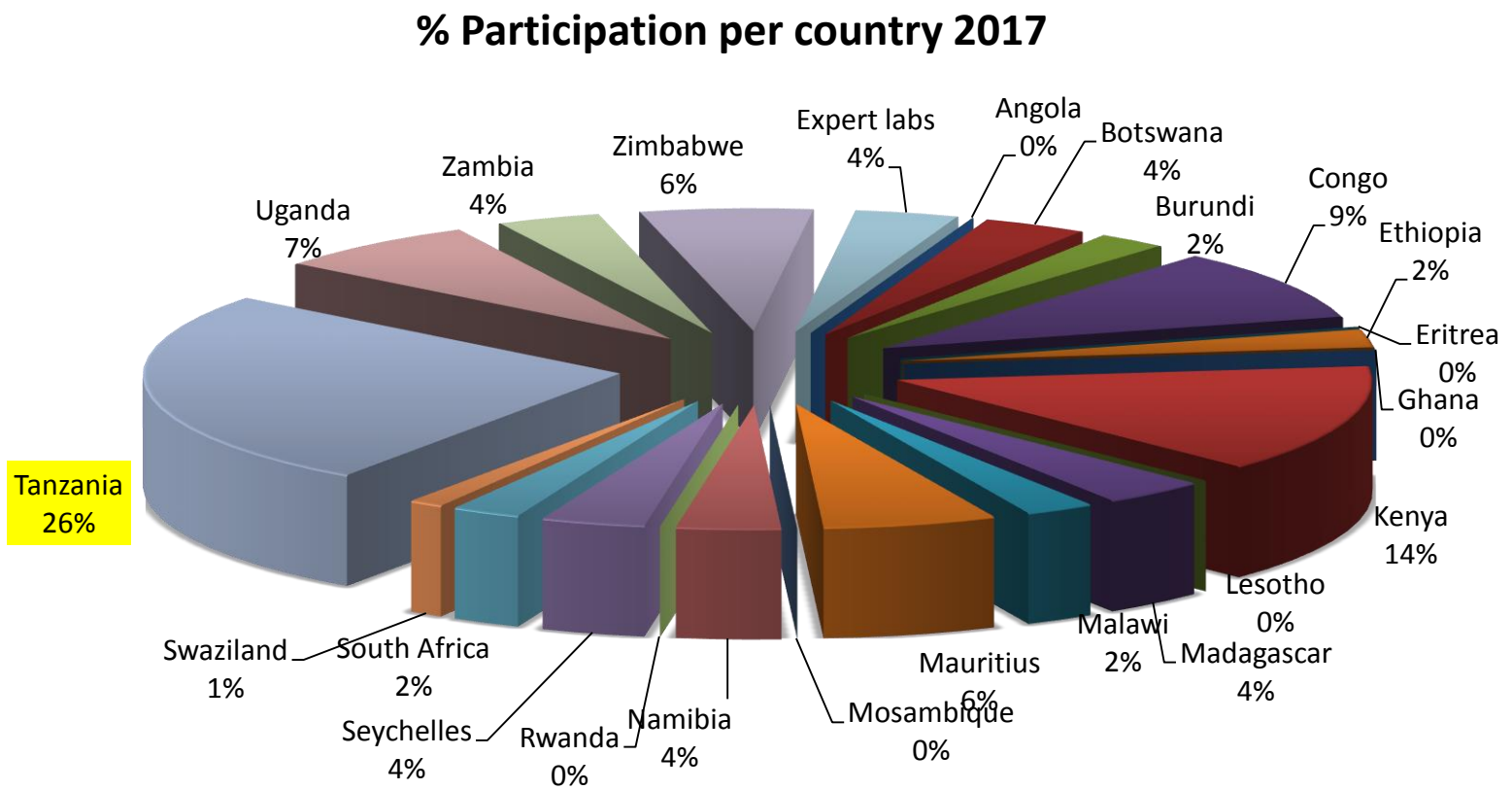
% Participation per country





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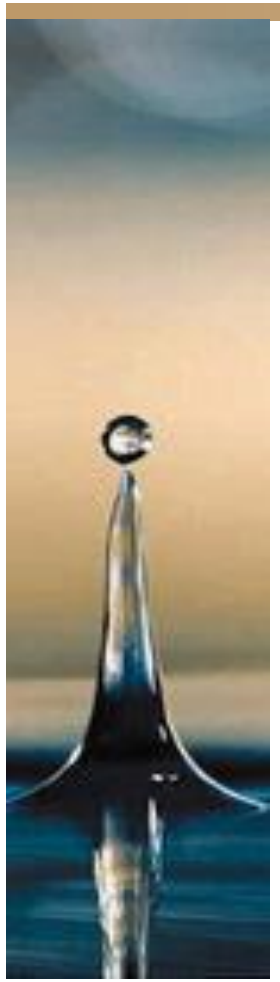
of laboratories per country



	2006	2007	2008	2009	2010	2011	2013	2014	2015	2016	2017
Angola	0	0	1	0	0	0	0	0	0	0	0
Botswana	2	4	2	3	3	3	3	3	3	3	3
Burundi					1	1	1	2	2	2	2
Congo					4	5	3	8	7	5	8
Eritrea	0	0	1	0	0	0	0	0	0	1	0
Ethiopia	1	0	0	0	0	1	1	2	1	2	2
Ghana						1	0	0	0	0	0
Kenya	5	3	3	7	9	7	12	13	8	10	12
Lesotho	1	1	1	1	1	1	1	1	1	1	0
Madagascar	2	2	3	3	2	2	2	3	3	3	3
Malawi	2	3	1	1	2	2	1	1	1	2	2
Mauritius	4	3	5	6	6	5	4	5	5	4	5
Mosambique	2	0	0	0	0	0	0	0	0	0	0
Namibia	3	3	3	3	3	3	3	3	3	4	3
Rwanda					1	1	1	1	0	0	0
Seychelles	2	1	1	1	1	1	1	3	3	3	3
South Africa	0	1	1	1	1	1	1	1	1	1	2
Swaziland	0	1	2	3	0	0	0	0	1	1	1
Tanzania	6	12	11	12	13	10	12	15	18	14	22
Uganda	5	5	5	5	4	5	4	2	3	5	6
Zambia	2	3	1	3	3	1	1	2	2	2	3
Zimbabwe	2	5	5	5	4	4	6	7	5	5	5
Expert labs										3	3
TOTAL	**39**	**47**	**46**	**54**	**58**	**54**	**57**	**72**	**67**	**71**	**85**

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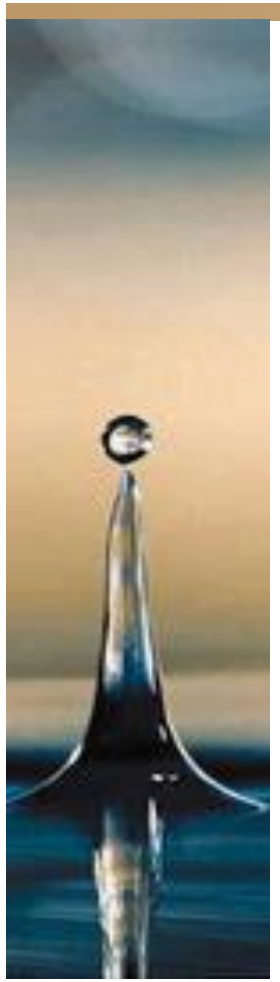
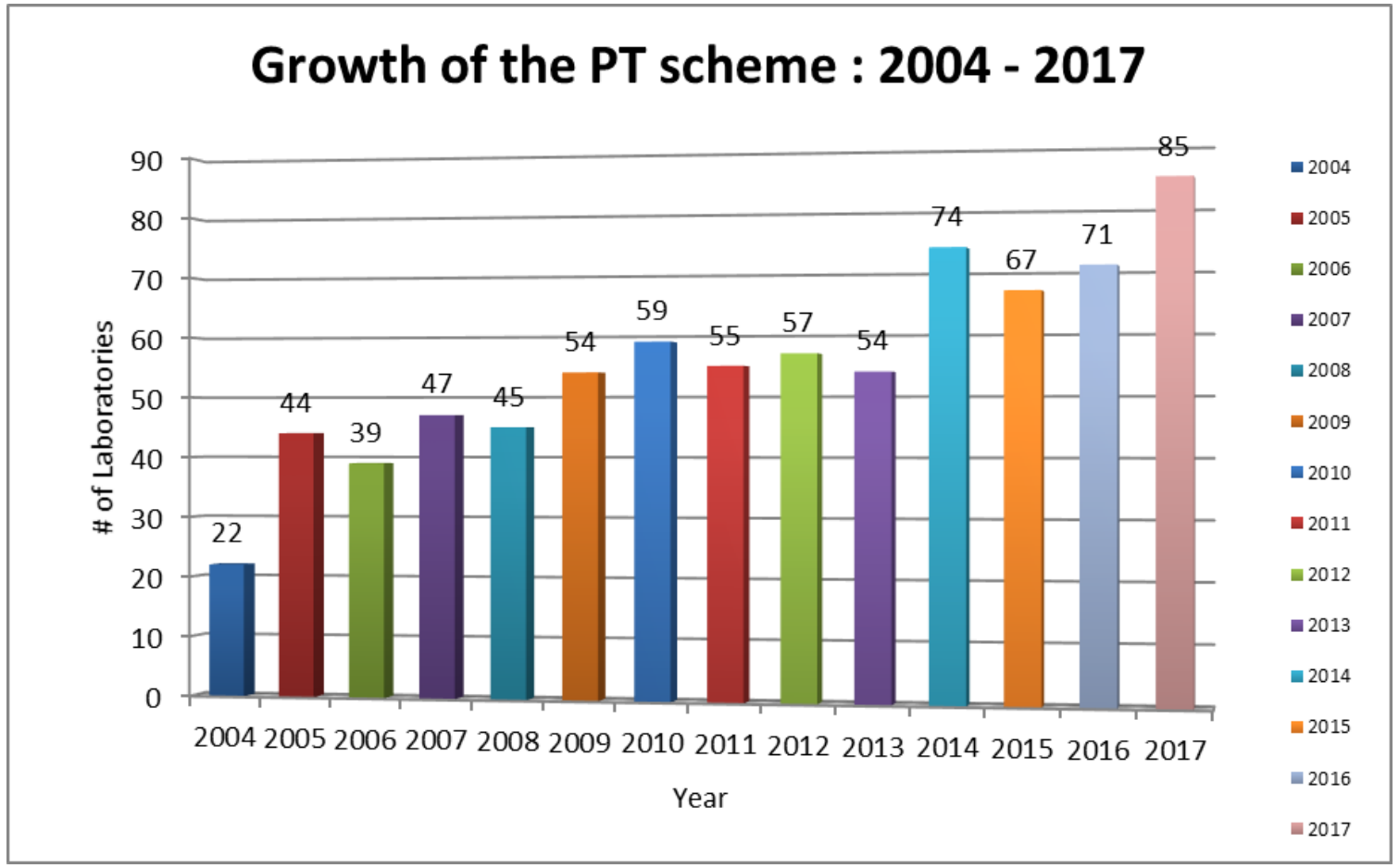
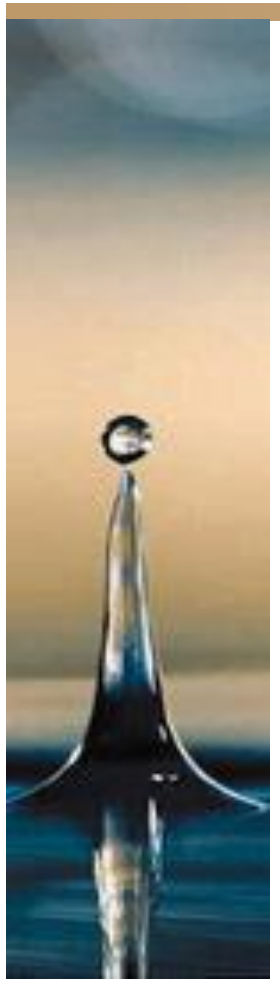
Growth of the SADC PT scheme





Details of the PT processes

Overview of a round



Phase 1

- The annual notification is send out by the end of February with the schedule of activities for the year.
- Registration usually close by the end of April

Phase 2

- Identification & calculation of target values
- Ordering of Chemicals & Consumables
- Download certificates of analyses (COA)

Phase 3

- Preparation of the stock solutions and bulk samples
- Packing and distribution of the parcels

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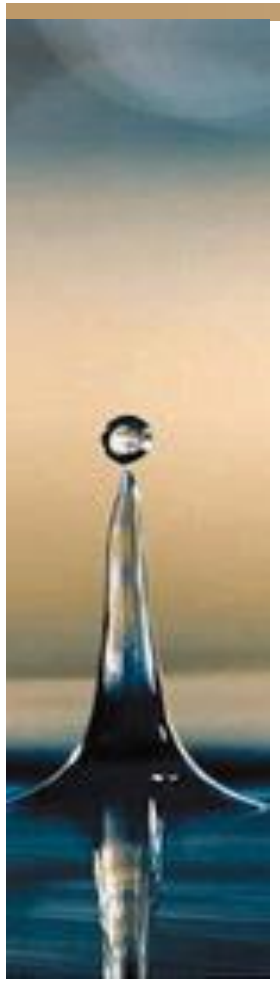
Details of the PT processes

Overview of a round



Phase 4

- Calculations of reference values and measurement uncertainties
- Results submission by participants

Phase 5

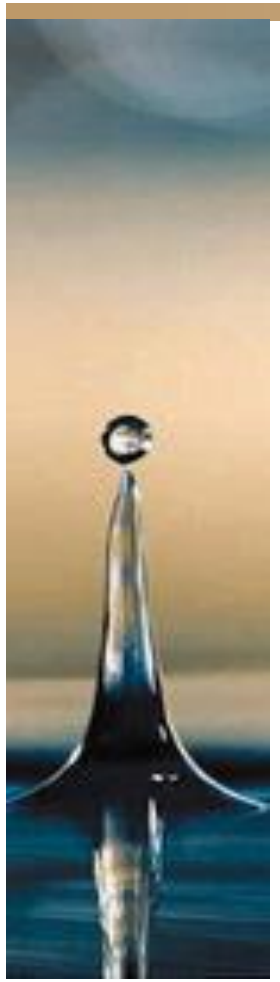
- Evaluation of the Results
- Generation of reports

Phase 6

- Deal with enquires
- Preparation for evaluation workshop

Details of the PT processes

Sample bottle preparation



- Wash 540 bottles twice with deionized water
- Bottles & caps were put in the oven @ 60 °C overnight
- Check dryness
- Prepare the exact amount of labels for the number of bottles (540 for 90 laboratories)
- Stick labels on the bottles
- Store the bottles until needed

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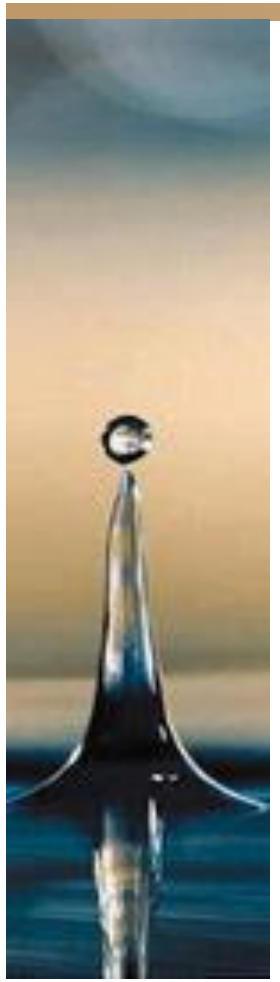
Details of the PT processes

Labelling of the bottles



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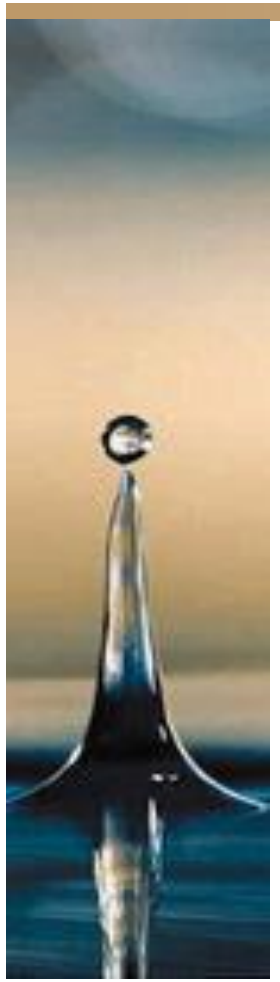
Details of the PT processes
Preparation of the balances



- We make use of gravimetric weighings throughout the process
- Calibration of the balances is very important
- This is done by an external body (Namibian Standards Institution)
- Calibration certificates are obtained for all three balances
- Daily verification with certified internal mass pieces
- **Certificates are documented:**
  - Certificate of analyses (COA) for reagents used
  - Calibration certificate for thermometer
  - Calibration certificate for pycnometer
  - Calibration certificates for balances

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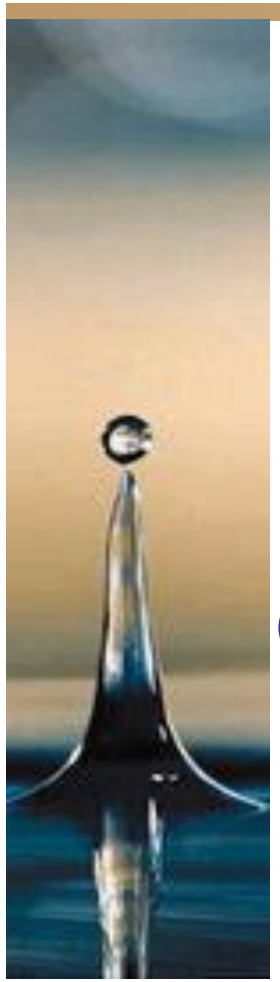
Details of the PT processes
Preparation before weighing



Purity:

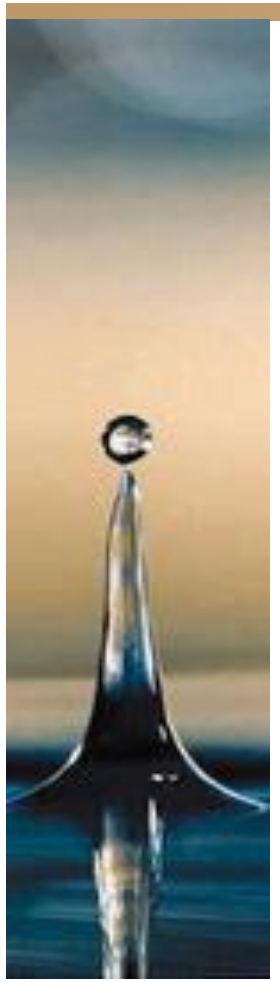
- The COA (Certificate of Analysis) of all the salts and wires are obtained
- The purity for all substances and wires is used to calculate the reference values

Glassware:

- Only clean and properly labelled glassware is used
- Arrange the glassware accordingly to create a systematic flow

Details of the PT processes

Weighing of substances



Start of by weighing the different target masses for the 3 levels of each parameter in a beaker by difference

Start of with the wires , digest wires until completely dissolved, continue with salts

Continue to prepare the stock solution

Continue with the salts

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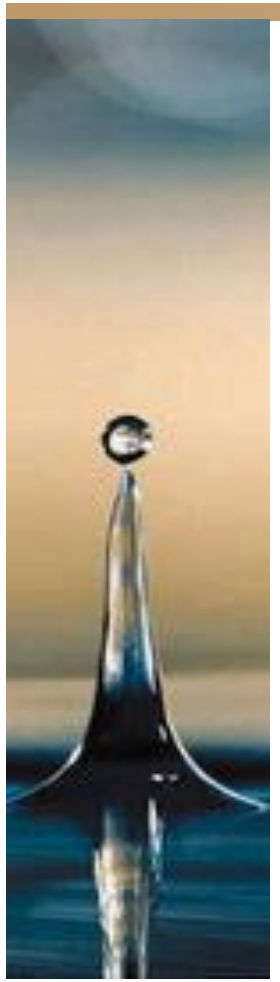
Details of the PT processes

Preparation of stock solutions



Weigh empty flask, transfer of substance into flask, fill, weigh full flask, balance 2

Dilution (where necessary) – Weigh 100g of diluted stock solution in beaker, difference weighing, balance 2

Repeat for all 20 parameters – 3 levels

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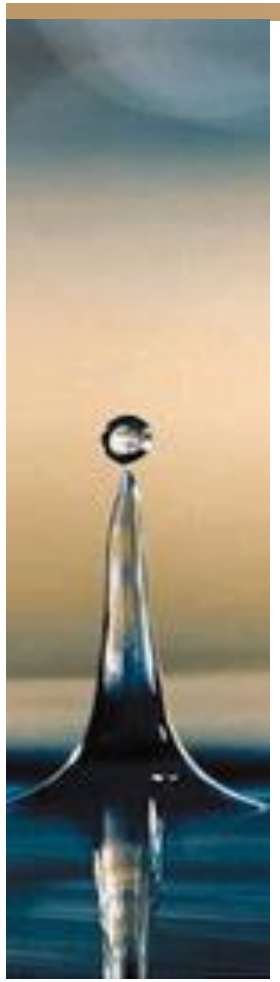
Details of the PT processes

Digestion of the wires



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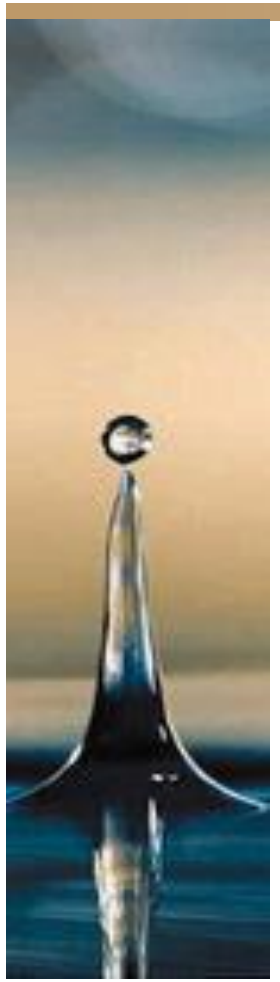
Details of the PT processes
Preparation of bulk samples



- Initial weighing of the empty containers
- Fill the containers with deionized
- Calculate target weight from density
- Rinse stock solutions into the 100L container
- Fill to target weight
- Stir combined solution for 20 minutes

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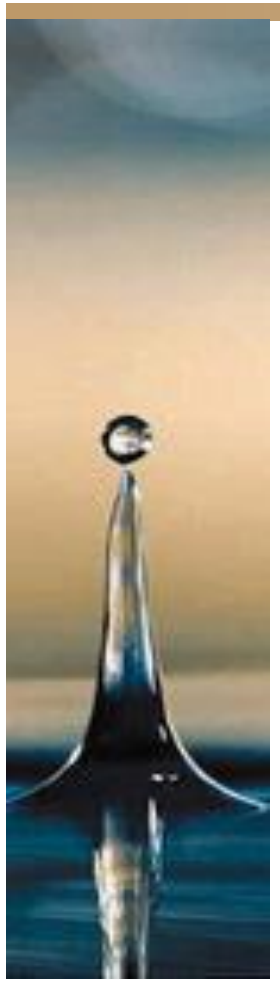
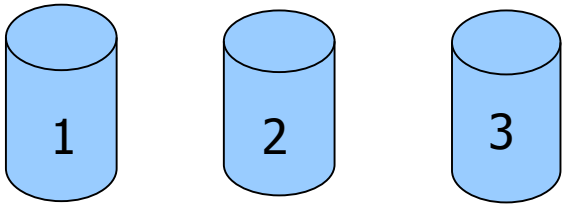
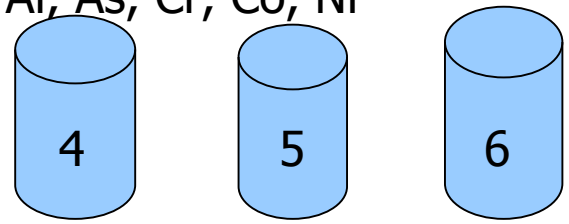
Details of the PT processes
Preparation of bulk samples



Anions : SO_4, Cl, NO_3, F, PO_4,
TDS, Conductivity



Cations : Na, K, Ca, Mg, Fe,
Mn, Cd, Cu, Pb, Zn,
Al, As, Cr, Co, Ni



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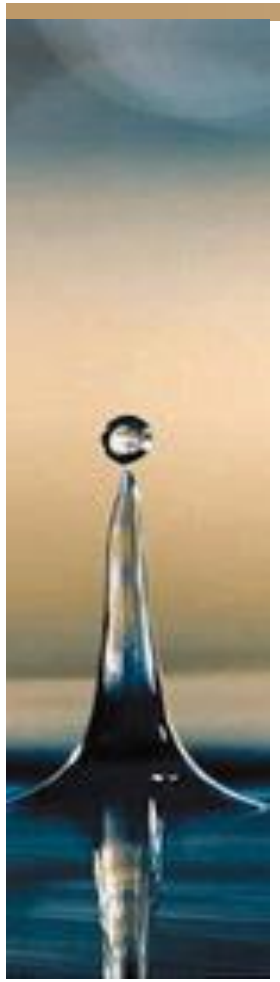
Details of the PT processes
Sample dispensing

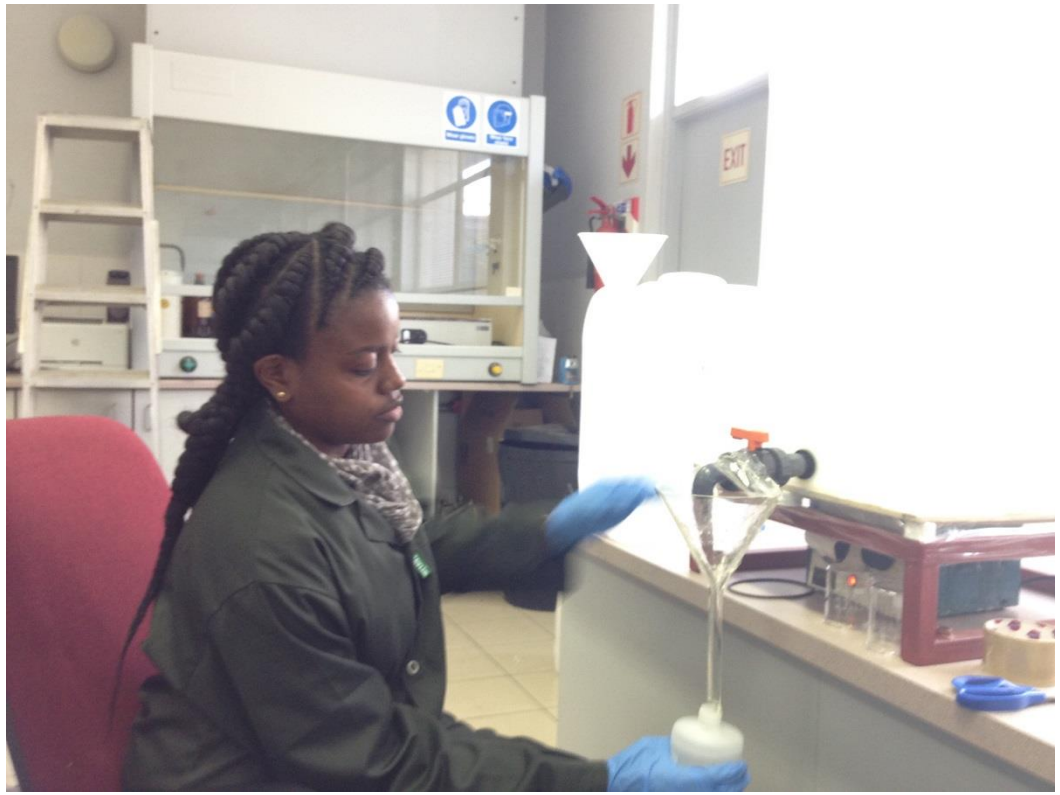


1 L is flushed out from the tank sample is dispensed into the sample bottles. Sample bottles (90) were filled after each batch

Put in crates in fridge at 4 º C

Tank washed properly (4-5 x) in between . Check the conductivity of the wash water until = deionized water and also after every 20th sample

Start to prepare for the next batch



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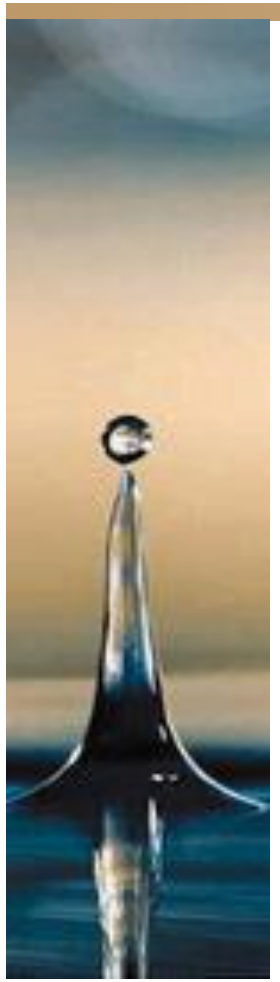
Details of the PT processes

Storing of the samples



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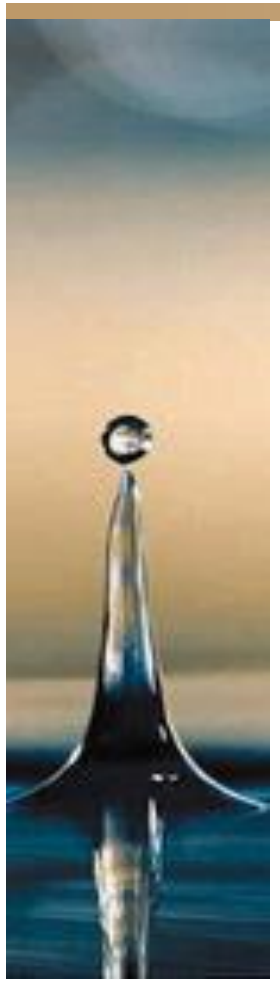
Details of the PT processes
Preparation of documentation



- Documentation is send out with all the parcels as well as electronically
- Prepare hard copies of all the documentation
- Prepare all the labels and documentation for courier for the transportation for all the countries and participants

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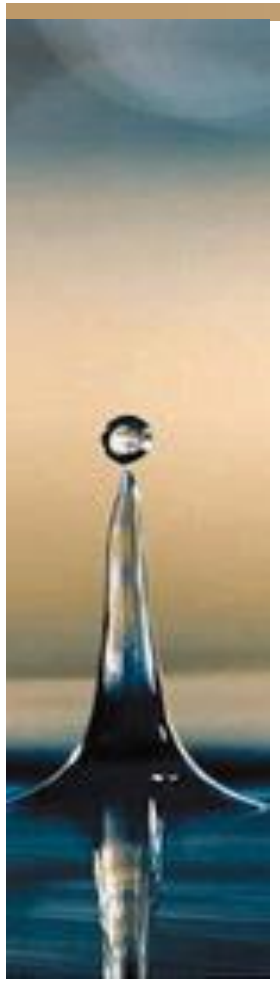
Details of the PT processes
Packaging of the samples



- Packaging of the samples
- Request quotes from the courier
- Pack the samples (one at a time) into the boxes
- Add documentation and addresses of all the participants
- Confirm the costs with the PTB before proceeding

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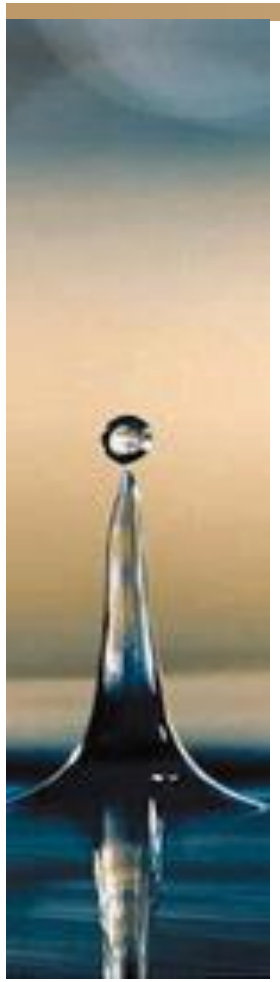
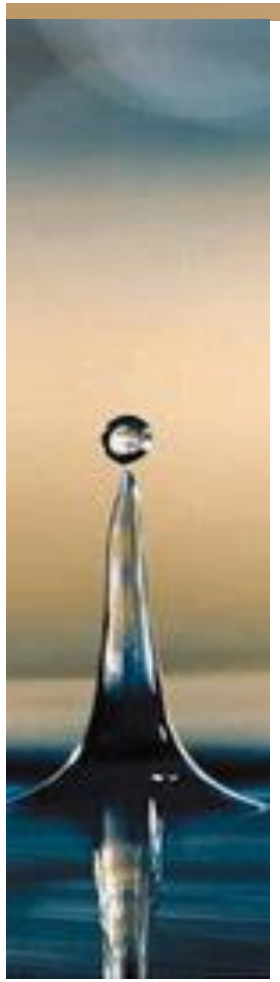
Details of the PT processes

Packaging of the samples



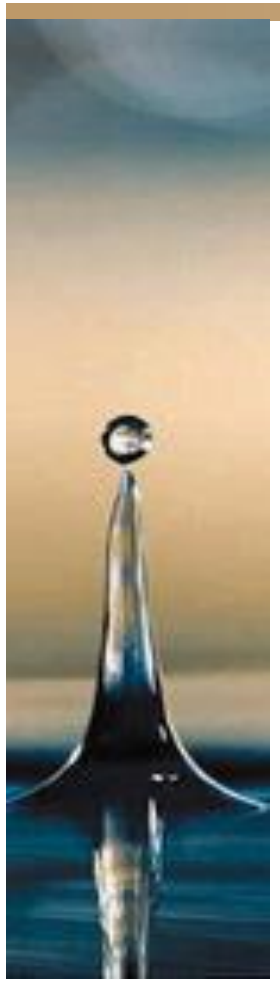
Details of the PT processes

Sample pick up and dispatch



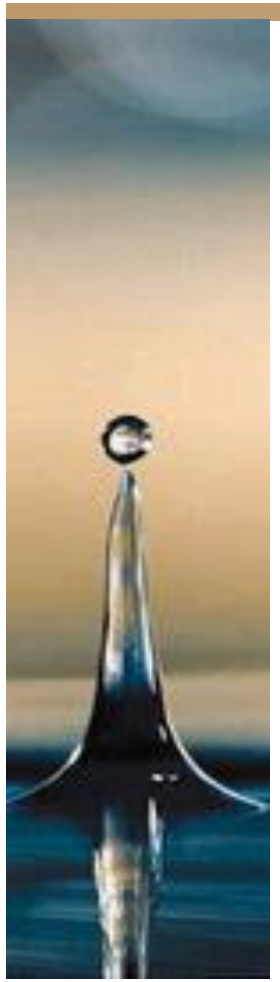
Parcels were picked up on the 01 September 2017 at NamWater

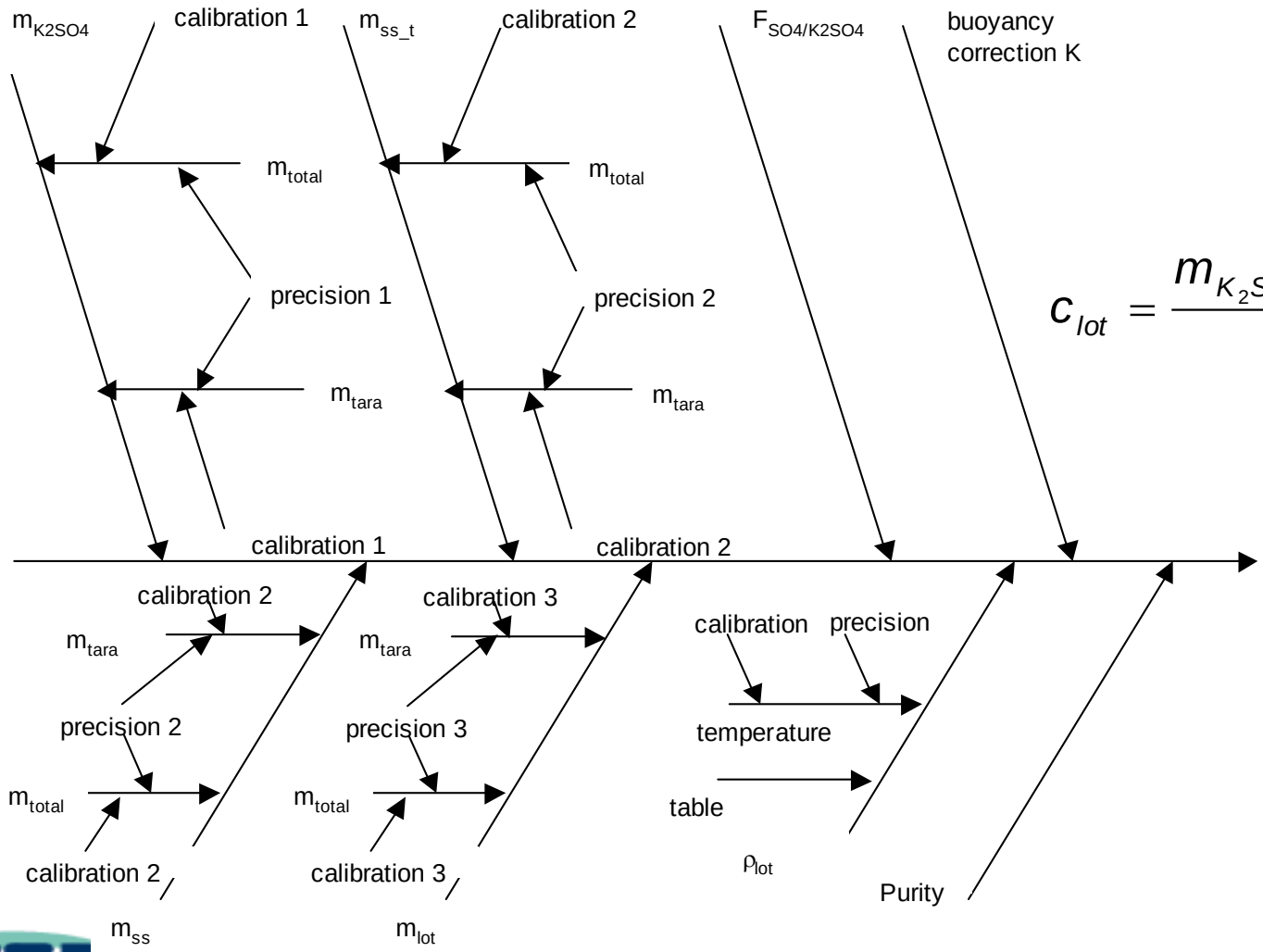
Details of the PT processes
Calculation of the reference values



- All sources of uncertainty in the analytical measurements were identified with the use of a fishbone diagram.
- The identified sources were:
- Purities of the chemicals
- Uncertainty of the three balances used:
- Sartorius Balance ED124S
- Sartorius Balance ED42025-CW
- Sartorius Balance FBG64EDE-H
- Uncertainties of molecular mass were neglected
- Densities of final samples
- Buoyancy

Details of the PT processes
Fish Bone diagram

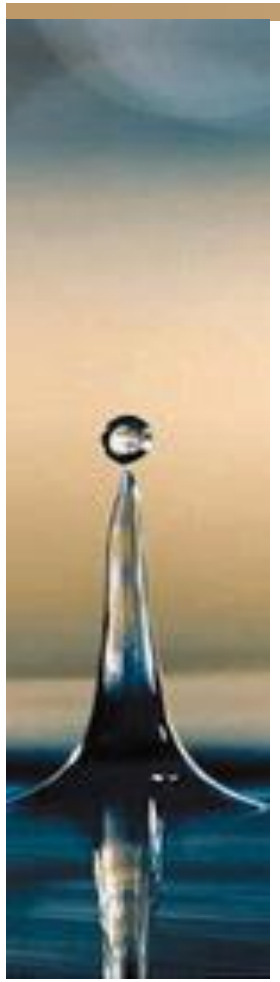




$$c_{lot} = \frac{m_{K_2SO_4} \cdot F_{SO_4/K_2SO_4} \cdot P \cdot m_{ss} \cdot \rho_{lot}}{m_{ss_t} \cdot m_{lot} \cdot K}$$

Details of the PT processes

Determination of the uncertainty of the density



- Samples and a bottle with pure water were kept in the balance room
- Temperature of the water and the samples were measured with a calibrated thermometer
- A 100mL pycnometer was used to determine the density of the 6 Samples
- The pycnometer was filled with water and weighed 10 times
- Between each measurement the pycnometer was opened and filled repeatedly to determine the uncertainty of the filling process
- The pycnometer was filled and weighed with the 6 samples 3 times repeatedly
- The densities and uncertainty of the measurements were calculated

Pycnometer

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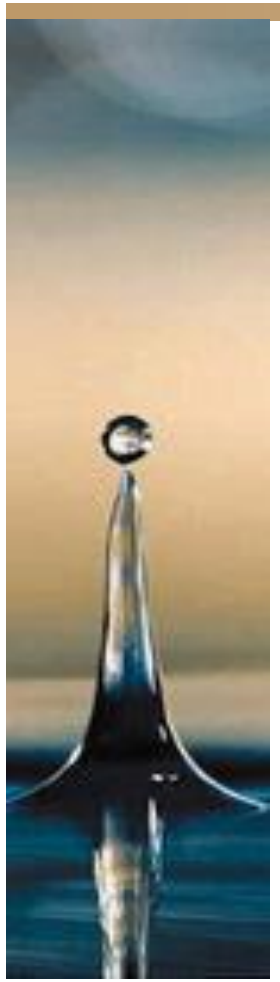
Details of the PT processes

Measurement uncertainty of reference values



- The combined standard uncertainties (mg/l), the combined relative uncertainty(%), the combined expanded uncertainties (mg/l) and the combined relative standard uncertainty (%) were calculated and reported
- The size of the different contributions was compared using a histogram showing all the standard uncertainties
- The reference values were calculated with the combined expanded standard uncertainty taken into consideration all the parameters for the different levels

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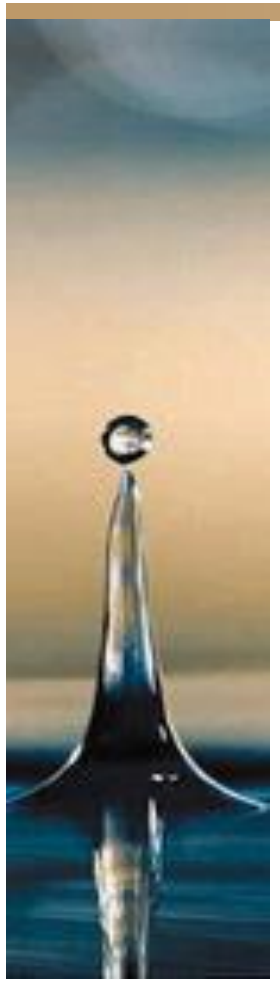
Details of the PT processes
Biggest Uncertainty components



The biggest uncertainty components from histograms that was identified were:

Mass of the stock solution

- Fe, Mn, Al, Cu, Zn, Ni, As, Cd, Co

Purity of salts

- SO, Cl, F, NO_3, PO_4, TDS, Ca, Mg, Na, K, Mn (Level 3), Pb, Cr

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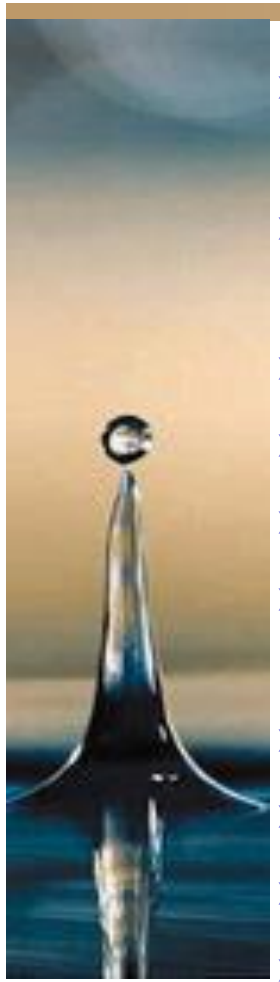
Details of the PT processes
Evaluation & assesment



- Reference values are calculated from the synthetic, gravimetrical samples with an uncertainty budget
- Calculation of standard deviation is done by using the Algorithm A method from ISO 13528 provided it is lower than the calculated value
- Where the calculated value is higher, the fitness-for-purpose value is used
- The fitness-for-purpose [limit] value was agreed on between participants
- The process that applied for the elimination of gross outliers is:
- All values < ref.-value/8 and all values > ref.-value x 8 were excluded before applying statistical procedures
- The report contains:
- a graphical display of lab results vs the assigned value to assist with corrective actions
- A method specific evaluation to assist the laboratories in methods choices
- Assistance is provided for laboratories that need corrective actions

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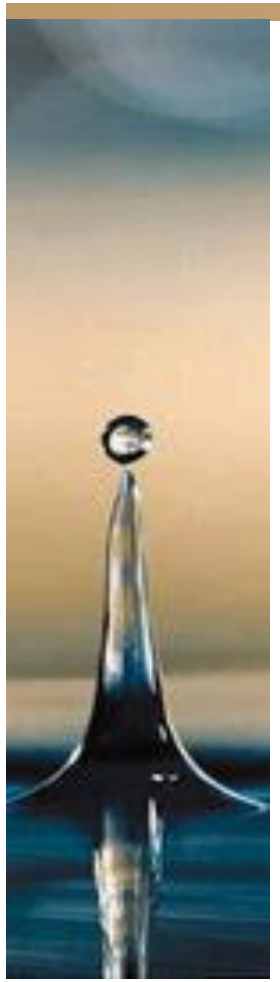
Details of the PT processes
Performance scoring



- The assessment of performance is based on Z-scores
- Z-scores are a common practice in the assessment of laboratory results
- Z-scores reflects the actual accuracy achieved – the difference between the participant's result and the reference value
- A score of zero implies a perfect result
- Z-scores are rounded to one digit after decimal point as requested by ISO17043 and ISO13528
- Usually laboratories produce scores between -2 and 2
- The sign(i.e., + or -) of the score indicates a negative or positive error respectively.

- $|z\text{-score}| \leq 2.0$ - s- satisfactory
- $2.0 < |z\text{-score}| < 3.0$ - q- questionable
- $|z\text{-score}| \geq 3.0$ - n-non satisfactory

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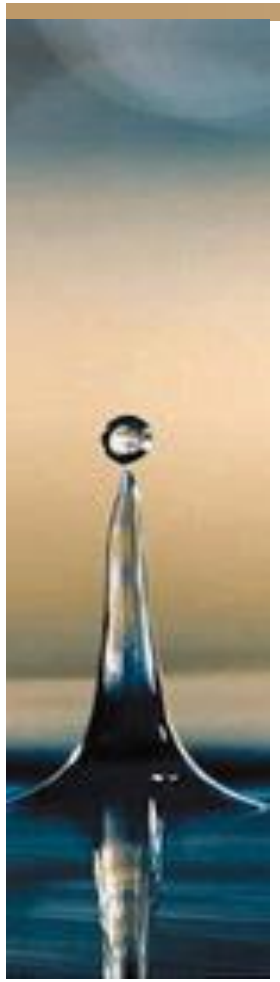
Details of the PT scheme

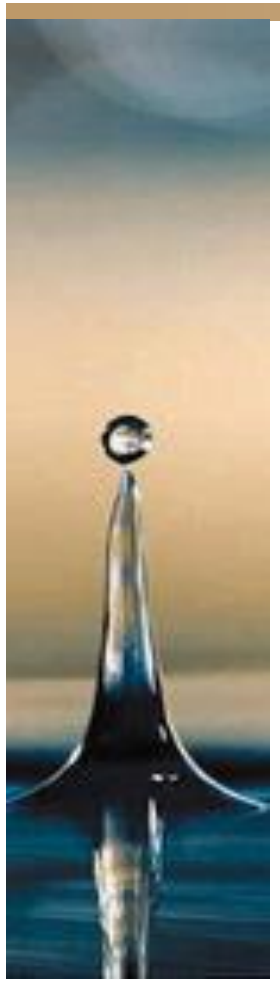
Limits for the standard deviation



PARAMETER	Std Limit (%)
Sulphate	10
Chloride	10
Fluoride	10
Nitrate	10
Phosphate	10
TDS	10
Conductivity	10
Calcium	10
Magnesium	10
Sodium	10
Potassium	10

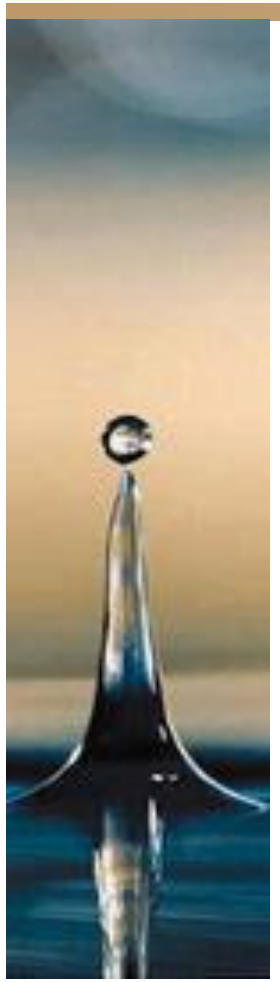
PARAMETERS	Std Limit (%)
Iron	20
Manganese	20
Aluminium	20
Lead	20
Copper	20
Zinc	20
Chromium	20
Nickel	20
Cadmium	20
Arsenic	20
Cobalt	20

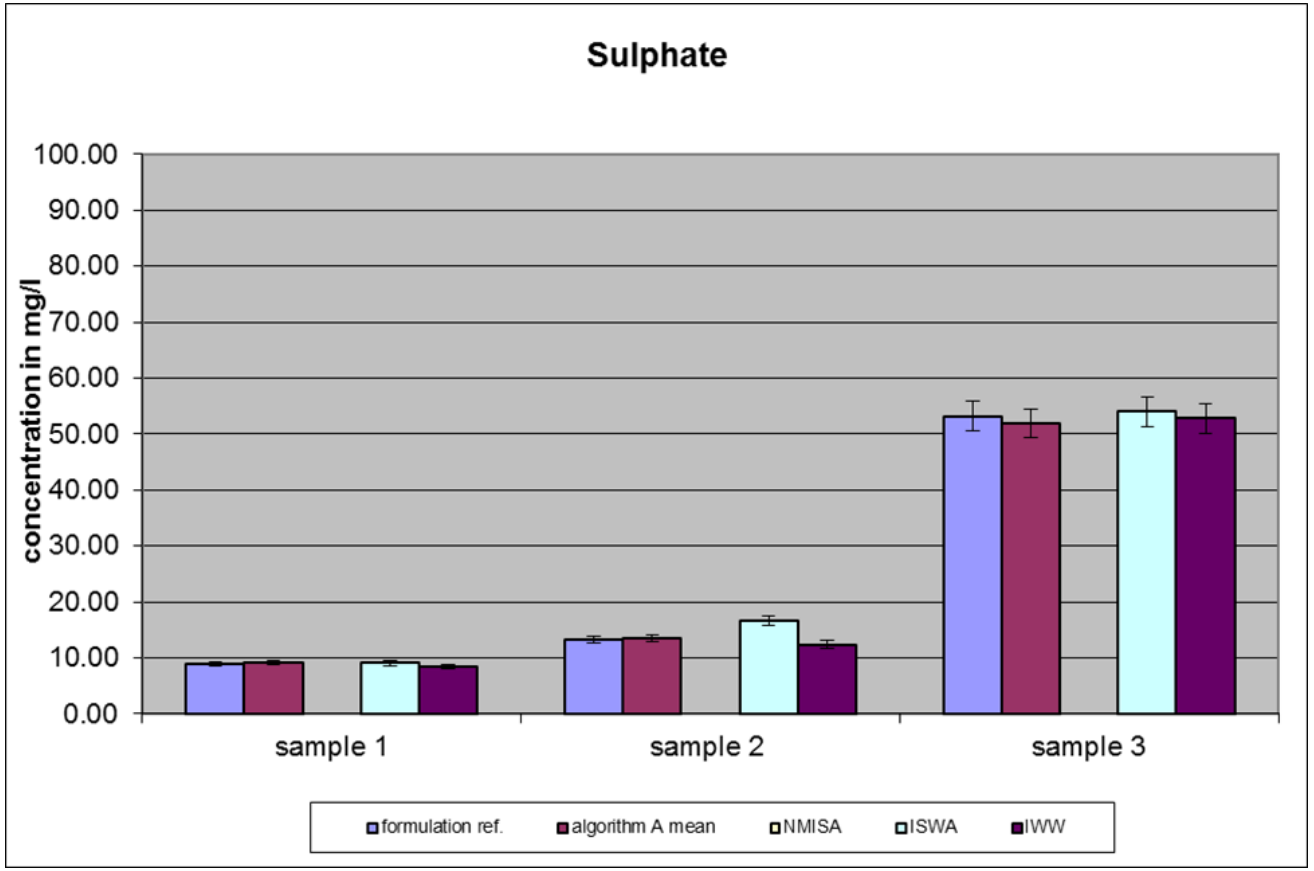
Details of the PT scheme
Ranges of the round 1-14



PARAMETER	RANGES	PARAMETER	RANGES
Sulphate in mg/l	9.50 - 80.00	Iron in mg/l	0.09 – 4.61
Chloride in mg/l	10.00 -73.40	Manganese in mg/l	0.03 – 5.10
Fluoride in mg/l	0.20 - 2.54	Aluminum in mg/l	0.05 – 4.41
Nitrate in mg/l	9.10 - 88.00	Lead in mg/l	0.05 – 3.33
Phosphate in mg/l	3.20 -50.00	Copper in mg/l	0.05 – 4.05
TDS in mg/l	0-1000 mg/l	Zinc in mg/l	0.45 – 5.89
Conductivity in mg/l	0-400 mS/m	Chromium in mg/l	0.05 – 2.90
Calcium in mg/l	8.40 – 90.0	Nickel in mg/l	0.06 – 3.55
Magnesium in mg/l	7.45 – 55.3	Cadmium in mg/l	0.02 – 1.10
Sodium in mg/l	8.50 – 90.0	Arsenic in mg/l	0.04 - 1.20
Potassium in mg/l	5.00 – 50.0	Cobalt in mg/l	0.05 – 2.68

Sulphate
mean vs. ref.-value





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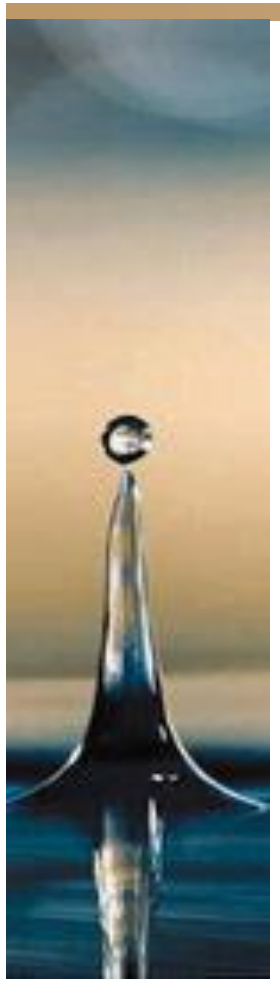
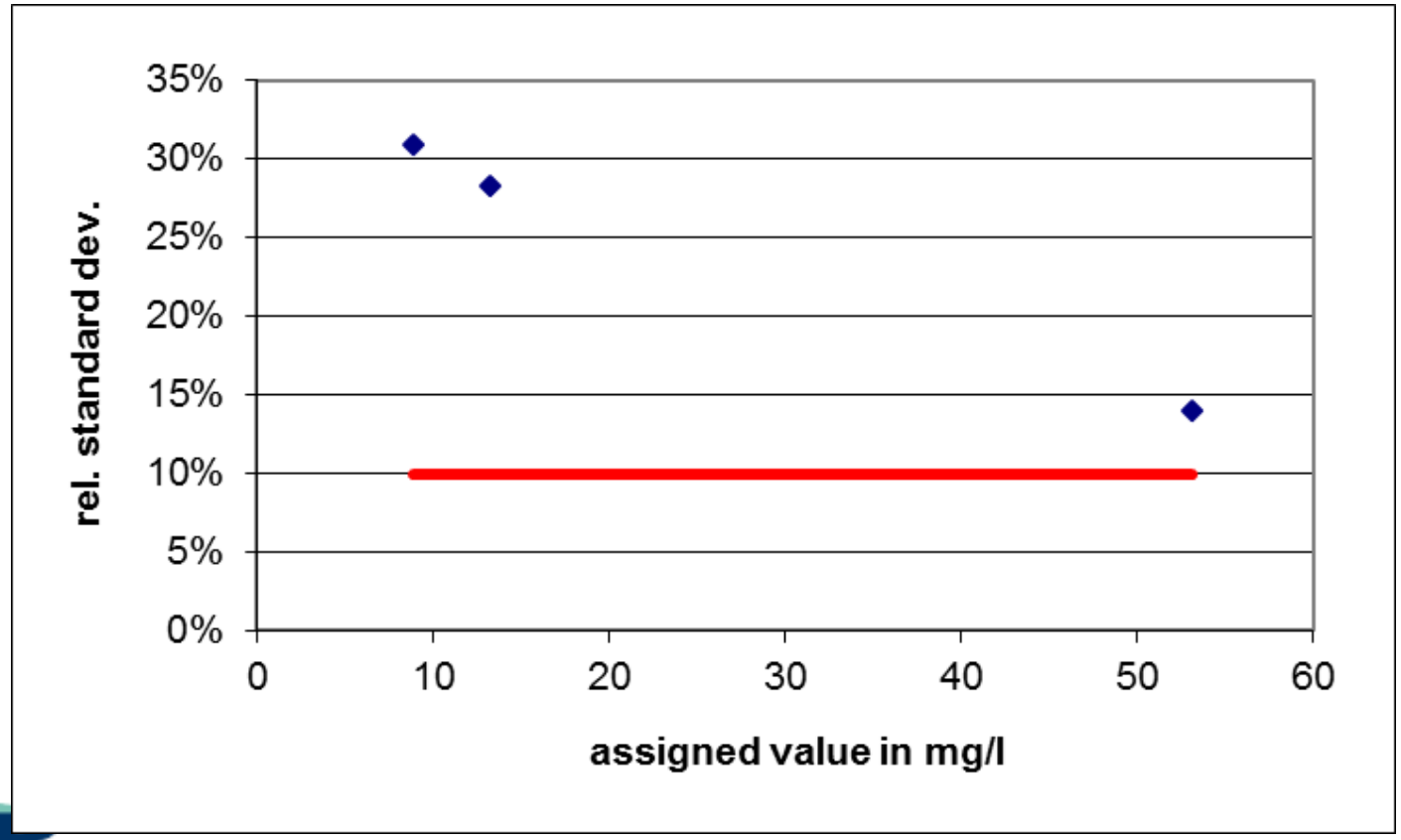
Sulphate
Calculated standard deviation and limit





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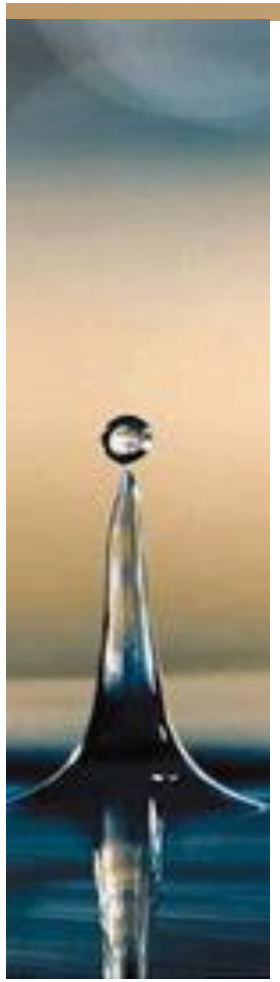
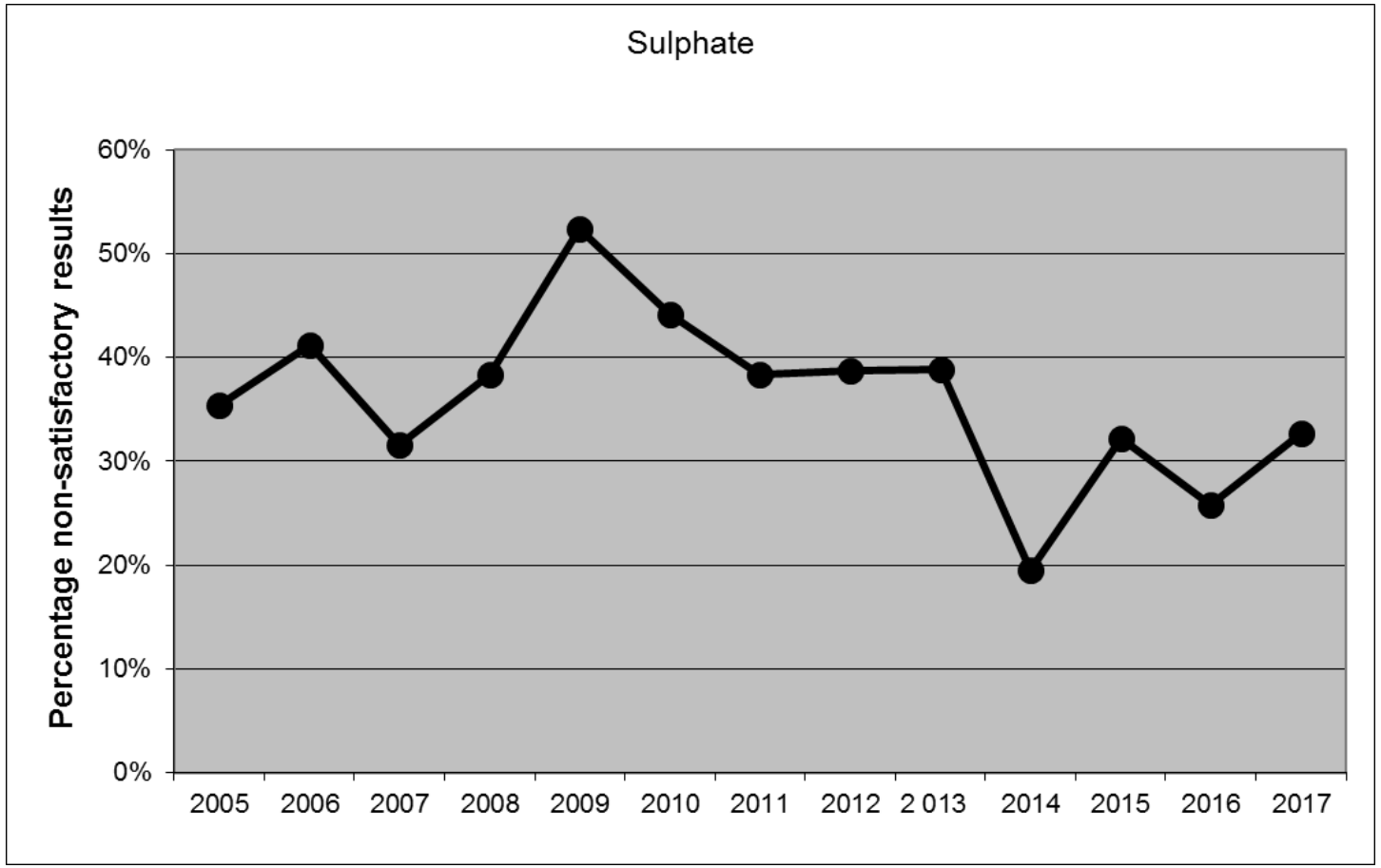
Sulphate
Percentage non-satisfactory results





