

Cleaning the Dispensette® S Trace Analysis and achievable blank values

Introduction

The usual orders of magnitude magnitudes for concentrations in trace analysis are ppb and ppt. Magnitudes which we rarely encounter outside the laboratory. The following comparisons are intended to give a sense of these quantities. It is assumed that 1 m³ water is equal to 1,000 kg.

ppm = mg/kg: parts per million

1 part per 10⁶ parts;
for ex., 1 sugar cube (3 g) was dissolved in 1 m³ water* = 3 ppm

ppb= µg/kg: parts per billion

1 part per 10⁹ parts;
for ex. 1 sugar cube (3 g) was dissolved in 1,000 m³ water* = 3 ppb
*(1,000 m³ correspond to a container of 10 m x 25 m x 4 m)

ppt = ng/kg: parts per trillion

1 part per 10¹² parts;
for ex., 1 sugar cube (3 g) was dissolved in 1,000,000 m³ water* = 3 ppt

*(1,000,000 m³ correspond to a lake about the size of 564 m in diameter and 4 m depth)

Material and methods:

Before use in trace analysis applications, the Dispensette® S Trace Analysis must first be thoroughly cleaned. Reagents having the purity level „per analysis“ (p.A.) or better should be used. A recirculation valve can assist in the reduction of media losses. If a model with a recirculation valve is used, cleaning must be done in the dispensing and recirculating position.

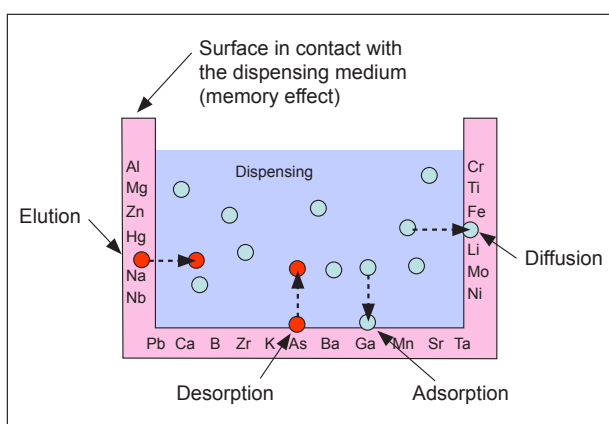


Figure: Graphical representation of surface effects

The cleaning method described below leads, in practice, to minimal blank values:

1. Thread the device onto a bottle filled with acetone p.A., deaerate and fill up to the maximum. Leave the piston at the upper stop and close the discharge tube with the screw cap. Dispense twice after approx. 24 hours reaction time, then the device must be completely drained and rinsed five times with p.A. pure water.
2. Thread the device onto a bottle filled with 37 % p.A. hydrochloric acid, deaerate and fill up to the maximum. Leave the piston at the upper stop and close the discharge tube with the screw cap.
3. After approx. 24 hours reaction time, dispense twice and fill again to the maximum.
4. Repeat step 3 two more times. After another 24 hours of reaction time, completely drain the device and rinse it 5 times with p.A. pure water.
5. Repeat steps 2 to 4 with a 65% p.A. nitric acid.
6. Thread the instrument onto a bottle filled with ultra high purity water for trace analysis, deaerate (3 strokes) and discard the contents of the first two dispensings. The third dispensing is placed in a test tube for the determination of the blank values.



The blank values is determined using ICP-MS in accordance with DIN EN ISO 17294-2 (E29) and ICP-OES in accordance with DIN EN ISO 11885 (E22).

Results:

Parameters screening ICP	Analyses results	Determination limit	Unit	Method ICP
Aluminum	<0,010	0,01	mg/l	DIN EN ISO 17294-2 (E29)
Antimony	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Arsenic	<0,00050	0,0005	mg/l	DIN EN ISO 17294-2 (E29)
Barium	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Beryllium	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Bismuth	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Boron	<0,010	0,01	mg/l	DIN EN ISO 17294-2 (E29)
Cadmium	<0,00030	0,0003	mg/l	DIN EN ISO 17294-2 (E29)
Calcium	<0,10	0,1	mg/l	DIN EN ISO 17294-2 (E29)
Chrome tot.	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Cobalt	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Copper	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Iridium	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Iron tot	<0,0050	0,005	mg/l	DIN EN ISO 17294-2 (E29)
Lead	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Lithium	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Magnesium	<0,10	0,1	mg/l	DIN EN ISO 17294-2 (E29)
Manganese	<0,010	0,01	mg/l	DIN EN ISO 17294-2 (E29)
Mercury	<0,00020	0,0002	mg/l	DIN EN ISO 17294-2 (E29)
Molybdenum	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Nickel	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Phosphorus tot.	<0,0050	0,005	mg/l	DIN EN ISO 11885 (E22)
Platinum	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Potassium	<0,10	0,1	mg/l	DIN EN ISO 17294-2 (E29)
Selenium	<0,0020	0,002	mg/l	DIN EN ISO 17294-2 (E29)
Silver	<0,020	0,02	mg/l	DIN EN ISO 11885 (E22)
Sodium	<0,10	0,1	mg/l	DIN EN ISO 17294-2 (E29)
Strontium	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Sulfur tot.	<0,50	0,5	mg/l	DIN EN ISO 11885 (E22)
Tantalum	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Tellurium	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Thallium	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Tin	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Titanium	<0,0050	0,005	mg/l	DIN EN ISO 17294-2 (E29)
Tungsten	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Vanadium	<0,0010	0,001	mg/l	DIN EN ISO 17294-2 (E29)
Zinc	<0,010	0,01	mg/l	DIN EN ISO 17294-2 (E29)

All analytical values are below the detection limit of the measurement method.

Alternatively, the cleaning method can be modified. A variation using semi-concentrated acids can be found in the Dispensette® S operator manual Trace Analysis. If the cleaning is insufficient, we recommend repeating the cleaning process.