C5 - Water chloride ion (Cl-) dosage - Water conductivity determination

1.Water chloride ion (Cl-) dosage

1.1. Principle :

$Cl^-_{\text{water}} + AgNO_3$ silver nitrate in burette $\longrightarrow AgCl$ silver chloride precipitate $+ NO_3^-$

Potassium chromate $K_2Cr_2O_4$ in demineralized water is a yellow compound.

It is an end reaction indicator : the first quantities of surplus silver Ag^+ ions, give, with potassium chromate, a red precipitate :

$2\ Ag^+ + Cr_2O_4^{2-} \longrightarrow Ag_2Cr_2O_4$ red precipitate

Data :

M $AgNO_3 = 108 + 14 + 48 = 170$ g / mol

C = $2.818 * 10^{-2}$ mol $AgNO_3$ / L

1 mL $AgNO_3$ poured = $2.818 * 10^{-5}$ mol $AgNO_3$ react with $2.218 * 10^{-5}$ mol Cl- = **1 mg Cl^- water**

Field of application : 0.5 to 15 mg Cl^- in 100 mL water test volume (WTV) :

5 to 150 mg Cl^-/ L

1.2. Procedure

Test water volume : 100 mL (be careful to the amount of chloride)

Add 1 mL of potassium chromate : solution is yellow

Pour, with burette, silver nitrate until appearance of permanent brown - red precipitate

2. Water conductivity determination

2.1. Principle :

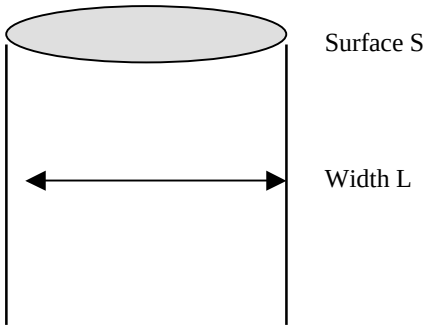
Conductivity is the water property to conduce electric current ; it depends on the kind of dissolved ions, their concentration, and temperature.

Reminder :

Resistor (ohms Ω) = Voltage / Intensity (A)

G conducatance (Siemens S) = 1 / R

Sensor description : it is constituted by 2 electrodes between which a given voltage is applied. Resistor measure or electric conductance measure of a water volume delimited by these two parallel platinum electrode :



R is the water volume resistor (Ω), S its surface (cm^2), L its width (cm)

The resistivity is ρ : ρ (Ω. m)= R * S / L

The **conductivity γ is :** γ (S . cm -1) = 1 / ρ = 1/R * L / S

Other unit : **µS . cm^{-1}**

☞ L / S is called *cell constant* (cm^{-1}) : it must be adjusted as indicated in the notice (generally about 1 cm^{-1}).
☞ Conductivity depends on temperature : some conductimeters give directly conductivity values *recalculated for a temperature equal to 20°C (reference*); these conductimeters have temperature sensor ; other indicate conductivity measured without compensation (test water temperature)
☞ Demineralized water conductivity is about 1 µS / cm

☞ Standard solutions (20°C) :
KCl 0.01 mol / L : 1,277 µS / cm
KCl 0.1 mol / L : 11,680µS / cm
The recent conductimeters don't need to adjust the zero during calibration.
☞ drinking water conductivity in between about 300 and 600µS / cm ; its chloride concentration should be inferior to 250 mg / L and its conductivity inferior to 2,500µS / cm.
☞ MM Na = 23 g / mol
MM Cl = 35.5 g / mol

2.2. Procedure
Read the notice conductimeter :
- is there a temperature compensation ?
- calibrate the conductimeter.
Immerse the electrode ; don't stir (conductivity depends on agitation)
Select units and range
Read the conductivity value.

Field of application : drinking waters, industrial waters

3. Practical works

3.1. With powdered NaCl and volumetric flasks, prepare with precision, solutions containing chloride concentrations between about 5 and 150 mg / L : at least five points
Example of solution preparation :
5 to 150 mg Cl^- / L = 7.53 to 226.05 mg NaCl / L
preparation of solutions : between 10 and 200 mg NaCl / L
One litre of Stock Solution SS : 2 g NaCl / L

Flask A *0.01 g NaCl / L*	*Flask B* *0.01 g NaCl / L*	*Flask C* *0.1 g NaCl / L*	*Flask D* *0.15 g NaCl / L*	*Flask E* *0.2 g NaCl/ L* *SS / 10*
10 mL E in 200mL	*50 mL E in 200mL*	*100 mL E in 200 mL*	*150 mL E in 200 mL*	*100 mL SS in 1000 mL*

3.2. Measure each solution chloride concentration

3.3.Measure each solution conductivity

4. Report

4.1.Draw a board presenting, for each prepared solution :

a) weighed powdered NaCl masses
b) prepared solutions volumes
c) poured $AgNO_3$ volumes
d) chloride concentration : mg Cl^- / L
e) conductivity : µS / cm

4.2. Interpret part d) with waited values.

4.3. Plot conductivity = f (chloride concentration)

Verification of your work precision : calculate the correlation coefficient : it must be inferior to 99 %

Material and reagents requirements (for 12 students)

6 flasks containing 400 mL $AgNO_3$ 4.791 g/L
Flask for Ag containing liquid waste
6 flasks with 50 mL of $K_2 Cr_2 O_4$ 50g/L
Powdered NaCl + weighing machine (precise)
Demineralized water
6 conductimeters with their reference solution + notice
6 volumetric flasks of 1L
30 flasks : 100 or 200 mL