25.8% in 2016 to 32.7% in 2017

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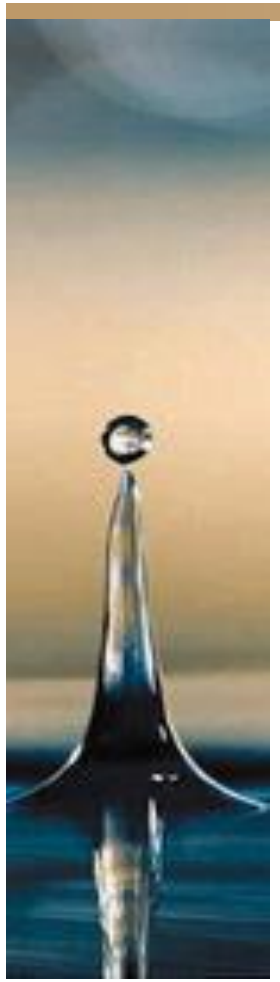
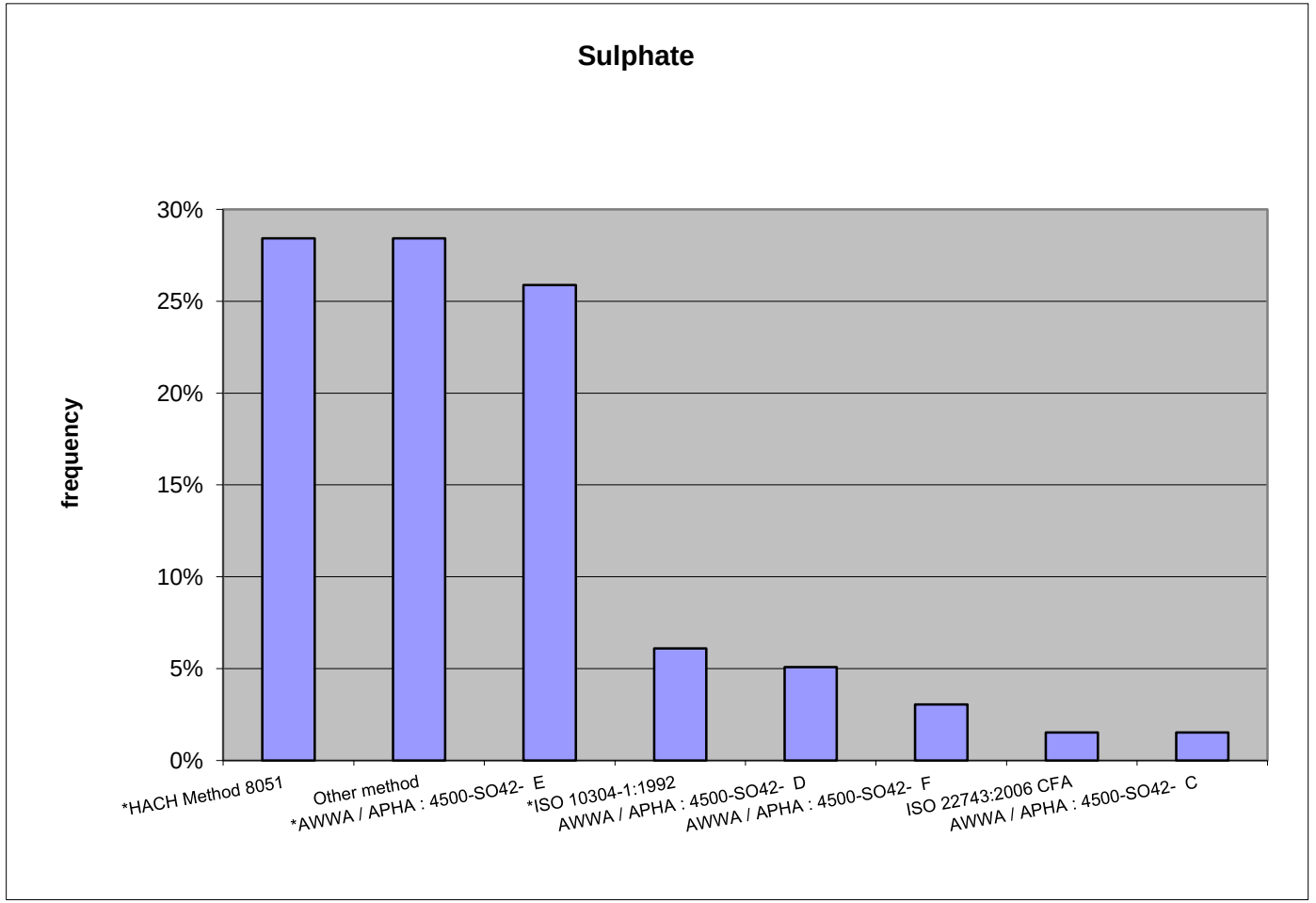
Method used





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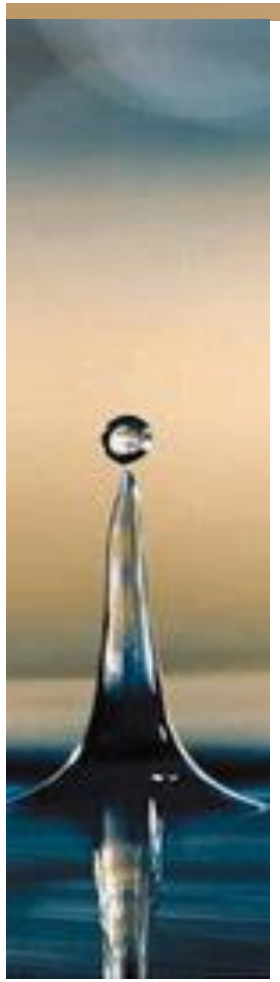
Summary **Sulphate**



- Average recovery was higher than in the previous round with 98.0 %
- STD are still > 10 %, with the lowest level at 30.94 %
- 64 data points outside the limits
- 28.4 % of methods classified as “other
- Many results too low from participants using the Hach method 8051 – 12 labs obtained correct results from the same method
- Not a big change compared to 2016

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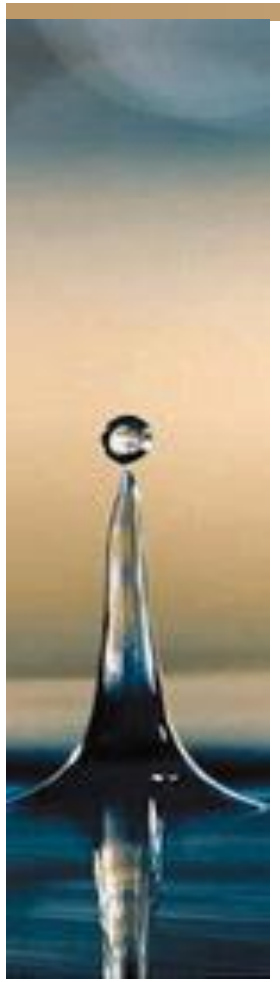
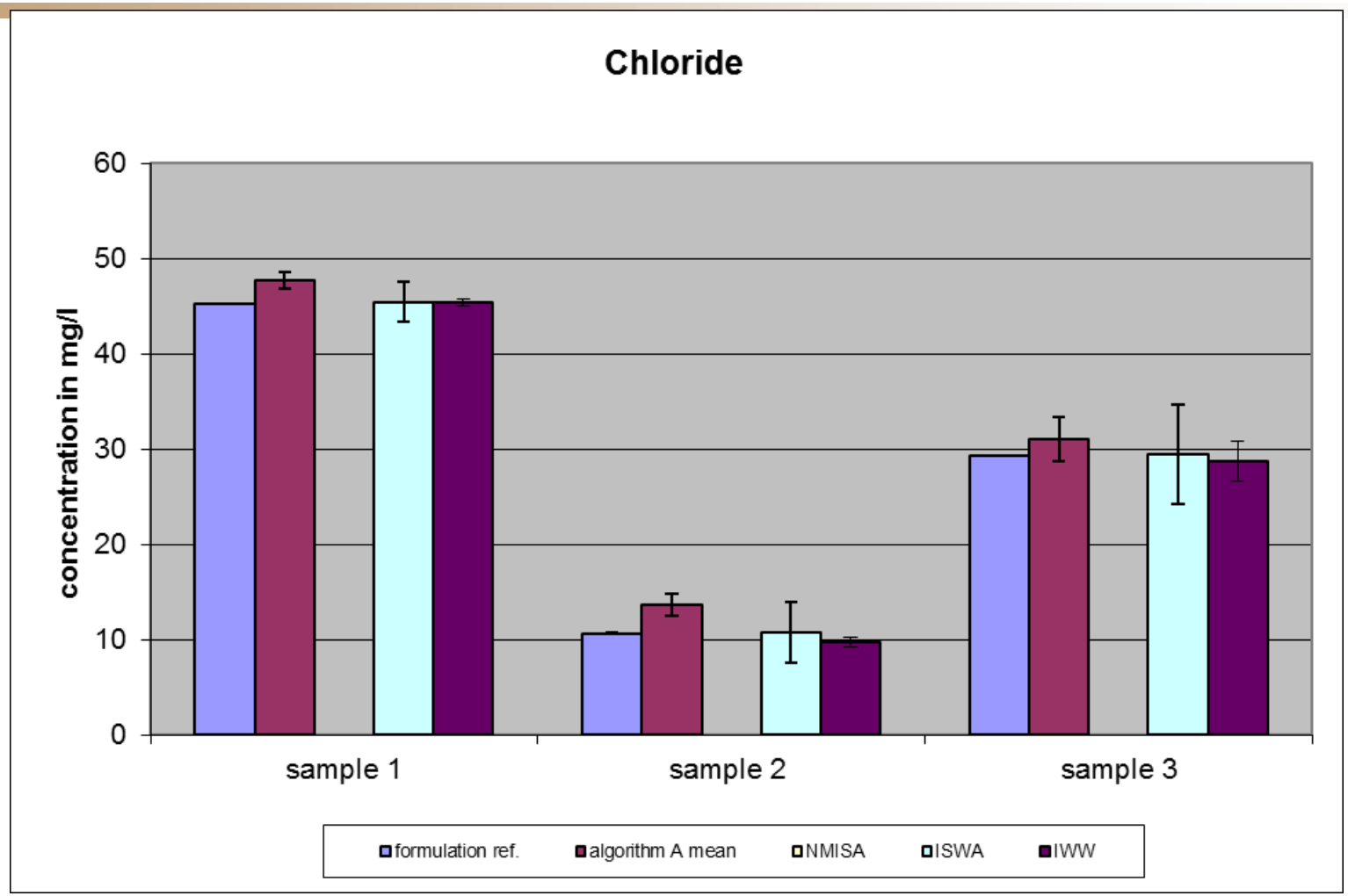
Chloride
mean vs. ref.-value





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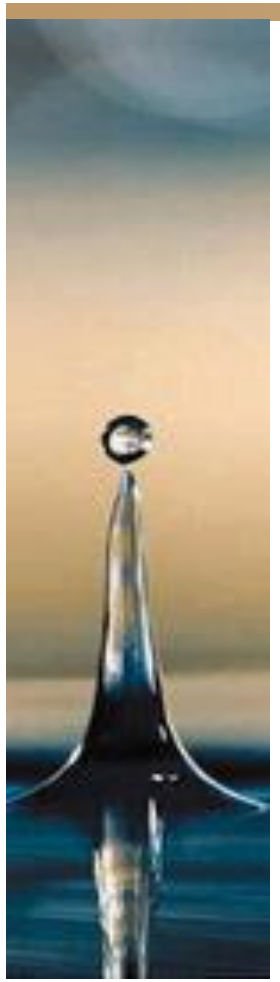
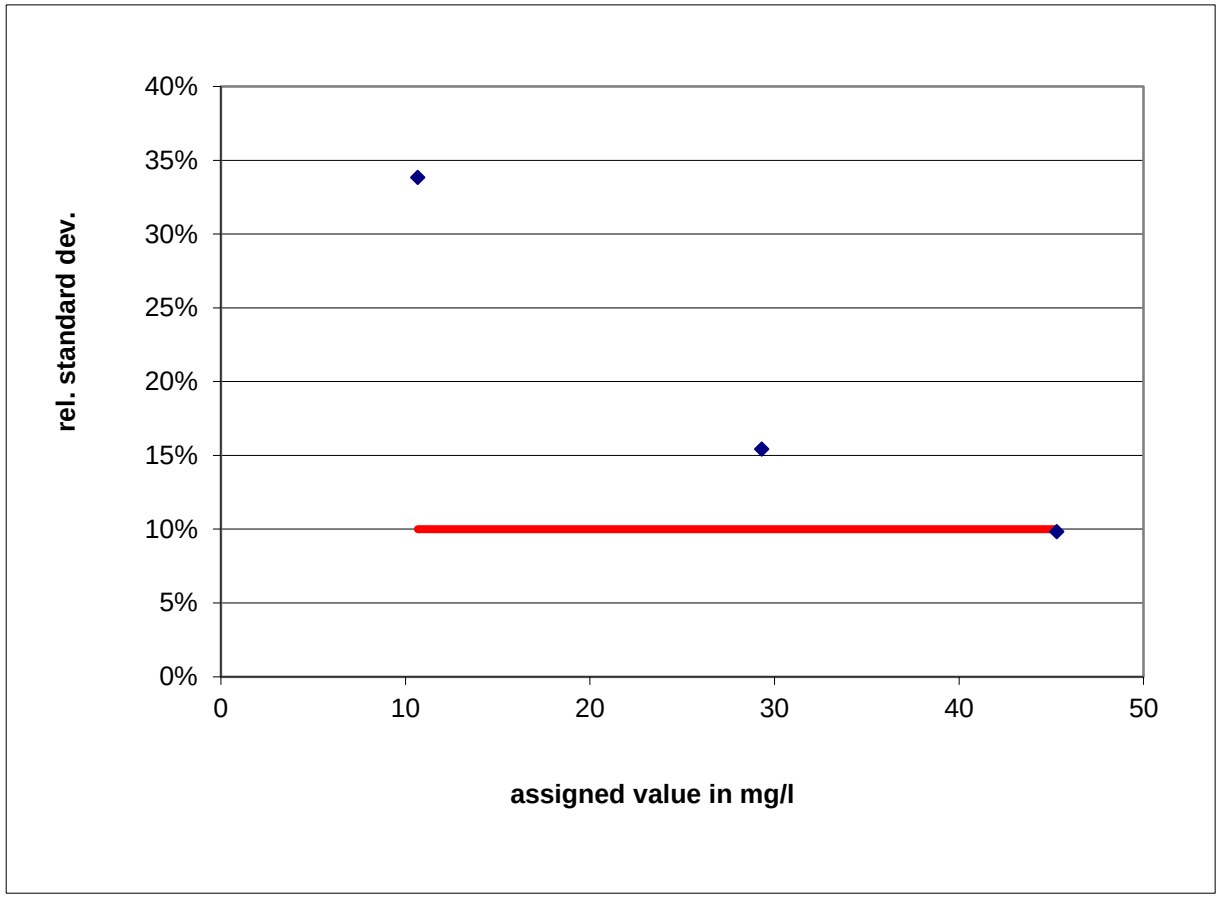
Let's go forward

Chloride
Calculated standard deviation and limit





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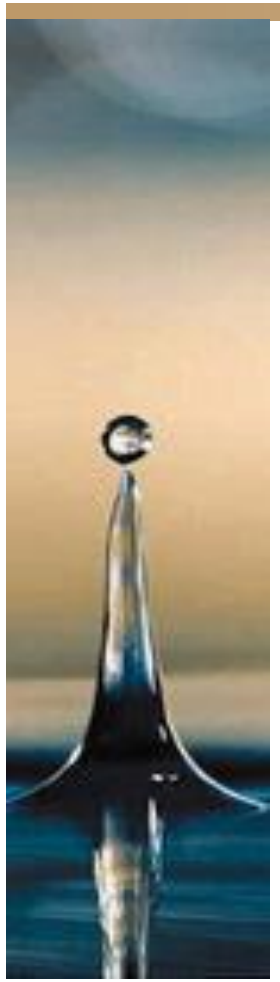
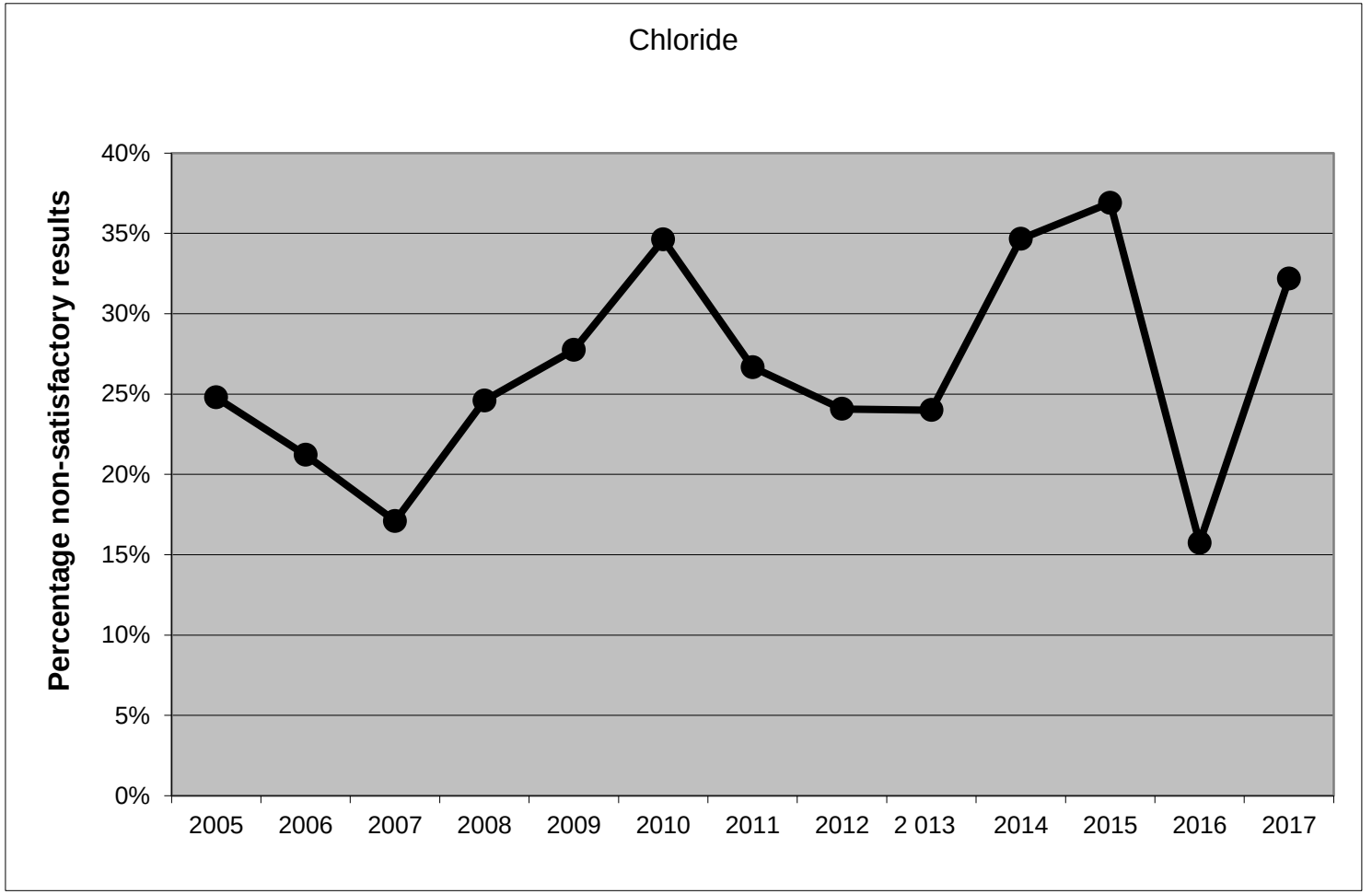
Chloride
Percentage non-satisfactory results





15.7 % to 32.2 % in 2017

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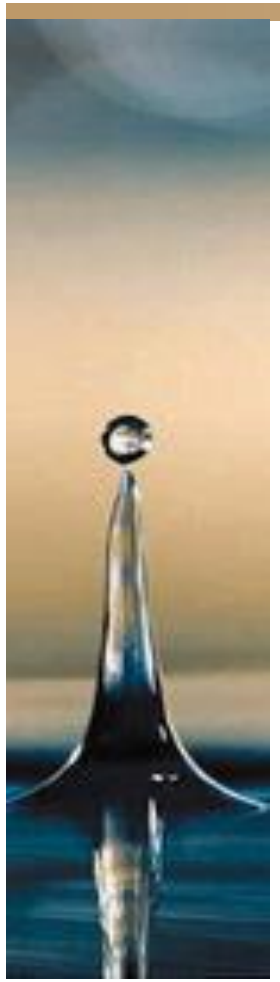
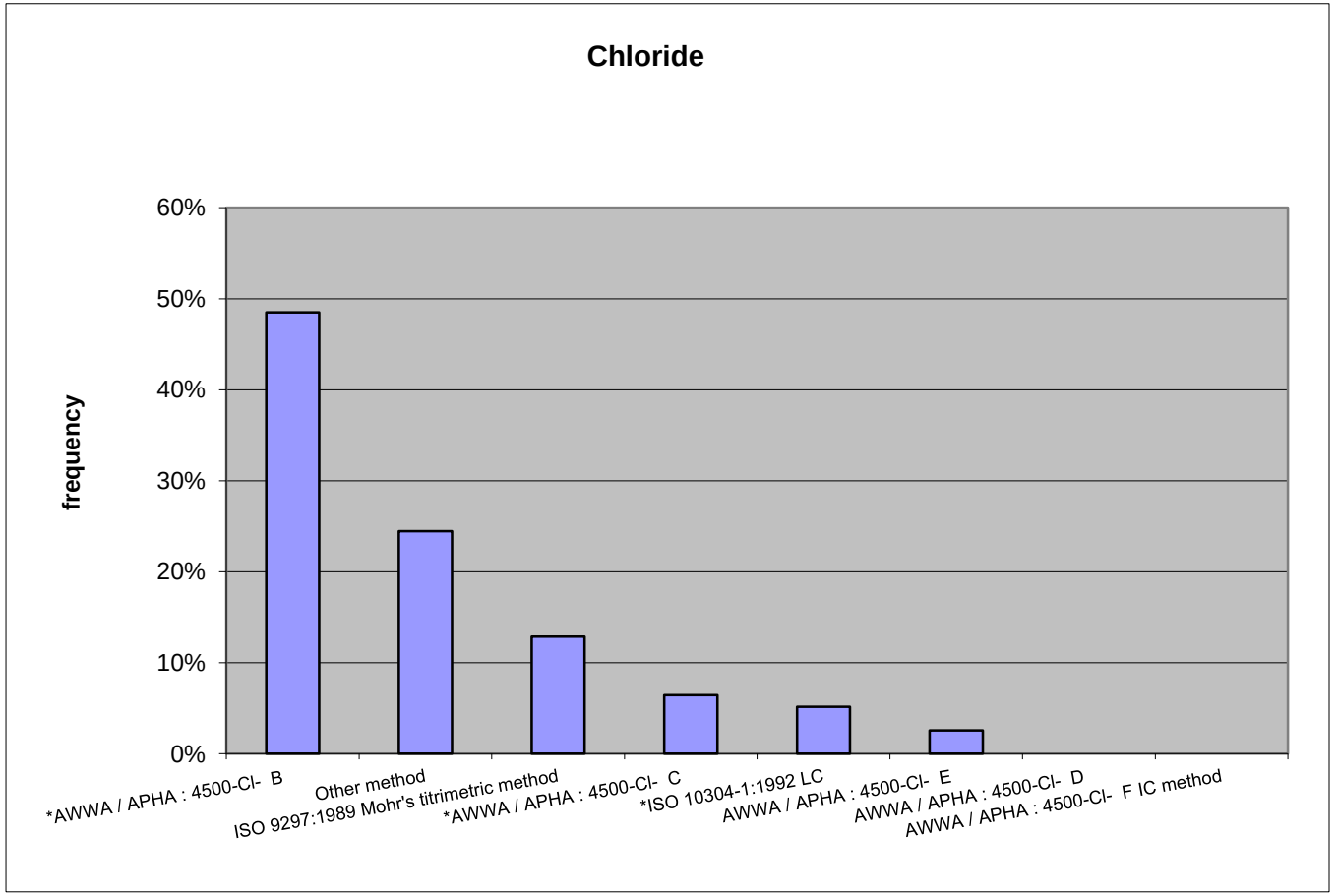
Method used





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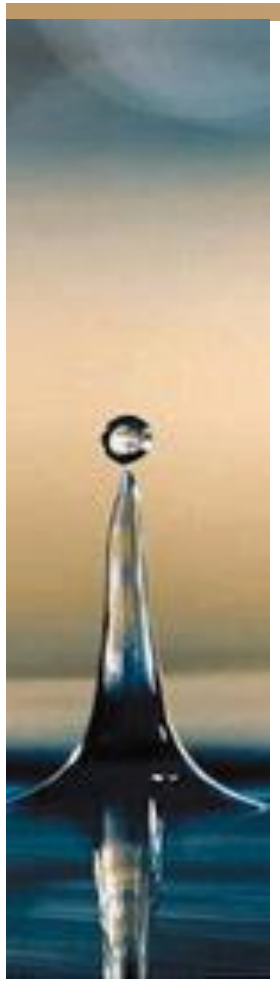
Summary **Chloride**



- Average recovery was 106.4 %
- STD are still > 10 %, especially for low conc. (33.8 %)
- 76 data points outside the limits
- 24.5 % of methods still classified as “other”

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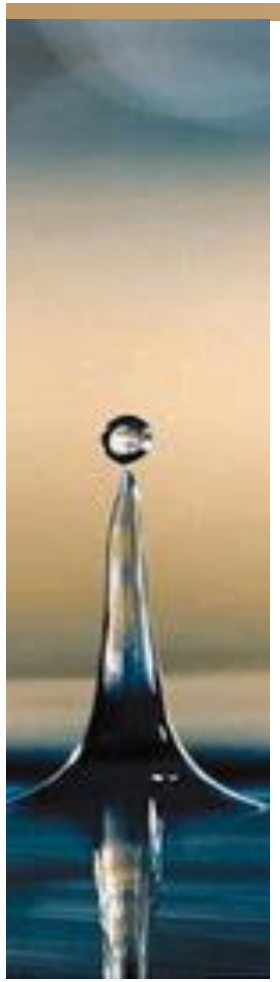
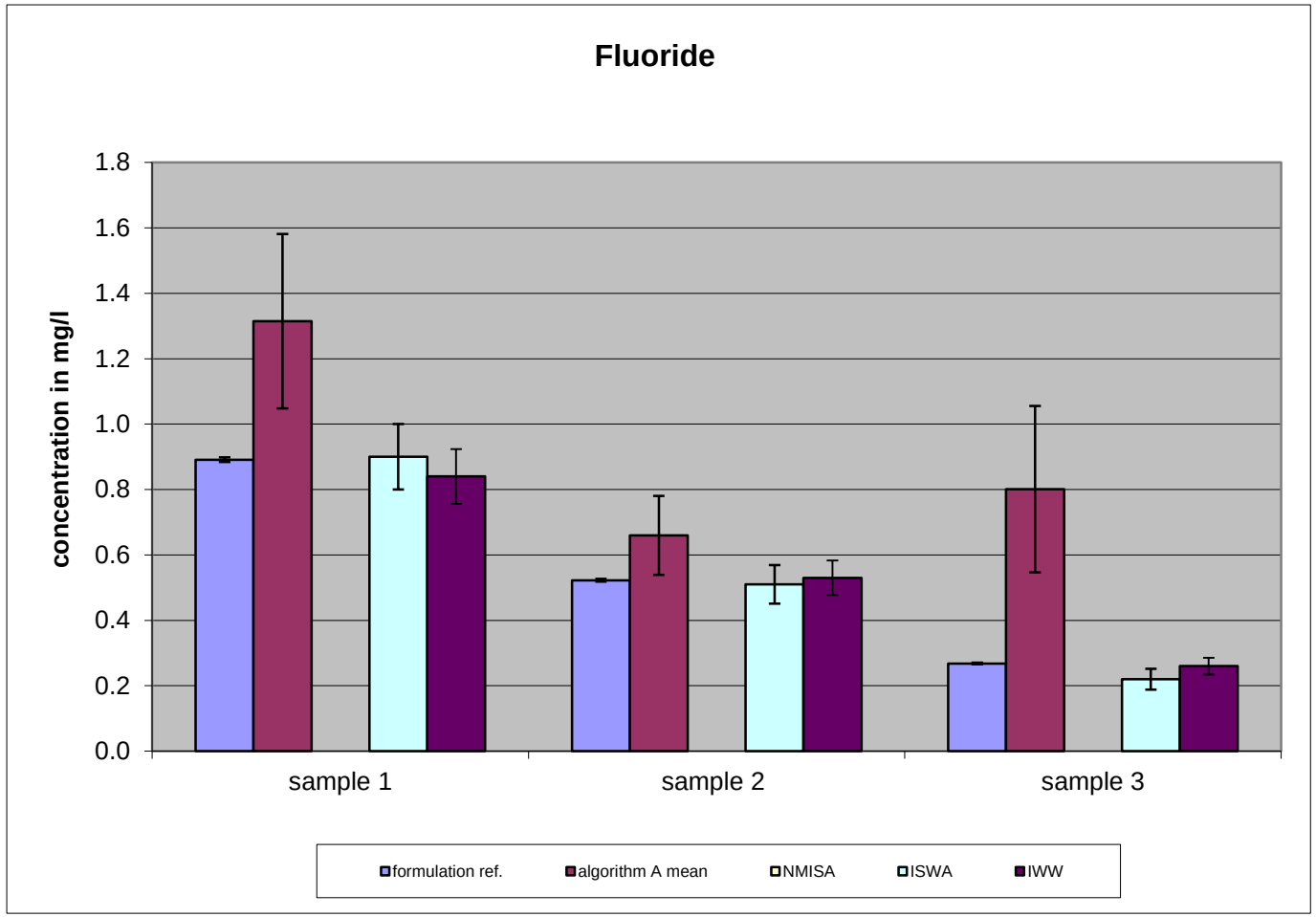
Fluoride
mean vs. ref.-value





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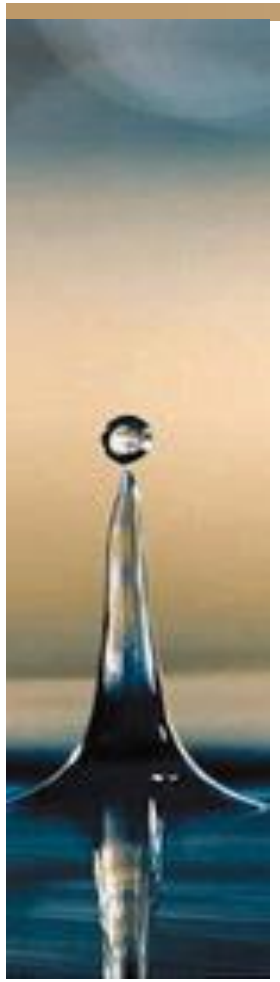
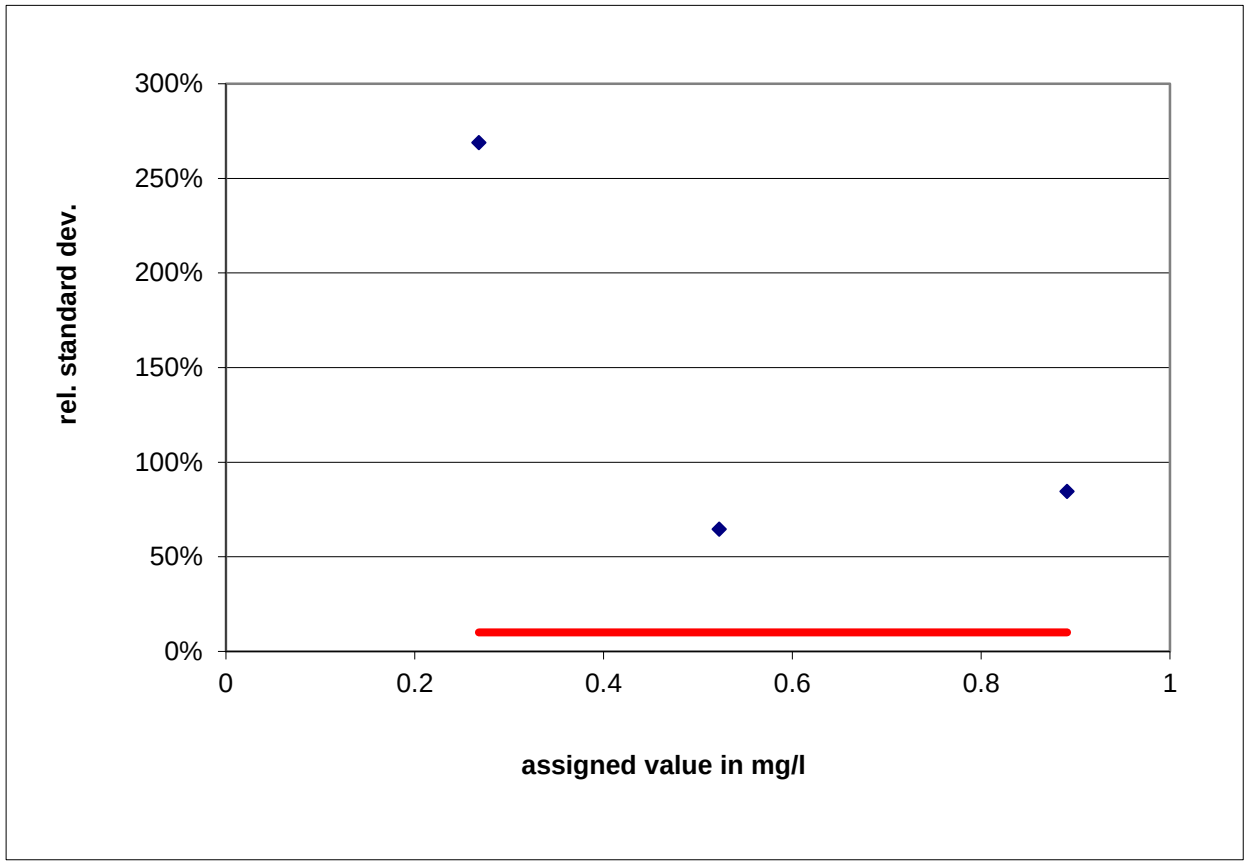
Fluoride

Calculated standard deviation and limit





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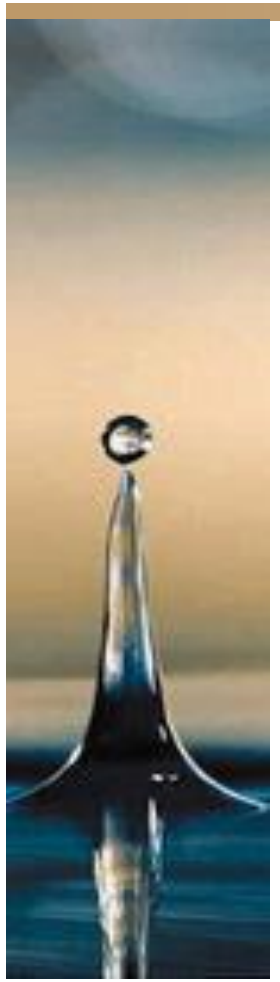
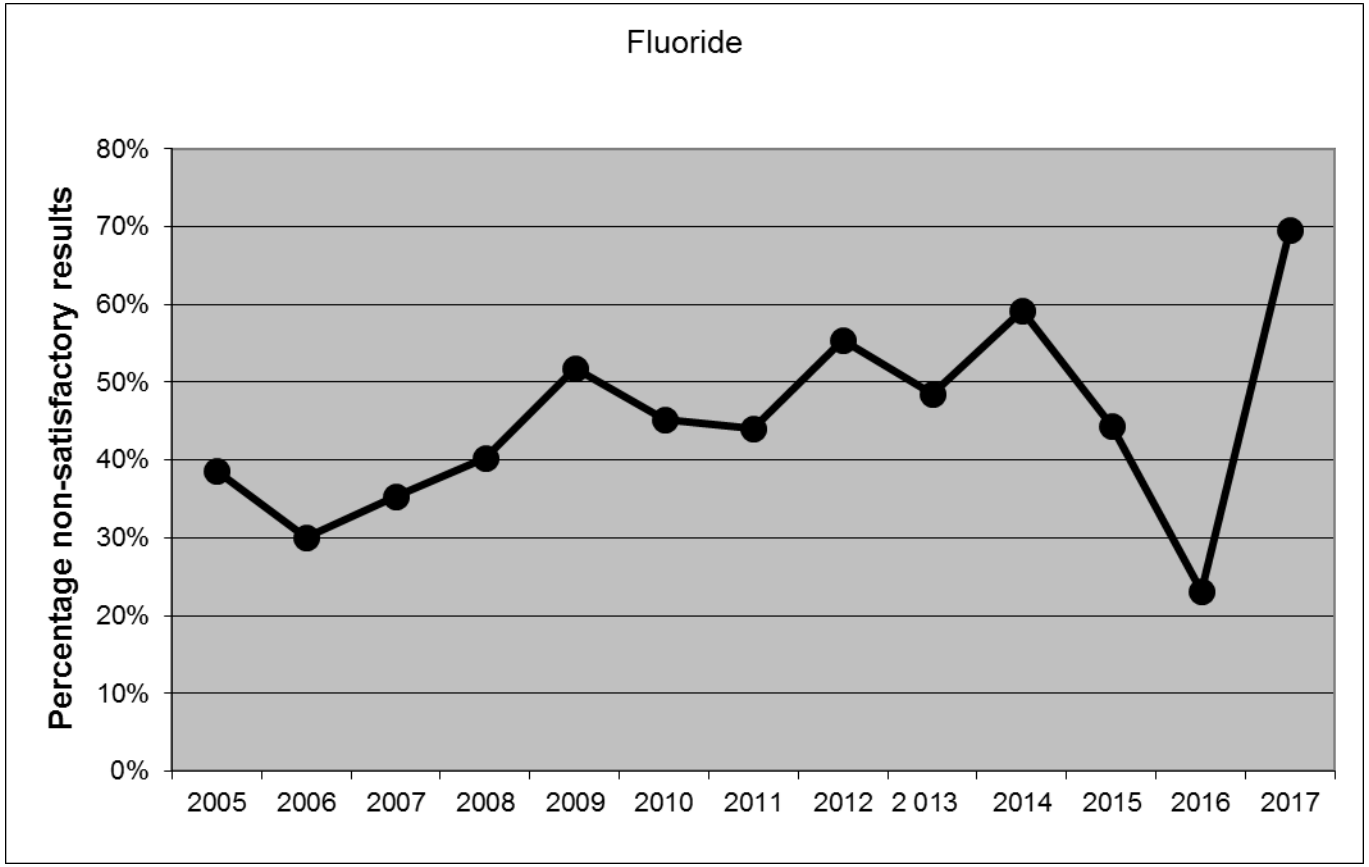
Fluoride
Percentage non-satisfactory results





23.1% to 69.6% in 2017

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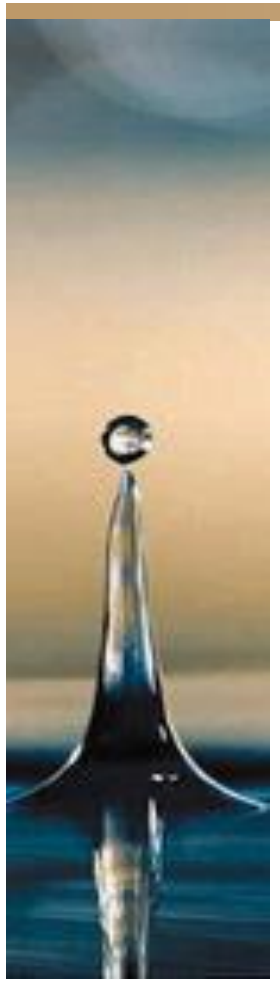
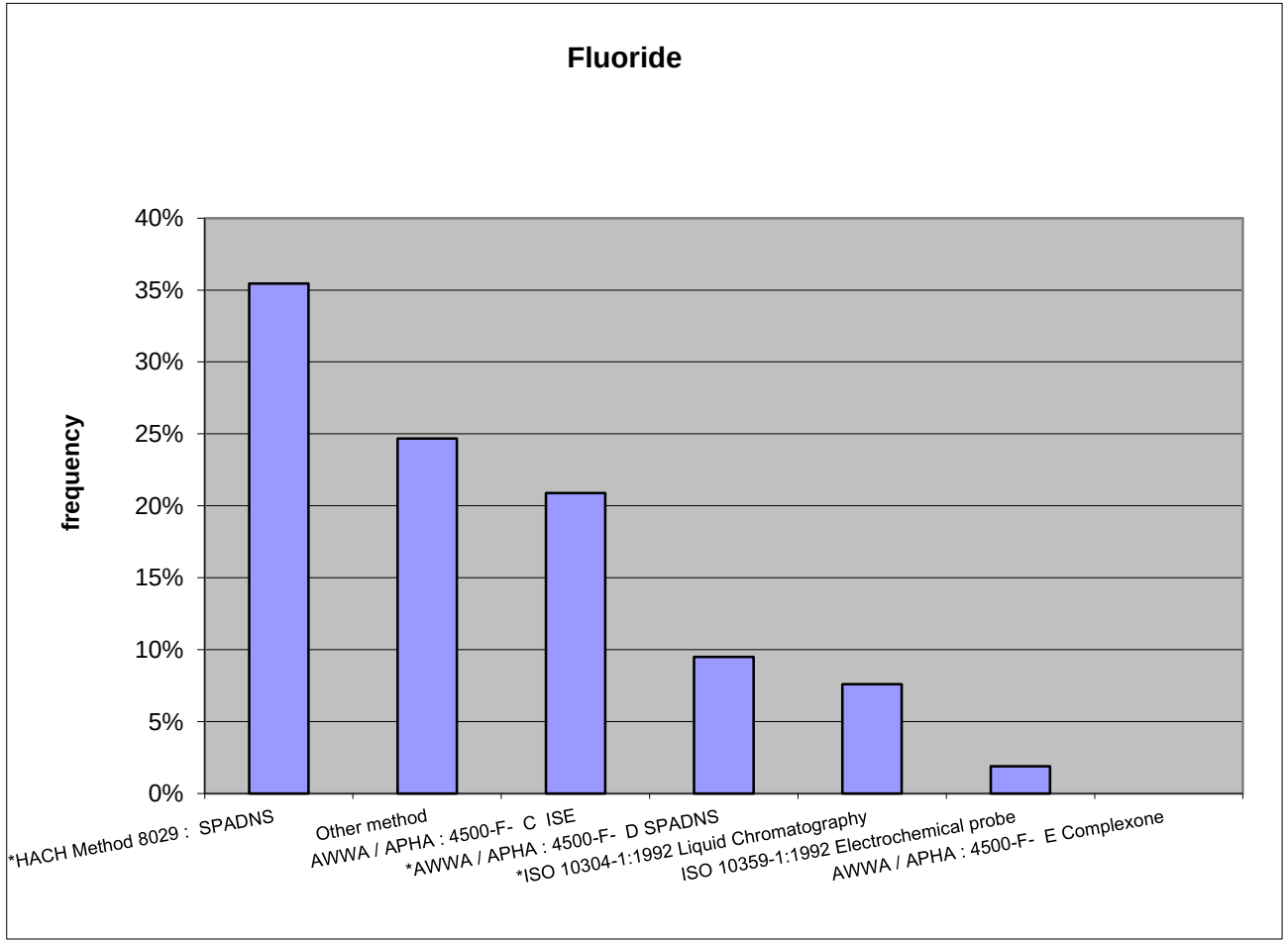
Method used





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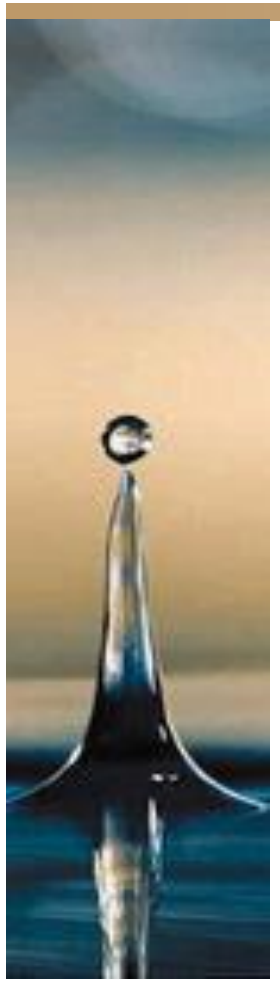
Summary **Fluoride**



- Many results too high results for lowest level mainly for the colorimetric results
- STD very high, > 268.9% ! for the low level
- Increase in the percentage of non-satisfactory results – 23.1% in 2016 to 69.6% in 2017
- 76.8 % of the results are too high for the Hach method 8029 –correct results are possible !
- It was also the same situation for 2017

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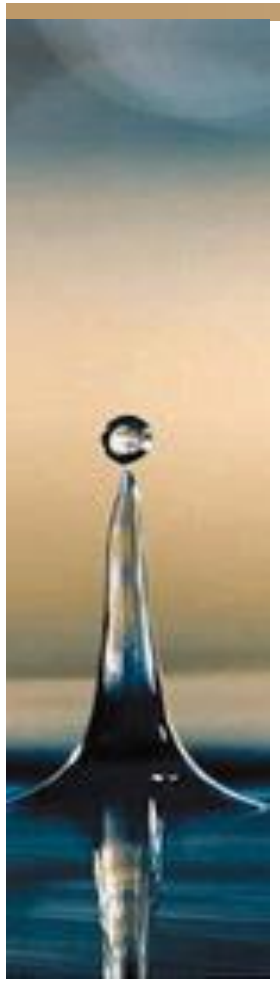
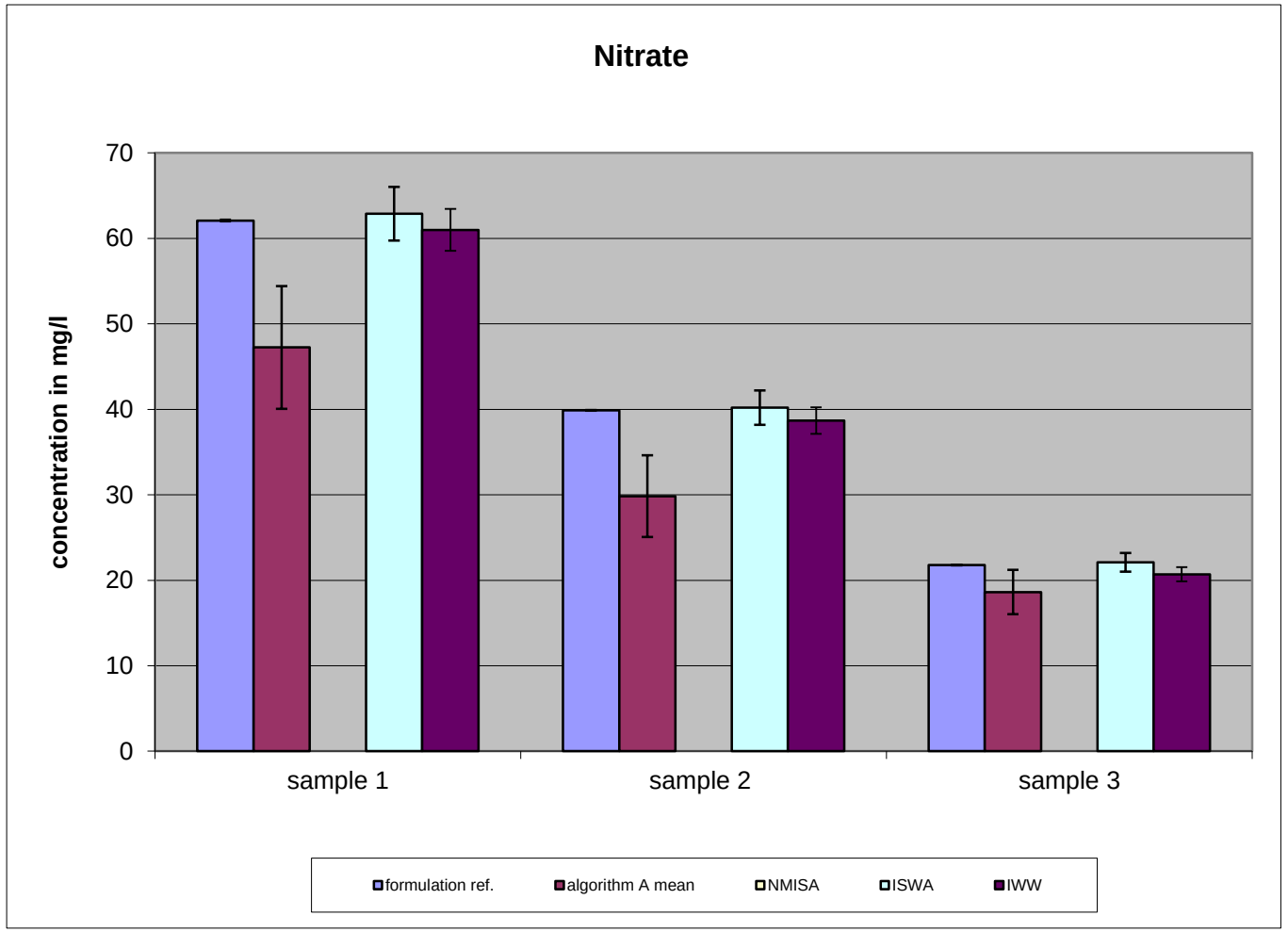
Nitrate
mean vs. ref.-value





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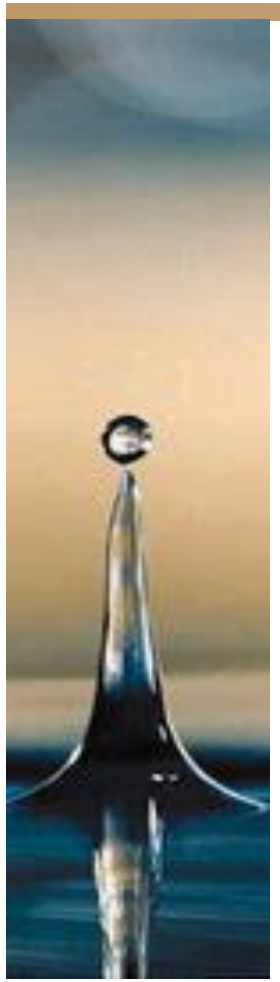
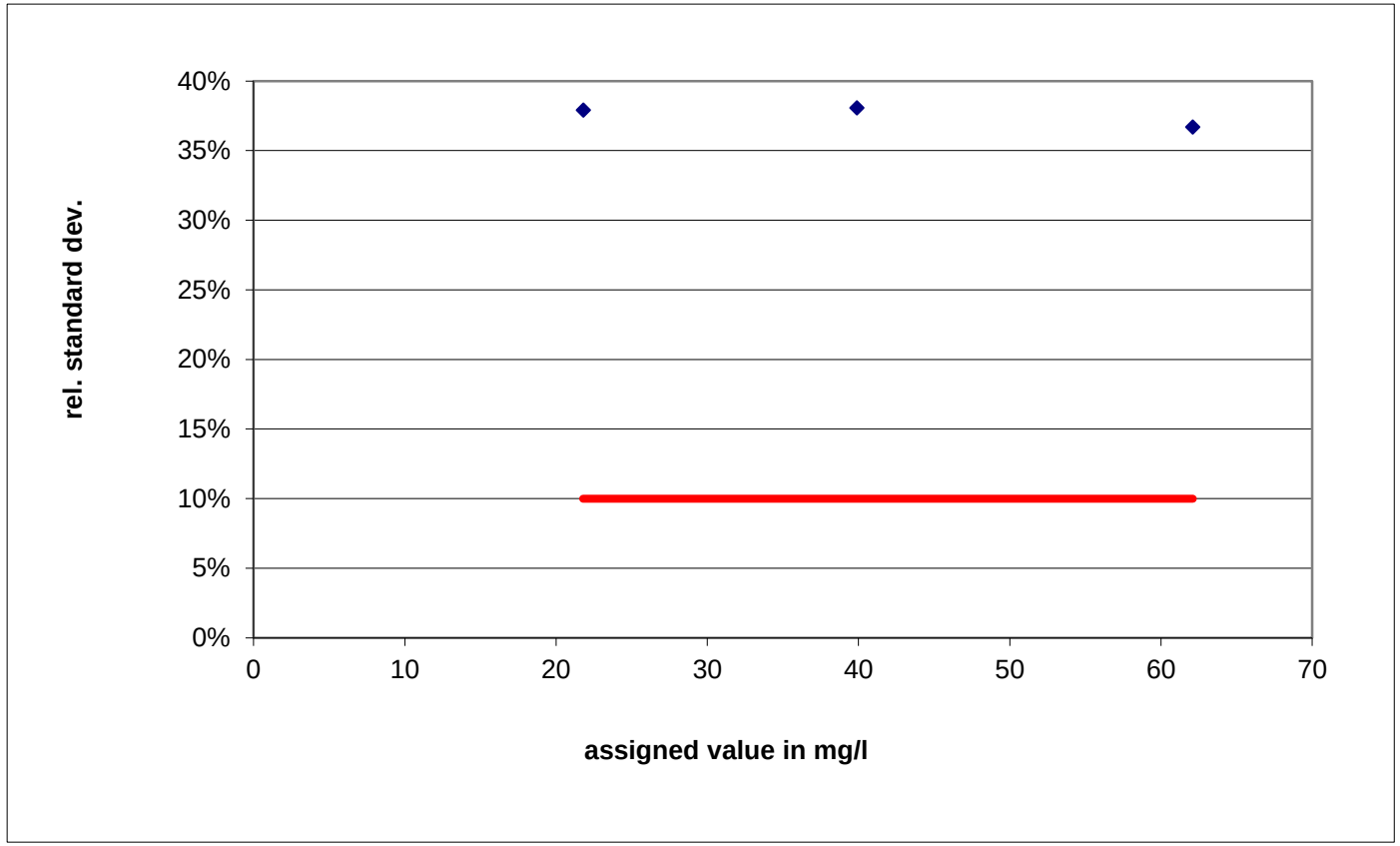
Nitrate

Calculated standard deviation and limit





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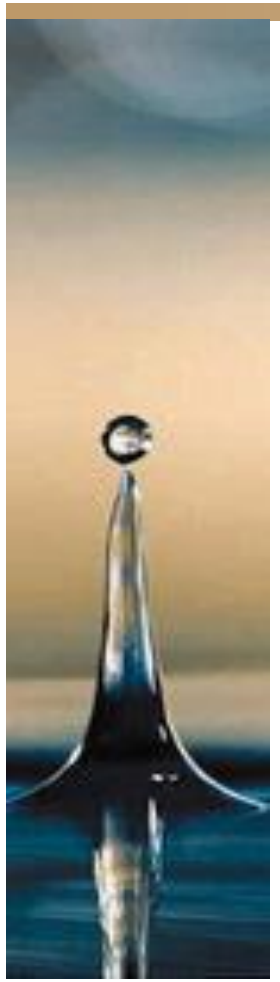
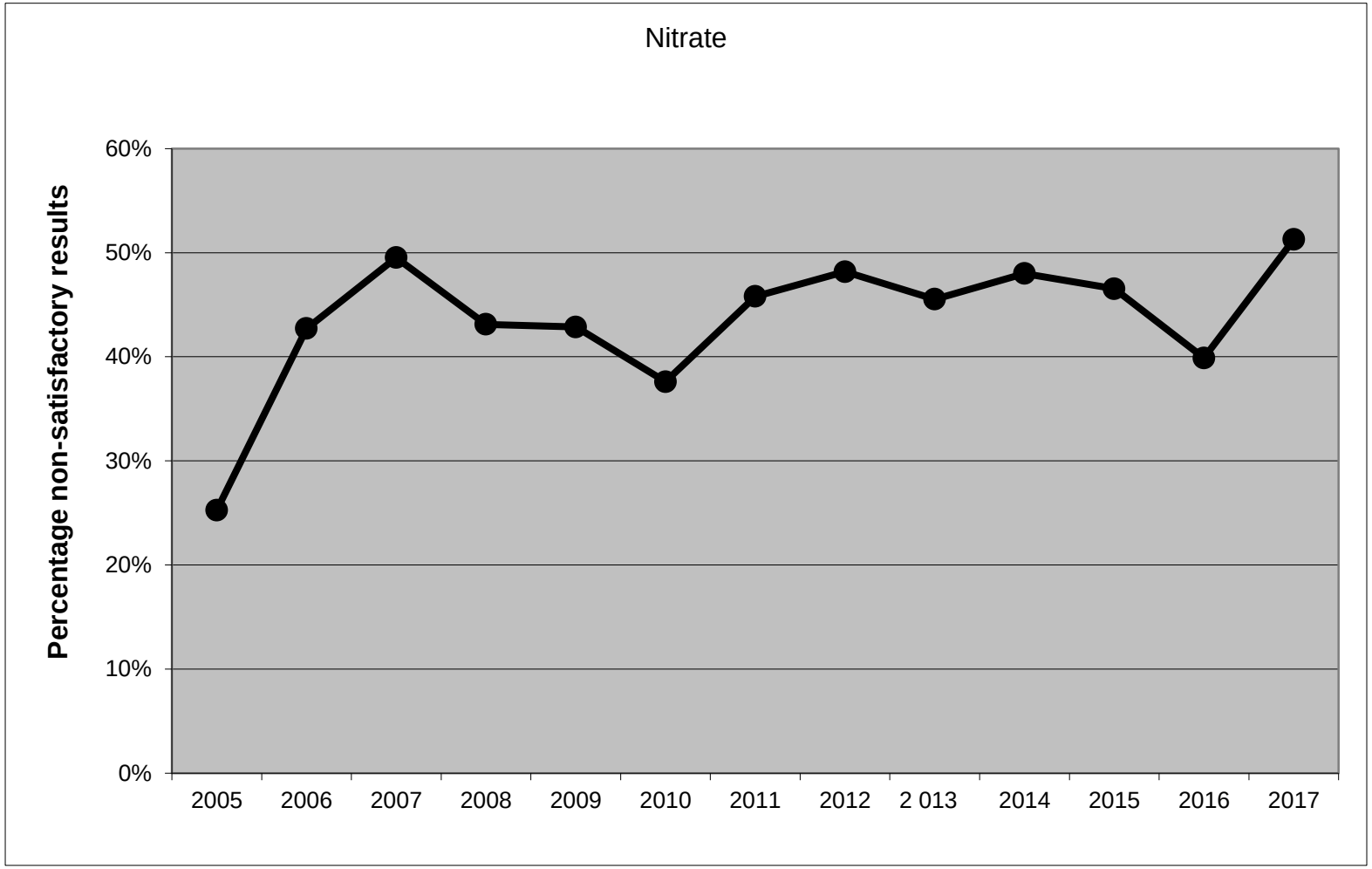
Nitrate
Percentage non-satisfactory results





39.9% to 51.3% in 2017

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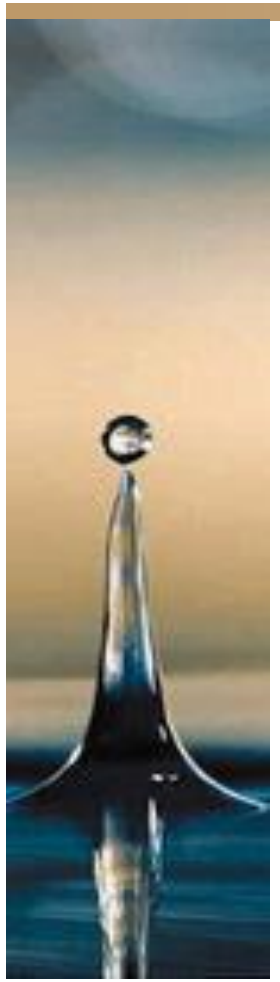
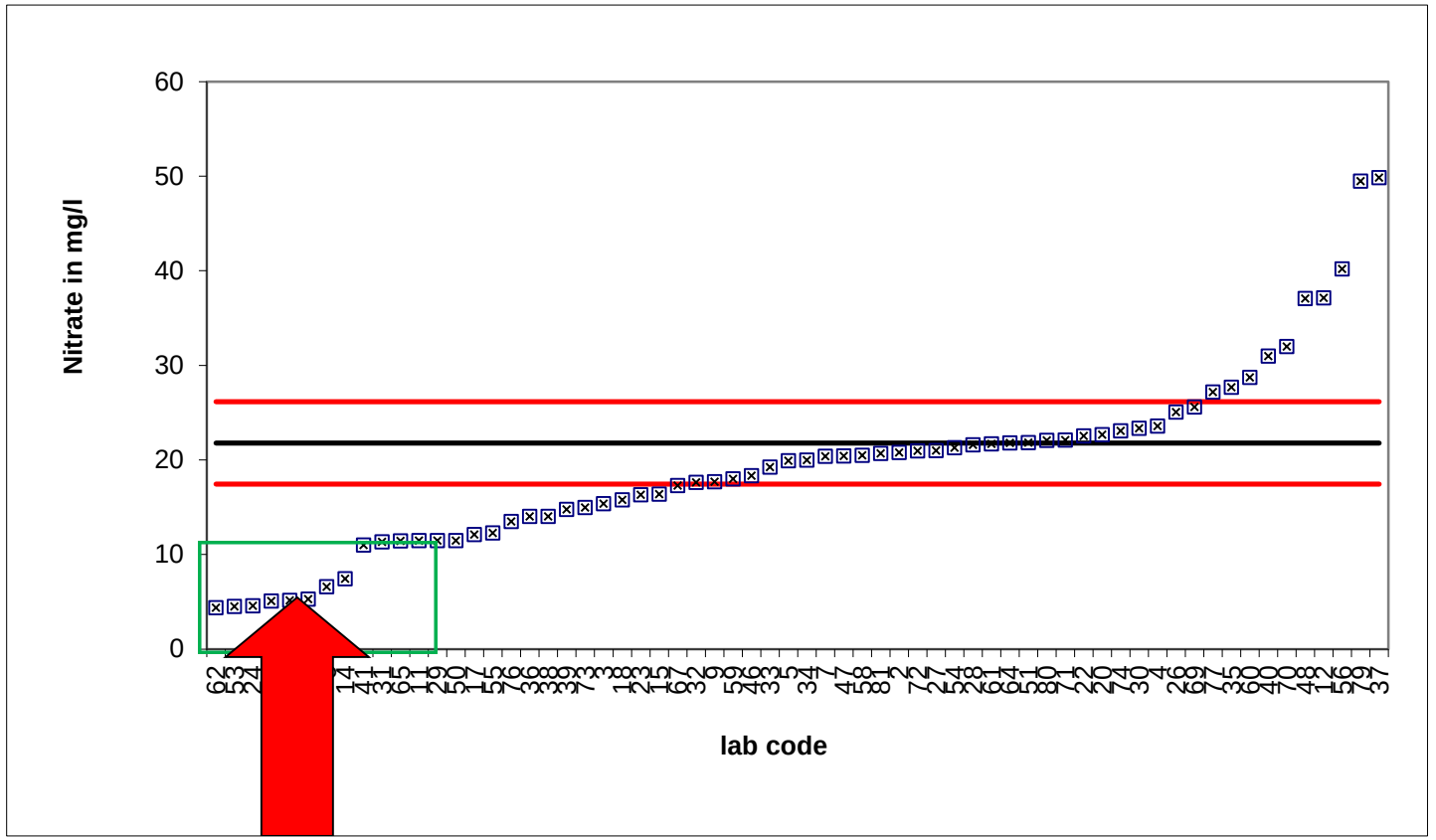
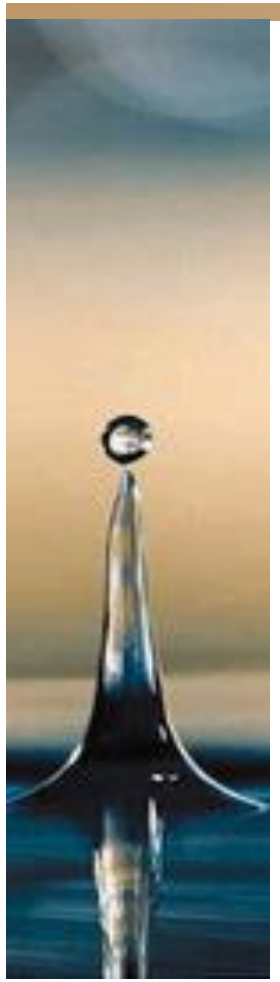
Nitrate 1

