

Alameda County Water District
Water Quality Laboratory
ELAP Certificate No. 1524

Quality Assurance Program

STANDARD OPERATING PROCEDURE

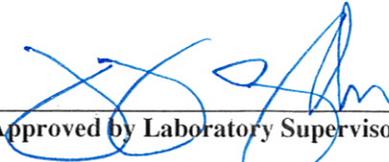
**Total Dissolved Solids (TDS), Dried at 180°C, SM 2540-C
Version #: V1**



Reviewed by QA/QC Officer

10/4/2011

Date



Approved by Laboratory Supervisor

10.4. 2011

Date

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1.0 SCOPE AND APPLICATION

- 1.1 Total Dissolved Solids (TDS) refers to all the matter that is dissolved in a water sample (i.e. not suspended or filterable). TDS is also referred to as “non-filterable residue”. Waters with TDS higher than 500 mg/L are generally regarded as having inferior palatability.
- 1.2 A well-mixed sample is filtered through a standard glass fiber filter. The filtrate is then evaporated to dryness at 180 °C in a tared evaporating dish. The dried dissolved solids leave a residue behind. The increase in dish weight (weight of the residue) is the TDS and is reported in mg/L.

2.0 INTERFERENCES

- 2.1 Waters high in calcium, magnesium, chloride, and sulfate content may require longer drying times and rapid weighings to achieve accurate and reproducible results.
- 2.2 Samples high in bicarbonate may require prolonged drying at 180 °C to ensure complete conversion of bicarbonate to carbonate.
- 2.3 Because excessive residue in the dish may form a water trapping crust, sample size is limited to 200 mg of residue.

3.0 APPARATUS AND MATERIALS

- 3.1 Glass fiber filter disks, Whatman grade 934AH or equivalent. Practical filter diameters are between 2.2 and 12.5 cm.
- 3.2 Vacuum filter flask, 250 mL capacity or larger.
- 3.3 Filter funnel apparatus with adapter support for a Gooch or Bitumen filter crucible.
- 3.4 150-mL porcelain evaporating dishes (Figure 1). Dishes must be uniquely marked.

3.5 Drying oven with temperature range between 95-180 °C (Figure 2).

3.6 Analytical balance capable of weighing at least 150 g to the nearest 0.1 mg.

3.7 Glass desiccators with indicating desiccant (Silica gel with cobalt chloride).

3.8 Crucible tongs.

3.9 Graduated cylinders, 100-mL, 50-mL and 25-mL.

3.10 500-mL Nalgene bottles.

4.0 DOCUMENTATION

4.1 TDS bench worksheet: T:\WQ Lab\Forms\Analyst Worksheets\Inorganic Chemistry\TDS by SM2540C Bench (See Attachment 1).

4.2 TDS calculation worksheet:
T:\WQ\Lab\Forms\Analyst\Worksheets\Inorganic Chemistry\TDS by SM2540C (See Attachment 2).

5.0 REAGENTS AND STANDARDS

5.1 1000 mg/L TDS standard, NSI Solutions Cat # QCI-055.

5.2 Laboratory reagent water with a minimum resistivity of 10 megaohms-cm.

6.0 SAMPLE COLLECTION AND PRESERVATION

6.1 Samples are collected in 500-mL Nalgene bottles. Bottles are rinsed with sample prior to collection.

6.2 Samples should be run as soon after collection as possible but can be held for up to 7 days at 1-4 °C.

7.0 SAMPLE HANDLING

- 7.1 Samples must be brought to room temperature prior to analysis.
- 7.2 Choose a sample volume that will yield between 2.5 and 200 mg of dried residue. 100 mL would be the standard sample size and can be reduced for high samples (e.g. 50 mL would be used if a 1:2 dilution is desired and 25 mL for a 1:4 dilution, etc.) Sample volume may be increased to a maximum of 250 mL, if needed. Record the volume of sample to be used in the "Volume" column.

8.0 PROCEDURE

- 8.1 Heat clean evaporating dishes at 180 ± 2 °C for at least 1 hour. It is a good idea to bake extra dishes to have a few spares.
- 8.2 Using crucible tongs transfer the evaporating dishes into desiccators and allow them to cool to room temperature. Dishes can be stored in the desiccators until needed. Weigh dishes immediately before use.
- 8.3 Zero the balance and using crucible tongs, place an evaporating dish on the balance pan. Allow the reading to settle and record the dish ID and weight on the bench worksheet in the "crucible ID" and "crucible weight" columns, respectively. Repeat this step for all remaining dishes.
- 8.4 Place a new glass fiber filter onto the filter holder and apply the vacuum.
- 8.5 Measure out the appropriate sample size and pour this onto the filter. Continue to apply the vacuum until the filter appears dry. Once dry, rinse the filter with three successive 10-mL portions of reagent water.
- 8.6 Carefully transfer the filtrate and washings, collected in the vacuum flask, to the previously weighed evaporating dish. Rinse the flask between samples twice with deionized water. Repeat steps 8.4 – 8.7 for all remaining samples.