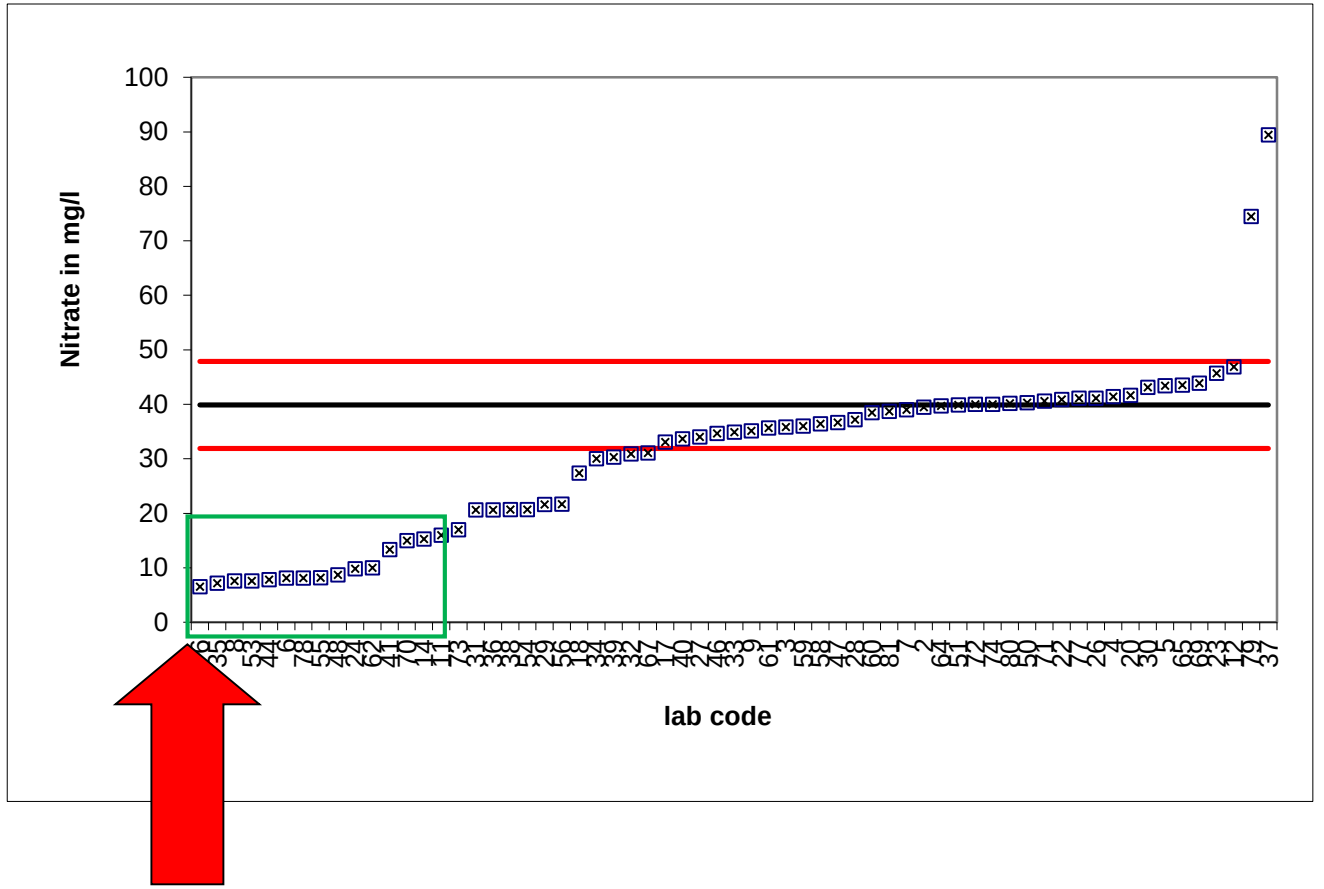




Wrong units again as NO_3^--N instead of NO_3^-

Nitrate 2





Wrong units again as NO_3^--N instead of NO_3^-

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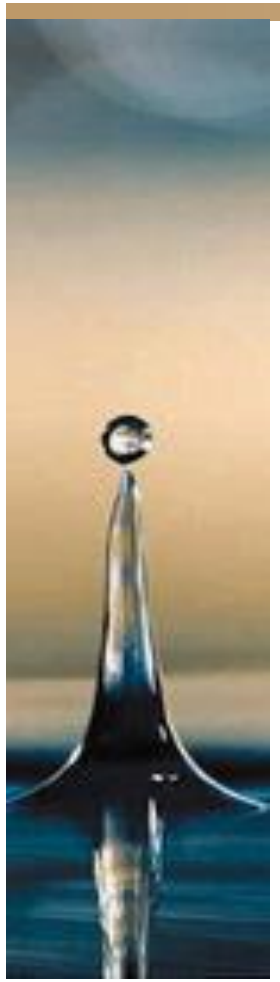
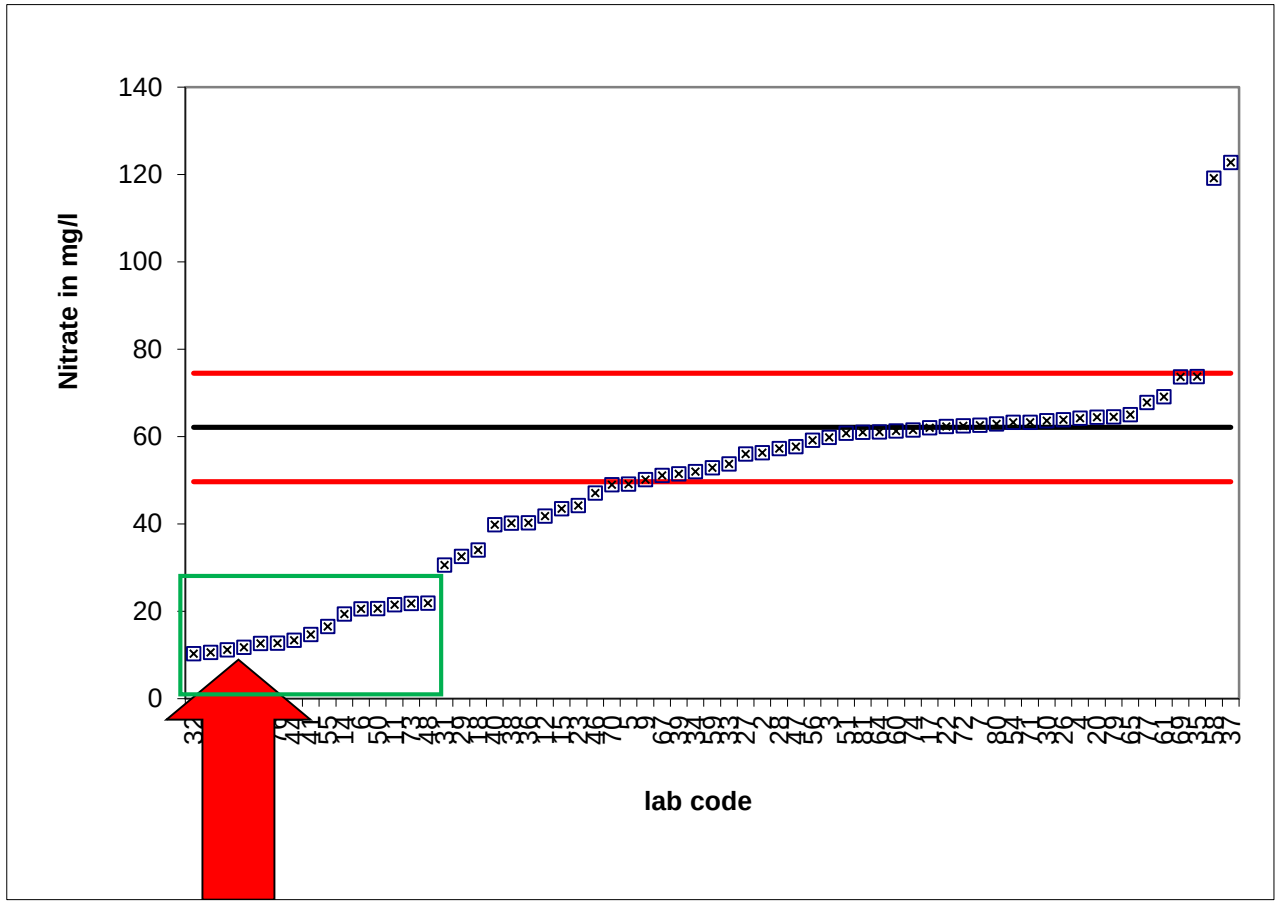
Let's go forward

Nitrate 3





Wrong units again as NO_3^--N instead of NO_3^-

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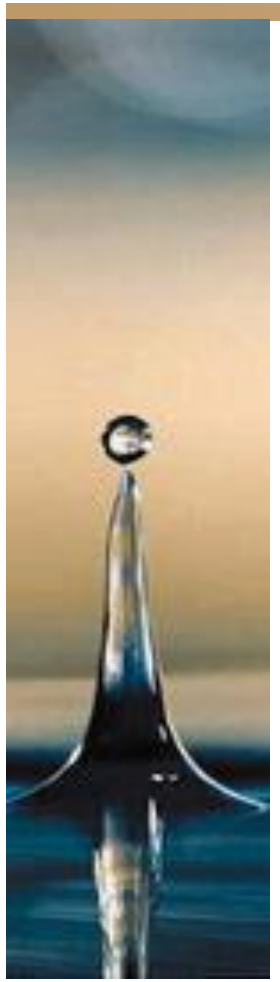
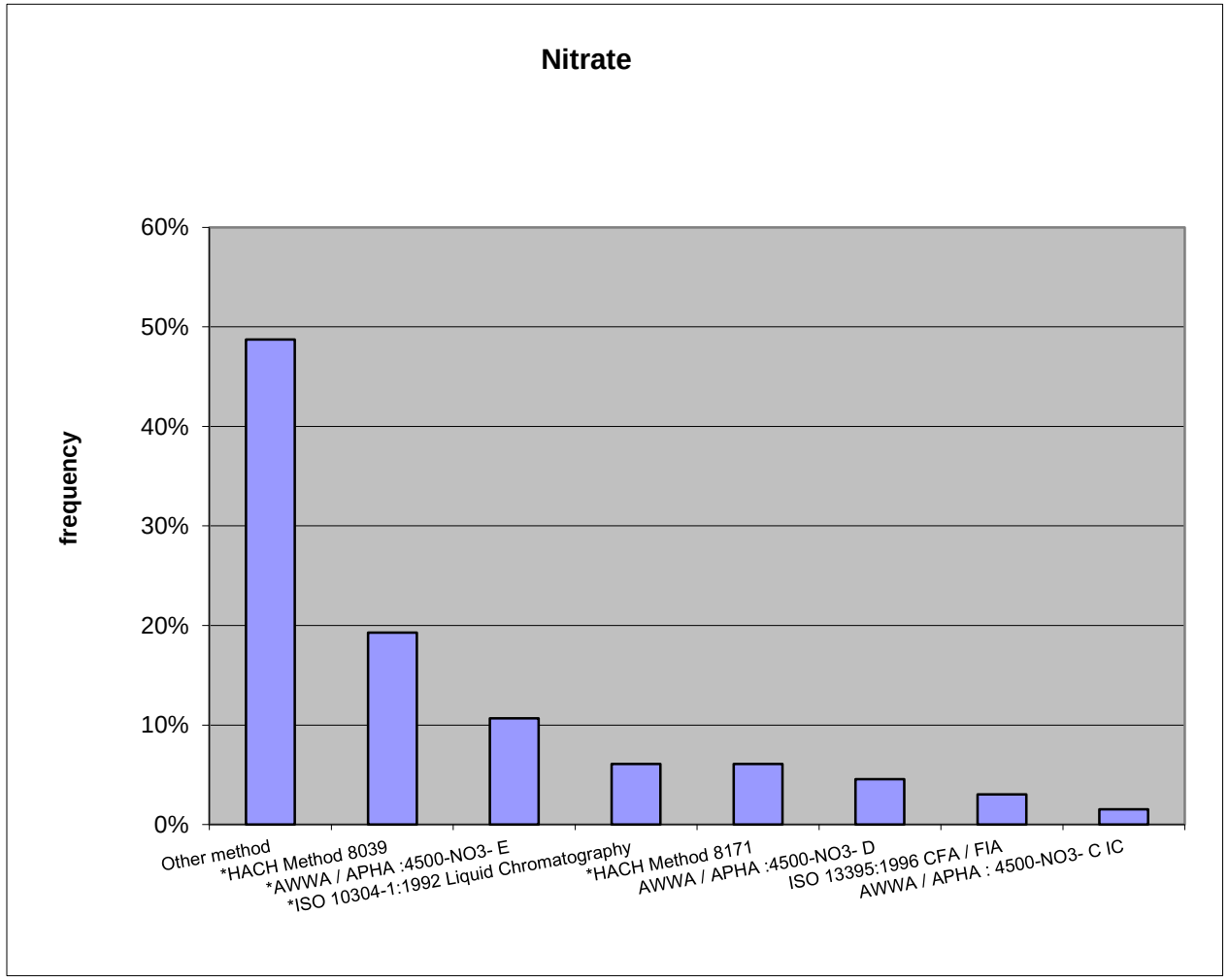
Let's go forward

Method used





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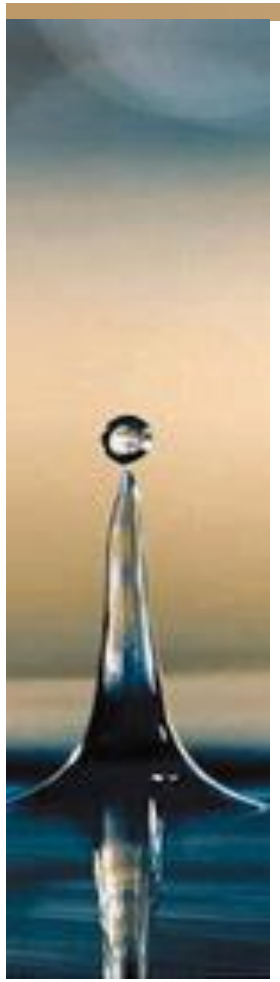
Summary **Nitrate**



- Still problems with reporting of NO_3 in the wrong units
- Labs either do not read / do not understand / are not able to calculate or convert to the correct unit
- STDs very high – mostly because of wrong units
- Percentage of non-satisfactory results again very high (units!) – from **39.9% to 51.3% in 2017**
- 48.7% of the labs are using "other" methods

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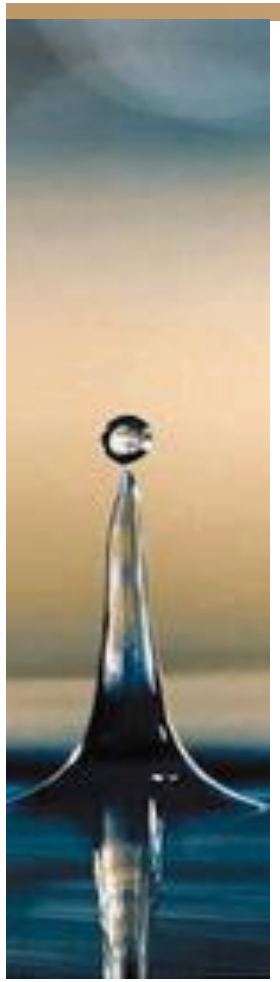
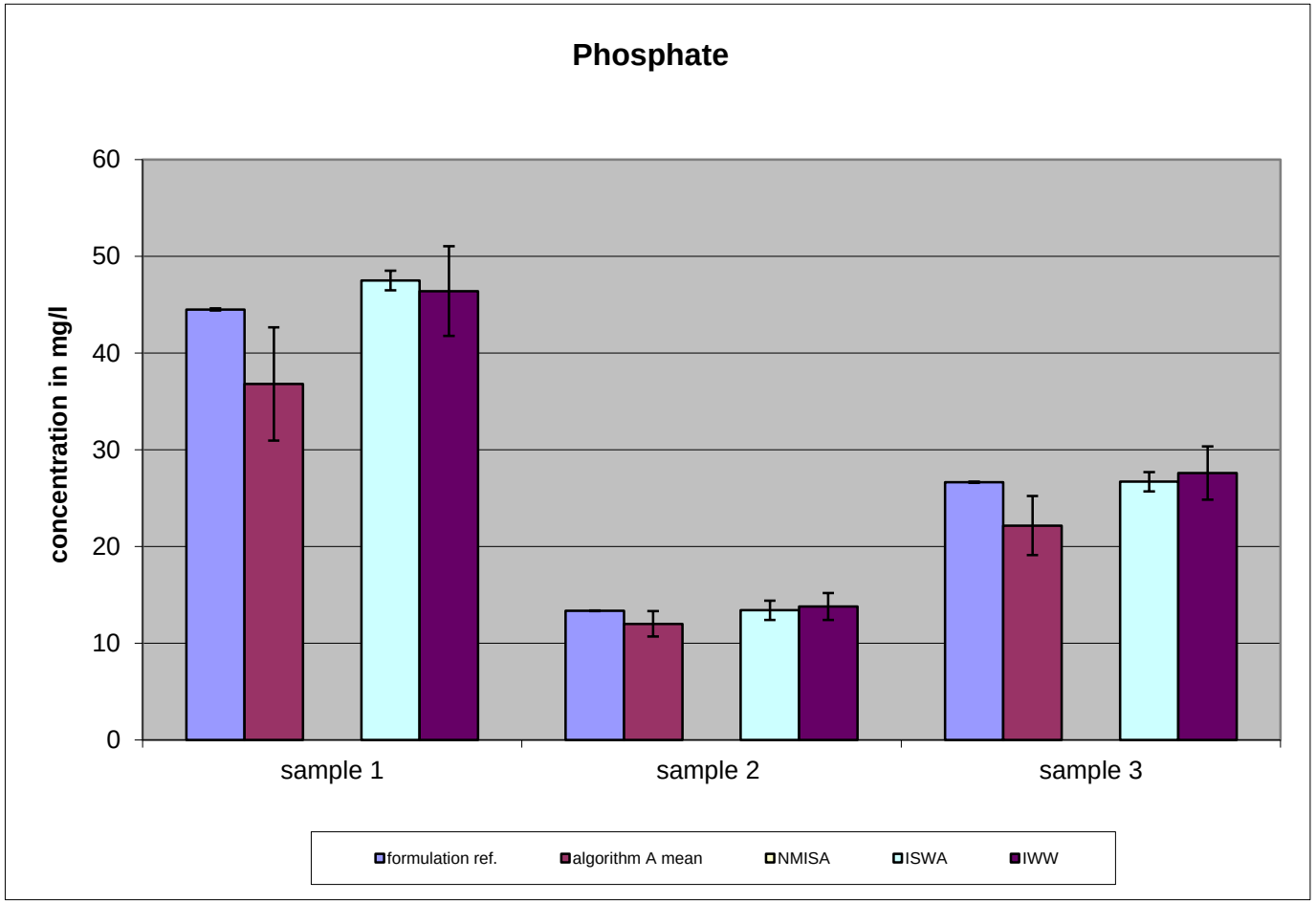
Let's go forward

Phosphate
mean vs. ref.-value





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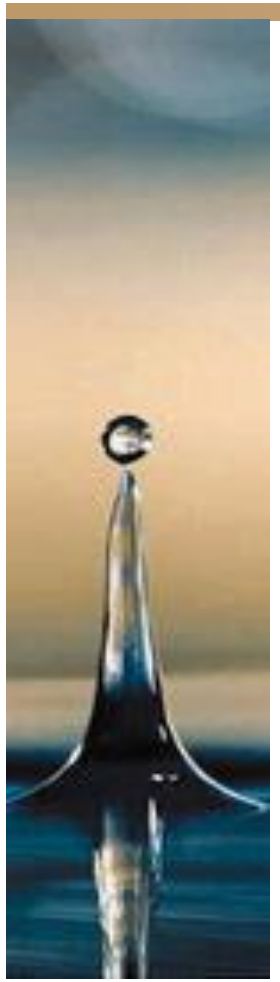
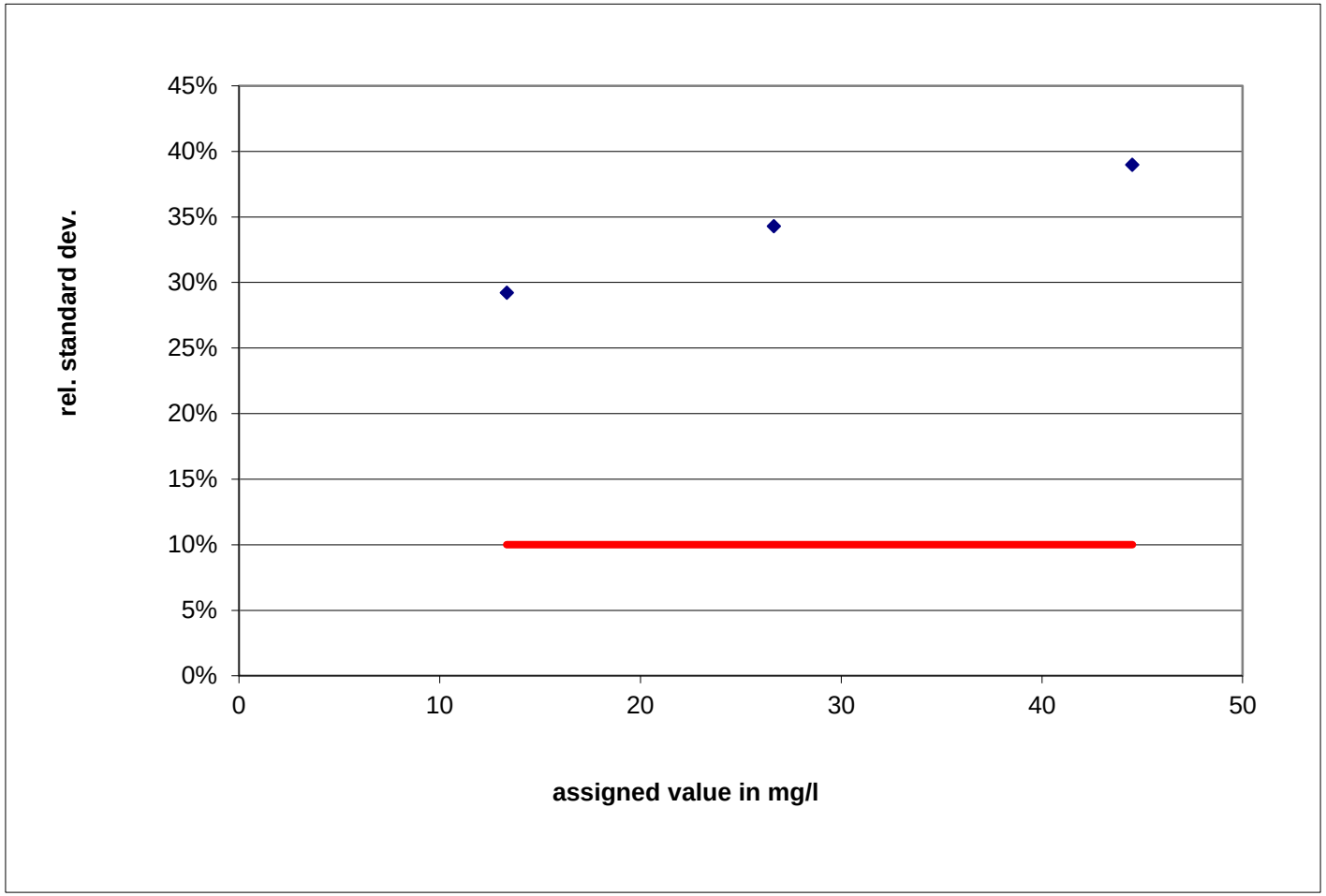
Phosphate
Calculated standard deviation and limit





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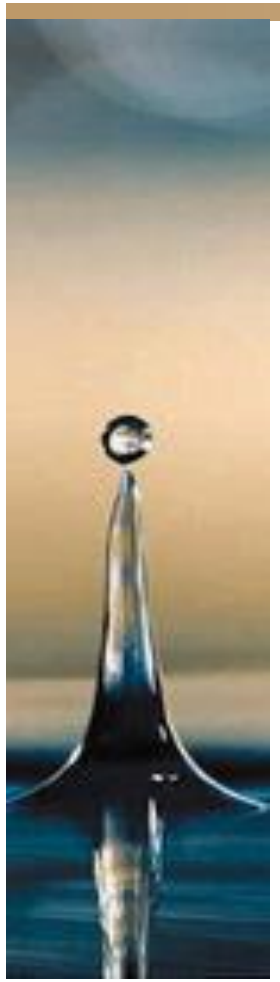
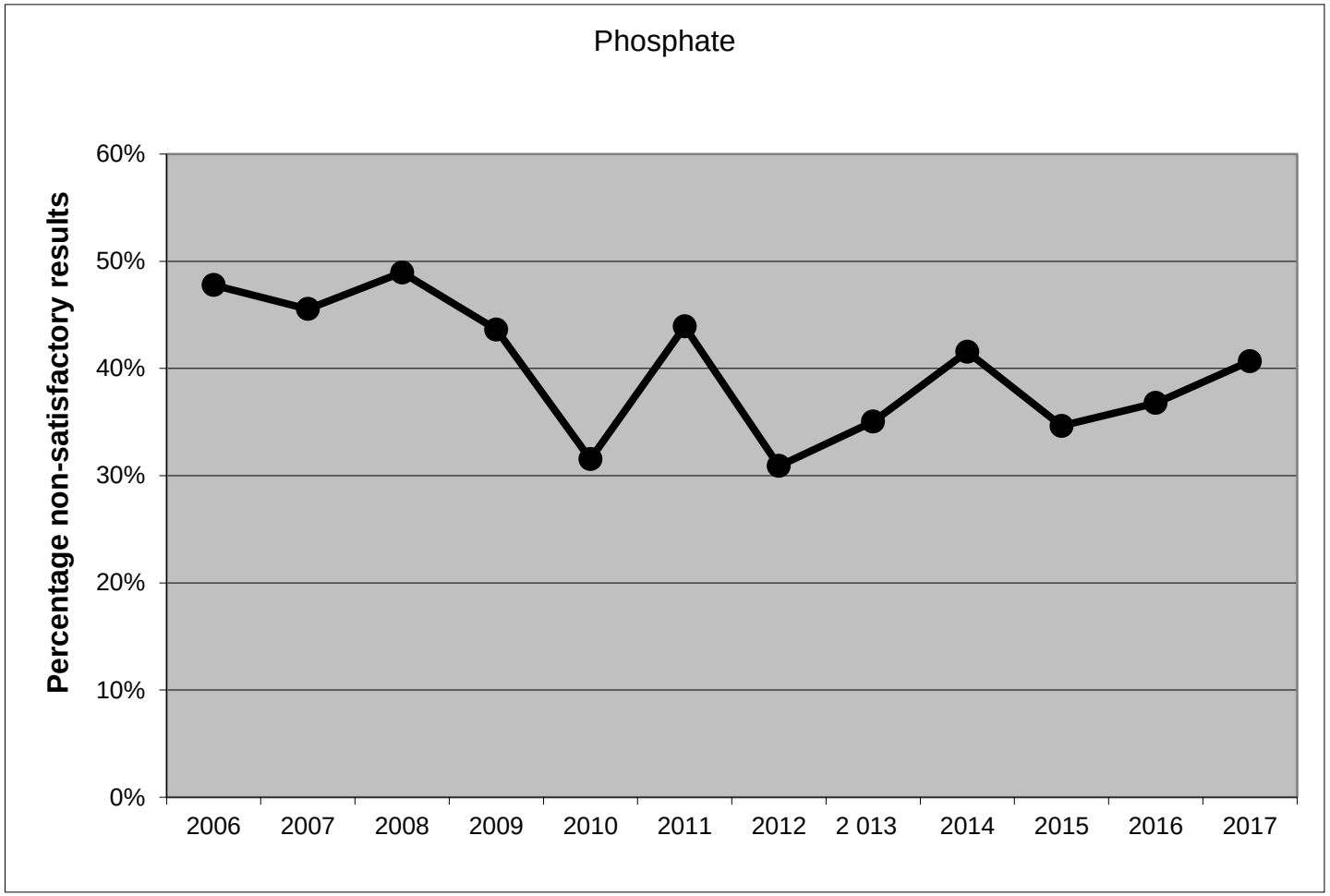
Let's go forward

Phosphate
Percentage non-satisfactory results





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36.8 % to 40.7 in 2017

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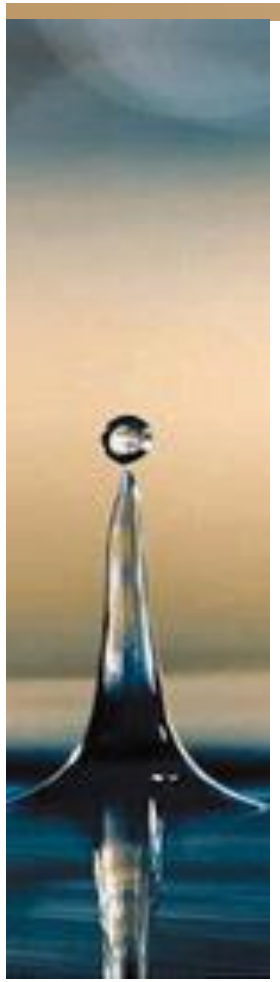
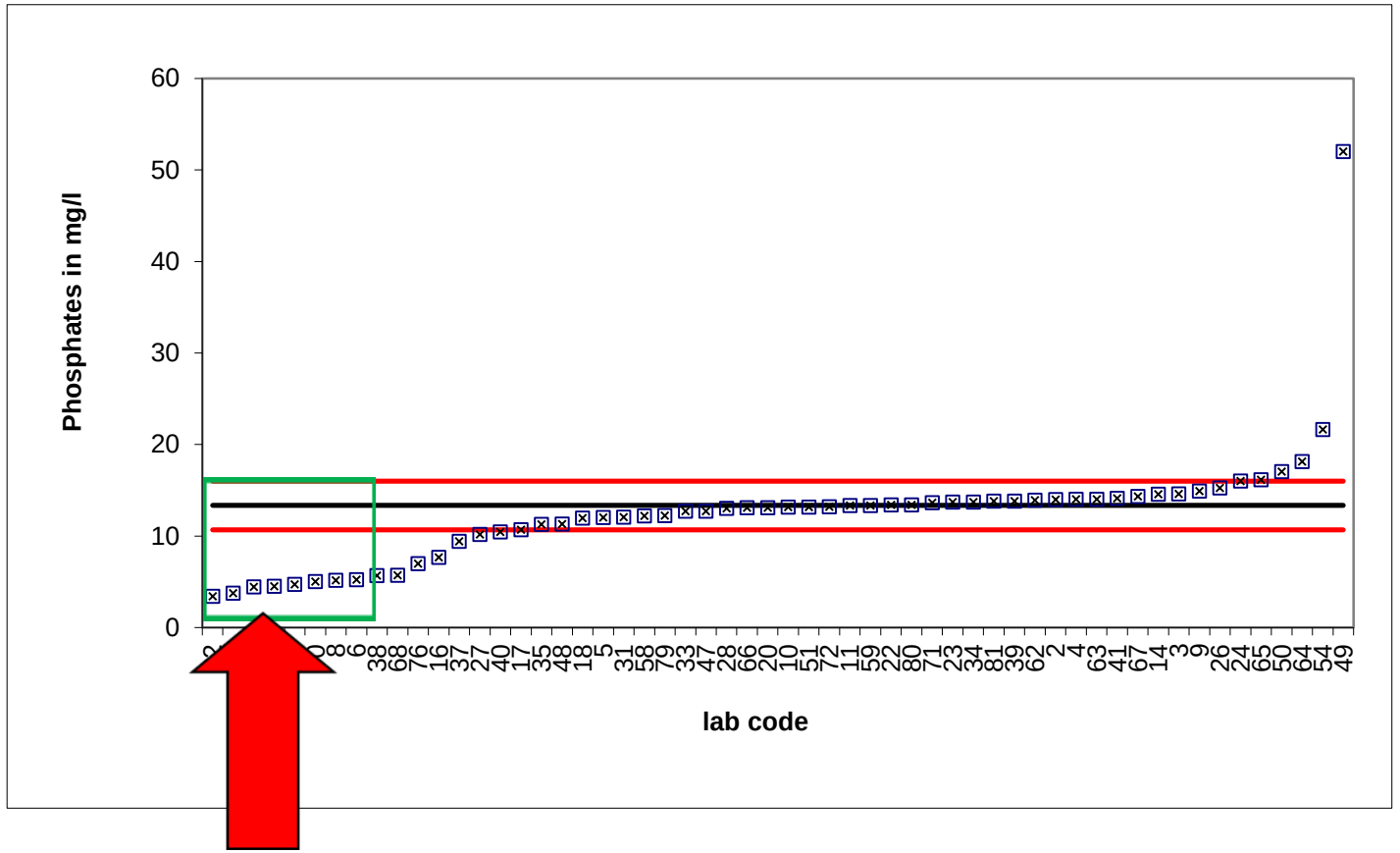
Let's go forward

Phosphate 1





most probably reported in PO_4^{3-}-P instead of PO_4^{3-}

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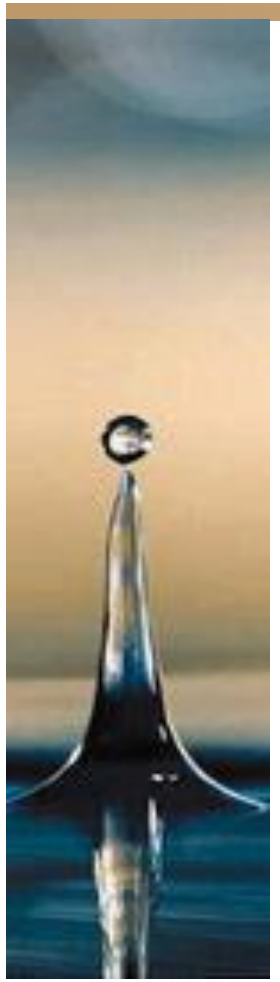
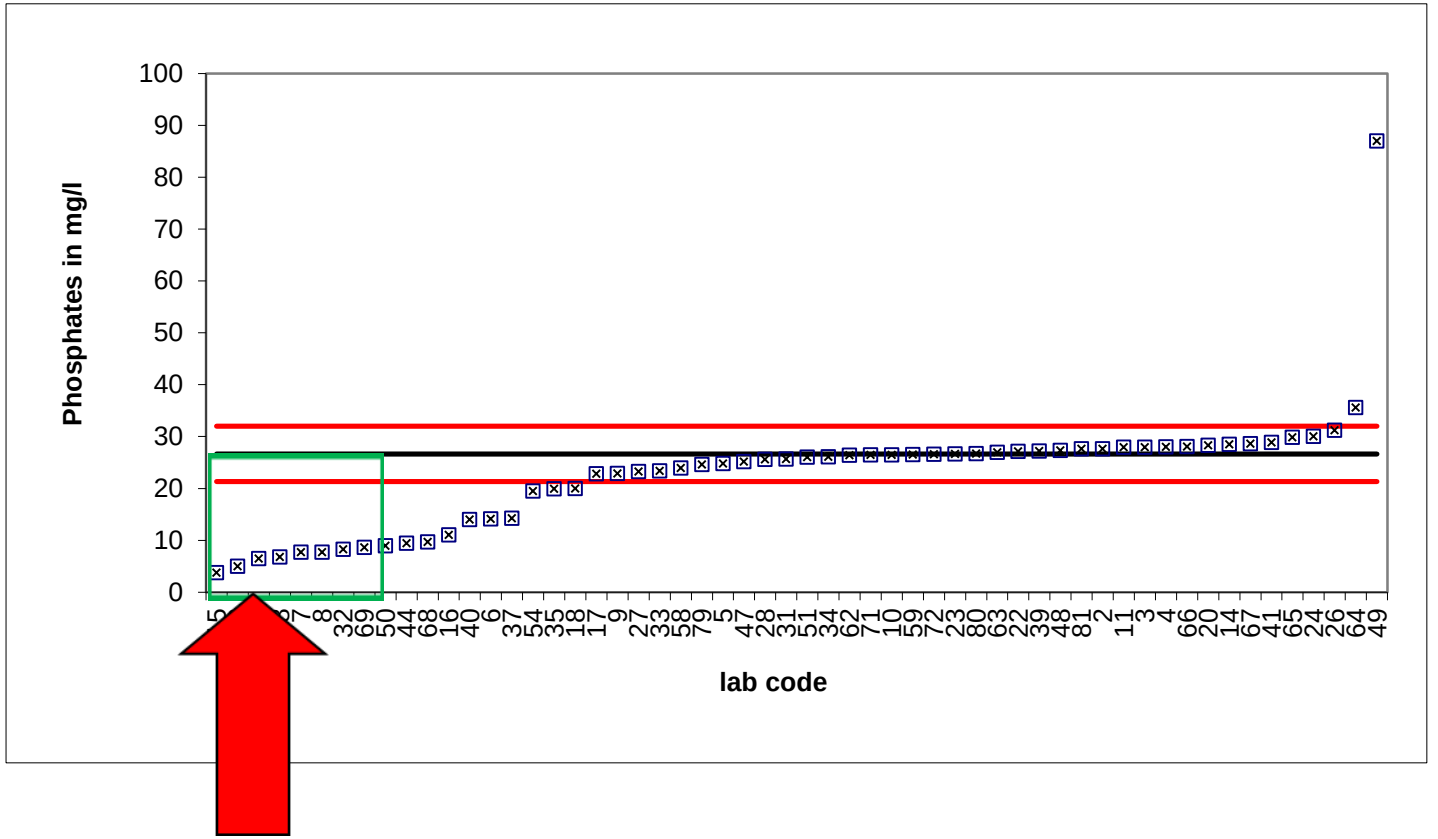
Let's go forward

Phosphate 2





most probably reported in PO_4^{3-}-P instead of PO_4^{3-}

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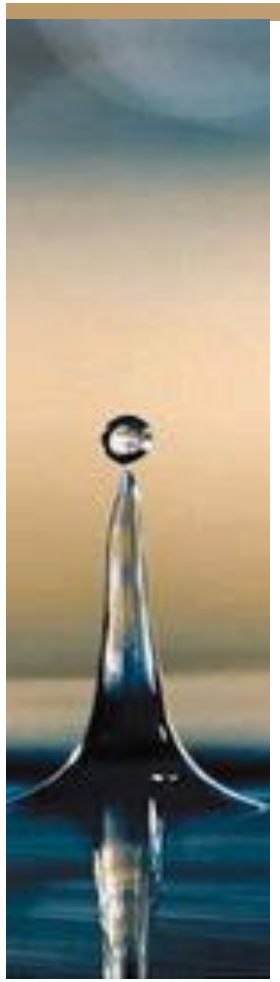
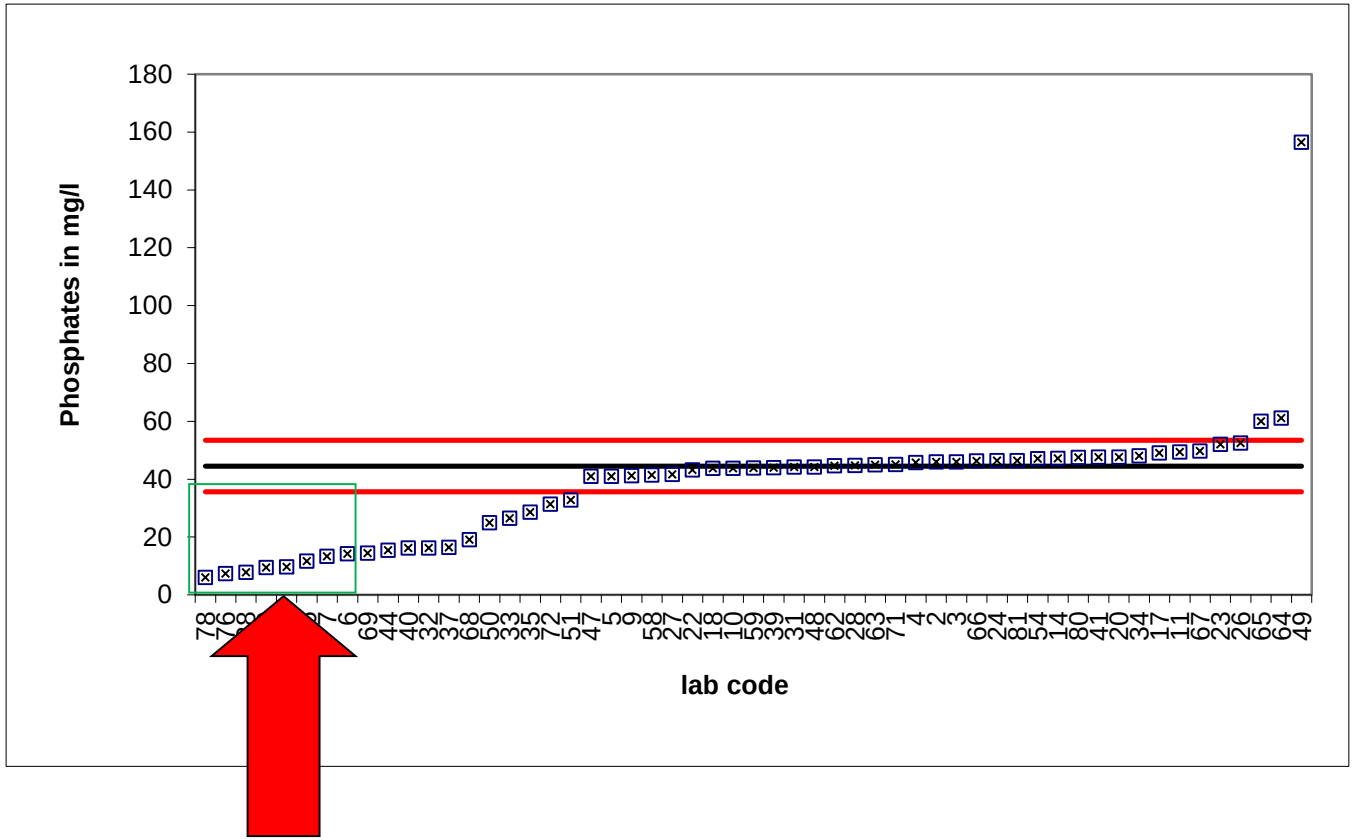
Let's go forward

Phosphate 3





most probably reported in PO_4^{3-}-P instead of PO_4^{3-}

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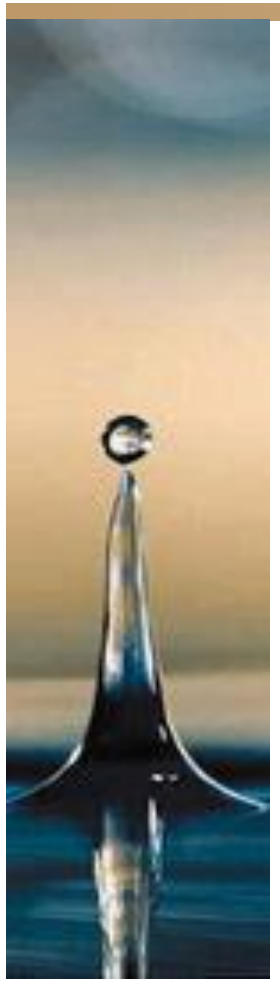
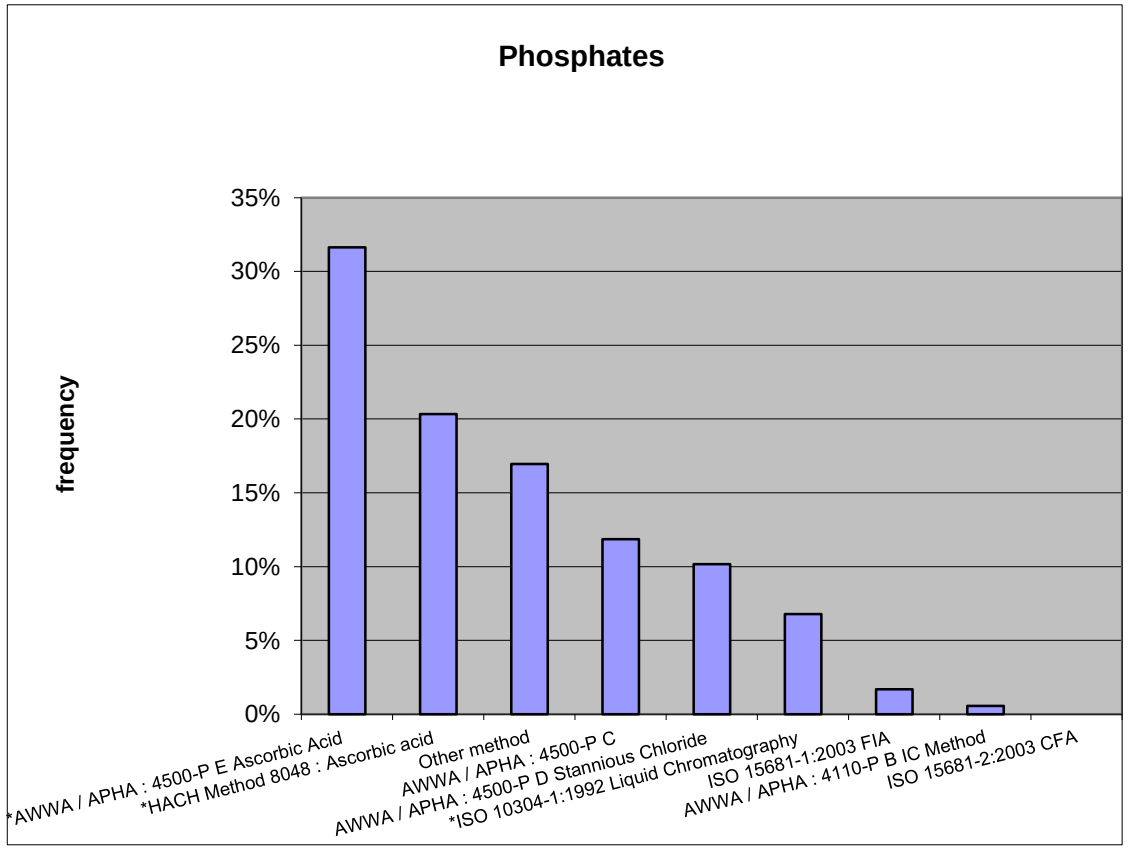
Let's go forward

Method used





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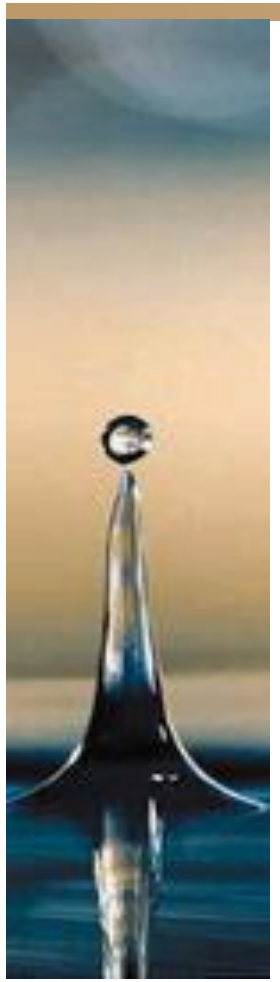
Let's go forward

Summary **Phosphate**



- Laboratories reported in the wrong units again
- Standard deviations are too high
- Percentage of non-satisfactory results increased from 36.8 % to 40.7 in 2017

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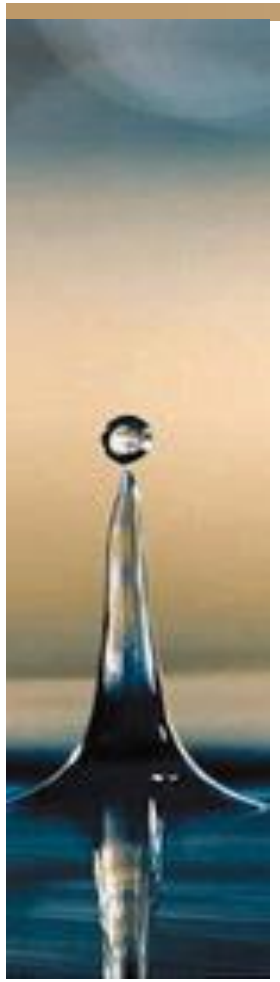
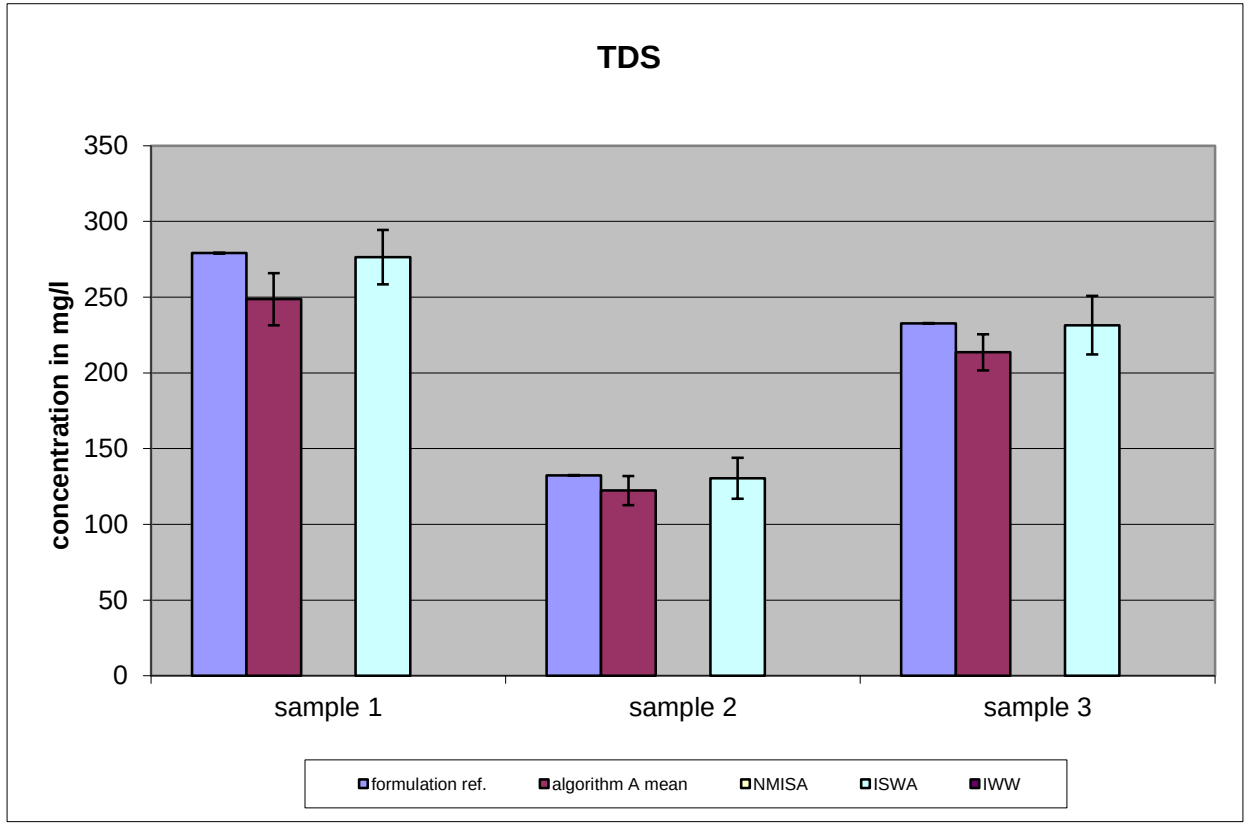
Let's go forward

TDS
mean vs. ref.-value





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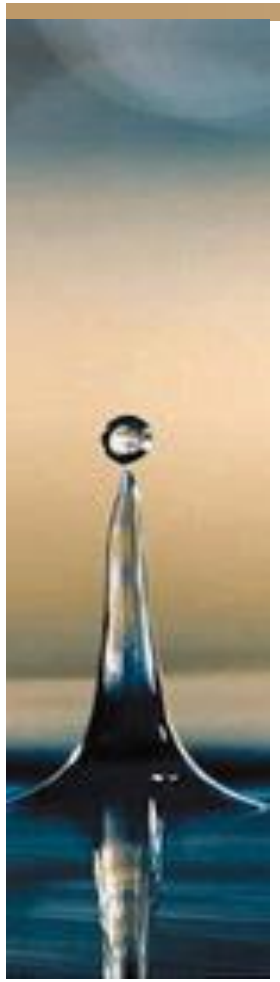
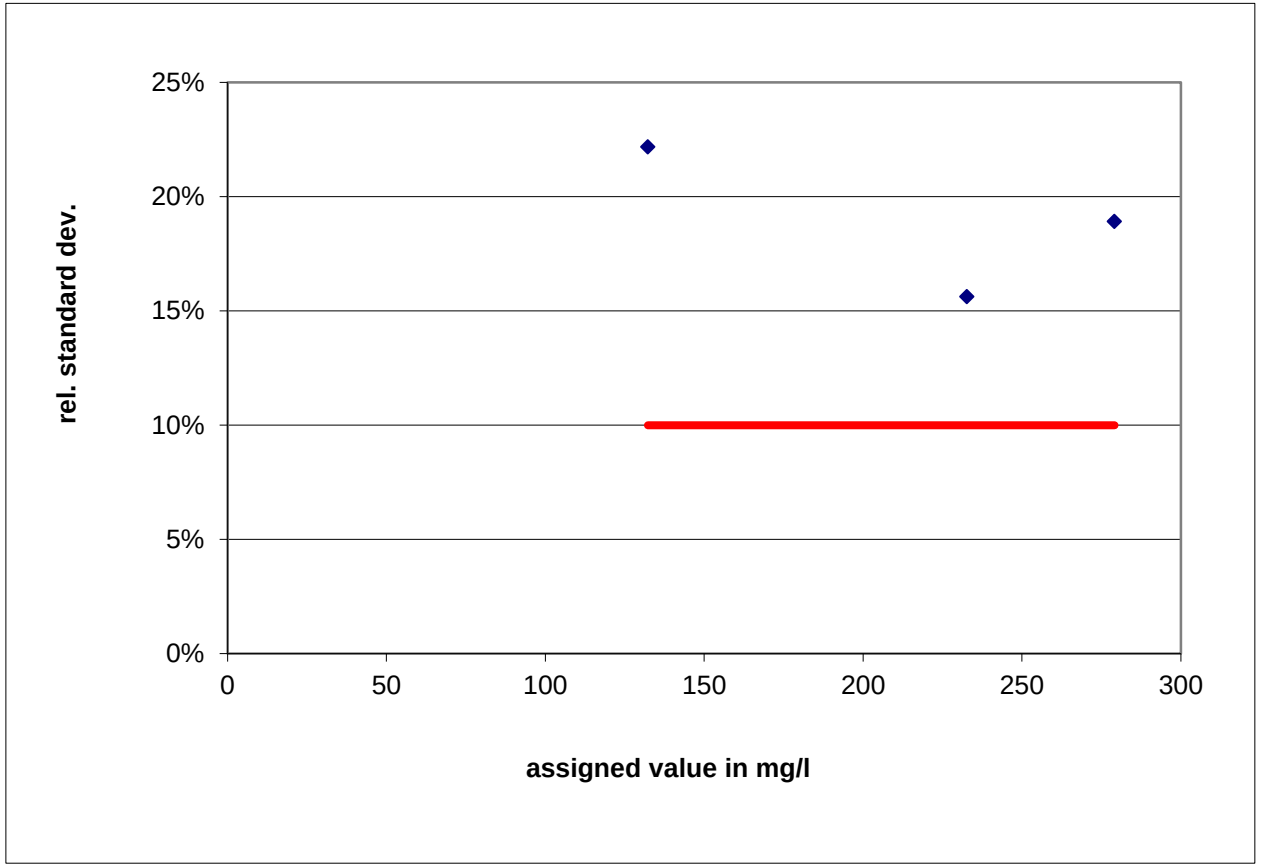
Let's go forward

TDS
Calculated standard deviation and limit





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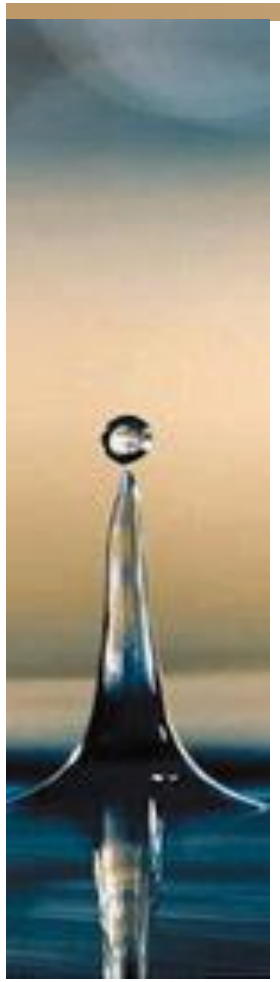
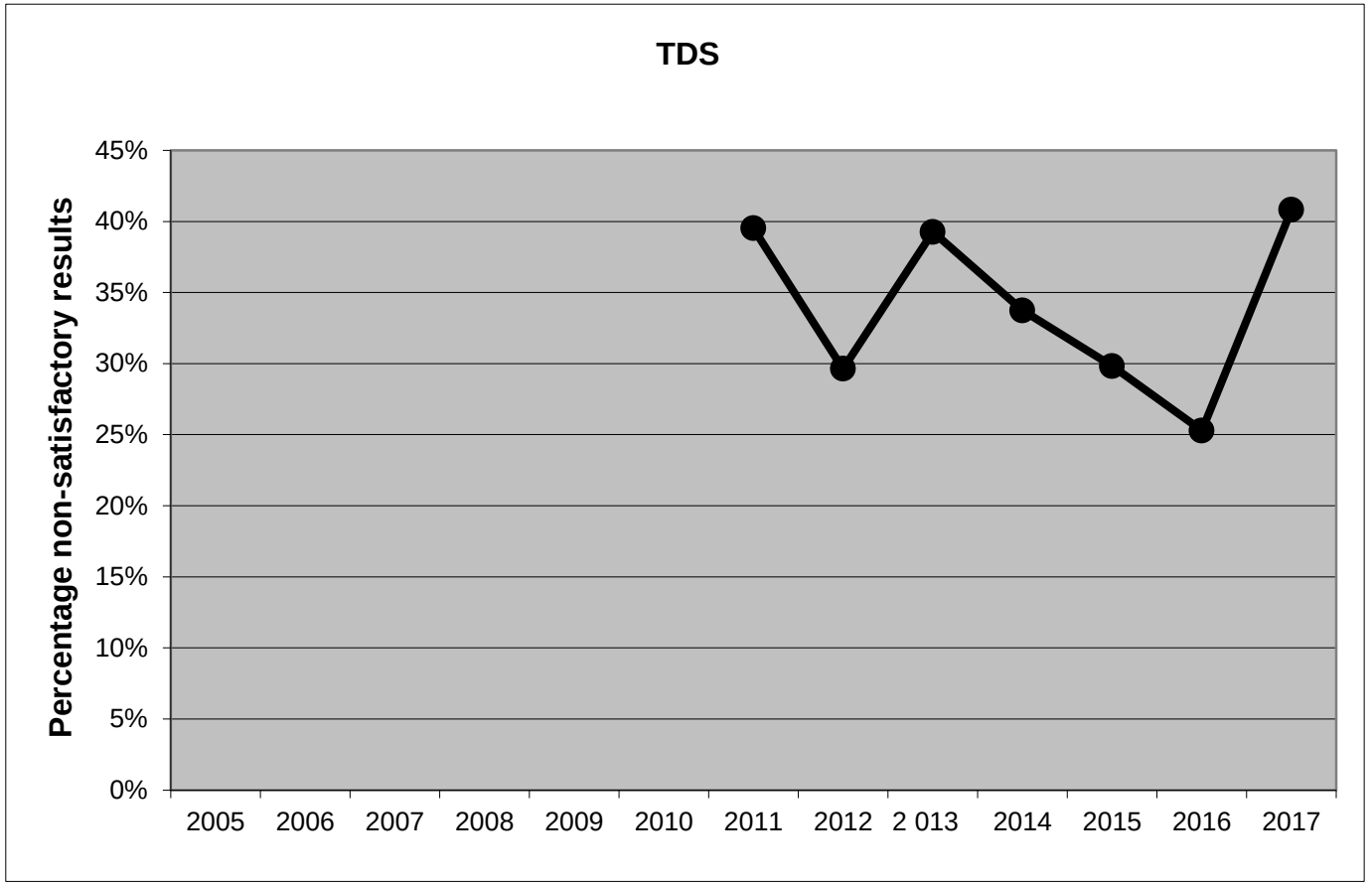
Let's go forward

TDS
Percentage non-satisfactory results





25.3% to 40.8% in 2017

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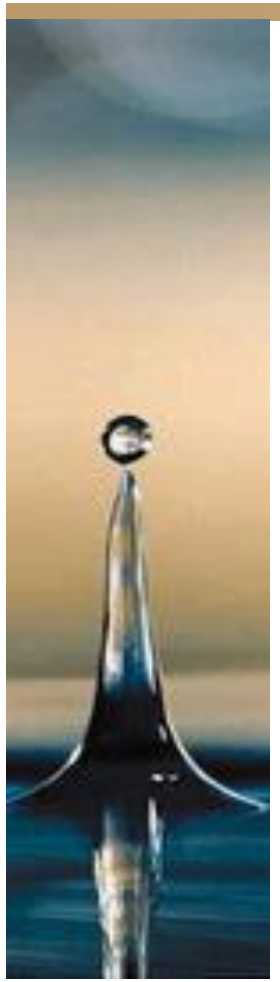
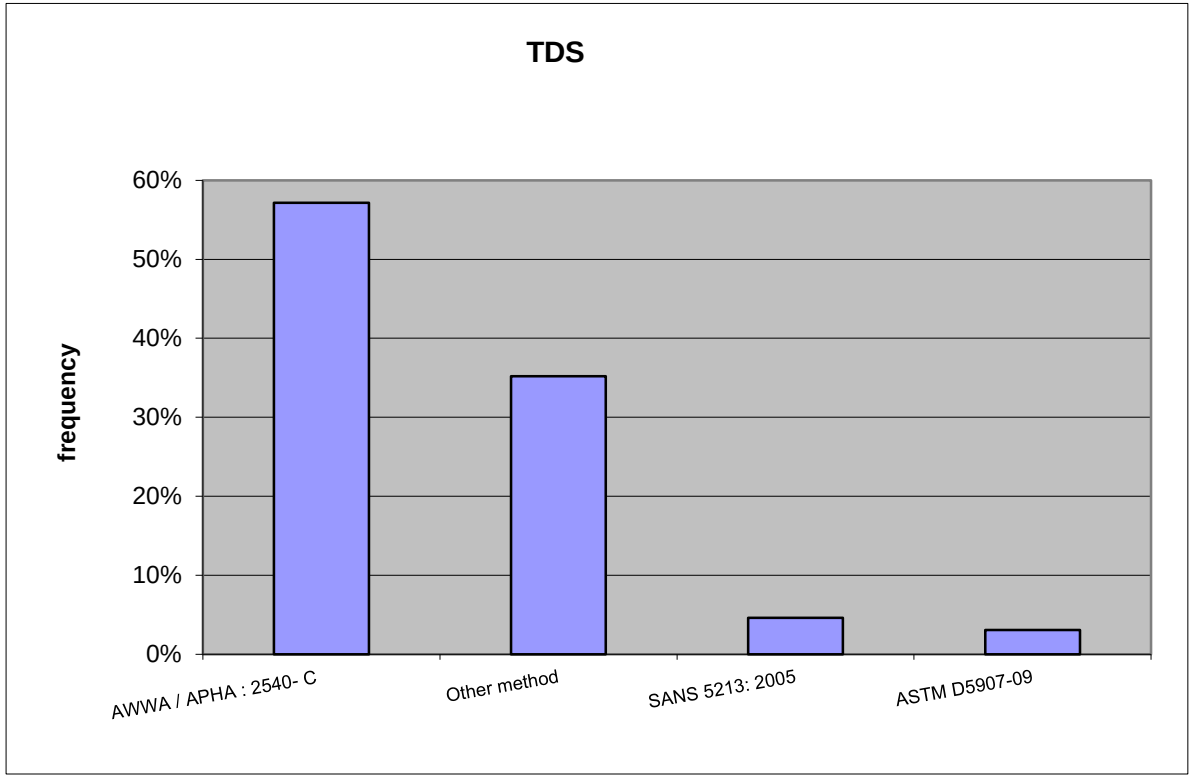
Let's go forward

Method used





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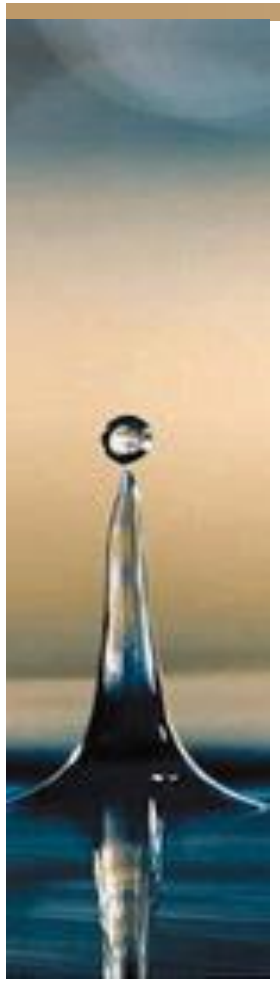
Let's go forward

Summary **TDS**



- Average recovery was 90.5 %
- STD's still too high
- Percentage of non-satisfactory results improved from 25.3% to 40.8% in 2017
- 35,2% "other" methods

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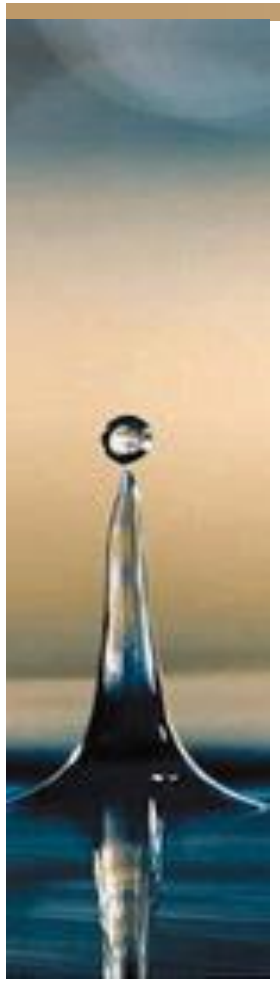
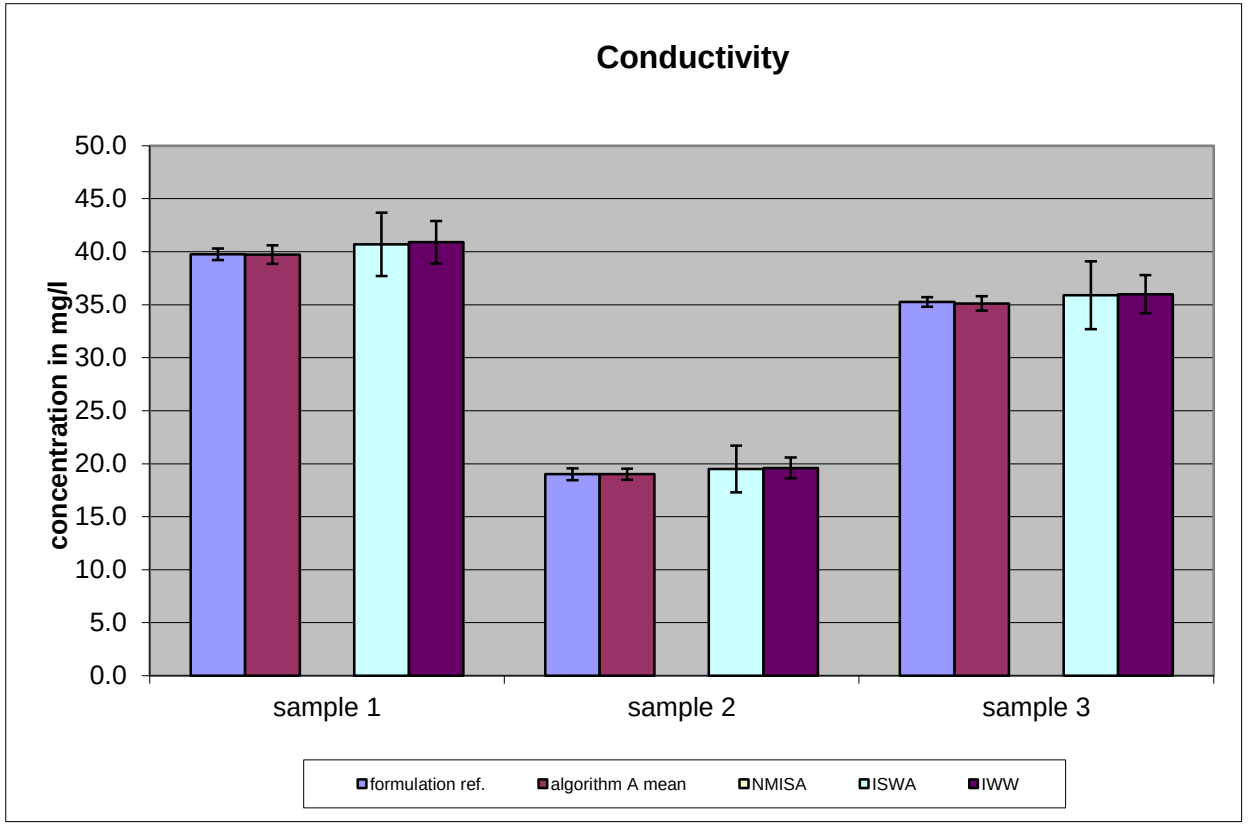
Let's go forward

Conductivity
mean vs. ref.-value





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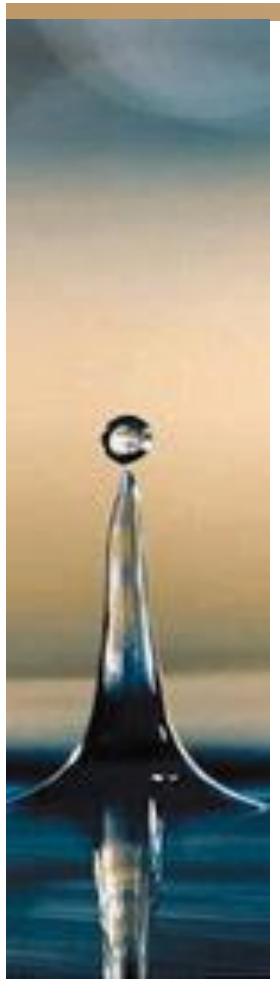
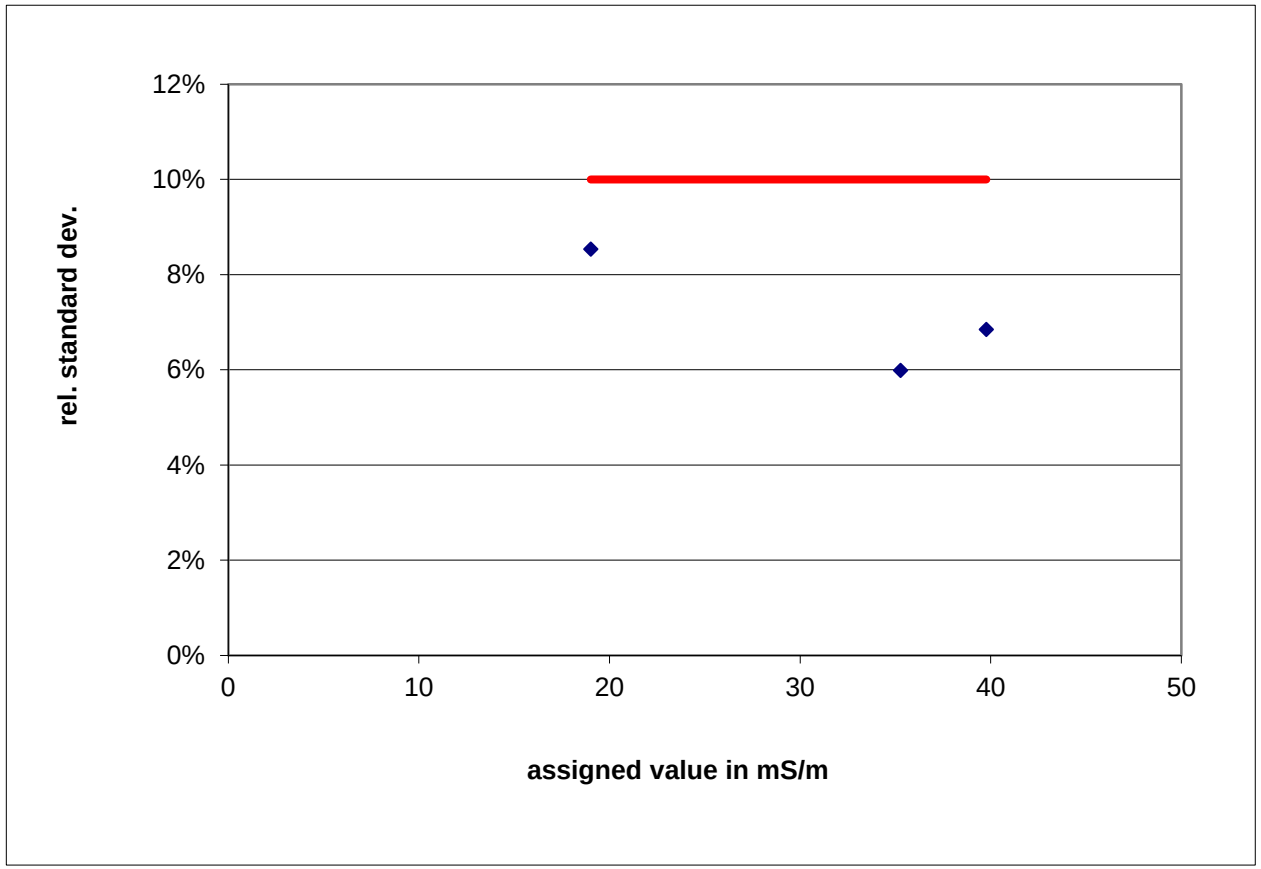
Let's go forward

Conductivity
Calculated standard deviation and limit





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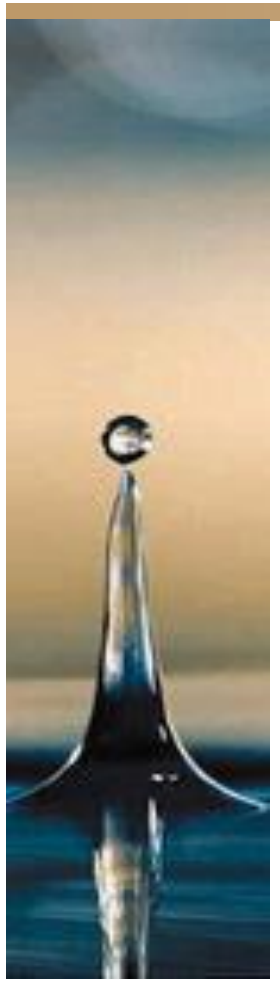
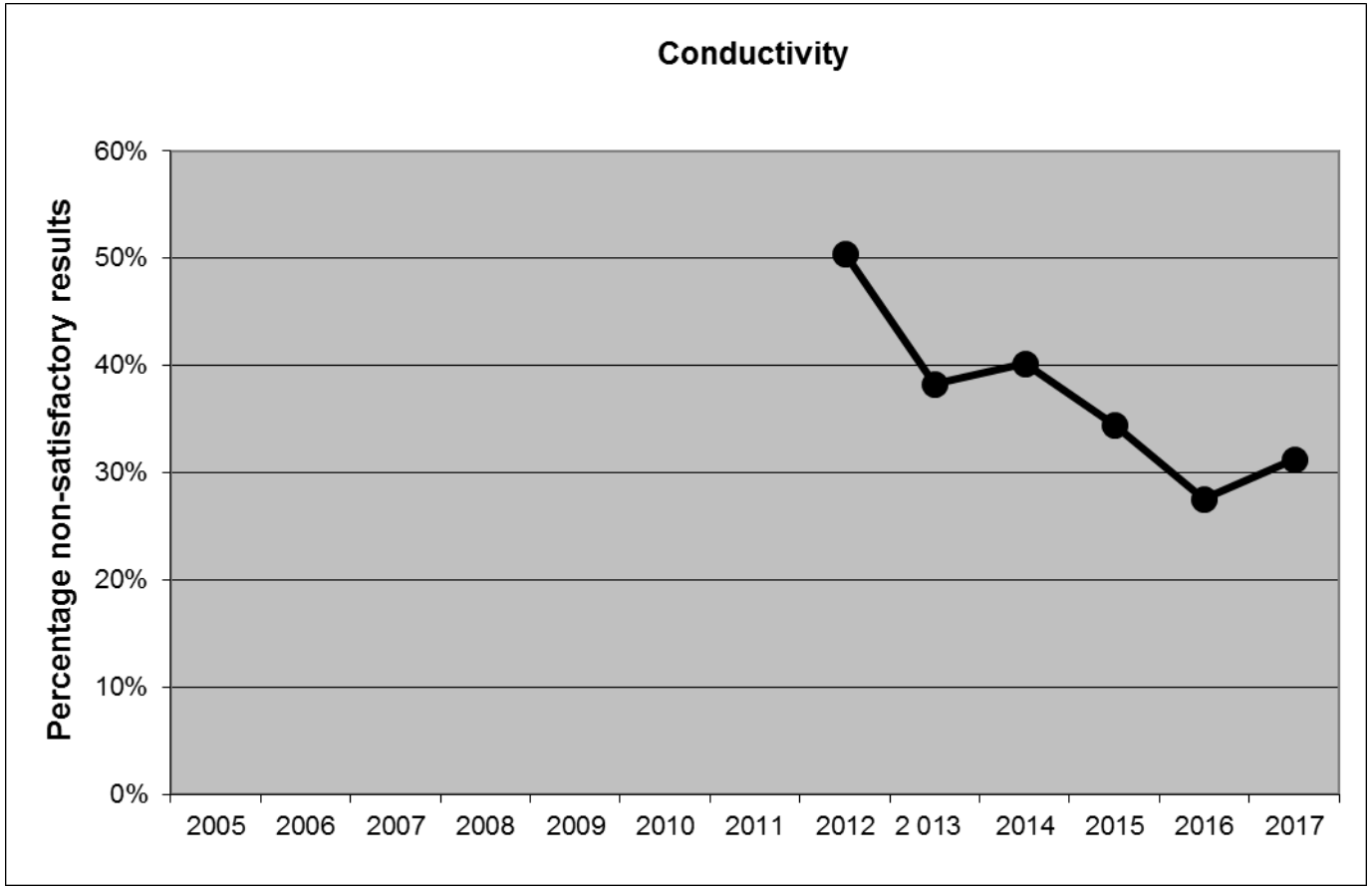
Let's go forward

Conductivity
Percentage non-satisfactory results





27.5% to 31.3% in 2017

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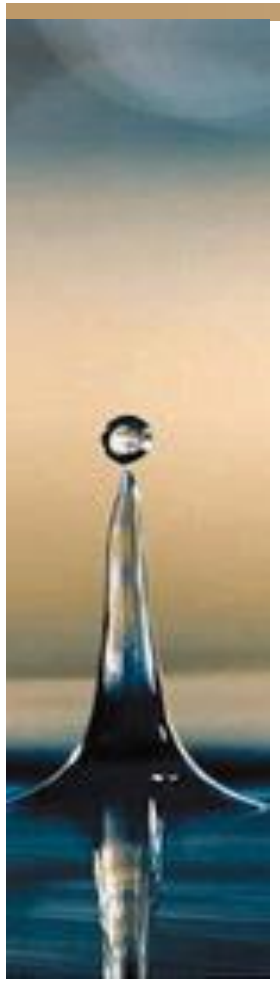
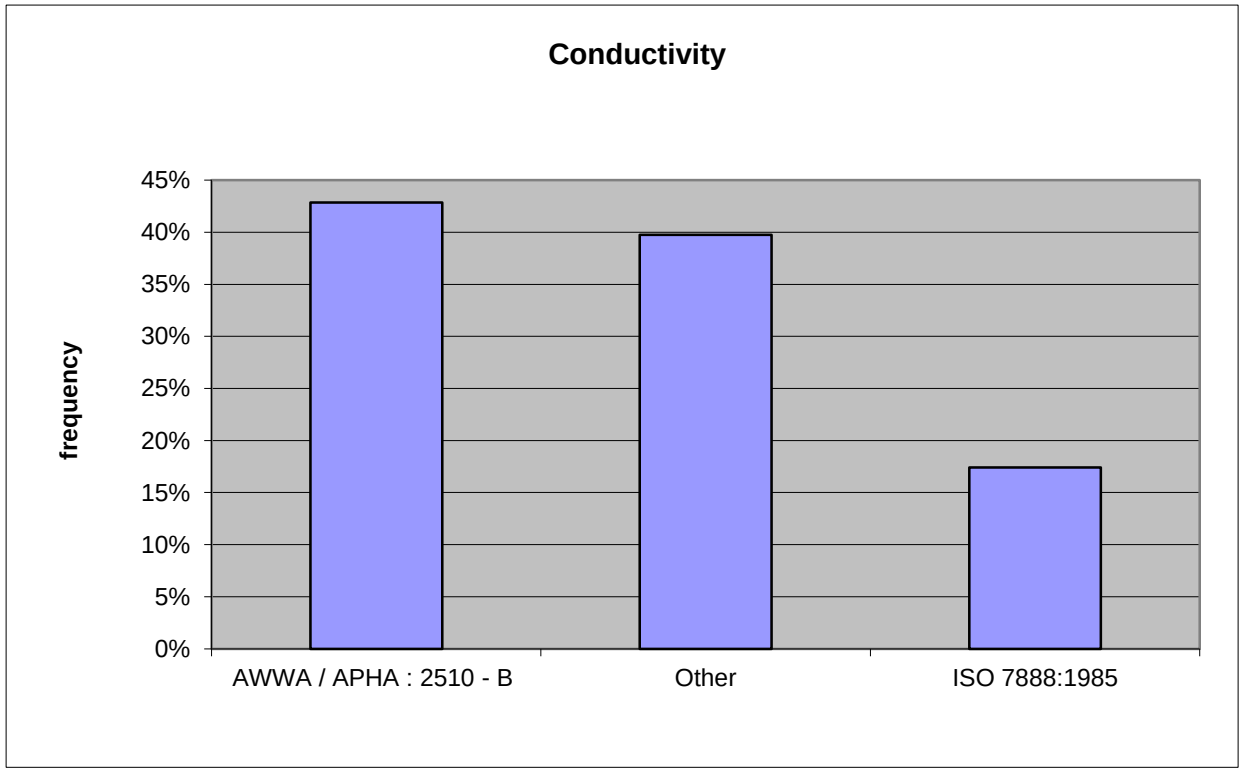
Let's go forward

Method used





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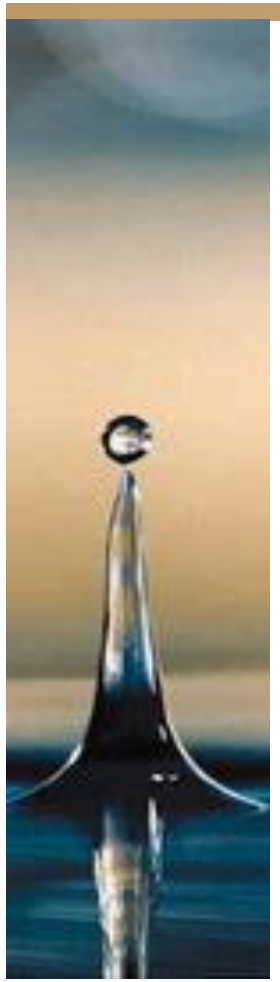
Let's go forward

Summary **Conductivity**



- Laboratory still do not report method information - “other”
- Average recovery of 90.5 %
- STD are below the 10% limit
- Percentage of non-satisfactory results slightly higher but still high - 27.5% to 31.3% in 2017

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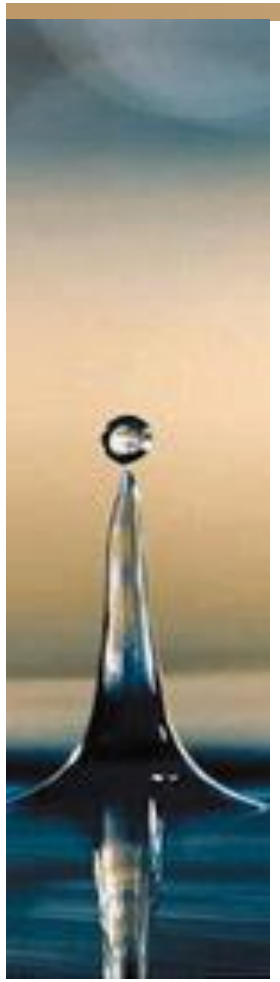
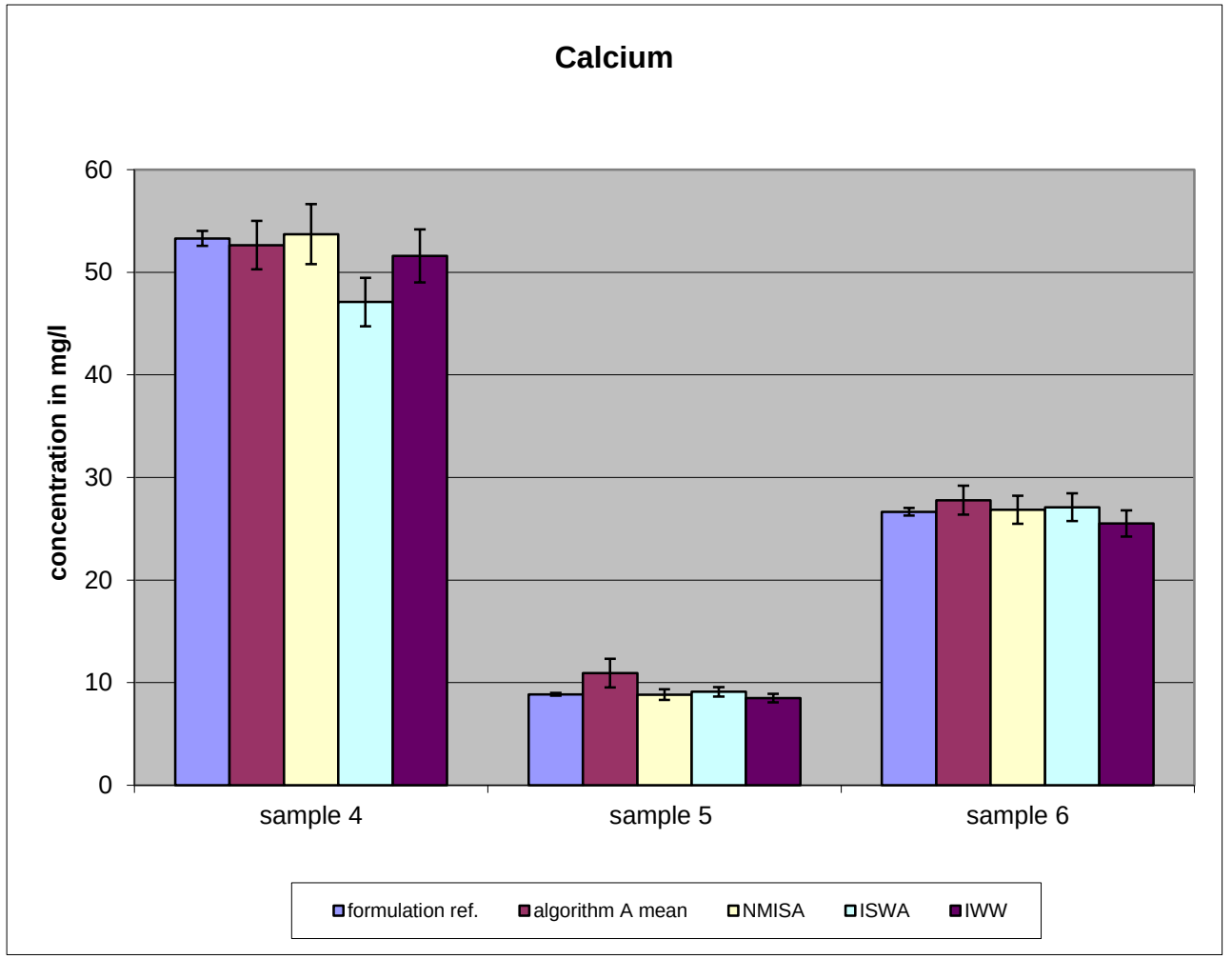
Let's go forward

Calcium
mean vs. ref.-value





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Namibia Water Corporation Ltd

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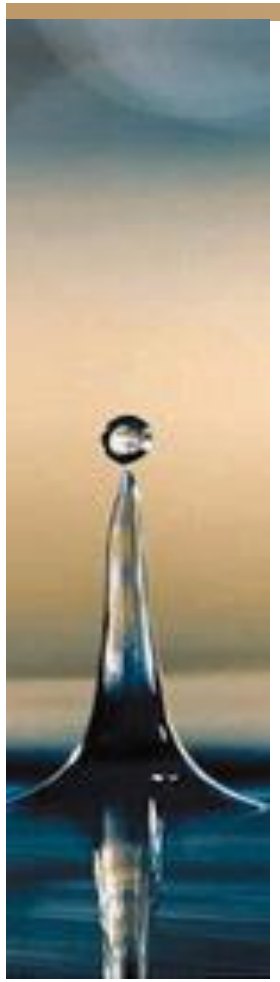
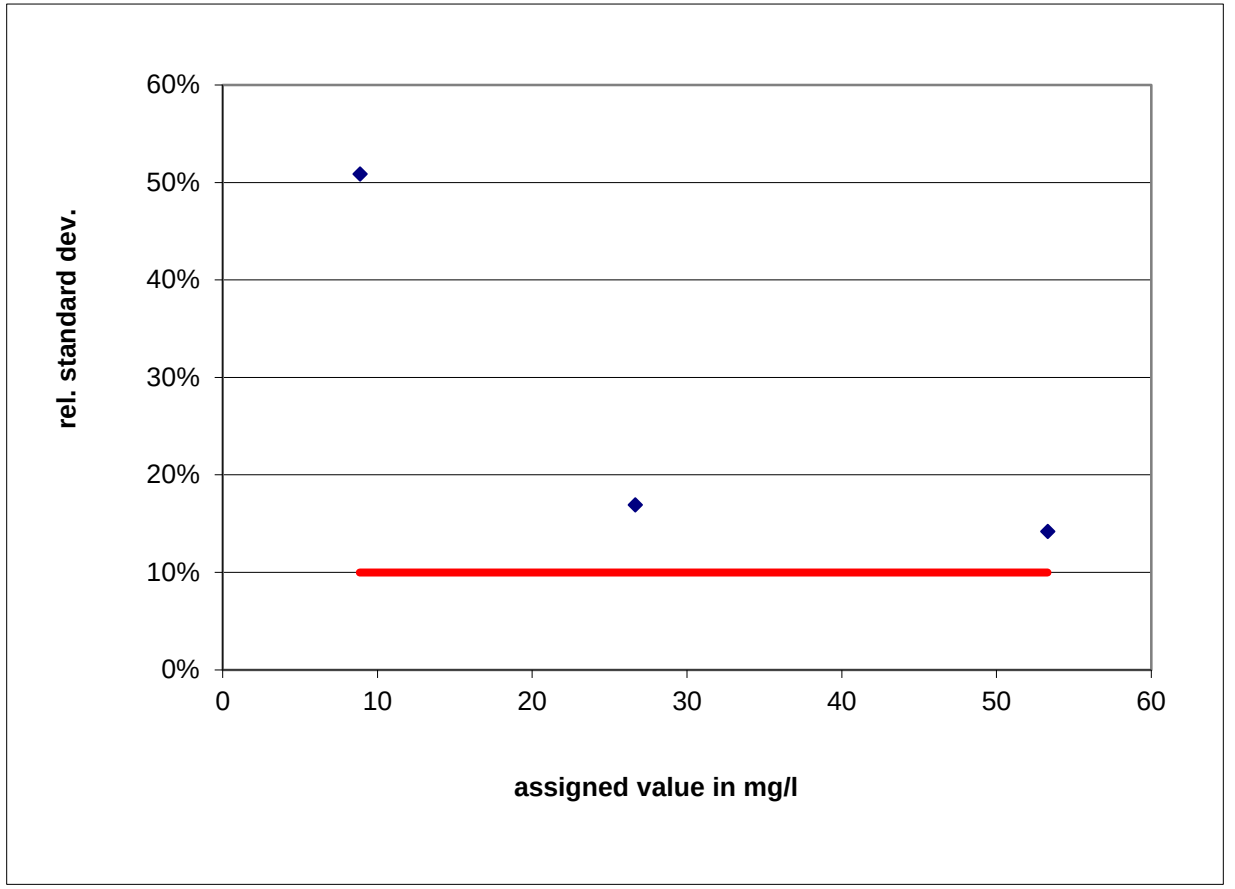
Let's go forward

Calcium

Calculated standard deviation and limit





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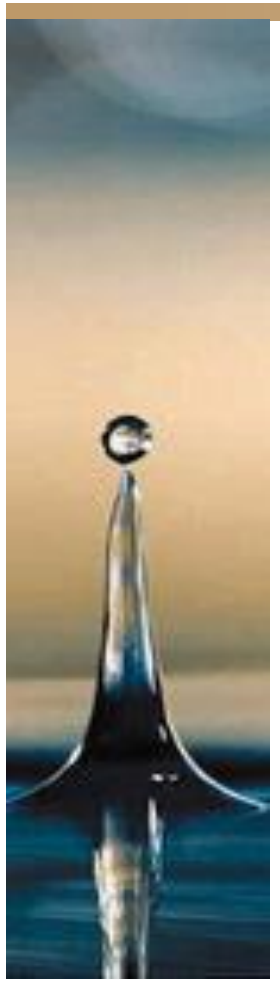
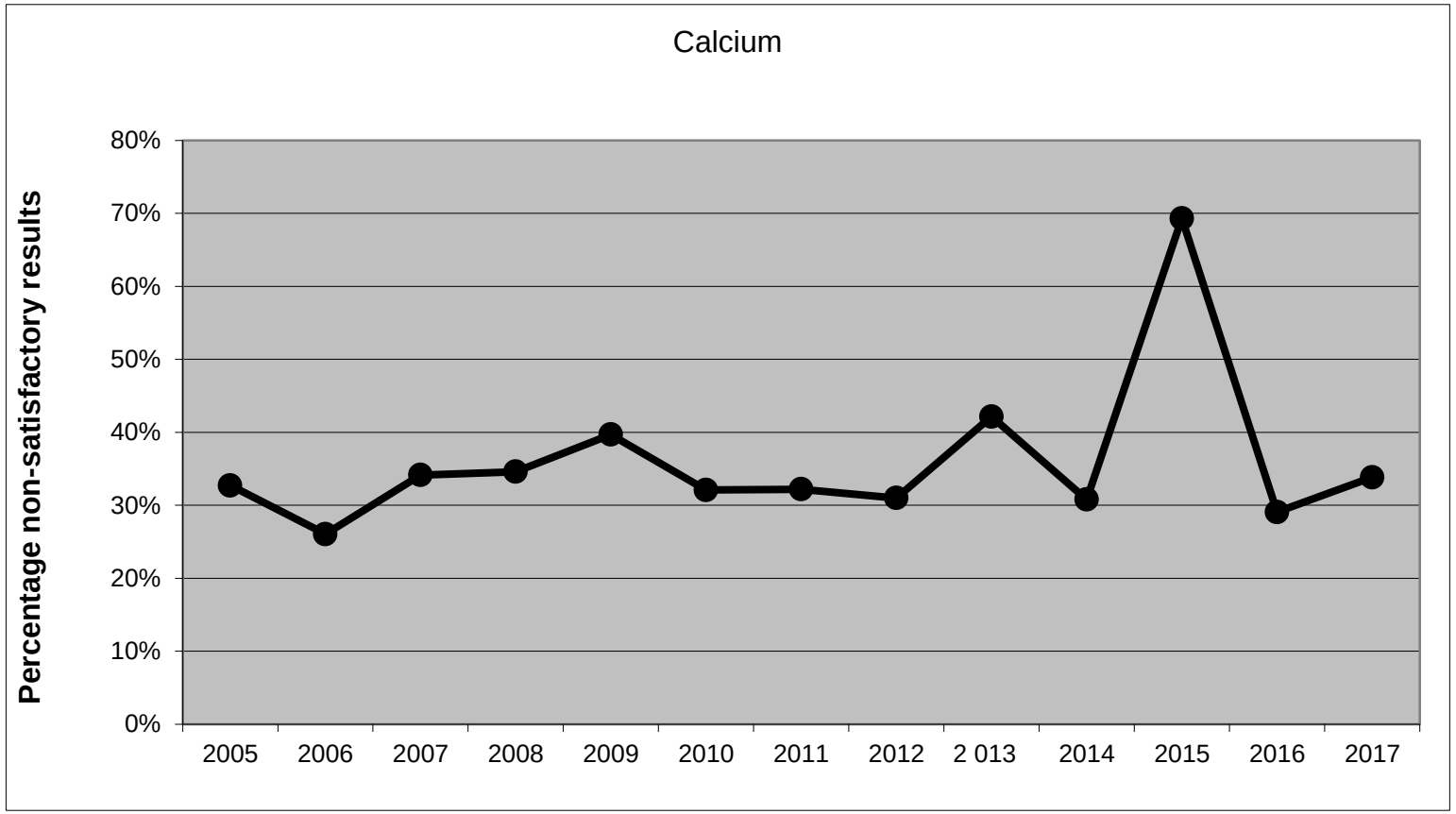
Let's go forward

Calcium
Percentage non-satisfactory results





29.1 % to9 33.8 % in 2017

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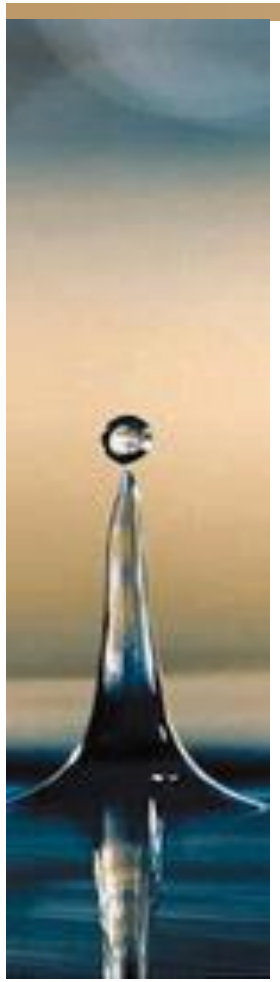
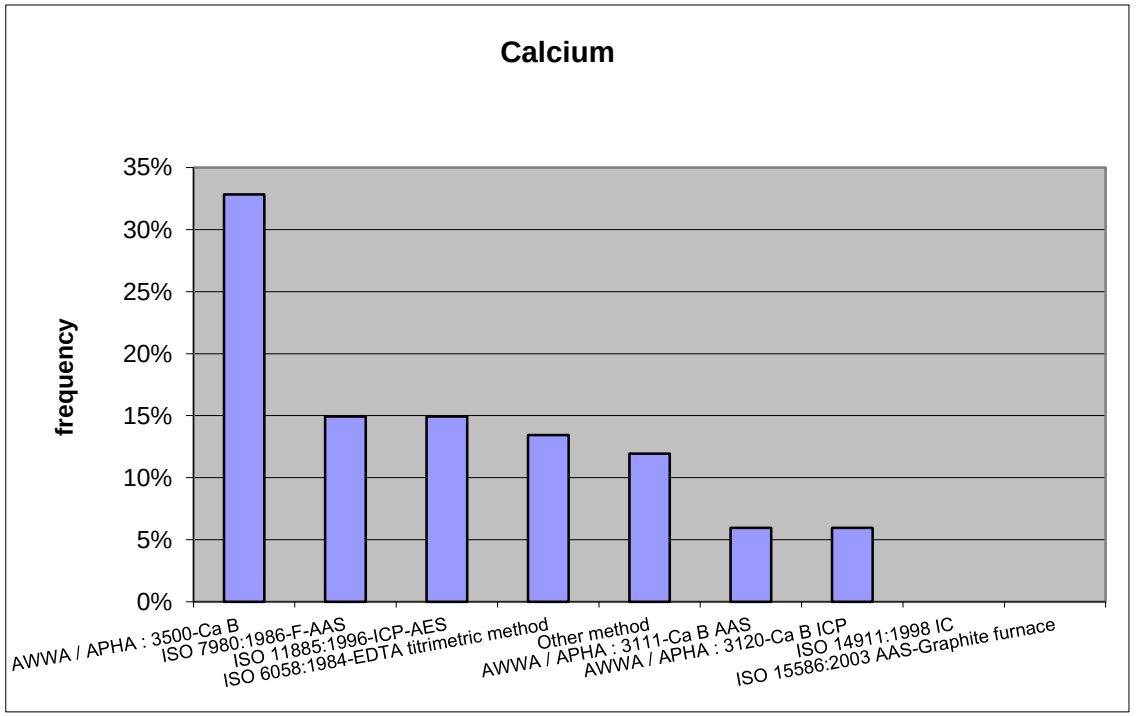
Let's go forward

Method used





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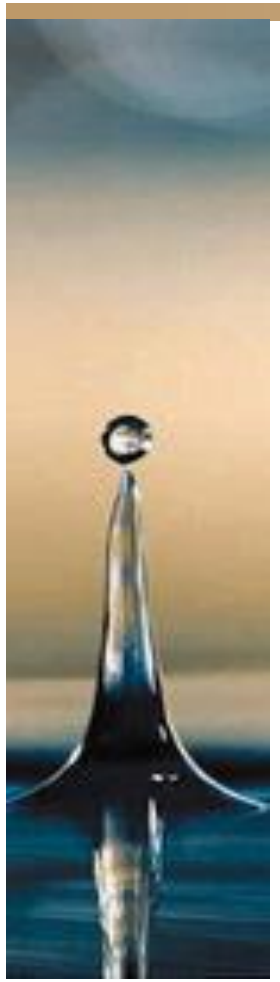
Let's go forward

Summary **Calcium**



- Perfect average recovery of 100 %
- STD for the lowest level is 50.8%
- Percentage of non-satisfactory results from 29.1 % to 33.8 % in 2017- no improvement

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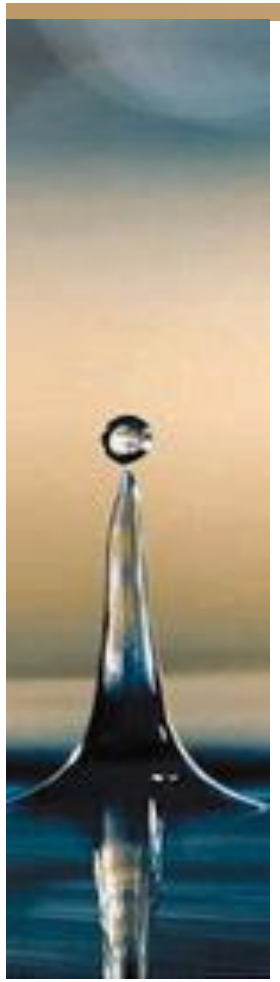
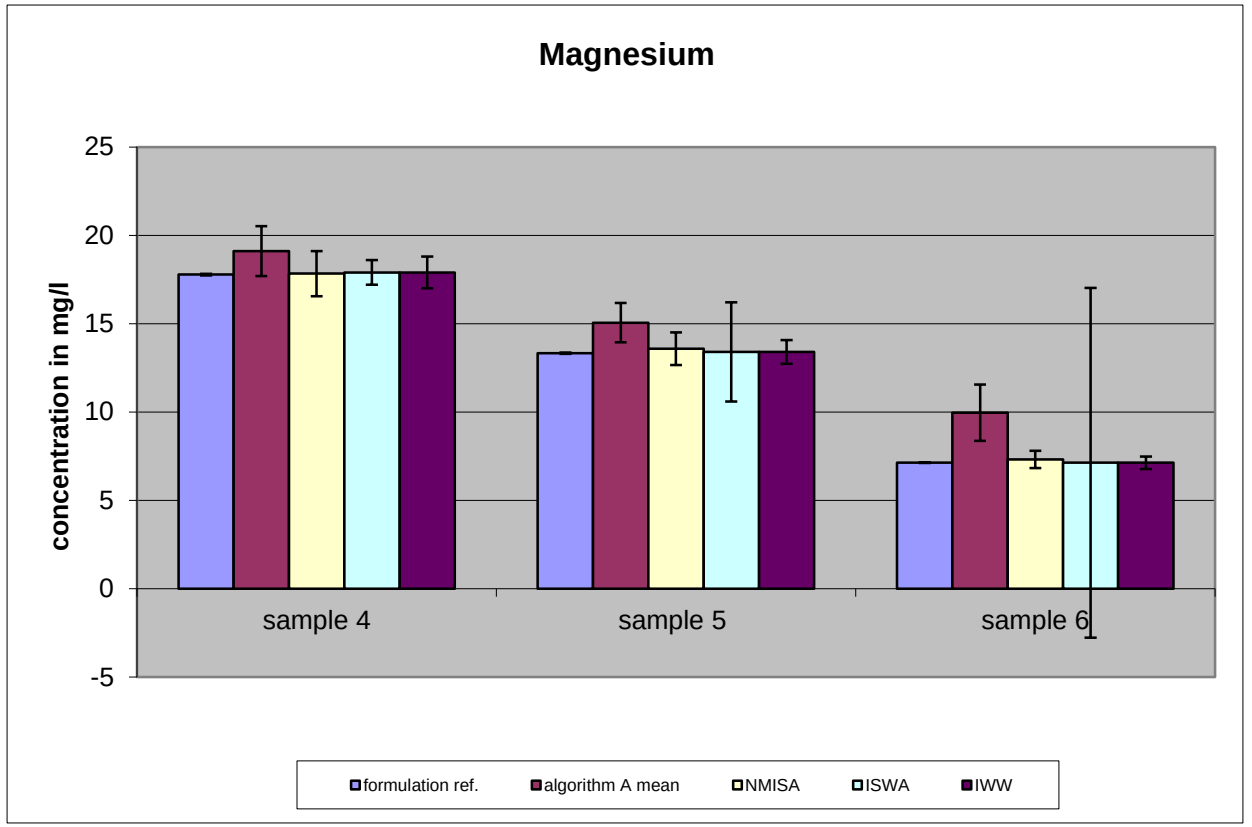
Magnesium
mean vs. ref.-value





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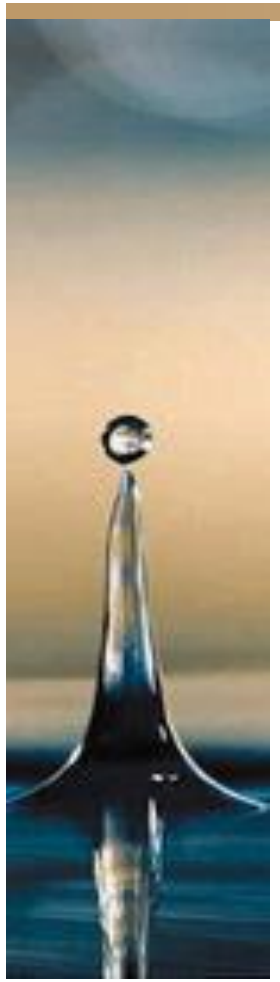
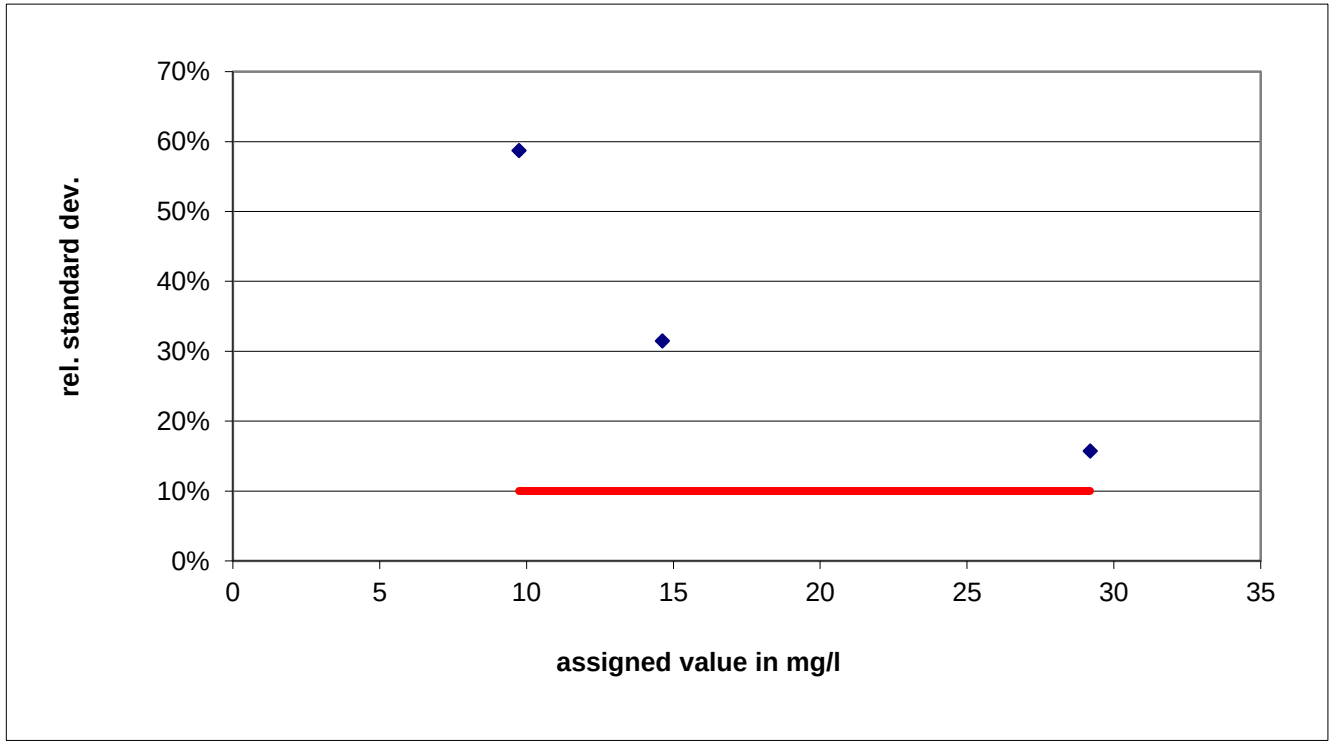
Magnesium
Calculated standard deviation and limit





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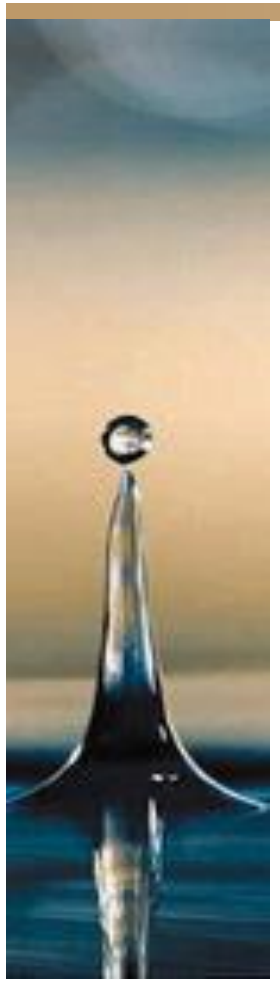
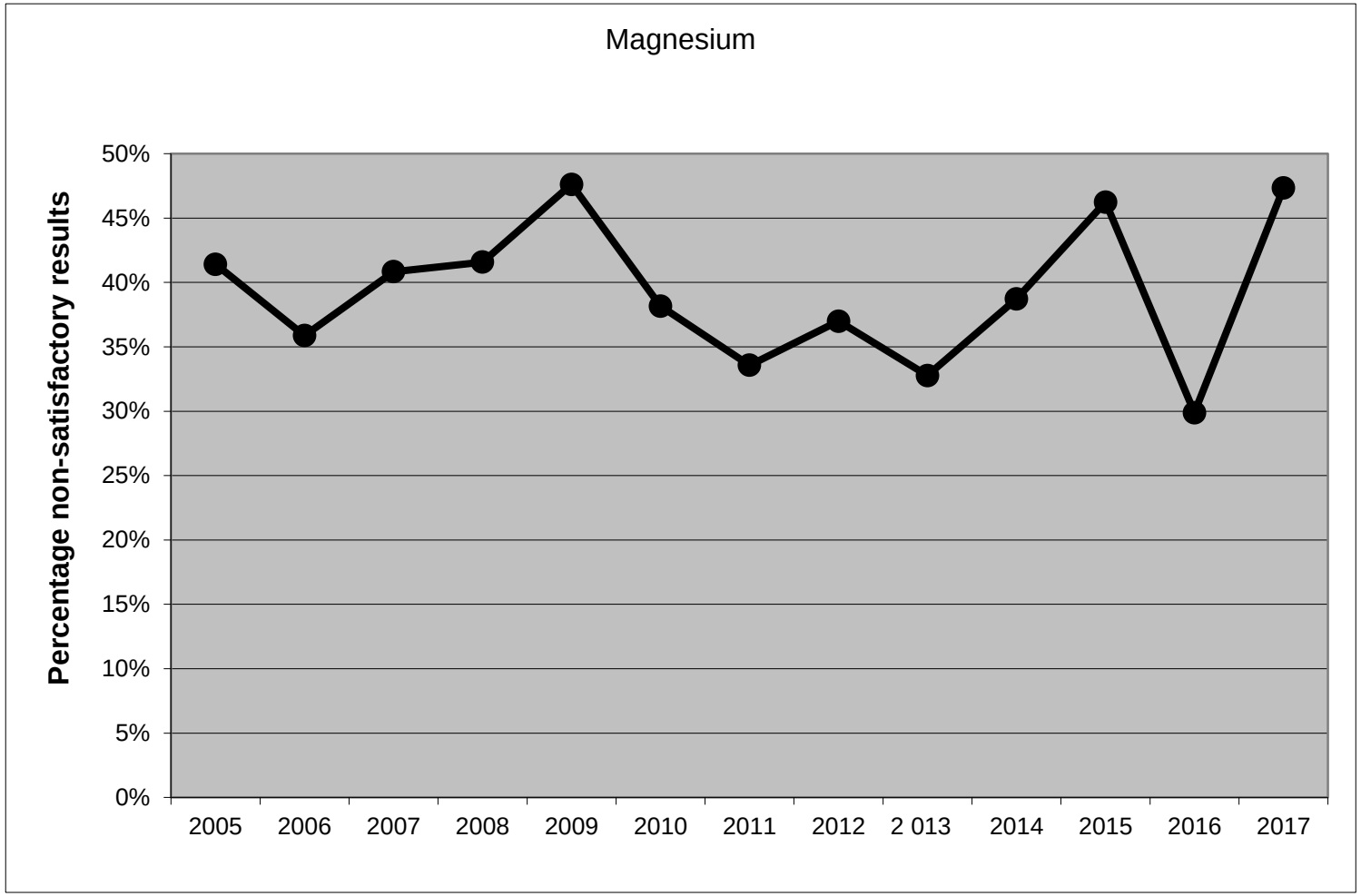
Magnesium
Percentage non-satisfactory results





29.9% to 47,3% in 2017

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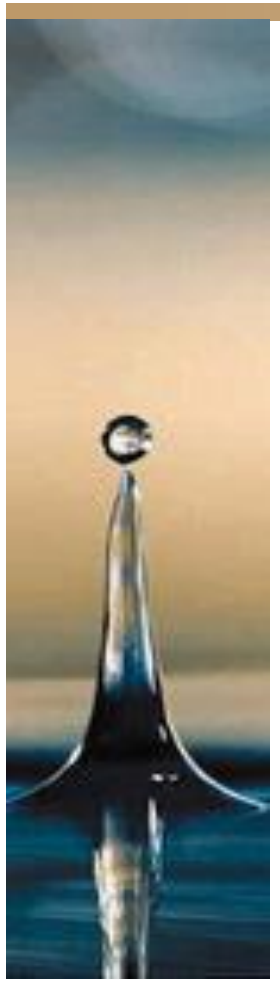
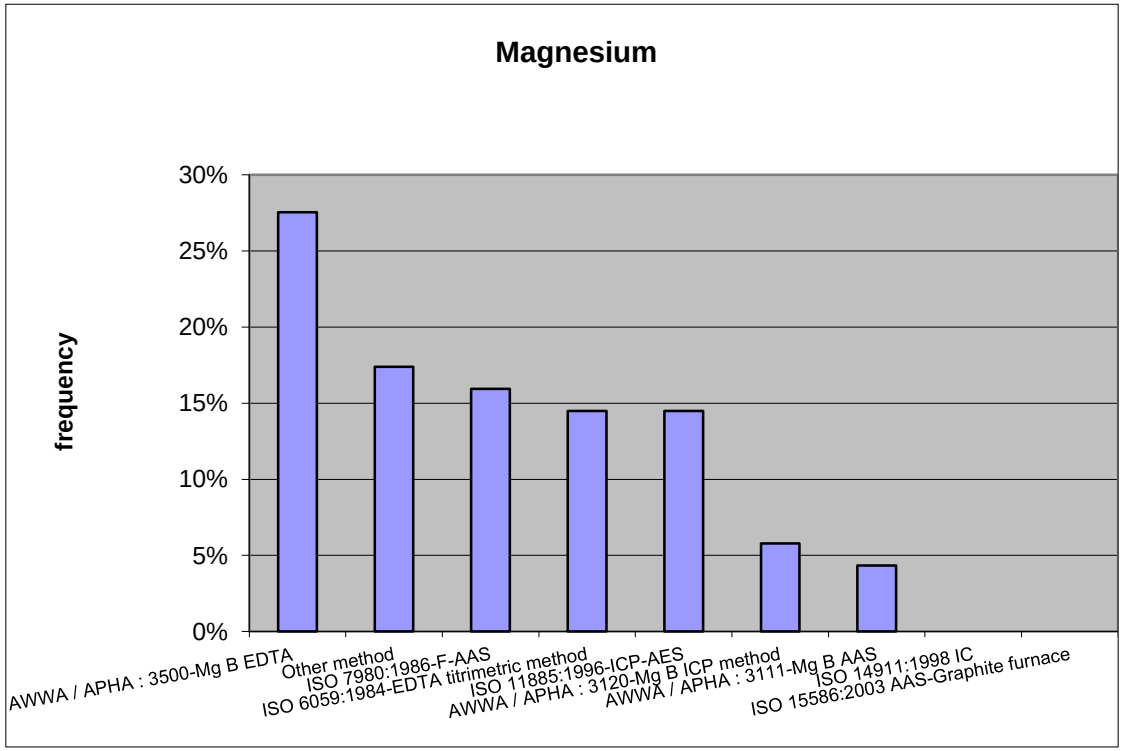
Let's go forward

Method used





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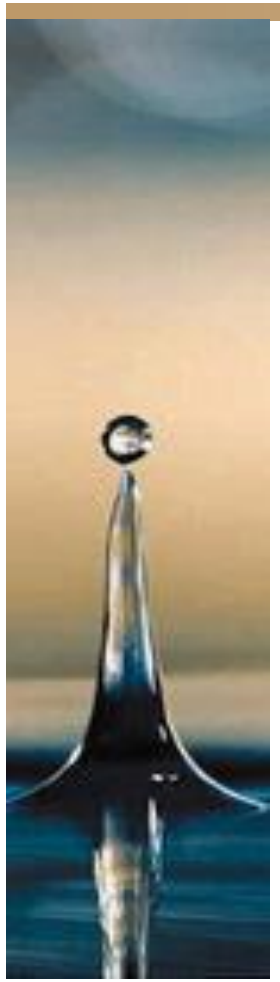
Summary **Magnesium**



- 17,4 % of “other” methods
- STD higher too high – 71.6 % for the lowest level
- Titrimetric results - a high portion of too high results for this method
- No improvement in comparison with last year

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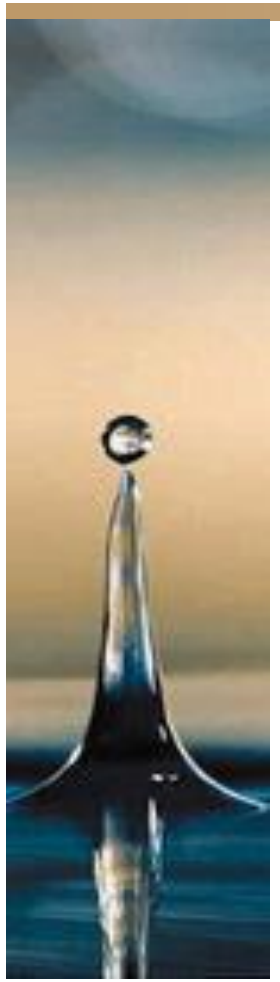
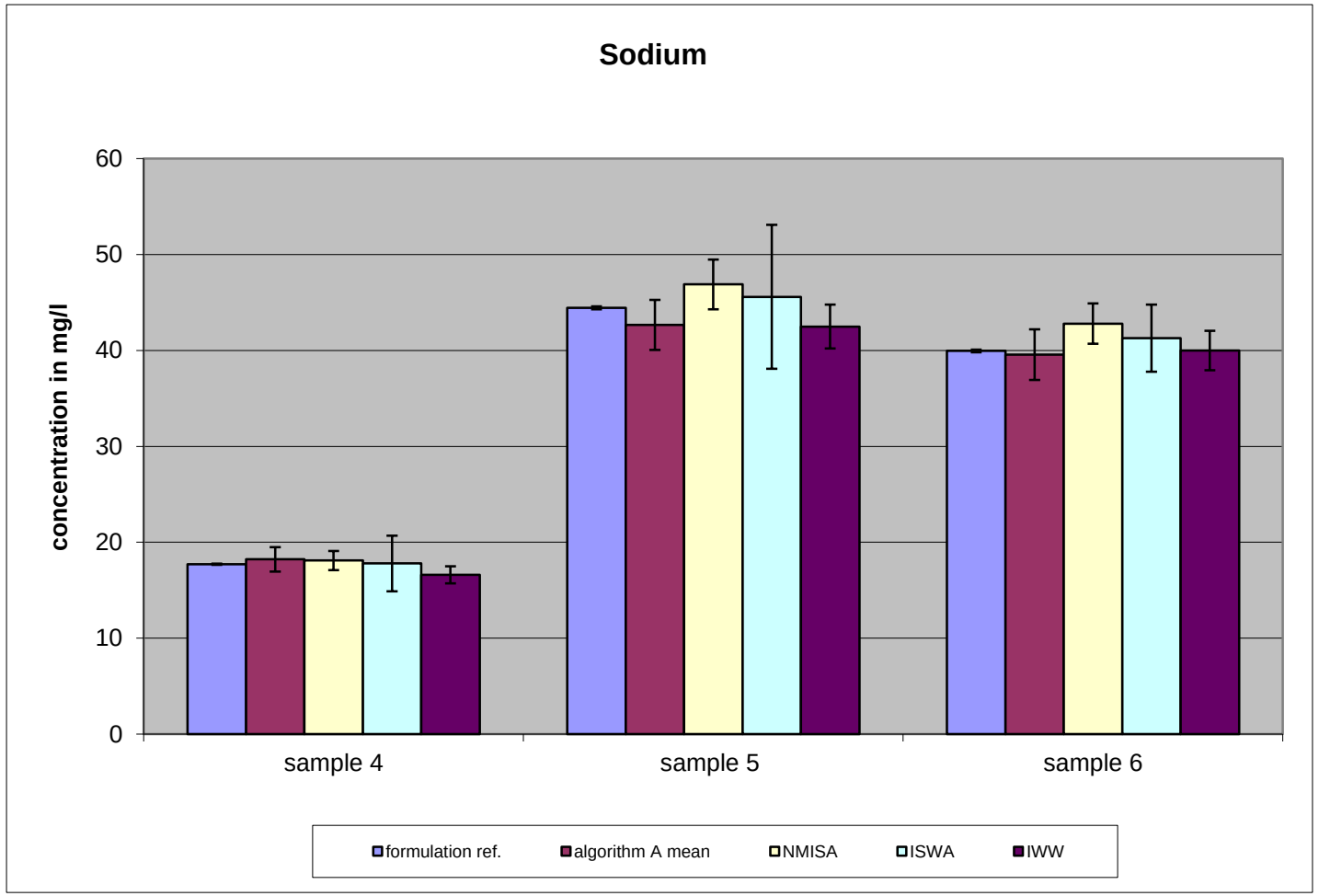
Sodium
mean vs. ref.-value





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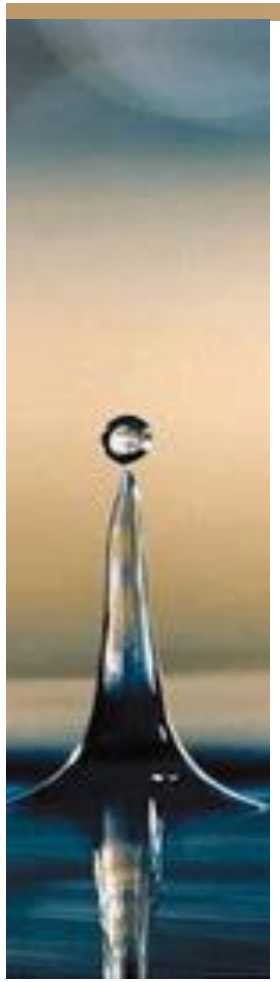
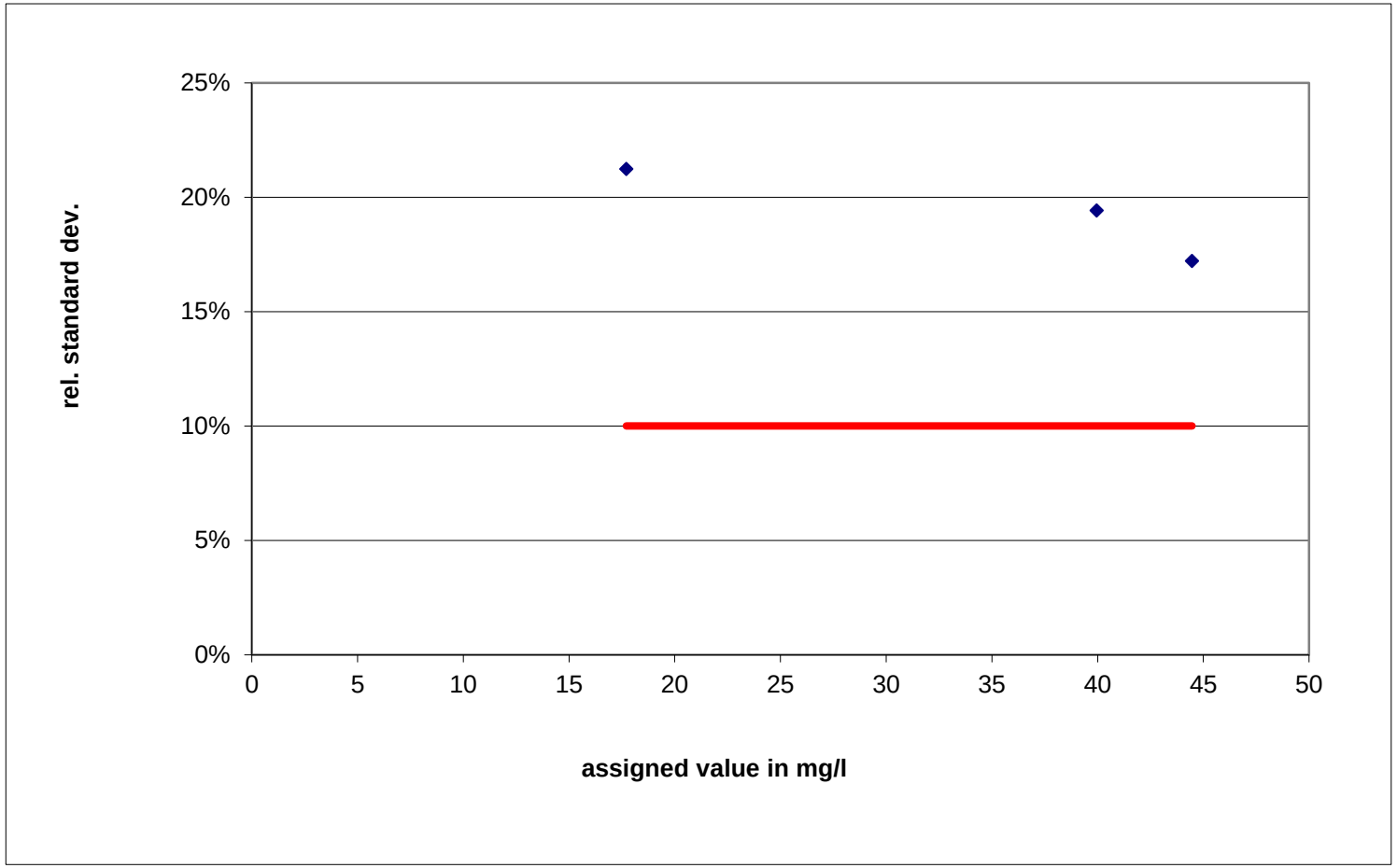
Let's go forward