- 8.7 Place samples in to drying oven and evaporate to dryness at 95-99 °C. Once dry, increase the temperature to 180 °C and bake out for at least one hour.
- 8.8 Using crucible tongs transfer the evaporating dishes into desiccators and allow them to cool to room temperature (approximately 3 hours).(Note: For more consistent weighings, duplicate whatever cooling time you decide upon. If you use three hours, then use three hours each time.)
- 8.9 Weigh the dishes as before and record the gross weight of the evaporating dish plus residue in the first available “Weighings” column. Record the date and time of the each set of weighings in the box at the top of each column.
- 8.10 Repeat the drying, cooling and weighing cycle until a constant weight is reached or until the weight change between successive weighings is less than 4% or 0.5 mg, whichever is less.

9.0 QUALITY ASSURANCE /QUALITY CONTROL (QA/QC)

- 9.1 A blank must be analyzed with each batch. The blank is 100 mL of laboratory reagent water.
- 9.2 A check standard must be analyzed with each batch. The check standard result must be between 90-110 % of target.
- 9.3 Duplicate analysis must be performed on at least 10% of samples. Duplicate determinations must agree within 5.0 Relative Percent Difference (RPD).

10.0 CALCULATIONS

- 10.1 The following formula is used to calculate TDS:

$$\text{TDS (mg/L)} = \frac{(A-B) \times 1000}{C}$$

A = Gross weight (weight of the dried residue + dish) in mg.
B = Weight of dish in mg.
C = Volume of sample used in mL.

10.2 Formula for calculating % recovery:

$$\% \text{ Recovery} = \frac{\text{Observed result}}{\text{Expected result}} \times 100$$

10.3 Formula for calculating RPD:

$$\text{RPD} = \frac{200 \times (\text{Base Result} - \text{Duplicate Result})}{(\text{Base Result} + \text{Duplicate Result})}$$

11.0 DATA HANDLING

11.1 Enter the data from the bench worksheet into the TDS Calculation Worksheet. Once all parameters have been entered, the TDS results will be calculated automatically. Duplicate calculations and QC percent recovery must be calculated by the analyst. Print out the completed calculation worksheet.

11.1.1 Significant Figures – Report all results to 2 significant figures.

11.1.2 Reporting Limits - This method has a Practical Quantitation Limit of 10 mg/L.

11.1.3 LIMS analysis name – TDS.

11.1.4 Method Detection Limit (MDL) – a MDL study is not required for this method.

11.2 Go to LIMS and generate an Analysis Worksheet (See Attachment 3).

11.3 Enter all results into LIMS.

11.4 Printout the Analysis Worksheet and include this in the final data packet.

11.5 Assemble the data packet in the following order:

11.5.1 LIMS Analysis Worksheet

- 11.5.2 Copy of relative Chain of Custodies
- 11.5.3 TDS Bench Worksheet
- 11.5.4 TDS Calculation Worksheet

11.6 Forward the final assembled packet to the QAO for review.

12.0 MAINTENANCE

- 12.1 The filter apparatus, cylinders and flask are dedicated to this assay so when finished, wash with deionized water and let air dry.
- 12.2 Clean evaporating dishes after each use by soaking in 10% hydrochloric acid then rinsing with warm water and deionized water.
- 12.3 Regenerate the desiccant as needed. Blue desiccant indicates that the desiccant is still useable. Pink desiccant indicates that the desiccant is exhausted and requires regeneration.

12.3.1 Desiccant can be regenerated by placing desiccant on a shallow, foil-lined, metal pan and placing in a 210 °C drying oven for at least 2 hours.

12.3.2 Regeneration frequency can be reduced by minimizing the amount of time that the desiccator is open. When the desiccator is open it allows moist air to enter thereby exhausting the desiccant faster.

13.0 WASTE MANAGEMENT

- 13.1 Hydrochloric acid can be reused multiple times. Consult MSDS for disposal requirements.

14.0 SAFETY

- 14.1 Care should be taken when working with hot ovens and dishes.
- 14.2 Hydrochloric acid has the potential to be highly toxic, refer to the MSDS regarding the handling of this chemical.

15.0 REFERENCES

- 15.1 Standard Methods for the Examination of Water and Wastewater, 20th Edition, 1998, SM 2540-C, pages 2-56 thru 2-57.