Sodium
Calculated standard deviation and limit





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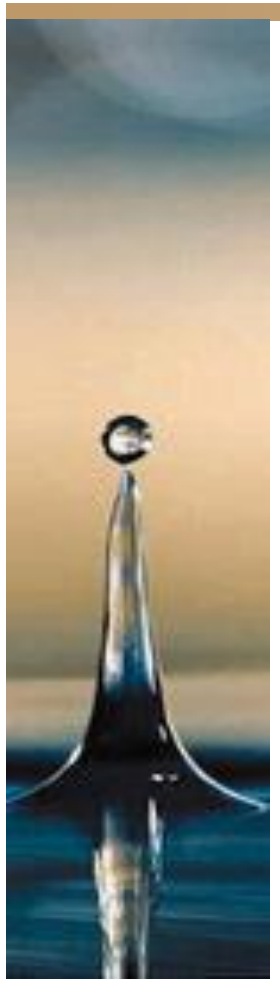
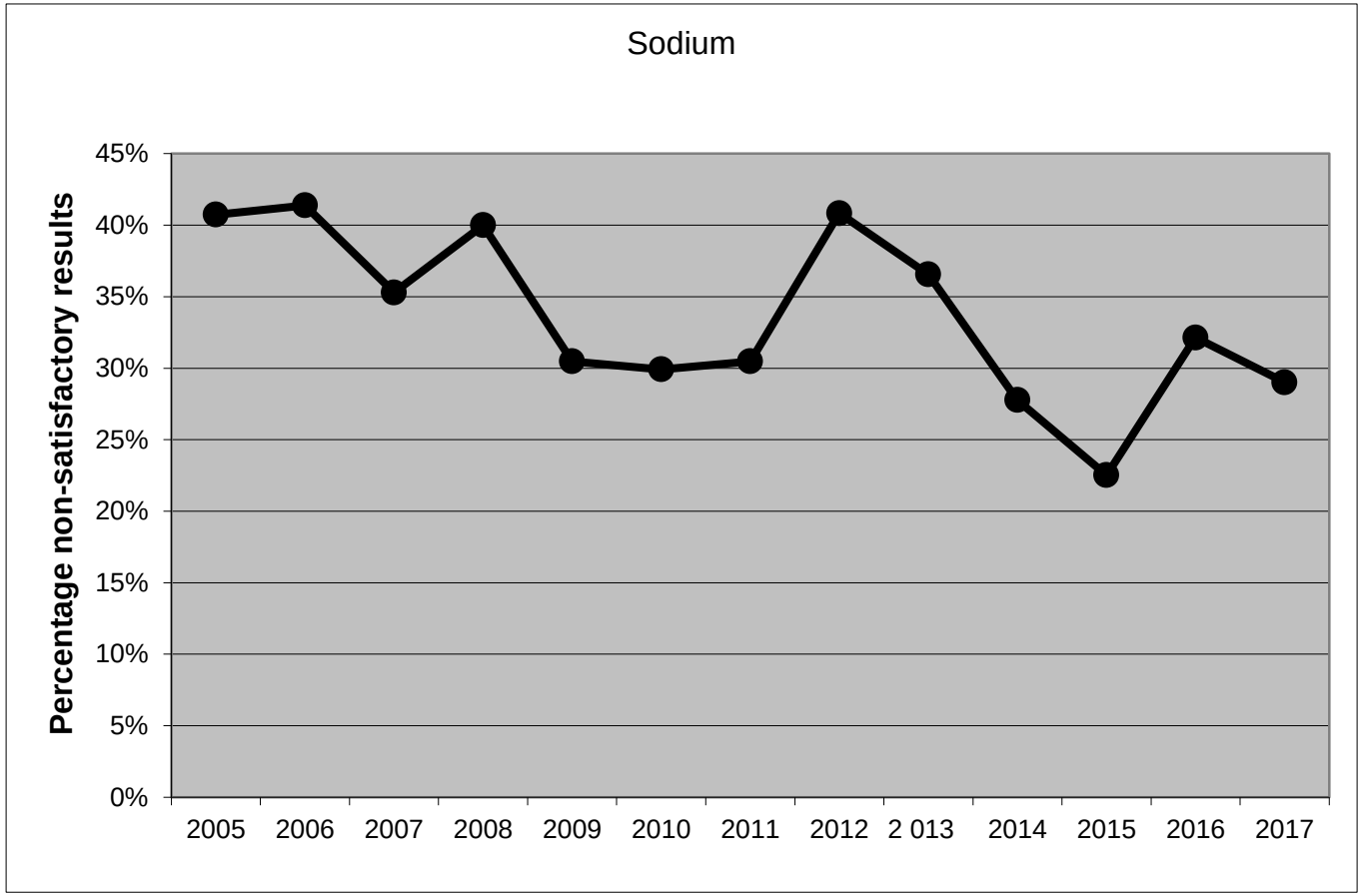
Sodium
Percentage non-satisfactory results





32.1% to 29.0% in 2017

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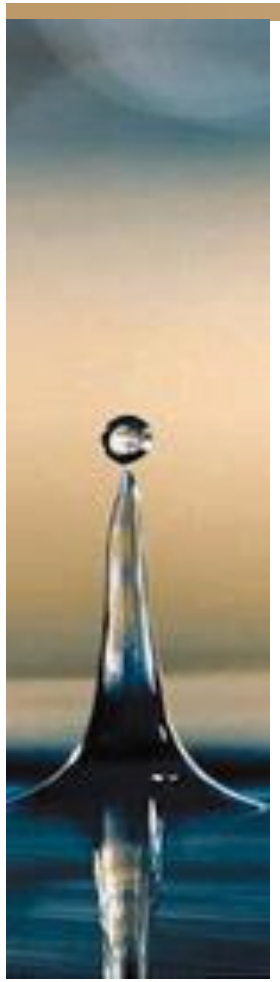
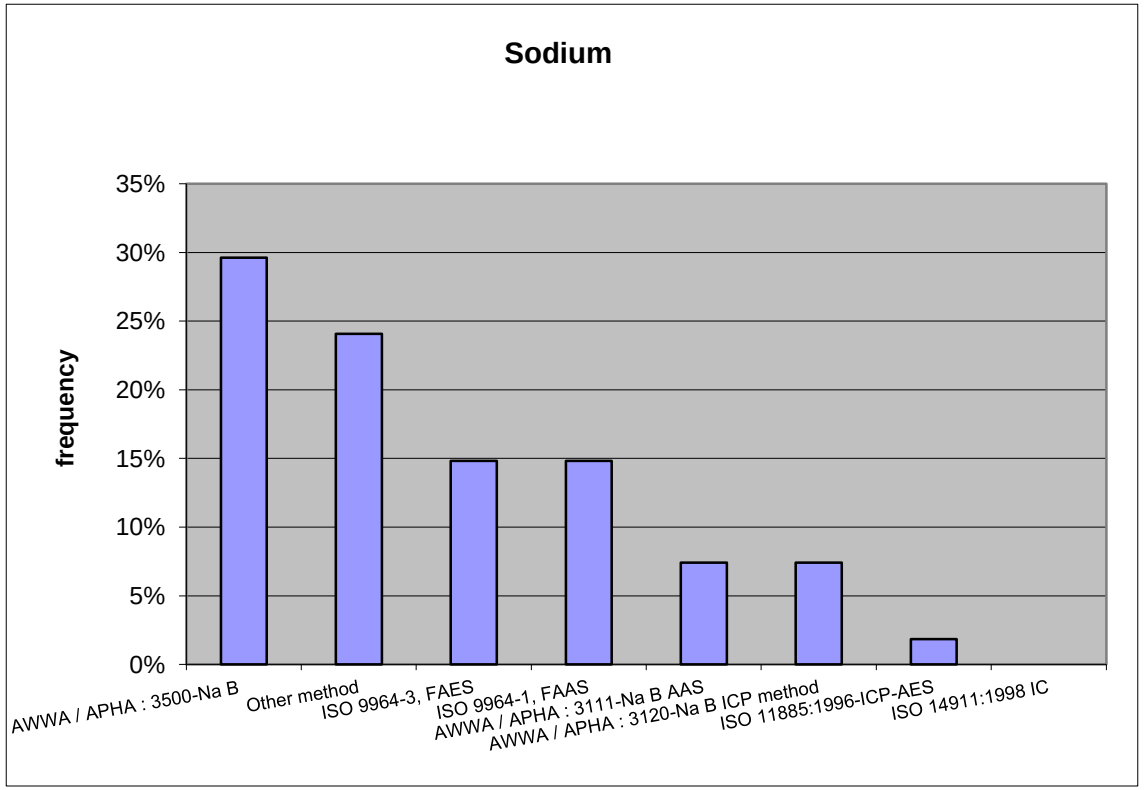
Let's go forward

Method used





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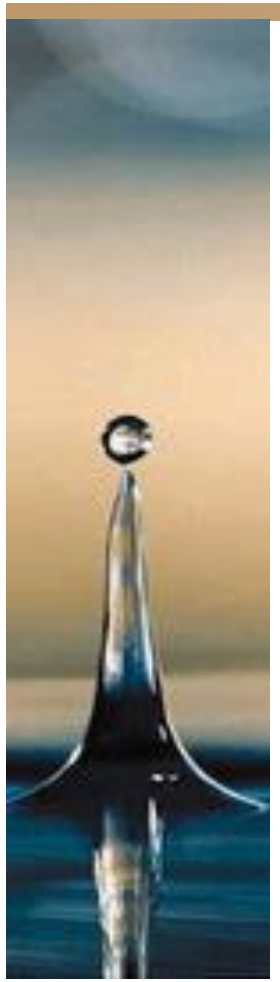
Let's go forward

Summary **Sodium**



- Again problems with high results for lowest level – high blank?
- STDs above 10%
- Percentage of non-satisfactory results improved from 32.1% to 29.0% in 2017

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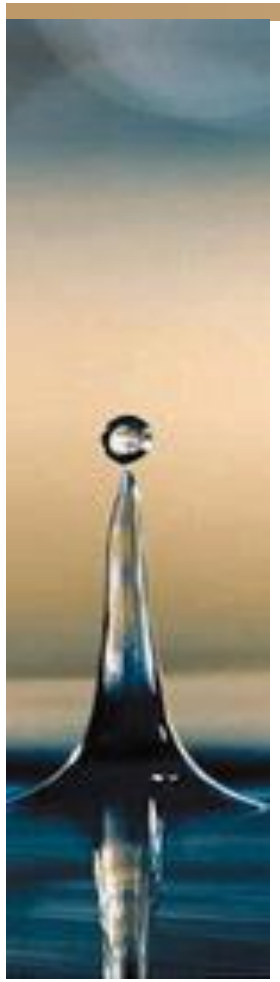
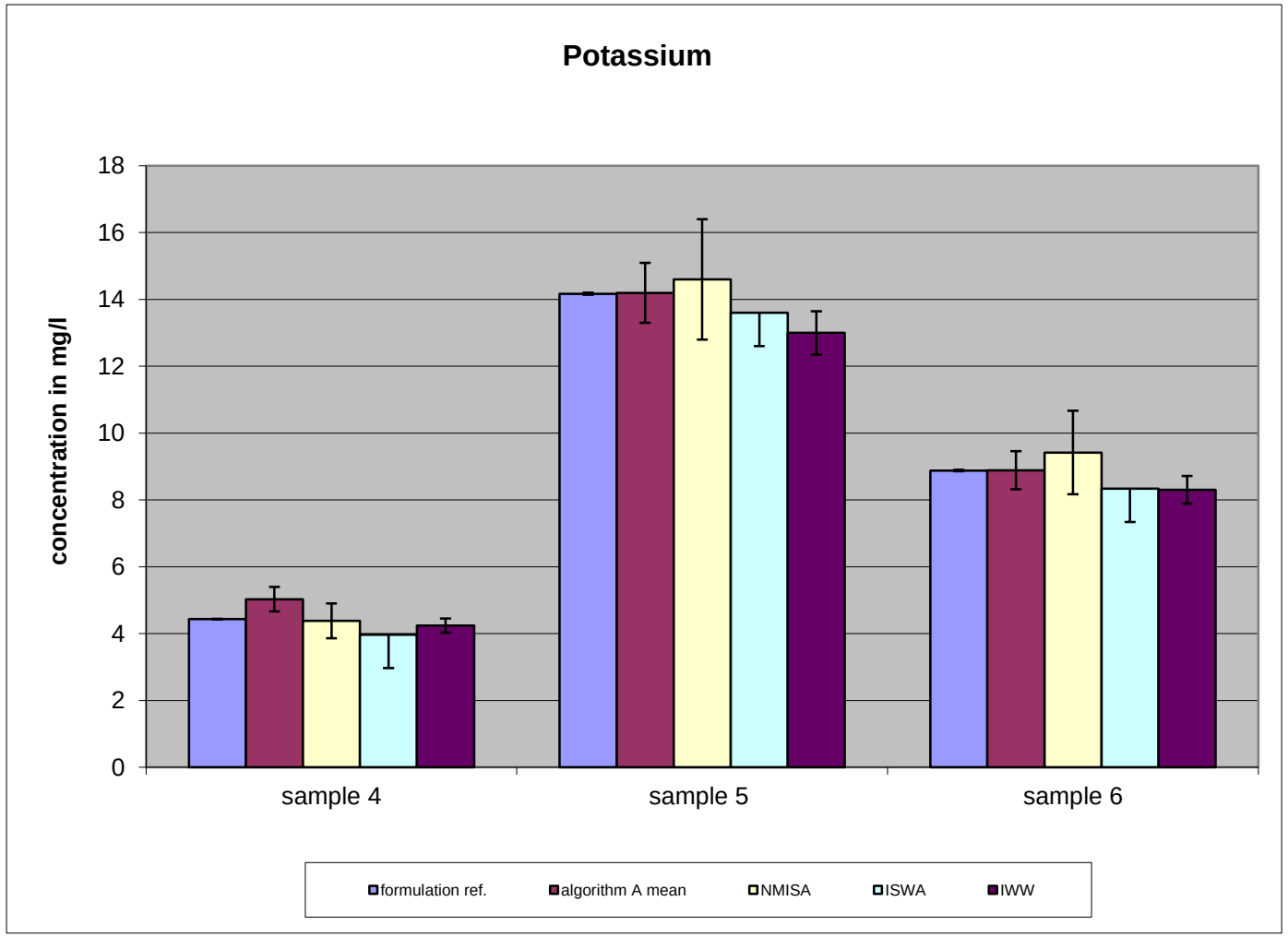
Let's go forward

Potassium
mean vs. ref.-value





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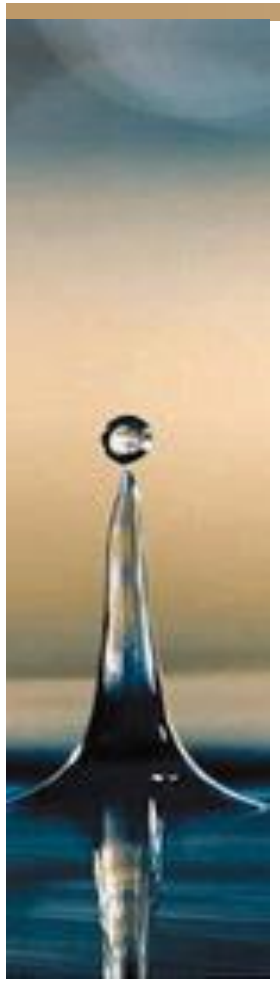
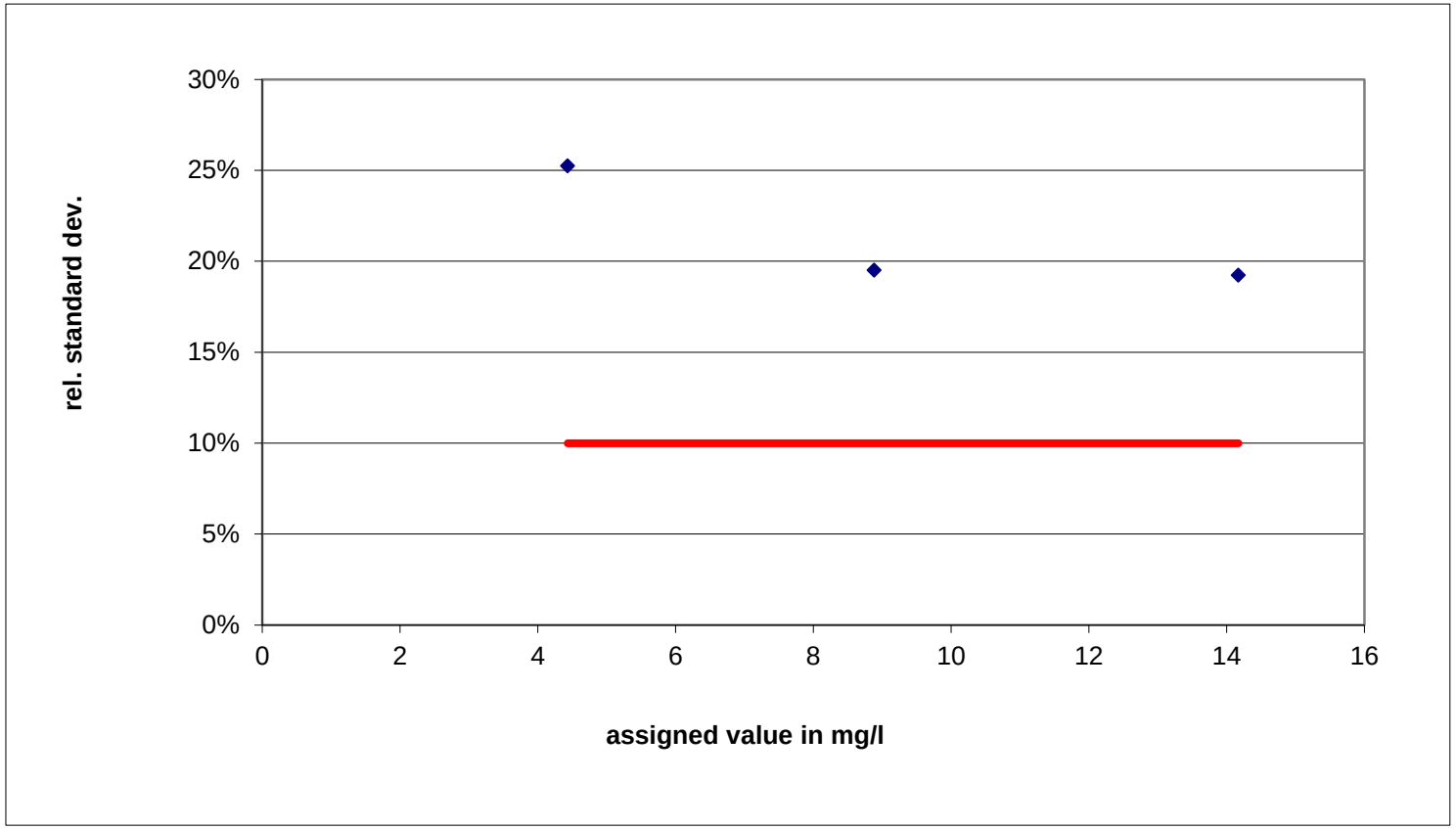
Let's go forward

Potassium

Calculated standard deviation and limit





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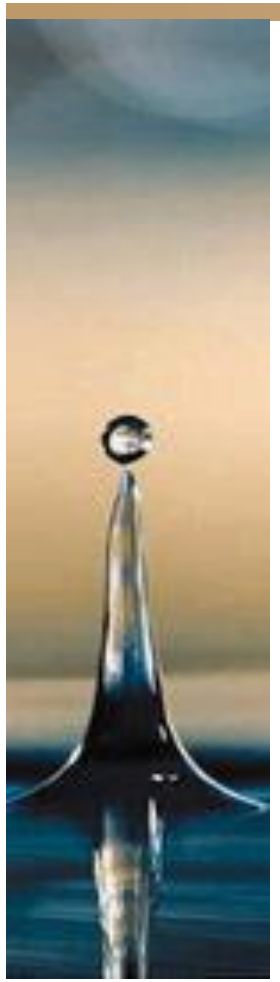
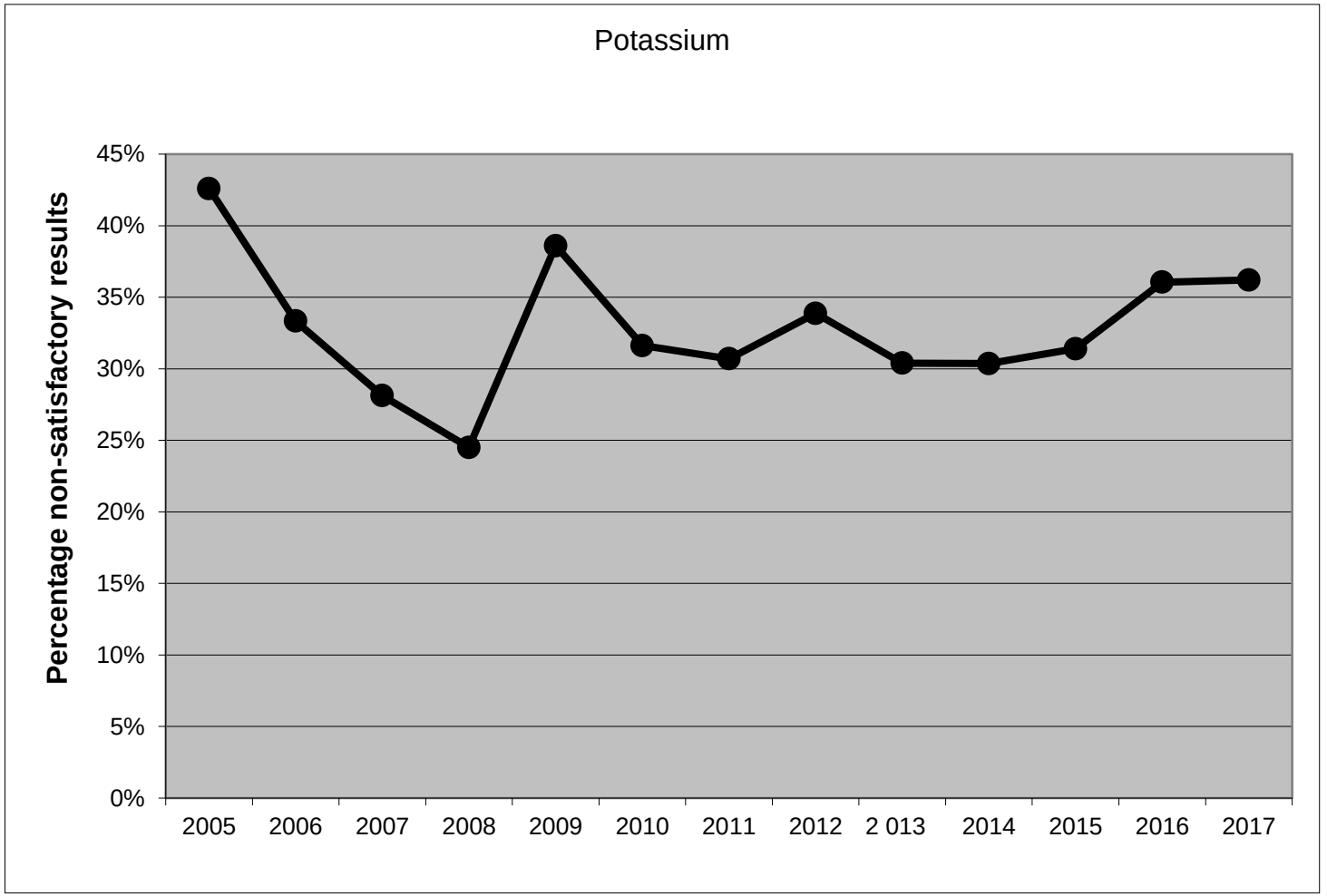
Let's go forward

Potassium

Percentage non-satisfactory results





36.1% to 36.2% in 2017

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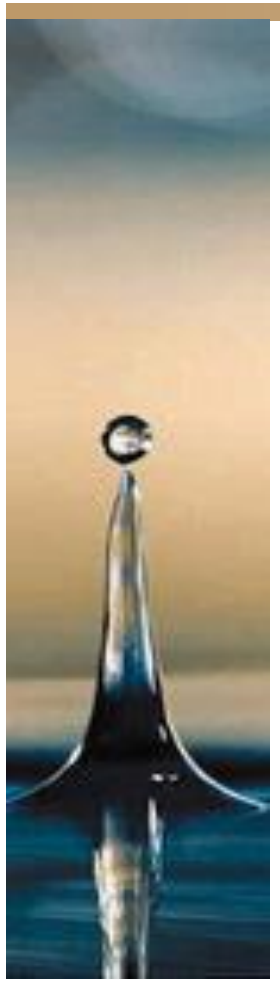
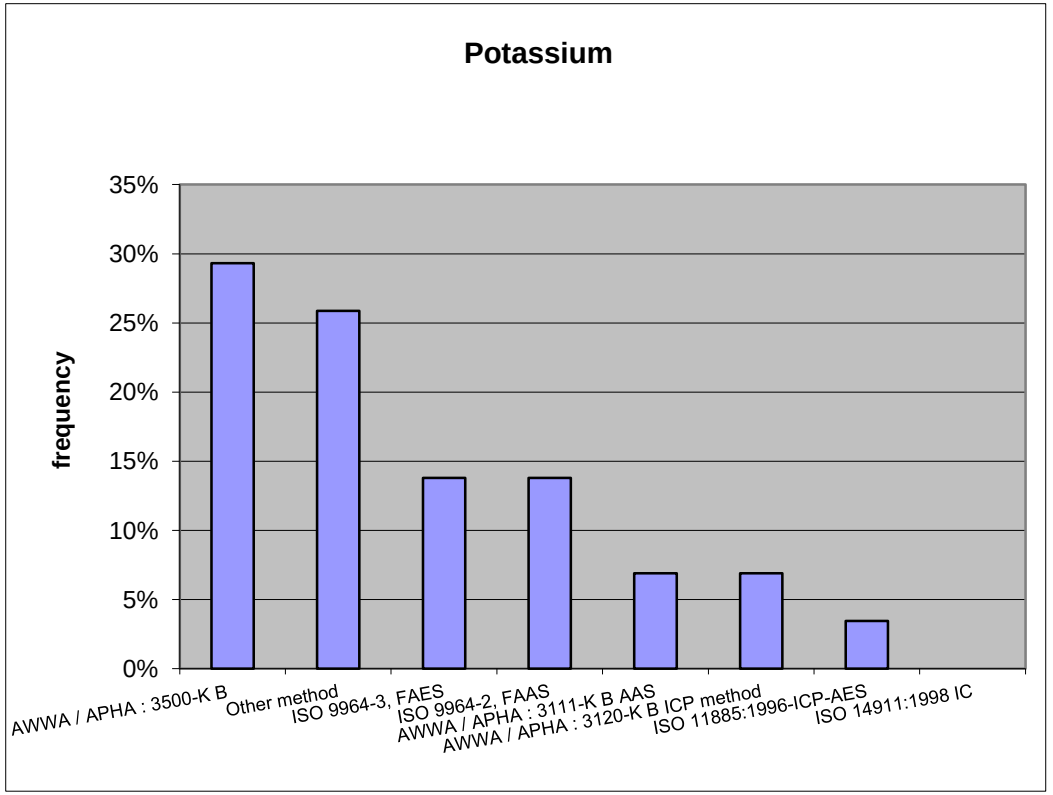
Let's go forward

Method used





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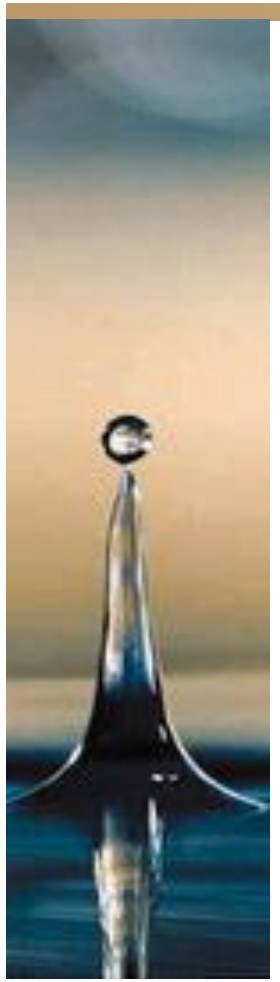
Let's go forward

Summary **Potassium**



- Average recovery is 101 % k
- STDs still outside the limits
- Percentage of non-satisfactory results still high

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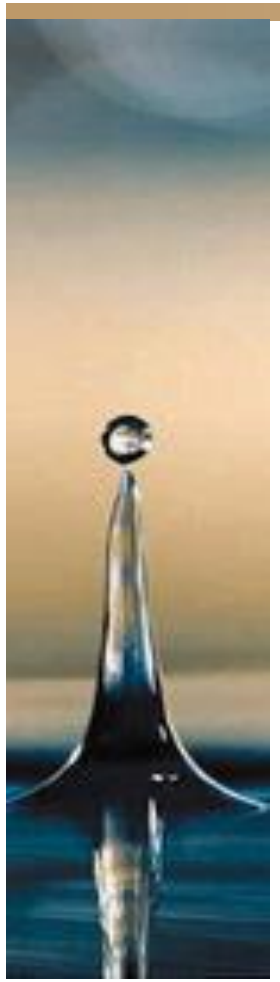
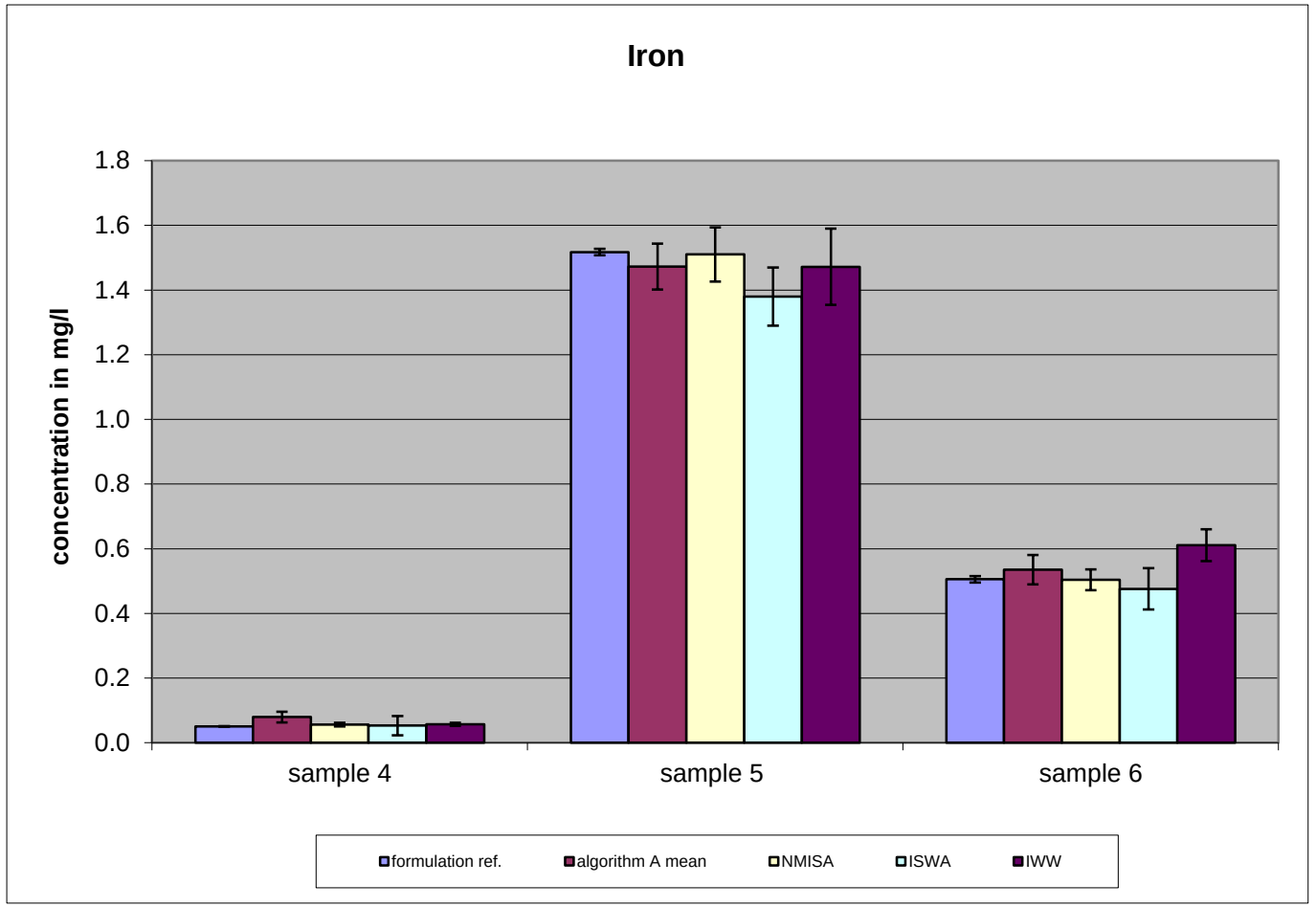
Let's go forward

Iron
mean vs. ref.-value





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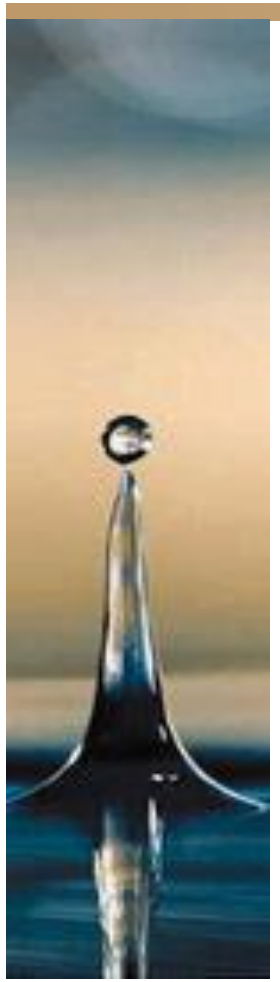
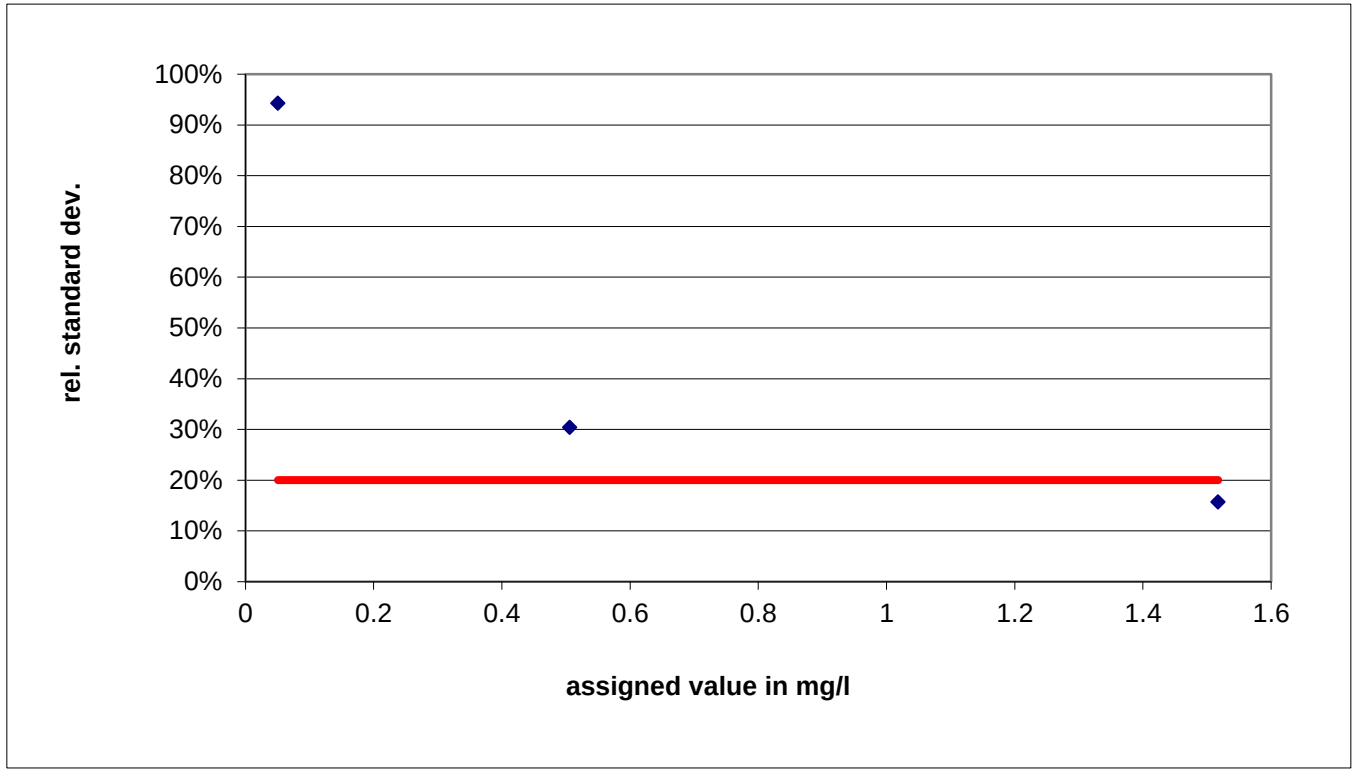
Let's go forward

Iron
Calculated standard deviation and limit





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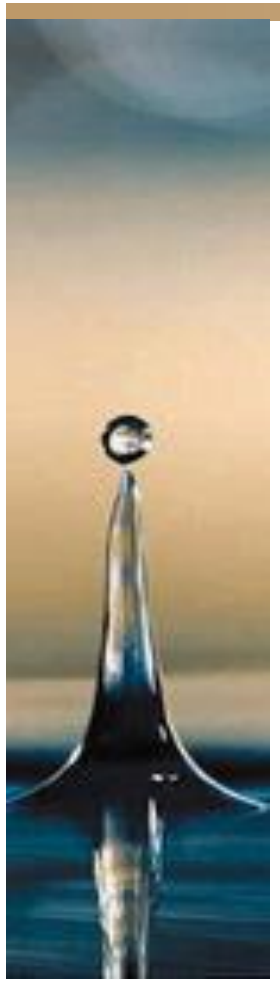
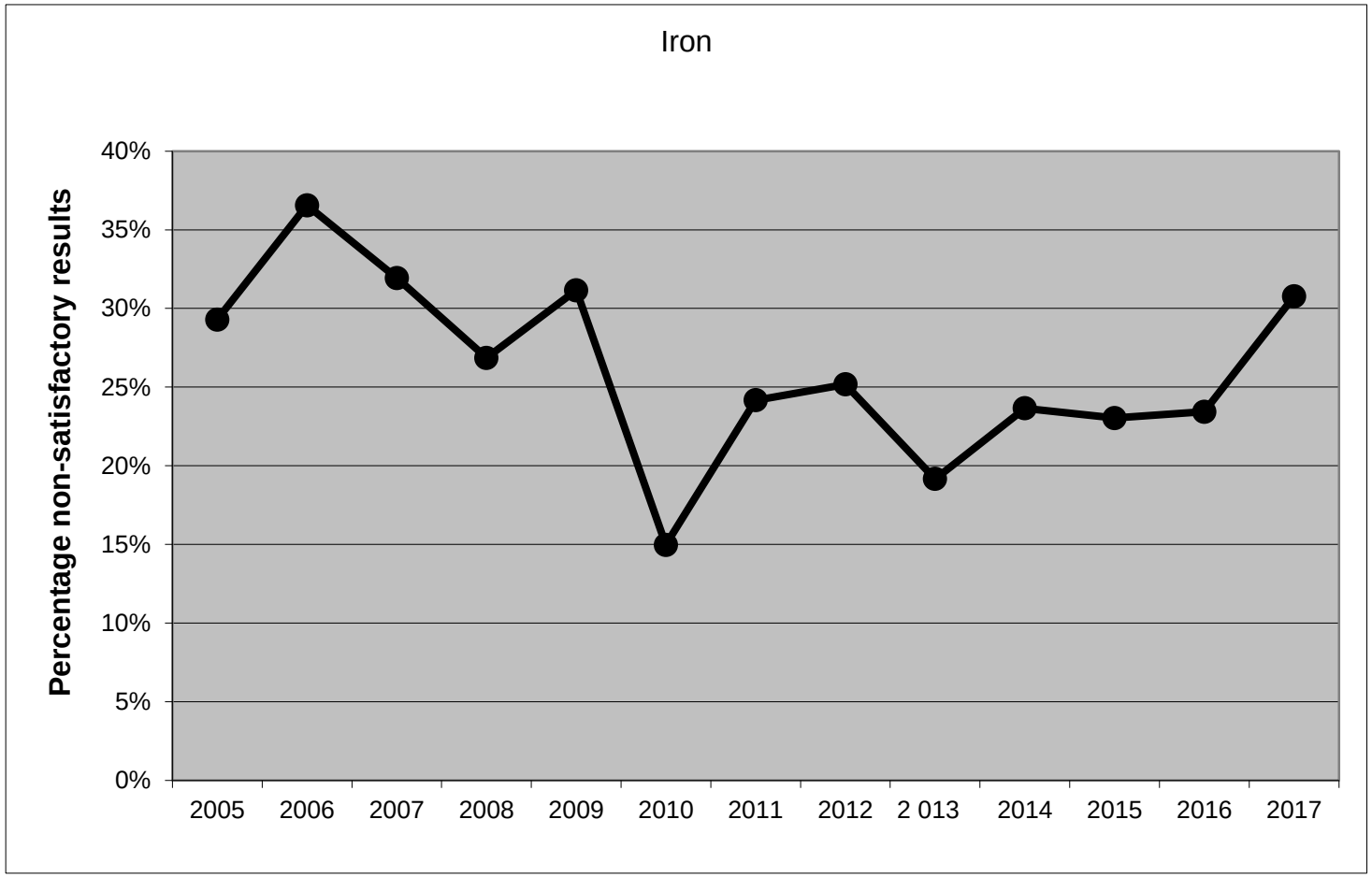
Let's go forward

Iron
Percentage non-satisfactory results





23.4% to 30.8% in 2017

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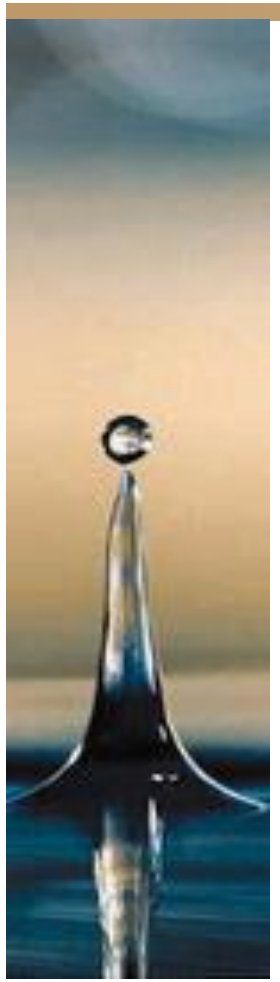
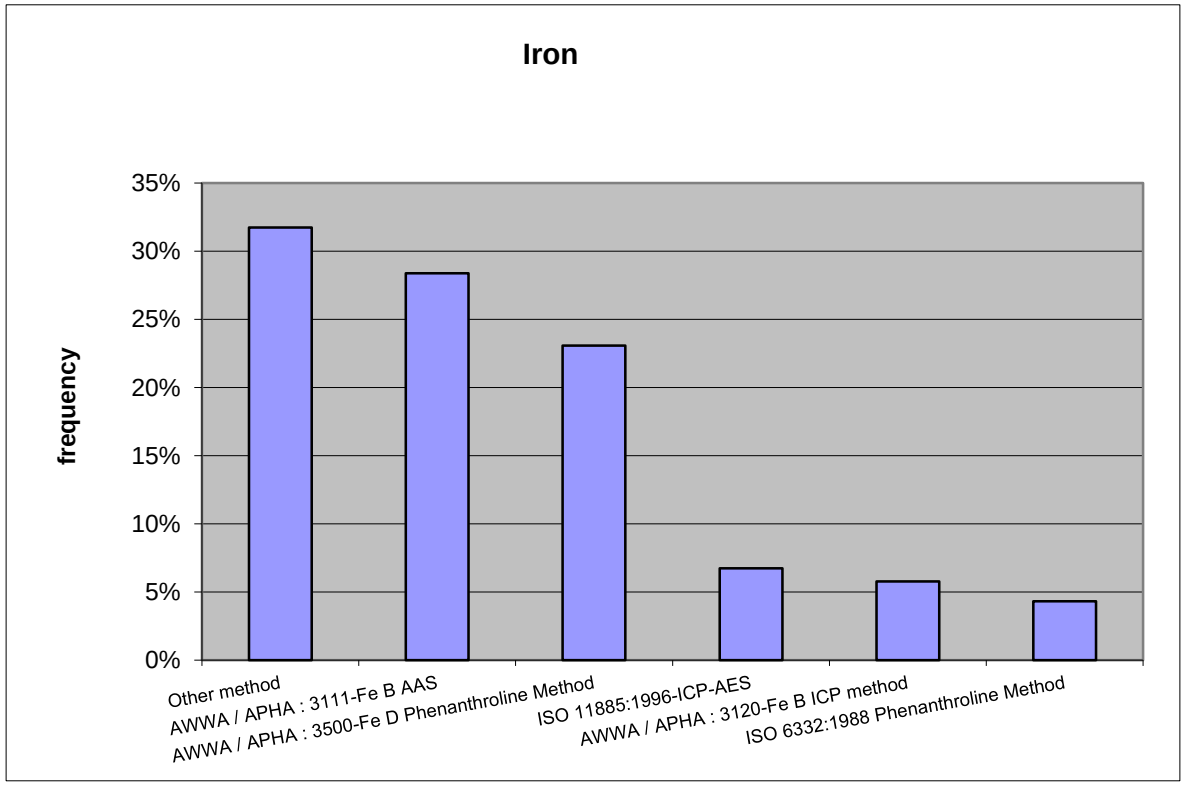
Let's go forward

Method used





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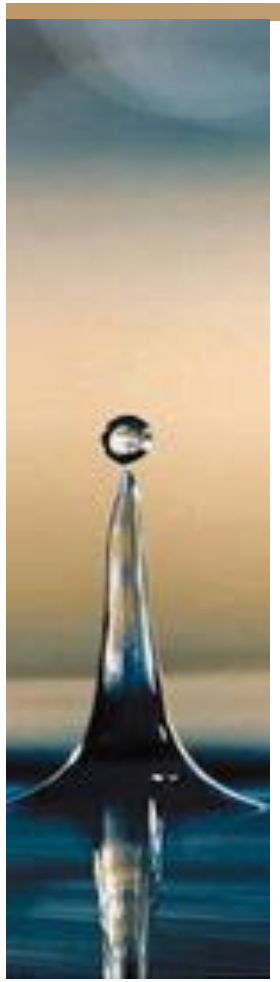
Let's go forward

Summary **Iron**



- Average recovery is 98%
- Significant improvement in 2017 for the lowest (68% to 28%) Now we are back to a SD of 94.23
- Problems with the lowest level – high blank
- Number of non-satisfactory results increased from 23.4% to 30.8% in 2017

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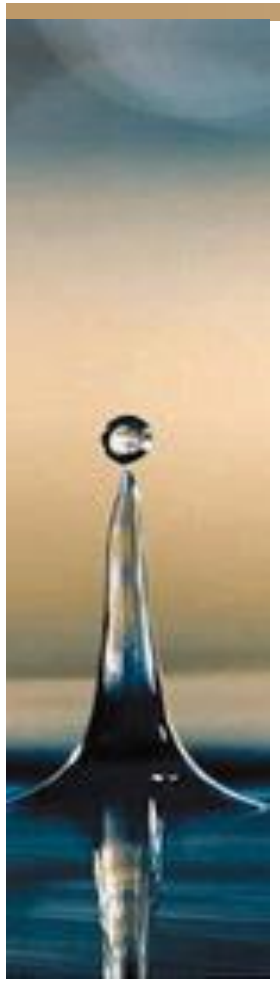
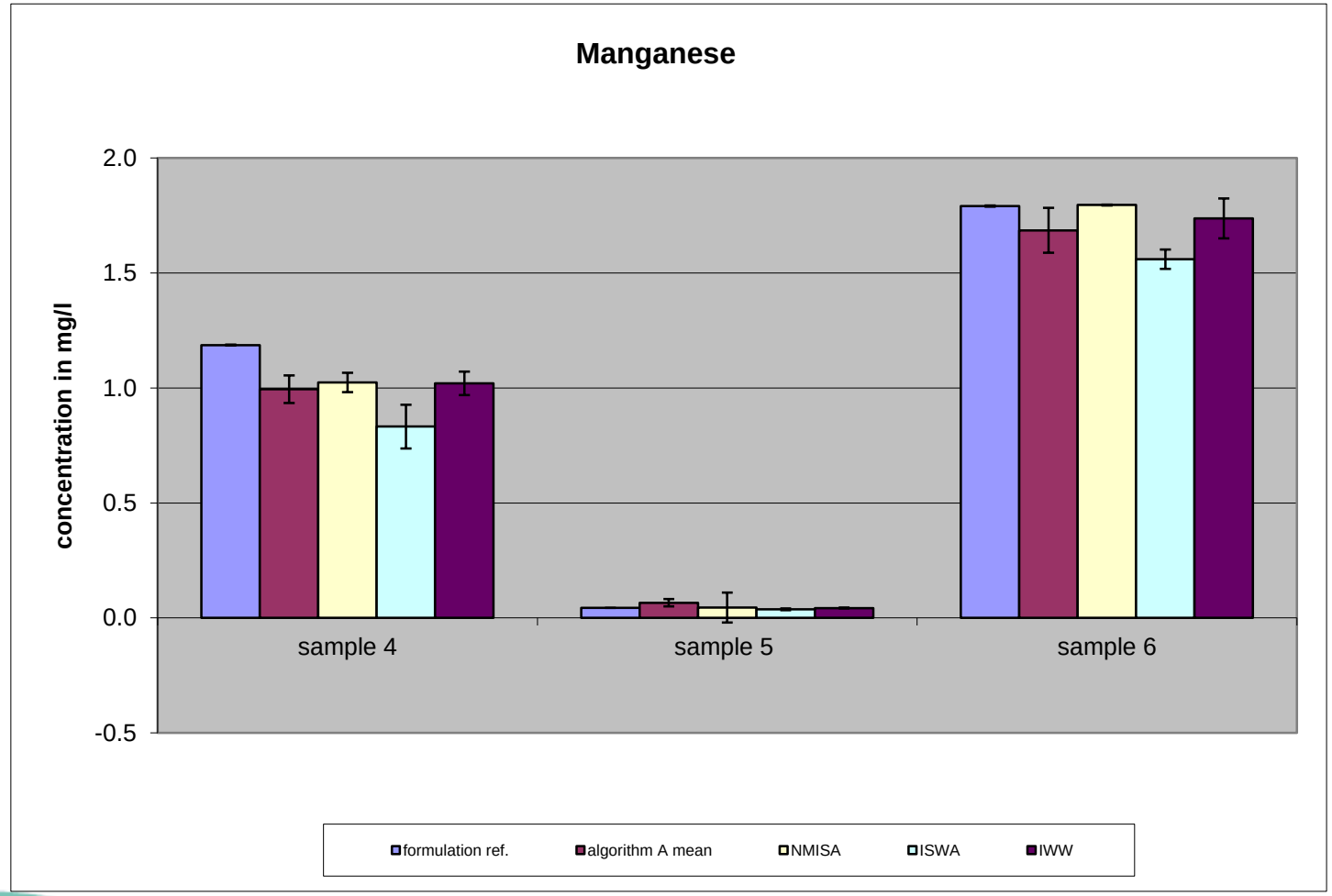
Let's go forward

Manganese
mean vs. ref.-value





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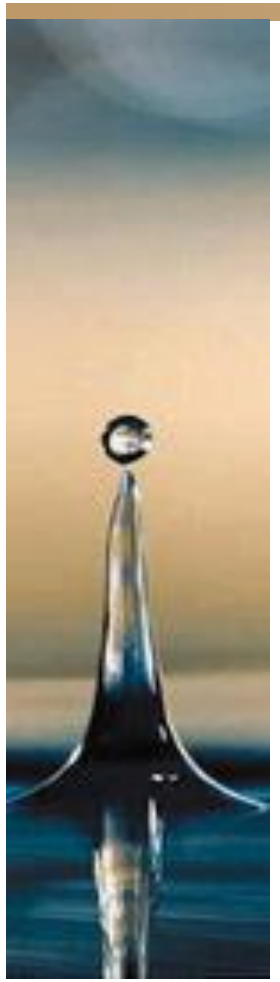
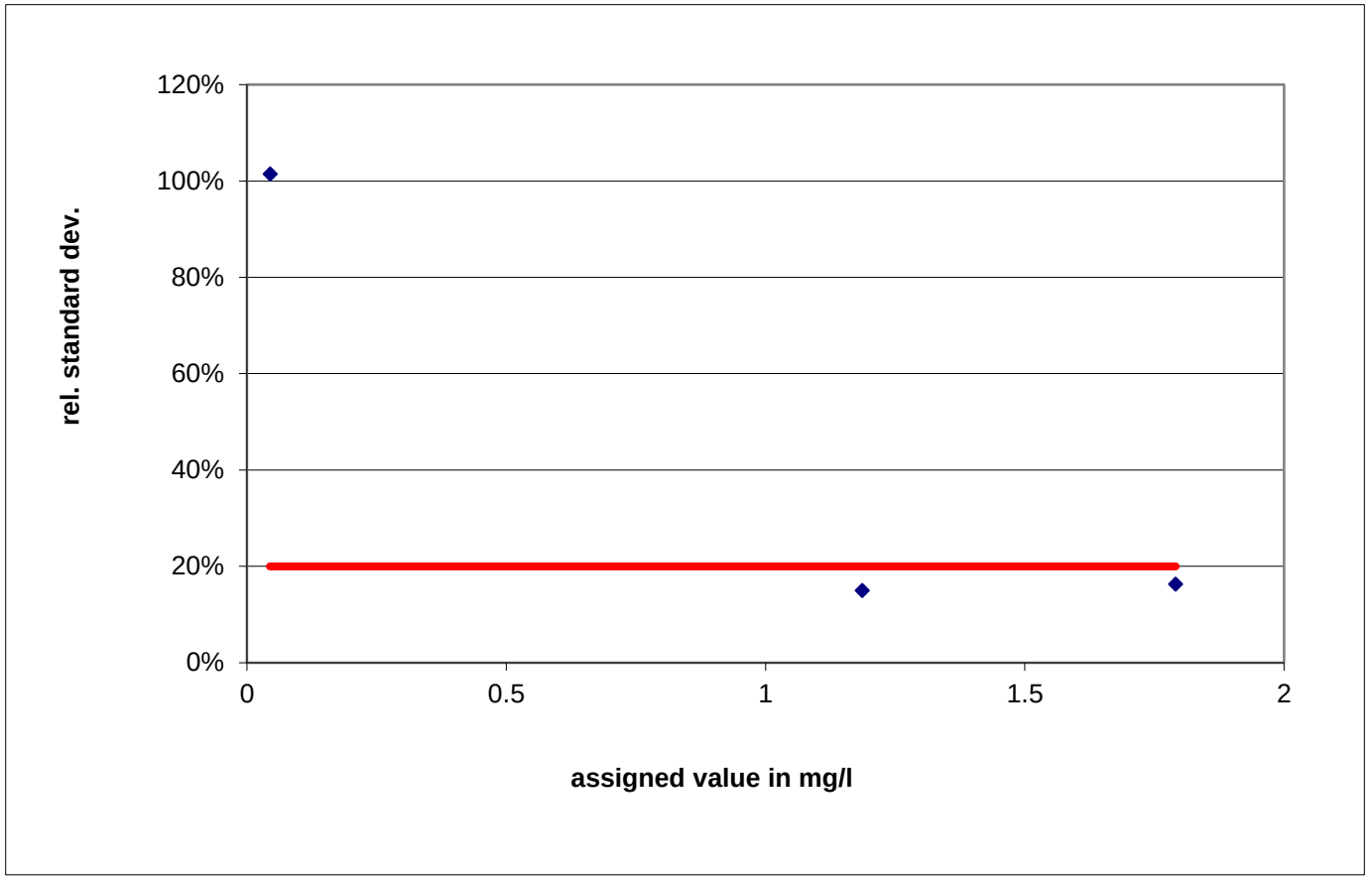
Let's go forward

Manganese
Calculated standard deviation and limit





NAMWATER
Namibia Water Corporation Ltd

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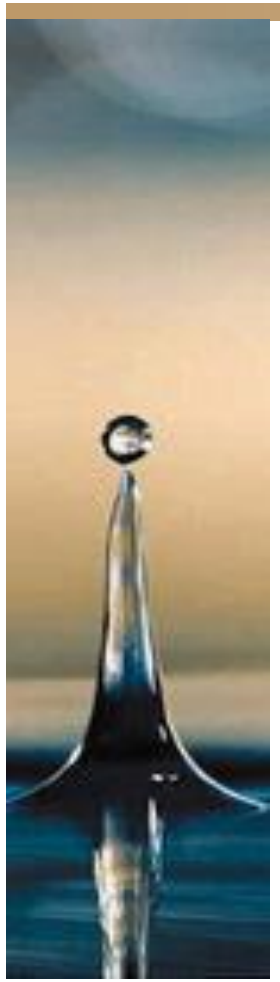
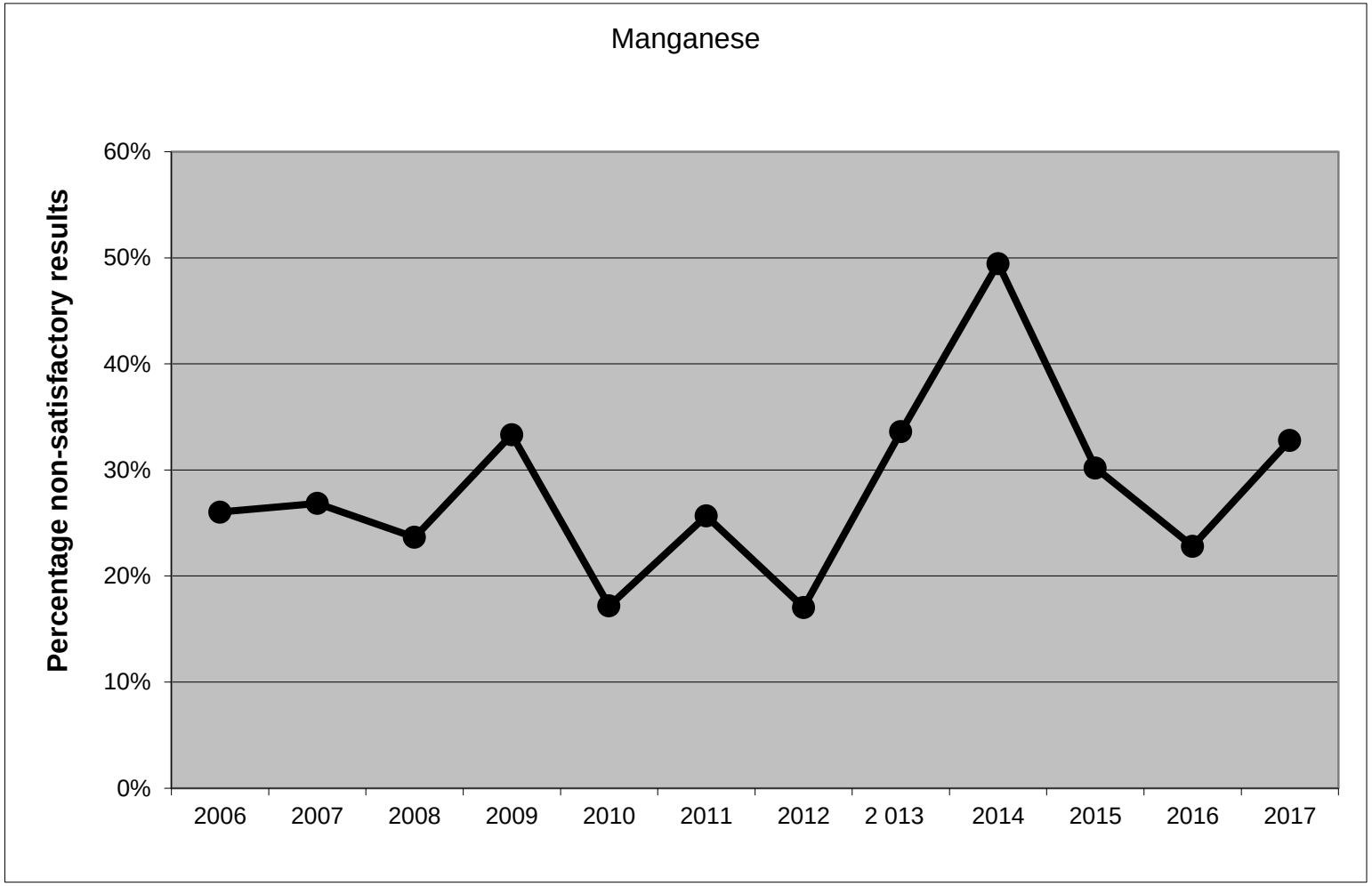
Let's go forward

Manganese
Percentage non-satisfactory results





22.8% to 32.8% in 2017

NAMWATER
Namibia Water Corporation Ltd

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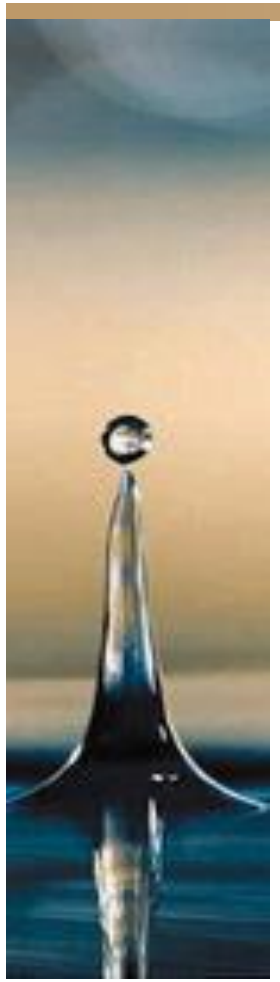
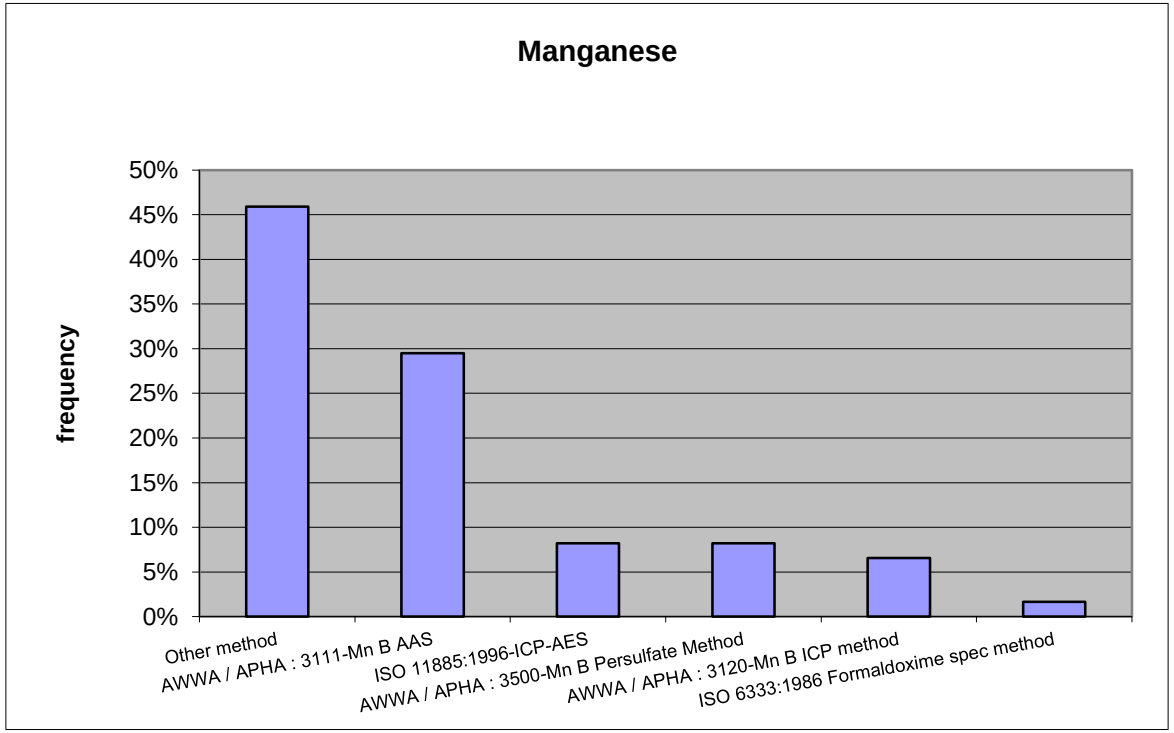
Let's go forward

Method used





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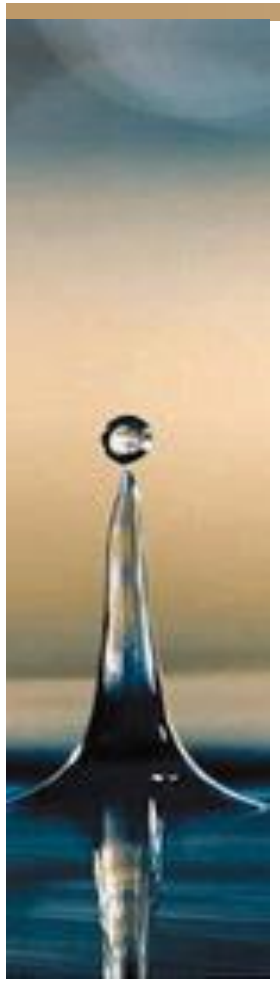
Let's go forward

Summary **Manganese**



- STDs for second highest level and highest level are below 20 %
- Lowest level – STD of 101.5%
- Percentage of non-satisfactory results **22.8% to 32.8% in 2017**