Figure 1
150-mL Evaporating Dish

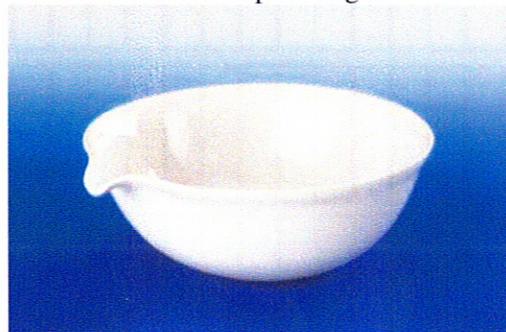
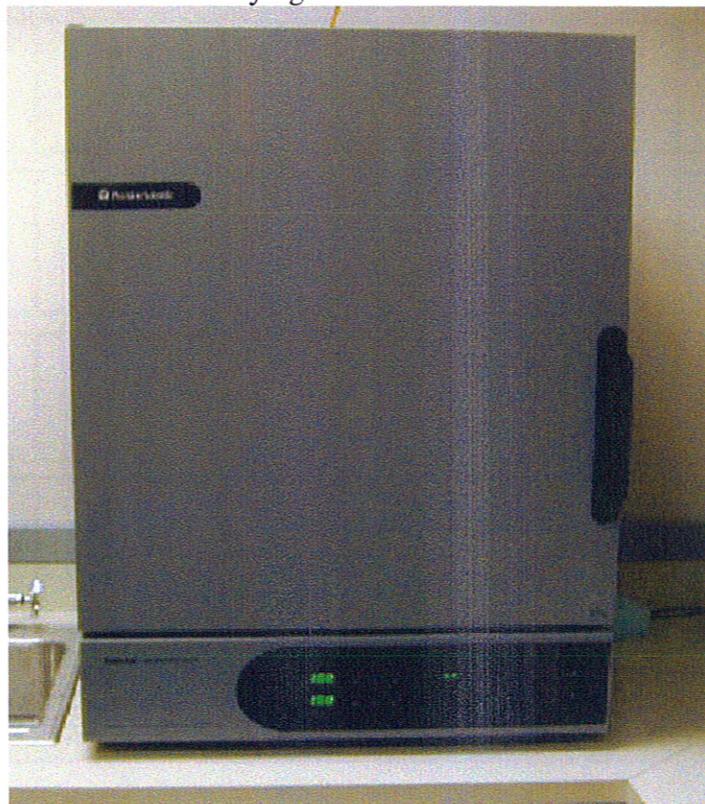


Figure 2
Drying Oven at 180 °C



Attachment 1. TDS Bench Worksheet

Total Dissolved Solids Bench Worksheet

ACWD - Water Quality Lab

Method: Standard Methods 2540C

Analyst: _____

Check Std
LOT#:

True
Value:

Date/Time: _____

Weighings (g) (Dried Sample + Crucible)

No.	Sample ID	Weighing Date/Time		Weighings (g) (Dried Sample + Crucible)				Sample Comments
		Crucible ID	Crucible Wt.	Volume (ml)	1	2	3	
1	Blank							
2	Check Standard							
3	Dup of :							
4	Dup of :							
5								
6								
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Data Entry: _____ Date: _____

QA Review: _____ Date: _____

Attachment 2. TDS Calculation Worksheet

Total Dissolved Solids Calculation Worksheet

ACWD- Water Quality Lab

Method: Standard Methods 2540C

No.	Crucible Wt.	Volume (ml)	Final Wt	Difference	TDS (mg/L)	Sample Comments
1	87.9375	100	87.9388	0.0013	13	
2	60.413	50	60.4331	0.0201	402	100% recovery
3	95.4557	50	95.4812	0.0255	510	Dup of #5 3.8 RPD
4	54.8202	50	54.8612	0.041	820	Dup of #15 1.2 RPD
5	93.7555	50	93.782	0.0265	530	
6	88.9643	50	88.9939	0.0296	592	
7	92.9285	50	92.9591	0.0306	612	
8	53.378	50	53.4163	0.0383	766	
9	57.1042	50	57.1368	0.0326	652	
10	52.1549	50	52.1718	0.0169	338	
11	57.6837	50	57.7167	0.033	660	
12	56.0754	50	56.0989	0.0235	470	
13	95.6364	100	95.664	0.0276	276	
14	54.0958	50	54.1276	0.0318	636	
15	57.9849	50	58.0264	0.0415	830	
16	53.7417	50	53.7712	0.0295	590	
17				0	#DIV/0!	
18				0	#DIV/0!	
19				0	#DIV/0!	
20				0	#DIV/0!	
21				0	#DIV/0!	
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23				0	#DIV/0!	
24				0	#DIV/0!	

Worksheet Identity TDS_19

ANALYSIS WORKSHEET

Generated On 18-Aug-2009 09:33

Generated For JL

Description Joseph Lennen

Analysis ID TDS

Technique Total Dissolved Solids

Results required for this analysis

Component Name	Type	Minimum	Maximum	Units
TDS	Numeric	0	1000	mg/L

RESULTS

Sample Name MOWRY-11-AUG-2009-024847		Sample Number/Replicate 194877 / 1	
Component Name	Result Type	Result	Units
TDS	Numeric	530	mg/L

Sample Name PT-11-AUG-2009-024848		Sample Number/Replicate 194878 / 1	
Component Name	Result Type	Result	Units
TDS	Numeric	592	mg/L

Sample Name ACWQMS-11-AUG-2009-024850		Sample Number/Replicate 194880 / 1	
Component Name	Result Type	Result	Units
TDS	Numeric	612	mg/L

Sample Name ADLL_AADV-11-AUG-2009-024853		Sample Number/Replicate 194883 / 1	
Component Name	Result Type	Result	Units
TDS	Numeric	766	mg/L

Sample Name ADLL_AV-11-AUG-2009-024854		Sample Number/Replicate 194884 / 1	
Component Name	Result Type	Result	Units
TDS	Numeric	652	mg/L