NAMWATER
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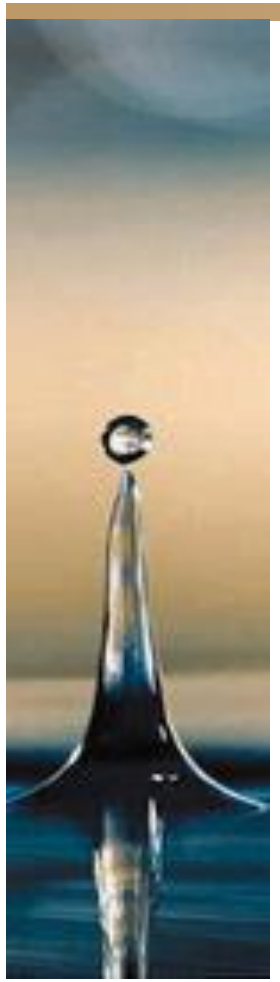
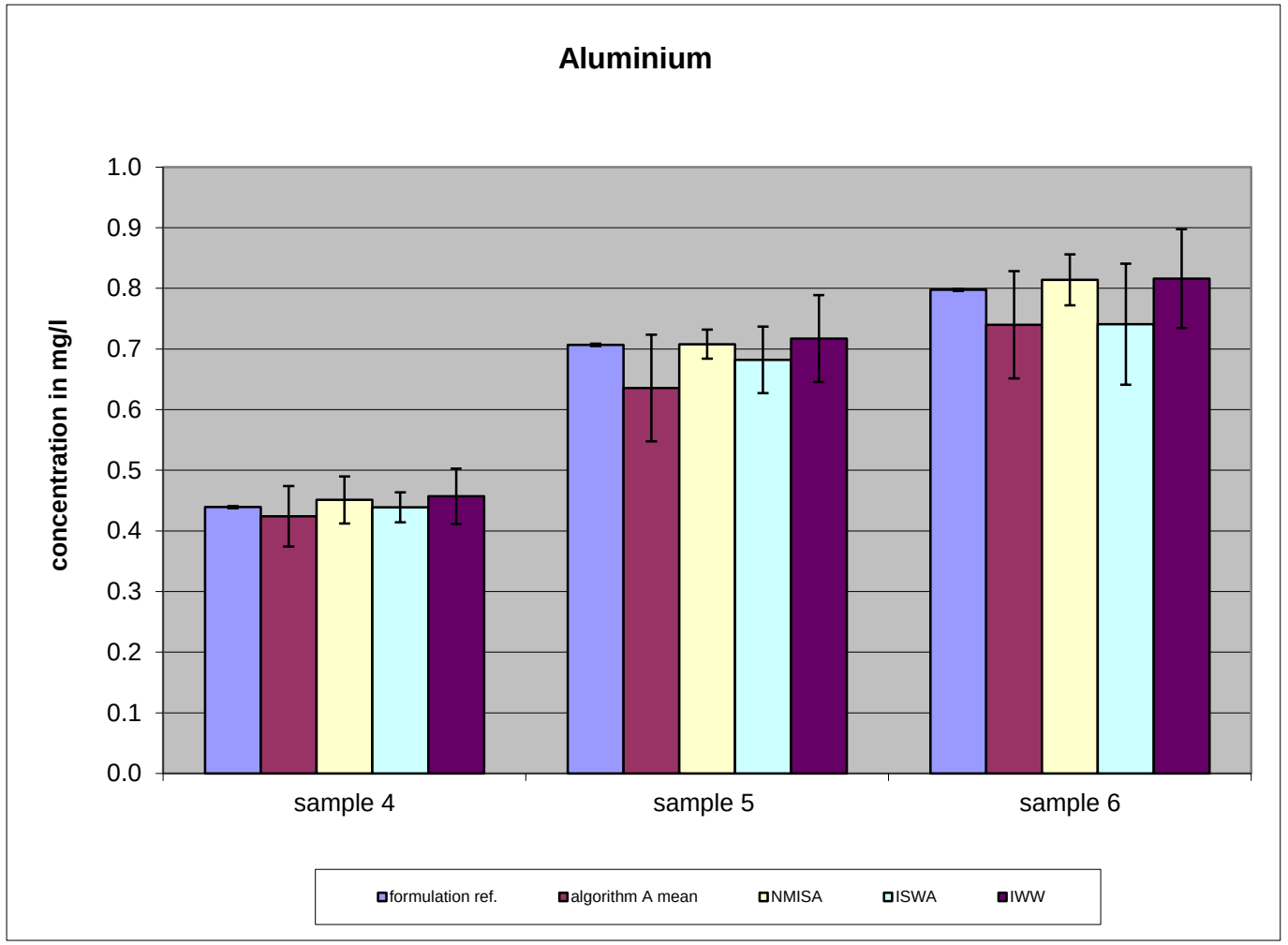
Let's go forward

Aluminium
mean vs. ref.-value





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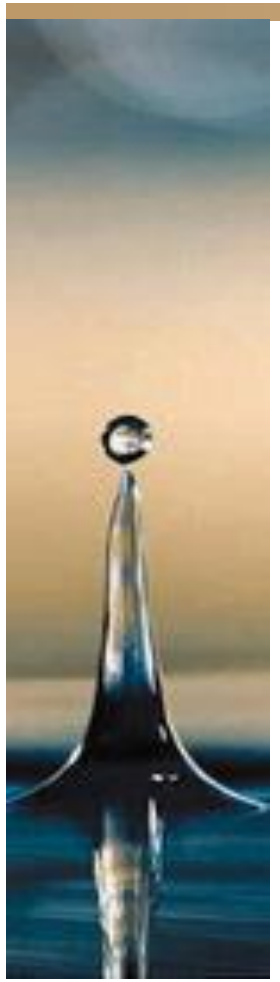
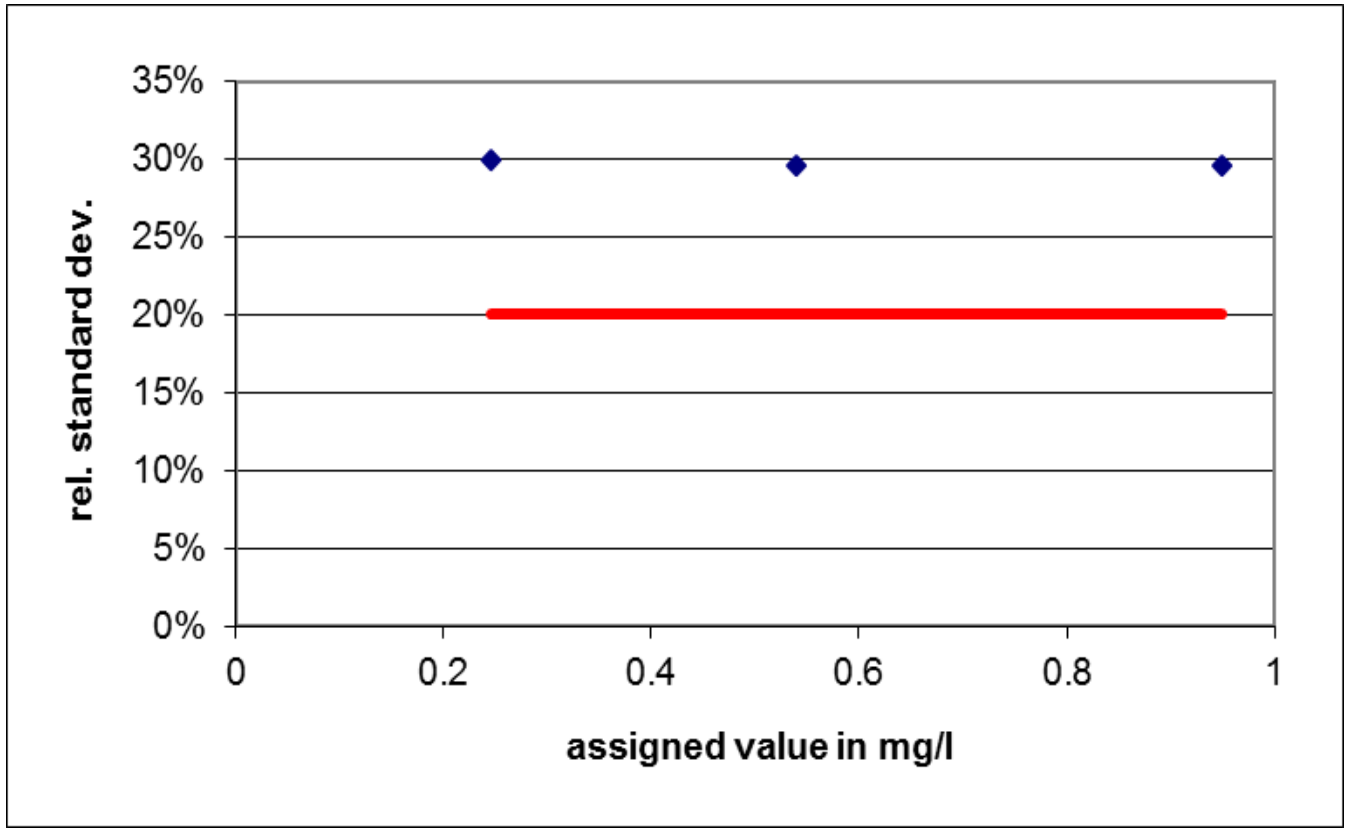
Aluminium

Calculated standard deviation and limit





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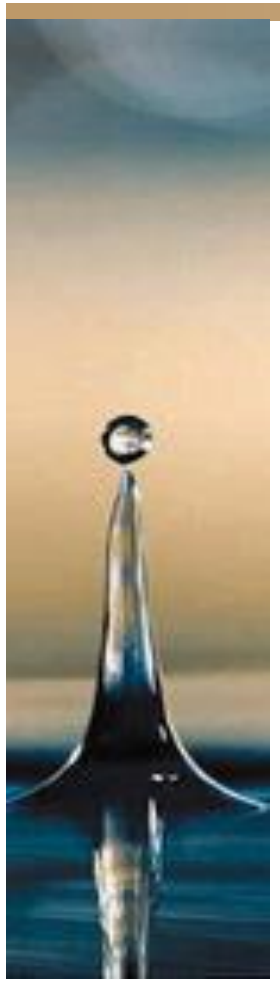
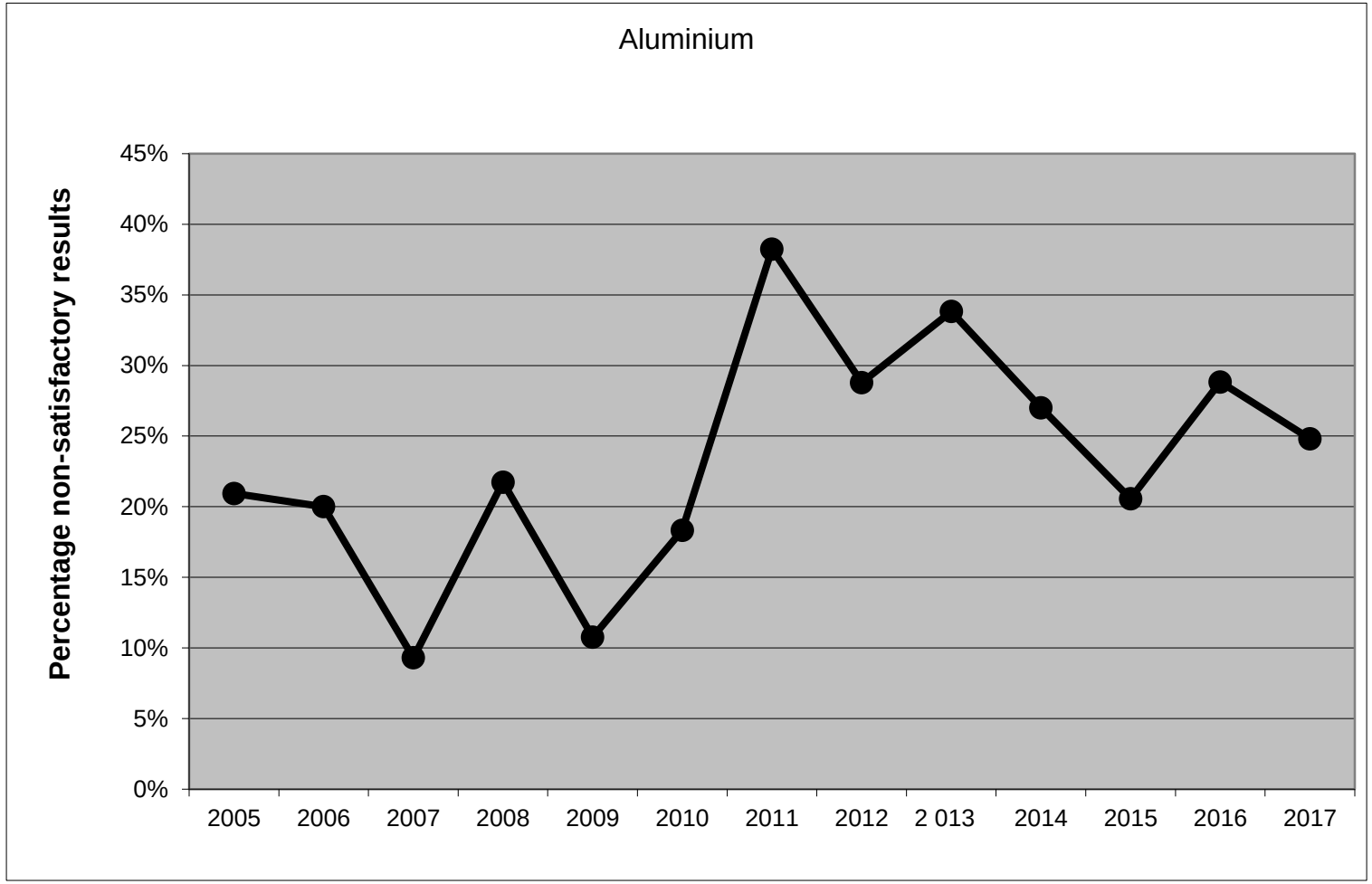
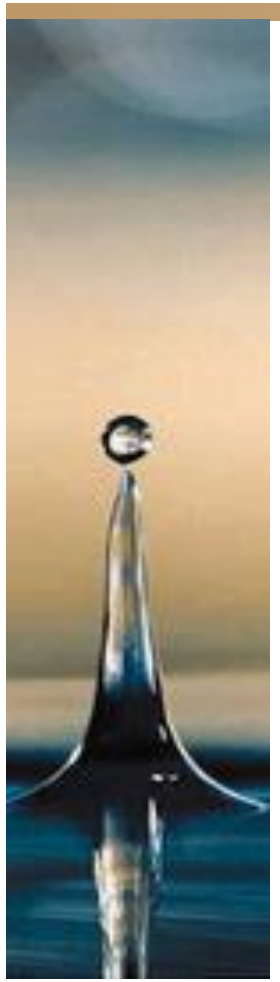
Aluminium
Percentage non-satisfactory results

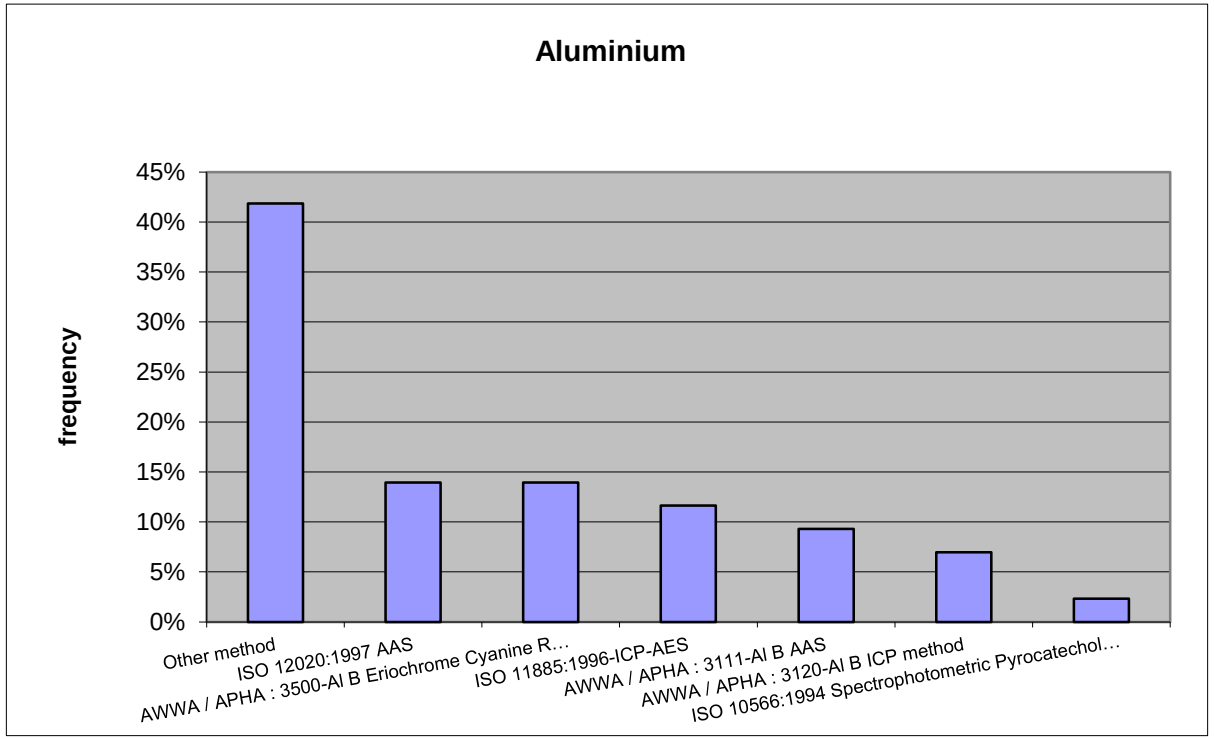




28.8% to 24.8% in 2017

Method used





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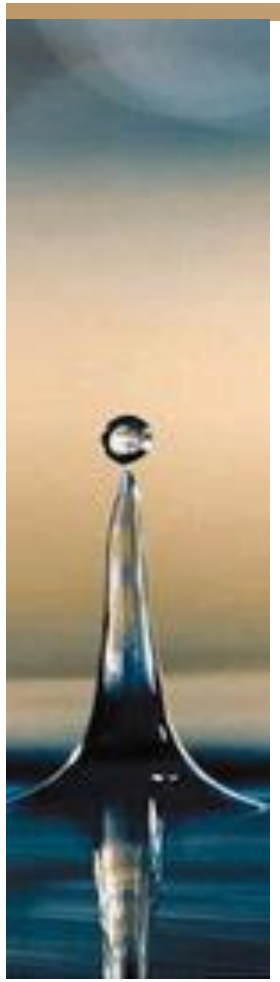
Summary **Aluminium**



- 41.9 % “other methods”
- SDs above the limit for all three levels
- Percentage outliers reduced from 28.8% to 24.8% in 2017
- Problems with the AAS method

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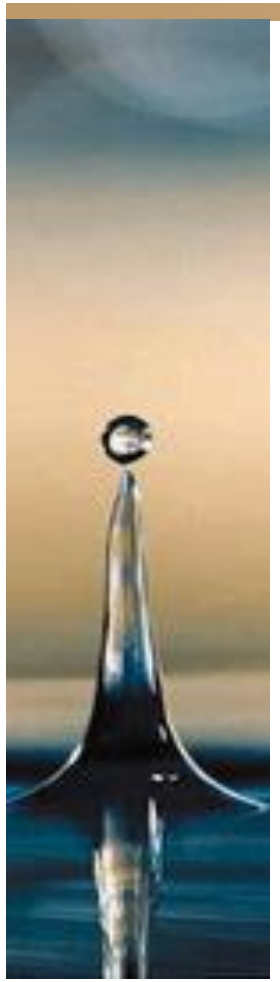
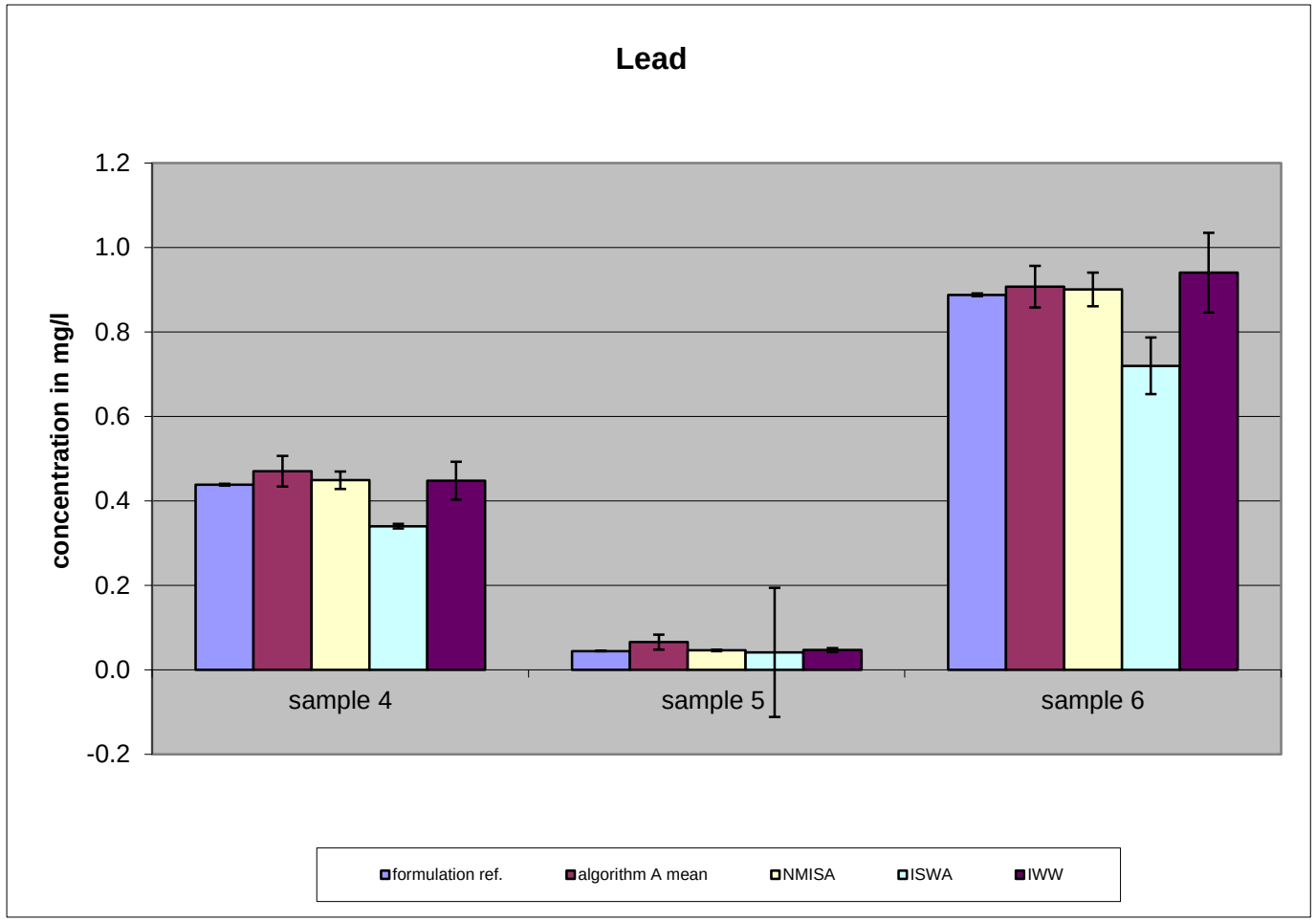
Lead
mean vs. ref.-value





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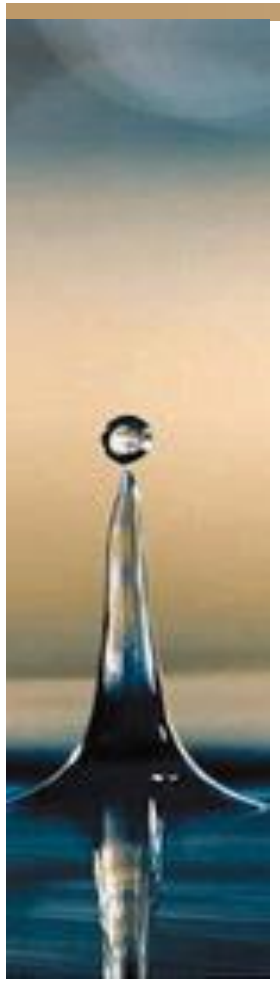
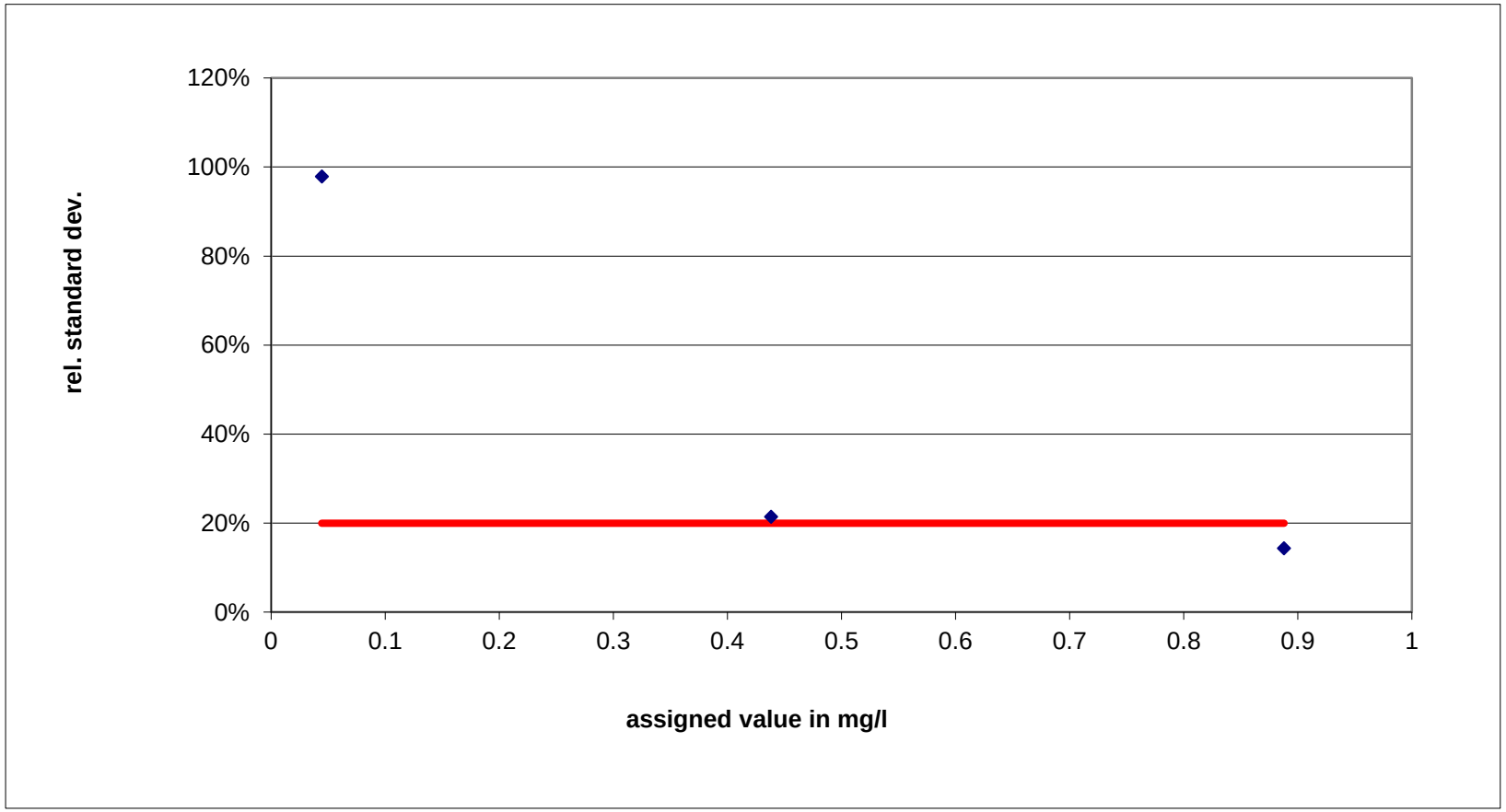
Lead
Calculated standard deviation and limit





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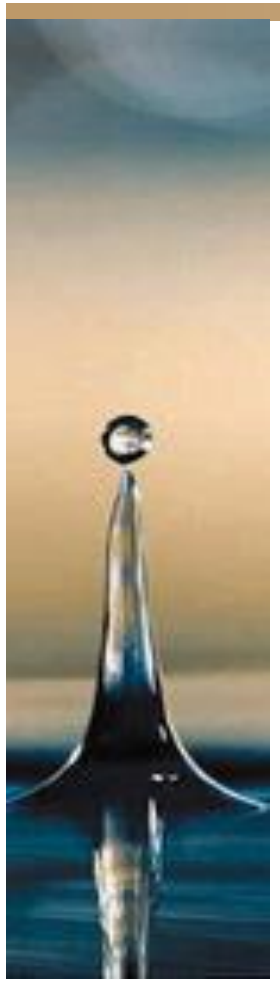
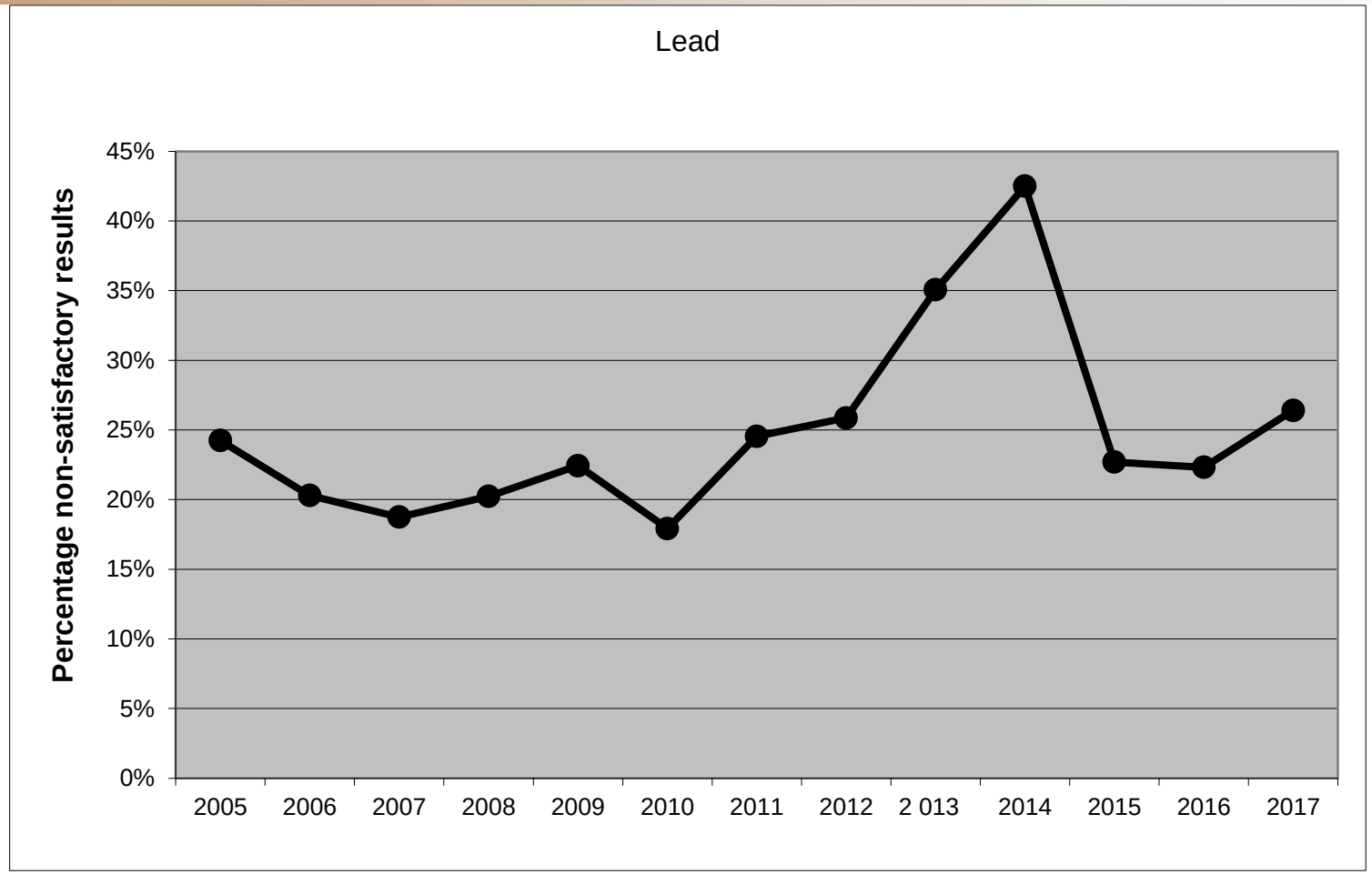
Lead
Percentage non-satisfactory results





22.3% to 26.4% in 2017

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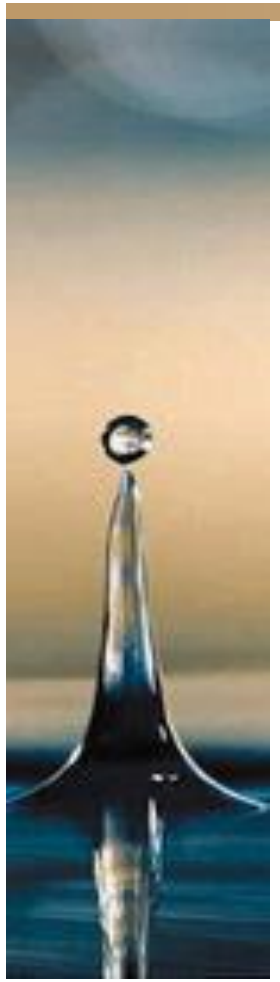
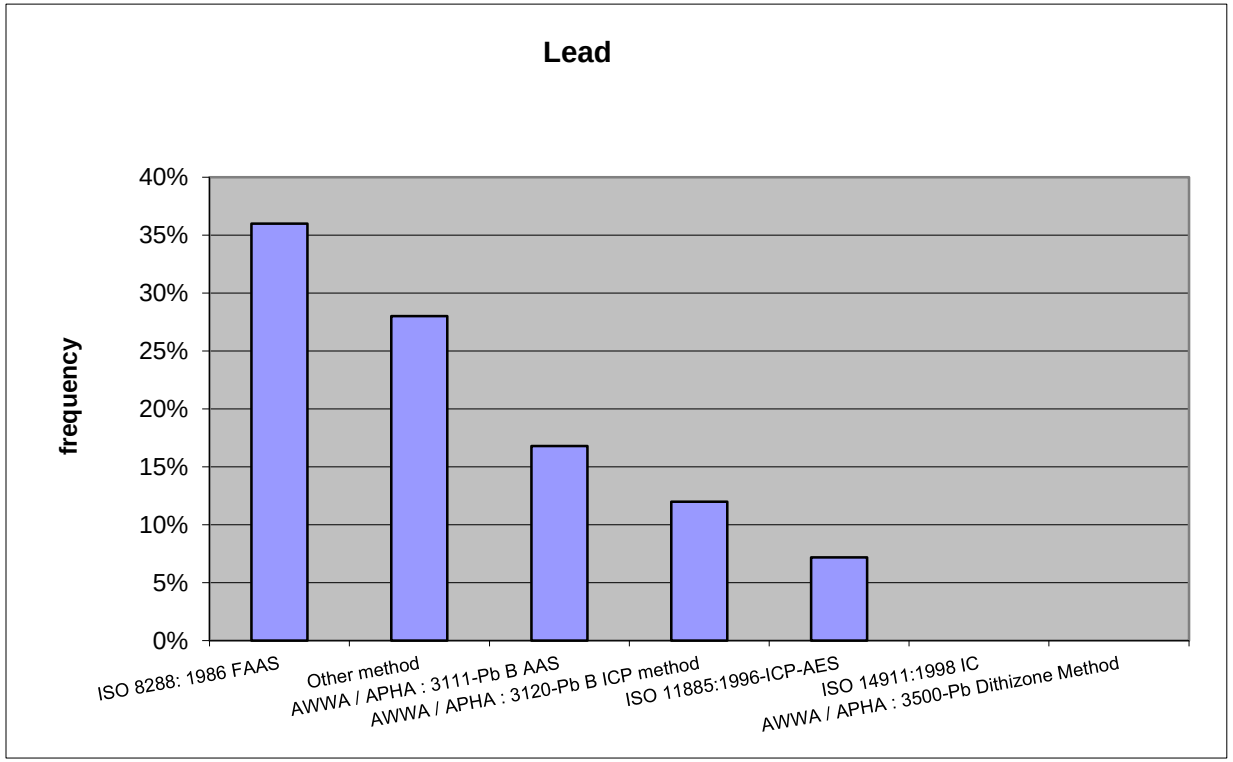
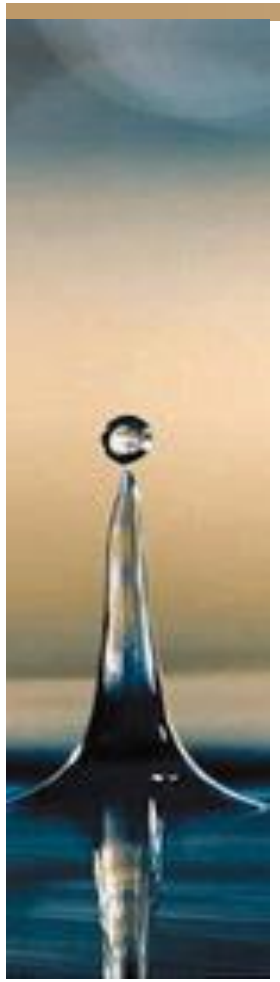
Let's go forward

Method used




Lead
frequency
40%
35%
30%
25%
20%
15%
10%
5%
0%
ISO 8288: 1986 FAAS
Other method
AWWA / APHA : 3111-Pb B AAS
AWWA / APHA : 3120-Pb B ICP method
ISO 11885:1996-ICP-AES
ISO 14911:1998 IC
AWWA / APHA : 3500-Pb Dithizone Method

Summary **Lead**



- Average recover is 103.2%
- Obviously problems with the lowest level – high blank?, high STD (97.9 % !)
- STDs for the other levels are 21.42% and 14.36%
- Variety of all the other methods causes a problems
- 28% of “other” methods

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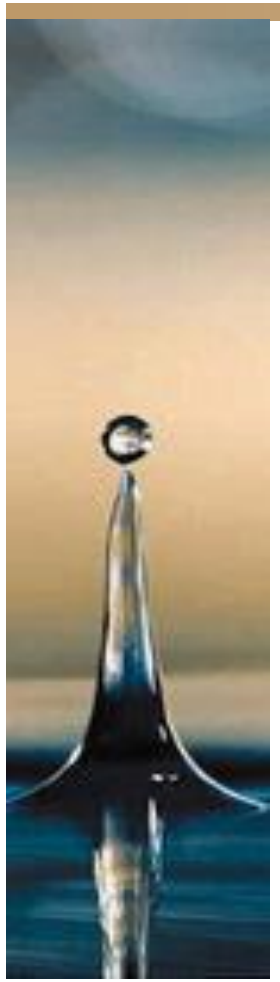
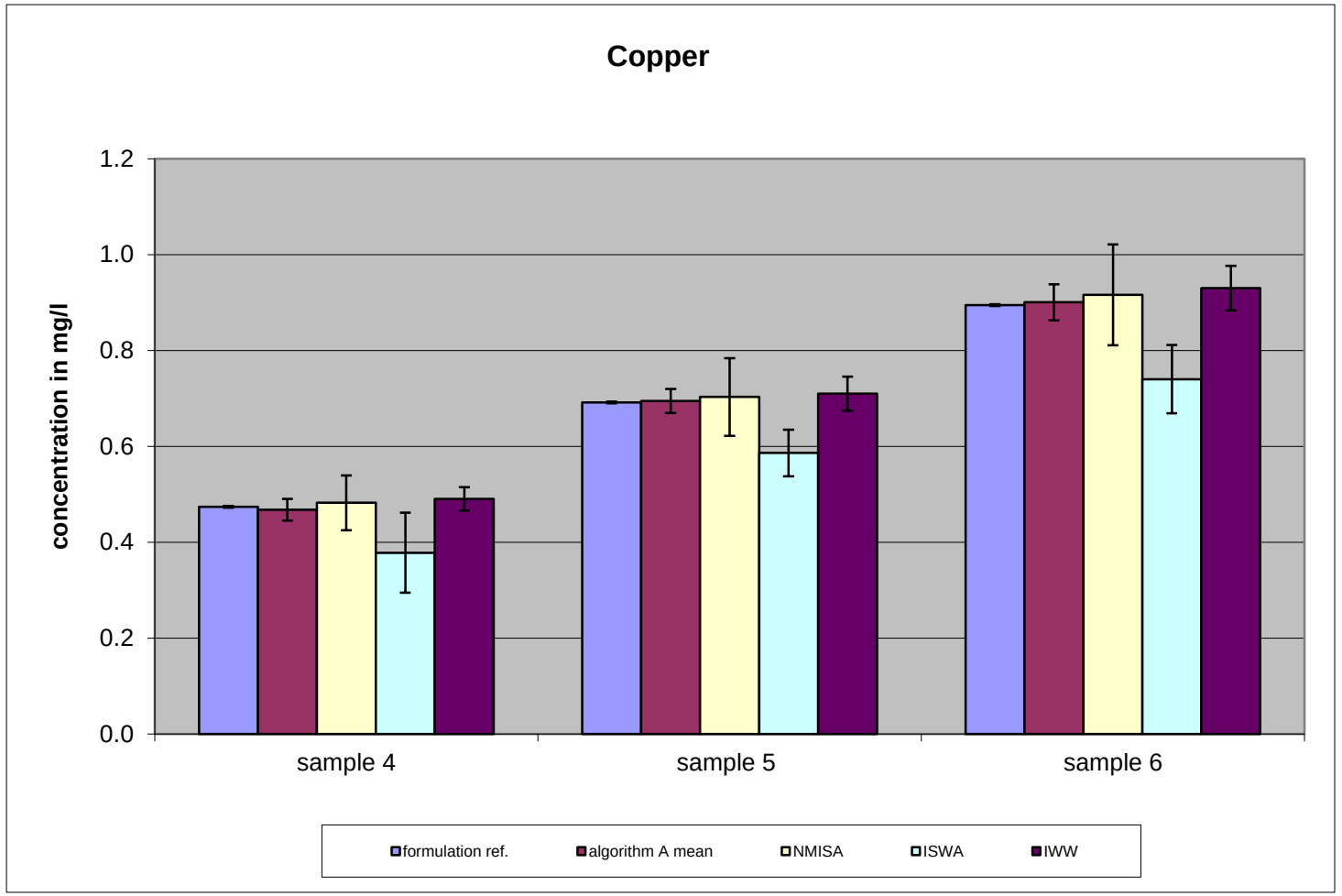
Copper
mean vs. ref.-value





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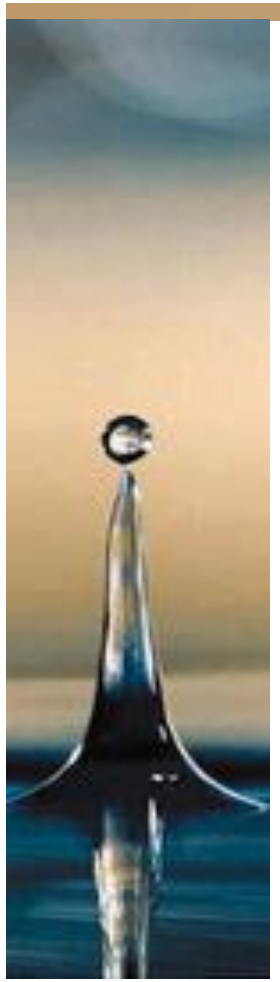
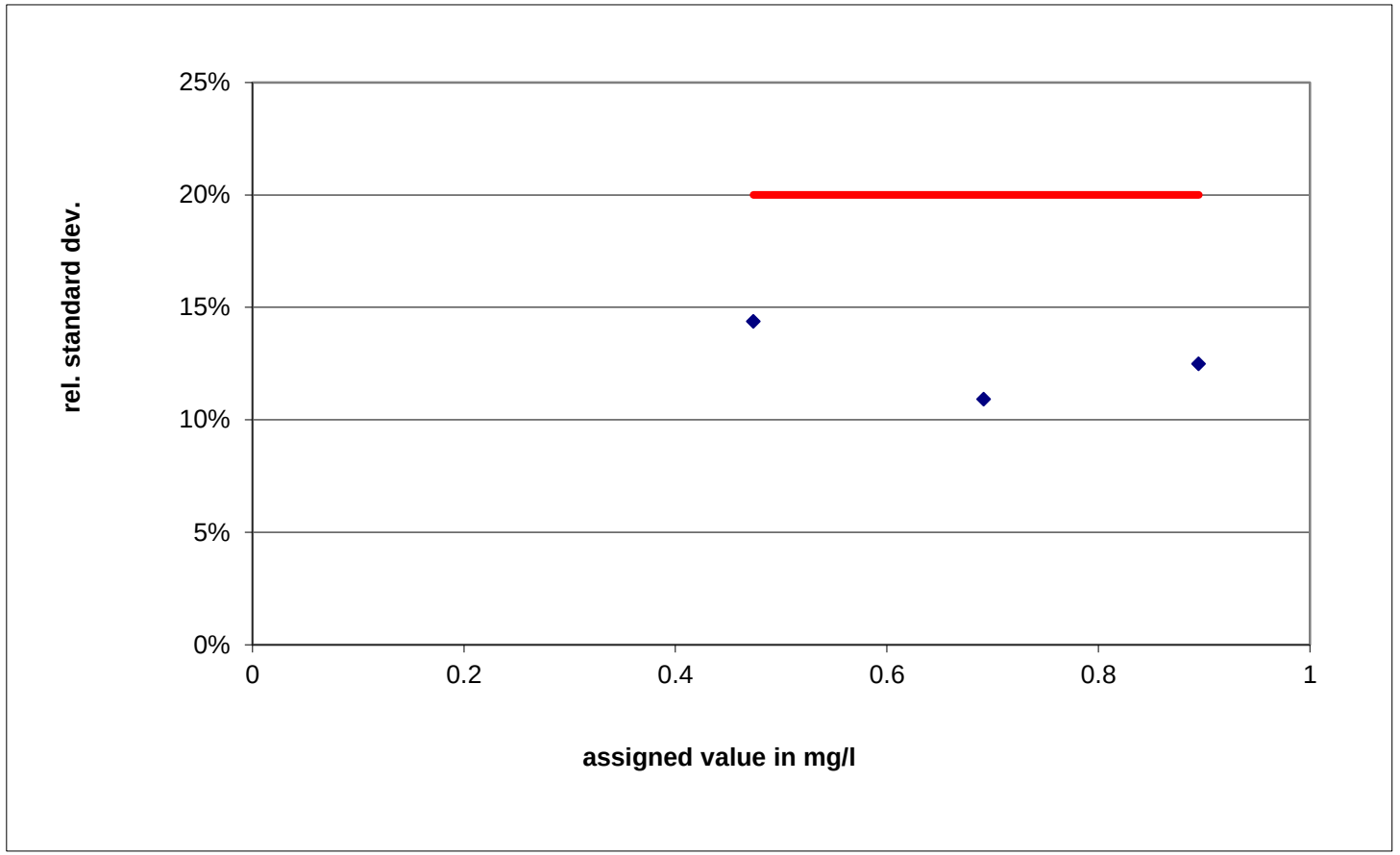
Copper
Calculated standard deviation and limit





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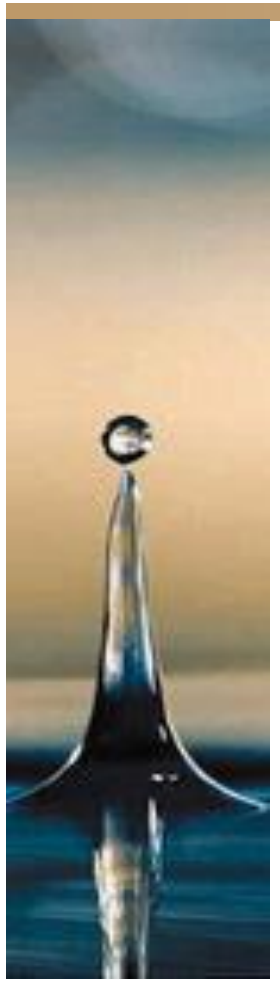
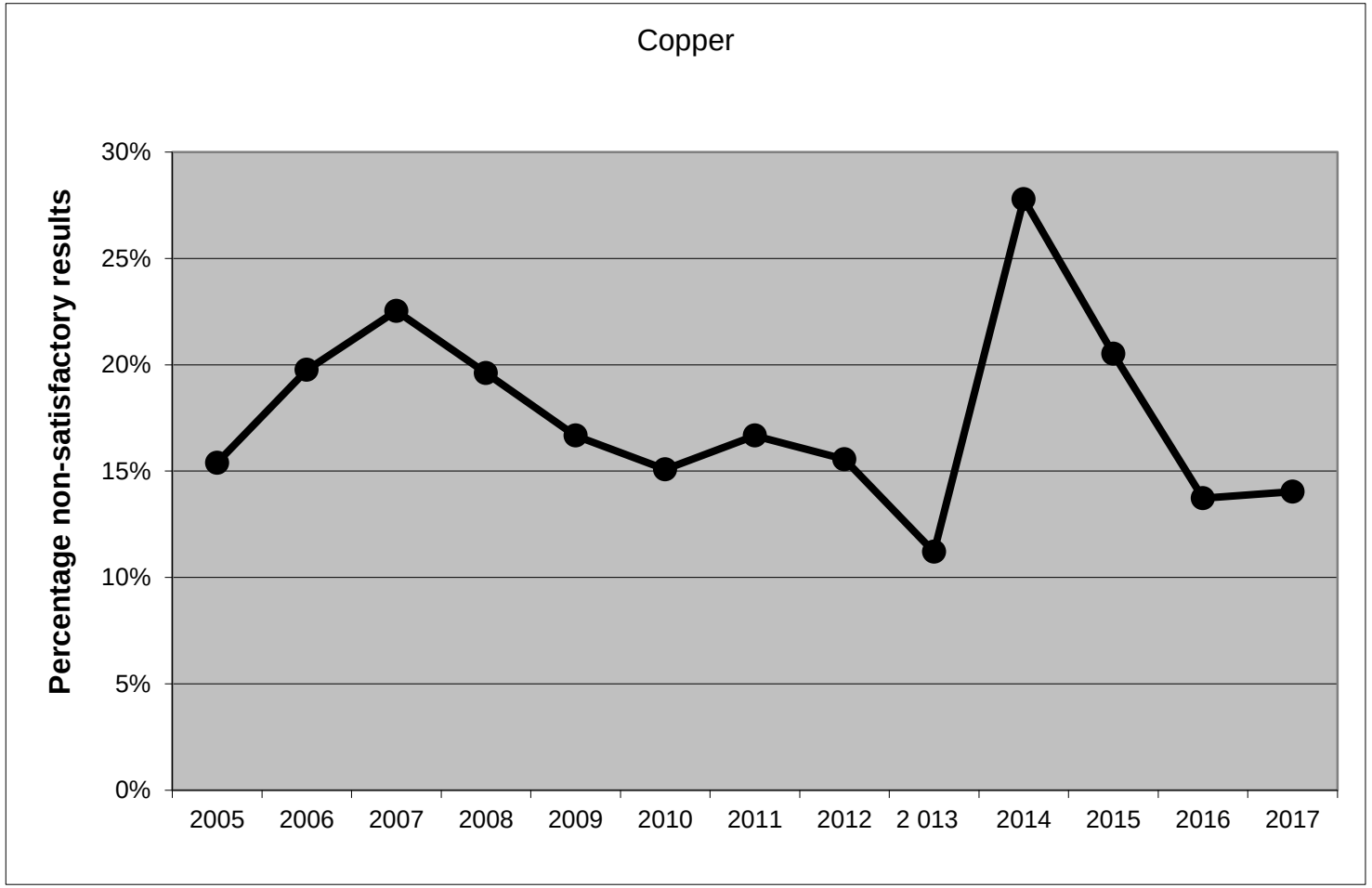
Copper
Percentage non-satisfactory results





13.7% to 14.0% in 2017

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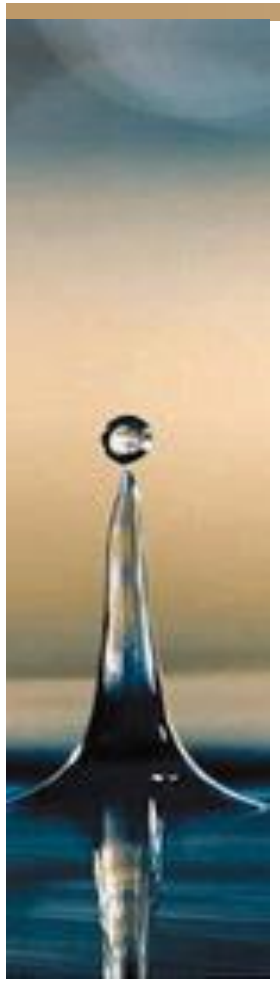
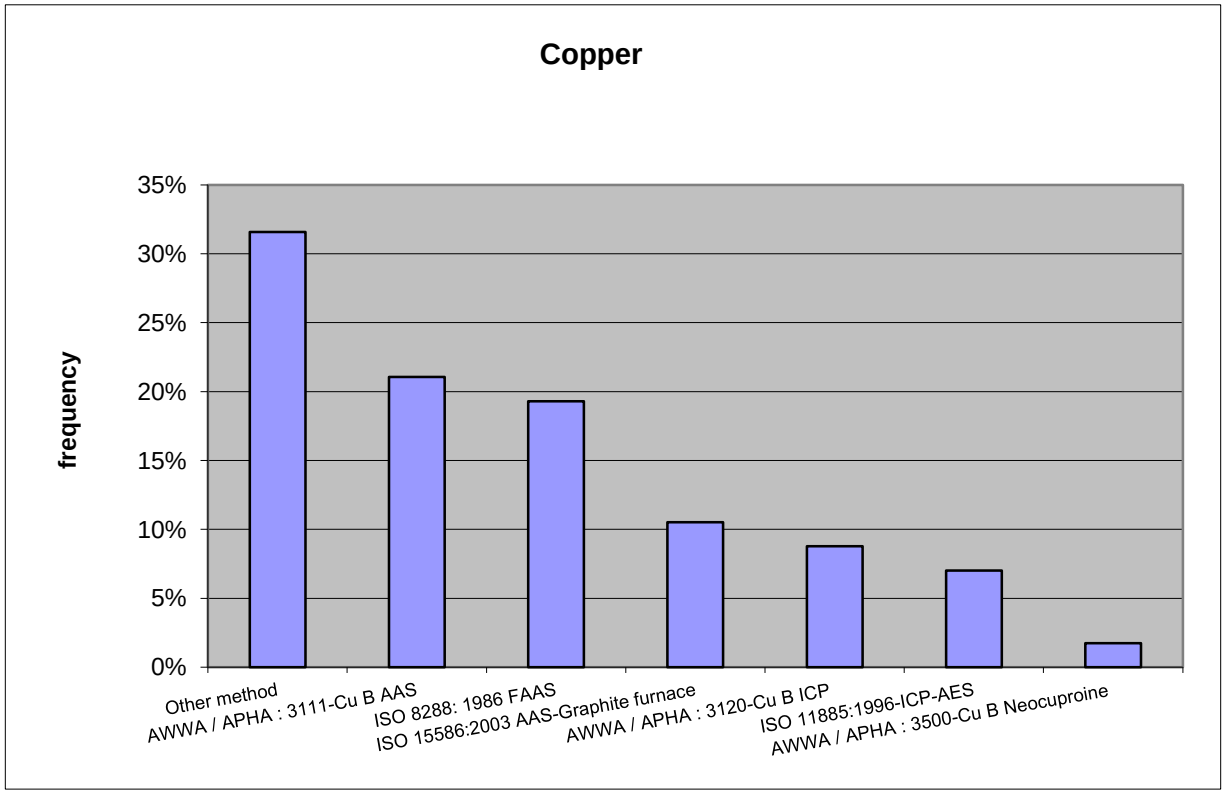
Let's go forward

Method used





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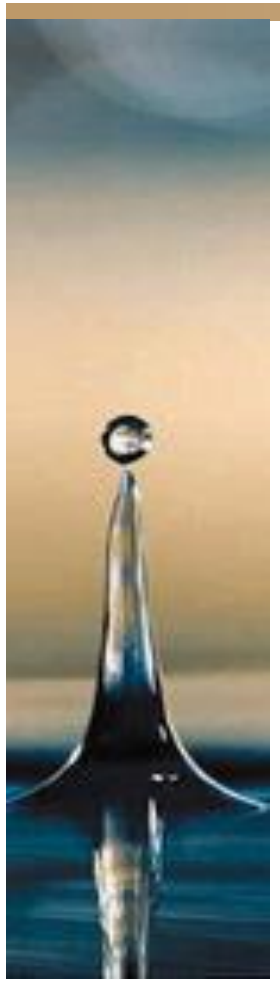
Let's go forward

Summary **Copper**



- Perfect recovery of 100.3%
- Standard deviations below 20% for all three levels
- Non satisfactory results remained similar than in 2016 - 13.7% to 14.0% in 2017
- 31.8% of “other” methods

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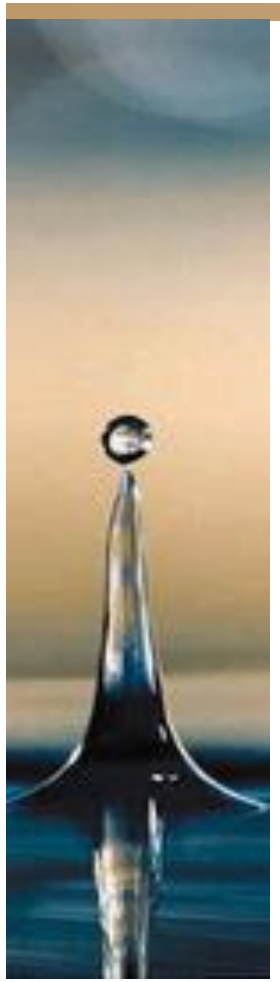
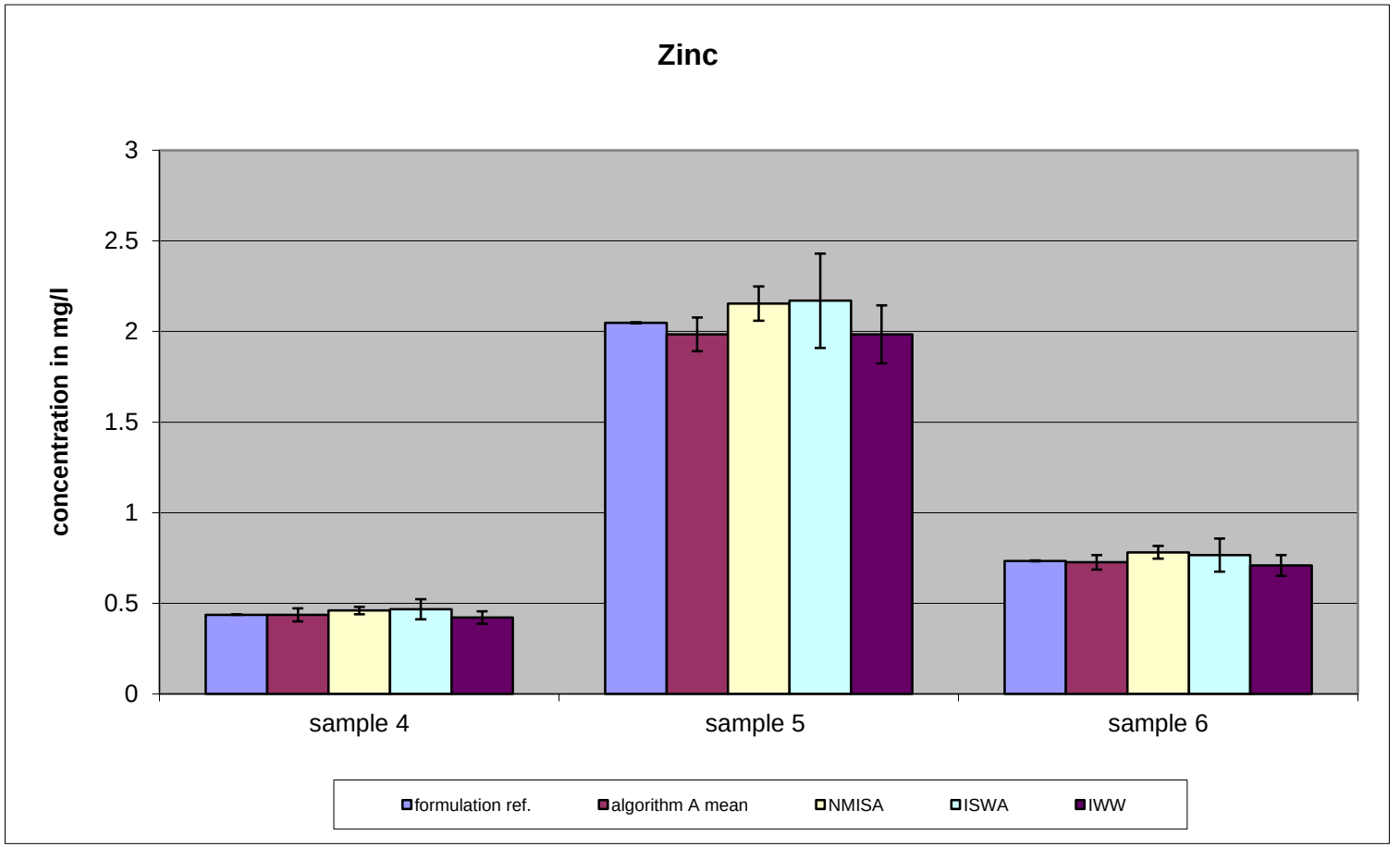
Let's go forward

Zinc
mean vs. ref.-value





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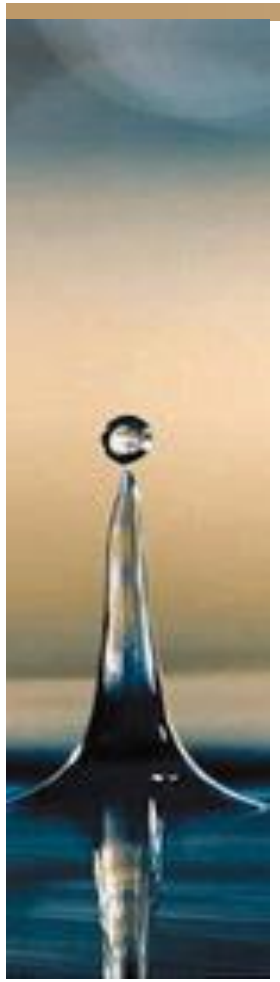
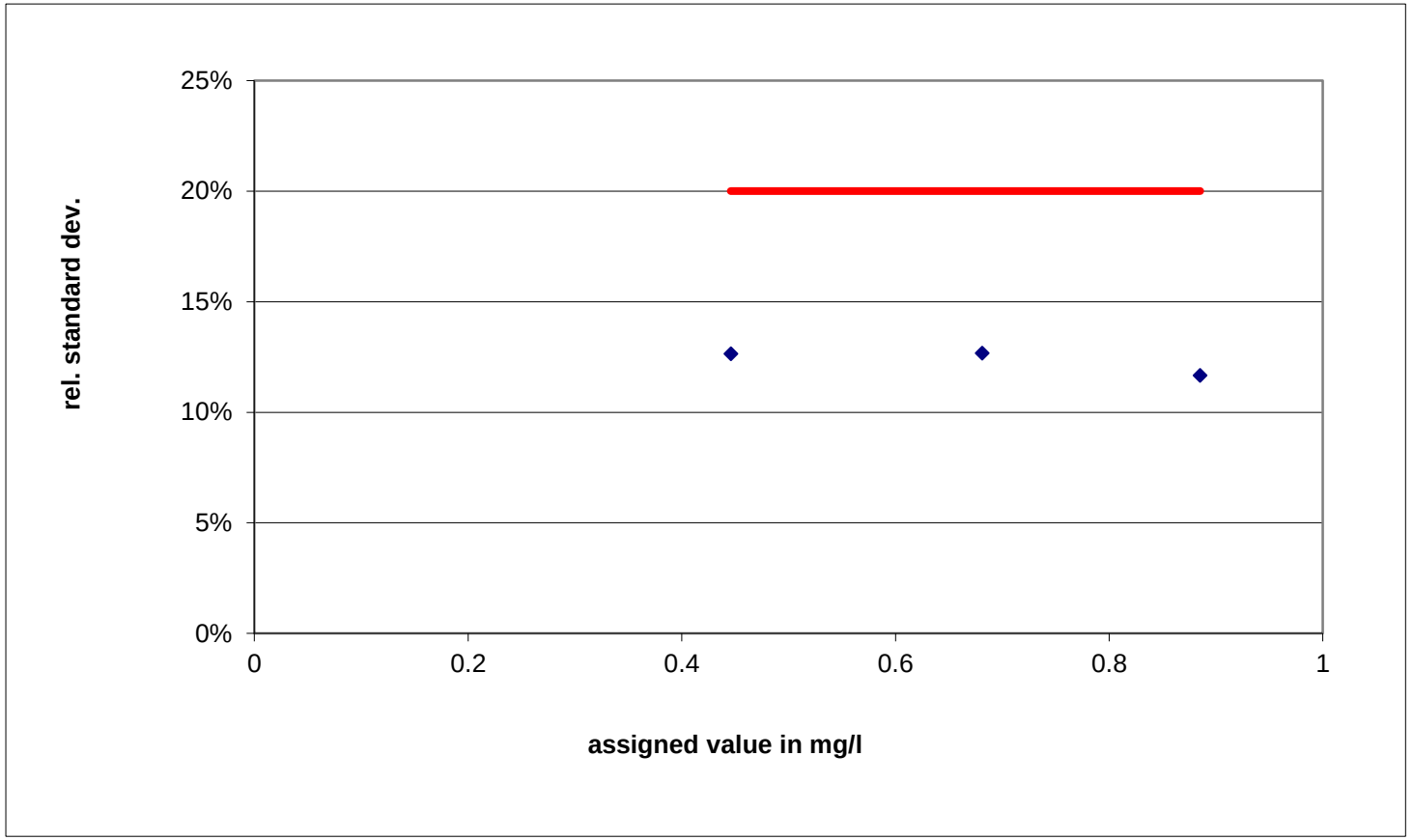
Let's go forward

Zinc

Calculated standard deviation and limit





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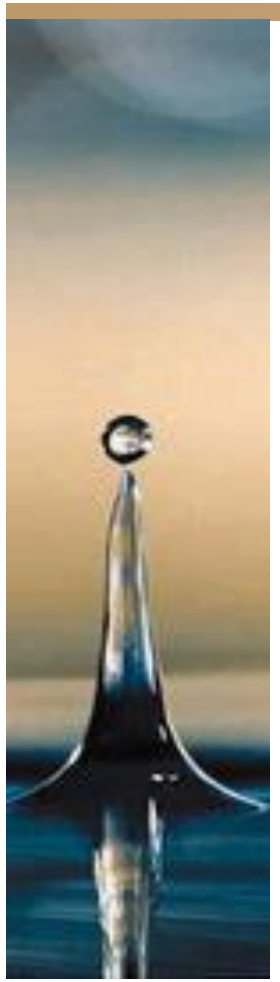
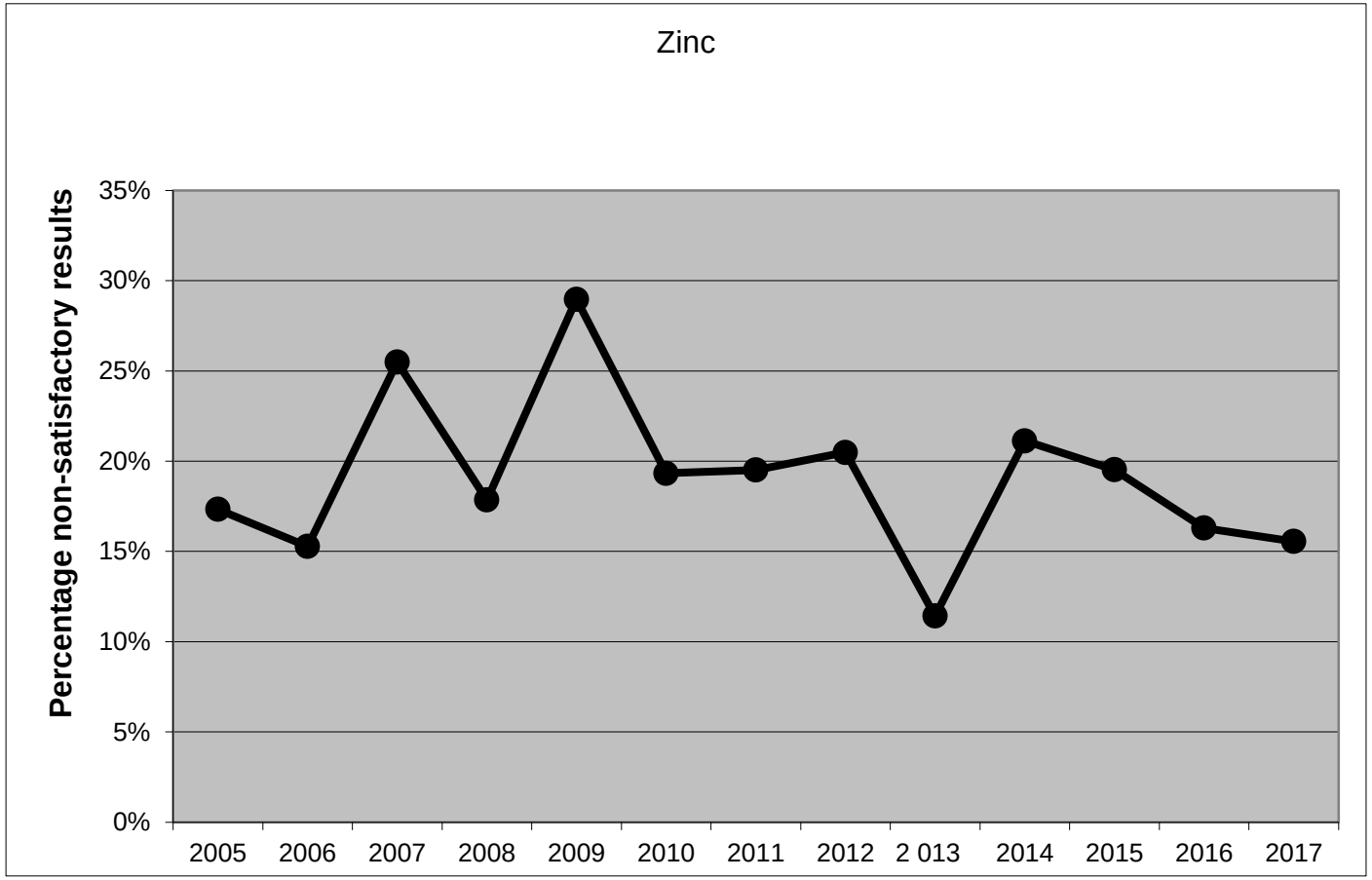
Zinc
Percentage non-satisfactory results





16.3% to 15.6% in 2017

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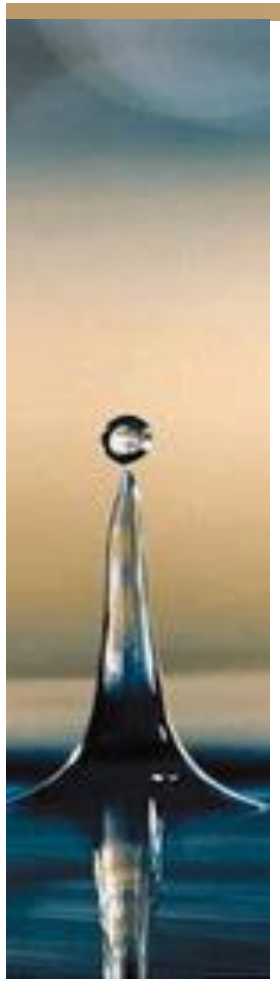
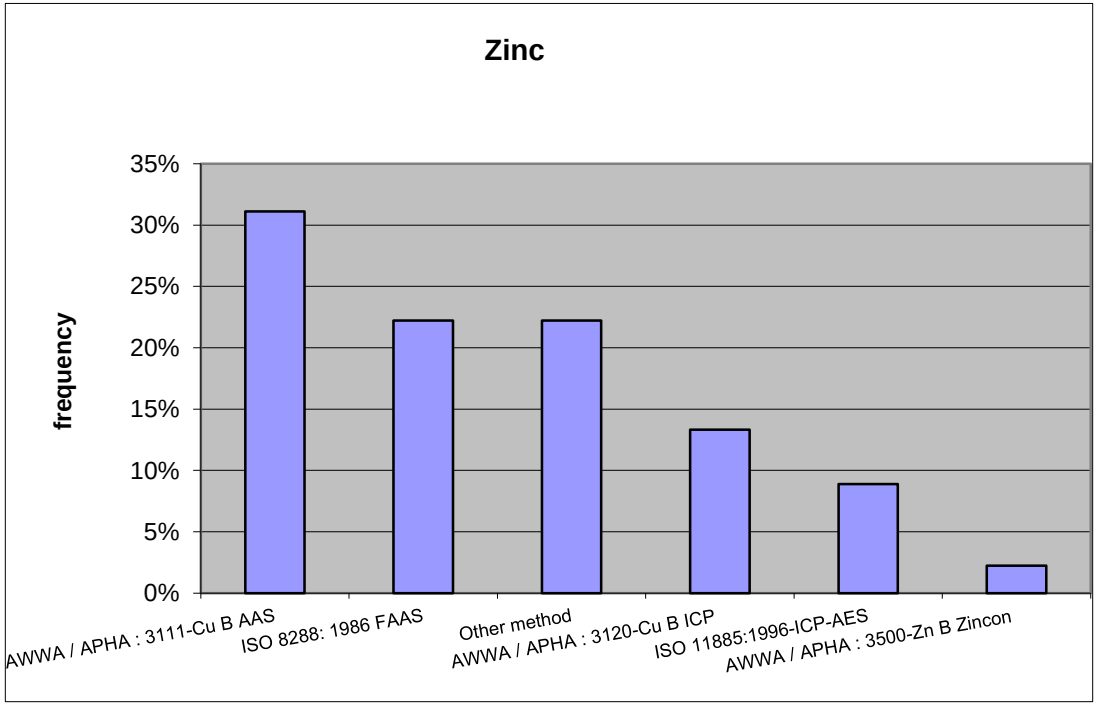
Let's go forward

Method used





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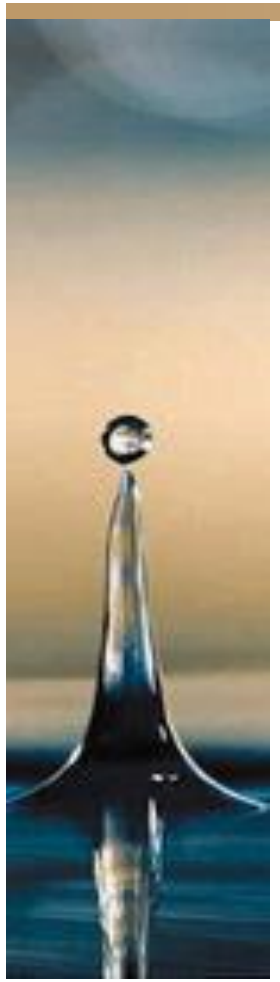
Summary **Zinc**

23.20%
15.32%
12.78%



- Perfect recovery of 101.69%
- Standard deviations below 20% for all three levels
- 22.2 % of “other” methods
- Slight improvement for the percentage of non-satisfactory results - 16.3% to 15.6% in 2017

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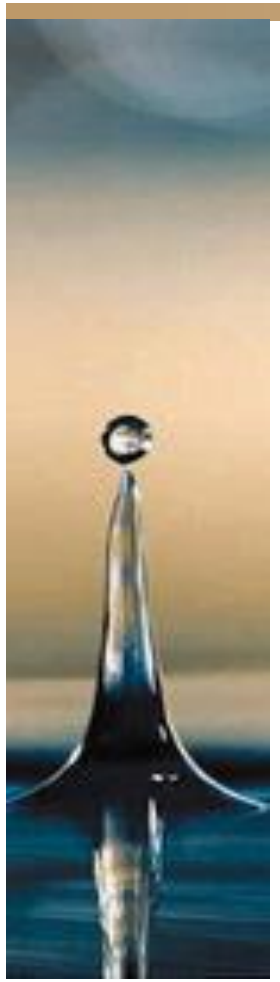
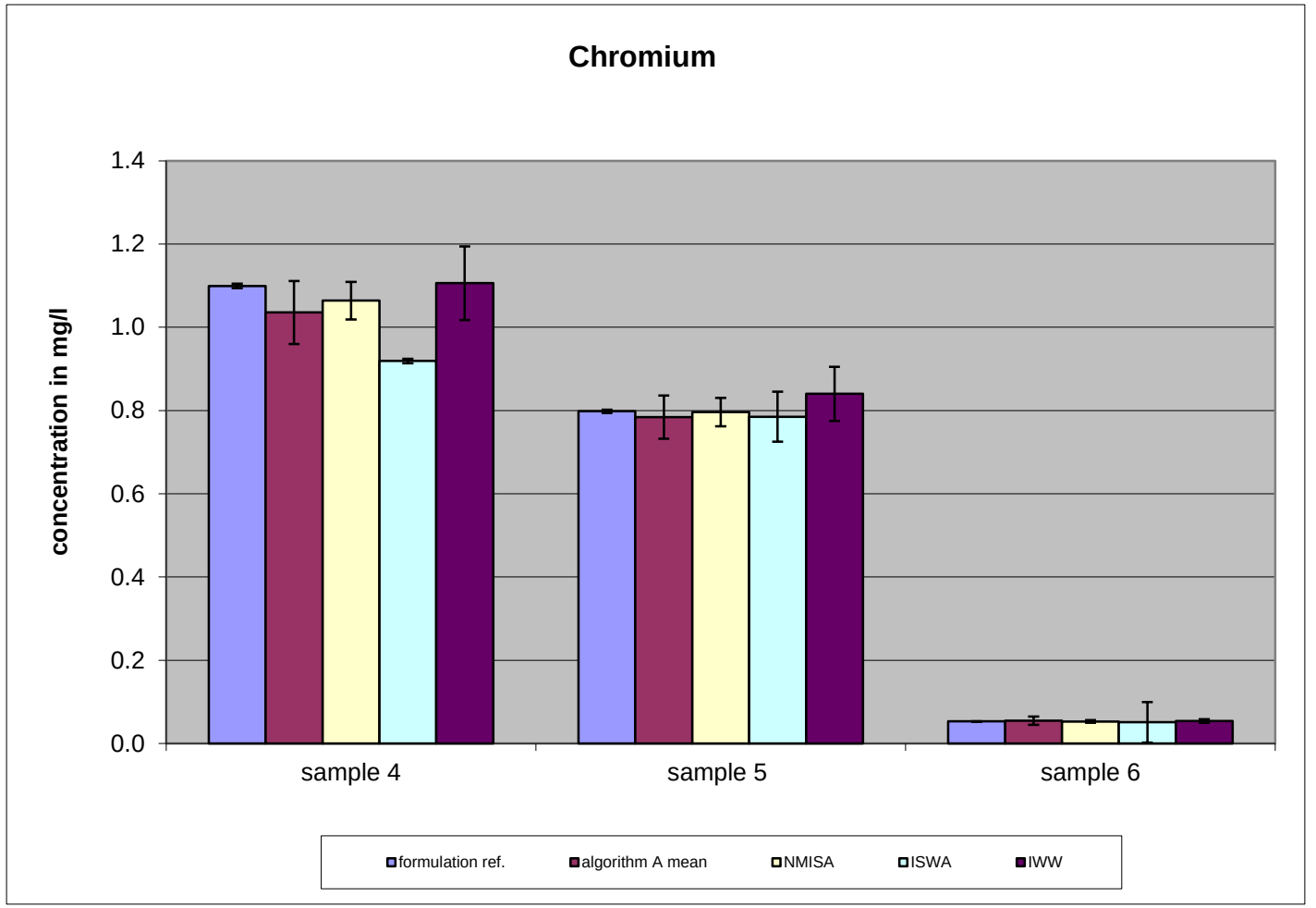
Let's go forward

Chromium
mean vs. ref.-value





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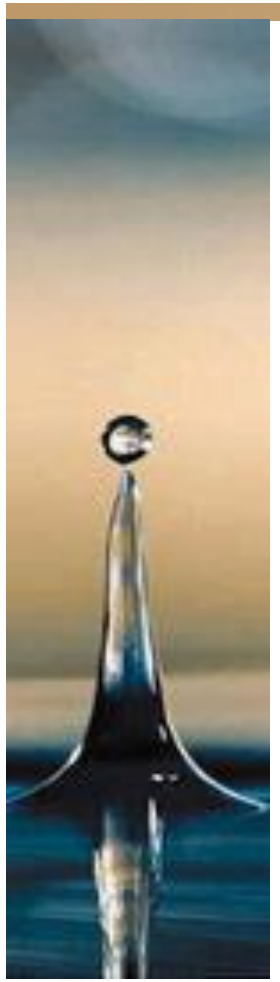
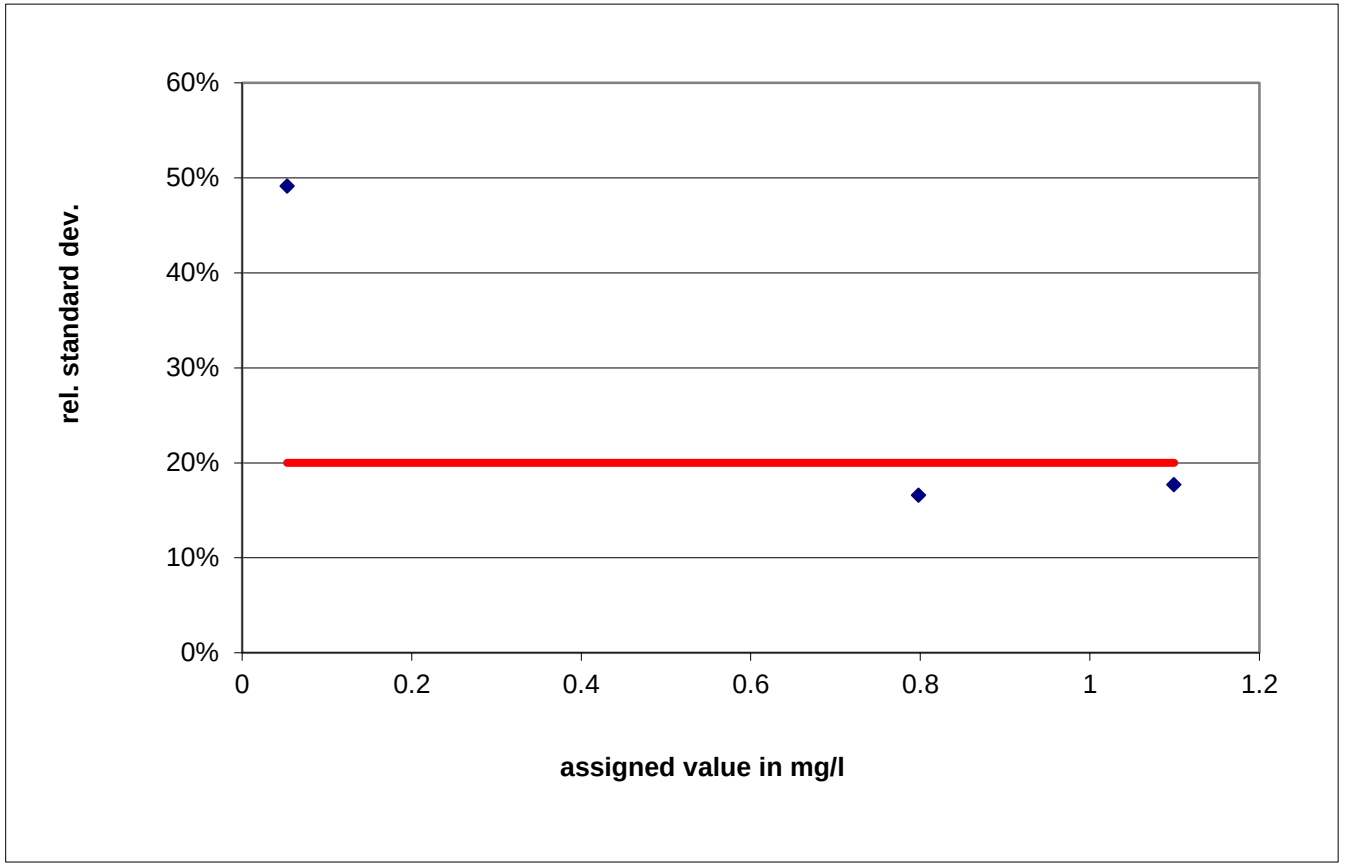
Let's go forward

Chromium
Calculated standard deviation and limit





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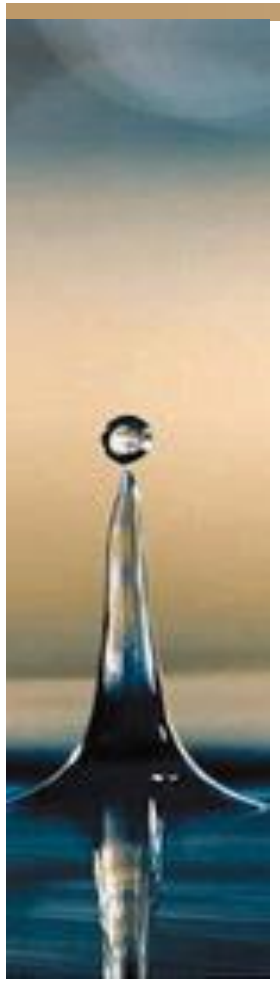
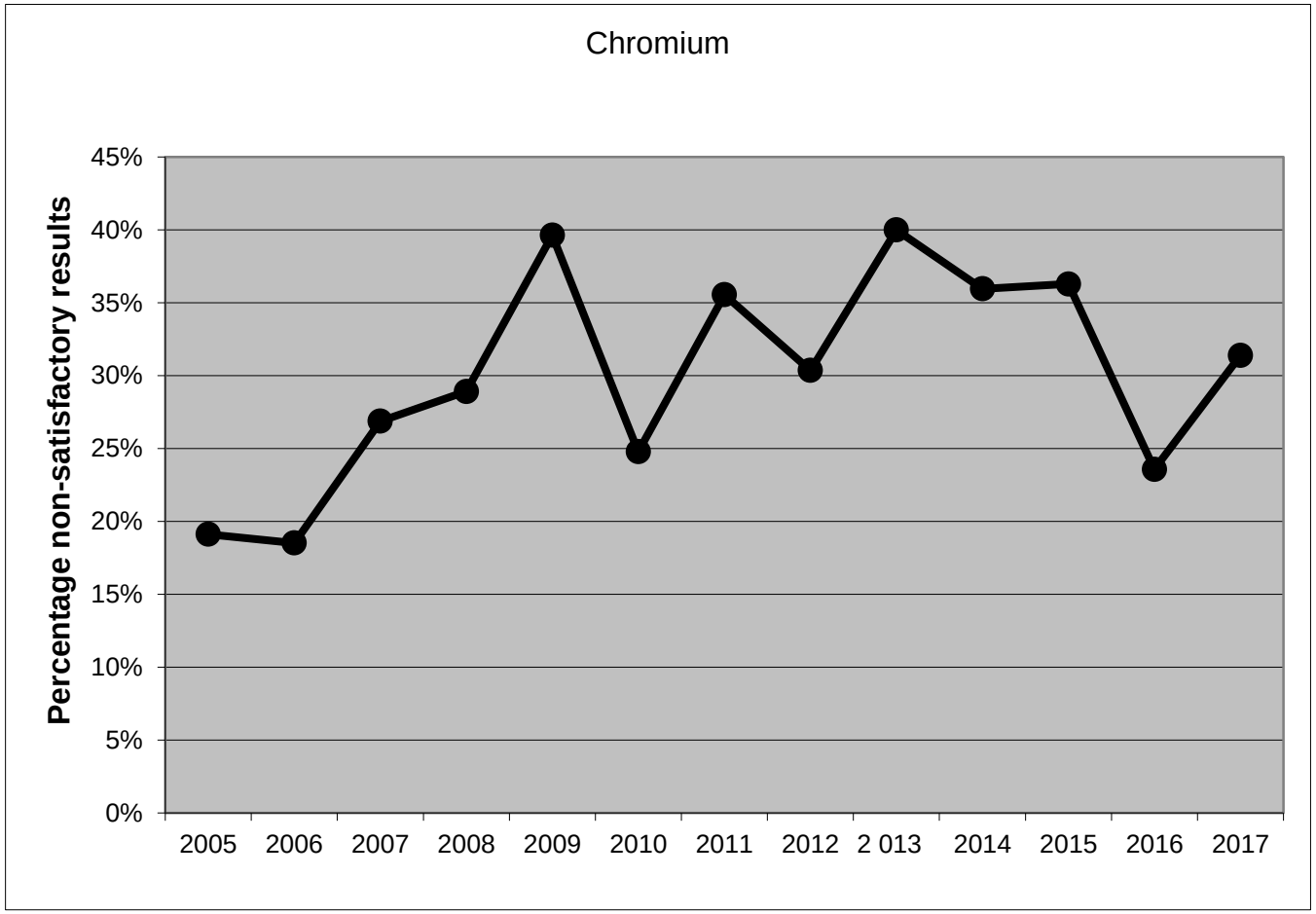
Let's go forward

Chromium
Percentage non-satisfactory results





23.6% to 31.4% in 2017

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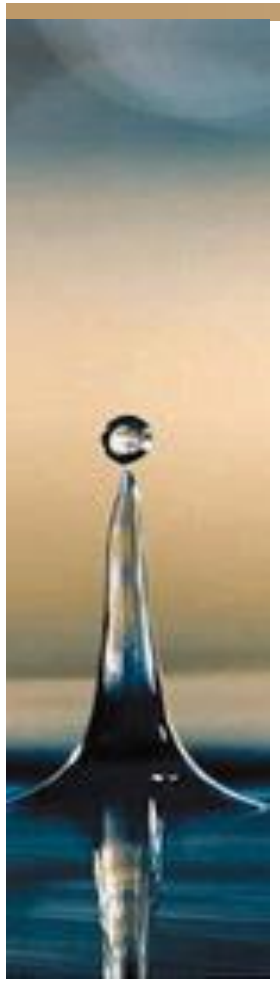
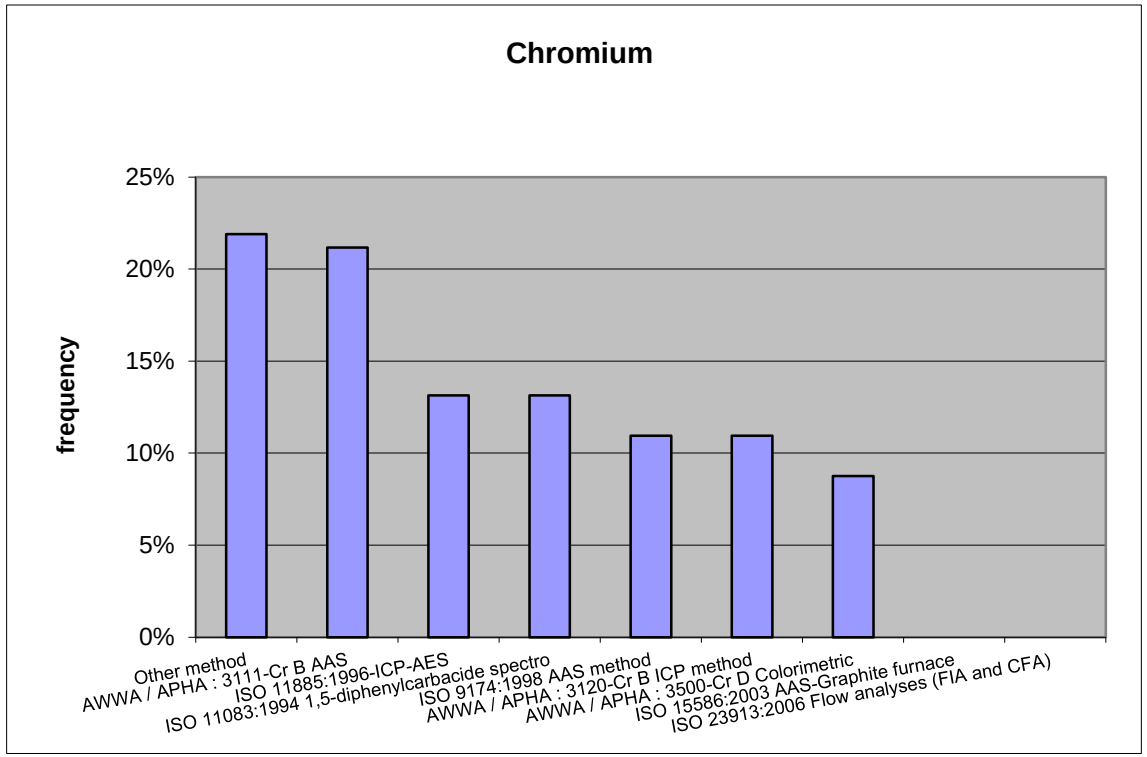
Let's go forward

Method used





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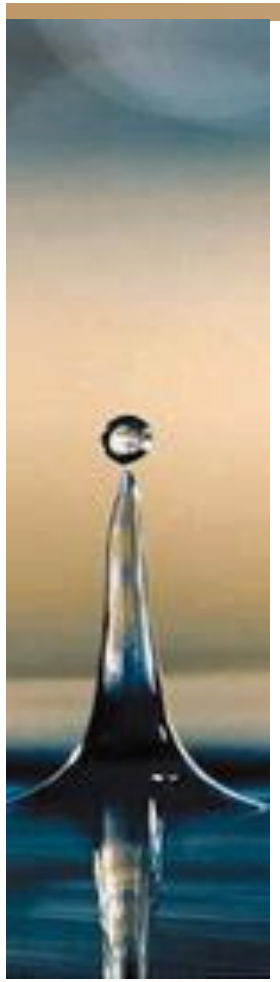
Let's go forward

Summary **Chromium**



- Average recovery is 95.6% - not bad
- Blank problems with the lowest level – SD of 49.1%
- 21.9% "other" methods
- Percentage non-satisfactory results slightly improved - 23.6% to 31.4% in 2017

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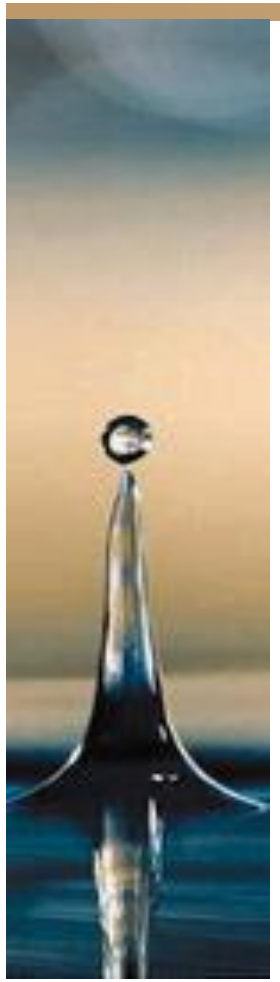
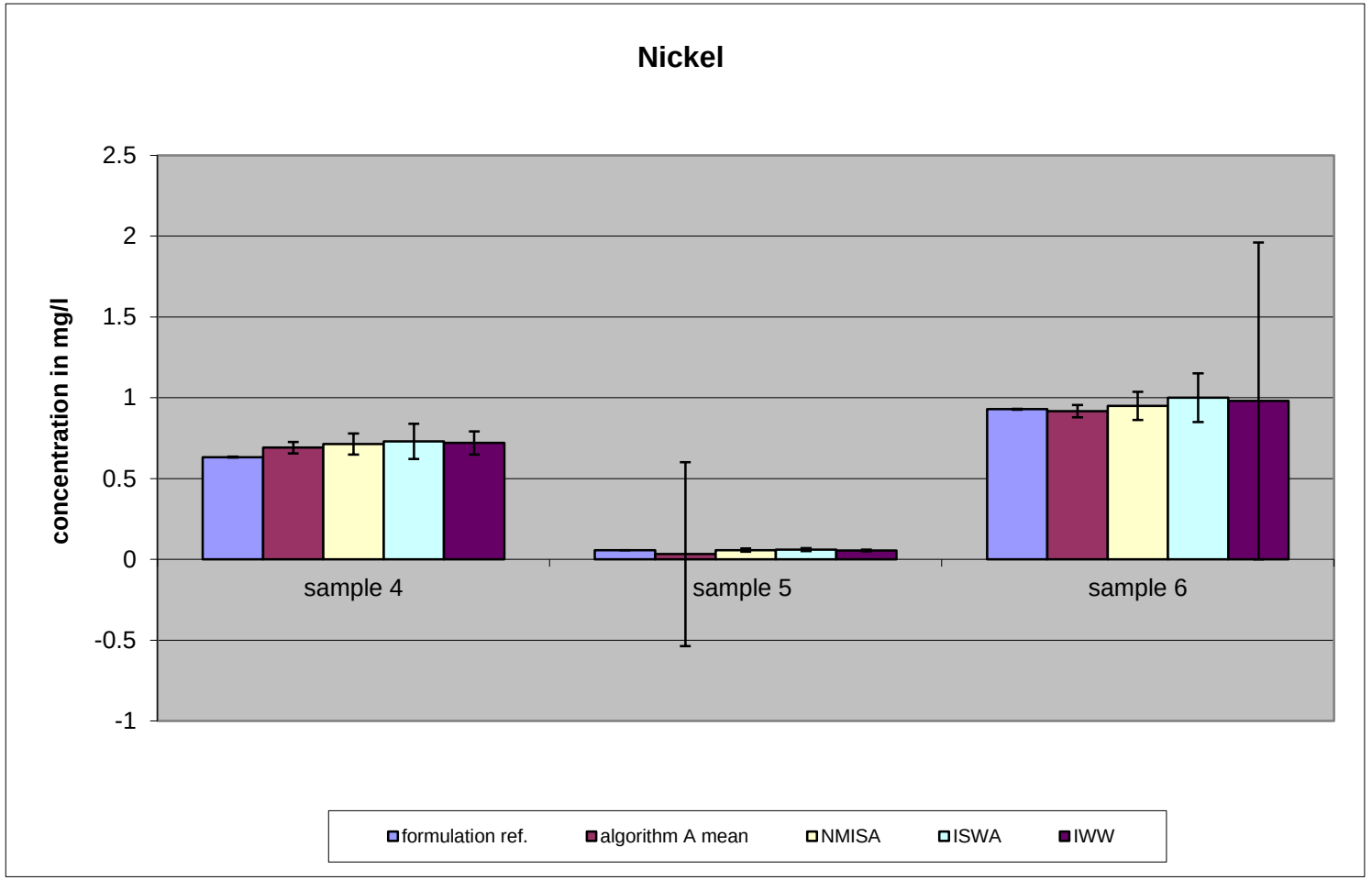
Let's go forward

Nickel
mean vs. ref.-value





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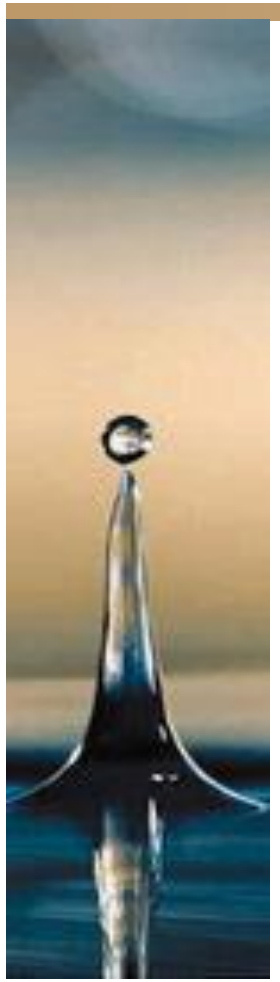
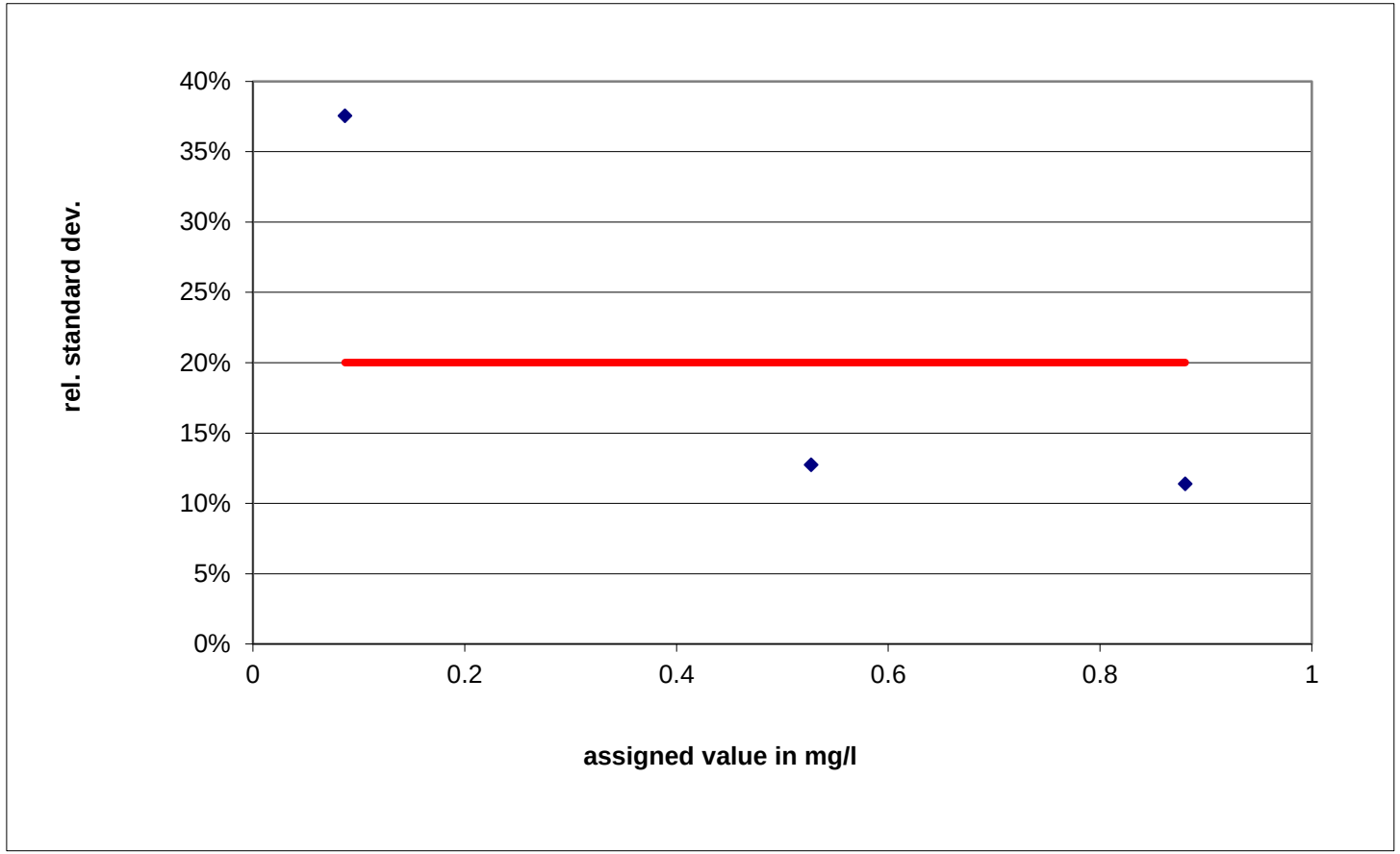
Let's go forward

Nickel

Calculated standard deviation and limit





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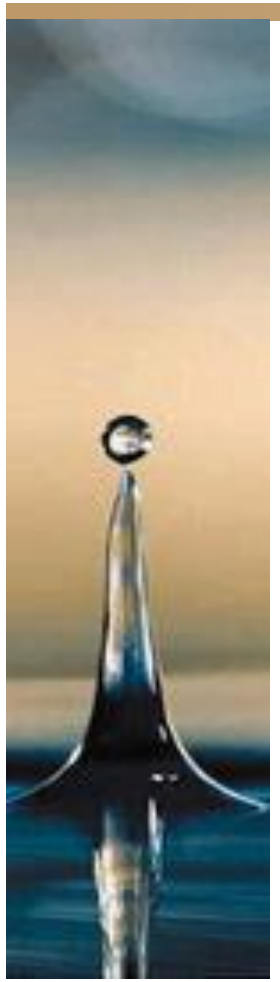
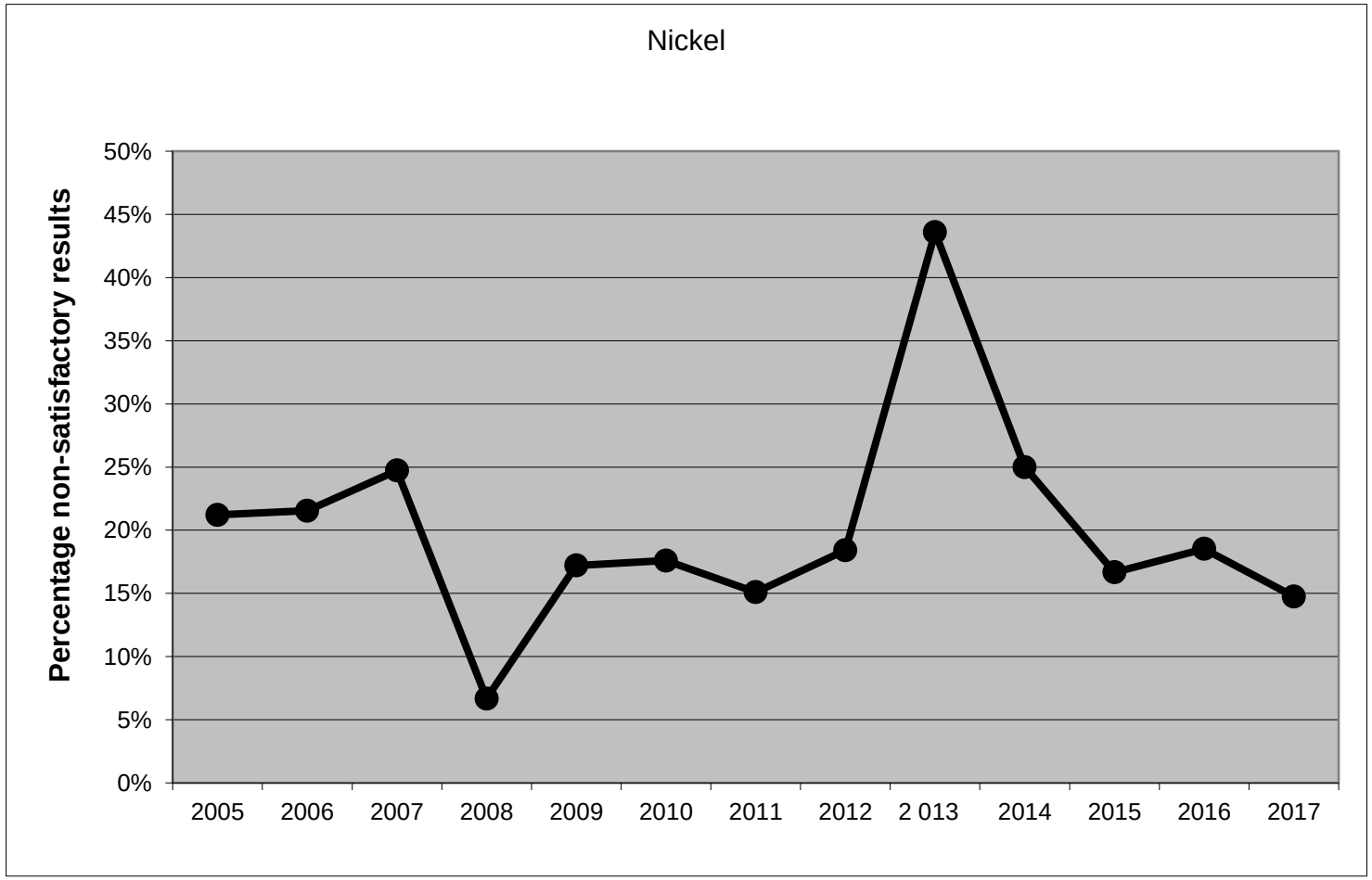
Nickel
Percentage non-satisfactory results





23.6% to 31.4% in 2017

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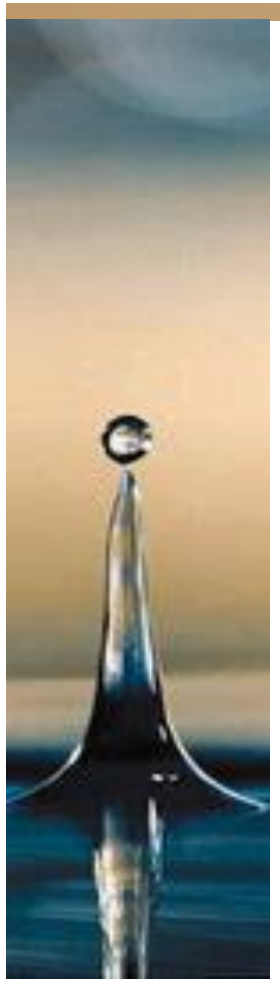
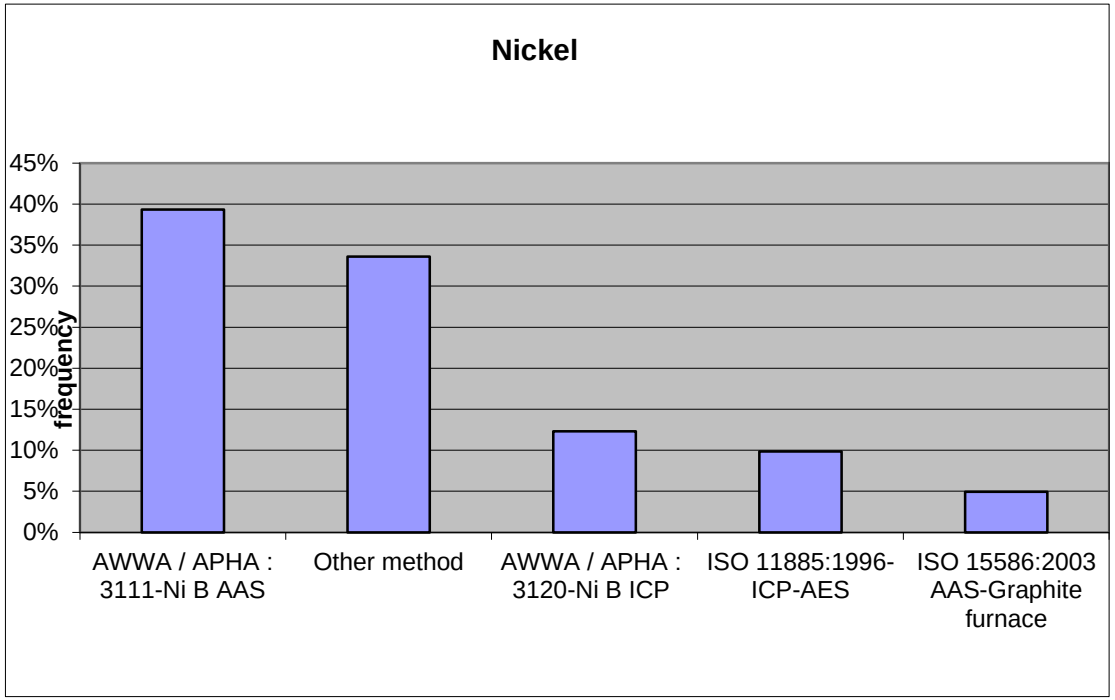
Method used





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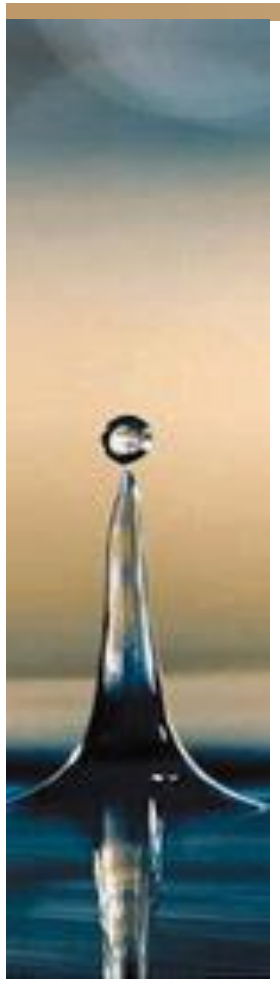
Summary **Nickel**



- High STD for the lowest level – Blank problems with the lowest level – SD of 37.6%
- The other two were both below 20%
- Percentage non-satisfactory results increased from 23.6% to 31.4% in 2017
- Average recovery is 99.1%
- 33.6% "other" methods

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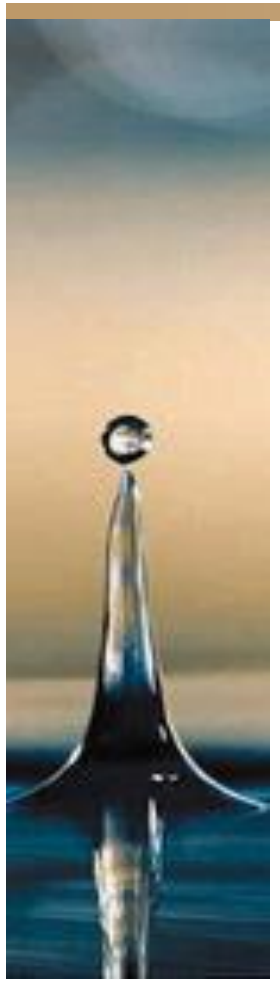
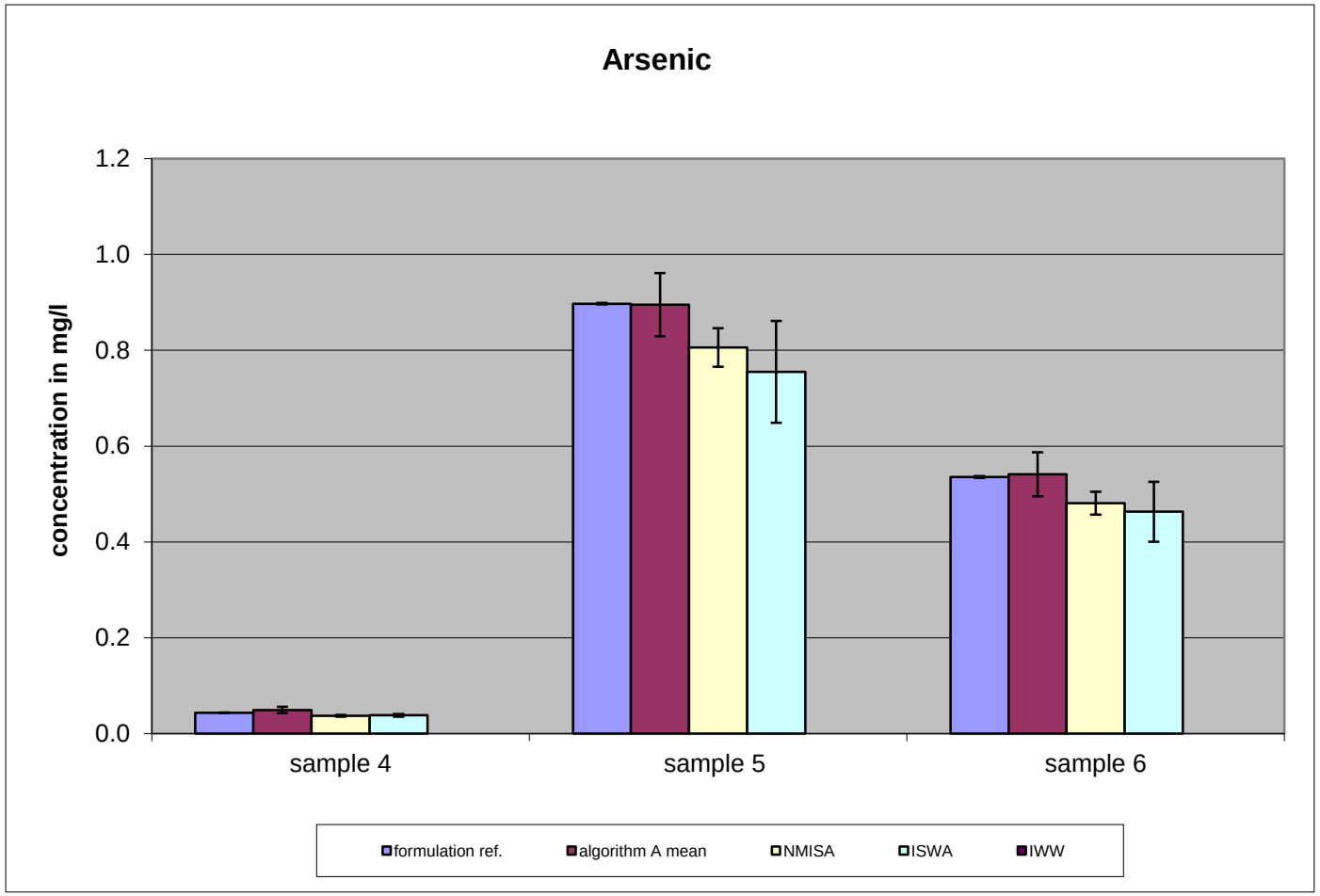
Arsenic
mean vs. ref.-value





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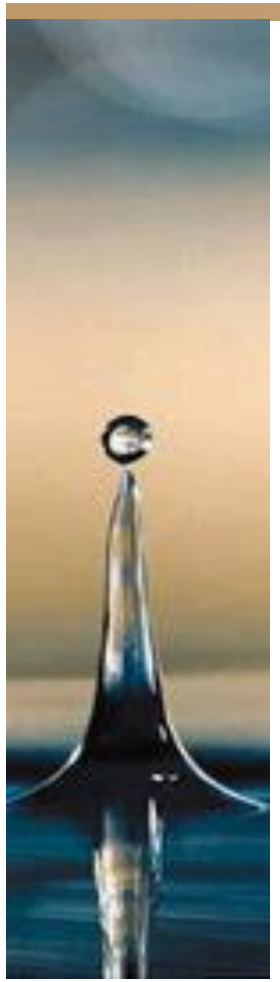
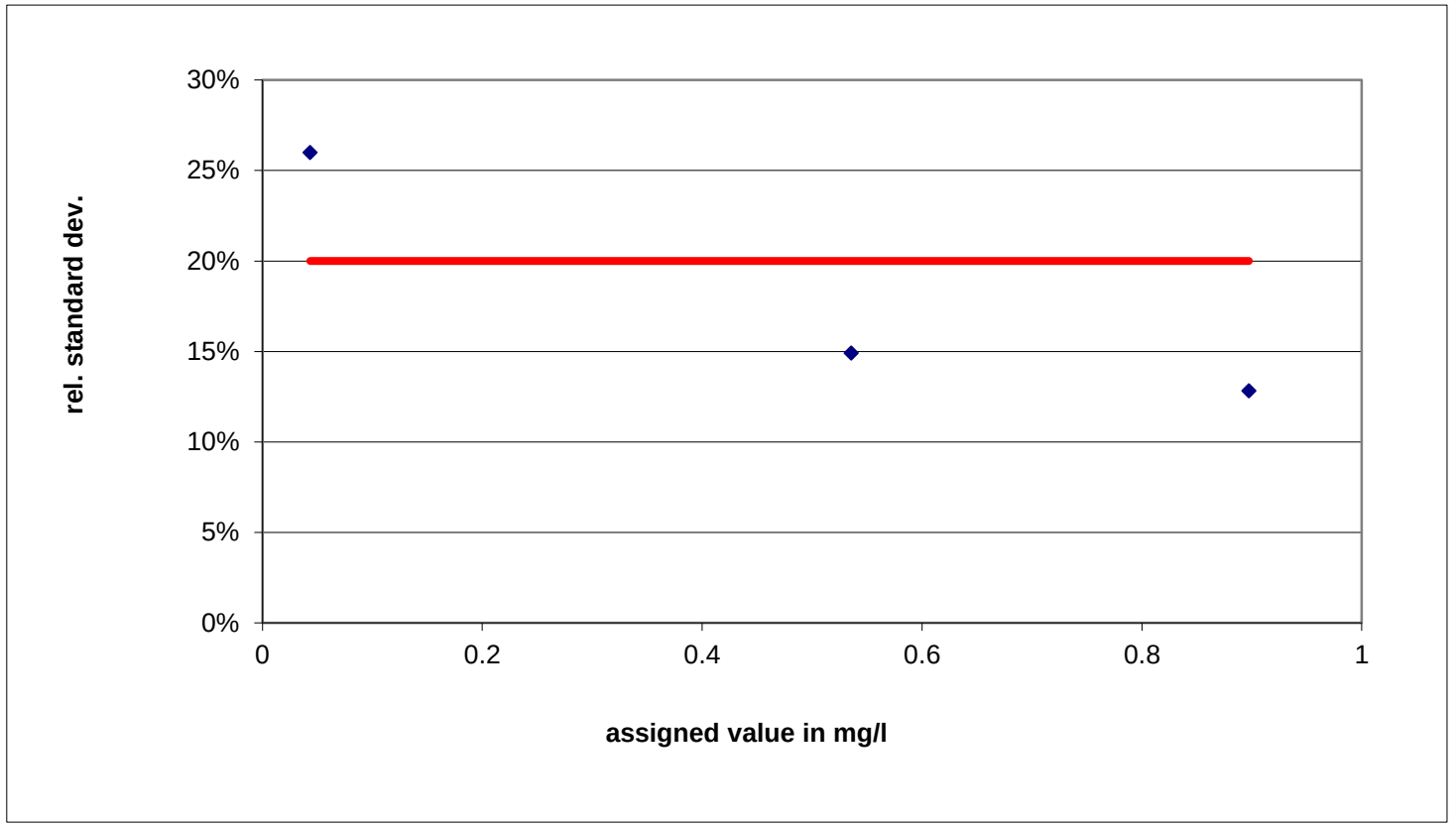
Arsenic

Calculated standard deviation and limit





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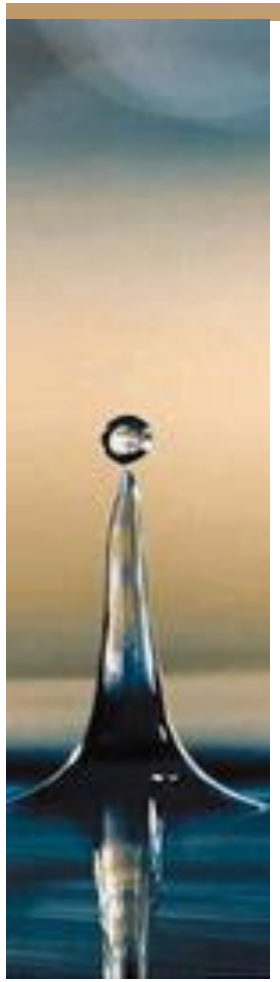
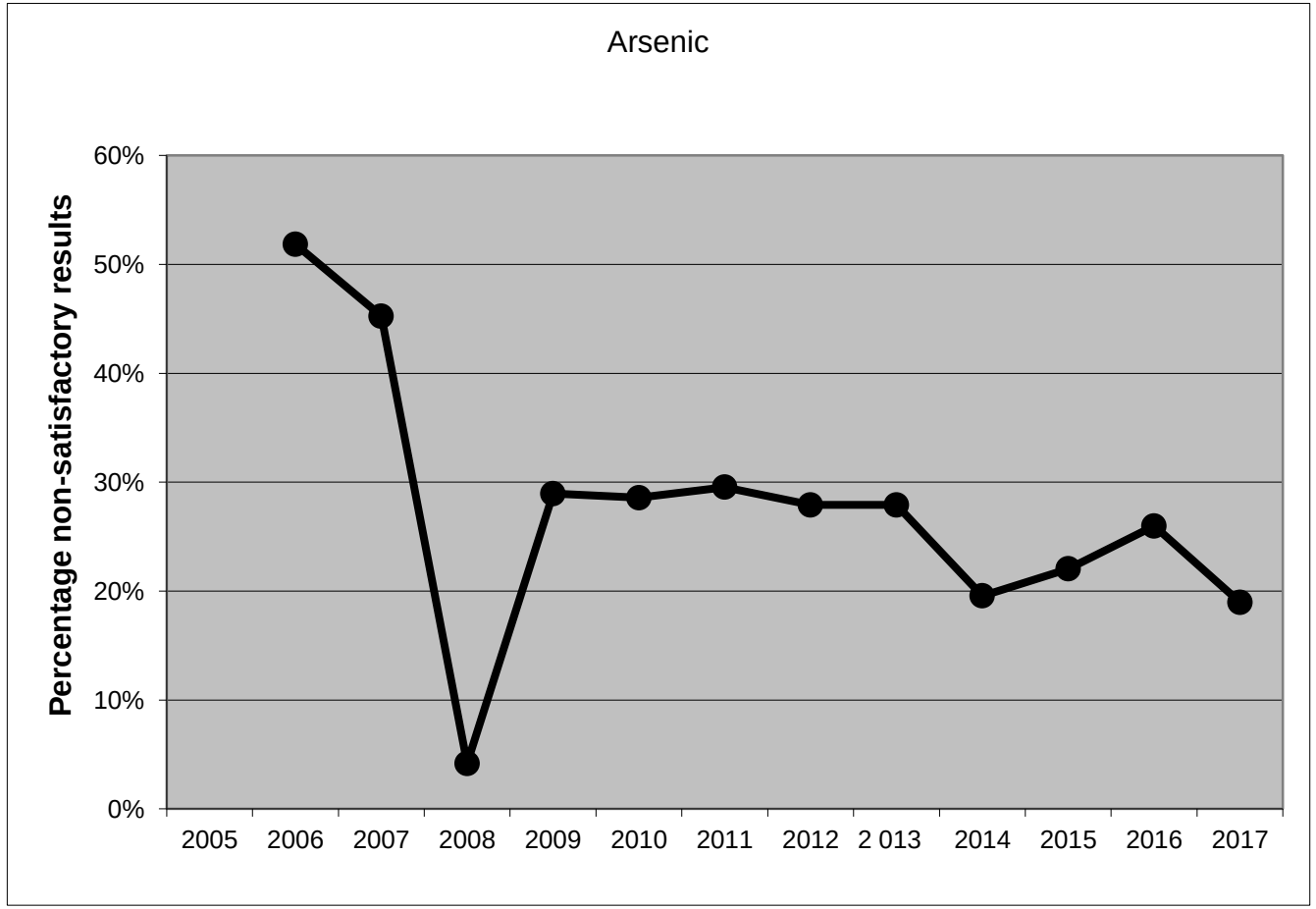
Arsenic
Percentage non-satisfactory results





26.0% to 19.0% in 2017

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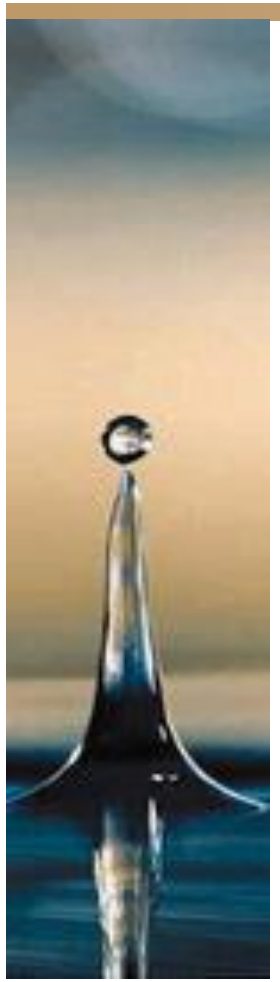
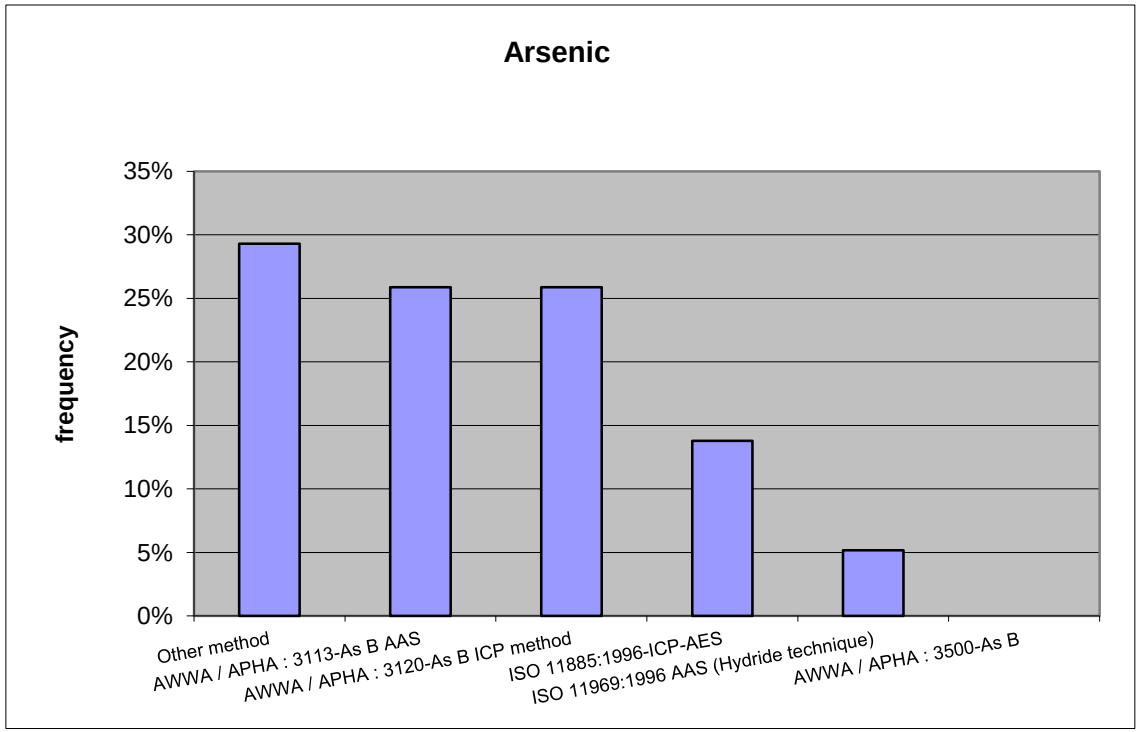
Method used





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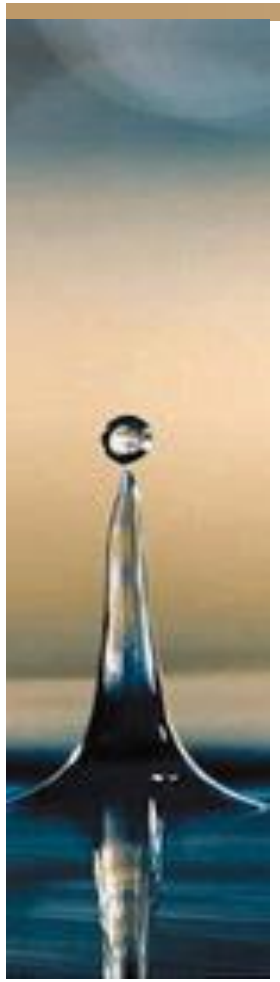
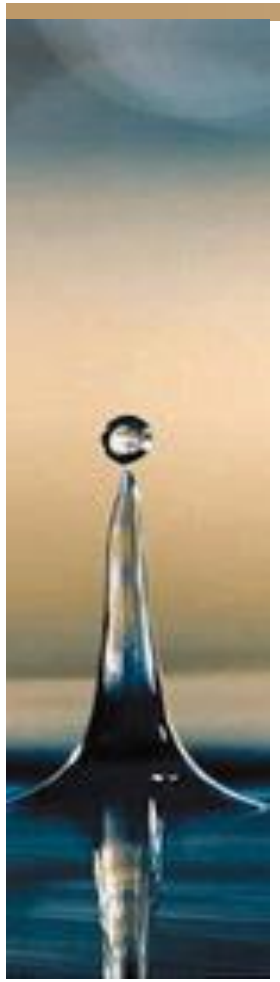
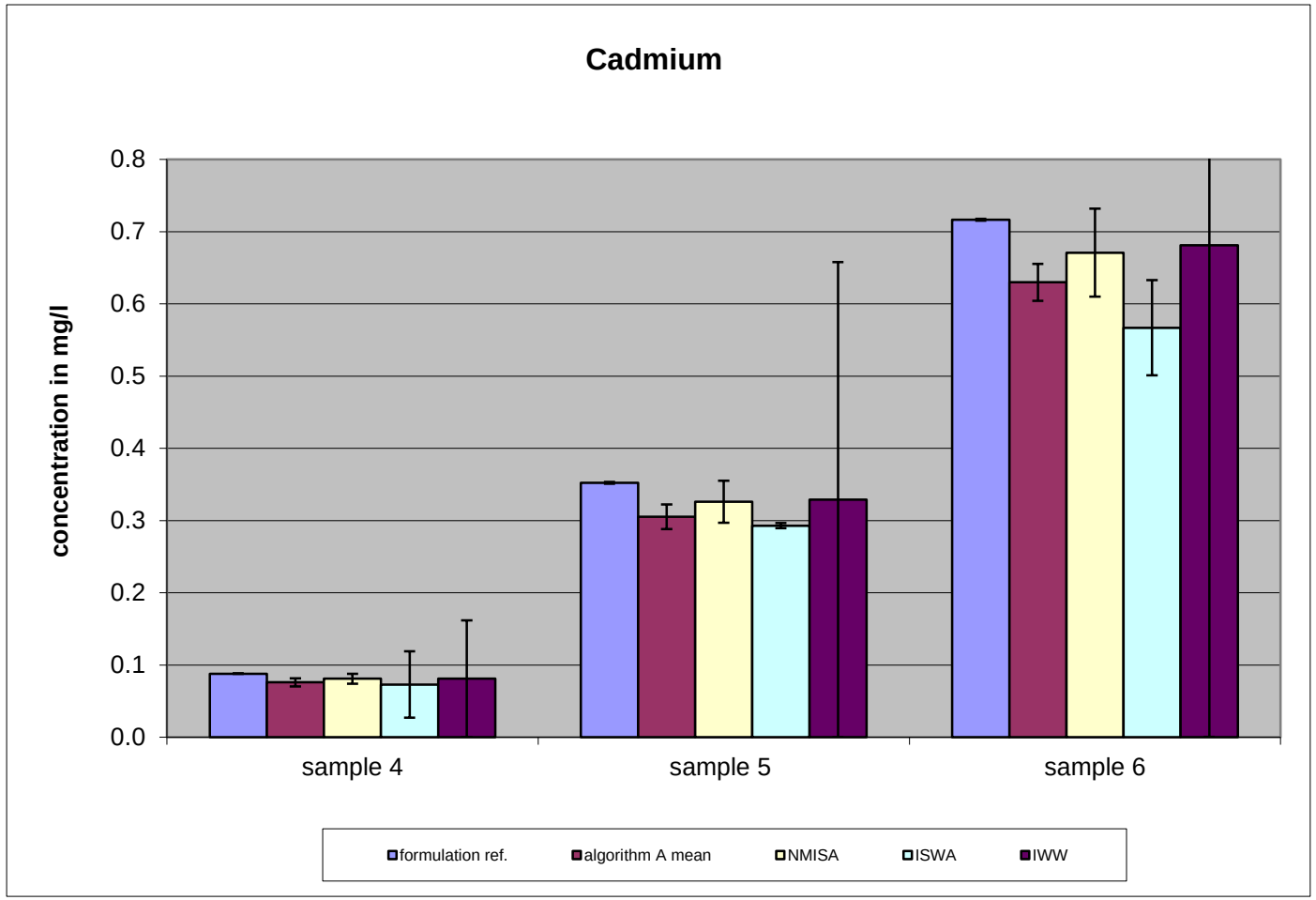
Summary **Arsenic**



- Average recovery is 100.1%
- Low number of values
- Problems with ICP and AAS method
- High STD for the lowest level – Blank problems with the lowest level – SD of 25.98%
- The other two were both below 20%
- Percentage non-satisfactory results increased from 26.0% to 19.0% in 2017

Cadmium
mean vs. ref.-value





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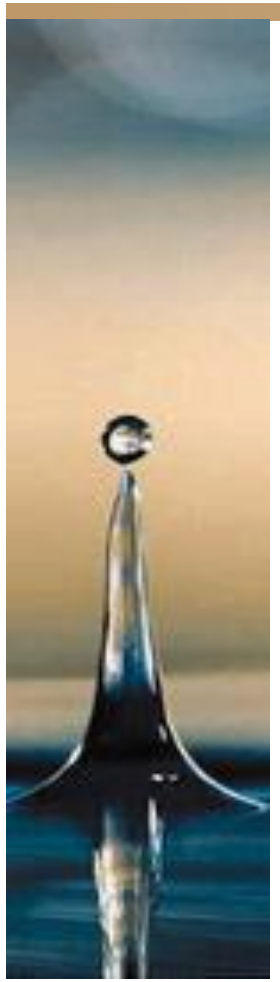
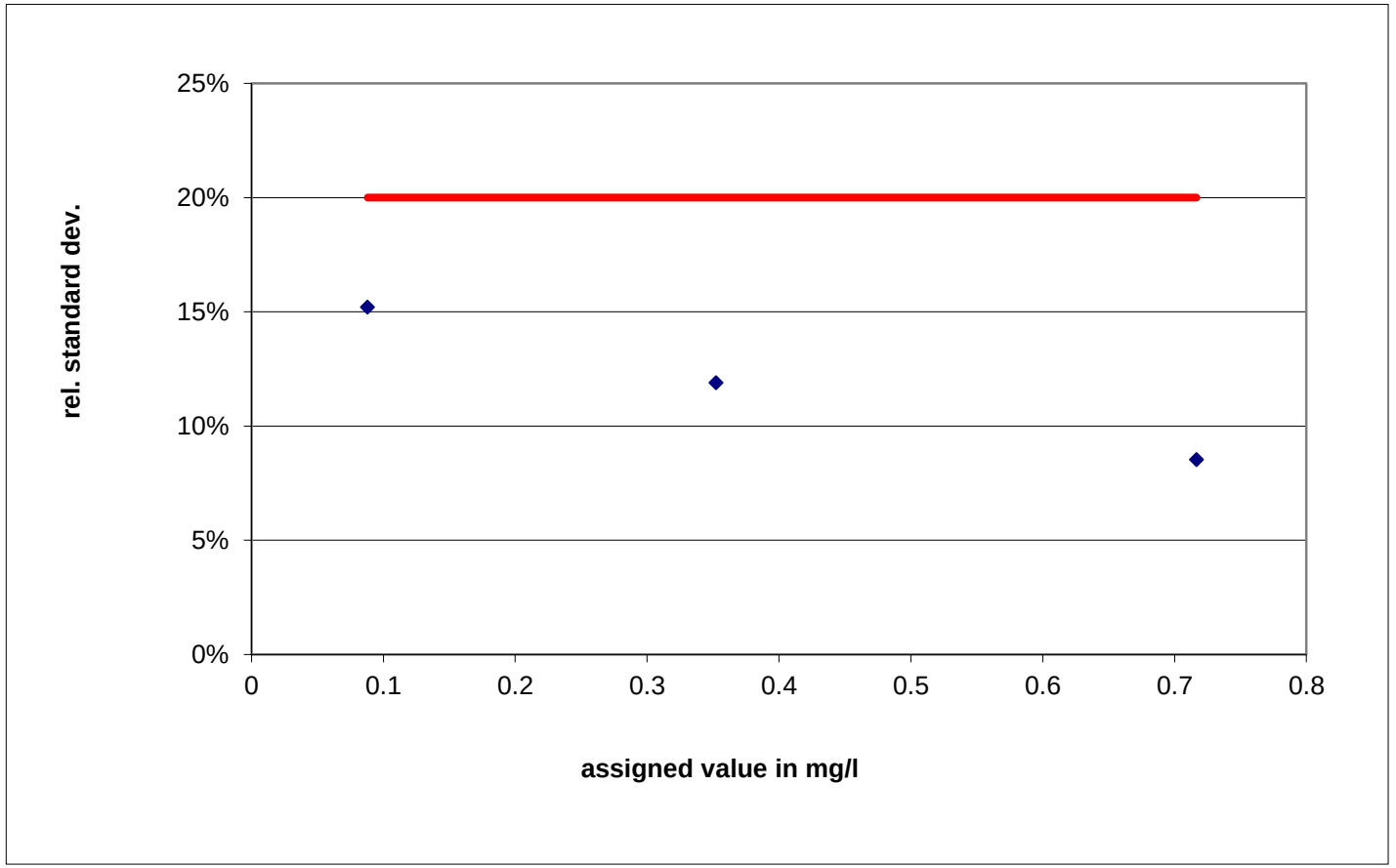
Let's go forward

Cadmium
Calculated standard deviation and limit





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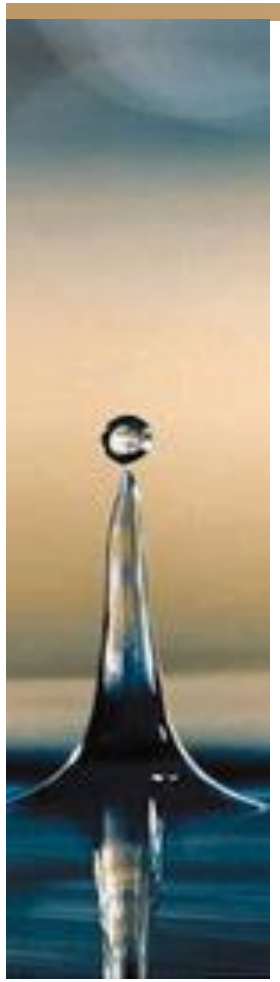
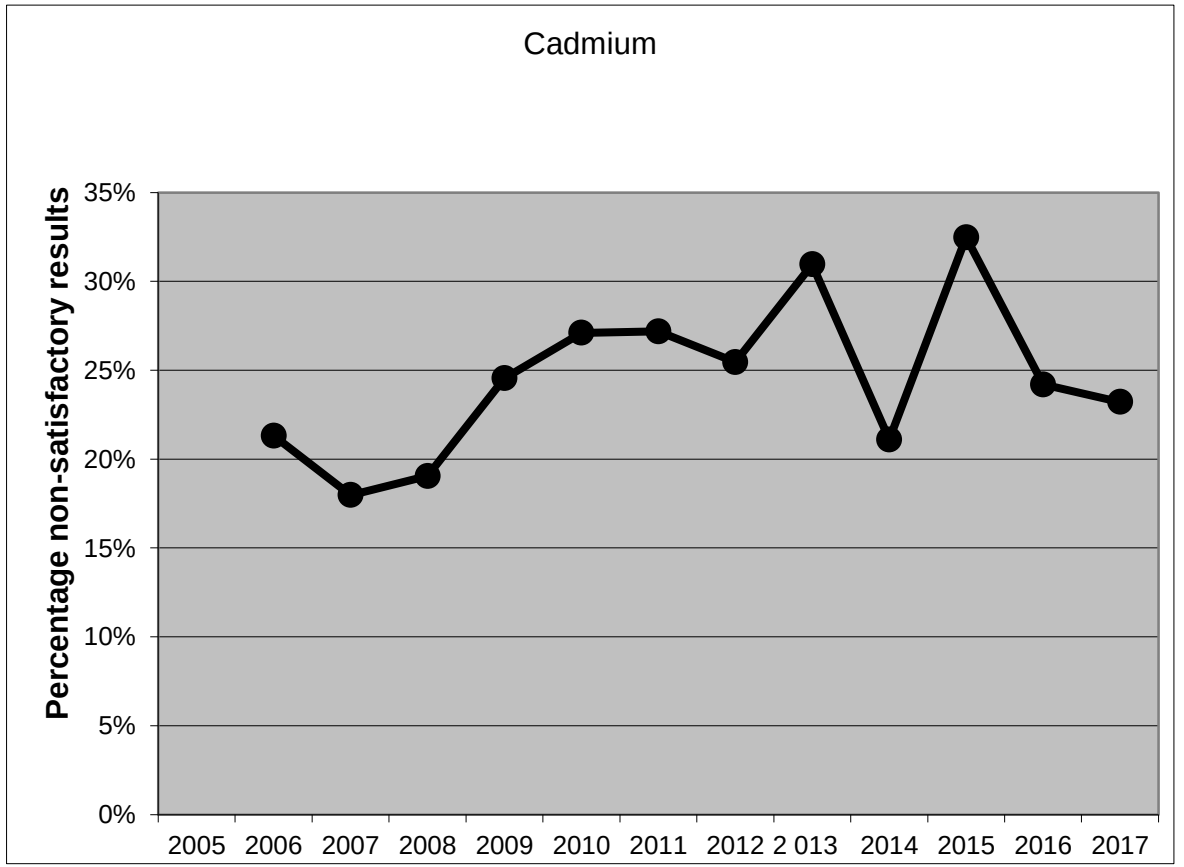
Cadmium
Percentage non-satisfactory results





24.2% to 23.2% in 2017

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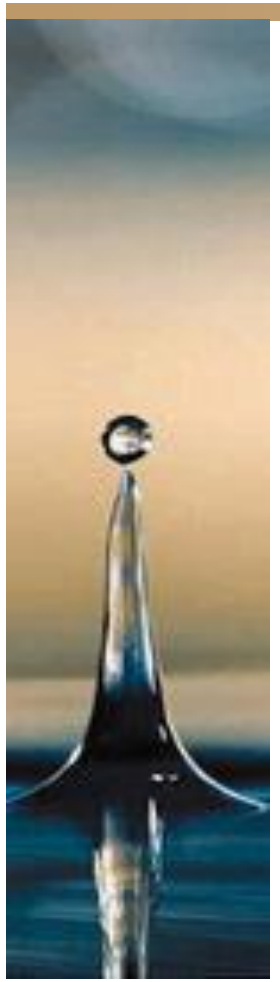
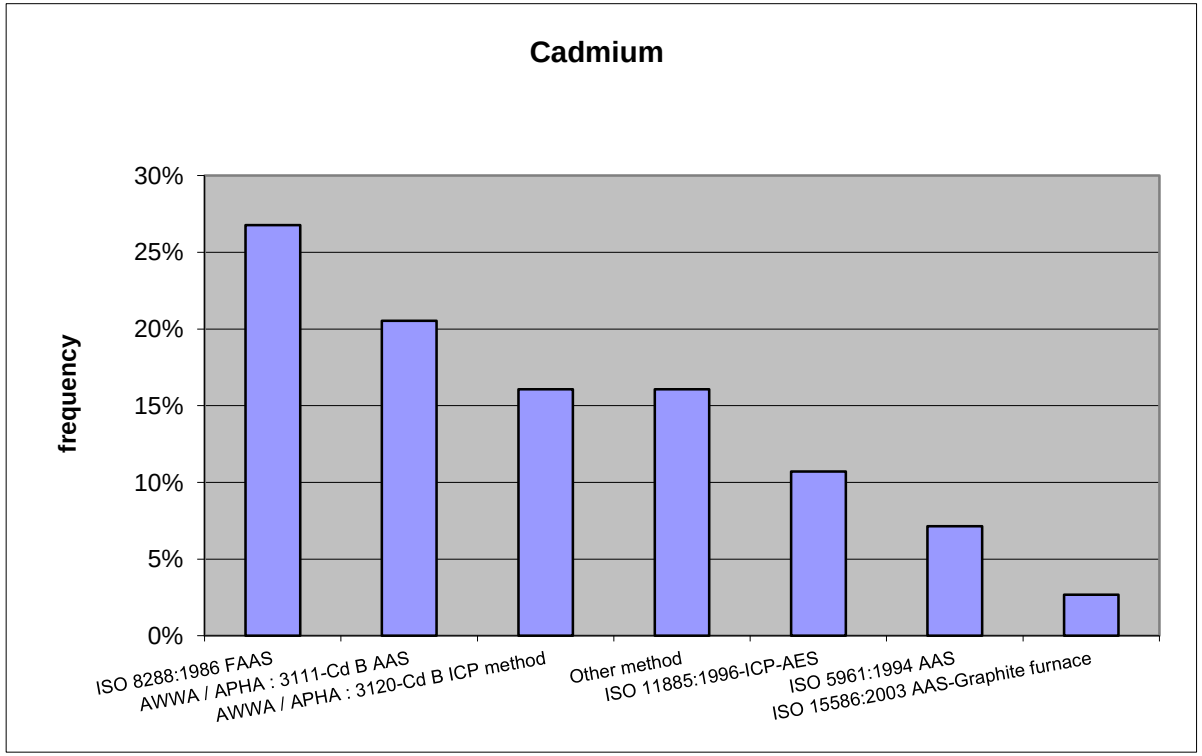
Method used





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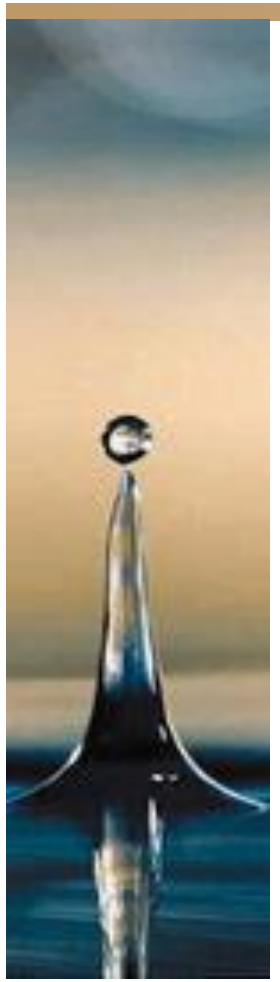
Summary **Cadmium**



- STDs varies were below 20% for all three levels
- % Percentage non-satisfactory results similiar than in 2016
- No serious problems

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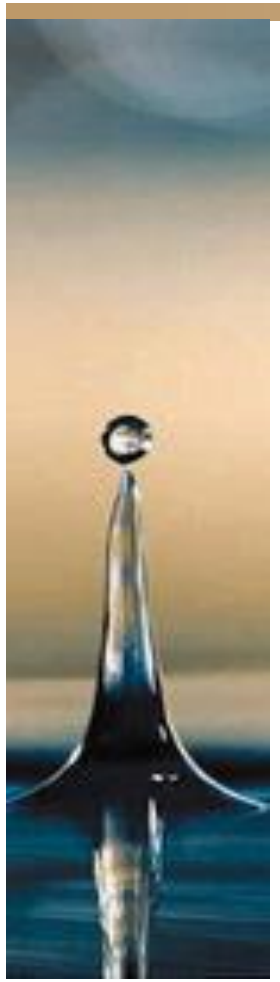
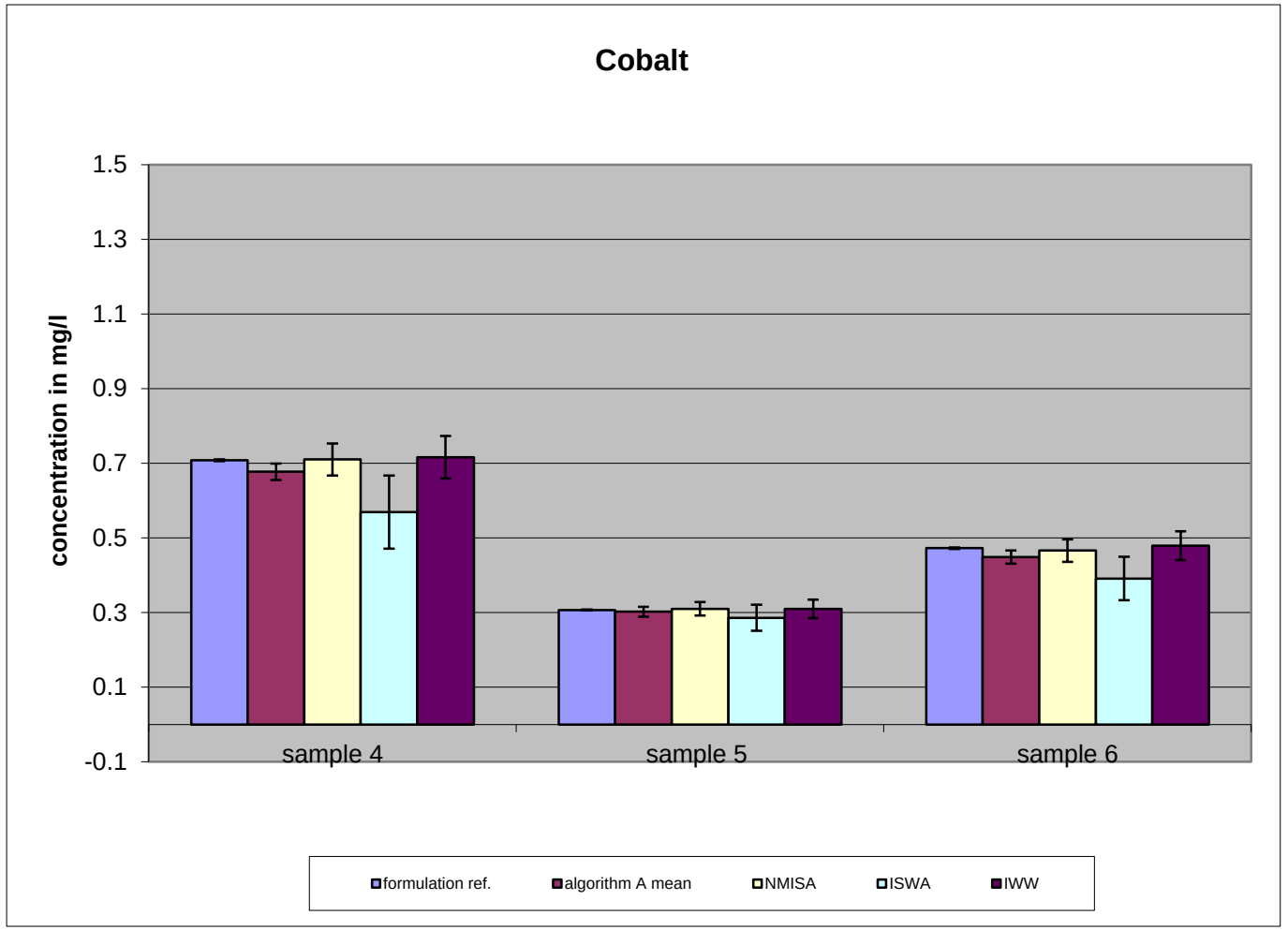
Cobalt
mean vs. ref.-value





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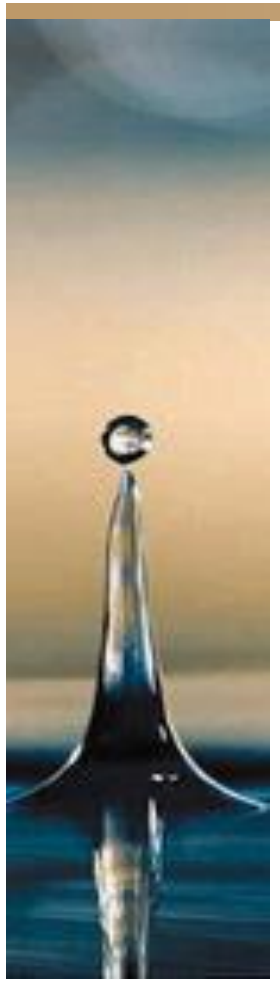
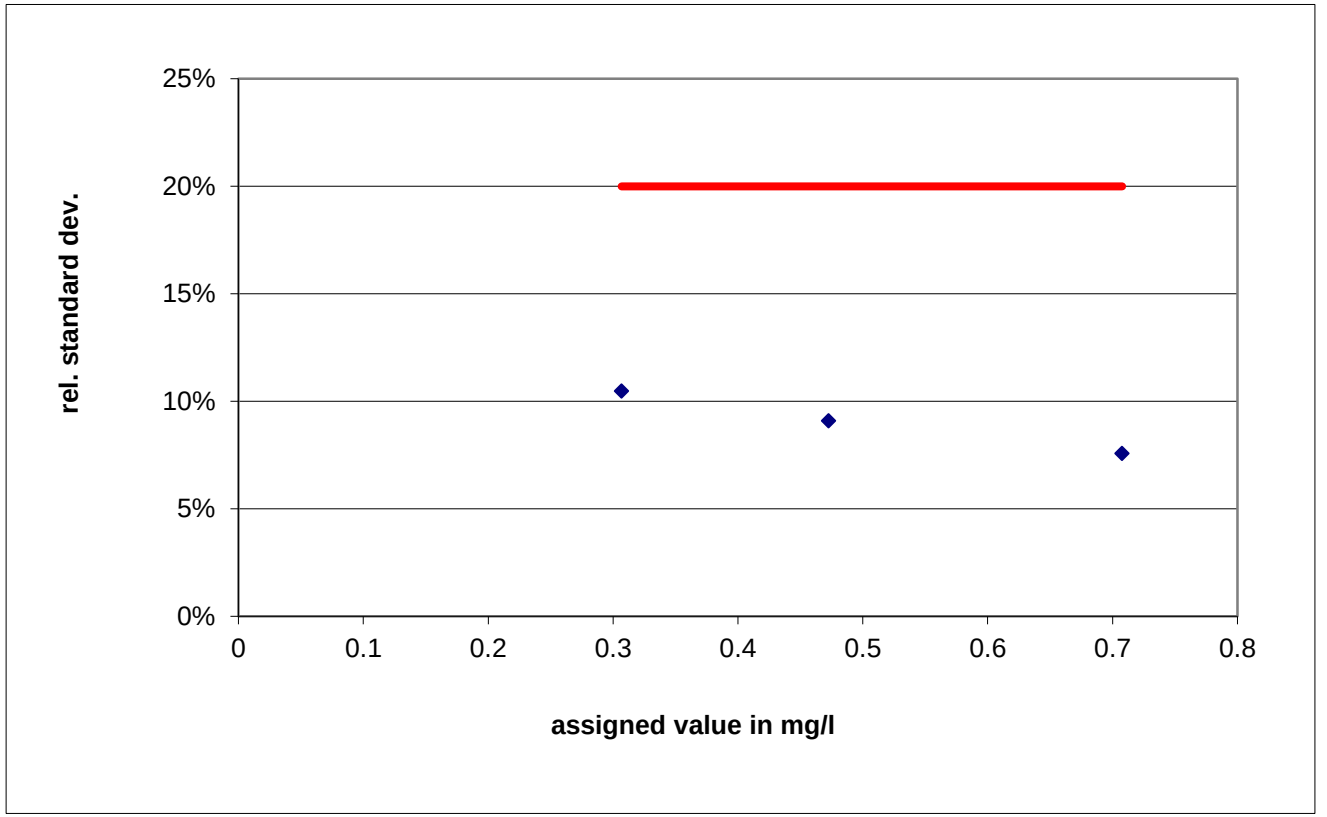
Cobalt
Calculated standard deviation and limit





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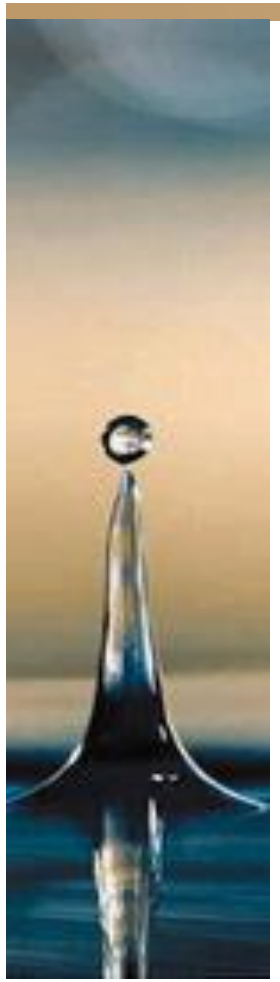
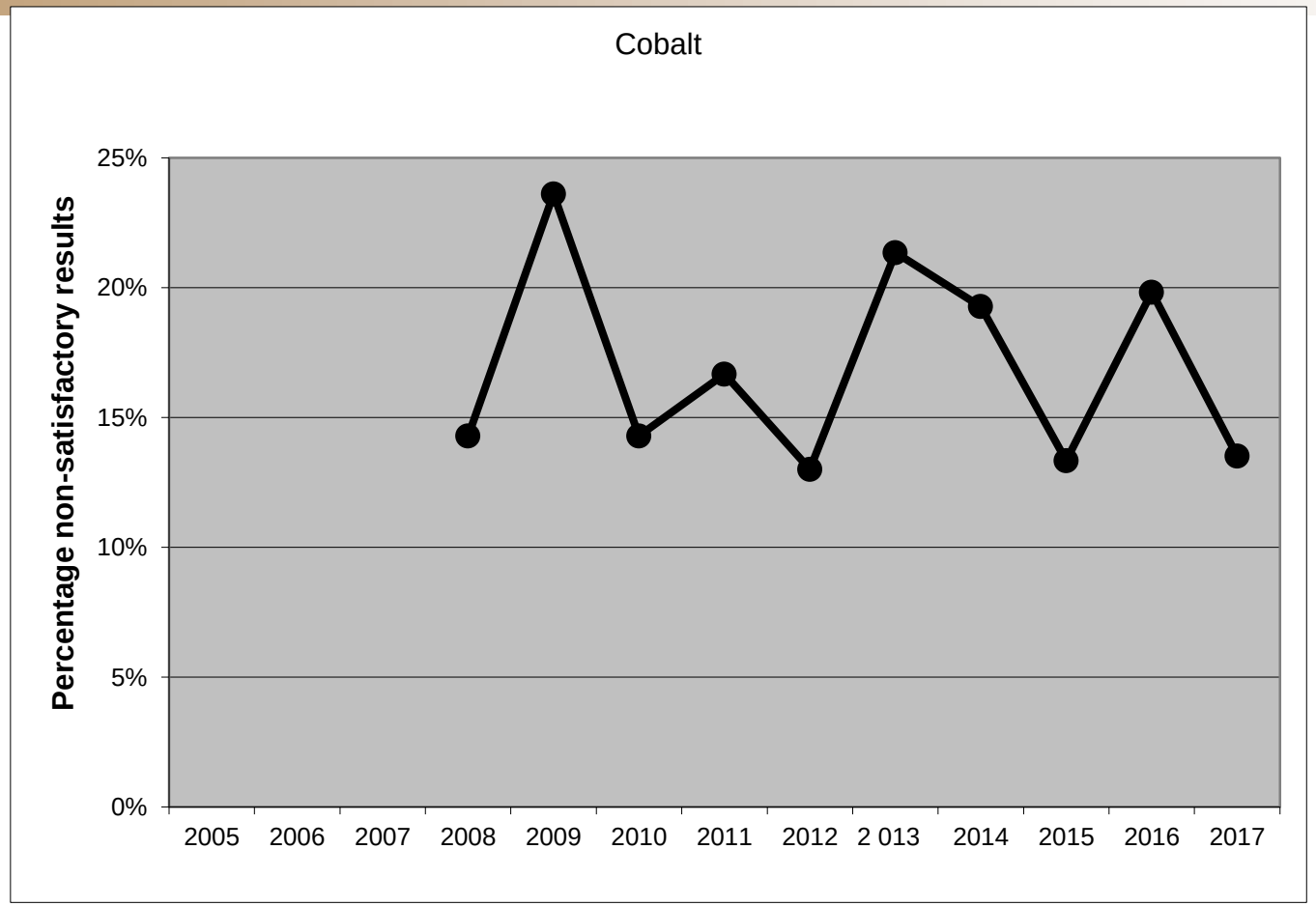
Cobalt

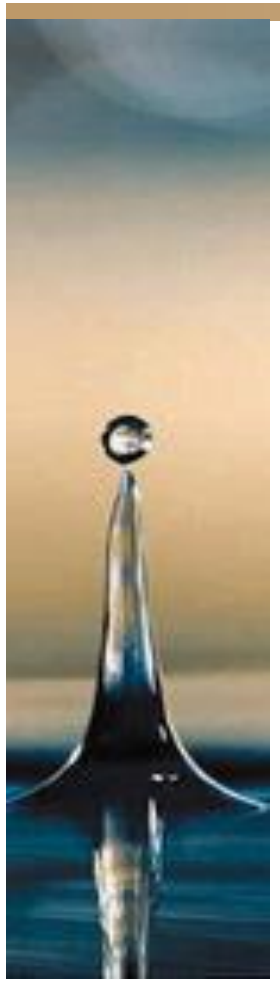
Percentage non-satisfactory results

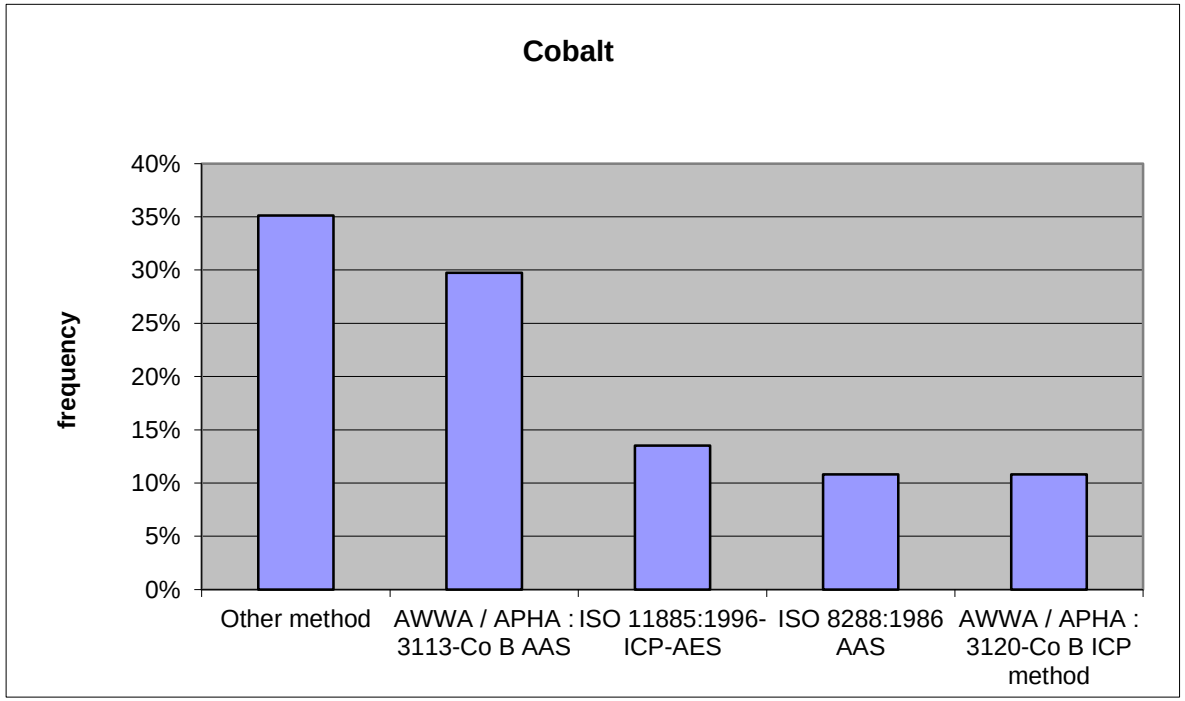




19.8 % to 13.5% in 2017

Method used





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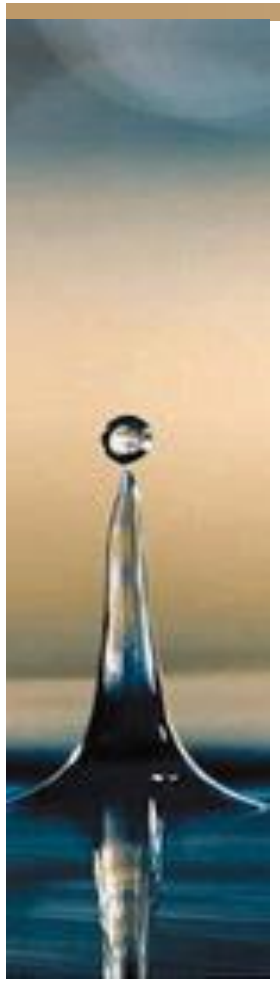
Summary **Cobalt**



- Average recovery is 95.8%
- STDs all below 20%
- 35.1% use “other” methods
- No serious problems

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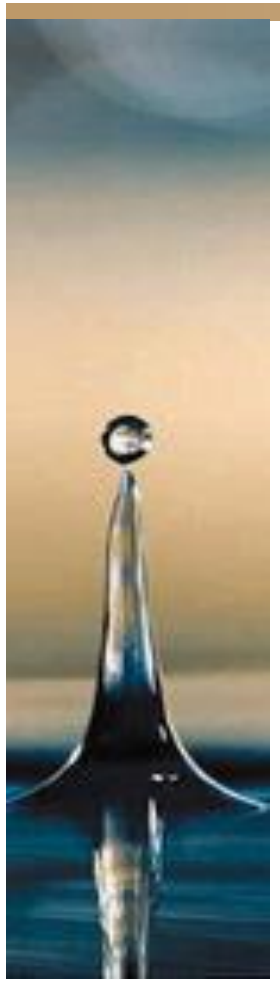
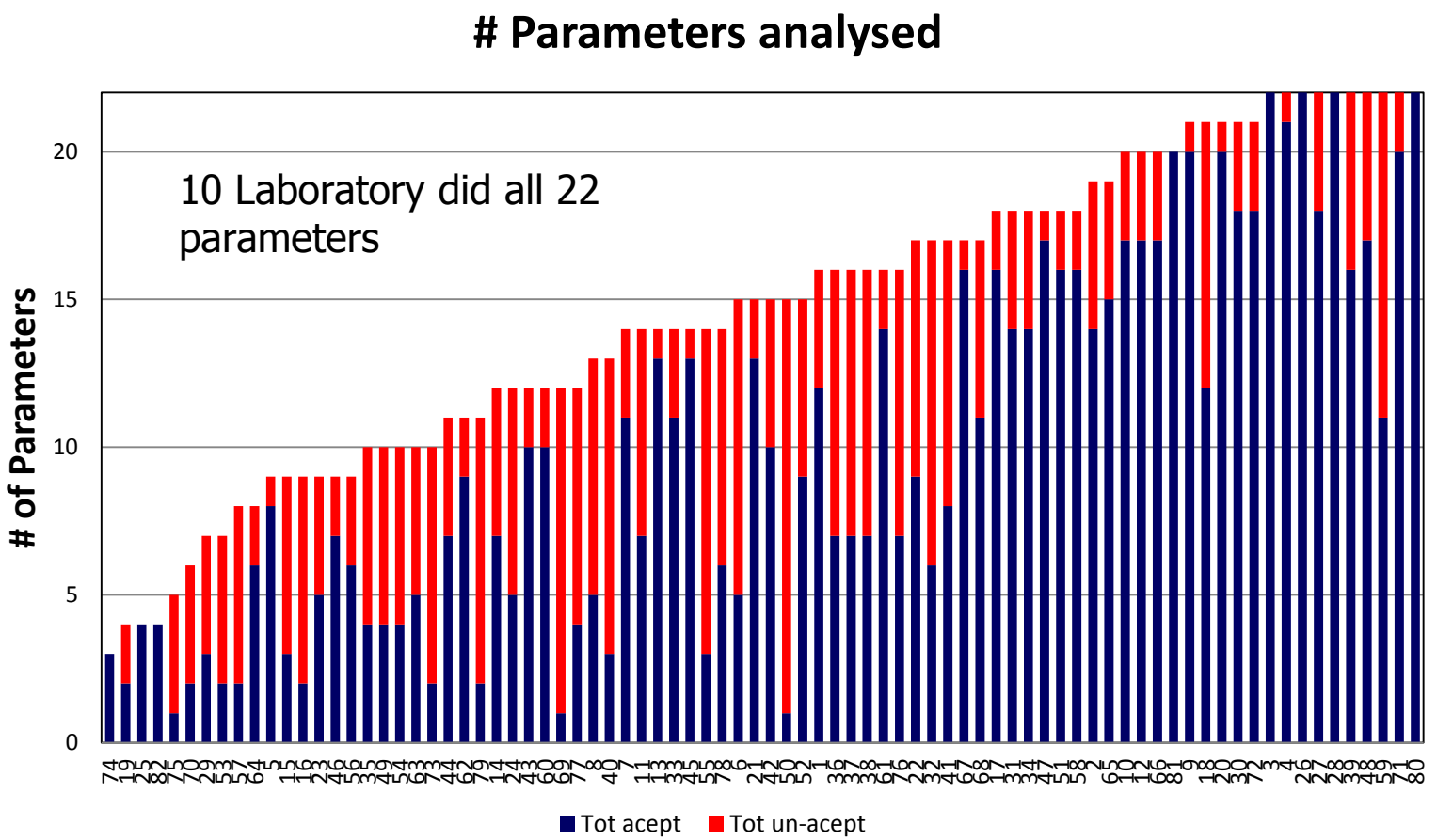
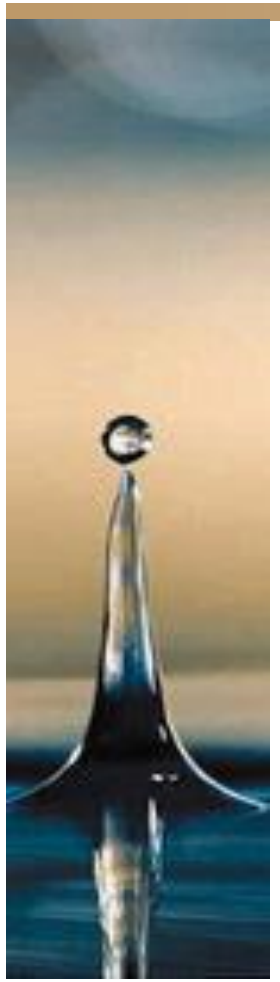
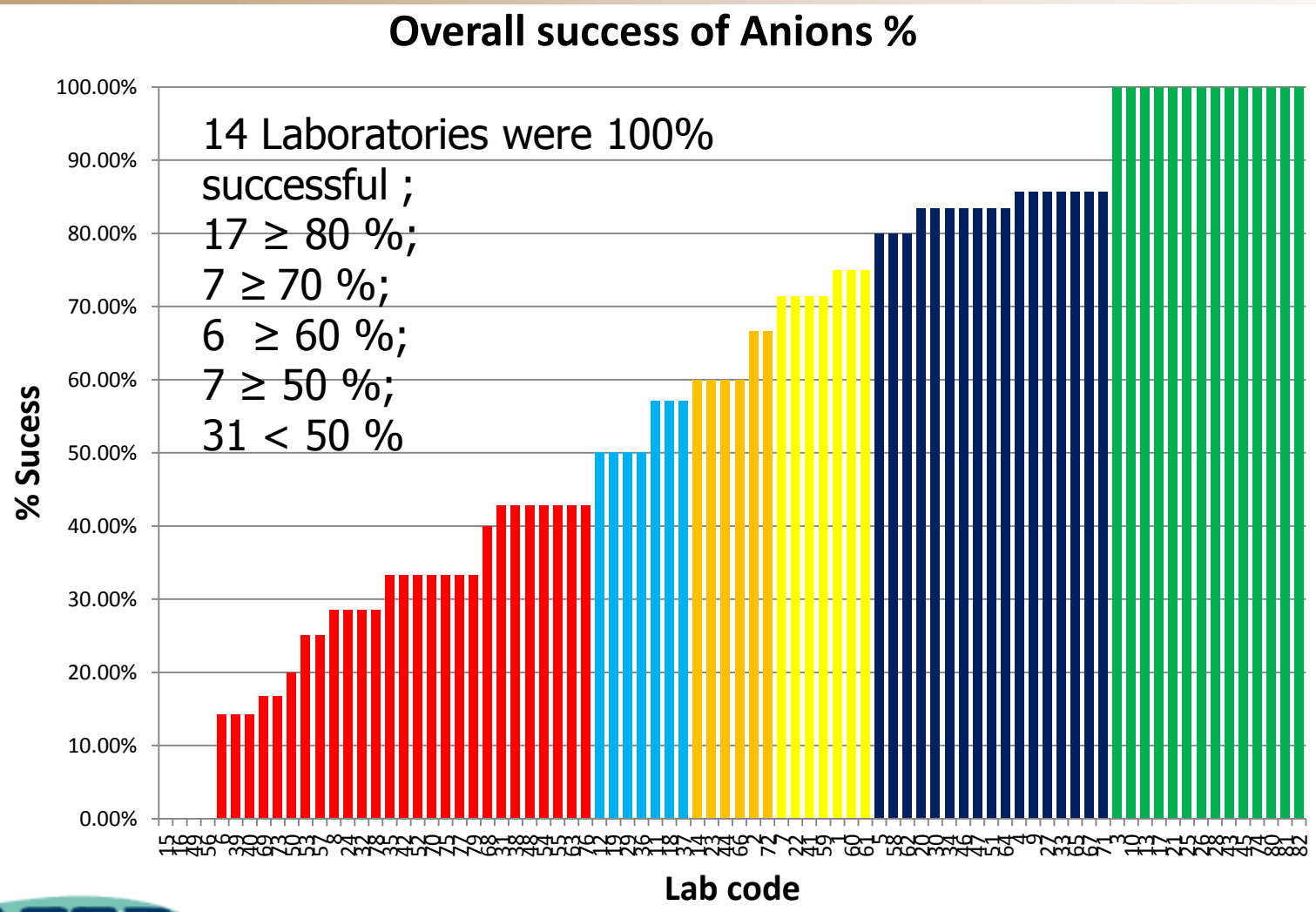
Parameters analysed



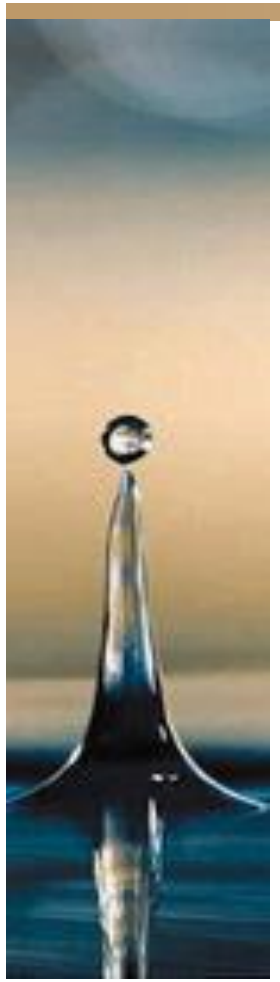


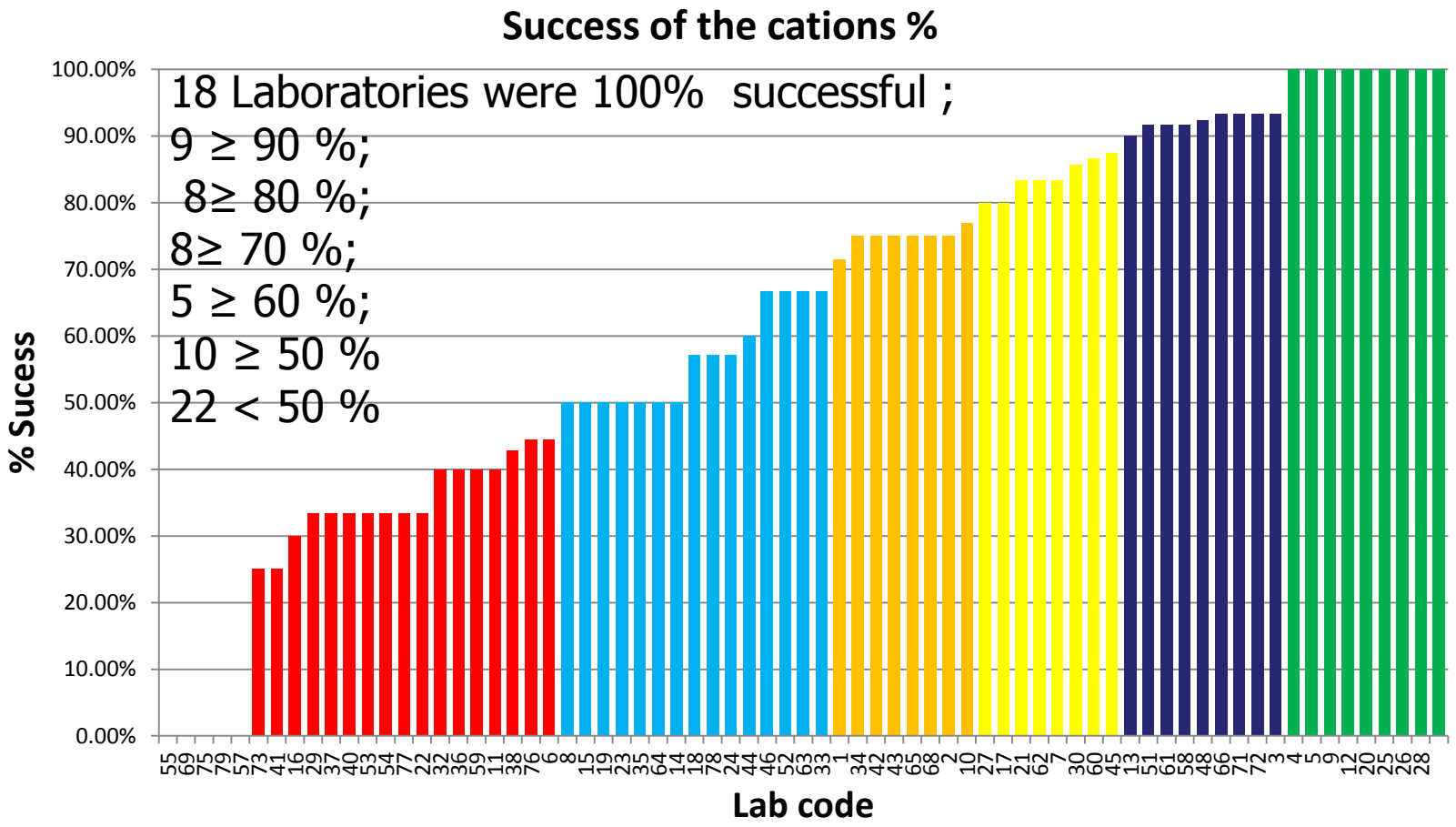
% Overall success of anions





% Overall success of cations





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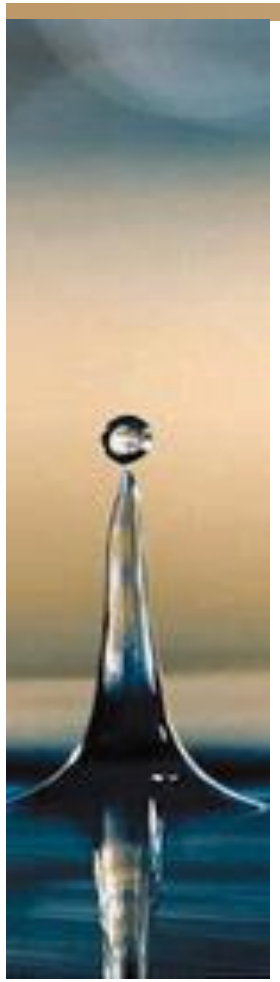
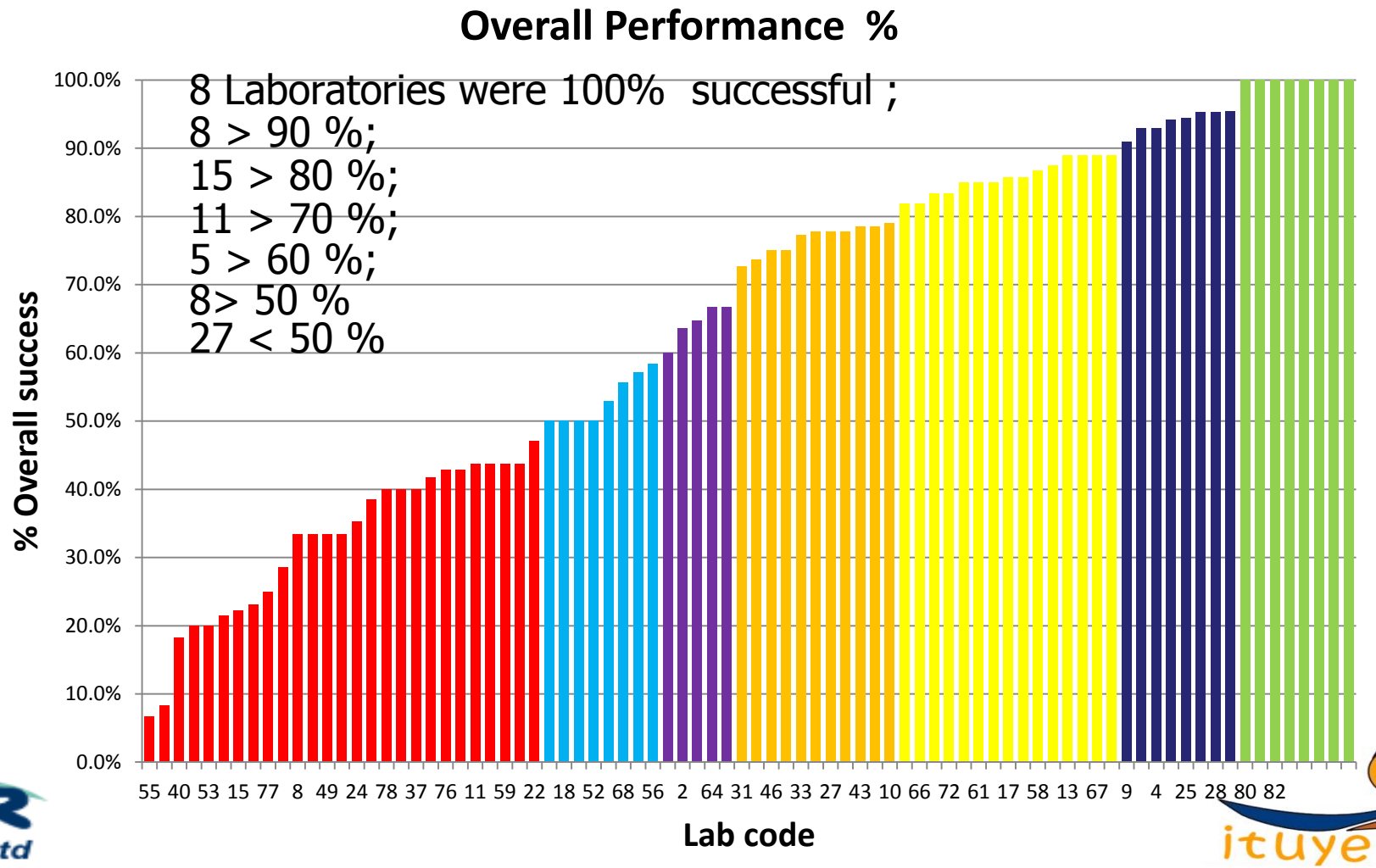
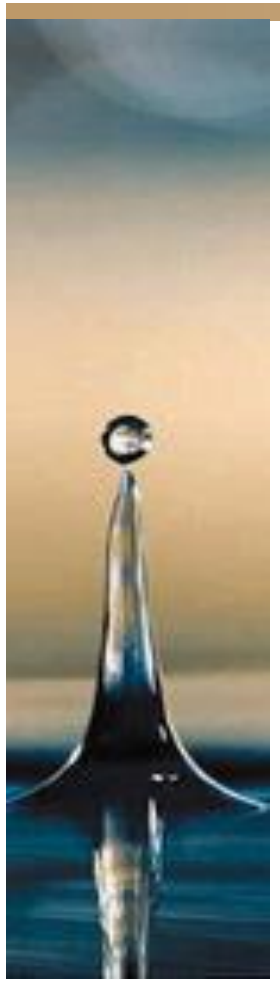
% Overall performance





Challenges 2018



- Participants do not honour the stated deadlines
- Rregistration forms are sometimes still not clear – email addresses are important participation.
- No registration forms – no samples
- No proof of payment – no samples
- No results – no evaluation reports
- Standard deviations are too high
- Correct procedures for implementation of methods
- Wrong unit reporting remains a challenge
- Corrective actions are still not implemented

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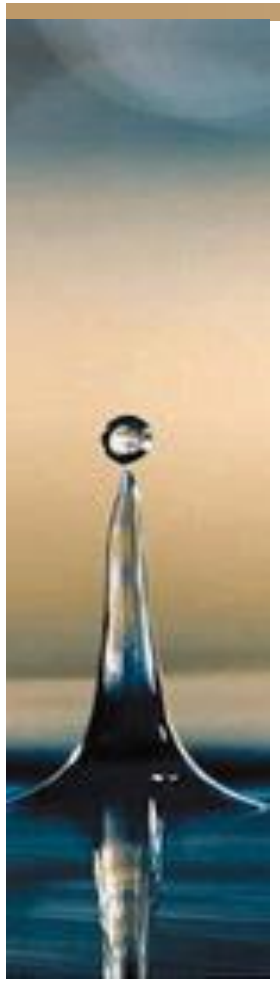
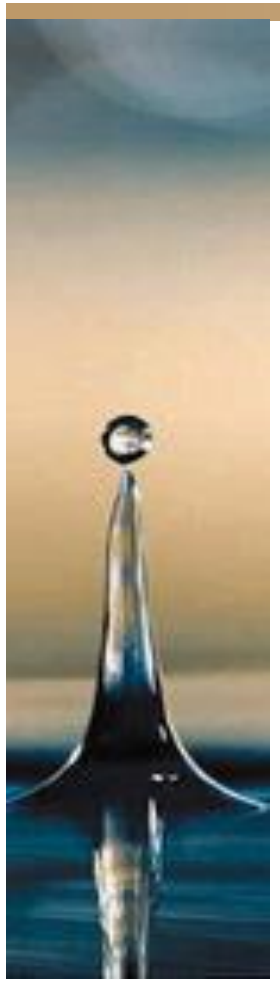
Conclusion



- Laboratories will have to pay for distribution and participation – if you do not analyse the samples – waste of money
- Overall the results of this PT round indicated a worse performance than 2016
- Root cause analyses are not done
- Method selection is still a big problem - Laboratories should identify the gaps that prevent them from applying a proper method
- A list of recommended methods were compiled and it is sent to all participants – but they do not use it
- "ICP" reported as a method is not an international method - ISO 11885:1996-ICP-AES is !
- The evaluation and assessment procedure is fit for the purpose

Conclusion



- Software addresses the changes from ISO/IEC 17043 and ISO 13528.
- Name and address of the PT provider and name of the round can be inserted
- Usage of median is not possible anymore
- Graphical display of kernel densities included. You may find more information about kernel density diagrams http://www.rsc.org/images/data-distributions-kernel-density-technical-brief-4_tcm18-214836.pdf
- z-scores are rounded to one digit after decimal point as requested by ISO/IEC 17043 and ISO 13528
- assessment changed to satisfactory, questionable, non satisfactory as requested by ISO/IEC 17043 and ISO 13528

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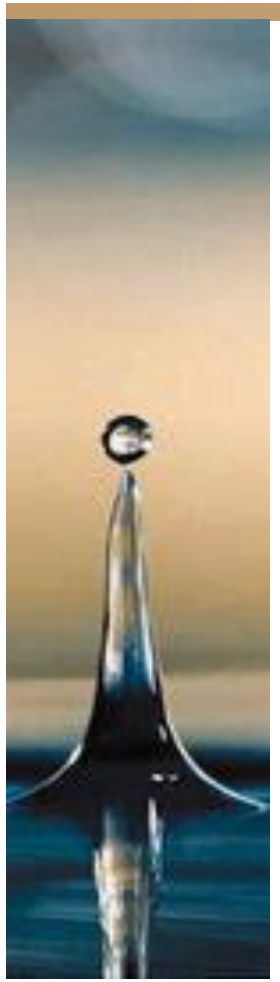
Conclusion



- PT plays a vital role in laboratory management for ongoing maintenance of confidence and improvement, irrespective of whether or not the laboratory needs to participate for accreditation.
- The SADCMET Water PT schemes offers an additional educational role for participants to help the participants to improve and to compare with peers and
- Jessica Klazen did a very good job

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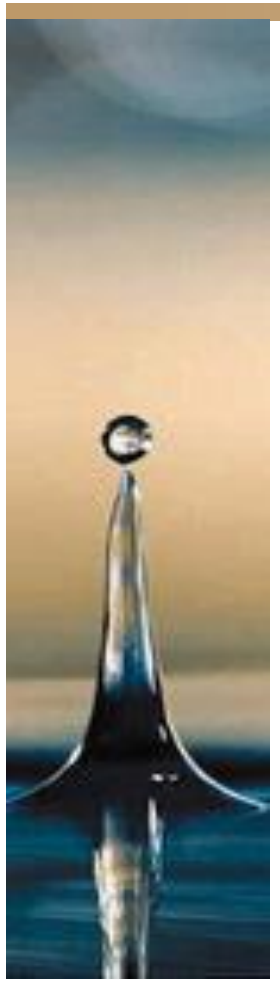
Acknowledgments



- PTB payment of sample distribution
  - Kathrin Wunderlich
  - Karin Vondeberg
  - Stephen Virchow
- SADCMET
  - Donald Masuku
  - Christelle Louwrens (NMISA)
  - University of Stuttgart
- Expert labs – NMISA – Maré Linsky; ISWA – Dr Michael Koch; IWW –Dr Ulrich Borchers
- NamWater personnel, Local coordinators, Participants
- Malawi Bureau of Standards

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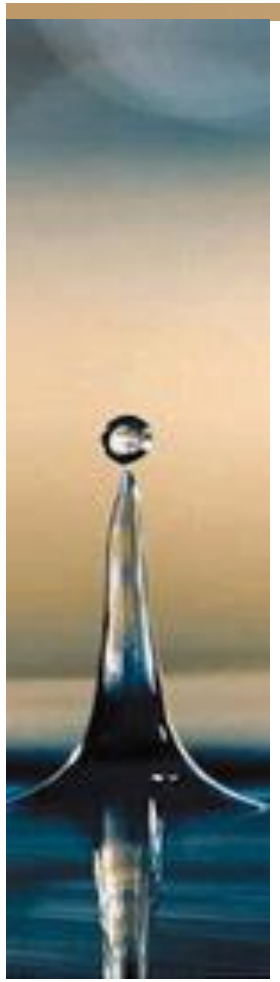
Questions



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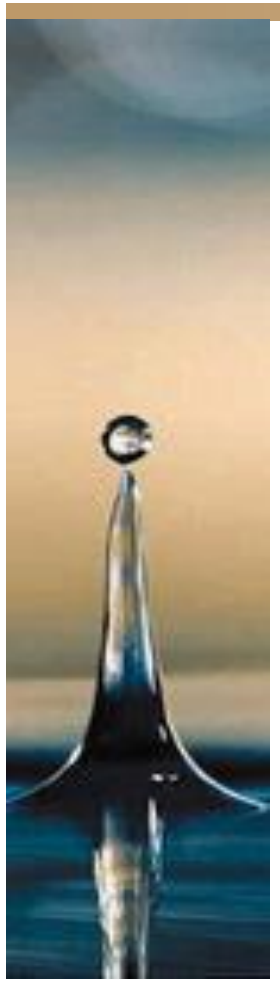

thank you!

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